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SELLERS' Midwifery

Second Edition



Pauline McCall Sellers
Revising editors: Joan Dippenaar and Dicky da Serra

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Second edition

Editors:
Joan Dippenaar
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Sellers' Midwifery

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List of Abbreviations

BBI	Better birth initiative
BCG	Bacilli Calmetti-Guérin vaccine
BEOC	Basic essential obstetric clinics
BFHI	Baby friendly hospital initiative
BHF	Board of healthcare funders
BMI	Basic metabolic index
BMR	Basic metabolic rate
BNBAS	Brazelton Neonatal Behaviour Assessment Scale
BPA	Bishenol A
CAM	Complementary and alternative medicine
CEOC	Comprehensive essential obstetric clinics
CF	Cystic fibrosis
CNS	Central nerve system
COC	Combined oral contraceptive
CPAP	Continuous positive airway pressure
CPD	Cephalopelvic disproportion
CTOP	Contraceptive termination of pregnancy
CVS	Cordo villi sampling
DHA	Department of Home Affairs
DIC	Disseminated intravascular coagulation
DM	Diabetes mellitus
DMB	Donor milk banks
DoH	Department of Health
DSC	Developmental supportive care
ECP	Emergency contraceptive
EDD	Expected date of delivery
EPI	Expanded programme on immunisation
ESMOE	Essential steps in the management of obstetric emergencies
FAS	Fetal alcohol syndrome
FDA	Food and Drug Administration
FGM	Female genital mutilation
FIGO	Federation of gynaecologist and obstetricians
FISH	Fluorescent *in situ* hybridisation test
FSBU	Free standing birth unit
GP	General practitioner
HCG	Human chorionic gonadotrophin
HDN	Haemolytic disease of the newborn
HPV	Human Pappillomovirus
ICEA	International Childbirth Education Association
ICM	International Confederation of Midwives
ICN	International Council of Nurses
IMCI	Integrated management of childhood illnesses
IOL	Induction of labour
IPPV	Intermittent positive pressure ventilation
ISCO	International standard classification of occupations
IUD	Intrauterine death or Intrauterine device (depends in which context it is used)
IUGR	Intrauterine growth restriction
KMC	Kangaroo-mother-care
LBW	Low birth weight
LMP	Last menstrual period
LSD	Lysergic acid diethylamide
LSPR	Lecithin sphyngomyalin
MC&S	Microscopy, culture and sensitivity
MDG	Millennium Development Goals
MLC	Midwifery-led care
MMR	Maternal mortality rate
MNCWH	Maternal and child and women's health
MODS	Multi-organ dysfunction syndrome
MOU	Midwife obstetric units
MRC	Medical Research Council
MUAC	Mid-upper arm circumference
NCCEMD	National Confidential Enquiry into Maternal Deaths
nCPAP	Nasal continuous positive airway pressure
NEC	Necrotising enterocolitis
NGO'S	Non-governmental organisations
nREM	non-Rapid Eye Movement
NTD	Neural tube disease
OTC	Over the counter
PAPP'S	Pregnancy associated plasma protein
PGR	Phosphatidylglycerol ratios
PHC	Primary health care
PID	Pelvic inflammatory disease
PIH	Pregnancy induced hypertension

PMTCT	Prevention of mother-to-child transmission
PND	Postnatal depression
PPCM	Peripartum cardiomyopathy
PPIP	The Perinatal Problem Identification Programme
PROM	Premature rupture of membranes
pPROM	pre-Premature rupture of membranes
PZP	Porcine Zona Pellucida Vaccine
RBS	Red blood cells
RDA	Recommended daily allowance
RDS	Respiratory distress syndrome
REM	Rapid eye movement
Rh	Rhesus
SADHS	South African Demographic Health Survey
SFH	Symphysis fundal height
SIDS	Sudden infant death syndrome
SMI	Safe Motherhood Initiative
SOMSA	Society of Midwives of South Africa
STI	Sexual transmitted infections
TBV	Total blood volume
TENS	Trans cutaneous nerve stimulation
TSB	Total serum bilirubin
UK	United Kingdom
UNICEF	United Nation Children's Fund
USA	United States of America
USAID	The United States Agency for International Development
VBAC	Vaginal birth after caesarean section
WBC	White blood cells
WHA	World Health Assembly
WHO	World Health Organisation
WRA	White Ribbon Alliance
YFS	Youth friendly services

ACRONYMS

ACCOL	Anaemia Cyanosis Clubbing Edema Lymphadenopathy
ADME	Absorption, distribution, metabolism, and excretion
ACTH	Adrenocorticotropic hormone
AHPCSA	Allied Health Professions Council of SA
ALPHA	Antenatal psychological health assessment
AMTSL	Active management of the third stage of labour
AOP	Apnoea of premature
ART	Antiretroviral therapy
BANC	Basic antenatal care
GOPATJ	General appearance, orientation, perception , affect, thoughts and judgement
POPSAMSS	Psychiatric history, obstetric history, partner relations, support network, attitude, mental status, self concept, suicide risk
SPLEN	Skin, plantar creases, labia or male, ear, nipple

Preface

The midwife remains the principal caregiver to women and Children during childbirth in southern Africa. With this understanding, the clinical discipline of Midwifery is experiencing transformation that will impact on service delivery and the practice of midwifery.

The writing of *Sellers' Midwifery* second edition has been influenced by the integrated nursing education model that includes Midwifery in the South African Qualifications Authority higher education and training band. The proposed changes to the nursing curricula (South African Nursing Council, Education and Training Quality Assurance body) have also been considered in this long-awaited update.
The content has been further influenced by:

- The Maternal and perinatal mortality in South Africa and the recommendations of the Saving Mothers and Saving Babies reports (1998–2009).
- Evidence-based care principles to improve clinical care (including the Better Birth Initiative).
- Ongoing initiatives by the World Health Organization, International Council of Midwives and International Council of Nurses to strengthen the practice of Midwifery.
- The Scope of Practice of Basic Midwifery (focusing on normal pregnancy and childbirth) with reference to common disorders, recognition of such and care of specific conditions and situations.

A postbasic diploma in Midwifery is required to be registered as an additional qualification with SANC. In this book, a midwife with this qualification is refered to as a 'Skilled midwife'. New pathways and specialisation options are being developed for South African needs in line with international standards.

This new edition of the popular and well-established *Sellers' Midwifery* has been updated by a variety of specialists in their fields, who have considered both the contextual realities as well as scientific principles within the framework of the latest scientific developments in the field.

We hope you enjoy the new larger format, which has allowed both volumes to be combined into one book; be assured that content has not been lost. Each chapter considers the core objectives for learning, with tasks, activities and highlights that link the learner to local and international references and information. The new updated version is richly illustrated.

Juta's Clinical Guide for Midwives by Diana du Plessis, which contains the necessary clinical procedures, should be used to supplement and support this new edition.

An additional electronic workbook, based on the ICM's core competencies for midwives, is available free of charge from www.juta.co.za (click on the Student Support Material link). This allows lecturers to adapt activities in line with their own curricula.

We trust that the lecturers and learners will find the references and support material useful.

Joan Dippenaar
Dicky da Serra
(Editors)

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Section One

Maternal and child healthcare

1 The history of midwifery in South Africa

2 Maternal and perinatal mortality and morbidity

3 Midwifery practice and care

4 Maternal and newborn healthcare in South Africa

CHAPTER

1 The history of midwifery in South Africa

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- explain the development of midwifery globally and in South Africa
- explain the occurrences that influenced midwifery
- identify and explain the current trends in midwifery globally and in South Africa.

KNOWLEDGE ASSUMED TO BE IN PLACE

Background knowledge of the history of South Africa

KEYWORDS

Midwifery • Obstetrics • Safe Motherhood Initiative (SMI)

1.1 Introduction

Midwifery is one of the oldest known professions in the world. This first Chapter looks at midwifery in a global context and then focuses on the development of midwifery in South Africa to give you a better understanding for your chosen profession.

1.2 Midwifery in a global context

Historically, midwives were the only caregivers for women in childbirth. The first references to a midwife can be found in the book of Genesis with a further reference in Exodus. The presence of midwives and their role are well documented in history and in much of the classical literature of various populations. Midwifery preceded the medical and nursing professions by millennia.

The development of midwifery as a modern profession

Midwifery until the 17th century

In the period up to the 17th century, community midwives were the main carers of women and children, with little or no male involvement. Midwifery care was informal.

The development of midwifery as a formal profession was influenced by changes in social structure, industrialisation, urbanisation and modernisation, as well as increasing scientific and medical knowledge. Some of the highlights of this period include:

- 10th century The first medical school in the world was founded in Salerno, Italy, where a female doctor 'Trotula' gave guidelines to midwives on retained placenta, puerperal care and third degree tear management.
- 1500 Jakob Nufer successfully operated on his wife to deliver a baby.
- 1530 Rösslin wrote a book in Germany that would be used for the next 200 years as a guide for childbirth.
- 1561 Fallopius van Padua described the female reproductive organs, and named the Fallopian tubes, vagina and placenta.
- 1501–1590 Ambroise Paré sutured the perineum.
- 1598 Peter Chamberlain developed the obstetric forceps.
- 1616 William Harvey described the blood circulation and the embryo and fetus in all stages.

Midwifery until the 18th century

Until the 18th century childbirth in most parts of the world still remained informal and exclusively managed by women. Hospital births were uncommon. The care of women was one-to-one with a traditional midwife as caregiver. Some of the highlights of this period include:

- 1637–1709 The mechanism of labour was described by Francois Mauriceau. He developed the labour chair.
- 1718–1983 William Smellie (a Scot) developed techniques in midwifery, for example the Smellie breech manoeuvre.
- 1718 The first maternity hospital was opened in England.
- 1718–1983 William Hunter, an anatomist, described the gravid uterus and the placenta.
- 1768 A young French student performed a symphysiotomy.
- 1768 Margaret Stephens, a midwife herself, was the first tutor in midwifery and wrote a thesis on 'The domestic midwife'.
- 1773–1841 Madame Marie Anne Boivin was awarded the degree, Doctor of Medicine. She wrote 'Memorial of deliveries' with illustrations. She contributed to the medical literature of her day. During this period both medical practitioners and midwives developed and used models to demonstrate and teach midwifery.

Midwifery in the 19th century

During the 19th century women began giving birth in institutions. This period was marked by problems associated with puerperal sepsis. Puerperal sepsis had been described since the 1600s, but was poorly understood during the period because the role of micro-organisms in infection was not recognised.

Women gave birth in lying-in wards and not at home, which caused puerperal fever to spread and caused the mortality rate to increase. Puerperal fever reached epidemic proportions in Europe between 1770–1846 and remained a problem over of the following two centuries until the role of micro-organisms was discovered by Semmelweis and Oliver Holmes. Charles White (1788–1812) provided guidelines on its prevention. The development of the magnifying glass by Anthony van Leeuwenhoek (1623–1725) continued to add to the understanding of pathological micro-organisms.

The most important advances in midwifery during the 19th century were pioneered in America. John Stearns reintroduced an ancient remedy, ergot (called St Anthony's fire), and applied it in obstetrics. In addition, William Morton developed the use of chloroform as an anaesthetic agent and changed the face of surgery and birth. James Young Simpson (1811–1870) (Professor of Midwifery at the University of Edinburgh) used and promoted chloroform for use in labour and Queen Victoria agreed to use it during her labour.

During this period, nurses and midwives were poorly trained and conditions in hospitals were poor. In 1853 Florence Nightingale started the reformation of nursing in England. A training school for midwives was opened in 1861. This was followed by the opening of the Institute of Midwifery in 1881, which raised standards in the profession. Midwifery started to develop into a formal independent profession. Some highlights of this period include:

- 1819 Naegele developed Naegele's rule to determine the expected date of delivery.
- 1822 Gregor Mendel described the science of genetics.
- 1824 James Blundell completed the first successful blood transfusion.
- 1860 Louis Pasteur showed that Streptococcus was the cause of puerperal sepsis.
- 1872 John Braxton described the uterine action during labour.
- 1879 Neisser described the micro-organism Gonococcus.

Midwifery in the 20th century

Midwifery in the 20th century was still unsophisticated, but the foundations for change were laid by the introduction of 'pro-maternity' care to make giving birth safer for mothers and newborns.

Some highlights of the period include:

- 1928 Selmar Aschheim developed the pregnancy test.
- 1939 Alexander Weiner and Dr Karl Landsteiner discovered the rhesus (Rh) factor.
- 1940 Alexander Flemming developed penicillin.
- 1953 Du Vigneaud isolated oxytocin.

Developments in politics, economics, technology and medicine affected the practice of midwifery in the 20th century. At the same time, improvements in maternal care were recognised and investigated.

In 1979, during the International Year of the Child, the World Health Organization (WHO) and 33 member states recognised unresolved issues in maternal healthcare. A five-year study was conducted in Europe called 'Having a baby in Europe'. The conclusions from this study showed that the fragmentation of care of women in childbirth and the high level of interventions in healthcare systems were having an impact on midwifery practice. It was recognised that midwives are the sole providers of care only when a medical practitioner is not present. The Safe Motherhood Initiative (SMI) followed in 1987. This was supported by the International Council of Nurses (ICN), International Confederation of Midwives (ICM), the United Nations Children's Fund (UNICEF) and the World Bank. The original aim was to reduce maternal mortality by 50% by 2000. This goal was not reached. The White Ribbon Alliance for Safe Motherhood is an international movement that joined forces with several other civil organisations to create awareness of the need to make childbirth safer.

The SMI recognised human resource problems and problems in healthcare systems and published several documents to strengthen midwifery by reconginsing its value. Midwifery is now part of a global agenda. Eighty percent of births are still conducted by midwives globally. Several partnerships have been formed to strengthen midwifery and healthcare systems.

Major activities undertaken by the SMI are:

- 1987 SMI was launched in Nairobi.
- 1987 The partogram was launched as a tool in labour.
- 1989 First global study and fact book on maternal mortality (WHO 1991b) was released.
- 1990 ICM conference decided on actions to strengthen the midwifery curriculum with a move to more community-based learning and better understanding of obstetric emergencies (WHO/UNICEF/ICM 1991).
- 1994 Mother-baby packages were produced with 'appropriately trained midwives' as key healthcare providers.
- 1996 Education modules were produced for midwives.
- 1996 The WHO led a working group to define 'normal birth'.

Midwifery in the 21st century

At the beginning of the 21st century there was global reflection on the role and function of midwives in healthcare. It was apparent from research that midwives were carrying the burden of care in childbirth and that often nurses and midwives were the main and only caregivers for the poor. The WHO expressed concern about the recruitment and retention of skilled and motivated nurse-midwives and midwives for the healthcare workforce and, in May 2001, the 54th World Health Assembly adopted Resolution WHA 54.12, strengthening nursing and midwifery.

Several strategies were adopted to improve maternal healthcare in different settings. In the USA the Pew Commission accepted the 'midwifery model' of care as the official model for the 21st century. Similar initiatives in Europe refer to 'midwifery led care' as a model to improve and strengthen standards of care in midwifery. The purpose of the changed approach was to improve continuity of the carer and to avoid the fragmentation of care, thereby improving maternal healthcare outcomes.

Between 2000 and 2005, the SMI was further promoted and the 'making pregnancy safer' campaign started, in which the 'skilled attendance' approach was supported and promoted. The SMI identified the indicators required for the reduction of maternal deaths and the ICM developed several documents to strengthen midwifery. These include the definition of a midwife, and an outline of the core competencies of midwives as determined by research that involved midwives in all member states. In addition, the International Council of Nurses and Midwives published the standards of education for nurses and midwives. The research and developmental support of the SMI/ICM is ongoing.

1.3 The development of midwifery in South Africa

In South Africa midwifery followed trends emerging from Europe. This meant that midwives were trained in the same way as they were in Europe. Private nursing and midwifery were available in South Africa from the time of the first European settlers.

The early days

The recorded history of midwifery in South Africa starts with the arrival of Jan van Riebeeck in 1652. Jan van Riebeeck was the first commander at the Cape and was employed by the Dutch East India Company (DEIC). His task was to create a way-station for the trading route between Europe and India. This included a medical post for those who became ill on the long journey.

On 6 June 1852 the first white child was born in the Cape to the wife of Willem Wijlants. It is not clear who delivered the baby. On 19 April 1854 a Khoisan woman was recorded giving birth on her own: 'She immediately cleaned the child, rubbed it with cow dung, and put it to the breast'.

Midwifery and medicine in South Africa was established by trained and skilled healthcare practitioners from Europe. A system of licensing and registration was put in place immediately, based on the Statutes of India. Midwives came from Europe and worked in South Africa as 'sworn midwives'. They were employees of the DEIC and received a monthly salary. These midwives were 'skilled attendants' and one of their tasks was to name the father of the child, as many were the children of soldiers. The regulations and principles put in place then are still used today.

Hospitals were established in the Cape and they compared favourably with European hospitals. In 1703 the first full-time sworn midwife was appointed in the Cape. These sworn midwives usually came from the Netherlands, but sometimes local women were sworn in as well, for example Marie Buisset (1676–1708). These sworn midwives enjoyed some status in the community. Maternal deaths were uncommon and puerperal sepsis was unheard of because women did not deliver in institutions.

During the 17th and 18th century medical practitioners were drawn from a variety of occupations, but unfortunately

not all were well qualified. Towards the close of the 18th century a university-educated medical professional, Dr JHFCL Wehr settled in the Cape, which was then under British control. Dr Wehr was to play a significant role in the history of midwifery in South Africa.

The 19th century

South African midwives were the first in the world to obtain state registration. This took place in 1891 through the Medical and Pharmacy Act (Act 34 of 1891), which regulated their practice.

Dr Wehr started the first midwifery school in 1810. On 2 August 1813 the first seven who graduated took the oath, developed from an ethical code of conduct. Later, non-white midwives were also trained and registered. Midwifery in the interior was in the hands of the 'ou tannies' and 'monthly nurses' who had a high status in the community and acted as medical practitioners. Indigenous people delivered with traditional assistance.

Other highlights of this period include:

- 1809 The first Midwifery Handbook was completed by a Dr Kemp.
- 1816 Dr James Barry performed the first caesarean section in the Cape.
- 1858 Beds were made available for midwifery cases in Albany Hospital, Grahamstown.
- 1876 Sr. Henrietta Stockdale (from Britain) was trained by a Dr Prince (a Canadian) as a midwife in Kimberley.
- 1887 Mary Hirst Watkins, a nurse/midwife, became the founder of modern midwifery in South Africa.
- 1891 Midwives in South Africa were registered (18 August 1891). The Act was extended to native territories.
- 1892 Regulations for the certification of midwives were gazetted on 31 May 1892. Section A made provision for recognising overseas qualifications. The first seven midwives to register on 6 September 1892 were midwives holding qualifications from Stockholm, the City of London, Dublin and Edinburgh.
- 1896–1899 By the end of the 19th century, midwifery education and registration were well established in South Africa. Midwives also worked in other regions of southern Africa.

The 20th century

The 20th century laid the foundations for the development of nursing and midwifery in South Africa. In 1904 the Orange Free State made provision for the registration of health professionals that included nurses and midwives. With the merging of the colonies all the laws were consolidated. This led to the Medical, Dental and Pharmacy Council Act (Act 13 of 1928). In 1944 the Nursing Act (Act 44 of 1944), was approved, giving nursing and midwifery self-regulation in South Africa. Two statutory bodies were created: the Nursing Council (to safeguard the public) and the South African Nursing Association (to look after the interests of the profession). The Nursing Act (Act 69 of 1957) replaced Act 44 of 1944 and aimed to address the diverse needs of the population with the aim of increasing the number of non-white nurses and replace all white nurses in non-white hospitals. Some highlights of this period include:

- 1922 Post-basic nursing courses started in South Africa.
- 1947 Midwifery lecturer courses were established at the University of Witwatersrand and the University of Pretoria.
- 1955 Thirty scholarships were made available for nursing students to enrol in the first Faculty of Arts and the Faculty of Science at the University of Pretoria. Other universities followed.
- 1968 The training of nurses and midwives became integrated in a four and a half year programme and later a four year degree/diploma.
- 1972 Direct entry to midwifery was ruled out by SANC and only people with a previous professional qualification were admitted for a one year midwifery diploma.
- 1992 The political landscape of South Africa changed, with the first democratic general election taking place in 1994, which affected all political, legal and management structures. A new Nursing Act (Act 33 of 2005), was enacted. The South African Nursing Association became the Democratic Nursing Association of South Africa. Transformation of the healthcare system and nursing took place after this period.

The 21st century

The transformation of the healthcare system in South Africa has also affected midwifery.

Midwifery is facing several challenges in South Africa today. Although midwifery is an integral part of the healthcare system it has not been mentioned in documents on healthcare human resources over the last 10–12 years. The Nursing Strategy for South Africa 2009 also does not mention midwives. This suggests that not enough attention is being paid to the main challenges, such as inadequate numbers of lecturers and inadequate records of those actively practising midwifery. This is confirmed by a recent study of nursing in sub-Saharan Africa (including South Africa) which indicated that there are not enough midwifery lecturers

with higher degrees in the area. In addition, the dual registration of nurses and midwives blurs the true number of midwives practising in South Africa. There is a lack of information on the number of midwives needed in South Africa and the number of midwives currently working with mothers and babies.

1.4 Conclusion

South African midwives are facing the same challenges as midwives globally, but with their rich history, midwives in South Africa once again need to show leadership and innovation through education, collaboration and evidence-based research, to resolve the challenges facing in midwifery.

CHAPTER

2 Maternal and perinatal mortality and morbidity

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- explain the 'big five' causes of maternal deaths in South Africa in chronological order
- explain the main causes of perinatal deaths in South Africa
- know and apply the ten recommendations of the 'saving mothers' report
- be familiar with the strategies to improve perinatal outcomes.

KNOWLEDGE ASSUMED TO BE IN PLACE

Basic knowledge of epidemiology

KEYWORDS

Maternal mortality • Perinatal mortality • Saving Mothers • Saving Babies • National Committee on Confidential Enquiries into Maternal Deaths (NCCEMD) • The Perinatal Problem Identification Programme (PPIP) • Essential steps in the management of obstetric emergencies (ESMOE)

2.1 Introduction

This chapter gives an overview of the development of strategies to improve perinatal and maternal healthcare outcomes in South Africa.

2.2 Terms and definitions

Maternal and newborn outcomes are important indicators of how well a healthcare system is functioning. These include evaluated mortality and morbidity figures. Figures such as birth rate and maternal, perinatal and neonatal mortality and morbidity are important indicators of maternal healthcare. The accurate measurement of these remains a challenge.

Health statistics

Birth rate

The *birth rate* is the number of reported live births per 1 000. The birth rate for South Africa in 2009 was 19.93/1 000.

Birth weight is an important indicator of the health of the mother and the baby. Low birth weight is associated with higher mortality. *Low birth weight* refers to babies born *alive* below 2 500 g. In South Africa (2006) the rate of low birth weight was estimated at 9%.

2.1 The average global birth rate

The average birth rate for the whole world (2009) is 19.95 per year per 1 000 total population. According to The World Fact book, the country with the highest birth rate currently is Niger at 51.6 births per 1 000 people. The country with the lowest birth rate is Japan at 7.64 births per 1 000 people. Countries with birth rates ranging from 10–20 births per 1 000 are considered low and countries ranging from 40–50 births per 1 000 are considered high. The birth rate for South Africa (2009) was 19.93 per 1 000.

Maternal and perinatal mortality

The *maternal mortality rate* is defined as the death of a woman while pregnant or up to 42 days after termination of pregnancy, expressed per 100 000 live births.

Direct causes of maternal mortality are factors associated with pregnancy and birth.

Indirect causes are pre-existing conditions, such as cardiac conditions, which are aggravated by pregnancy and birth.

Accidental maternal deaths are non-obstetrical and therefore not included in the statistics.

The *perinatal mortality rate* (PNMR) is defined as the death of a fetus from 28 weeks *in utero* or 1 000 g in weight (WHO use 24 weeks/500 g) or neonate less than eight days of age, expressed per 1 000 live births. Still births and early neonatal deaths are included.

In developed countries the PNMR is 6/1 000. In developing countries it is 30–200/1 000 live births. The PNMR for South Africa (2000–2006) varies between 37.5–40/1 000 live births.

The *neonatal mortality rate* (NNMR) is defined as the death of a newborn within 28 days of birth expressed per 1 000 live births. It is divided into *early* neonatal death, seven days after birth and *late* neonatal death, within the first 28 days after birth. The NNMR for South Africa between 1998–2008 ranged from 13.6–19.8/1 000 live births (PPIP). (A *neonate* is defined as a newborn fetus less than 28 days old.)

A *stillbirth* is the birth of a fetus that died *in utero* and shows no signs of life expressed per 1 000 live births. An abortion refers to the death of a fetus before viability. Viability in South Africa is considered to be 28 weeks of gestation. The stillbirth rate is included in the PNMR, but when considered separately it is estimated at 32/1 000 live births in developing countries versus 5/1 000 live births in developed countries.

Maternal and perinatal morbidity

Morbidity is the number of complications and long-term health problems that result from pregnancy and birth. For every maternal death there are 30 women who will develop illnesses that result in long-term health problems. Neonatal morbidity has both short- and long-term effects on development, some of which may carry over into adulthood.

2.3 Maternal mortality in South Africa (Saving Mothers Report)

Since 1990 South Africa has followed the WHO and other countries in gathering information to determine the rates and causes of maternal and perinatal deaths in South Africa. This data is used to identify the causes of death and to develop ways to prevent these deaths.

The maternal mortality rate differs between countries. Sweden currently has the lowest maternal mortality, at 0.1/100 000 live births. The USA is 5/100,000 and the United Kingdom 12/100 000. The estimated maternal mortality for South Africa is 150–382(2007)/100 000 births. This is about five deaths per day. Most maternal deaths are preventable.

South Africa measures maternal mortality directly. The death of a woman in pregnancy and birth has been a notifiable condition since 1 October 1997, in terms of The National Policy Act (Act 116 of 1990), when the Minister of Health appointed the National Committee on Confidential Enquiries into Maternal Deaths (NCCEMD). Six reports have been generated since then. The main 'big five' causes of direct and indirect maternal deaths are listed in Table 2.1. Ten recommendations were generated. The NCCEMD concluded that, overall, the implementation of recommendations has been poor (Saving Mothers Report 2004:305). Clear targets were set for most of the recommendations (see Table 2.2).

Table 2.2 indicates the need for improved action in maternal healthcare.

2.2 Saving Mothers Report

The full Saving Mothers Report (2006–2007) is available online from http://www.doh.gov.za/docs/savingmothers-f.html. and is updated every four years.

In summary, the latest report indicates that the maternal mortality in South African remains high. Rates differ between provinces and districts. It is estimated that 38.4% of these deaths are avoidable.

In South Africa pregnancy-induced hypertension is the most important direct cause of maternal death and this has been reduced by 14% since the first report. Globally, ante- and postpartum haemorrhage is the biggest cause of maternal death. The first 24 hours after birth are the most vulnerable.

Table 2.1

The 'big five' causes of maternal deaths in South Africa

Causes of maternal mortality in South Africa (1998–2007)	Indirect	Direct
HIV/AIDS	✓	
Pregnancy-induced hypertension		✓
Ante- and postpartum haemorrhage		✓
Sepsis		✓
Medical conditions, diabetes, cardiac conditions, thrombosis	✓	

Table 2.2

Saving Mothers Report recommendations, targets and outcomes

	Recommendations	Targets for December 2004	Target met by 2004
1	Protocols on the management of conditions.	100%	47%
2	All pregnant women to be offered information and screening on communicable and non-communicable diseases.	40%	Met
3	Criteria for referral routes must be established and utilised.	80%	0–60%
4	Emergency transport must be available for all pregnant women and their babies.	50% within one hour	Only one province above norm
5	Staffing and equipment norms must be established for each level of care and for every health institution concerned with the care of pregnant women.	None	No national guidelines
6	Blood for transfusions must be available at every institution where surgery is performed.	100%	38–98% provinces reached the target
7	Contraceptive must be promoted and unsafe abortion must be reduced.	60% subdistricts 1st trimester, 20% districts 2nd semester, 20% districts advertising strategy	4 of 9 provinces have met the target
8	Correct use of the partogram through a quality assurance programme.	30% institutions with quality programme	Met by most provinces
9	Skills in anaesthesia should be improved at all levels of care.	75% c/s by regional anaesthesia Training programmes	17%
10	Women, families and communities must be empowered, involved and participating actively in activities, projects and programmes aimed at improving maternal and neonatal health and reproductive health.	Unclear targets	No audit

Saving Mothers Report 2004:205

In South Africa the main cause of maternal deaths is indirect and is associated with HIV/AIDS. Currently 43.7% of deaths are related to HIV/AIDS.

Other factors to be considered include:

- 20 years and younger (hypertensive risk)
- 35 years and older (obstetric haemorrhage risk, and other direct and indirect causes)
- administrative problems, transport problems, lack of facilities and staff
- patient problems: non- or delayed attendance
- healthcare provider problems: poor assessment, failure to recognise the problem and to follow protocols.

The most notable recommendation in the 2007 report is that staff and equipment norms are needed, as is the involvement of civil society.

2.3 Essential steps in the management of obstetric emergencies (ESMOE)

One of the strategies to improve the quality of outcomes is the skill drills of ESMOE. Another is the strengthening of postnatal care as most deaths happen after birth. The establishment of staff and equipment norms is now essential.

Midwives in South Africa must be well versed on the maternal mortality report and its recommendations to improve midwifery practice, specifically in terms of the development of norms and standards for staff and equipment.

2.4 Perinatal mortality (Saving Babies Report)

The Medical Research Council (MRC) Maternal and Infant Health Care Strategy Research Unit was started on 1 October 1999. To date, 244 sites collect information on newborns, which is estimated to record 40% of all births in South Africa. There are plans to increase this coverage. This is called the Perinatal Problem Identification Programme (PPIP).

The sixth report was submitted in 2007. These reports will be ongoing. Findings of this report show perinatal deaths are higher in the age group < 17 and > 35 years. This relates to the same increased risk for maternal death for this group.

The main reasons for perinatal deaths are:

- intrapartum asphyxia and birth trauma (17%)
- preterm births (23%)
- pre-eclampsia and abruption (23%).

Assessors felt that 44% of these deaths were avoidable.

2.4 The top 10 avoidable factors in perinatal deaths

1. delay in seeking medical attention in labour
2. inadequate facilities
3. no initiation of antenatal care
4. late booking
5. inadequate neonatal care
6. fetal distress not detected
7. inadequate resuscitation
8. poor management of prolonged second stage
9. lack of transport
10. fetus not monitored in labour.

Table 2.3

Causes of the PNMR in South Africa 2007

Causes	Rate
Unexplained stillbirth	24%
Spontaneous preterm birth	23%
Intrapartum asphyxia birth trauma	17%
Complications of maternal hypertension	13%
Antepartum haemorrhage (maternal)	10%

Stillbirths

It is estimated that there are 8 000 stillbirths in South Africa annually and that 40% of these are macerated. Of these, four are patient causes and six are healthcare system problems.

Table 2.3 lists the causes of PNMR in South Africa in 2007.

Three out of four neonates die due to immaturity or hypoxia. The highest risk of mortality is in district hospitals.

2.5 Conclusion

It is important to consider maternal and perinatal mortality together. Identifying and referring problems in the antenatal period, monitoring fetal movements, high standards of intrapartum care, improved postnatal care and skill drills are some of the topics highlighted as factors that require improvement. This improvement needs to be supported by improved health systems, reliable transport and more early bookings and compliance.

CHAPTER

3 Midwifery practice and care

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- define midwifery
- explain the core functions of a midwife
- explain the role of the midwife in South Africa
- explain new global trends in midwifery practice and education
- demonstrate and internalise knowledge of the code of conduct, and legal and ethical aspects of midwifery practice.

KNOWLEDGE ASSUMED TO BE IN PLACE

Nursing philosophy and theories

KEYWORDS

Midwife • Core competencies • Code of conduct • Litigation

3.1 Introduction

Chapter 1 gave a brief overview of the development of midwifery in South Africa. This chapter will look at the current and future role and function of midwives, benchmarked against international trends in midwifery.

3.2 Definition of a midwife

Midwifery is a sub-section of the collective nursing profession and is regarded as a separate profession by the International Confederation of Midwives (ICM) because it preceded nursing and medicine. However, in the third version of the International Standard of Classification of Occupations (ISCO-88 (2)), as agreed upon by the International Labour Organisation 1987, nurses and midwives are classified as one category in ISCO, namely code 223. Together with medical practitioners (ISCO code 222) they are classified as healthcare workers. Midwifery is not regarded as a separate discipline or healthcare worker in the ISCO-88.

However, in the field of nursing, midwifery remains a separate discipline. The International Council of Nurses and Midwives considers issues of nurse-midwives, and the International Confederation of Midwives considers issues of midwives. The most recent South African Nursing Act (Act 33 of 2005) defines a midwife in Chapter 2; 30 (2) as 'a person who is qualified and competent to independently practise midwifery in the manner and to the level prescribed and who is capable of assuming responsibility and accountability for such practice'. This is in line with the international definition of midwifery. In South Africa, midwifery is acknowledged as a separate discipline by referring to nursing and midwifery in the Nursing Act (Act 33 of 2005).

The definition of a midwife adopted by the International Confederation of Midwives at a council meeting on 19 July 2005, in Brisbane, Australia states (ICM/WHO/FIGO 1992):

> *A midwife is a person who, having been regularly admitted to a midwifery educational programme, duly recognised in the country in which it is located, has successfully completed the prescribed course of studies in midwifery and has acquired the requisite qualifications to be registered and/or legally licensed to practice midwifery.*

The definition of the ICM is expanded to recognise a midwife as a responsible and accountable professional who works in

partnership with women to give the necessary support, care and advice during pregnancy, labour and the postpartum period. The midwife conducts births independently and provides care for the newborn and the infant. This care includes preventive measures, the promotion of normal birth, the detection of complications in mother and child, the accessing of medical care or other appropriate assistance and the carrying out of emergency measures. The midwife has an important task in health counselling and education, not only for the woman, but also within the family and the community. This work should involve antenatal education and preparation for parenthood and may extend to women's health, sexual or reproductive health and childcare. A midwife may practise in any setting including the home, community, hospitals, clinics or health units. In 2008, 67 of the 200 members of the ICM voted in favour of making abortion care part of the practice of midwives.

There are different categories of midwives found in formal and informal healthcare settings. These are traditional midwives, lay midwives and professional midwives or nurse-midwives. The term 'nurse-midwife' refers to midwives trained in general nursing and in midwifery. Around the world, 50% of nurses have also trained as midwives.

South Africa has only two categories of midwives registered with the South African Nursing Council (SANC): professional nurse-midwives and enrolled midwives. Midwives are professional nurses who are also trained as midwives and in South Africa, approximately 50–60% of midwives are nurse-midwives. There are separate rolls for the registration of nurses (general, community and psychiatry) and midwifery. There is no database of the number of midwives actively and directly involved in maternal child care. Because of this it is difficult to know the midwifery workforce needed for the future.

3.3 The core functions of midwives

The ICM found that the core clinical functions (content of care) of midwives are similar globally. The midwife is the preferred and primary caregiver during *normal* pregnancy, birth and the postnatal period, including newborn care, and looks after the care of women, neonates and their families in the community under a variety of jurisdictions and mandates, in a wide variety of settings.

The midwife has the knowledge and skill to care for women and their newborns.

The style or form of midwifery practice varies greatly between healthcare systems due to contextual differences. The task environment of the midwife refers to all the types of authoritative jurisdictions or mandates that define the structural and regulatory boundaries or demands for midwifery practice. In South Africa, transformation of the healthcare system and higher education has had an impact on the role and function of the midwife.

Midwives may find themselves doing many other tasks assigned to them by the workplace, particularly if they are nurse-midwives. Traditionally, midwives were seen as a separate profession in South Africa with separate rolls. However, since 1992 the approach has changed, and the integrated training programmes of nurse-midwives resulted in the view that nurses and midwives are one and the same. The primary healthcare approach and the undefined nature of midwifery in South Africa has had an impact on midwifery practice and the needs of the work environment for midwives in South Africa.

There is consensus on the tasks of the midwife globally, but not on the optimal provision and form of midwifery care to the community. The midwife's practice ranges from being the only practitioner a woman will ever see (independently or as an employee in an institution) to a referral practice, to being part of a multidisciplinary team within a tertiary healthcare setting.

Midwifery is an integral part of the healthcare system in South Africa. This means that most women will receive care from a midwife during childbirth in some form or other. Data on the number of midwives varies, depending on the source of information. The SANC (2005) had 57 000 registered midwives on their roll. How many of these that are directly practising as midwives is not known.

Most midwives in South Africa work within the national healthcare system at different levels of care. It is estimated that only 300 midwives are providing private ante- and postnatal care, of whom only 30 are doing home and hospital deliveries as private one-to-one caregivers. The 1998 South African Demographic Health Survey (SADHS) indicated that only three out of 10 women in the public sector see a medical practitioner once in pregnancy and labour. This means that public sector maternal healthcare is solely in the hands of midwives without set ratios and the skill-mix and support needed.

It is up to midwives in South Africa to develop the norms and standards for safe practice, guided by evidence and existing models of care. Chapter 2 indicates this as a critical aspect of the improvement of maternal healthcare outcomes. How many cases can a midwife manage safely at a time? What equipment and support are needed for high-quality, safe and effective practice?

The Safe Motherhood Initiative aims to strengthen midwifery through the development of norms and standards for midwifery. One of their first activities was to define the core competencies of midwives.

3.4 The core competencies of midwives

South Africa is a member of the ICM. Although the transformation of nursing and midwifery is still in progress, South African midwives through The Society of Midwives of South Africa (SOMSA) subscribe to the principles of the ICM and ICN. The core competencies of midwives have been defined by the ICM in a document entitled the 'Essential Core competencies for basic midwifery practice' (May 2002) (see Box 3.1). The ICM promotes evidence-based midwifery practice and has established clearly defined core competencies for midwives. These guidelines are used by midwives around the globe. See Table 3.1.

3.1 Activity: The International Confederation of Midwives

The International Confederation of Midwives has defined the core competencies of midwives. The basic knowledge and skill of the above-mentioned competencies can be found and downloaded at: www.internationalmidwives.org/AboutICM/.../Default.aspx.

The scope of practice of midwives globally and in South Africa is normal pregnancy, birth and newborn care. Registered and enrolled midwives in South Africa are trained in the care of women and newborns in *normal* pregnancy, birth and postnatal care. SANC Reg. R2488 of 26 October 1990 is the guideline for midwifery practice in South Africa, clearly indicating the scope of practice of midwives as the 'normal' pregnancy, postnatal and newborn care. However, midwives need to understand complications and abnormalities in order to refer appropriately and to manage an emergency where necessary.

The midwife as skilled attendant

The Safe Motherhood Initiative (SMI) considers skilled attendance as one of the main ways to improve maternal healthcare outcomes.

A 'skilled attendant' is defined as a 'nurse, doctor or midwife' with emergency and *midwifery skills* that attend a birth, and 'skilled attendance' refers to birth in *a well-resourced environment*, backed by political will.

Table 3.1

Essential core competencies of midwives

Competency	Description
Competency # 1 General knowledge of social science, public health and professions	Midwives have the required knowledge and skills from the social sciences, public health and ethics that form the basis of high-quality, culturally relevant, appropriate care for women, newborns and childbearing families.
Competency # 2 Pre-pregnant care and family planning	High-quality cultural sensitive health education to all communities to promote healthy, family life (planned pregnancy and positive parenting).
Competency # 3 Care and counselling during antenatal care	Midwives provide high-quality antenatal care to maximise health during pregnancy, which includes early detection and treatment or referral of selected complications.
Competency # 4 Care during labour and birth	Midwives provide high-quality, culturally sensitive intrapartum care, conduct a clean and safe delivery, and handle selected emergency situations to maximise the health of women and their newborns.
Competency # 5 Postnatal care of women	Midwives provide comprehensive, high-quality, culturally sensitive postnatal care for women.
Competency # 6 Newborn care (2 months)	Midwives provide high-quality, comprehensive care for the essentially healthy infant from birth to two months of age.

The SMI requirement for decreasing maternal mortality, is that of the attendants present at a birth, 72% should be skilled. South Africa has a rate of 94% skilled attendants at birth but has not experienced the required drop in maternal mortality. However, skilled attendance alone cannot reduce the maternal mortality. This needs political and economic input to create the required norms and standards for a well-resourced environment. Capacity building includes improving the level of education, the development of scholarship and research in midwifery.

3.5 Midwifery education and research

The democratic transformation of the South African health-care system and the transformation in higher education in South Africa influenced changes in nursing education. New nursing and midwifery education programmes are not yet finalised but will be designed to fit the needs of South Africa.

The new education programmes will be in the higher education band. Currently midwives are mainly educated in the integrated nursing programmes as nurse-midwives. Box 3.2 gives the philosophy, beliefs and model of care accepted by the ICM for midwifery care. This model has not been officially accepted for midwifery practice in South Africa as yet.

3.2 Philosophy and model of midwifery care

Statement of belief

As midwives we believe that:

1 Childbearing is a profound experience, which carries significant meaning to the woman, her family and the community.

2 Birth is a normal physiological process.

3 Midwives are the most appropriate care providers to attend women during pregnancy, labour, birth and the postnatal period.

4 Midwifery care empowers women to assume responsibility for their health and for the health of their families.

5 Midwifery care takes place in partnership with women and is personalised, continuous and non-authoritarian.

6 Midwifery care combines art and science. Midwifery care is holistic in nature, grounded in an understanding of the social, emotional, cultural, spiritual, psychological and physical experiences of women and based upon the best available evidence.

7 Midwives have confidence and trust in, and respect for women and their capabilities in childbirth.

8 The woman is the primary decision-maker in her care and she has the right to information that enhances her decision-making abilities.

continued

As a result:

1 Midwifery care promotes, protects and supports women's reproductive rights and respects ethnic and cultural diversity.

2 Midwifery practice promotes and advocates for non-intervention in normal childbirth.

3 Midwifery practice builds women's self-confidence in handling childbirth.

4 Midwives use technology appropriately and effect referral in a timely manner when problems arise.

5 Midwives offer anticipatory and flexible care.

6 Midwives provide women with appropriate information and advice in a way that promotes participation and facilitates informed decision-making.

7 Midwifery care maintains trust and mutual respect between the midwife and the woman.

8 Midwifery care actively promotes and protects women's wellness and enhances the health status of the baby.

Guiding statement to member associations:

Member associations can use this document as a guide for the education of midwives, organisation of midwifery care, supportive supervision of midwives and evaluation of care. It can also be used to guide the relationship between the midwife and the patient. Member associations can share the statement with other health professions and governments during the development of regulations for and legislation of midwifery practice.

ICM 2004

The essential competencies of midwives and skilled attendants are listed in Tables 3.1 and 3.2.

There is a lack of research and development of theory and models in midwifery globally. The USA (Pew Commission) accepted the midwifery model of care as the model for the 21st century. It supports the '3Cs' of choice: continuity of carer and control of events by the women which aims to restore women-centred or humane care to the community and focus on normal pregnancy, birth and care for mother and newborn (see Box 3.2).

The three core elements of the midwifery model of care (choice, continuity of carer and control) are briefly discussed on page 17.

Table 3.2

The essential competencies listed for a skilled attendant matched with the proposed unit standards for SAQA

Essential Competencies of skilled attendants ***Clinical, cognitive and attitudinal***		
	Competencies for skilled attendants	**Unit standards**
Pregnancy	Monitor the health of the woman and fetus	252082
	Provide preventive and curative care for common illnesses such as anaemia, sexually transmitted infections, urinary tract infections, and malaria, and provide tetanus toxoid immunisation	252091
	Educate patients about danger signs and offer guidance in planning for the delivery	
Labour and delivery	Perform general and abdominal examinations	252091
	Observe and monitor the woman's physical status	
	Conduct a normal delivery	
	Recognise and respond to signs of distress in the woman or fetus	
	The skilled attendant should provide the basic elements of supportive care: • encourage a woman to move about during labour • appropriate methods of pain relief • provision of fluid and food intake during labour.	
Postpartum	Care of the umbilical cord	252085
	Appropriate management of the third stage of labour	
	Provision of a safe and warm environment for the mother and infant	
	Encourage early and exclusive breastfeeding	
	Counsel about appropriate family planning methods	
Emergency	Manage the clinical situations that pose major threats to the lives of mothers and newborn: • maternal haemorrhage • pre-eclampsia and eclampsia sepsis • preterm or obstructed labour • abortion complications • preventing neonatal deaths • conditions that can complicate pregnancy and childbirth (e.g. anaemia, malaria, HIV/AIDS)	252088
Interventions	Induction of labour. Surgical intervention (i.e. caesarean section, laparotomy in case of ectopic pregnancy, emergency hysterectomy, dilatation and curettage). Destructive operations. Diagnosis and management of diabetes, chronic hypertension, cardiac disease, kidney disease, and other common chronic conditions during labour and birth	
Attitude	Understand local customs so that the midwife can work with communities in making healthy choices. Communicate effectively with women and their families	
Cognitive	Problem-solving and quick decisive action. Gather information – through interviews, dialogue, observation, and clinical examination – and decide what is relevant to the situation(s). Identify signs and symptoms of serious and/or life-threatening conditions and develop a plan of care, balancing speed with attention to details. Evaluate the effectiveness of actions taken and modify or adapt the plan of care when needed, in individual cases and when a similar situation arises in the future.	252093

Choice

The essence of the midwifery model is the recognition that the (pregnant or labouring) woman can make decisions, giving choice and control back to the woman. The role of the midwife is to identify problems, give information, provide options and give support for the choices made, using scientific principles. There is a partnership with the woman through trust, mutual control and shared decision-making. Women are partnering in the care alliance between the midwife, the family and the environment. This dynamic partnership between the midwife and the woman is clearly defined in the birth process. It reflects a natural perspective on birth as a point of departure with emphasis on aspects of the environment to improve birthing. It recognises the nature of the birthing process as a normal physiological process until proven otherwise.

Continuity of carer

Continuity of carer suggests that when midwives know the women for whom they provide care, interventions are minimised through early detection of potential problems. It calls for the continuous care by one caregiver throughout pregnancy, birth and the postnatal period and the presence of a skilled 'hands-on assistant', particularly when in labour. It is a time-, education- and relationship-intensive practice. Midwives use their own energy to encourage, support and comfort women in normal pregnancy, labour and during the postnatal period. The identification of risk factors is a basic function of the midwife. The continuous presence of a known carer using scientifically grounded clinical processes allows early identification of potential complications and referral. Continuity of carer is also important in collaborative practice where teams of midwives work together and are known to the women they take care of. Collaborative practice also includes back-up from a medical practitioner or practitioners.

Control (autonomy)

The midwifery model as described provides comprehensive emotional, social and cultural care, and views birth as a meaningful experience that empowers the woman and strengthens bonds between father, mother, baby and siblings. It is seen as a critical development phase for a woman and portrays the transition to motherhood as a positive experience.

Women are allowed to make informed choices about the care they prefer and about the place of birth, the choice of provider, the choice of inductions, caesarian section and other interventions such as pain relief, the presence of a significant person during labour, breastfeeding and other important aspects of care.

In South Africa the philosophy of 'humane care' and the 'midwifery model of care' are followed by independent private midwives who do deliveries at home or in natural birthing centres in larger cities. There is no official philosophy of care for midwifery in South Africa and the primary healthcare philosophy of the Deparment of Health negatively affects midwifery practice in terms of the midwifery model of care.

3.3 Research

There is currently little research in midwifery practice in South Africa. Most research focuses primarily on maternal healthcare and the healthcare system or clinical care. Research on factors that could influence policies around maternal healthcare planning in general and by midwives in particular is limited in South Africa. The word 'midwifery' only appears in two sources reporting health human resources since 1995. In a case study of human resource requirements for primary health care (PHC), Daviaud and Chopra (2008:46), fail to highlight the need for midwives in the healthcare system. The Nursing Strategy for SA (2008) also does not differentiate midwifery from nursing.

The principal researchers in maternal healthcare come from related disciplines. Sociologists, anthropologists, economists, medical doctors and researchers from unidentified fields conducted the studies. There is thus a particular need for midwives to be involved in or spearhead relevant research that can affect policy decisions impacting on midwifery practice. The role and function of the midwife is unique but is still undervalued and this is reflected in the lack of research on midwifery practice and its context.

3.6 Empowerment of midwives

Empowerment is defined as 'the process of gaining influence over events and outcomes important for an individual or group'. The independent women-centred practice (midwifery model of care) is the 'event and outcomes of importance' for the empowerment of midwifery. An empowerment scale was developed that included conditions of control, support, recognition and skills as important in the facilitation of midwifery empowerment. It asserts that midwives themselves need to be empowered if they are to empower women. In South Africa, the process of empowering midwives is still ongoing.

3.7 Regulation of professional practice

Registration of midwives takes place through the South African Nursing Council after completion of a prescribed programme in midwifery. Registration requirements differ between countries. In Europe, midwifery training requires, for example, the completion of 40 deliveries of which one must be a breech. In South Africa only 15 deliveries are required. Licensing refers to the unique legal requirements that permit midwifery practice by a midwife, agent or institution according to set standards. These licensed structures are the official structures in a healthcare system (WHO 1985:5) recognised by law and government.

Table 3.3 summarises the published standards of midwifery adopted in America (2005).

3.8 Ethical considerations/code of conduct

THE ICM developed a code of conduct for midwives, which was revised in 1999. This code acknowledges women as people with human rights, seeks justice for all people and equity in access to health care, and is based on mutual relationships of respect, trust, and the dignity of all members of society. Box 3.4 gives the main chapters of the code by the ICM.

Table 3.3

Midwifery standards

	STANDARD
STANDARD I	Midwifery care is provided by qualified practitioners.
STANDARD II	Midwifery care occurs in a safe environment within the context of the family, community and a system of healthcare.
STANDARD III	Midwifery care supports individual rights and self-determination within boundaries of safety.
STANDARD IV	Midwifery care comprises of knowledge, skills and judgements that foster the delivery of safe, satisfying and culturally competent care.
STANDARD V	Midwifery care is documented in a format that is accessible and complete.
STANDARD VI	Midwifery practice may be expanded beyond the core competencies to incorporate new procedures that improve care for women and their families.

3.4 The code of conduct (ICM)

I Midwifery Relationships
II Practice of midwifery
III The professional responsibilities of midwives
IV Advancement of midwifery knowledge and practice.
The full code is available at: www.internationalmidwives.org/AboutICM/.../Default.aspx.

3.9 Litigation and indemnity

The practice of midwifery is regulated by the laws that guide practice and protect the consumer. Midwives are affiliated through nursing associations or unions to protect themselves from litigation. If a midwife wishes to start a private or independent practice he or she needs to be insured against potential lawsuits. Midwifery practice carries the highest risk of litigation in nursing. Liability insurance for obstetricians is among the highest in the medical profession and is rising for midwifery practice.

3.5 Current laws and regulations applicable on midwifery practice in South Africa (Changes to be announced in 2010–2011)

Act 33 of 2005 Nursing Act.
Professional regulations:
SANC Reg. 2418 2 November 1984. Keeping, supply, administering or prescribing of medicines by registered nurses.
SANC Reg. 2488 26 October 1990. Conditions under which a registered/enrolled midwife may practice.
SANC Reg. 2489 26 October 1990
SANC Reg. 2598 30 November 1984. Scope of Practice
SANC Reg. 387 18 February 1985. Acts and Omissions
Act 51 of 1989 Human Tissue Amendment Act.
Reg. no 24727 10 April 2003. Obtaining of pethidine or preparations or admixtures thereof by registered midwives
Reg 47 (*Gov Gazette* no 7636) (Previous R 777 10 April 1981)
R1575 Notification of birth
Act 61 of 2003. National Health Act
Act 92 of 1996. Choice on Termination of Pregnancy
Act 51 of 1992. Birth and Registration of Death
Act 16 of 1990. Notification of Maternal Death
Act 101 of 1996. South African (including Patients' Rights Charter)
DOH No. R 1001. 27 May 1988.

3.6 Litigation in Midwifery

In 2007, 600 midwives in the USA indicated that they had been involved in litigation. 75% of these cases were resolved before going to court. Of these, approximately 36% were dropped, 47% were settled before going to court and 9% were dropped without settlement. Of the remaining cases, approximately 4.5% favoured the defendant and 3.5% the plaintiff.

In South Africa litigation against private midwives has increased over the last 20 years. Information is available from the SANC website (www.sanc.co.za). Many lawsuits against the DoH indirectly indicate the quality of care in the public sector and may indicate the liability of midwives e.g. a baby that was burnt when bathed for the first time, this is clearly a practitioner error. On the other hand, the liability falls on the institution when administrative problems restrict the quality of care e.g. a case where babies died due to the lack of incubators.

As the practice of midwifery becomes more independent, the risk of litigation for malpractice increases. Litigation of obstetricians is well documented. Litigation against midwives globally is on the increase and is the highest for all categories of nurses because of the nature and scope of midwifery practice.

3.10 Midwifery and medication

In the current healthcare system in South Africa there is a shortage of medical practitioners, therefore midwives are often the primary carers for pregnant women and their babies. However, midwives always need to use their judgement when administering medication to a pregnant woman and/or a woman in labour, after birth or to a neonate. In an emergency, midwives may administer appropriate medication. If unsure, the midwife must consult a medical practitioner or a pharmacist.

Midwives require specialist training in administering medication and should understand the side-effects and risks associated with any medication they administer. Chapter 54 can be studied in this context.

3.11 Non-midwifery duties and support

The functions of midwives are flexible and diverse depending on the legislative, structural and economic factors influencing their practice in given healthcare services. However, research shows that the roles of the midwife are often restricted by fragmentation of care and non-nursing duties and lack of support.

In South Africa the Department of Health intends to train a new level of healthcare worker, 'midwifery assistants'. Their proposed scope of practice is, as yet, unclear, but these assistants will not be able to practise independently.

'Doulas' are trained lay care workers who assist with care for women in labour. They are used widely in many healthcare settings and research has shown their value. In South Africa only a few places train and use dualas. In the absence of the father or significant person in public hospitals in South Africa, or until a workable policy to allow the father in the labour ward is in place, dualas can lift the burden of care in the labour ward.

3.12 Conclusion

Midwives, through the Midwifery Society of South Africa (within the framework of the ICM and WHO to strengthen midwifery), should take the lead in the determination of the norms and standards for midwifery practice.

CHAPTER

4

Maternal and newborn healthcare in South Africa

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- explain the healthcare system and the Maternal, Newborn, Child and Women's Healthcare Directorate
- explain the programmes to improve healthcare to women and children in South Africa
- explain the supportive structures in maternal and child healthcare service delivery
- demonstrate knowledge of quality improvement strategies for maternal and infant care.

KNOWLEDGE ASSUMED TO BE IN PLACE

Knowledge of the South African healthcare system and healthcare systems in general

KEYWORDS

Healthcare system • Reproductive healthcare

4.1 Introduction

Chapter 1 gave an overview of the history of midwifery in South Africa, Chapter 2 summarised the maternal mortality of women and infants in childbirth in South Africa to guide decision, education and practice, Chapter 3 discussed issues of midwifery practice and challenges that midwives in South Africa are facing. This chapter looks at the healthcare system and its impact on midwifery practice.

4.2 Reproductive healthcare

Reproductive healthcare refers to the healthcare of women and men during their reproductive years. The normal physiology and psychology of sexual behaviour and reproduction are important aspects of reproductive health. There are several factors that have an impact on reproductive health:

- *Political will.* Policies that focus on women and children will influence the quality of healthcare, the type of healthcare services, and the training of appropriate healthcare workers.
- *Education level.* Educating women has been shown to be the single most important factor in good reproductive and child health.
- *Sociocultural factors.* The status of women affects the level of importance that maternal and child health is given by a society. Traditional beliefs and practices are also important, as are taboos such as not talking about sex. Men are frequently not involved in the process of childbirth in societies that stick to traditional norms. However, it is important not to make assumptions based on a person's perceived culture as this can lead to misunderstanding.

Women and children in developing countries still suffer from poor outcomes as a result of poor socioeconomic conditions. South Africa is one of the world's most unequal societies. At least 44% of the population are defined as poor. Of these people, 75% live in rural areas. Two-thirds of the poor live in three provinces, the Eastern Cape, KwaZulu-Natal and Northern Province, where between 80–90% of people lack clean water, water-borne sewage and electricity. At least half of these people cannot access healthcare because of the cost or lack of transport. There are few healthcare services in these areas, leading to poor maternal health outcomes (Saving Mothers Report 2005–2007). Poverty is associated with high birth rates and high maternal and perinatal mortality.

Understandably, the availability, accessibility, affordability and acceptability of healthcare influences health outcomes.

4.3 Maternal, child and women's health in South Africa

The Maternal, Child and Women's Health Directorate 1994 and 1995 was developed to guide policies and programmes in the public sector and to set priorities for maternal healthcare in South Africa.

Maternal, child and women's care in the public sector falls under primary healthcare (PHC) and serves 70% of the population. Primary healthcare and the district health system (DHS) are intended to bring care closer to the community and to integrate services. Maternal, child and women's healthcare is one of the seven core programmes in primary healthcare. It runs parallel with other supportive programmes, such as gender issues, HIV, AIDS, TB and mental health.

Since 1994, three directorates in the South African healthcare system share the organisation and management of maternal care in the public healthcare sector (see Figure 4.1).

1 The Sub-directorate, Maternal, Child, Women and Nutritional Health that developed (see Box 4.1):
2 The sub-directorate, Hospital Services and Human Resources and Disease Prevention covers private and public hospitals. The Draft Strategic Framework for Human Resources for Health Planning, South African National Department of Health was published on 3 August 2005.
3 The third directorate is the Chief Financial Office, which is responsible for financial matters.

4.1 Surveillance systems for maternal deaths

- national maternity care guidelines
- maternal case sheets
- promotion of the Decentralised Education Programme for Advanced Midwives (DEPAM)
- reduction of perinatal mortality through Perinatal Problem Identification Programme (PPIP)
- educational material for public education
- promulgate the National Maternal and Child Policy document 1995.

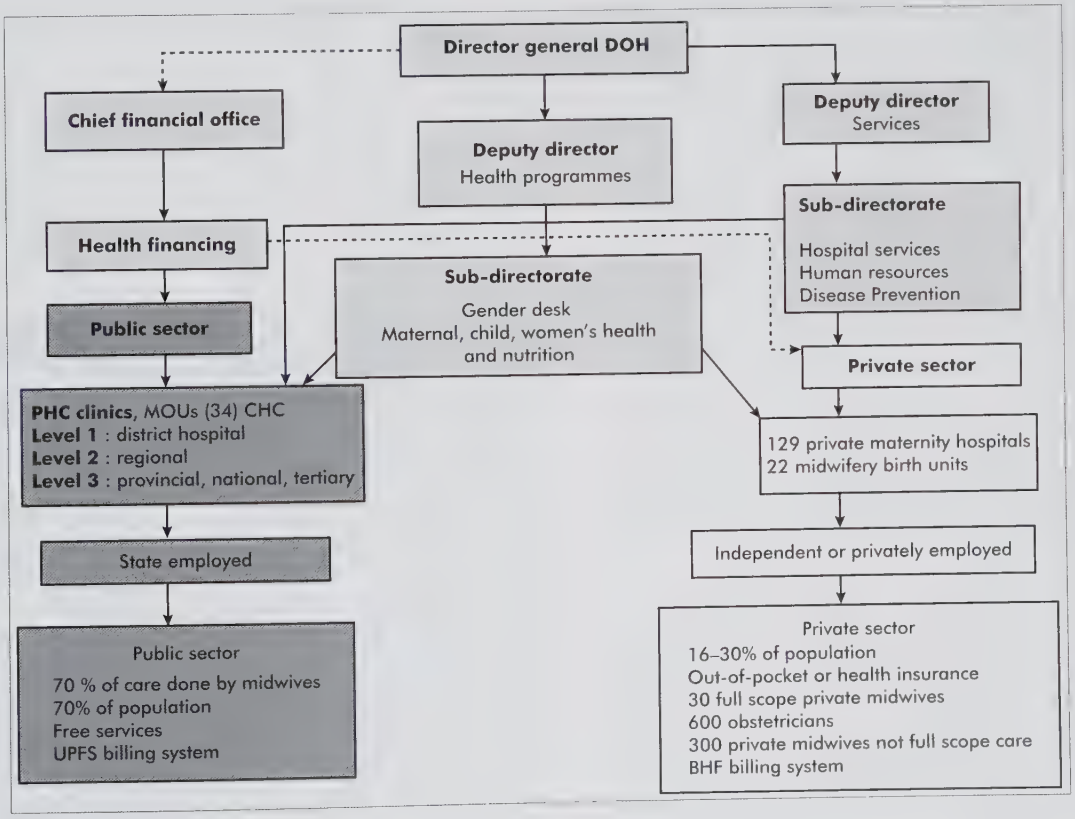

Figure 4.1 Organogram of Governing Bodies of Maternal Health in South Africa
Compiled and adapted from Van Rensburg, *et al* (2004) and multiple sources.

The following should be available at any point of delivery at any level of the health system (see Box 4.2):

4.2 Primary healthcare programmes for women and child health

Women's health and genetics
Antenatal care
Postnatal care
Contraception
Screening for cervical cancer
Termination of pregnancy
Genetic services
Child and youth health
Integrated management of childhood illnesses
Expanded Programme on Immunisation (EPI) and nutrition

In addition, maternity services are offered in the public sector through a range of care facilities through PHC clinics These are:

- *Fixed clinics*. This is a stationary or fixed facility of varying size staffed by nurses and offering varying packages of PHC at least eight hours a day during the week, in a radius of 5 km, which is considered to be walking distance.
- *Satellite clinics*. These are extensions of fixed clinics, working from a base and rendering service at predetermined points and times.
- *Community health services (CHS)*. These are day hospitals offering facilities that fall between the clinic and the district hospital. They deliver a wider spectrum of care and operate 24 hours a day, seven days a week. They provide emergency services and generally have a medical practitioner available full time and after hours.
- *Mobile clinics*. These are specially equipped vehicles stopping at specific points to provide out-reach services to outlying areas.
- *Midwife obstetric units (MOUs)*. These are specialist maternal services, staffed by midwives and are found mainly in the Western Cape and Gauteng (as reported in the Hospital Yearbook 2004/6).

In order to provide 'one stop care' all health facilities should ideally have a midwife available. The district system, which is part of the PHC system, does now provide improved antenatal services. However, several shortcomings have been identified such as lack of equipment and laboratories (HIV testing, Pap smears, pregnancy testing and Rhesus (Rh) testing).

Midwifery is integrated into PHC in the public sector and is also available privately.

Goals of maternal and newborn healthcare in South Africa

The Safe Motherhood Initiative (SMI) launched by the World Health Organisation in 1987 is focused on improving the provision of healthcare to women and children. The WHO advocate strengthening midwifery competencies and skills and assisting the healthcare system to improve the quality of healthcare to women and children. The Millennium Development Goals provide the targets that should be achieved through improved quality of care globally.

South Africa is committed to achieving the Millennium Development Goals (MDGs). Five of the eight Millennium Development Goals involve women and children's health. These are:

- MDG 1 eradicate extreme poverty and hunger
- MDG 3 promote gender equality and empower women
- MDG 4 reduce child deaths by two-thirds between 1990 and 2015
- MDG 5 calls for a three-quarters reduction of maternal deaths between 1990 and 2015 and to provide universal access to reproductive health services
- MDG 6 combat diseases, especially HIV/Aids and malaria.

Unfortunately, many sub-Saharan African countries are struggling to achieve these goals, which is why it is particularly important that healthcare workers are better trained and become more skilled.

The South African Department of Health (DoH) and the Maternal, Newborn, Child and Women's Healthcare Directorate (MNCWH) have set eight key strategies for maternal and newborn healthcare in order to achieve the MDGs. These are shown in Box 4.3:

4.3 Strategies of MNCWH

1 Addressing inequity through targeting under-served areas
2 Development of a comprehensive and coordinated framework for provision of MNCWH and nutrition services
3 Strengthening community-based MNCWH and nutrition interventions
4 Strengthening provision of key MNCWH and nutrition interventions at PHC level
5 Strengthening provision of key MNCWH and nutrition interventions at district hospital level
6 Strengthening the capacity of the health system to support the provision of MNCWH and nutrition services

continued

7 Strengthening human resource capacity for delivery of MNCWH and nutrition services
8 Strengthening systems for monitoring and evaluation of MNCWH and nutrition interventions and outcomes.

The following are focus areas for maternal and newborn healthcare in South Africa:

- improved access to contraception and termination of pregnancy (TOP) services, including pregnancy confirmation and emergency contraception
- basic antenatal care – four visits for every women beginning during the first trimester and a first visit within at least 20 weeks of gestation
- HIV testing during pregnancy with initiation of antiretroviral therapy where indicated
- intrapartum care (with a specific focus on the correct use of the partogram and standard protocols for managing complications)
- postnatal care for mother and baby within three days of delivery (which should ideally be home-based, although facility visits may be practical in some settings)
- prevention of mother-to-child transmission (PMTCT) of HIV (including infant feeding counselling and support)
- resuscitation of newborns
- kangaroo-mother-care (KMC) for stable low birth weight (LBW) infants
- promotion of early and exclusive breastfeeding (except where mothers who meet acquired fetal alcohol syndrome (AFASS) criteria have decided not to breastfeed)
- postnatal visit at three days that focuses on identifying problems, and supporting mothers in exclusive breastfeeding
- care for ill newborns according to standard protocols.

All healthcare workers who care for women in pregnancy, during birth and for newborns, irrespective of their level of training, must have the core competencies and skills required for South Africa to reach the MDG goals for maternal and newborn healthcare by 2020.

4.4 Maternal and child health profiles

When setting priorities for healthcare it is important to know the current status of the health of women and children.

The health profiles of women and children given here are from the 1998 and 2003 South African Demographic Health Survey (SADHS 1998 and 2003).

There are 17 international indicators of maternal healthcare. Audits and surveys are carried out every three to four years to determine progress. The South African Demographic Health Survey (SADHS 1998 and 2003) showed the following:

- *Total fertility rate*. The most recent SADHS (2003) information showed a total fertility rate of 2.2 children per women. This is an acceptable ratio for positive population growth.
- *Contraceptive prevalence*. The same SADHS reported a contraceptive prevalence rate of 65% (up from 61% in 1998). This shows that an increased number of women are using contraceptives.
- *Maternal mortality rate*. Maternal death is a notifiable condition. The 1998 South African Demographic and Health Survey (SADHS) reported a maternal mortality ratio (MMR) of 150 per 100 000 live births in South Africa. This is too high for the level of development of South Africa. This important indicator is a reflection of the overall quality of healthcare in a system.
- *Antenatal care coverage*. 95% of women have four antenatal visits per pregnancy.
- *Births attended by a skilled healthcare worker (nurse, midwife or medical practitioner)*. 94% of births are attended by a skilled healthcare worker.
- *Availability of basic and comprehensive essential obstetric care*. South Africa has above the norm obstetrical facilities for a developing country and a well-developed medical infrastructure.
- *Perinatal mortality rate*. Neonatal deaths (0–28 days) account for approximately one-third of all deaths in children. The stillbirth rate in South Africa is 19–24/1 000 deliveries (birth weight ≥ 1 000 g). This is comparable with rates in other middle-income countries, although the intrapartum stillbirth rate is higher than in these countries, suggesting that intrapartum care needs to be improved. Reductions in under-five mortality rates will only be possible if deaths during the neonatal period are substantially reduced.
- *Prevalence of low birth weight*. The early neonatal death rate is estimated to be 14/1 000 live births (or 9.5/1 000 live births if infants weighing less than 1 000 g are excluded), which is lower than rates in other middle-income countries. The most important causes of death in this period are immaturity (51%), hypoxia (26%), infection (10%) and congenital abnormalities (8%). Hypoxia mainly affects larger babies, and improvements in intrapartum monitoring and care would prevent many of these deaths. 15.5% of babies were classified as low birth weight (< 2.5 kg).
- *Prevalence of positive syphilis serology in pregnant women*. The prevalence of syphilis was 2.8% in 2007, showing that we still need ongoing screening and treatment of pregnant women.

- *Prevalence of anaemia in women.* 29.4% of pregnant women are anaemic, contrasting with adequate folate levels in most cases.
- *Percentage of obstetric and gynaecological admissions owing to abortion.* Approximately 60 000 women terminate pregnancies safely each year and the mortality rate from unsafe abortion has declined by 90%.
- *Reported prevalence of women with genital mutilation.* This is not a practice in South Africa and reported cases are from North Africa.
- *Prevalence of infertility in women.* The 2003 SADHS found that by the age of 19, 27.3% of women had been pregnant at least once. The level of infertility is not indicated.
- *Prevalence of HIV infection in pregnant women.* The 2007 National HIV and Syphilis Prevalence Survey found an HIV prevalence rate of 28.0% among pregnant women who were tested.

The nutritional status of women is important because being underweight or overweight can cause pregnancy and birth complications. The 2005 National Food Consumption Survey (NFCS) found that 4.6% of women were underweight, and 51.5% of women aged 16–35 years were overweight or obese.

Cancer of the cervix is the the most common cancer in South African women. There were 5 318 reported cases in 1997, representing 18.2% of all cancers. Breast cancer is the second most common cancer, with 4 789 new cases reported annually, constituting 16.4% of all cancers.

Prevention of all forms of violence against women is critical to efforts to empower women. There are high rates of violence against women in South Africa. The South African Police Service (SAPS) statistics show that 45 825 cases of rape were reported to the police between 1 April 2003–31 March 2004. This gives a rate of reported rape of 194/100 000 women. There is no reliable national data on rates of domestic violence, but community-based surveys have shown that at least 25% of women experience violence.

Three mutually supportive indicators of the MDG for healthcare are antenatal coverage, skilled attendance, and the delivery of care through basic and comprehensive obstetric facilities (WHO 2006:27).

4.4 Activity

The South African Demographic Healthcare survey is done every four years and the profile will change. Nurses and midwives can update themselves on the reports published on the DoH website. www.doh.gov.za/facts/sadhs2003/main.html.

The overall quality of maternal healthcare in South Africa has not been determined. There are negative reports about the poor attitude, lack of caring and lack of empathy among nurses and midwives in maternal and newborn healthcare in the public domain. This shows that it is essential to improve the quality of care delivered during pregnancy and birth.

4.5 The quality of maternal services in South Africa

The service delivery outcomes of maternal and newborn healthcare in South Africa are not well documented. South Africa ranked thirty-seventh in the Annual Mothers' Index (2006) comparing mother and child wellbeing in 125 countries (Saving the Children Report 2006:44). The newborn outcomes ranked seventeenth out of 78 countries (Saving the Children Report 2006:12). Measuring health service outcomes in South Africa may improve service delivery.

The Saving Mothers reports (1998–2006) for South Africa suggested setting norms and standards for staffing and equipment to improve maternal healthcare outcomes. These have not yet been realised.

Quality of maternal healthcare includes:

- availability (existence of the service)
- accessibility (location for provider or patient convenience)
- affordability (ability to pay for the service)
- accommodation (ability of patient to use service time schedules)
- acceptability (cultural differences and waiting times).

Availability of maternal healthcare

Maternal healthcare is accessible in South Africa as part of the public sector, exceeding the norms laid out by the UNICEF/WHO/UNFPA Safer Motherhood Policy. The availability of these services varies between rural and urban areas as well as between the public and private sectors. The content, scope, type and choice of birthplace and providers vary considerably between provinces and public and private healthcare sectors. In some areas lack of resources and availability of medical practitioners means that some services are unavailable, for example ultrasound screening in pregnancy and caesarean section. Furthermore, some investigations are unavailable because areas lack laboratories. Access to legal abortions remains a problem in the public health sector. Although primary healthcare services are available, local resources and conditions hamper the content and quality of the services.

The private sector has 129 private birthing facilities with an estimated 300 private midwives. These services are available

mainly in urban areas, but are only available to those with means. The private sector also provides low-risk birthing centres, where midwives conduct deliveries. These centres are found mainly in larger cities and only an estimated thirty private midwives conduct deliveries in these centres and at home.

The equivalent of these services in the public sector is the MOUs (midwife obstetric units). There are 28 MOUs located mainly in the Western Cape and in Gauteng (Figure 4.2).

Accessibility of care

Accessibility of care refers to the location of services and how easily patients can use these services. In South Africa 95.1% of women attend antenatal care, 73.1% have more than four visits during their pregnancy and 63.8% have their first visit before 24 weeks, meeting the WHO criteria for antenatal care. Only 30% of women have access to doctors in the public sector (SADHS 1998). In the public sector 83.7% of women deliver in an institution, 94% have skilled attendance at delivery and 15.8% have a caesarean section. Overall, 10% of women deliver outside a hospital, the figure rising to 20% in provinces with poor facilities (SADHS 1998). Twenty-three percent of clinics did not have access to ambulances, 50% do not provide pregnancy testing and 33% of clinics are not supervised.

Affordability of care

Maternal health care and care for children under five is free in the public sector. However, cost and inequality of funding and investment are still barriers to the quality of and access to better care in South Africa. Poverty is a barrier to improved access and quality of care. Cost to the patient is not a barrier to maternal services in the public sector where care is free, but may be a factor in funding of health services overall. Women may have problems accessing care if transport is not available or is unaffordable. In an emergency an ambulance service can be used free of charge, if it is available.

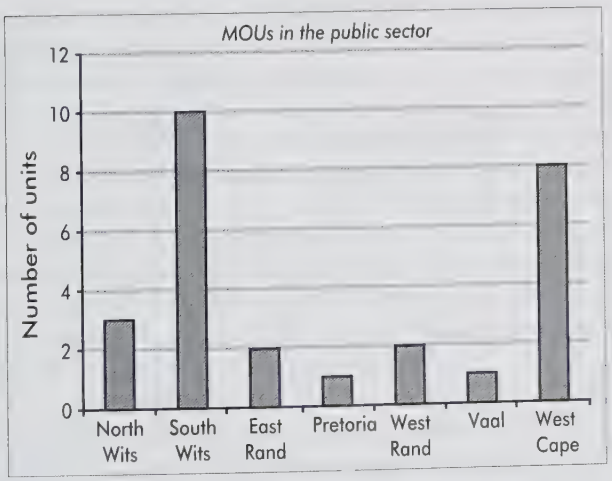

Figure 4.2 Midwife obstetric units
Adapted from the *Hospital Yearbook* 2002 to 2006

Access to private healthcare in South Africa is generally through medical aid or insurance, but may be limited in the cheaper schemes. Only 9% of women deliver in private institutions. Another 23% of women pay for private services themselves. The caregiver in this case may be a midwife, general practitioner or specialist. Such a practitioner may be the sole caregiver or may be part of a team. Many women make use of a private midwife to lower the cost of private care.

Accommodation

Accommodation is the term used to describe the conflict that exists between users and providers' schedules for service delivery. Antenatal care, for example, is not available after 4 pm and most women work until 4 pm. They have to take a day's leave to attend antenatal care and wait in long queues. Women may live some distance from the antenatal clinic and require transport to attend.

4.5 Transport as a quality factor

In South Africa one in six South Africans spend more than one hour travelling to the nearest health facility, with one in three in rural areas, of which 41% of users were using private transport and 31% public transport. 28% walked to the nearest clinic.

A study at Baragwanath of 100 women in labour indicated that 59% of women used private transport, 25% used public transport, 11% were transported by ambulance and 5% walked. The median time to reach the hospital was 120 minutes for this group. Transport time remains one of the quality barriers of healthcare for most of the population in South Africa. (The Second Kaiser Family Foundation Survey 1998 in Penn-Kekana & Blaauw, 2004:17)

Factors that reduce the quality of maternal healthcare in South Africa include long waiting times at antenatal clinics, waiting lists of several weeks for ultrasound screening, lack of transport and lack of basic medications. Few public sector maternity services allow women their own birth attendant. This is in contrast to the private sector, where the father or another partner is encouraged to be present during labour and delivery.

Acceptability

Jewkes, *et al* (1998) and Penn-Kekana and Blaauw (2004:23) highlighted the negative perceptions of maternal care in the public sector. Patients reported nurses and midwives as inhumane, rude and non-caring. Midwives on their part complain about women's behaviour, unbooked cases and lazy patients.

Box 4.6 lists aspects of quality in maternity care in South Africa.

4.6 Quality issues

The following were found to contribute significantly to the poor maternal healthcare outcomes in South Africa (Ronsman 2001b; Mantel, *et al* 1998; DoH 1999a in Penn Kekana, *et al* 2004:20):

- 84.5% cases reported that no companion in labour was allowed
- 46.7% are not allowed to move freely
- 83.7% were not offered fluids
- 43.2% had an intravenous line
- 52.6% received enemas
- 83.2% were not offered or given pain relief
- 97% were restricted to the supine position in labour
- 35% had an episiotomy
- 16% felt alone
- 18% were shouted at
- 5.3% perceived that they had bad care
- 4.5% reported that they were beaten or slapped.

No information is available on the acceptability of care in the private sector either for services provided by medical practitioners or midwives.

4.6 Improving maternal and newborn health

The following key programmes have been developed and are monitored with the aim of improving maternal and newborn care in South Africa.

Antenatal care

Basic Antenatal Care (BANC) promotes early attendance at an antenatal clinic (during the first trimester), to ensure the provision of high-quality antenatal care, and to integrate prevention of mother-to-child-transmission (PMTCT) of HIV into routine antenatal provision.

Cancer screening

According to the National Guidelines for Cervical Cancer, screening should be offered to all women over the age of 30 at 10-year intervals. Current coverage is estimated to be 40%.

Efforts to improve cervical cancer screening need to focus on increasing coverage and ensuring that women with abnormal smears receive appropriate follow-up and care. The best time to have the test done is during pregnancy, before 28 weeks, or six weeks after delivery. The majority of cervical cancers are associated with human papilloma virus (HPV). There is now a vaccine against HPV, but this needs to be given early in a woman's reproductive life.

Women should be shown how to examine their breasts as part of breast cancer screening when pregnant.

Prevention of mother-to-child transmission (PMTCT) of HIV

One of the key goals of the HIV, AIDS and STI Strategic Plan for South Africa is to reduce mother-to-child transmission of HIV, with a target of less than 5% transmission by 2011. There will be a significant reduction in child mortality rates if this target is achieved. The four pillars of the strategy are: primary prevention of HIV infections, prevention of unwanted pregnancies among HIV infected women, provision of antiretroviral therapy to mothers and infants to prevent transmission and *ensuring that eligible mothers receive antiretroviral therapy*. The nurse-initiated antiretroviral roll-out guidelines and five day training started in 2010. Antiretroviral treatment should now be available at most public healthcare centres.

The expanded PMTCT package includes additional services, which target both HIV-positive and HIV-negative mothers. These include provision of contraception and fertility services, reducing unintended pregnancies, involving men in decision-making, provision of nutritional support to breastfeeding mothers and provision of HIV prevention services for uninfected pregnant women.

Comprehensive care, management and treatment of children with HIV and AIDS (CCMTP)

Provision of care is guided by the Comprehensive Care, Management and Treatment Plan implemented in 2003 and the HIV, AIDS and STI Strategic Plan: 2007–2011. The care of children with HIV and AIDS is closely integrated with provision of other services such as PMTCT, the expanded programme of immunisation (EPI) and intergrated management of childhood illnesses (IMCI).

Early diagnosis and management of children with HIV and AIDS is key to improved outcomes. Diagnosis in children less than 18 months is facilitated by PCR testing, which is now available throughout the country, with an average of 20 000 tests being done per month. Cotrimoxazole should be given to all HIV-infected children, since it reduces mortality and morbidity. HIV-exposed children should be identified and tested during routine visits, for example for vaccination.

The most recent guidelines for treating HIV-infected children (see Chapter 51) were published in 2010 by the Department of Health. Children now make up 10% of the total number of people on antiretroviral therapy.

Intrapartum care

Care must be taken to ensure that protocols are followed and that partograms are correctly used during labour.

Postnatal care

In contrast to the antenatal and intrapartum periods, little attention has been paid to ensuring that mothers are supported during the early postnatal period. Not only do many maternal and neonatal deaths occur in this period but mothers also require support in caring for their babies and implementing the feeding choices which they have made.

Integrated management of childhood illness (IMCI)

The IMCI starts at birth. All babies receive the Road to Health Chart at birth and polio and TB immunisation is given before they leave the healthcare system. The IMCI is included in the pre-service curricula of all health professionals in South Africa. In many developing countries most deaths in children under five years of age are due to a limited number of preventable and treatable conditions. The IMCI aims to reduce mortality from these conditions through improved case management at health facilities, and by promoting improved childcare and health-seeking behaviours at household and community levels. IMCI also has a strong preventive focus. The case management process for each child should include an assessment of the child's immunisation and nutritional status. Counselling on appropriate feeding during health and illness should be provided where necessary and Vitamin A, de-worming medication and immunisations should be provided when required.

An infant and young child feeding policy, which aims to harmonise infant and young child feeding messages and practices, has been developed. Key components of the policy include promotion of exclusive breastfeeding, supporting appropriate and safe infant feeding choices for mothers who are HIV-infected and promotion of appropriate complementary feeding.

Expanded programme of immunisation (EPI)

South Africa has achieved high cover of routine immunisation, with the aim of 100% cover. Approximately one third of districts currently achieve the target of ensuring that 90% of children complete the primary EPI schedule by one year of age. The Reach Every District (RED) strategy has been implemented in order to ensure that all districts reach and maintain high immunisation coverage rates.

South Africa was declared free of wild poliovirus in 2006, and neonatal tetanus has also been eliminated. The number of measles cases has been dramatically reduced.

The routine EPI schedule has recently been updated, and now includes immunisation with tetanus toxoid at six and 12 years. This should mean, in the long term, that pregnant women do not require tetanus toxoid.

Vaccines against pneumococcal and rotavirus infection are also being introduced as part of the routine immunisation programme. These vaccines are expected to have a positive impact on under-five mortality rates and their introduction needs to be as rapid as possible.

Growth monitoring and promotion

Early identification and appropriate classification of malnutrition is pivotal to appropriate and timely intervention, especially in children below five years of age. Regular weights, correctly plotted and interpreted on the growth curve in the childs Road to Health Chart form the core of the growth monitoring and promotion strategy.

Growth monitoring also provides an opportunity for assessment of the child's development. Children with poor eyesight, hearing loss, and other developmental and behavioural problems can be identified, and referred for the appropriate remedial support.

Vitamin A supplementation

Vitamin A deficiency contributes to as many as one out of four childhood deaths. It may result from inadequate dietary intake of vitamin A or from rapid utilisation of vitamin A during illness, pregnancy and lactation and during phases of rapid growth in young children. Children between the ages of six and 59 months experience more serious effects from vitamin A deficiency than other groups. Although the vast majority of children with vitamin A deficiency have no clinical signs, even moderate vitamin A deficiency significantly increases a child's risk of dying from infectious diseases. A combination of interventions is usually used to prevent and eliminate vitamin A deficiency – these include breastfeeding protection and promotion, food fortification, vitamin A supplementation and dietary diversification.

Routine vitamin A supplementation for children younger than five years was introduced in South Africa in 2003. Non-breastfed infants receive a once-off dose of 50 000 IU at six weeks, while children 6–11 months receive a single dose of 100 000 IU and children aged 12–60 months receive 200 000 IU every six months. Data from the DHIS shows that 94% of children 6–11 months and 56% of children 12–59 months received at least one dose of vitamin A supplementation annually.

Promoting healthy lifestyles

Healthy lifestyles among pregnant women can play an important role in improving the health of mothers and their newborn babies.

Adequate nutrition and moderate exercise are particularly important during pregnancy. The WHO recommends a daily intake of fresh vegetables and fruit (including green leafy and other vegetables, legumes and fruit in adequate quantities) to reduce the risk of coronary heart disease, stroke and high blood pressure. Other important interventions include promotion of safe sex and avoiding smoking and alcohol intake during pregnancy.

Micronutrient control

All pregnant women should receive supplementation with iron and folate during pregnancy, and one dose of vitamin A (200 000 IU) in the postpartum period. All pregnant women should be given calcium supplementation (at least 800–1 000 µg per day).

Genetics services

The goal of genetic services is to prevent and improve the management of genetic disorders, birth defects and disabilities. All provinces are implementing the Policy Guidelines for the Management and Prevention of Genetic Disorders, Birth Defects and Disabilities. Guidelines for the Care and Prevention of Common Birth Defects have also been developed. Of the 52 districts, 32 have at least one nurse trained in genetics, and 36 districts are implementing the standardised birth defects collection tool.

Reproductive health services (including family planning)

Although termination of pregnancy is legal and should be readily available, studies have shown that many women experience barriers to accessing the service, especially in the second trimester. Extending access to emergency contraception and promoting early confirmation of pregnancy (through improving knowledge of sexual and reproductive health and promoting pregnancy testing) are important for reducing second trimester terminations and unintended pregnancies. However, it is also important to ensure that services are accessible in all districts for both first and second trimester terminations.

All PHC facilities should provide a full range of contraceptive services and promote the use of dual methods (contraceptive and condom use). It is especially important to ensure that adolescents have access to reproductive health services, including family planning and pregnancy testing services. All PHC facilities should provide these services in a youth-friendly manner and ensure that all users (and their sexual partners) are empowered with information on sexual and reproductive health and contraceptive use.

Youth-friendly services (YFS)

Youth services are important. The SADHS (1998) indicated that many young girls fall pregnant before 18 years of age. Provision of health services for youth is guided by the Policy Guidelines for Youth and Adolescent Health, which outline five intervention strategies, namely promoting a safe and supportive environment, providing information, building skills, counselling and access to health services. The PHC facility survey (undertaken in October 2006) showed that 41% of PHC facilities were implementing the YFS approach, 15% of PHC facilities were accredited as being youth-friendly and 20% of PHC nurses were trained in youth issues.

Since 2006, annual National Youth Health Indabas, which aim to promote the health and well-being of youth have been held. The youth who have participated in these events have expressed willingness to be more involved in programmes such as volunteer peer educators, and more active involvement of young people should be promoted.

There is also a need to strengthen collaboration with the Department of Basic Education to extend the provision of information to youths in school. It is also important to strengthen teaching of sexual and reproductive physiology and health in schools, and to ensure that all students have adequate knowledge before they enter the reproductive years, and start sexual activity. Addressing gender issues is also a key component of this process.

Post-rape services

The Sexual Assault Care Policy (2005), and the accompanying Clinical Management Guidelines have been developed and implemented nationally. The guidelines emphasise both the medical and psychological management of rape survivors as well as the medico-legal responsibilities of health professionals.

Although post-rape health services have been substantially improved over the last decade, many health professionals providing care are still untrained and services for children are particularly limited. Continued efforts are needed to ensure that services meet the physical and mental health needs of adult and child victims. Standardising training using the recently developed national curriculum for training sexual assault care providers is important in improving service quality, and this needs to be extended to all post-rape service providers. Continued efforts are needed to strengthen service infrastructure, and to ensure 24-hour access to all post-rape services.

Auditing of maternal deaths

In 1997 maternal deaths were made notifiable. The Minister of Health appointed a National Committee on Confidential Enquiries into Maternal Deaths (NCCEMD), which has

recently celebrated its tenth anniversary. The Saving Mothers Reports generated 10 recommendations for improved quality of care to prevent maternal mortality.

Improving the quality of newborn care through the use of mortality reviews

The Perinatal Problem Identification Programme (PPIP) is a facility-based approach to auditing perinatal deaths. It relies on regular institutional review meetings to discuss deaths, and identify and address possible shortcomings in care. One hundred and sixty-four facilities currently submit data for national collation – this represents approximately 20% of perinatal services in South Africa. This provides valuable data regarding perinatal health and health services in the country, and forms the basis of the Saving Babies Reports, which have been published regularly for the past 10 years. The reports identify low birth weight and asphyxia as the main causes of death in neonates – it is thus clear that efforts to reduce neonatal mortality should prioritise the prevention and management of these conditions.

The baby-friendly hospital initiative (BFHI)

The BFHI recognises the special role of maternity services in early support and protection of breastfeeding, while promoting safe infant feeding for breastfeeding and non-breastfeeding babies. It aims to ensure early initiation of breastfeeding, provide an enabling environment for safe infant feeding and to ensure that all mothers receive continued support irrespective of their feeding choice. Hospitals that meet the BFHI criteria can apply to be accredited as being baby-friendly. Currently 41% of the 545 maternity facilities in South Africa are accredited – just over half (51%) of supervised deliveries in South Africa take place in these facilities.

Follow-up of women once they leave maternity facilities is often not optimal, and needs to be strengthened (provision of early postnatal care provides an opportunity for this). In particular, improved support for breastfeeding at community and household levels is urgently needed. There is also a need to strengthen mechanisms for monitoring and scaling-up of the BFHI initiative.

Kangaroo-mother-care (KMC)

Complications related to prematurity and low birth weight are the leading cause of death in newborn babies. Studies have shown that provision of kangaroo-mother-care, where the baby is carried on the front of the mother's chest (with direct skin-to-skin contact) is an effective and safe way of caring for these small babies. PPIP data has shown that hospitals that implemented KMC reduced their mortality rates among small babies (weighing between 1–2 kg) by 30%.

KMC is currently being implemented in all provinces, although coverage data for facilities is not yet available. KMC has the potential to reduce mortality and morbidity in low birth weight (LBW) infants and needs to be implemented in all facilities that provide newborn care. Incorporating KMC assessments into BFHI assessments would ensure that more facilities implement both strategies.

Infant and young child feeding

The index for equity in health has been identified as the proportion of children under five who have stunted growth (no more than two standard deviations below the median for height). South Africa did not reach the target of 20%, with a score of 22.9%. Eradication of poverty is the biggest challenge facing the government.

Undernutrition contributes significantly to deaths in young children, and improving infant and young child feeding and nutrition therefore have an important role to play in reducing infant and child mortality rates.

Additional aspects that are of value in evidence-based maternal care are mother-friendly care and the Better Births Initiative.

4.7 Evidence-based care

As a provider of maternity care in a hospital or health centre, a variety of procedures, checks and interventions are used to manage pregnancy, labour and the postpartum period. This includes procedures such as taking a women's blood pressure and checking her pulse and temperature. These and other procedures are done routinely to ensure the health of the mother and baby, to enable a safe birth and healthy outcome. However, there is evidence that some of the procedures routinely used during childbirth are not offering any benefit to women. Certain procedures are not always appropriate and can be harmful, unpleasant or uncomfortable for women.

Good care is based on procedures and interventions that have been justified by scientific research – in other words, evidence-based care. As health professionals we must be aware of the most up-to-date research evidence and change our practice accordingly. Ideally, only interventions that are of benefit to women should be used, and those that are potentially harmful or humiliating should be stopped.

The Better Births Initiative (2006) is a South African initiated programme that seeks to improve maternal healthcare through the incorporation of evidence-based practices into obstetric practices. The following tables summarise Better Births Initiative (BBI) principles (see Table 4.1) and evidence-based aspects (see Table 4.2) for obstetric care.

Table 4.1

Principles of the Better Births Initiative (BBI)

Humanity	Women treated with respect.
Benefit	Care that is based on the best available evidence.
Commitment	Health professionals committed to improving care.
Action	Effective strategies to change current practice.

Table 4.2 lists the evidence-based care that should be incorporated into care of women and children in all healthcare settings by all healthcare institutions and workers.

4.8 Mother-friendly care

The care given to women and newborns in pregnancy and birth stretches beyond medical procedures and practices. Women-centred care refers to care where the needs of women are considered in pregnancy and birth and is called *supportive care*.

Table 4.2

Evidence-based care

	Evidence-based aspects	**Application**
Pregnancy	*Magnesium sulphate for treating eclampsia* Studies have shown it to be much more effective than other anticonvulsants. In addition it is relatively cheap and easy to use.	Magnesium sulphate should be used routinely to treat all women with eclampsia following the protocols.
	Corticosteriod therapy To prevent hyaline membrane disease of the newborn.	Give IM injection to the mother between 32–34 weeks when at risk for premature birth following a protocol.
	Folic acid Prevention of neural tube abnormalities of the newborn.	All pregnant women to take folic acid orally before pregnancy.
Labour	*Positions for labour* A number of studies suggest that an upright, or semi-upright position shows more benefits than a supine position.	Allow women to take the position that feels comfortable in first and second stage unless contraindicated.
	Mobility during labour Several studies show that the supine position affects blood flow in the uterus, and can reduce the intensity of contractions.	Standing or lying on the side can be more beneficial to the woman as long as there are no complications. Women should be encouraged to walk around, choose other more comfortable positions, and even take baths or showers during labour.
	Fluids and food during labour Labour requires lots of energy and can last for hours. Women need to maintain their energy levels. Restriction of oral intake can lead to dehydration and ketosis – this is usually treated with IV infusion.	Women are able to monitor their own intake, and will intuitively avoid heavy meals. For normal and low-risk births, avoid interfering with women's wishes for food and drink during labour.
	Encourage companionship during labour There is evidence to suggest that women who are supported throughout labour by a partner, friend, relative or carer enjoy several benefits.	Encourage women to bring someone they trust or feel comfortable with: a partner, relative, or friend. Alternatively, establish a childbirth companionship system at your hospital/clinic.

continued

	Enemas are not always necessary There is insufficient evidence to recommend the routine use of enemas. Further medical trials need to be conducted before the benefits and harms can be properly evaluated.	An enema should be given only if the women requests it.
	Stop pubic shaving Shaving is an unnecessary procedure.	If you stop shaving, you will reduce the discomfort and embarrassment for women.
	Avoid episiotomy Episiotomy carries a number of risks, and the evidence suggests that routine use does not reduce perineal trauma or improve healing.	There is clear evidence to recommend restricted use of routine episiotomy. Only done when indicated.
	Reduce use of early amniotomy Routine early amniotomy is associated with both benefits and harms.	Until there is more evidence, amniotomy should be reserved for women with abnormal or slow progress and avoided in HIV-positive women.
	Suction of newborns Routine nasopharyngeal suctioning of all newborns is unnecessary, and costly.	It is recommended that only those babies with meconium present should undergo suctioning on delivery.
HIV-positive women PMTCT	*Antiretroviral therapy* Triple therapy is evidence-based best practice in developed, well-resourced settings.	Nevirapine, one tablet to the mother during labour, and one dose of syrup to the baby after birth, is highly effective in reducing the risk of transmission in low resource settings.
	Artificial rupture of membranes Risk of MTCT increased.	Avoid the artificial rupture of membranes.
	Breastfeeding 12% risk of contracting HIV from breast milk.	If women are in a position to provide safe alternative feeding, they may be encouraged not to breastfeed. If they need to or wish to breastfeed, they should be encouraged to give their baby ONLY breast milk for 6 months then introduce complementary feeds and continue breastfeeding for 12 months.
	Mode of delivery Evidence suggests that caesarean delivery can reduce mother-to-child transmission of HIV.	Caesarean section is only indicated under safe conditions.
	Vaginal cleansing Highest risk for MTCT is during vaginal birth.	Vaginal disinfecting before and/or during labour may help to prevent transmission of HIV. Disinfective agents, such as chlorhexidine, may be particularly useful because of their activity against HIV.
	Vitamin and nutritional supplements Studies suggest that the risk of MTCT of HIV infection is associated with vitamin A deficiency in the mother.	Give vitamin A to pregnant women

Adapted from: *Implementation Aids: An Introduction to the Better Birth Initiative.* 2006

Midwifery care reflects the use of self (midwife) as an instrument of care, meaning support and 'being with' women (that makes an alliance with women) to assist them during pregnancy, childbirth and the postnatal period. This is an essential component of care. The way in which care is organised and provided should incorporate the principles of women-centred care. This includes continuity of carer and respect for a woman's choice of provider and birth place.

The Patients' Rights Charter, Batho Pele in South Africa, incorporates the principles of women-centred care. Women should know their caregivers by name, have continuity of caregivers and choice of care, provider and birthplace.

More information and advice on the steps to mother-friendly care is available for free download from http://www.mother friendly.org

Civil society participation

Maternal healthcare services exist for the benefit of civil society and should meet standards and criteria that will meet the needs of society for safe care.

4.9 Conclusion

A review in 1997 of the SMI's performance over 10 years led to the adoption of the resolutions that state that alliances are needed between governments, policymakers, non-governmental organisations, and citizens. These alliances advocate for human and women's rights, but also include men and religious groups, non-governmental organisations, donors, and other sectors of government. The White Ribbon Alliance for Safe Motherhood was formed by a group of international non-governmental organisations (NGOs), United Nations (UN) agencies, and the US Agency for International Development (USAID) in an effort to raise awareness of the need to make pregnancy and childbirth safe for all women and newborns in developed as well as developing countries. In South Africa the White Ribbon Alliance (WRA) was formed in 2004. More information on this organisation can be found at www.whiteribbonalliance.org.

Section Two

The female reproductive system

5 Female reproductive organs

6 The menstrual cycle and hormonal control

7 Genetics, gametogenesis, fertilisation, placental development and embryology

Colour Illustrations

8 The Ps of labour: passage, passenger and powers

9 The breasts and lactation

CHAPTER

5 Female reproductive organs

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- identify and describe the normal structure, function, blood and nerve supply of the internal and external female reproductive structures/organs important in pregnancy and birth.

KNOWLEDGE ASSUMED TO BE IN PLACE

Anatomy of the female reproductive organs

KEYWORDS

Female reproductive organs • Genitalia

5.1 Introduction

This chapter explains the anatomical structure and function of the female reproductive organs.

Table 5.1

Structures found in the female reproductive system

External	Internal
Vulva (pudenda)	Vagina
Mons pubis	Uterus
Clitoris	Fallopian tubes
Labia majora	Ovaries
Labia minora	Supporting structures of female pelvis
Vestibule	Bony pelvis
Urethral meatus	Pelvic floor
Skene's ducts	Accessory breast tissue and milk ducts.
Bartholin's glands	
Perineum	
Nipples	

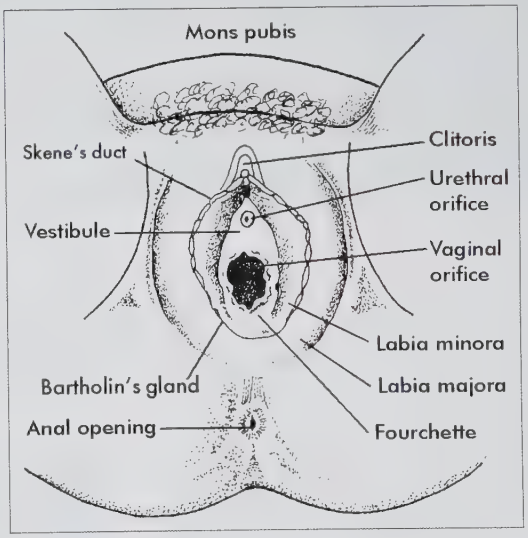

Figure 5.1 The structure of the female genitalia

Normal reproductive anatomy can be affected by:

- age
- genetic make-up
- birth or congenital defects

- malnutrition
- disease (e.g. TB, polio)
- trauma (e.g. a pelvic fracture)
- hormonal abnormalities
- previous births.

5.2 External female genitalia

(See Figure 5.1.) The external female genitalia are highly vascular and are supplied and drained by branches of the internal pudendal vessels (from the internal iliac vessels). The external pudendal artery (a branch of the femoral artery) also supplies the vulva. Lymphatic drainage takes place via the sacral nodes, the internal iliac nodes and the inguinal nodes.

The mons pubis (also known as mons veneris) is the fatty cushion over the pubic bone, covered with pubic hair after puberty which protects the pubic bone.

The clitoris is a small erectile body beneath the mons pubis. It has abundant blood and nerve supply. It is comparable to the penis and becomes erect during sexual arousal.

5.1 Female genital mutilation (FGM)

In North Africa and parts of the Middle East female genital mutilation is a form of circumcision of women, where the labia minora and majora and the clitoris are removed in childhood. This may make childbirth difficult or impossible, particularly in forms of mutilation in which the vaginal entrance is narrowed.

The labia majora are the two folds of adipose tissue that conceal the underlying structures in nullipara. In multiparous women the labia may remain open and in menopause they may shrink. The outer surface is covered with pubic hair, and the inner surface is smooth. The labia majora are homologous to the scrotum in the male.

The labia minora are two thin hairless folds that lie between the labia majora and are richly supplied with blood vessels and nerves. At the anterior, they converge to form the frenelum of the clitoris and at the posterior, they form the fourchette.

The vestibule is an almond-shaped area bordered by the labia minora. It stretches from the fourchette posteriorly to the clitoris anteriorly. The structures that open into the vestibule are:

- *The urethral meatus of the urinary tract.* The opening is about 1.5 cm below the clitoris, and is sometimes difficult to find in multiparous women.
- *Two Skene's ducts (one on each side) that secrete mucus.* These ducts are often infected in cases of gonorrhoea.
- *The vaginal introitus or orifice.* The opening to the vagina occupies the posterior two-thirds of the vestibule. Before puberty, the opening may be partially hidden by a membrane known as the hymen. This membrane is usually ruptured during initial sexual intercourse, but can also be torn during strenuous physical exercise or with the use of vaginal tampons during menstruation. Further tearing takes place during the delivery of a child and the remaining tags of skin and fibrous tissue are known as carunculae myrtiformes.
- *Bartholin's glands* (two) are situated on either side of the vaginal introitus. These are pea-sized, compound racemose glands, and are situated posterior-laterally in the vestibule, embedded deep in the labia majora and the bulbo-cavernosus muscle. These glands have a lubricating function, especially during sexual intercourse, and they open into the vestibule on either side of the vaginal introitus through the Bartholin's ducts.

5.2 Bartholin's gland infection

A Bartholin's gland might become infected and form an abscess. This may be caused by gonoccoccal infection. A Bartholin's duct could also be damaged by a badly performed or incorrectly positioned episiotomy.

The perineum, sometimes referred to as the obstetric perineum, is the small area of muscle and fascia between the vaginal opening and the anus. This area is often traumatised in childbirth. These layers of muscle and skin may tear or

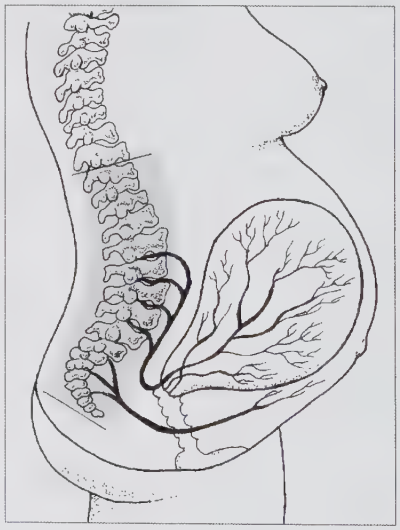

Figure 5.2 The uterine nerve supply

may have to be surgically incised during delivery. Perineal tears during delivery may involve the anal sphincter (a third degree tear).

This is a very sensitive area, richly supplied by branches of the pudendal nerve (sacral 2, 3 and 4). The posterior cutaneous nerve (sacral 1, 2 and 3), together with the genitofemoral nerve (lumbar 1 and 2) and the ilio-inguinal nerve (lumbar 1) also supply the structures of the external genitalia (See Figure 5.2).

The vulva (also known as the pudenda) consists of all the structures externally visible from the pubis to the perineum.

5.3 The internal female reproductive organs

(See Figure 5.3.) The structures that make up the internal genitalia are the vagina, the uterus (including the cervix), the uterine tubes and the ovaries. These organs are all contained within the true pelvis in the non-gravid (not pregnant) state.

Vagina

The vagina is a muscular tube that connects the vestibule with the uterus. It has three functions:

- It is the excretory duct for menstrual flow.
- It is the organ that receives the penis during sexual intercourse.
- It is the birth canal.

The walls of the vagina are folded with rugae (like a concertina) and this allows the vagina to stretch during birth.

The vagina is lined with stratified squamous epithelium, very similar to skin, but without glands. Under the influence of oestrogen the squamous cells of the vagina lay down large stores of glycogen, which nourish the lactobacilli (Döderlein's bacillus) normally inhabiting the vagina. These bacilli produce lactic acid, which maintains the vaginal pH between 4.0 and 5.5 and this acidic medium helps to reduce vaginal infections. Prior to puberty and after the menopause, with reduced ovarian function, the pH of the vagina is less acidic and vaginal infections are more common.

5.3 Bacterial vaginosis (BV)

Bacterial vaginosis is vaginitis that develops in women when the Ph balance of the vagina is disturbed and opportunistic infections occur. Hormonal changes may be the cause of the pH imbalances. Vaginal infections are associated with premature labour. Testing the vaginal pH is an easy way to determine the presence of vaginal infections. It is important to maintain the delicate physiological balance of the vagina during pregnancy.

The cervix opens into the posterior part of the upper vagina. The upper portion of the vagina is called the fornix, which is divided

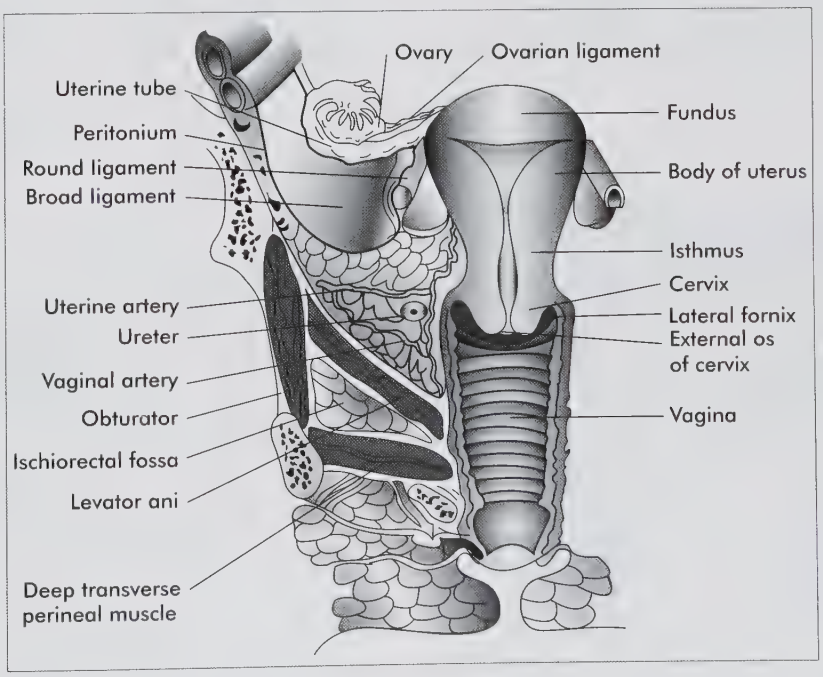

Figure 5.3 The internal female genitalia

into anterior, posterior and two lateral portions. The vagina is a highly vascular organ and the blood vessels are full of turns and twists to allow for the stretching that is necessary during pregnancy and labour. Any trauma to the vagina during labour usually heals rapidly because of the generous blood supply.

The main blood supply to the vagina is from the vaginal arteries and from the descending branches of the uterine arteries (branches of the internal iliac arteries) (see Figure 5.3). Lesser supplies are from the arteries of the bladder, the rectum and the internal pudendal arteries. An extensive network of veins accompanies these arteries. Varicose veins may affect the vaginal area.

The vagina is sensitive to stretching, but not to touch and is supplied by sympathetic and parasympathetic nerve fibres.

The uterus

(See Figure 5.4.) The uterus is hollow and pear-shaped and in its non-gravid state is approximately 7.5 cm long, 5 cm wide (at its widest point) and 2.5 cm thick. It is made up of a body and a neck or cervix, which are joined at a constricted area, the isthmus. During pregnancy the isthmus becomes larger and softer and Hegar's sign (in early pregnancy) is the softening that can be felt during vaginal examination.When pregnant the uterus is referred to as gravid.

The wide, rounded, upper portion of the body is called the fundus. The fundus is the muscular part of the uterus. The uterus is functionally divided into the upper and lower segment in pregnancy. The fundus represents the upper segment and the cervix the lower segment. The isthmus divides the two segments. Immediately below the fundus, on either side of the body, the fallopian tubes arise at the cornua (horns) of the uterus. The uterine cavity is continuous with the lumen of the uterine tubes.

The position of the uterus

(See Figure 5.5.) The uterus is a pelvic organ in the cavity of the true pelvis, behind and above the bladder and in front of the rectum. In the normal non-gravid state, it lies over the bladder, at right angles to the vagina in a position of anteversion and it bends forward in a position of anteflexion. The uterus is maintained in this position by the uterine ligaments, the round ligament and the broad ligament in a non-pregnant woman.

The structure of the uterus

The uterus is composed of three layers: the endometrium, the myometrium, and the perimetrium.

The endometrium. The endometrium is made up of three layers. The two most superficial layers are known as the functional layers, because they are shed during menstruation.

- The first layer is the compact layer, which lines the uterine cavity and is made up of columnar epithelial tissue.

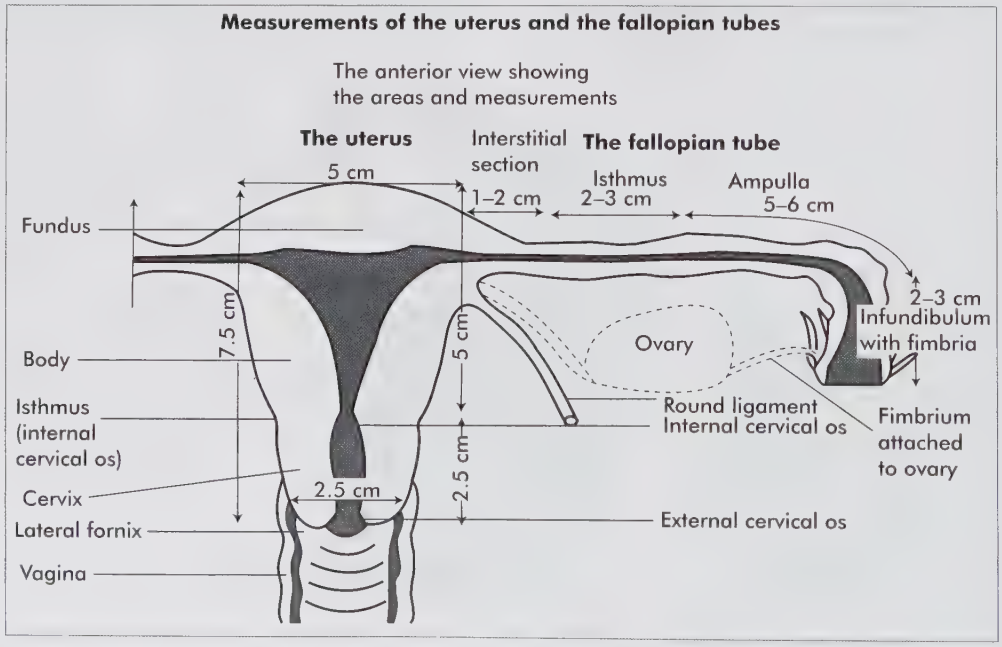

Figure 5.4 The size of the uterus

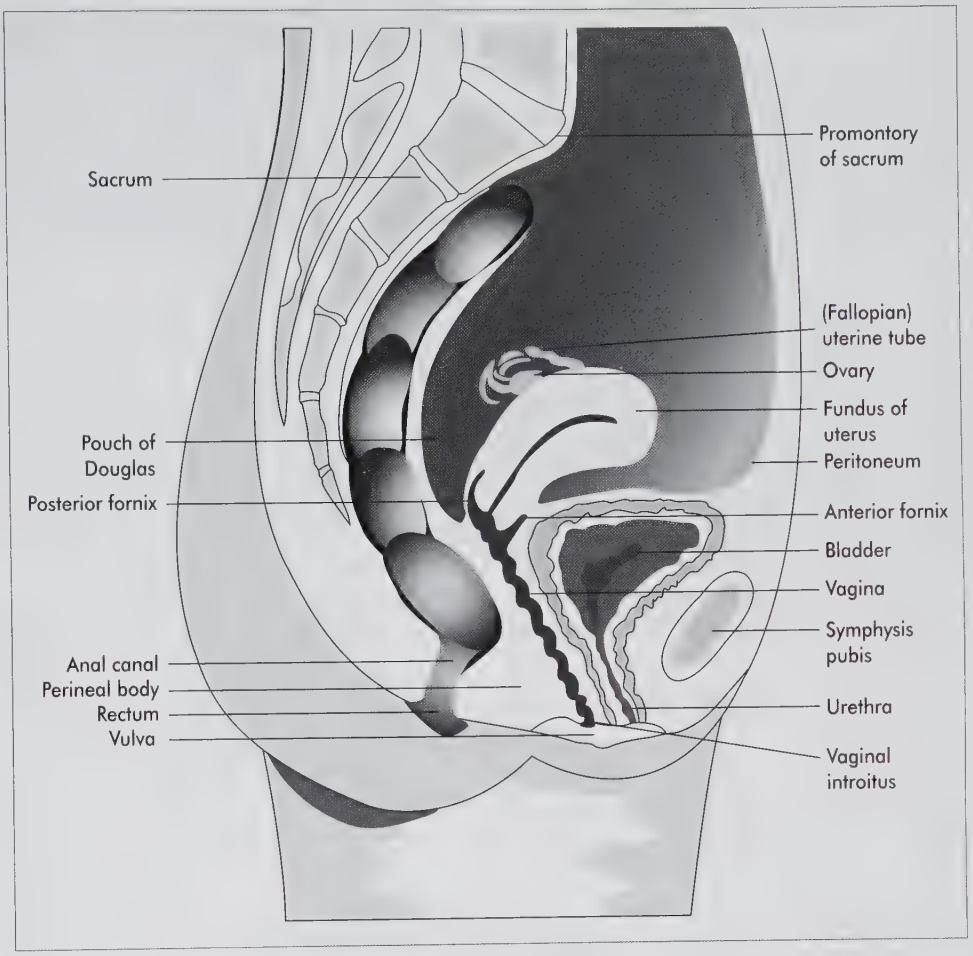

Figure 5.5 The position of the reproductive organs

- The second layer is the spongy layer, and is a layer of connective tissue (stroma), interspersed with glands that respond to the influence of oestrogens and progesterone by becoming more secretory. The thickness and the secretions of this layer of endometrium depend upon the stage of the menstrual cycle. If the fertilised ovum does not implant the layers are shed in menstruation.
- The third layer is known as the basal layer. This is also a layer of connective tissue and glands, but this layer is not shed during menstruation as it forms the basis for the regeneration of the two superficial layers of the endometrium after menstruation has taken place. Oestrogen acts on the cells of this basal layer to encourage regeneration. (See menstrual cycle in Chapter 6 and colour Illustration Figure 6.1, **C1.**) When the basal endometrium is damaged a woman cannot fall pregnant again. This is called Asherman's syndrome.

5.4 Decidua

In the gravid (pregnant) state, the endometrium is called the decidua and under the influence of oestrogens and progesterone, it greatly increases in thickness and produces heavy secretions to receive and support the fertilised ovum, which is called a zygote.

The myometrium. (See Figure 5.6.) The myometrium is the thick middle layer of the uterus. The myometrium is made up of three layers of muscle:

- An inner layer of circular muscle fibres that keeps the shape of the uterine cavity.
- A middle layer of criss-crossing fibres, enclosing the numerous blood vessels supplying the walls of the uterus.

The function of these fibres is to control bleeding from these vessels by acting as living ligatures after the detachment of the placenta in the third stage of labour.

- An outer layer of longitudinal muscle fibres extends from the fundus of the uterus to the external cervical os, but these muscle fibres are four times more plentiful in the fundus. New muscle fibres are developed in pregnancy to make the uterus a powerful muscular organ.

The contraction of these muscle fibres during labour causes the fetus (and/or other contents of the uterus) to be expelled.

The perimetrium: the outer covering of the uterus. This is a layer of peritoneum that covers the body of the uterus and also divides the pelvic cavity from the abdominal cavity above. Anteriorly, it is reflected forward over the bladder forming the uterovesical pouch and posteriorly it is reflected upward over the rectum forming the uterorectal pouch (of Douglas). On either side of the uterus this layer of peritoneum covers the uterine tubes (and the ovaries) and is then attached to the sides of the pelvis to form the broad ligament/s.

5.5 Myoma

Myoma are growths within the myometrium that are caused by high oestrogen levels and are usually found in women 30 years of age and older. When present in pregnancy they become large and vascular, causing complications in pregnancy and birth.

Cervix

The cervix or lower third of the uterus is cylindrical, and is 2.5 cm in diameter and 2.5 cm long. The walls are 1.25 cm thick and surround a central canal, the cervical canal. This canal is approximately 2.5 cm long and is constricted at either end, where it opens into the uterine cavity at the internal cervical os and into the vagina at the external cervical os. In pregnancy the internal os becomes part of the uterine cavity.

The layers of the cervix differ slightly from those of the body of the uterus in the following ways:

- The inner layer or lining of the cervical canal is thrown into folds and is made up of ciliated columnar epithelium, interspersed with deep compound racemous glands,

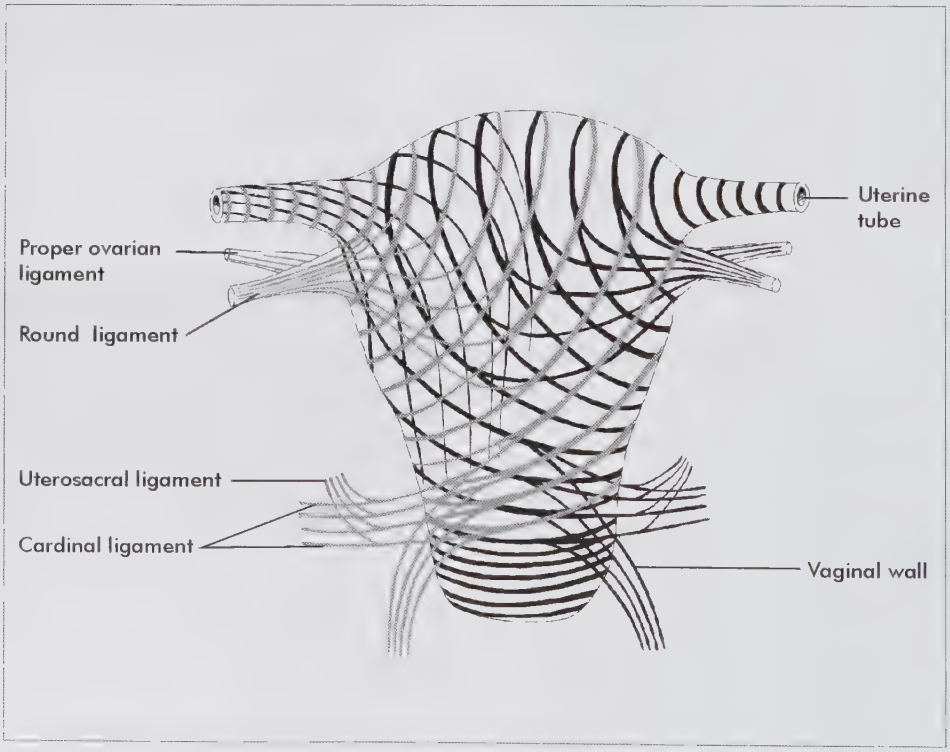

Figure 5.6 A schematic representation of the uterine musculature and ligaments

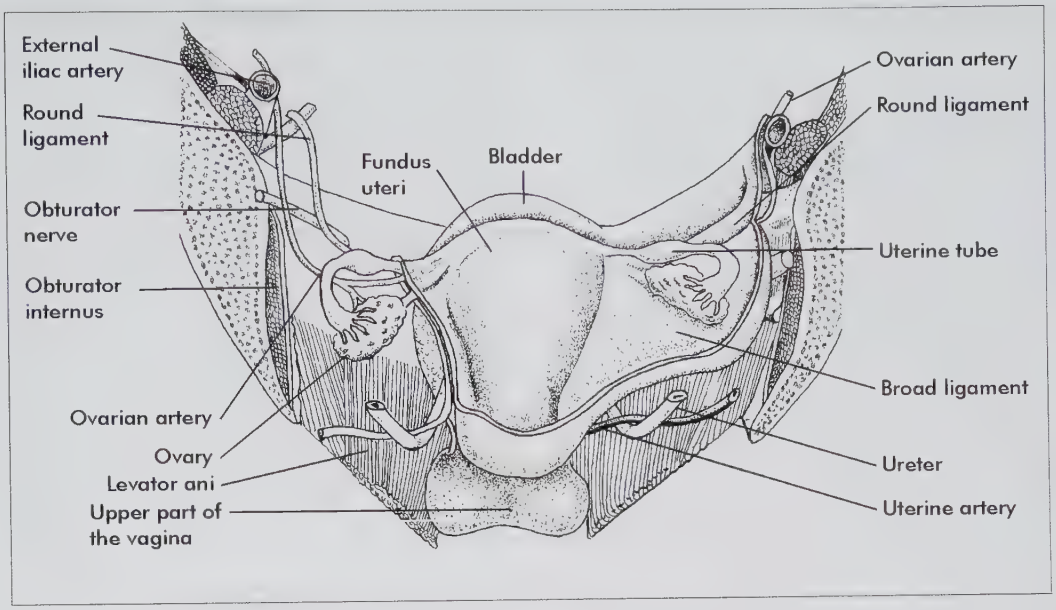

Figure 5.7 Ligaments supporting the uterus (posterior view)

which secrete alkaline mucus. The alkalinity of this mucus, which leaks into the posterior fornix of the vagina, affords protection to sperm deposited into the vagina during intercourse. (The acid medium of the vagina, while protecting the vagina from infection, is also harmful to sperm.)

- The alkaline mucus of the cervix, together with the cilia, which have an upward sweeping effect, helps the sperm move from the vagina into the uterine cavity.

During pregnancy, this mucus becomes thick and tenacious, forming a cervical plug, the operculum. This plug seals off the uterine cavity from the vagina and helps to protect the contents of the uterus from ascending infections.

The external cervical os is a small round opening of approximately 0.5 cm in diameter in a nullipara and is called the primip os. However, after vaginal birth it is an oval opening of 2 cm or more and is known as a multip os and is never completely closed again.

5.6 Cervical incompetence

Cervix incompetence describes a situation in which the cervix does not close and a woman cannot maintain a pregnancy. This may cause loss of pregnancies and needs medical intervention. Cervical incompetence may occur due to trauma at birth, but is usually ideopathic.

The Fallopian tubes

The fallopian tubes stretch from the superior portion of the uterus to the ovaries. Sperm enter the tubes from the uterus and meet with the ovum that has been drawn in by the fimbria of the tubes. Fertilisation takes place in the fallopian tube. The cilia (small hairs), in the tube move the fertilised ovum to the uterus. The tubes assist with peristaltic movement. If the cilia are damaged by infections the ovum may be stuck in the tube and implant in the tube (middle). This is called an ectopic pregnancy. The tube may burst when the ovum develops with disastrous consequences. Ectopic pregnancy rarely reaches 20 weeks of gestation. The fallopian tube is removed in the case of ectopic pregnancy. Loss of both tubes would prevent further conception, leading to infertility.

The ovaries

The ovaries lie on either side of the uterus in the true pelvis and are attached to the broad ligament. Each one is about the size and shape of an unshelled almond, approximately 3 cm long, 2 cm wide and 1 cm thick and greyish-white in colour.

The ovaries are attached to the uterus on either side by strong ligaments, the ovarian ligaments, which arise at the cornua of the uterus. These ovarian ligaments contain smooth muscle fibres and are continuous with the round ligaments.

The ovaries are also attached to the lateral pelvic walls by the infundibulopelvic (suspensory) ligaments and to the infundibulae of the uterine tubes by one of the fimbria.

The structure of the ovary

The ovary has a complex structure, with an inner medulla (middle) and an outer cortex (covering):

- The medulla is composed mainly of connective tissue, which forms the attachments for the ovarian and infundibulopelvic ligaments and which contains blood, lymph vessels and nerves.
- The cortex, which is the functional part of the ovary, consists of theca cells (specialised connective tissue) interspersed with primordial and developing ovarian follicles. Within these follicles are the primary oocytes (see Figure 5.8). The follicles are responsible for the gradual development of these primary oocytes, which will later become ova (eggs). There are between 100 000 to 200 000 primordial follicles present in each ovary of a female child at birth. Under the influence of pituitary and ovarian hormones, these oocytes gradually develop and mature. It is only at puberty that these ovarian (Graafian) follicles begin to reach maturity, when one mature follicle will burst open approximately every 14 days of the 28 day menstrual cycle to expel a mature ovum into the peritoneal cavity.

The ovaries appear to lie outside the fold of peritoneum known as the broad ligament, but are attached to it on their anterior surfaces by a fold of the peritoneum known as the mesovarium. The outer layer of the cortex of the ovary is made up of germinal epithelium, which is continuous with the mesovarium and is therefore probably a modified form of peritoneum.

The ovarian follicle

The next generation of cells is already formed at eight weeks *in utero* in the ovaries of the female fetus. Some of the 200 000 to 400 000 follicles in the ovaries, together with the primary oocytes within them, start to develop and this development continues throughout childhood and puberty and only ceases at menopause. The female ova are exposed to diseases and environmental influences such as radiation and the nutritional status of the woman throughout life. Conditions that cause a high fever and pelvic infections can affect a woman's fertility. These developing follicles are initially called primary and later secondary follicles and only reach maturity in puberty, when the menstrual cycle starts and then they are known as ovarian (Graafian) follicles.

These follicles, which in the embryonic stage are solid structures of granulosa cells, gradually become cystic, with fluid forming between the ovum and the granulosa cells. The surrounding connective tissue develops into the theca (see Figure 5.8), encircling the follicle.

The theca divides into two functional layers:

- The theca externa or outer layer, is a highly vascular, connective tissue layer that becomes the capsule of the follicle.

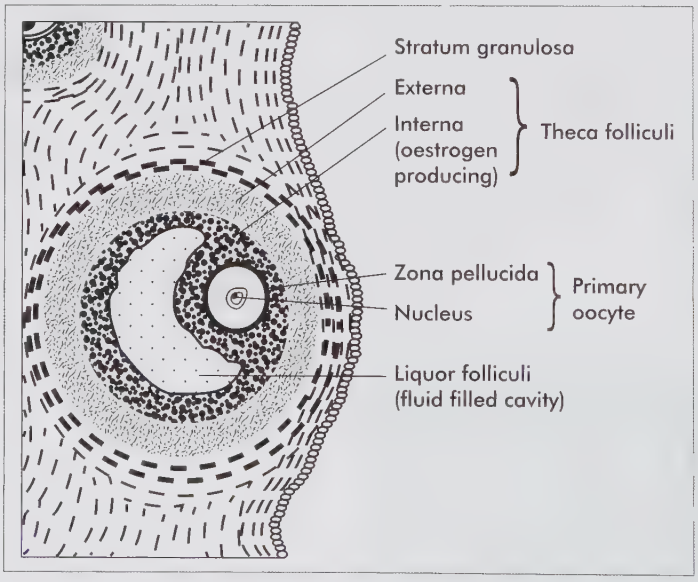

Figure 5.8 An ovarian follicle reaching maturity

- The theca interna, or inner layer of cells, develops into epithelioid-like cells which are responsible for the secretion of the female hormone oestrogen, as are the granulosa cells.

As these follicles develop, so the primary oocytes inside them also mature and become known as secondary oocytes and finally as ova.

The onset of menstruation (the menarche) takes place during puberty. A number of follicles reach a mature stage each month. However, only one follicle reaches full maturity, which then ruptures at ovulation, expelling the ovum into the peritoneal cavity. This occurs approximately once every 28 days in the menstrual cycle. In the young woman, psychological factors and stress can disrupt the female menstrual cycle. At puberty, with the maturation of these follicles, larger amounts of oestrogens are secreted and the genitalia and the breasts increase in size. Adrenal androgens are also secreted stimulating cell duct and sweat gland development.

After the rupture of the ovarian follicle on the 14th day of the menstrual cycle, or in other words, after ovulation has taken place, the remaining granulosa cells in the follicle undergo a change. These become known as lutein cells and increase in size and are filled with yellow lipid inclusions. This yellow mass within the ruptured follicle is called the corpus luteum (yellow body) and is responsible for the secretion of the female hormone progesterone.

Approximately seven days after ovulation (if the ovum is not fertilised), the corpus luteum starts to degenerate, gradually shrinks in size and eventually becomes fibrous and white. It is then known as the corpus albicans (white body).

Large amounts of progesterone are secreted in the second half of the menstrual cycle, which act on tissues primed by the oestrogens. The function of progesterone in the non-pregnant state is to promote secretory changes in the uterine endometrium.

Immediately after ovulation, the ovary contains primordial, primary, secondary and ovarian (Graafian) follicles, together with a corpus luteum and many degenerated follicles.

In the ovaries of a woman up to the age of 45–50 years, thousands of follicles have matured and degenerated and about 450 have ovulated and the ovaries stop functioning. The menstrual cycle becomes irregular and ovulation does not always occur during many of the cycles. In time, varying greatly between individuals, the menstrual cycle stops altogether and almost no female sex hormones are then secreted. This is known as the menopause.

The blood vessels

(See Figure 5.9.) The blood supply to the ovaries is from the ovarian arteries, one on either side, which are direct branches of the descending aorta. The blood supply to the ovaries is augmented by the anastomosis of the uterine arteries with the ovarian arteries. These become enlarged in pregnancy. The venous drainage is via the ovarian veins, which drain into the inferior vena cava on the right side and into the renal vein on the left side.

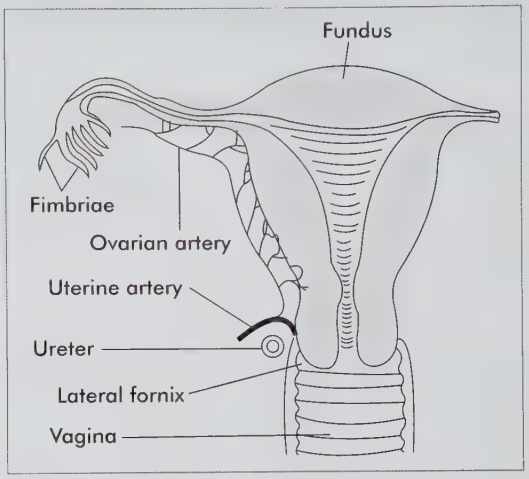

Figure 5.9 The uterine blood supply

The lymphatic drainage

This is via the para-aortic and inguinal nodes.

The nerve supply

(See Figure 5.2.) The nerve supply is autonomic, with both motor and sensory, parasympathetic and sympathetic nerves accompanying the ovarian vessels.

5.4 Congenital abnormalities of the female organs

There are a variety of congenital abnormalities of the female organs that can affect a woman's ability to conceive or to carry a baby to term or give birth.The incidence of these abnormalities is 7.3%. Hormonal abnormalities also exist, but in these cases, the reproductive organs may be normal. A uterine malformation is the result of the abnormal development of the Müllerian duct(s) during embryogenesis. Common symptoms and signs range from primary amenorrhoea, infertility, and/or pain, or normal functioning, depending on the nature of the defect. Abnormalities may be associated with early and reccurring pregnancy loss, premature labour, obstetric interventions and ante- and postpartum haemorrhage. The simplest and most common uterine abnormality

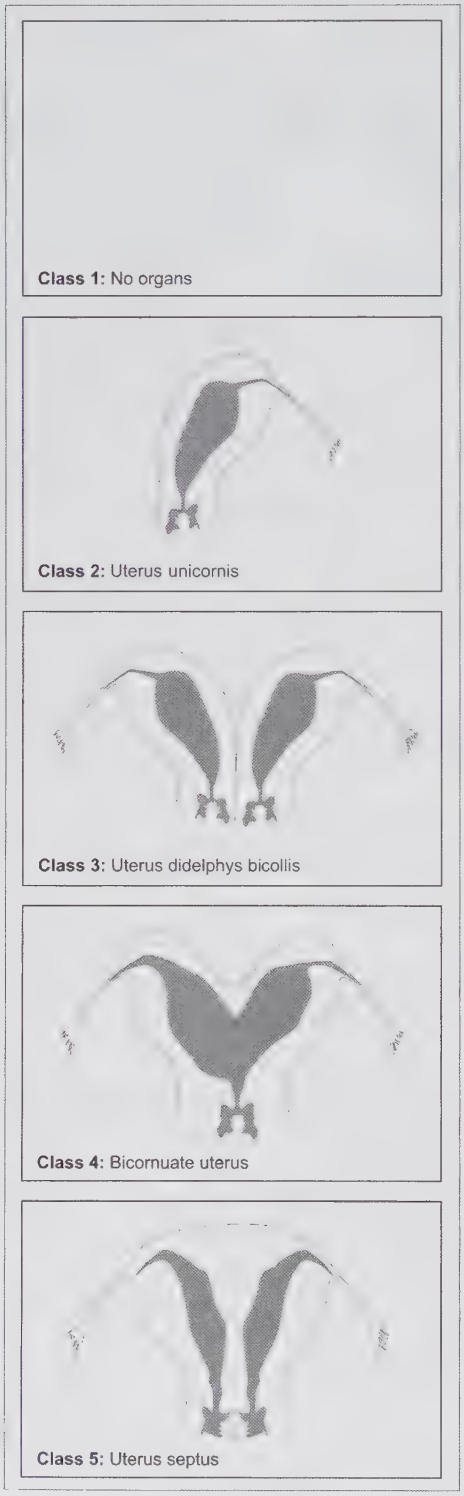

Figure 5.10 Congenital abnormalities of the uterus

is uterus arcuatus where the fundus has not developed completely, forming a concave dent (Class 4). A rudimentary uterus is a uterine remnant that is not connected to the cervix and vagina. Patients with uterine abnormalities may have associated renal abnormalities, including unilateral renal agenesis.

Congenital malformations (see Figure 5.10) are classified by the American Society of Reproductive Medicine as:

- Class 1: Müllerian agenesis. Absence of the uterus, and the vagina is underdeveloped or absent. The woman has primary amenorrhoea.
- Class 2: Unicornis (a one-sided uterus), which occurs when only one side of the Müllerian duct forms.
- Class 3: Uterus didelphys (double uterus). Both Müllerian ducts develop but fail to fuse, resulting in a 'double uterus'. This may be a condition with a double cervix and a vaginal partition or two uteri and cervices and one vagina.
- Class 4: Bicornuate uterus (uterus with two horns), which occurs when the upper part of the Müllerian system that forms the uterus fails to fuse, partially of completely, with or without a septum.
- Class 5: Septate uterus (uterine septum or partition). The two Müllerian ducts have fused, but the partition between them is still present, splitting the uterus into two parts. With a complete septum the vagina, cervix and the uterus can also be completely divided. A uterine septum is the most common malformation that causes miscarriages. It is diagnosed using ultrasound or MRI. A uterine septum can be surgically corrected.

5.5 Conclusion

The internal and external female reproductive organs are present at birth and develop after puberty under the influence of hormones. The normal development is characterised by the development of pubic hair and the breasts and the start of menstruation. Failure to start menstruation by the age of 16 years can be an indication of congenital abnormalities of the reproductive organs and should be investigated. In cases of infertility investigations are done to exclude abnormalities of the internal and external reproductive organs. Any of the structures can be affected. The pelvic and perineal structures are described in Chapter 8. The effects of pregnancy on female organs are described in Chapters 10 and 24.

CHAPTER

6 The menstrual cycle and hormonal control

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- identify and describe the physiology and process of menstruation
- demonstrate knowledge of all the hormones that are involved in menstruation and conception.

KNOWLEDGE ASSUMED TO BE IN PLACE

Knowledge of the endocrine system of the human body with particular reference to the female hormones and the menstruation cycle

KEY WORDS

Oestrogen • Progesterone • Gonadotrophin • Human placental lactogen • Somatotrophin • Prolactin • Prostaglandins

6.1 Introduction

This chapter briefly explains the function of the female reproductive hormonal system, hormonal control of menstruation and the hormones involved in the maintenance of pregnancy and lactation.

6.2 Reproductive hormones

Reproductive (sex) hormones are chemical compounds that produce profound physiological effects in the target organs of the female reproductive system. These hormones are responsible for the differentiation of a female and the development of the female organs for reproduction. These hormones are controlled by the hypothalamic-pituitary-gonad axis:

- The hypothalamus secretes gonadotrophin-releasing hormone (GnRH) to the anterior pituitary gland, which then secretes luteinizing hormone (LH) and follicle-stimulating hormone (FSH).
- The anterior pituitary gland secretes FSH and LH. This stimulates the ovaries to produce oestrogen and inhibin to regulate the ovarian cycle and the menstrual cycle. It also secretes growth hormone, adrenocorticotrophin, thyroid stimulating hormone and prolactin.
- Only two hormones are secreted from the posterior pituitary: antidiuretic hormone and oxytocin, which stimulates contraction in labour and play a role in lactation.
- The ovarian hormones oestrogen and progesterone are secreted in the ovaries in response to the FSH in the follicular phase and LH in the luteal phase of the menstrual cycle.

The primary hormones of the female reproductive system are FSH, and LH (from the anterior pituitary) and oxytocin (posterior pituitary), oestrogen and progesterone (ovaries).

Menstruation and pregnancy are controlled by these hormones. Failure to conceive and reproduce can be contributed to a range of possible problems along this axis. In the case of hypovolaemia in postpartum haemorrhage, the pituitary gland may suffer an insult due to hypotension and become necrotic and malfunction. Failure to produce the hormones needed for lactation and menstruation will result in failure to produce milk and fall pregnant again. This is called Sheehan's syndrome. This condition will need medical intervention.

FSH and LH are glycoproteins. They stimulate the granulosa cells of the Graafian follicle to secrete oestrogen and progesterone and LH also stimulates the production of inhibin A and B. The steroid hormones, androgens, oestrogens and progesterone are produced by the gonads and adrenals. Women also produce small amounts of androgens. Cholesterol plays a role in the development of steroid hormones. Although most of the steroid hormones are produced from cholesterol in the gonads and adrenals, the placenta also produces progesterone and pregnenolone. The steroid levels of women vary throughout the reproductive cycle and in pregnancy. Table 6.1 lists the effects of female hormones.

Oestrogens

The human body forms two types of oestrogen: oestradiol and oestrone. Oestriol is an end product of both and is of low functional value. Oestrogen is mainly synthesised by the theca interna of the corpus luteum in the follicular phase of the menstrual cycle and later from the placenta. A small portion comes from the adrenals (which is also the case in males). The steroid, 17α hydroxyprogesterone is important in the synthesis of oestrogens. Oestradiol is the main functional hormone.

Oestrogen is also involved in the regulation and concentration of plasma proteins such as angiotensin II and T4. Oestrogen promotes protein synthesis for cell development and also sensitises the receptors for progesterone and determines the effectiveness of the function of progesterone that will follow in the second phase of menstruation and/or pregnancy.

Table 6.1

Female hormones and the menstrual cycle

Organ/system	Actions of oestrogen	Actions of progesterone	Gonadotrophins
Uterus	Stimulates proliferation of endometrium Increases cervical mucus (Fering Spinnbarkeit) Promotes uterine growth in pregnancy Increases myometrial response	Promotes secretory phase Makes mucus permeable for sperm, loss of fering in mucus Promotes coiling of the uterine arteries Effect reaches a peak 1 week after ovulation Menstruation when no implantation	None
Fallopian tubes	Increases contractility	Decreases contractility	None
Vagina	Causes cornification of epithelium Maintains optimal pH 3.5–4.2	Changes epithelium to intermediate and basal cell	None
Mammary glands	Promotes ductal system, glands nipples, alveolar and fatty tissue Increases prolactin in pregnancy	Develops lobules and alveoli in preparation for lactation Causes breast swelling before menstruation	None
Ovaries	Releases ovum Produces oestrogen	Unsure	FSH stimulates ovarian follicle Promotes oestrogen production and secretion of LH that stimulates the growth of the Graafian follicle and aids the corpus luteum. Promotes progesterone

continued

Skin	Diminishes sebaceous activity Increases water content of the skin	Increases sebaceous activity	
Cardiovascular system	Increases blood flow, angiotensin factor V and prothrombin	Causes vasodilatation and decreases contractility	
Secondary sexual characteristics	Causes female contours, fat deposits and hair distribution	Involved in breast development	
Thermogenic activity	none	Increases basal temp by 0.4–0.6 °C after ovulation Deposit glucose in endometrium as nutrient for ovum	
Metabolism	Promotes sodium and water re-absorption from kidney tubules Affects calcium metabolism and bone growth	None	

Progesterone

Progesterone is secreted from the Graafian follicle in small amounts in the follicular phase. There is a 20-fold increase in the secretion of progesterone from the membrana granulosa of the corpus luteum in the luteal phase. The placenta secretes large amounts of progesterone and the adrenals secrete a small amount. The effect of progesterone is less marked in the body because it is only present at certain times. Several synthetic progesterones are available and are mainly used as contraceptives. Progesterone is the hormone that maintains pregnancy and is called the pregnancy hormone. The minor disturbances of pregnancy are related to the effects of progesterone on vasodilatation, vascularity and relaxation of smooth muscles in the body in pregnancy. The actions of progesterone are listed in Table 6.1.

Other hormones

Androgens are secreted in low concentrations from the adrenals and play a role in women's reproduction. The chemical structure of androgens (testosterone) is similar to that of progesterone.

The onset of menarche

The onset of menarche is related to the excretion of female hormones and varies between populations and depends on a variety of factors, for example nutrition. Tanner described the progression of the development of female reproductive organs from childhood to maturity.

The mean age of menarche varies between populations. In the USA, for example, it is 12.7 years. Failure to menstruate by the age of 16 should be investigated. Potential problems may be physiological (hormonal), or genetic (intersex states) or anatomical (congenital abnormalities). Factors that can delay the onset of menstruation are malnutrition

6.1 Tanner's stages of progression from childhood to maturity

Stage 1 Pre-puberty, neither breast nor pubic hair present:
- vaginal mucousa thin, red and dry.

Stage 2 (10–11 years):
- breasts bud
- labia majora become more vascular
- vaginal mucosa more moist, thicker and pink
- uterine fundus enlarges, hips widen and body fat redistributes
- height spurt begins.

Stages 3 (11–12 years):
- breasts enlarge
- pubic hair appears

continued

- labia minora enlarge
- vaginal length increases, mucosa thickens, white discharge
- uterus enlarges and Fallopian tubes increase in diameter
- sebaceous glands are activated, as well as sweat glands. Rapid growth with peak in height.

Stage 4 (12–13 years):
- breasts enlarge and areola forms
- pubic hair covers the mons veneris pubis and perineum
- vagina enlarges with uterus
- menarche starts, and linear growth decelerates.

Stage 5 (13–15 years):
- breasts and genitals reach adult proportions
- pubic hair grows on thighs
- linear growth ceases.

(anorexia nervosa), stress, and strenuous physical activity, for example in professional sportswomen. When menstruation first starts generally only oestrogen is secreted and the cycles are anovular and irregular. Generally, within two years the 28-day pattern will be established and ovulation starts.

6.3 The menstrual cycle

(See colour illustration Figure 6.1, **C1**). Midwives are concerned mainly with estimating gestational age based on information of the menstrual cycle. A history of irregularity, or even absence, of the menstrual cycle may indicate hormonal imbalances and congenital abnormalities, for example a bicornuate uterus.

Women often do not know their menstrual cycle patterns accurately. The use of contraception also blurs women's knowledge of the function of their natural bodies. Once women experience infertility problems they become more aware, conscious and focused on how their bodies function.

6.2 Marie Stopes

Marie Stopes (1880–1958) was the first woman to make and publish scientific observations of the woman's body, hormones, reproduction and sexuality. She had a PhD in botany.

The average normal menstrual cycle is 28.1 days. Menstrual cycles of 15 or 45 days are reported and are normal for woman with different hormonal profiles. Cycle length variations occur in the follicular-proliferation phase (oestrogen phase). The duration of the luteal phase is 14 days from ovulation. Menstrual flow is normally four days, with the heaviest flow on day two, with a blood loss of 35–80 ml. Iron loss varies between 0.4–1 mg/day (12 mg/cycle). (See colour illustration Figure 6.1, **C1**)

Phases of the menstrual cycle

The phases of the menstrual cycle are: follicular-proliferation phase (oestrogen-dominant phase with development of the Graafian follicle and oozyte and endometrium), ovulation (release of the ovum) and luteal secretory phase (progesterone-dominant phase maintaining the endometrium for conception), and menstruation or pregnancy.

Follicular-proliferation phase

Hormones of the endocrine system are responsible for the development and maturation of the ovarian follicle and the ovum, in the ovary for ovulation and for the preparation of the female body for conception and pregnancy. Fertilsation and pregnancy are only possible when an ovarian follicle has been brought to maturation and when ovulation has taken place.

Follicular growth (Class 1–5) occurs in response to gonadotrophin (FSH). Follicles are developed and matured over three cycles. With each cycle a few cells, 6–12, are prepared for ovulation. Class 1 follicles measure 0.15 mm and Class 5 measure 2.5 cm. The so-called dominant follicle is selected seven days before ovulation. Follicles measuring 18 m are the source of 90% of the secreted oestradiol (90%). Inhibin B plays a roll and increases concurrently with oestradiol.

Ovulation

LH increases ten-fold 12–24 hours before ovulation. The first meiotic division takes place and the oozyte is formed. Inhibin B decreases the secretion of oestrogen. The dominant follicle ruptures with an increase of inhibin A and progesterone excretion.

Luteal phase

Progesterone dominates the luteal phase. The granulosa cells change to the corpus luteum. Luteal cells of the cor-

pus luteum are the main source of progesterone. The corpus luteum degenerates 14 days after ovulation unless fertilisation has taken place. By day 26 the corpus luteum collapses and becomes the corpus albicans.

Menstruation

Arterial vasoconstriction and haematoma, followed by anoxia and bleeding occur during menstruation. Within 48–72 hours the endometrium is shed and only the basalis remains.

6.4 Hormones in pregnancy

Pregnancy is an anabolic state and a range of complex processes and hormones are involved in maintaining pregnancy, supporting the growth of tissue and the fetus, and preparing for lactation.

Hormones of the anterior pituitary

The pituitary gland enlarges at least 50% during pregnancy and increases its production of all hormones, particularly the following:

- Somatotrophin (growth hormone) promotes protein synthesis, glucogoneogenesis and muscle resistance to insulin. It increases lipolysis.
- Corticotrophin controls the glucocorticoid formation in the adrenals.
- Thyrotrophin controls the absorption of iodine and functions of the thyroid. The size of the thyroid gland increases in pregnancy.
- Prolactin plays a fundamental role in the production of milk. There is a low level of activity in pregnancy that is accelerated when the placental hormones drop after birth.

Hormones of the posterior pituitary

Oxytocin

This hormone is required for uterine contractions during labour. The placenta protects the uterus from contracting in pregnancy by breaking down oxytocin. It is not possible to induce a woman with oxytocin if the uterus is not ready for birth. Progesterone inhibits the action of oxytocin, while oestrogens have a tendency to increase the degree of uterine contractility.

Relaxin

Relaxin is produced in the ovary by the corpus luteum (and also in the placenta) during pregnancy and relaxes the pelvic ligaments.

Hormones of the placenta

Human chorionic gonadotrophin (HCG)

Human chorionic gonadotrophin is a glycoprotein that is similar to luteinizing hormone. The main function of this hormone is to prevent the degeneration of the corpus luteum, to continue the secretion of progesterone and oestrogens and to maintain the endometrium after the implantation of the zygote.

As the embryo develops, maintenance of the endometrium is taken over by the placenta. This hormone can first be measured in the maternal bloodstream eight to nine days after ovulation (shortly after implantation of the zygote). The rate of secretion increases rapidly, to reach a maximum at about seven to nine weeks after ovulation and then decreases to a relatively low level from 16–20 weeks after ovulation.

Chorionic gonadotrophin is present in blood or urine and is the hormone used to diagnose pregnancy. Home tests for pregnancy are 95% accurate and can be used one day after the first missed period.

Human placental lactogen (HPL) (or human chorionic somatomammotrophin)

The hormone is structurally similar to the human growth hormone. Its main function is to regulate glucose availability for the fetus. The hormone is secreted by the cytotrophic cells of the outer layers of the chorionic villi of the placenta from about the fifth week of pregnancy. It has a general metabolic action, with specific nutritional implications for both the mother and the fetus, particularly with regard to glucose and fat metabolism.

Human placental lactogen is found in the maternal bloodstream and has been used to measure the efficiency of the placenta during pregnancy. If the levels of HPL are low in early pregnancy, abortion is likely to occur and if they are low in later pregnancy, the fetus is at risk.

Oestrogens and progesterone

During pregancy, the placenta synthesises oestrogens and progesterone. There is a relationship between the hormones in maternal urine and the size of the placenta and fetus. Oestradiol is the main hormone synthesised. Part of the development of the hormone takes place in the fetal adrenals, after which it is altered in the placenta and transferred to the mother. The placenta has an enzyme system that can synthesise oestrogens from cholesterol and steroids. The levels of the hormone in the mother and fetus are unequal. The placenta will not let oestrogens pass freely to the fetus. Progesterone concentration is also regulated by the placenta and the fetus.

Prostaglandins

Prostaglandins are present and synthesised in all human tissue. The different types are PGE_1, PGE_2 and $PGF_{\alpha 2}$. The substances are biologically active when synthesised in tissue.

6.5 Conclusion

The endocrine regulation of hormones in female reproduction is complex. The midwife needs to have a basic knowledge of the hormones that influence the health of the women and the growing fetus in reproduction, pregnancy and lactation.

CHAPTER

7

Genetics, gametogenesis, fertilisation, placental development and embryology

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- identify the national priorities for genetic disease management of newborns in South Africa
- explain fertilisation, placental development and the stages of development of the embryo and fetus.

KNOWLEDGE ASSUMED TO BE IN PLACE

Basic anatomy and physiology, and the terminology used in reproductive health

KEYWORDS

Gametogenesis • Fertilisation • Placenta • Embryology • Genetics • Stem cells

7.1 Introduction

Chapter 7 gives an overview of genetics, the development of the ovum and sperm, the implantation and development of the fertilised ovum and placenta, and the stages of the development of the embryo and fetus to viability and birth.

7.2 Genetics

Genetics is the branch of biology concerned with the study of heredity (the transmission of characteristics from parents to their offspring) and the variation (the differences observed between living things).

The environment (nutrition, exercise, education and social, cultural and family experiences) contributes to the unique characteristics of each person.

All living organisms are made up of cells, and the human body is made up of billions of cells that have the same basic design. Each cell has a nucleus that carries chromosomes that contain deoxyribonucleic acid (DNA), the genetic material of the cell. A human has 46 chromosomes (23 pairs).

DNA is shaped like a helix consisting of repeating nucleatide units attached to each other by base pairing (see Figure 7.1.)

All cells have enzymes that maintain and regulate the replication of DNA. Mistakes occur when the genetic code is altered and is called a *spontaneous mutation*. This can cause abnormal development. There are many environmental factors that may contribute to mutations, such as background radiation, pollutants and smoking.

Twenty percent of pregnancies end in miscarriage. About 50% of these are due to chromosomal defects. Genetic accidents are not restricted to one gene and can include the whole chromosome. Less than 1% of children are born with a congenital abnormality. Box 7.2 gives developments and advances in genetics.

Heritable genetic disorders occur when mutations affect the gonads and these conditions are then passed on to offspring in ways that are governed by the laws of genetics. Families can be counselled about the risk of transmitting genetic diseases using this knowledge. Not all genetic disorders are heritable.

7.1 The Human Genome Project

The Human Genome Project was a collaboration between scientists of many countries. The aim was to map a complete and accurate sequence (blueprint) of the three billion chemical pairs of human DNA (20 000–25 000 genes), store it in a database, develop related technology and address associated social, ethical and legal issues. This was successfully completed in 2003. We now know the total genetic information of every human cell. As researchers learn more about the functions of genes and proteins this knowledge will have a major impact in the fields of medicine, biotechnology, and the life sciences. A large portion of human DNA is non-coding (with unknown functions) and is considered as 'junk'. The project is ongoing. Read more at www.ornl.gov/hgmis/home.shtml.

7.2 New developments and advances in genetics

Stem cells are the basic undifferentiated cells present during the development of life that have the potential to develop into any kind of cell, which may lead to cures for genetic diseases in the future.

Two different types of stem cells can be collected during childbirth: amniotic stem cells and umbilical cord blood stem cells. The collection of amniotic stem cells is part of the process of amniocentesis. Umbilical cord blood stem cells can be stored in stem cell banks.

Cloning: In 1997 a team of scientists created an identical copy of an adult sheep from a stem cell. Her mother was her identical sister. Cloning could lead to the ability to create organs for those who are waiting for organ donation. However, there are many ethical issues around this science.

Screening is available for some genetic disorders and birth defects. Box 7.3 shows all the genetic tests that can currently be done in South Africa.

In South Africa national guidelines are given by the Human Genetic Policy 2001. Box 7.4 and Table 7.1 give the national priorities for managing birth defects in South Africa.



Figure 7.1 A DNA helix showing nucleic acid within the helix
Source: Watts, Cockroft, Duncan, 2009. *Developmental Psychology*. 2 ed. Cape Town: Juta and Co

7.3 Genetic tests currently available

Genetic testing can be done on blood, hair, saliva, skin and amniotic fluid.

Prenatal testing includes:

- cordosentesis (fetal blood or placental tissue sampling in early pregnancy)
- CVS (cordovilli sampling) fetal blood or placental tissue sampling in early pregnancy (12 weeks)
- amniocentesis (amniotic fluid 16–20 weeks)
- serum alpha-feto protein (16 weeks)
- FISH test (20 weeks).

Postnatal testing includes:

- Routine newborn test, which can be done from a heel prick.

There are 3 000 defects catalogued. There are 1 700 tests developed for genetic defects.

7.4 Priority genetic services in South Africa

Priorities for genetic services in South Africa:

- Down's syndrome
- neural tube defects
- fetal alcohol syndrome
- albinism
- cleft lip and palate
- club feet (talipes equinovaris)
- congenital infections from TORCH (toxoplasmosis, rubella, cytomegalo virus and herpes).

In this chapter, normal cell activity, division, fertlilisation, implantation, and placental and embryo development are considered, alongside the abnormalities that can happen during pregnancy.

Human somatic cells (cells of the body) have 46 chromosomes (23 pairs) in the nucleus and are said to be diploid (double), whereas the gametes (sex cells) have half that number, (23 chromosomes) and they are said to be haploid (single).

7.3 Mitosis and meiosis

When a cell divides, the division results in two daughter cells, which are identical in every way to the parent cell. These daughter cells in turn become parent cells and each one divides into two more identical daughter cells. The original cell has now become four identical cells. These four cells continue to divide and each produce two identical daughter cells, bringing the total to eight, then sixteen, then thirty-two, then sixty-four and so on. Therefore, cell division results in a multiplication (reproduction) of the cells. There are two types of cell division: mitosis and meiosis.

Mitosis

(See Figure 7.2.) This is the nuclear division of somatic cells, resulting in diploid cells. In the nucleus of each cell in the human body there are 46 chromosomes, 23 pairs. The similar chromosomes are said to be homologous chromosomes.

These 23 pairs of chromosomes are made up of:

- Twenty-two pairs of autosomes and one pair of sex chromosomes. The autosomes determine the general characteristics of an individual, while the sex chromosomes determine the gender of the individual.
- In each cell, the two chromosomes making up a homologous pair of autosomes are similar to each other in appearance (karyotype). However, the female chromosome is large and is known as the X chromosome, while the male chromosome is small and is known as the Y chromosome. Females have two X chromosomes, and males have an X and a Y chromosome.
- During mitosis, the chromosomes, which are contained within the cell nucleus, divide in a way that ensures that identical chromosomal (genetic) material from the parent cell is duplicated and given to each of the daughter cells.

Mitosis is continuous, but it is usually divided into four stages to make the process easier to understand.

The phases are:

- *Prophase.* Early – the chromosomes shorten and thicken and are seen as double strands in the cell, called chromatids. The genetic material of the cell forms long, thin chromatin threads. Late – the chromosomes divide to form two centrioles, which move to the opposite ends of the cell. In summary, a chromatin network is seen as chromosomes made up of two chromatids attached by a centromere (the point of attachment of the two chromatids).

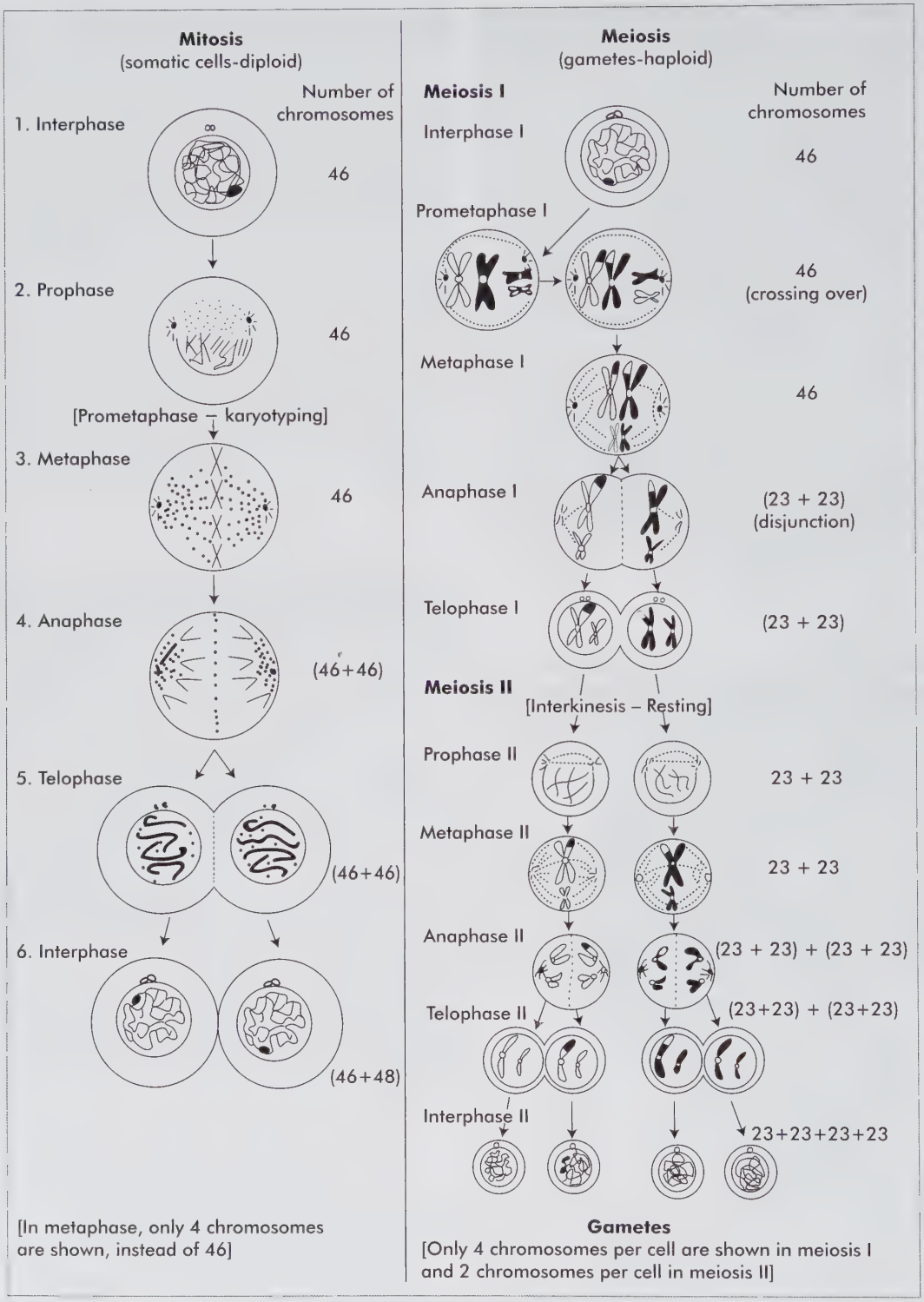

Figure 7.2 Meiosis and mitosis

Table 7.1

Guidelines for the management of genetic defects and disorders in South Africa

Primary	Secondary	Tertiary
Primary prevention aims at preventing first occurrences of specific genetic disorders and birth defects. Conditions most amenable to primary prevention are birth defects, caused by environmental factors that can be removed or neutralised, and non-hereditary genetic disorders such as chromosomal abnormalities, in which the association with advanced maternal age offers a basis for prevention. Strategies for primary prevention include: ◗ public efforts to improve health, nutrition, education and self-reliance, particularly of women; ◗ avoidance of unintended pregnancies, and proper birth spacing through access to contraception and other methods of family planning; ◗ improved access to, and quality of, prenatal care and genetic counselling; ◗ improved quality of birth care; ◗ control of possible occupational risks; ◗ peri-conceptual supplementation of folic acid to women of reproductive age to reduce the risk of neural tube defects and perhaps other congenital defects; ◗ encouraging women to procreate at the ideal reproductive ages (20–35 years) to reduce the risk of chromosomal abnormalities; ◗ avoidance of exposure to teratogens (e.g. alcohol, recreational drugs, and certain chemicals and infectious agents) during pregnancy.	Secondary prevention aims at the prenatal identification of women at increased risk for having a child with a genetic disorder or birth defect. Further it offers the option of termination of pregnancy. Strategies for secondary prevention include: ◗ identification of pregnant women at risk; ◗ identification of pregnant women aged 35 years or more; ◗ identification of pregnant women exposed to teratogens, e.g. alcohol, recreational drugs, infections (e.g. rubella, syphilis); ◗ medicines (e.g. phenytoin) or chemicals; ◗ ultrasound evaluation for all pregnant women for accurate gestational aging in order to detect fetal defects; ◗ amniocentesis or chorionic villus biopsy in appropriately selected pregnancies, e.g. previous chromosomal abnormality; ◗ termination of pregnancy for serious genetic disorders or birth defects.	Strategies for tertiary prevention include: ◗ anticipatory guidance (e.g. prevention of obesity in Down's syndrome); ◗ proper intervention to avert complications (e.g. laminectomy to alleviate spinal cord compression in achondroplasia); ◗ rehabilitation of disabilities (e.g. speech therapy, hearing aids in loss of hearing, physical therapy in neuromuscular diseases); ◗ psychosocial support of affected individuals and their families. (This is an essential, albeit commonly neglected component of care relating to genetic disorders and birth defects.)

◗ *Metaphase.* Chromosomes are arranged at the equator (middle) of the cell.

◗ *Anaphase.* Early – spindle fibres shorten, pulling the chromatids to either end of the cell. Late – the cell membrane starts to constrict, leaving spindles at either end. In summary, chromatids move to polar regions of the spindle and the chromatids split at the centromere. One chromatid of each chromosome moves to the opposite poles.

◗ *Telophase.* Two daughter cells are formed and are identical to the cells of the parent. Each cell has one half of a chromosome (chromatid) that has an identical half in the other daughter cell. A nuclear membrane forms around the chromatids, making up the nucleus.

Between cell division there is a resting stage when no division is occurring and the chromosomes are not easily seen. This stage is called interphase.

Meiosis

(See Figure 7.2.) This is the nuclear division of sex cells, resulting in haploid cells. In the process of meiosis, the number of chromosomes in the parent cell (the diploid number in the human is 46) is reduced by half in the daughter cells (the haploid number in the human is 23).

The process of meiosis takes place in two steps, each step having a prophase, a metaphase, an anaphase and a telophase stage, as in mitosis. For the sake of convenience, the stages in the first step are referred to as phase I and in the second step, as phase II.

Meiosis I can be understood in the following phases:

- *Prophase I.* The chromosomes become coiled and a spindle forms. Homologous chromosomes join together to form bivalents. Crossing over occurs, with exchange of genetic material. The nuclear membrane disintegrates in this phase.
- *Metaphase I.* The chromatids line up at the equator of the cell and the spindle fibres attach to the centromeres.
- *Anaphase I.* Homologous pairs of chromosomes separate out and one member of each pair moves to the opposite pole of the cell.
- *Telophase I.* The spindle fibre is broken down. The chromosomes uncoil and the cytoplasm begins to divide, which results in the formation of two cells. Each cell has only half the genetic make up of the original cell because it has only one chromosome from each homologous pair. This means that another division is needed because each cell contains two identical sister chromatids.

The next division is called meiosis II and consists of the following phases:

- *Prophase II.* Spindle fibres form in each of the two cells. The chrosomes re-form from the chromatin, but they are still made up of sister chromatids.
- *Metaphase II.* Spindle fibres attach to the centromeres and the chromosomes align themselves along the equator of the cell.
- *Anaphase II.* The centromere of each chromosome splits and the sister chromatids separate and move to opposite poles. The sister chromatids are now called chromosomes.
- *Telophase II.* The chromosomes move to each pole, the nuclei re-form, the spindle breaks down, the cytoplasm is divided and two new cells form.

It is during these processes of meiosis and mitosis that chromosomal defects can occur, resulting in fetal abnormalities. These chromosomal aberrations cause severe congenital abnormalities, most of which are not compatible with life. One of the abnormalities that is compatible with life and which is one of the most commonly seen is Trisomy 21 (Down's syndrome) (see Figure 7.3). Figure 7.4 gives the karyotyping of human genes.

Meiosis produces mature gametes through the process of gametogenesis.

Gametogenesis

Gametogenesis is the process by which the gametes – sperm and ova – are produced by the testes and ovaries.

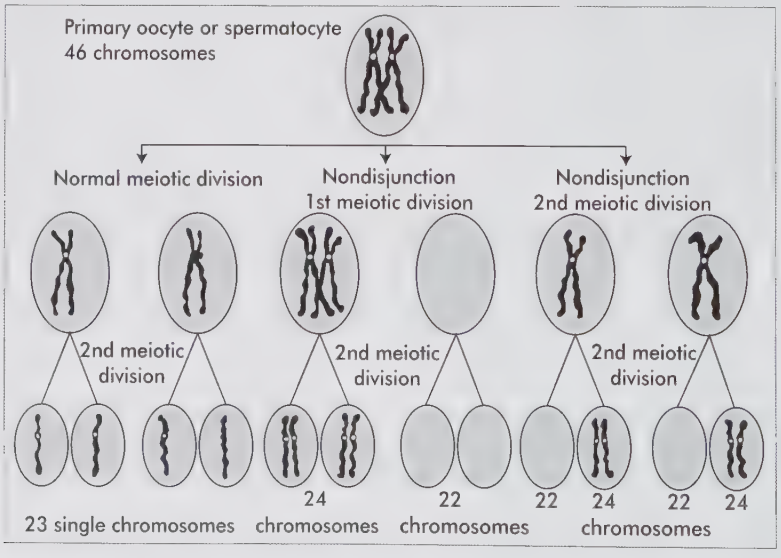

Figure 7.3 Normal and abnormal meiotic division

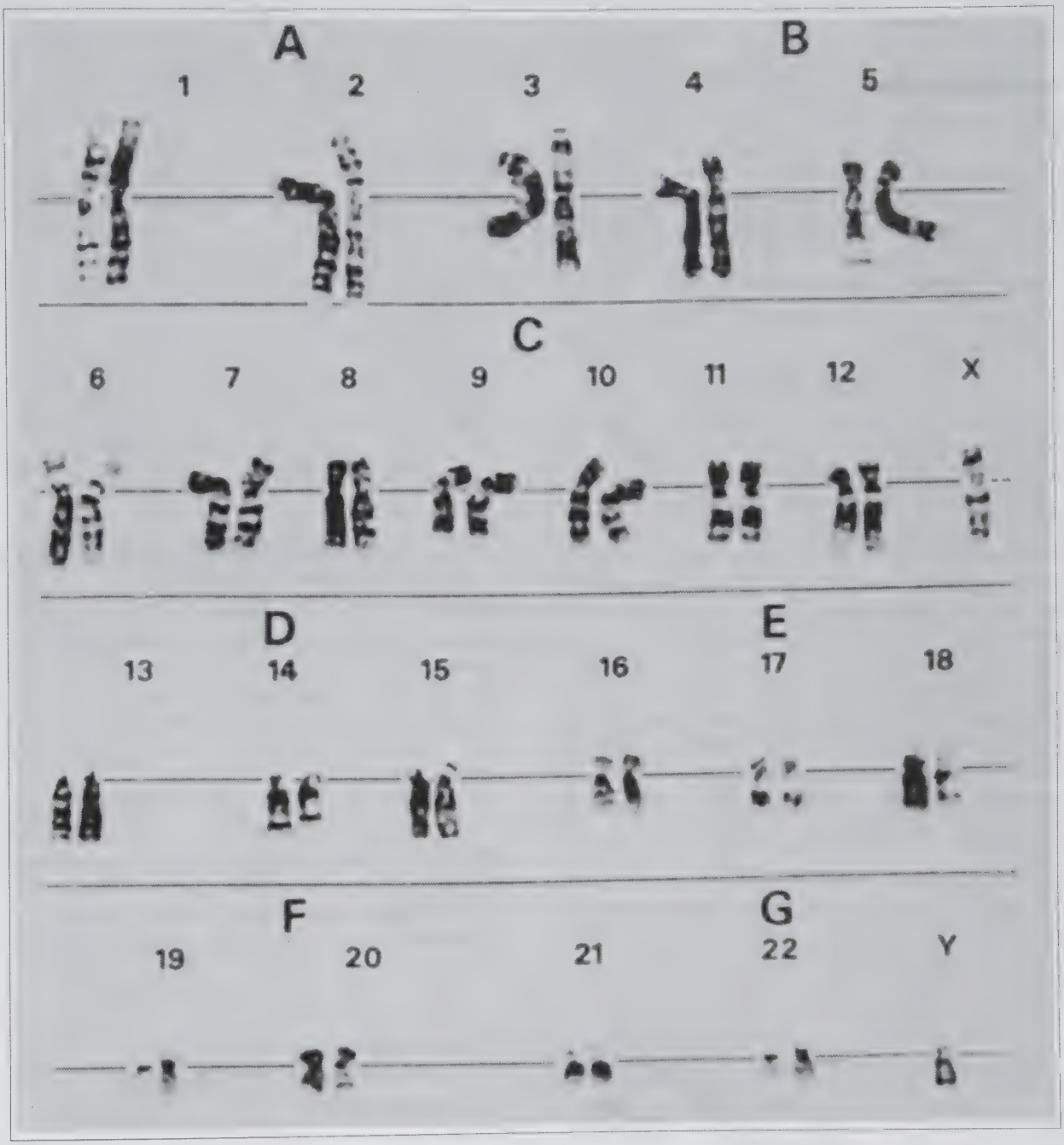

Figure 7.4 A human karyotype
Source: Harrison, 2008. *The Newborn Baby.* 5 ed. Cape Town: Juta and Co

There are two types of gametogenesis: spermatogenesis and oogenesis.

Spermatogenesis

Spermatogenesis is the process by which sperm are produced in the male sex cells. This takes place in the testes. Primary spermatocytes with 46 chromosomes divide to form two secondary spermatocytes, each with 23 chromosomes. These secondary spermatocytes divide to form a total of four spermatids, each with 23 daughter chromosomes. The spermatids eventually differentiate into spermatozoa (sperm). Meiosis in males always results in the production of four sperm.

After the first meiotic division, both the secondary spermatocytes will be haploid and one of the secondary spermatocytes will have an X chromosome and the other will have a Y chromosome. After the second meiotic division, there will be four haploid spermatids and two of these spermatids will have an X chromosome, and two will have a Y chromosome.

Oogenesis

Oogenesis takes place in the ovaries to produce the egg. The primary oocyte in the ovary has 46 chromosomes and divides by meiosis to produce two cells that each have 23 chromosomes. One of these cells is called the secondary oocyte and the other is the polar body. The secondary oocyte receives almost all the cytoplasm. The polar body may disintegrate or it may divide again. The secondary oocyte begins meiosis II and then stops at metaphase. The cell then leaves the ovary and enters the fallopian tube where fertilisation may occur (see Figure 7.8). Meiosis in females produces only one egg and three polar bodies.

The structure of the mature ovum

(See Figure 7.5.) The ovum consists of a central nucleus, surrounded by yellowish cytoplasm known as the vitellus. The vitellus is in turn surrounded by a space, called the perivitelline space. The polar bodies, produced during the process of maturation of the oocyte during meiosis, are discarded into this space.

The outer margin of the perivitelline space, formed by a thick membrane made from an opaque jelly-like substance, is called the zona pellucida. The zona pellucida, which acts as a protective shield around the ovum, is encircled by granulosa cells of the ovarian follicle, which have clumped together and appear to radiate outward from the zona pellucida. This formation of granulosa cells known as the corona radiata gives the ovum the appearance of a tiny, hairy ball, which, after ovulation is just barely visible to the naked eye: 100–150 microns in diameter.

The ovum is expelled from the ruptured ovarian follicle and is propelled by the fimbria lining the fallopian tubes into the ampulla of the tube. After ovulation, the ovum must be fertilised within the first 12 to 24 hours. After this time it begins to degenerate and finally, if not fertilised, disintegrates.

7.4 The male reproductive organs and sperm transport

The male sex cells are called spermatozoa or sperm and are produced in the testes, which are two oval-shaped organs suspended in the scrotum by the spermatic cords. The scrotum is a loose pouch of pigmented skin divided into two compartments and is situated in the perineal area, behind the penis and in front of the anus and is homologous with the labia majora in the female.

Each testis is made up of about 900 coiled seminiferous tubules, each about three quarters of a metre long. Sperm are formed from the germinal epithilial cells called spermatogonia in the walls of these seminiferous tubules.

The seminiferous tubules lead into the epididymis, another coiled tube within each testis, which is about 6 m long.

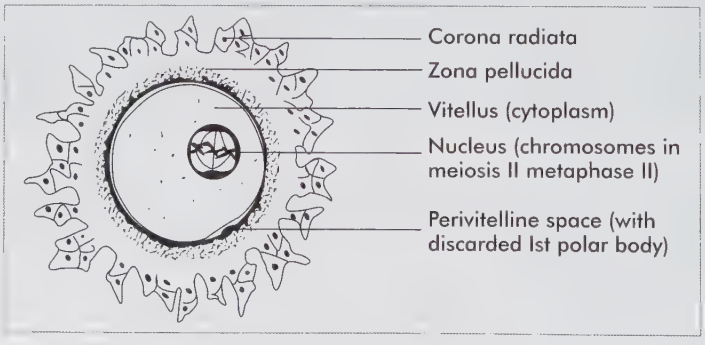

Figure 7.5 Human ovum (after ovulation but before fertilisation)

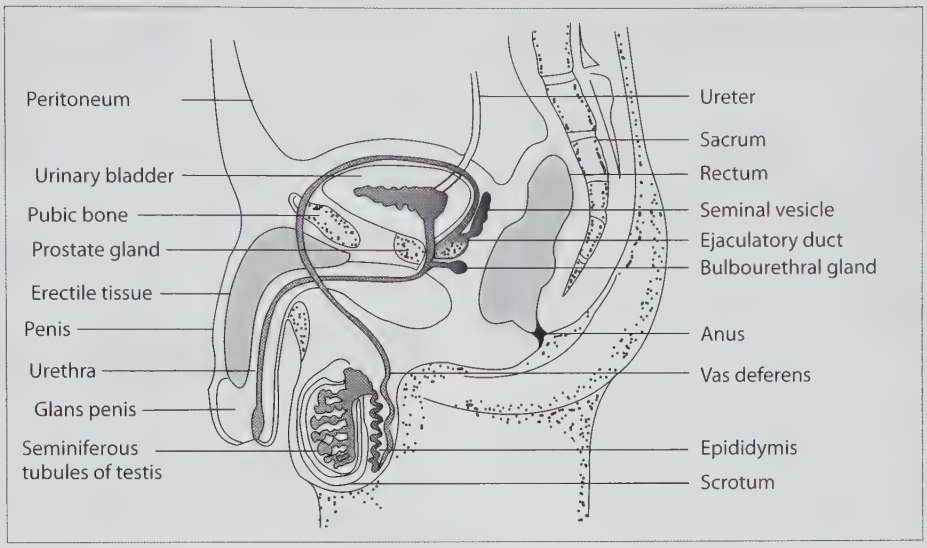

Figure 7.6 The male reproductive organs

The sperm take several days to pass through the epididymis, during which time they undergo final maturation and become motile. Most sperm are stored in the vas deferens and the ampulla of the vas deferens and can maintain their fertility for several months. The epididymis leads into the vas deferens, which is a long straight tube that leaves the scrotum and passes through the inguinal canal on either side of the pelvis and into the abdominal cavity. The vas deferens then curves over the bladder on either side and down the posterior surface of the bladder and back into the pelvis, where it joins with the duct of the corresponding seminal vesicle to form the ejaculatory duct.

The ejaculatory ducts are two short ducts that pass through the prostate gland and then enter the urethra, which is a tube leading from the bladder, through the penis, to the outside of the body via the external urethral sphincter at the glans penis (see Figure 7.6).

The testes, the epididymides, the vasa deferentia and the ejaculatory ducts are all paired, that is they are situated on both sides of the body. Only the urethra is a single tube and this tube conducts both urine from the bladder and the fluid containing the sperm from the ejaculatory ducts, which leave the body via the penis.

The sperm, together with the fluid in which they are suspended, is called the semen. This thick, white fluid is continuously secreted by the seminal vesicles, the prostate gland and the bulbourethral glands. Prostaglandins are also present in the semen. On sexual stimulation, the penis becomes erect, and then on further stimulation, there is an emission of more fluid from the seminal vesicles, the prostate gland and the bulbourethral glands into the urethra. Finally, there is ejaculation.

Sperm have a tiny, pear-shaped head, which is about 5–7 microns long and contains the nucleus, which contains the

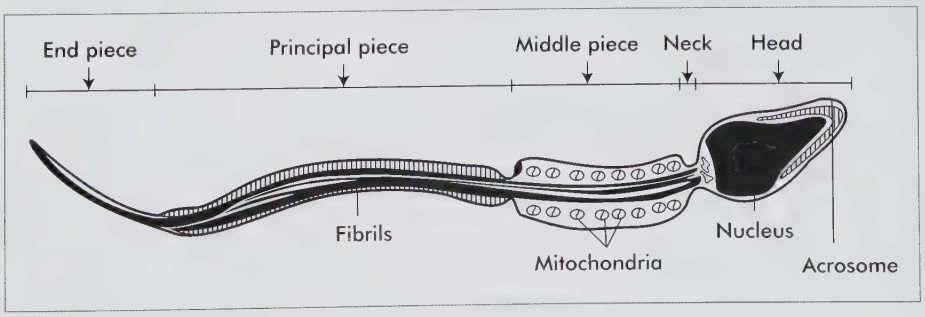

Figure 7.7 A human spermatozoon

chromosomes. The acrosome covers the front of the nucleus and contains hydrolytic enzymes, mainly hyaluronidase, and proteolytic enzymes, which disperse the cells of the corona radiata and dissolve the zona pellucida when the sperm penetrates an ovum at fertilisation.

The neck of the sperm is the constricted area between the head and the tail. In human sperm, a significant amount of cytoplasm often remains around the neck region. The tail is divided into a middle piece, a principal piece and an end piece. The middle piece, which is separated from the head by the neck, is about the same length as the head. Mitochondria are concentrated in the midpiece and generate the energy required for the flagellar movement of the sperm. The principal piece, which constitutes most of the tail, is made up of longitudinal fibrils, which are responsible for the motility of the sperm. The short end piece is merely the tapered end of the tail. (see Figure 7.7)

Out of 3 million sperm, only a few survive longer than 24 hours in the female genital tract. Most are destroyed by the lactic acid in the vagina, and many do not manage to negotiate the cervix, the uterus and the uterine tubes. Of the relatively few (1 000–3 000) that enter the tube containing the ovum waiting to be fertilised, only one will actually fertilise the ovum.

7.5 Male hormones

Androgens

These are the male hormones and are produced by the interstitial cells, called Leydig cells, in the seminiferous tubules of the testes. The main androgen is testosterone.

Testosterone

The male hormone, testosterone, secreted by the Leydig cells in the testes, is responsible for establishing male features in the embryo from the sixth week of development. It also stimulates the descent of the testes into the scrotum before birth. At about ten years of age, the hypothalamus matures and begins to secrete releasing hormones, which allow the anterior pituitary gland to secrete the gonadotrophic hormones FSH and LH, as in the female. Testosterone also promotes growth in the adolescent male, increasing the synthesis of proteins and metabolic rate. It is responsible for the development of the primary sexual structures and for all the secondary sexual characteristics, that is facial, pubic and axillary hair, voice deepening and muscle development. Testosterone is also responsible for the activity of sebaceous glands in the skin.

Follicle stimulating hormone (FSH): This hormone stimulates the development of the seminiferous tubules and is thought to promote spermatogenesis.

Luteinizing hormone: This stimulates the Leydig cells to secrete testosterone.

Oestrogens: There are small amounts of the female hormones, the oestrogens, in the male. These hormones are thought to be secreted by specialised cells, the Sefton cells, which are interspersed with the germinal epithelium and the Leydig cells, in the walls of the seminiferous tubules.

The Sefton cells also provide a special environment in which the germinal cells can develop, and play a special role in converting the spermatocytes into spermatozoa. These cells also secrete other hormones necessary in the process of spermatogenesis, one of which is inhibin.

7.6 Conception and fertilisation

(See Figure 7.8.) Conception refers to the process of joining the male and female elements and fertilisation is the first phase in this process.

Fertilisation usually takes place in the ampulla of the fallopian tubes, soon after the ovum enters the tube. After ejaculation about three million sperm are deposited in the female vagina, but only between 1 000 and 3 000 actually reach the ovum. The sperm propel themselves forward by a lashing movement of the tail.

When a sperm meets the ovum, it must first penetrate a barrier formed by the corona radiata and the zona pellucida. The sperm become capacitated, a process whereby the outer membrane of the acrosome is broken down and the hydrolytic and proteolytic enzymes are made available (activated). Many sperm attempt to enter the ovum and the combined enzymes produced by all these sperm appear to be necessary for the breakdown of this barrier so that one sperm penetrates into the cytoplasm (vitellus) of the ovum.

Once a sperm enters the ovum the barrier of the zona pellucida re-forms, so no more sperm can penetrate. The head of the sperm enlarges rapidly to form the male pronucleus and the tail degenerates.

The ovum completes the second meiotic division, forming the female pronucleus and expelling the second polar body into the perivitelline space.

The male and female pronuclei fuse on contact and lose their nuclear membranes. The 23 chromosomes from each

nucleus fuse to form a new diploid cell, containing 46 chromosomes (23 pairs) which will be the start of a unique person. This fertilised ovum is known as the zygote. The sex chromosome from the ovum will always be an X chromosome, therefore the new cell will always have one X chromosome.

This also means that the sex of the baby will depend upon which sex chromosome is contained within the nucleus of the fertilising sperm, which means that the male determines the gender of the baby.

7.5 Birth ratio male to female

There is a 50% chance that the new zygote is male (YX) or female (XX). More boys are conceived than girls because sperm carrying the Y chromosome have a competitive advantage. There are 100 girls born for every 105 boys, but more boys than girls die before birth.

The new cell, the *zygote*, then prepares itself for the first cleavage division in the process of mitosis.

7.7 Embryology

Embryology is the science of the development of the zygote, the embryo and the fetus *in utero*.

Terminology

Zygote: this is the name given to the developing ovum during the period from fertilisation to the twenty-first day (the end of the third week).

Embryo: this is the period from the twenty-second to the fifty-sixth day after fertilisation (from the beginning of the fourth week to the end of the eighth week; five weeks). This period is best expressed in days because the changes from fertilisation to the end of the embryonic period are so complex.

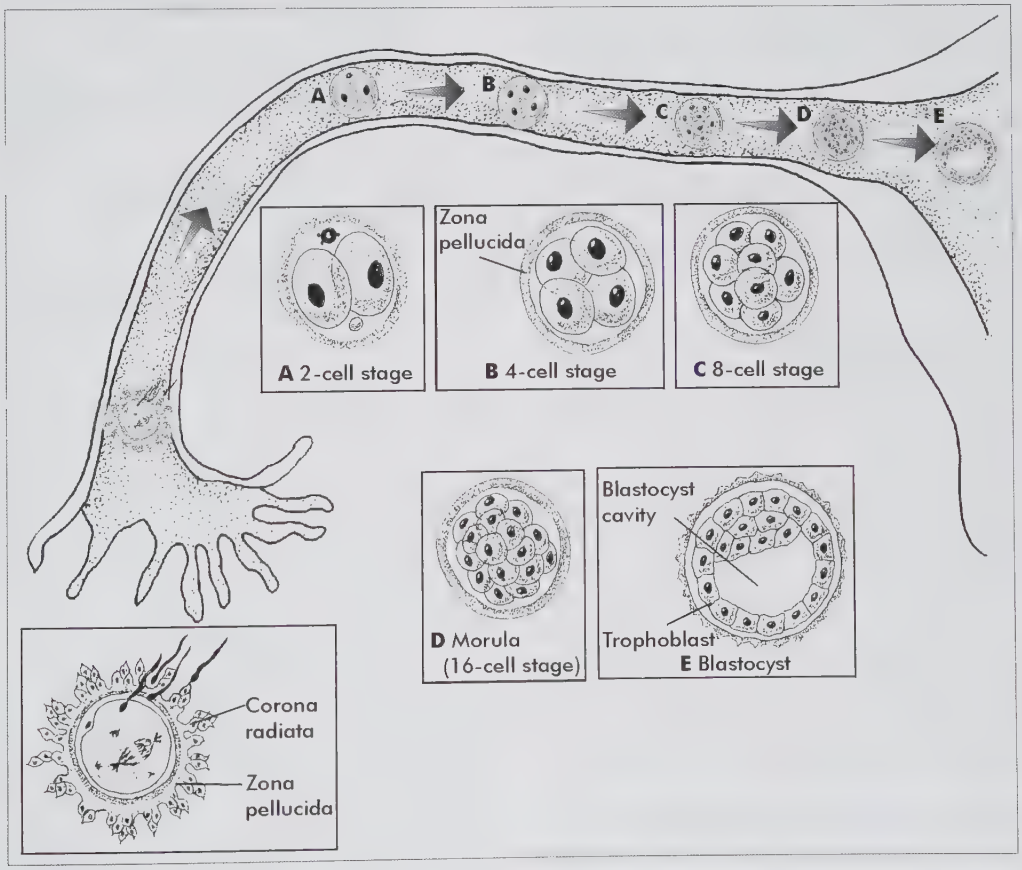

Figure 7.8 Fertilisation and transport of the ovum along the fallopian tube

Fetus: this term covers the period from the beginning of the ninth week after fertilisation, to term. After the embryonic period, the fetal age is expressed in weeks.

The duration of pregnancy and the estimated day of delivery (EDD)

Pregnancy in humans is 40 weeks, or nine months or 280 days with a range of normal between 37–42 weeks (259–294 days). The period of gestation in the human is divided into three trimesters (each a period of three months or approximately 13 weeks), which are known as the first, the second and the third trimesters.

The EDD is calculated as approximately 266 days after fertilisation. However, in order to have a recognisable landmark, the first day of the last *normal* menstrual period is used in obstetrics. Therefore, as fertilisation usually takes place within 24 hours of ovulation and ovulation takes place about 14 days after the onset of menstruation, 14 days are added to the 266 days, making the estimated date of delivery approximately 280 days after the onset of the last normal menstrual period.

When calculating the estimated date of delivery in months, seven days are added to the date of the first day of the last normal menstrual period and then nine months are added.

(Naegele's Rule: Add seven days to the first day of the last normal menstrual period, subtract three months and/or add nine months.)

Whether estimated in days, weeks or months, the periods of gestation given above are all approximate lengths of gestation and are merely guidelines.

Cleavage and the implantation and development of the zygote

This covers the period from fertilisation, up to the twenty-first day after fertilisation.

Because fertilisation usually takes place within 24 hours of ovulation, the terms fertilisation and ovulation are practically interchangeable in expressing the age and development of the zygote (see Figure 7.9).

The zygote now starts to divide by the process of mitosis into two identical daughter cells and then four and then eight and so on. This mitotic division of the zygote is known as cleavage and the daughter cells are known as blastomeres. The progress of the zygote, first along the fallopian tube and then in the uterine cavity, is described using the days following fertilisation.

The development of the zygote (1–7 days)

(See Figure 7.9) On the third day following fertilisation, a cluster of about 16 blastomeres form a solid ball, called the morula. The cells increase in number as the morula passes from the fallopian tube into the uterine cavity.

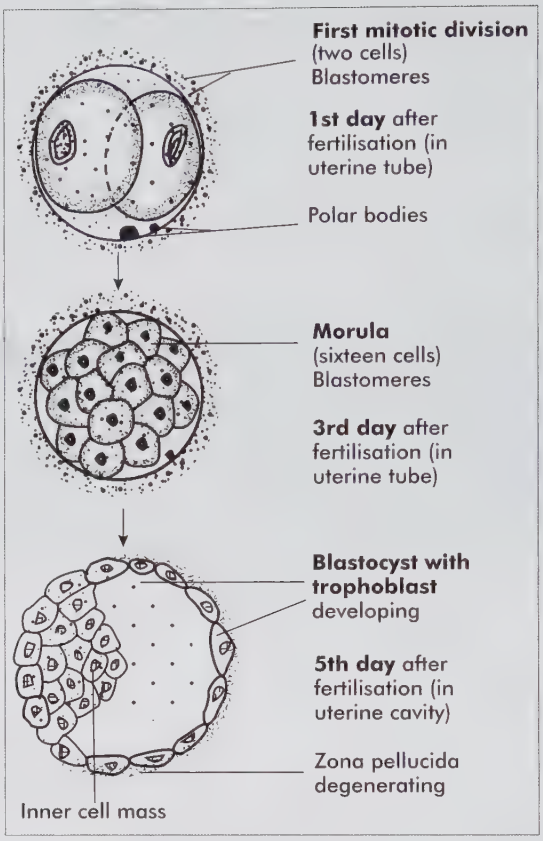

Figure 7.9 Cleavage of the zygote

By the fourth day, fluid from the uterine cavity has penetrated the morula and formed a fluid-filled cavity (cyst), pushing the inner cell mass to one side. This changes the morula into a blastocyst.

The inner cell mass will eventually become the embryo.

On the fourth and fifth days, the blastocyst remains free in the uterine cavity, receiving nourishment from the uterine secretions.

Implantation of the zygote

From about the fifth day, the zona pellucida starts to degenerate and the blastocyst attaches to the uterine wall.

On about the sixth day, the outer cells of the blastocyst become highly specialised and are called trophoblastic cells. These cells secrete proteolytic enzymes that digest and liquefy the cells of the inner lining of the uterine endometrium, known during pregnancy as the compact layer of the decidua.

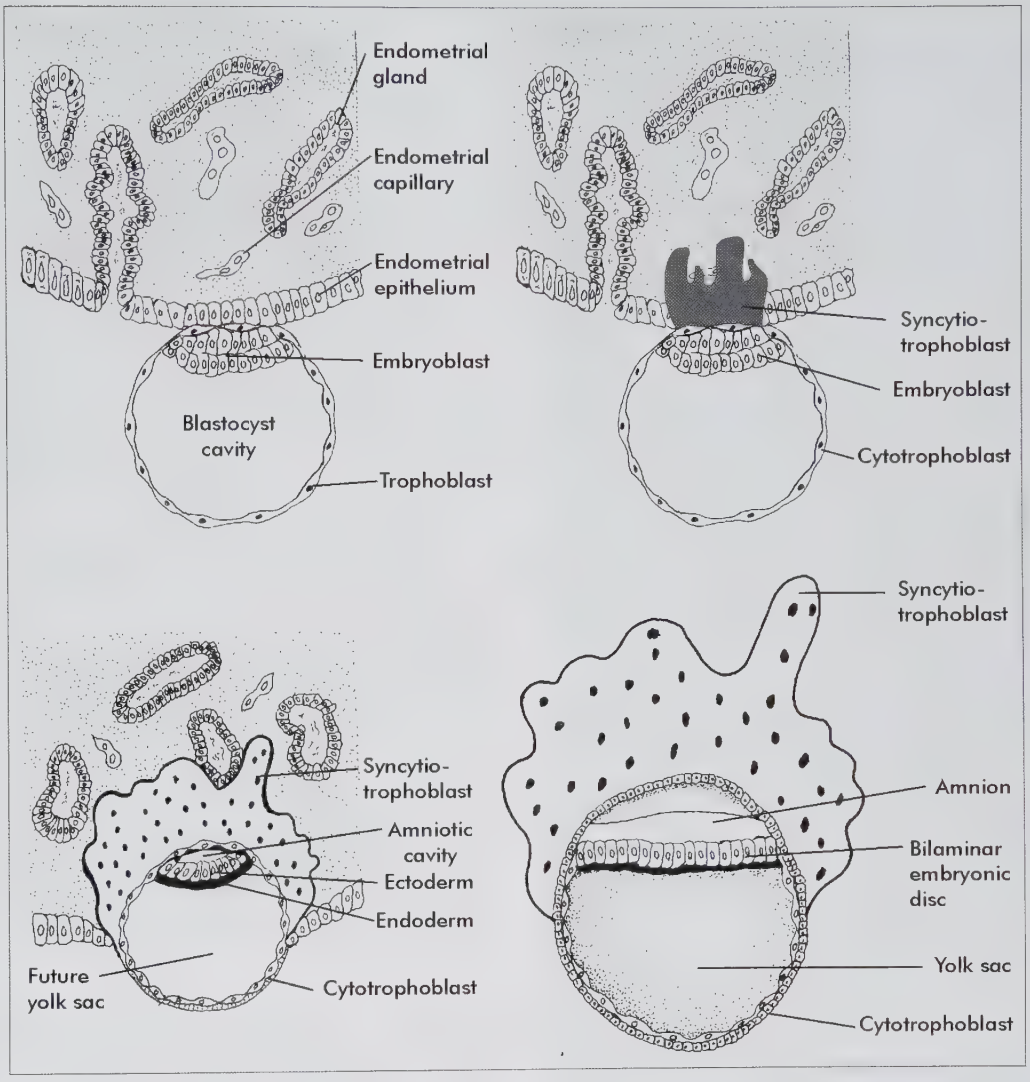

Figure 7.10 Stages of implantation of the blastocyst

By the end of the seventh day the blastocyst is superficially implanted into the lining of the decidua. In this way, the blastocyst is eventually able to embed itself into the spongy layer of the decidua and to acquire nourishment from the decidual cells. In order to achieve this, the trophoblastic cells develop into two distinct layers, which are together known as the trophoblast/syncytiotrophoblast (see Figure 7.10).

The two layers making up the trophoblast/syncytiotrophoblast are:

- *An outer syncytiotrophoblast layer (syncytial cells).* The cells of which continue to secrete proteolytic enzymes and so continue to invade the decidua and nourish the blastocyst.
- *An inner cytotrophoblast or Langhan's layer (cytotrophic cells).* This is closely attached to the outer synetial layer. These two layers of cells, therefore, form the outer membrane of the trophoblast.

Embedding and development of the zygote (blastocyst and trophoblast), occurs from the seventh to the 14th day after fertilisation (see Figure 7.11). The cells of this inner layer begin to secrete HCG, which is very similar to the LH of the pituitary gland.

The development of the decidua

Changes occur in the secretory endometrium of the uterus during pregnancy, which then becomes known as the decidua.

7.6 Human chorionic gonadotrophic hormone (HCG)

Human chorionic gonadotrophin (HCG) is the basis of laboratory tests (urine and blood) for the diagnosis of pregnancy.

In the non-gravid state, the corpus luteum in the ovary would by now be starting to degenerate (approximately the eighth day after ovulation), causing progesterone and oestrogen levels to start to fall. About 14 days after ovulation, the endometrium, which would no longer be sustained by these hormones, would slough away and be expelled and the unfertilised ovum would be expelled with it.

However, in pregnancy the chorionic gonadotrophic hormone, with its LH-like action, is able to act on the corpus luteum and cause it to continue secreting progesterone and oestrogens. As a result, the corpus luteum increases greatly in size; more and more progesterone and oestrogens are secreted; the endometrium grows larger and more vascular; greater invasion of the decidua by the synetial layer of the trophoblast occurs and the inner cell mass and consequently the developing embryo has all the nourishment that it requires to grow and develop.

On about the eighth to ninth day after fertilisation, the secretion of HCG can first be measured in the maternal blood. The rate of secretion then rises rapidly and reaches a maximum at about seven to nine weeks after fertilisation, after which it then decreases fairly rapidly to a much lower level by the 16th to 20th week after fertilisation. This low level is then maintained throughout pregnancy.

Should the urine and blood levels of HCG remain high or even increase after 10–16 weeks gestation, a hydatidiform mole (gestational trophobiastic disease) would be suspected. The diagnosis would be confirmed by ultrasonic scan. Alternatively multiple pregnancy is a possiblility.

HCG, with its luteinizing hormone (LH) effect, stimulates the testes in a male fetus to begin producing small amounts of testosterone and thus causes the development of the male sex organs of the fetus *in utero*.

The decidua is made up of three layers:

- *The basal layer*. This layer is the same layer as the basal layer of the endometrium in the non-pregnant state. It is not shed at menstruation and is the basis from which the new endometrium is regenerated each month; a permanent, regenerative layer.
- *The spongy layer of the decidua*. This is the broad band of connective tissue (stroma), interspersed with glands, that is regenerated from the basal layer under the influence of the oestrogens, which then proliferates under the influence of progesterone. It is called the spongy layer because it is like a sponge in texture; the cells are loosely knitted together, with large spaces (lacunae) in between the groups of cells. This layer is highly vascular and secretory and is secreted under the influence of progesterone when the ovum is fertilised and the trophoblast is formed. During pregnancy it becomes more vascular and secretory in order to provide the blastocyst with nourishment. The penetrating trophoblastic villi, with their syncytial layer containing the proteolytic enzymes, erode through the maternal blood vessels in the spongy layer of the decidua, causing the spaces between the villi to fill with maternal blood. These are then known as the intervillous spaces. These trophoblastic villi later become known as chorionic villi (chorion frondosum) and will eventually develop into the placenta.
- *The compact layer*. This is the first layer that the ovum encounters when it enters the uterine cavity because this layer is continuous with the lining of the uterine tubes. It consists of an outer layer of columnar epithelial cells, which forms the lining of the uterine cavity and keeps the cells of the spongy layer in place, together with an inner thicker layer of connective tissue (stroma). These superficial stromal cells are swollen and enlarged and as a result are tightly packed together or compacted.

Situated on the basal layer, between the basal and spongy layers, is a specialised layer known as the 'postage-stamp' layer or the fibrinous layer of Nitabuch. This collagen or 'postage-stamp' layer becomes highly specialised and forms a barrier to the invading trophoblastic cells, preventing them from penetrating the basal layer of the decidua and into the myometrium.

However, perforations in this layer allow the undamaged maternal spiral arteries and veins, supplying and draining the decidua, to pass through.

Detachment of the placenta at this zone allows a uniform separation of the placenta from the decidua in the third stage of labour, hence the name 'postage-stamp' layer.

Should this layer not develop sufficiently, allowing some or most of the villi of the chorion frondosum to invade the basal layer of the decidua and even to extend into the myometrium, the placenta would then become a morbidly adherent placenta.

The result of this would be that a part or the whole of the placenta would not be able to separate from the uterine wall in the third stage of labour and would be retained within the uterus: this is known as either a partial or total placenta accreta.

Implantation sites

Implantation of the zygote (blastocyst) into the maternal decidua is completed during the second week after fertilisation. The normal sites of implantation are the posterior, anterior or a lateral wall of the uterus, just below the entry of the fallopian tube, approximately in the centre of the uterus.

Any implantation site other than that of the uterine cavity is abnormal and will give rise to an ectopic pregnancy. Should the implantation site be low down in the uterine cavity, that is, near the internal cervical os (in the lower uterine segment) or in the cervical canal, this is also abnormal.

Abnormal implantation sites

Fallopian tube: Implantation in the fallopian tubes results in a tubal pregnancy, where the zygote may implant anywhere along the length of the tube. The zygote will start to develop and grow and will eventually become too large to be accommodated in the lumen of the tube and will cause the tube to rupture, resulting in a ruptured (tubal) ectopic pregnancy and the death of the embryo. This is a very serious condition causing severe pain and extensive intra-abdominal bleeding and, without emergency surgical intervention, can result in the death of the woman. This pregnancy mostly does not progress past the first trimester.

The abdominal/peritoneal cavity: Implantation in the abdominal cavity is called an extra-uterine or abdominal pregnancy, a very rare condition, with implantation in the ovarian tissue or in the mesentery, or in any organ, even the liver. Implantation in these tissues could result in the fetus surviving to term, but usually results in early fetal death and fetal abnormalities.

Sometimes, extensive damage to vital structures results in severe maternal intra-abdominal haemorrhage.

Unless delivered by abdominal incision, the fetus would eventually die in the abdominal cavity due to lack of nourishment, as it would not be able to be expelled by the uterus at term. The maternal system would eventually lay down calcium in the body of this dead fetus, resulting in a Lithopedian or calcified fetus. Pauline Sellers once nursed an elderly woman who complained that she had had a large lump in her abdomen for a great many years. At laparotomy, it was found to be a large, probably full-term, Lithopedian fetus.

The placenta in this case cannot be removed due to the risk of haemorrhage and is left *in situ* to be reabsorbed.

The lower uterine segment/cervical canal: This may result in a placenta praevia, which may cause severe bleeding from a detached placenta during late pregnancy and during labour, and because of the dearth of criss-cross muscle fibres in the cervix, may also lead to severe postpartum haemorrhage.

Implantation bleeding

When the syncytiotrophoblast erodes the maternal decidua and blood vessels, the woman may present with slight vaginal bleeding. This may be passed off as an early and smaller than usual menstrual period, as the woman would not yet be aware of the pregnancy. This implantation bleed can cause difficulties with the estimated date of delivery if the woman uses it as her last menstrual period: the actual date of delivery could, therefore, be about three weeks earlier than estimated.

The development of the zygote (7–14 days)

(See Figure 7.11.) From about the eleventh to the thirteenth day after fertilisation, the cells of the cytotrophic layer have greatly proliferated, pushing the syncytial layer outwards in finger-like processes or primary chorionic villi, which invade the decidua. The trophoblastic tissue, therefore, mingles extensively with maternal tissue, then known as secondary chorionic villi. Mesoblast cells also separate the trophoblast, which surrounds the zygote, from the inner cell mass.

All these outer mesoblast cells are called the *extra-embryonic mesoderm* and by the end of the twenty-first day or third week after fertilisation, will have developed into fetal capillaries (see Figure 7.12).

Once the fetal capillaries have been formed, the secondary chorionic villi become known as (tertiary) chorionic villi. These (tertiary) chorionic villi, together with the maternal decidua, will eventually form the placenta.

The three layers making up the walls of the secondary chorionic villi are:

- The syncytiotrophoblast (the syncytial layer) is the outer layer.
- The cytotrophoblast (the cytotrophic layer) is the middle layer.
- The mesoblast (the mesenchymal core) is the inner core.

By the eleventh to the thirteenth days changes have occurred in the inner cell mass of the blastocyst (see Figure 7.13).

Mesoblast cells have also formed within the inner cell mass and these will become the mesoderm at the centre of the embryonic plate, which, together with the ectoderm and the endoderm, will develop into the embryo.

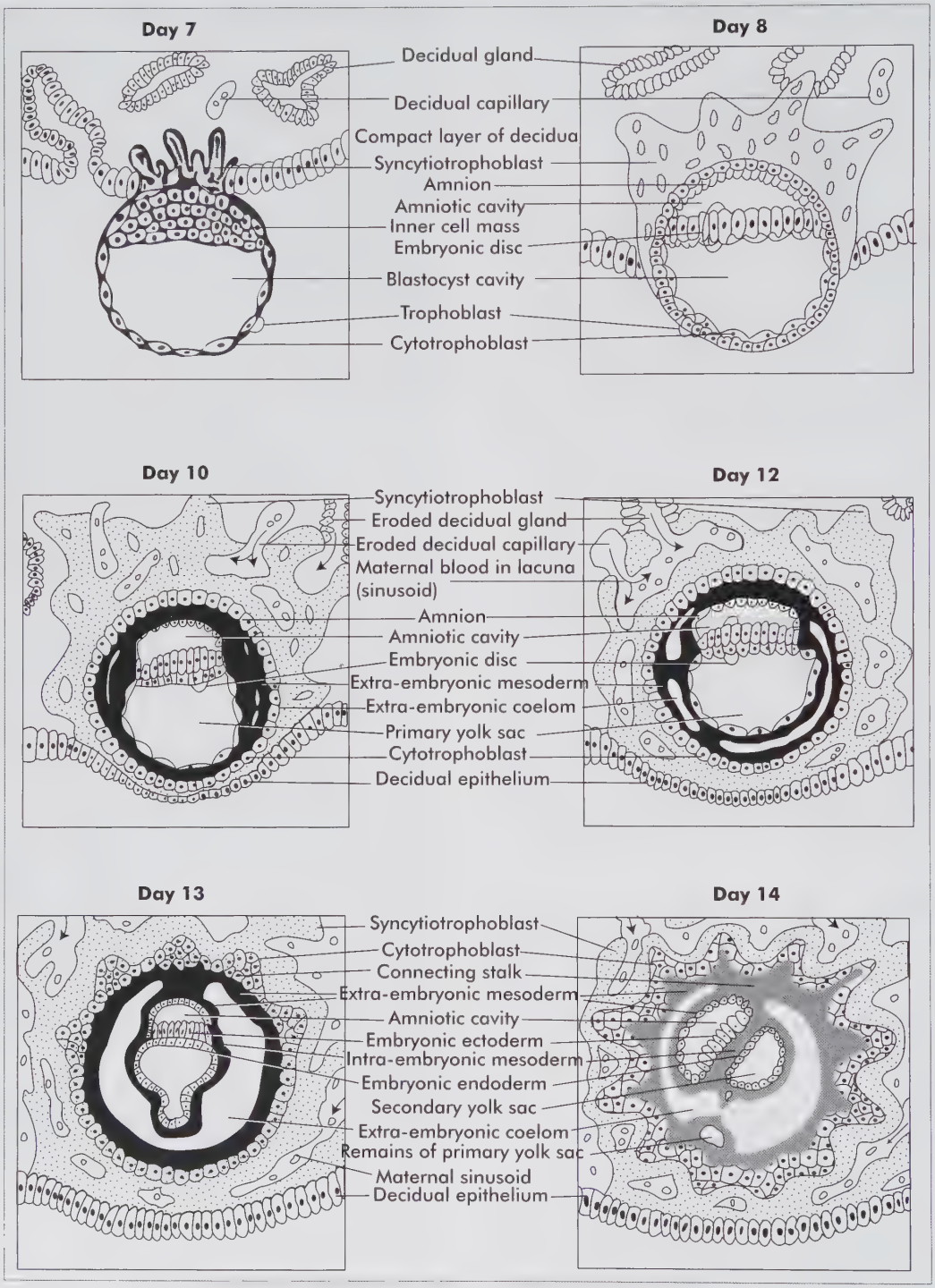

Figure 7.11 Embedding and development of the zygote (blastocyst and trophoblast) from the 7–14th day of embryo

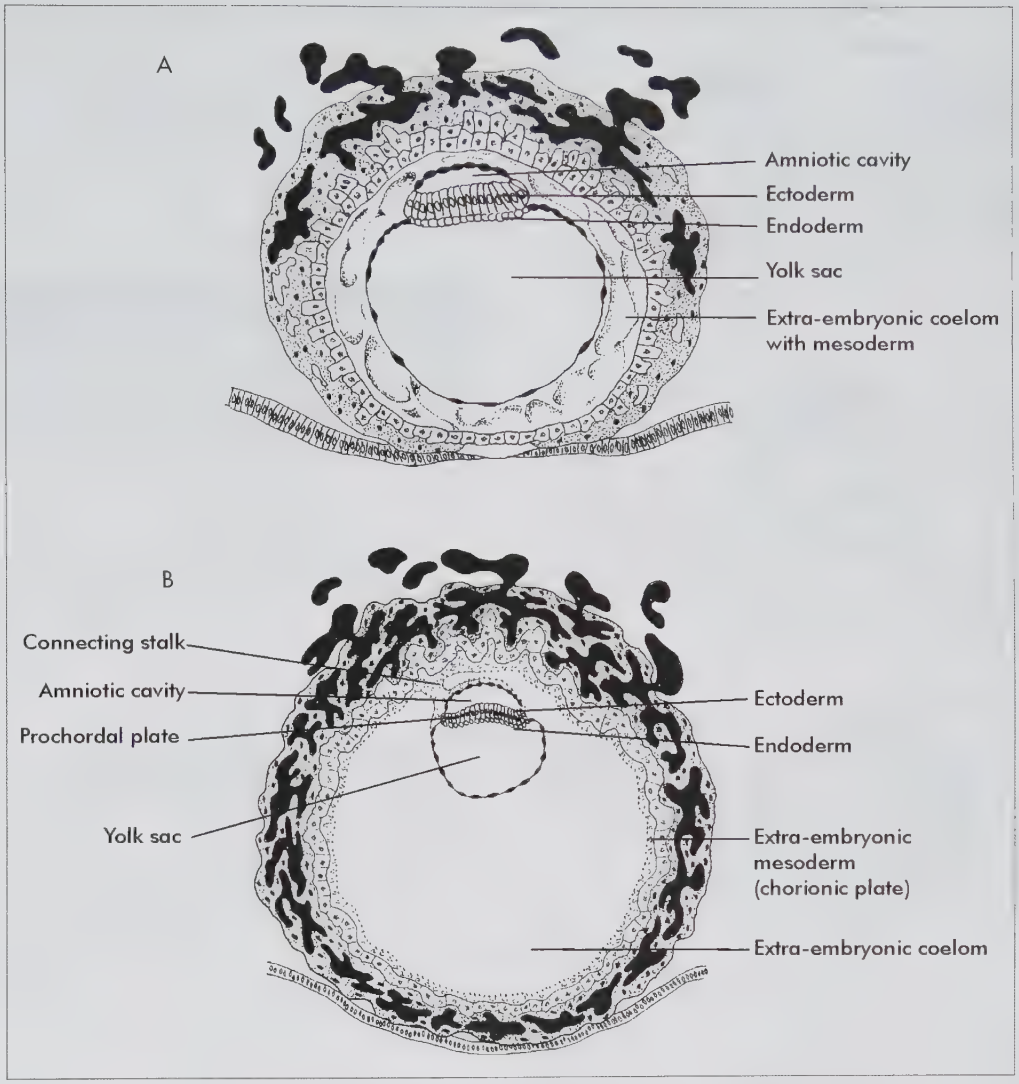

Figure 7.12 Development of the extra-embryonic mesoderm (A) and (B) coelom

Changes in the inner cell mass

The amniotic sac

The amniotic sac, a narrow, slit-like space, lined with ectoderm cells, develops between the inner cell mass and the outer trophoblast layers, forming the beginning of the *amniotic cavity or sac* (see Figure 7.12).

The inner cell mass

The inner cell mass differentiates into an embryonic disc. This is made up of three layers (germ layers) as follows:

- *The ectoderm.* Where the inner cell mass is closest to the trophoblast and on the side where the amniotic cavity has developed, there is a row of cells known as the ectoderm. This row of cells is continuous with the ectoderm cells which line the amniotic sac (see Figure 7.12).
- *The mesoderm.* At the central part of this embryonic disc is the mesoderm. This row of mesoderm cells is continuous with the mesoblast cells within the chorionic villi, which later develop into the fetal blood vessels.
- *The endoderm.* Lining the side of the mesoderm closest to the blastocyst cavity is a row of cells known as the endoderm. These cells are continuous with the cells lining the yolk sac.

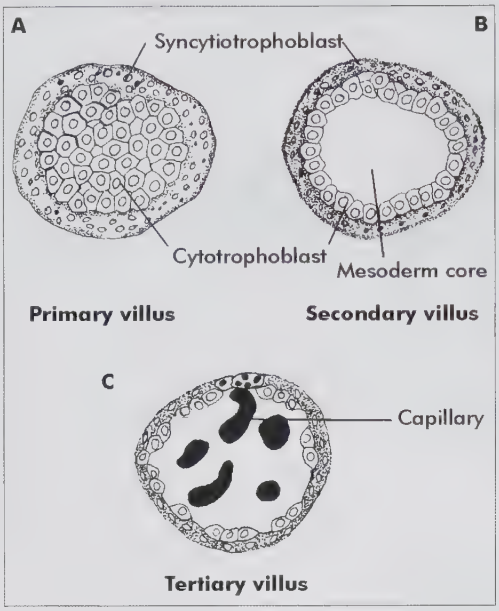

Figure 7.13 Structure of the villi

The yolk sac

(See Figure 7.12.) The cavity of the blastocyst has now developed into the yolk sac, which is lined with endoderm cells. The zygote has now differentiated into two distinct parts:

- The outer trophoblast, which is invading the maternal decidua and will eventually form the placenta and the chorionic membrane (the chorion), responsible for the nourishment and well-being of first the embryo and then the fetus.
- The inner cell mass, which will develop into the embryo and then the fetus, and will also form the amniotic membrane (the amnion) and become filled with fluid called liquor amni. The umbilical cord, which links the fetus to the placenta will develop from the (connecting) body stalk.

By the twelfth day, spaces have started to form within the extra-embryonic mesoderm. By the fourteenth day, the primary yolk sac has divided into two, and the remaining (secondary) yolk sac is much smaller. The extra-embryonic coelom has greatly enlarged and now surrounds the inner cell mass, except at the connecting or body stalk, The primary chorionic villi will have been established. This is the time at which the menstrual period would normally have taken place.

Early abortions

Early abortion is defined as the interruption and termination of the products of conception at six months of intrauterine existence and a gestation of not less than 26 weeks, when calculated on the calendar. Weight has become a more important criteria than gestational age. A weight of 500 g or 24 weeks gestation is acceptable in developing countries. In South Africa 1 000 g or 28 weeks is still the guideline for viability.

7.7 Legal aspects

When a baby is born dead or dies after viability a notification of birth is completed and a birth and death certificate issued.

Development of the zygote (15–21 days)

The third week of embryonic life (which is the period immediately following the first missed menstrual period) is a time of rapid growth.

The trophoblast

(See Figure 7.13.) The primary chorionic villi progress to secondary villi and then, when blood vessels have formed in these villi, to tertiary chorionic villi. These vessels become connected to vessels developing in the embryonic heart, via vessels in the connecting body stalk. By the twenty-first day, embryonic blood has started to circulate through the capillaries in the chorionic villi, and now carries nourishment from the maternal blood to the developing embryo and returns waste products to the maternal circulation.

The inner cell mass

The embryonic disc develops and changes from a flat disc and becomes pear-shaped and then elongated. The cranial area expands while the caudal area elongates. A fold or groove develops longitudinally down the centre of the ectoderm and the mesoderm – the neural plate. This neural plate folds around on itself and by the end of the third week, the edges of the neural plate meet and fuse in the centre of the embryo.

At 21 days the primitive cardiovasular and neural tube have formed. The neural tube is the precursor of the brain and the nervous system, together with the tissues covering and protecting the brain and spinal cord (see Figure 7.16).

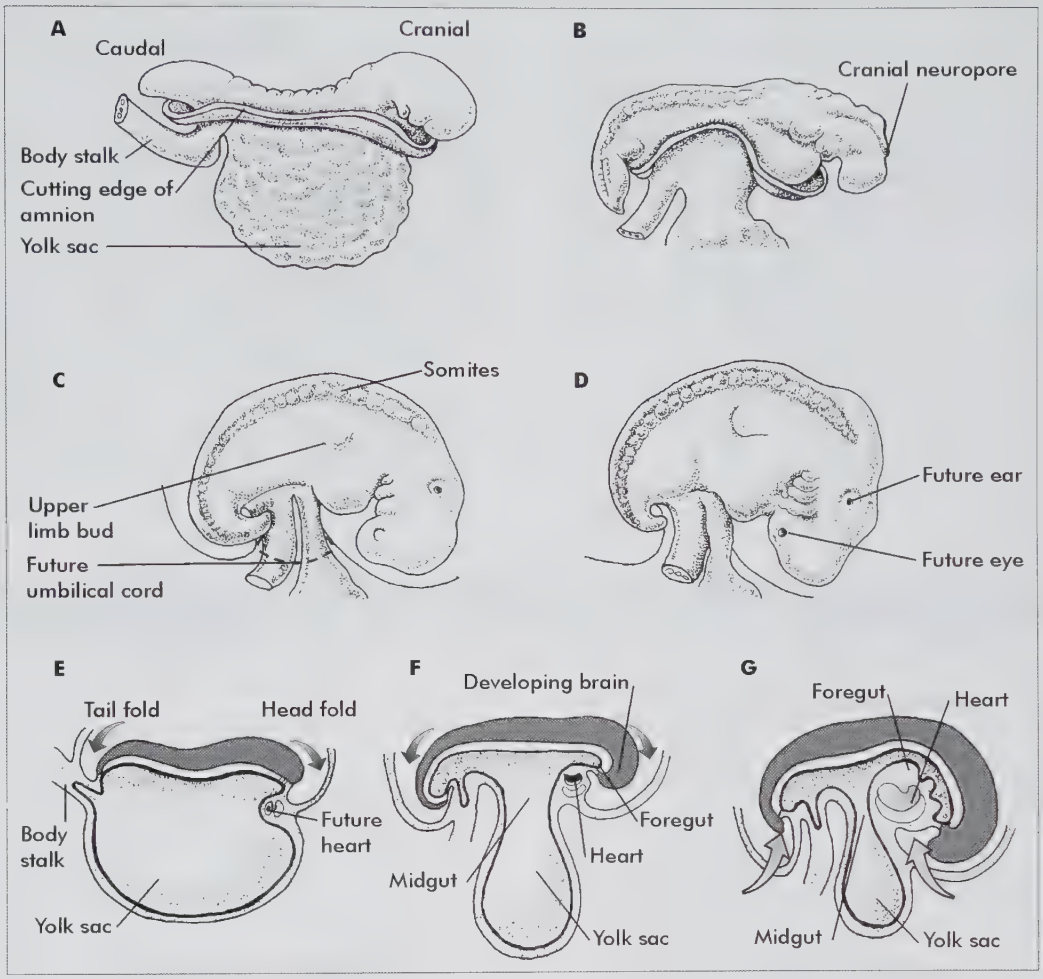

Figure 7.14 Folding of the embryo

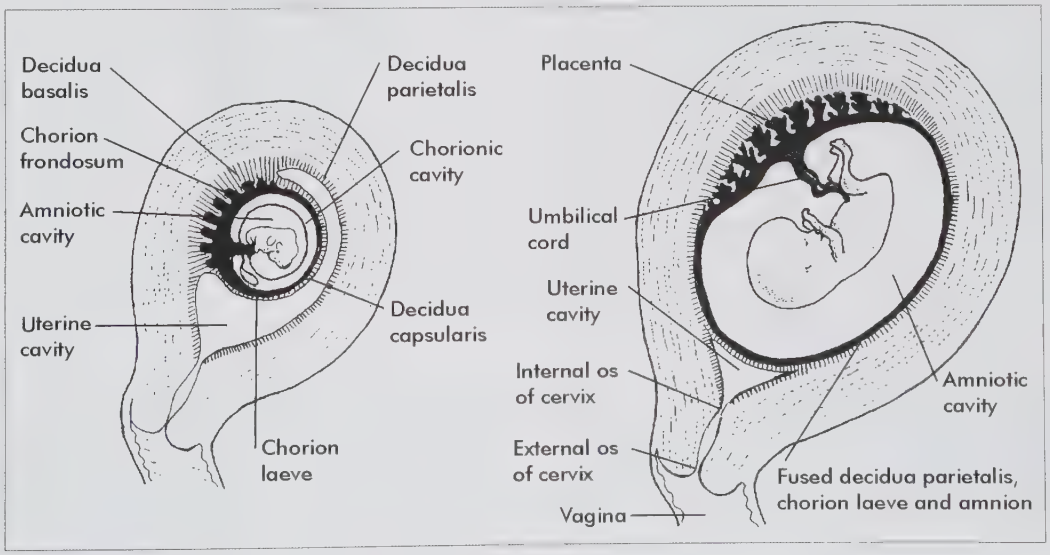

Figure 7.15 Formation of the chorion

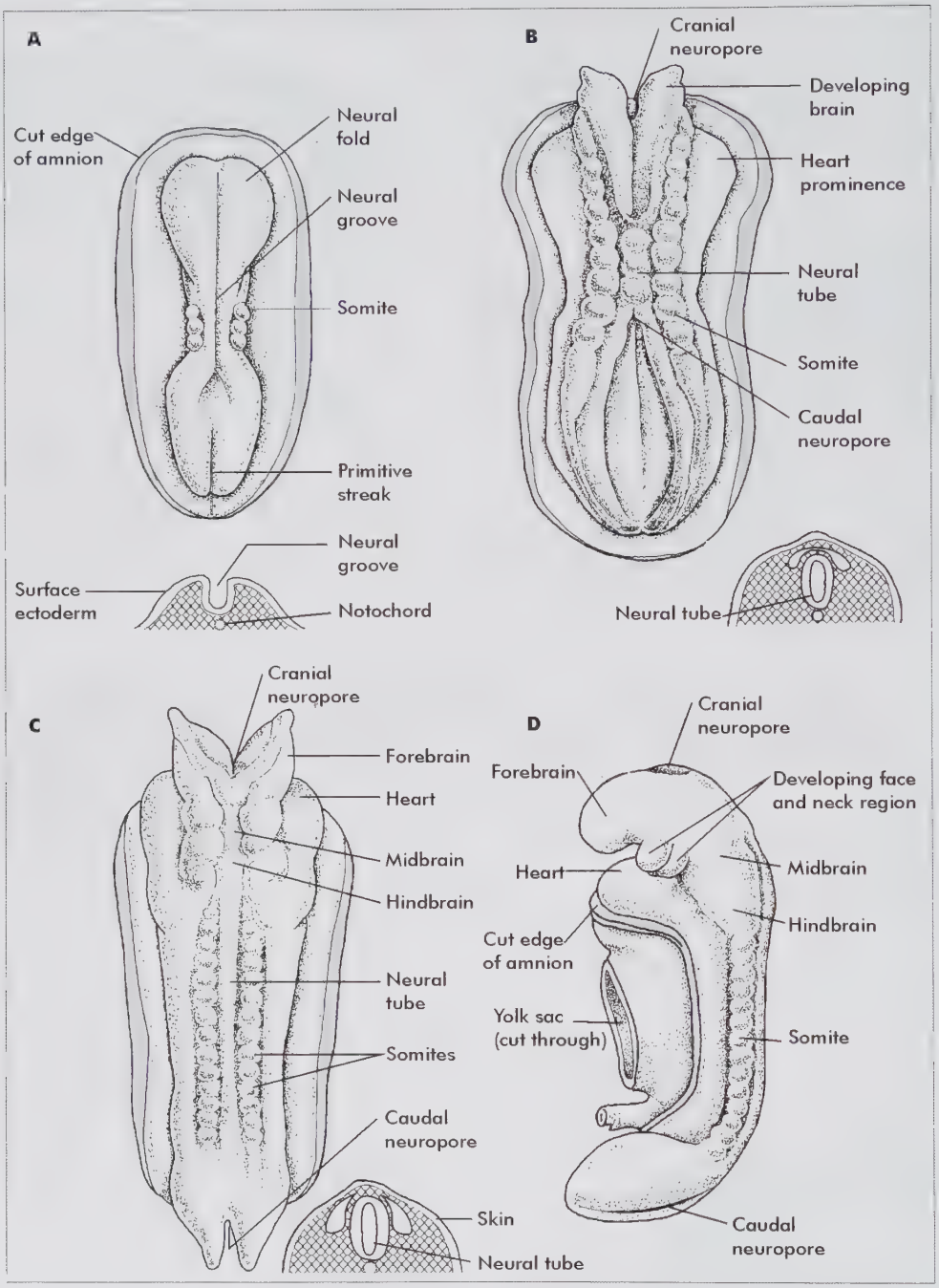

Figure 7.16 Development of the neural tube

Any disturbance during this process can result in severe abnormalities of the brain and spinal cord, such as anencephaly.

The intra-embryonic coelom or embryonic body cavities now appear as isolated intra-embryonic coelomic spaces within the intra-embryonic mesoderm. These spaces will later coalesce to form the heart and the pericardial cavity, the pleural cavities and the peritoneal cavity.

By the twenty-first day, a primitive cardiovascular system is established within the embryonic form and the yolk sac (see Figure 7.16).

The amniotic sac surrounds the embryonic form and begins to extend towards the yolk sac, which it will also ultimately surround.

Derivatives of the embryo and germ layers

(See Figure 7.14.) The three germ layers that have been formed by the end of the third week give rise to all the tissues and organs in the embryo. The main body systems are outlined as follows:

- The ectoderm gives rise to the nervous system, the brain, spinal cord, the eye, the ear, the nose, the pituitary gland, the skin, the mammary glands and the medulla of the adrenal gland.
- The mesoderm gives rise to the skeletal system, bone, cartilage and connective tissue, muscle tissue (striated and smooth), the cardiovascular and lymphatic systems, the heart, lungs, blood and lymph vessels and the blood cells, the spleen, the urogenital system, the kidneys and the gonads (but not the bladder), the serous membranes lining the body cavities and the cortex of the adrenal gland.
- The endoderm gives rise to the epithelial lining of the gastrointestinal tract, the respiratory tract, the liver, the remaining endocrine glands, the thyroid, the parathyroid and the thymus glands, the pancreas, the urinary bladder and urethra and the ear.

(Figure 7.17 shows how the amnion covers the umbilical cord and how the fetal sac develops.)

The development of the human embryo

The embryo (22–56 days)

The development of the embryo covers a period of five weeks, from the beginning of the fourth week to the end

Table 7.2

Early development of the embryo (gestational sack volume (GSV), crown rump length (CRL), and characterstics)

Age Weeks	Age Days	GSV ml	CRL ml	Main Characteristics
3 weeks	20–21	0.2	Fetus not noted	Neural groove present and neural tube forming
	22–23			Embryo slightly curved
	24–25			Embryo curving further; optic vesicles formed
	26–27			Upper limb buds and heart prominence appear
4 weeks	28–30	1.0		Embryo is C-shaped; upper limb buds flipper-like; lower limb buds and tail
	31–32			Upper limb buds paddle-shaped
5 weeks	33–36	4.5		**NB Primitive heart is beating**
	37–40			Foot plates formed. Hand plates formed; lower limbs paddle-shaped
6 weeks	41–43	5.9	4	Finger rays appear; trunk straightening
	44–46		6	Toe rays and elbow region visible; eye-lids forming; nipples and finger notches visible
	47–48		8	Limbs extend ventrally; trunk longer and straighter
7 weeks	49–51	17.8	10	Fingers distinct but webbed; toe notches seen
	52–53		12	Hands and feet approach each other; fingers distinct and longer; toes webbed
	54–55		14	Toes free and longer; eyelids and ears distinct
8 weeks	56	22.4	16	Head more rounded with human characteristics; tail has disappeared; bulge still present in umbilical cord due to herniation of intestines; sex not yet distinguishable.

Adapted from Chugleigh, P & Pearce, JM. 1995. *Obstetric ultrasound: how, why and when.* p 293. London: Churchill Livingstone

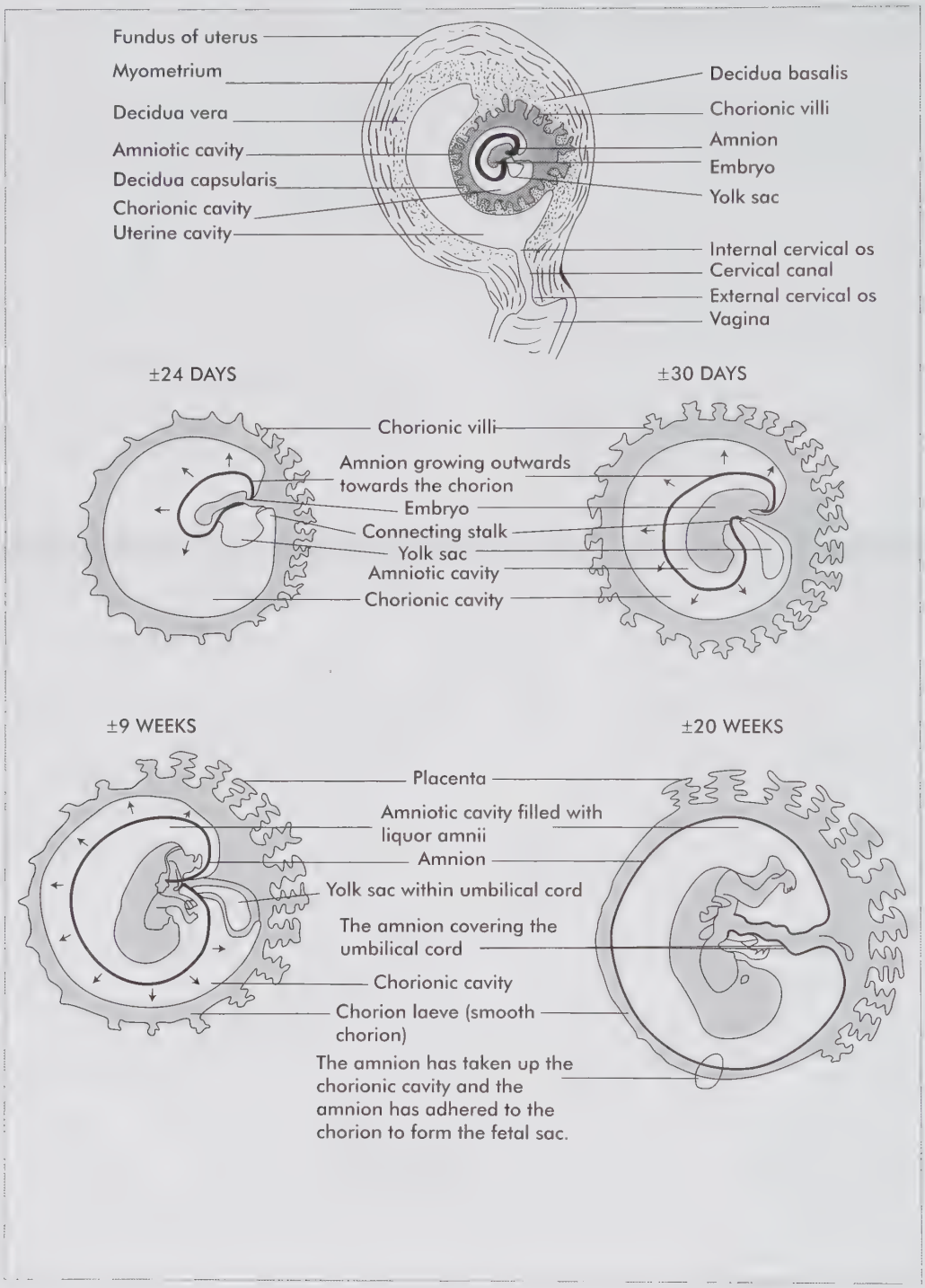

Figure 7.17 Sagittal section of a gravid uterus showing how the amnion covers the umbilical cord and how the fetal sac develops

of the eighth week after fertilisation. Until the sixth week the size of the gestation sac is measured with ultrasound to confirm pregnancy. The gestational sac volume (GSV) is measured in millilitres (ml) (see Column 3 in Table 7.2). Once the fetus is identified in the sac from the sixth week of gestation the crown rump length (CRL) is measured. This is the most accurate means of determining gestational age until the twentieth week. A viable pregnancy can be identified from the fifth week and is associated with the beating of a fetal heart (see Table 7.2).

This is an extremely important period of development in the human and is called organogenesis. All the main organ systems have started to develop by the end of these five weeks and are differentiated into specific organs. (See colour illustration Figure 7.19, **C2.**)

The shape of the embryo gradually changes as these developments take place.

If the embryo is exposed to certain toxic agents during this period this can lead to developmental anomalies, which will cause major congenital abnormalities. These agents are

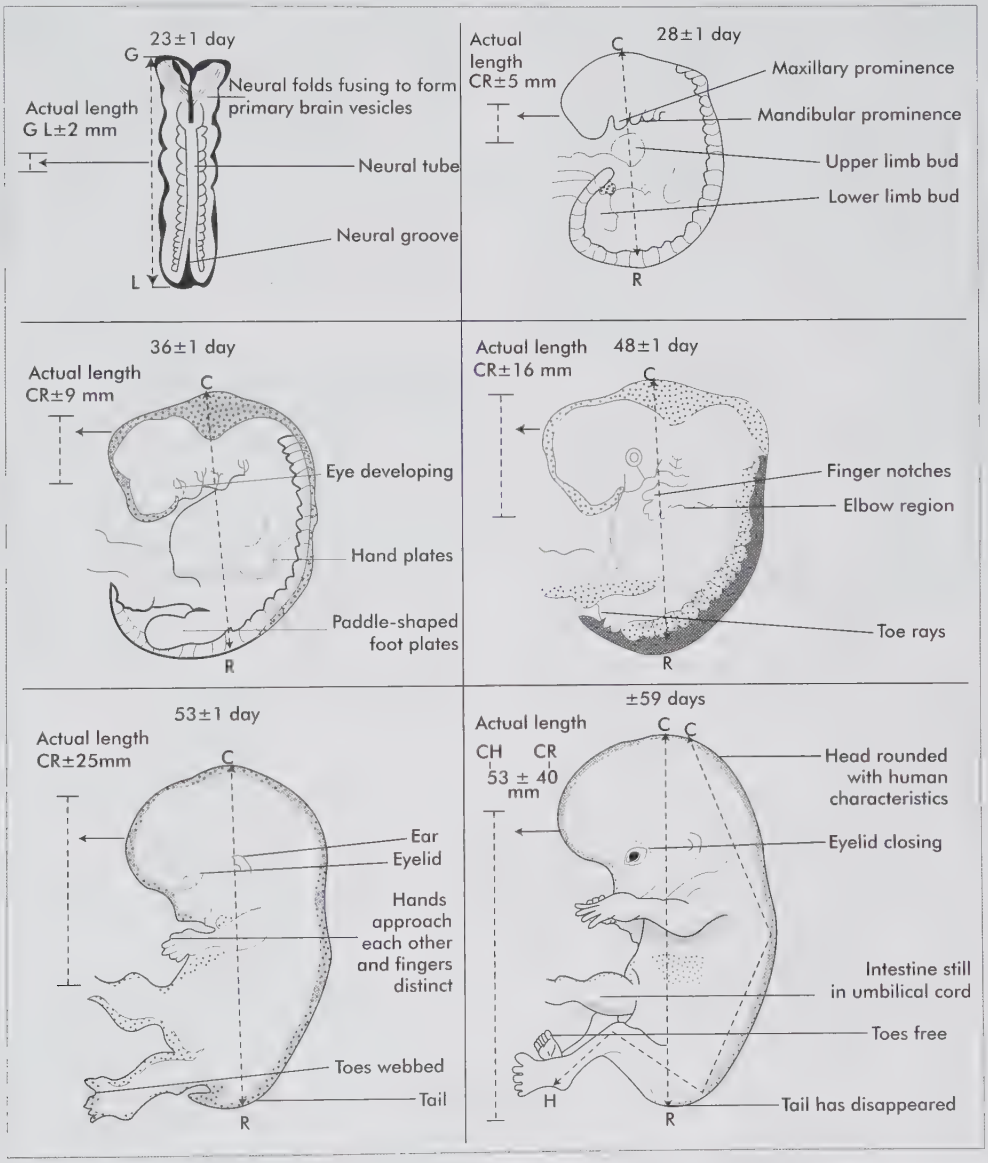

Figure 7.18 The age of the embryo is shown as days after fertilisation. The actual length is shown on the left of each drawing and the measurement is shown as a dotted line on each drawing GL = greatest length; CR = crown-rump; CH = crown-heel

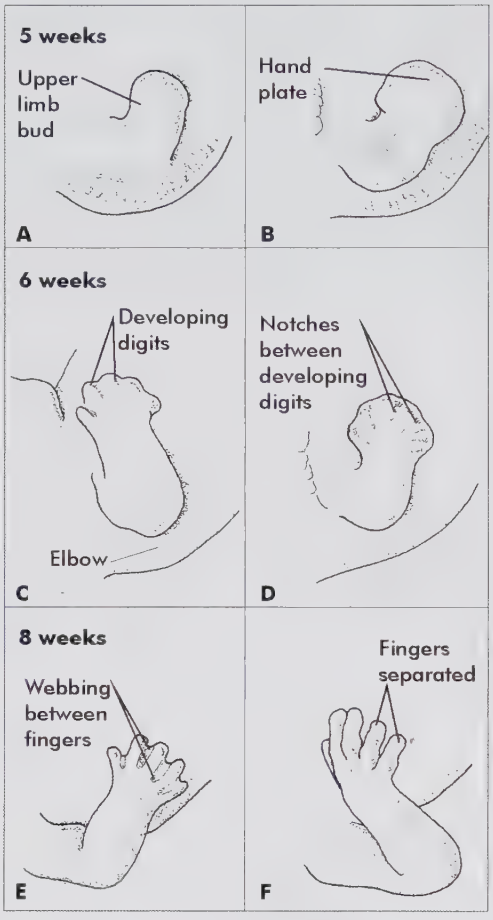

Figure 7.20 Development of upper limbs and digits

referred to as teratogenic agents and can include: irradiation, cytotoxic agents, viruses, alcohol, many medications (drugs), as well as air, water and food pollutants.

An agent that prevents cell reproduction is called an anti-mitotic agent, for example the medication thalidomide, which prevented the limb buds from developing into arms and legs in certain embryos.

While all these systemic developments are taking place, the embryo is taking on the fetal form and position in the uterus (see Figure 7.15). The flat, straight embryonic disc folds both longitudinally and transversely. This results in a cylindrical body-form, which curves, making the two ends (the head and the tail) approach each other so that the embryonic form then resembles the letter C. The curled embryonic form remains joined to the trophoblast by the connecting or body stalk, which is attached to the open end of the C – and which will become the umbilical cord. The yolk sac is incorporated into the embryonic form at this open end of the C. This uncurved portion will gradually be enclosed to form the anterior abdominal wall.

Gradually, the amniotic sac completely surrounds and encloses the embryo. The amniotic membrane covers the umbilical cord and is continuous with the fetal skin at the umbilicus (see Figure 7.17).

The umbilical cord (previously the body or connecting stalk), is attached into the centre of the developing placenta (chorion frondosum). The fetal side of the placenta is also covered with amniotic membrane. The development and growth of the embryo and the changes which occur, do so systematically and at specific times under normal circumstances.

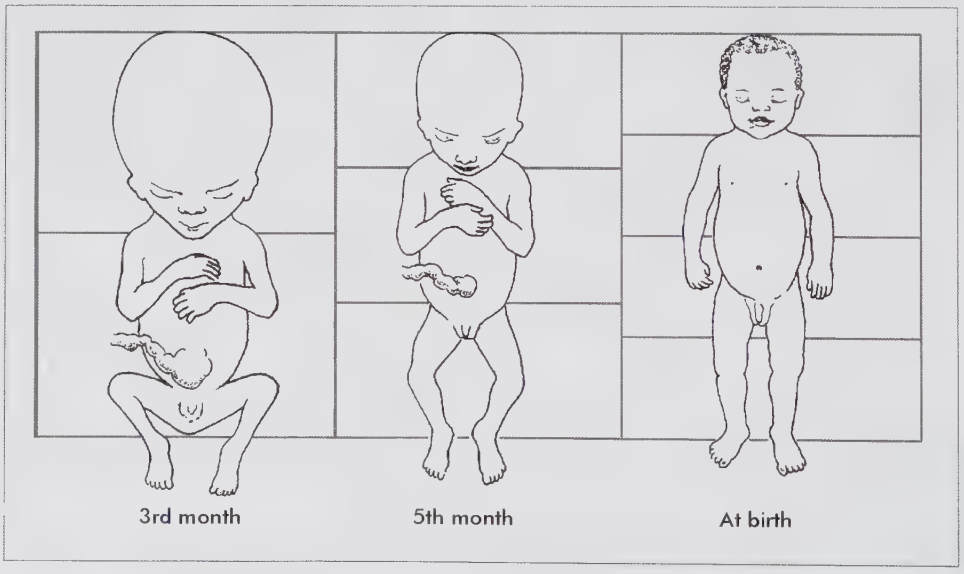

Figure 7.21 Proportional growth of the head in pregnancy

This facilitates the estimation of the stages of development in the embryo as shown in Table 7.2.

Figure 7.18 illustrates the development of organs in the embryo and Figure 7.20 gives the development of the fingers. The proportional growth of the head against the fetal body is explained in Figure 7.21.

The size and stage of development are of use where an embryo is aborted, so that the age of the embryo may be estimated, but an embryo of less than six weeks is very rarely seen as it is minute and not noticed in the blood clot.

Fetal heart beat

The cardiovascular system is the first system to function in the embryo. The primitive heart is contracting by the twenty-second day and the formation of the heart is essentially complete by the forty-second day (the sixth week after fertilisation).

The gestational sac within the uterus of the pregnant woman can be seen on ultrasound scan from four to five weeks after fertilisation, (that is, six to seven weeks from the first day of the last menstrual period (LMP)) and the heart can be seen beating by the seventh week.

The growth and development of the fetus

The fetal period is taken from the beginning of the ninth week after fertilisation to term (the end of the thirty-eighth week), or from the beginning of the eleventh week to the end of the fortieth week, after the first day of the last menstrual period (LMP).

By the beginning of the ninth week after fertilisation, the human embryo has developed into a recognisable human being and most of the body structures have already started to develop (see Figure 7.18). The fetal period is mainly concerned with the differentiation and growth of tissues and organs that have already appeared. For this reason, the fetus is far less vulnerable than the embryo to the harmful and deforming effects of teratogenic agents.

The transition from the embryonic to the fetal form is gradual, although the rate of body growth of the fetus is remarkable, especially between the ninth and sixteenth weeks.

There is also a significant gain in weight by the fetus in the third trimester, especially during the final month *in utero*.

Different fetuses will grow at different rates, blurring the findings of gestational age determined by ultrasound. A range of normal parameters are compared, to determine fetal growth and development (biparietal measure, femur length, abdominal circumference) (see Table 7.3). After the twentieth week of pregnancy the fetal growth parameters varies with 2 weeks until the thirtieth week and 3 weeks until the fortieth week.

Therefore, term, is the fortieth week from the first day of the last menstrual period and at term the average newborn baby is 500 mm (50 cm) long and weighs 3 400 g (3.4 kg).

Urinating, swallowing, hiccuping and peristalsis are all normal in the fetus.

Defecating, however, is not normal and may indicate periods of hypoxia, bringing about relaxation of the anal sphincter.

Breathing movements of the lungs are present so that the lungs are able to exhale and inhale when the baby is born. The lungs are inflated with fluid derived from the lungs and from the amniotic membrane at term, and this fluid has to be expelled at birth before it can be replaced by air.

Factors causing impaired fetal growth

The factors mainly responsible for fetal growth impairment are either directly acquired through the mother or are caused by an inefficient placenta, which is usually due to some maternal condition. Fetal causes are usually genetic. At birth babies with growth retardation are small for gestational age.

A summary of the causes of growth retardation are as follows:

- Placental insufficiency or impaired uteroplacental blood flow occurs.
- Maternal conditions such as hypertension, hyperpyrexia, chronic infections, and cardiac disease prevent the placenta efficiently transmitting nutrients from the mother to the fetus.
- Genetic factors and chromosomal aberrations. Babies born with Down's syndrome, achondroplasia and dwarfism are small-for-gestational birth.
- Smoking is known to affect the growth rate of the fetus because of its effect upon placental growth. The condition is worsened if the mother's diet is deficient.
- Alcohol and narcotic addiction can cause growth retardation, congenital abnormalities and addiction in the newborn.
- Infections and hyperpyrexia of the mother, for example viruses, such as rubella and some other pathogens such as *Treponema pallidum* can pass through the placental membrane and adversely affect fetal growth.
- In multiple pregnancy there is an increased nutritional burden on the mother for each additional fetus and the placenta and babies are smaller in size than a singleton.
- Maternal malnutrition. If the mother is lacking in certain necessary nutrients, the fetus will also be deprived.
- Prolonged pregnancy. It is widely believed that the placenta ages progressively towards the end of pregnancy. Thus, the longer the pregnancy lasts after term, the greater is the placental degeneration and therefore the greater is the risk of fetal hypoxia, together with intrauterine growth retardation and even fetal death. However, this view is not held by everyone.

Table 7.3

The growth and development of the fetus after nine weeks (bi-parietal diameter, mass and characteristics)

Age weeks	BPD mm	Average mass (gr)	Charactersitics
9		2	Eyelids closing or closed; head rounded
10		4	Intestine in abdomen; fingernails appearing; ossification centres have developed in most bones; urine is now excreted into the liquor amnii which is swallowed by the fetus
12	20	14	Sex distinguishable; neck well defined; the nasal septum and palate have fused
14	28	110	Head erect; lower limbs well developed
16	36	200	Ears stand out from head
18	40	320	Vernix caseosa present; toenails appearing; fetal movements present, which can be felt by the mother as quickening; the fetal heart can be heard on auscultation
20	48	460	Lanugo (body hair) visible; brown fat starts to form for heat production
22	54	630	Skin wrinkled and red; brain development occurring
24	60	820	Fingernails developed; body is lean; traces of surfactant present in lungs and respiration is now possible
26	64	1000	Eyes partially open; eyelashes present; slight breathing movements present
According to South African guidelines **The fetus is now viable**			
28	70	1300	Eyes open; hair on head plentiful; skin slightly wrinkled
30	74	1700	Toenails developed; body filling out; testes descending; pupillary light reflex is present
32	80	2100	Fingernails reach fingertips; skin pink and smooth
36	88	2900	Body plump; lanugo almost absent; toenails reach toetips; limbs flexed; grasp is firm; the circumference of the head and abdomen almost the same
38	92	3400	Prominent chest; breasts protrude; testes in scrotum or palpable in inguinal canals; fingernails extend beyond fingertips; ossification has progressed especially at ends of long bones
The fetus is at term			

Adapted from Chugleigh, P & Pearce, JM. 1995. *Obsetric ultrasound: how, why and when.* p 294. London: Churchchill Livingstone

The umbilical cord

The connecting or body stalk, which joins the inner cell mass to the trophoblast, develops into the umbilical cord, as explained in the development of the zygote. (See Figure 7.17 and 7.34)

The body stalk consists of mesoderm cells, which develop into fetal blood vessels contained within the umbilical cord.

These blood vessels transport nutrient-enriched fetal blood from the chorionic villi in the placenta, along the umbilical cord to the fetal heart and then return the nutrient-depleted fetal blood back to the placenta for replenishment.

Blood vessels in the umbilical cord (see colour illustration Figure 7.24, **C4**):

- *One umbilical vein*. This is a thin-walled, wide-bored blood vessel, which carries 85% oxygenated blood from the placenta to the fetus.
- *Two umbilical arteries*. These are thick-walled blood vessels with a narrower bore that carry de-oxygenated blood (only 50% oxygenated) from the fetus to the placenta.

This vein and these two arteries divide and narrow in the placenta until they are capillaries, where they then anastamose, making an unbroken circulation from the fetal heart, through the placenta and back to the fetal heart.

The arteries are usually wound loosely around the vein, along the length of the cord and the vessels are surrounded by a jelly-like substance called Wharton's jelly, which protects and supports the vessels. Wharton's jelly sometimes forms lumps, which are known as false knots (see Figure 7.37).

The outer sheath or covering of the umbilical cord is developed from the ectoderm cells of the amniotic membrane. At the placental end of the cord, the outer sheath is continuous with the amnion covering the fetal side of the placenta. At the umbilicus, the outer covering of the umbilical cord is continuous with the skin of the fetus.

At birth, the average diameter of the cord is 10–15 mm (1–1.5 cm) and the average length of the cord is 550–600 mm (55–60 cm). The cord should be inspected at birth to ensure that all three blood vessels are present, as the absence of an artery is often associated with a congenital abnormality.

Very rarely, four umbilical vessels (two arteries and two veins) can be present.

The membranes

Amnion and chorion

The amnion is also known as the amniotic membrane. The small cavity that appears in the ectoderm cells, between the embedding trophoblast and the inner cell mass at the end of the first week after fertilisation, is the beginning of the amniotic cavity or sac. The membrane encompassing this cavity or sac, which is formed from these ectoderm cells, is known as the amnion. The sac becomes filled with fluid that is derived from the maternal blood and which diffuses through the trophoblastic cells. This fluid is known as the amniotic fluid or the liquor amnii.

The amniotic sac increases in size until it completely surrounds the embryo, which then floats freely in the amniotic fluid. The umbilical cord, which is attached to the fetus at the umbilicus, is the link between the fetus and the placenta. The other end of the umbilical cord is inserted into the centre of the placenta, which is attached to the decidua of the uterine wall. As the amniotic sac swells in the chorionic cavity, the amnion ensheathes the umbilical cord, forming its outer covering. The amnion also comes into contact with the fetal side of the placenta and with the chorionic membrane (the chorion) and so completely fills the chorionic cavity by the twentieth week after fertilisation. Where the amnion comes into contact with the chorion, they adhere. However, after the delivery of the placenta and membranes, these two membranes can be separated from each other, up to the insertion of the cord into the placenta.

These two membranes, the amnion (near fetus) and the outer chorion (near decidua) (the amniochorionic membrane), form the fetal sac (see colour illustration Figure 7.22, **C3**).

The fully developed amnion is translucent and smooth and is a relatively tough membrane. This membrane usually ruptures at birth, allowing liquor amnii to escape, but, should it not rupture, and the baby is born with the amnion over its head, it could suffocate the baby. This is known as being born with a *caul*. (According to legend, this caul is supposed to have magical or divining properties and is greatly prized in certain cultures.)

The chorion is opaque and torn more easily. It is on the side of the uterus. If a piece of amnion or chorion remains in the uterus after birth it can cause massive bleeding.

Amniotic liquor

The fluid that fills the amniotic sack is also known as the amniotic fluid. It is normally a clear, pale straw-coloured, alkaline fluid (pH 7.2).

The origin of the amniotic fluid is not clearly understood, but is thought to be formed mainly by fluid diffusing through the chorionic and amniotic membranes, from the maternal blood in the decidua of the uterus. Some fluid is also thought to diffuse through the umbilical cord.

The fetus passes urine into the liquor. The fetus also swallows the liquor, which is then absorbed from the fetal intestines, passed into the fetal circulation and so back to the placenta and the maternal circulation. Half the volume of fluid contained within the amniotic sac is exchanged every 90 minutes or the whole volume every three hours. The amount of liquor in the amniotic sac increases at a rate which is fairly predictable, and is approximately as follows:

- 10 weeks: about 35 ml
- 10–20 weeks: a rapid increase in volume to about 300 ml
- 20–30 weeks: doubles to about 600 ml
- 30–38 weeks: increases slowly to about 1 000 ml
- after 38 weeks: decreases to about 600 ml at term (40 weeks).

Two abnormal conditions related to the volume of amniotic fluid are:

- *Polyhydramnios*. Too much liquor or more than 1 500 ml. Polyhydramnios is often associated with abnormal conditions

such as multiple pregnancy, or where the fetus cannot swallow, for instance, a fetus with anencephaly or with oesophageal atresia (see Chapter 23).

- *Oligohydramnios*. Too little liquor or less than 300 ml. Oligohydramnios is usually associated with conditions where the fetus cannot pass urine, such as congenital absence of the kidneys or urethral blockage. It is often associated with intrauterine growth retardation due to placental insufficiency. There is also a marked reduction of amniotic fluid in prolonged pregnancies and of course, in circumstances where the membranes have ruptured and the liquor has drained out (see Chapter 23).

The composition of the amniotic fluid

Amniotic fluid is similar to that of extracellular fluid and is as follows:

- 98% water
- 2% solids, made up of:
  - electrolytes
  - proteins and derivatives (creatinine, urea, uric acid)
  - glucose
  - fats; lipids (phospholipids and cholesterol)
  - hormones (HCG, HPL, oestrogens and progesterone, prolactin)
  - enzymes (all those known to exist in the human body)
  - pigments (bilirubin in early pregnancy and in prematures, which disappears as the fetal liver matures after 30 weeks)
  - exfoliated matter from the amnion and fetus (hair, vernix, cells from the skin, mouth and urinary tract, etc.)
- prostaglandin, levels of which increase abruptly during labour.

The functions of the amniotic fluid

During pregnancy amniotic fluid acts mainly to form a buffer between the fetus and the uterus to permit symmetrical growth of the embryo by equalising pressures and to prevent the amnion from adhering to the embryo and later the fetus. It also cushions the fetus from impacts to the maternal abdomen and maintains the fetus at a constant temperature. The fluid allows the fetus to move freely for the development of muscles and, together with the intact amnion, protects the fetus from infection.

During labour the amniotic fluid equalises the compression on the fetus caused by the uterine contractions, prevents excessive diminution of the placental site and consequent hypoxia of the fetus when the membranes rupture, and the fluid flushes the birth canal, and so helps to reduce the likelihood of the fetus becoming infected during birth.

The amniotic fluid is swallowed by the fetus and forms merconium in the colon. The fetus also breathes the fluid into the lungs and the lungs develop. When the fluid is diminished or lost, then hypoplastic (under developed lungs) may be present.

The placenta

When the zygote or conceptus implants itself, the uterine decidua is divided into three regions or areas as follows:

- The decidua basalis (see Figure 7.15) is that part of the decidua into which the trophoblast first embeds and which lies under or is at the base of the zygote. The decidua basalis, together with the chorion frondosum, will eventually develop into the placenta.
- The decidua capsularis (see Figure 7.15) is that part of the decidua that grows over or encapsulates the zygote. As the embryo develops and grows inside the trophoblast, the decidua capsularis, which encircles the trophoblast, is stretched outwards into the uterine cavity. This stretching thins out the decidua capsularis and also the chorion laeve (smooth chorion) within it, forming two membranes, which gradually come into contact with the remaining decidua of the uterine cavity, the decidua vera.
- The decidua vera or true decidua is that part of the uterine decidua that is not affected during the initial implanting of the trophoblast. However, as the conceptus grows and pushes the decidua capsularis and chorion laeve outwards, these eventually come into contact with the decidua vera and by 12 weeks the uterine cavity is completely filled.

The decidua capsularis and the decidua vera then fuse and the decidua capsularis disappears. The chorion laeve, which is made up of atrophied chorionic villi, remains and becomes the chorionic membrane or the chorion (see Figure 7.17).

The placenta is the connecting link between the baby and the mother. It is a circular or disc-shaped organ, with the chorionic membrane extending outwards from its edges to form a sac. The umbilical cord is attached to the centre of the fetal side of the placenta. The chorionic sac and the fetal side of the placenta are lined with the amniotic membrane, which is filled with amniotic fluid in which the fetus floats.

The fetus, together with the placenta, the umbilical cord, the membranes and the liquor, are referred to as the feto-placental unit. The baby is a true parasite, living within and deriving all its nourishment from and through the mother. Regular growth will take place and the baby will thrive until term, when, on delivery, it should present as a normal newborn baby.

All the nourishment that the baby derives from the mother is obtained through the placenta, which permits exchange of nutrients from the maternal bloodstream, through the placental membrane and into the fetal bloodstream.

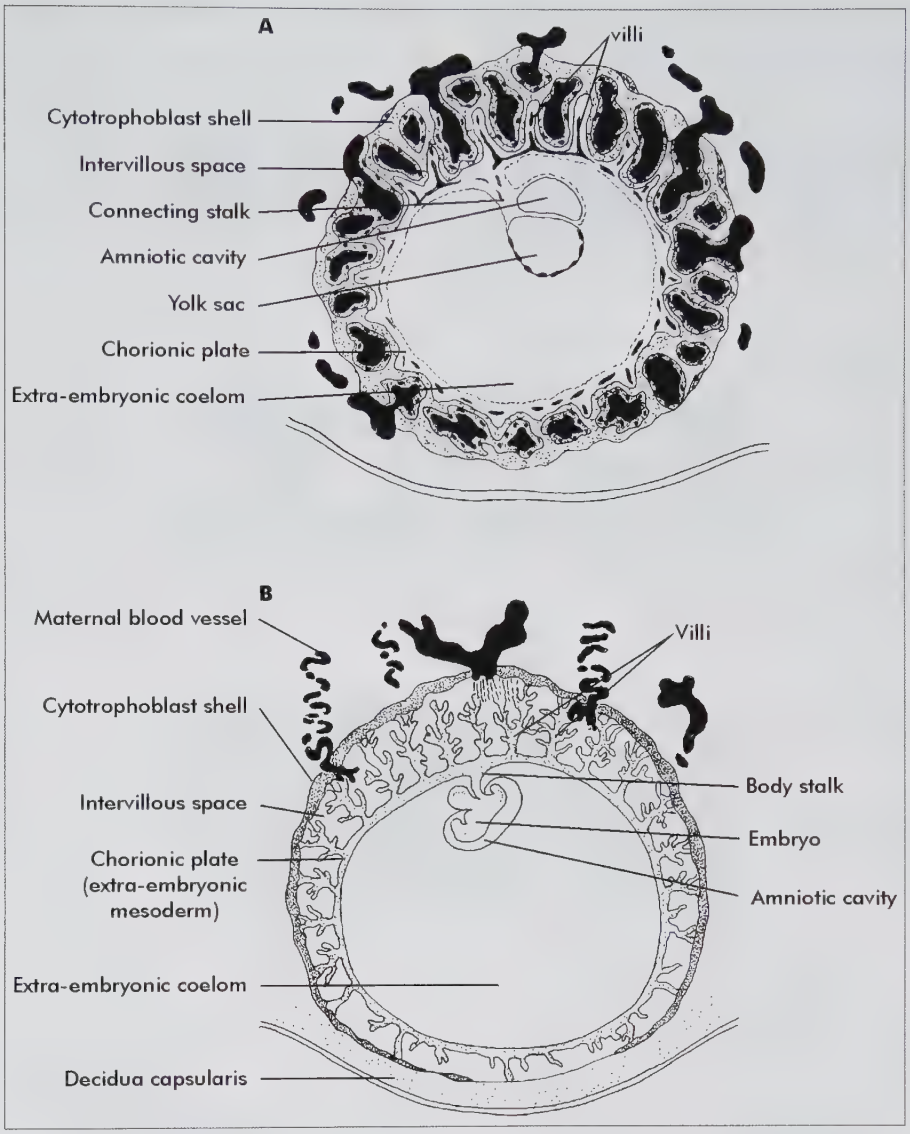

Figure 7.23 Radial appearance of villi

In this way, the maternal blood and the fetal blood do not come into contact with each other at all, unless there is an abnormal breakdown in the placental membrane. The mother and the fetus each have their own separate blood circulations and can have different blood groups.

Should the placenta not be as efficient as it is meant to be, the fetus will not receive all the necessary nourishment. This could also occur if the mother's intake of nourishment is insufficient or if the mother has an abnormal condition, preventing the nourishment from either reaching the placenta or from penetrating the placental membrane.

The placenta and its chorionic membrane (the chorion) are continuous with one another and develop from the outer trophoblast layers of the zygote, which are the precursors of the chorionic villi. The primary chorionic villi develop towards the end of the second week after fertilisation, and as they grow, they become known as secondary chorionic. By the end of the third week they have become fully developed (tertiary) chorionic (see Figure 7.23). As explained previously in the development of the zygote, the outer syncytial layer of these villi produces a proteolytic enzyme, which has the ability to erode the maternal decidua and blood vessels.

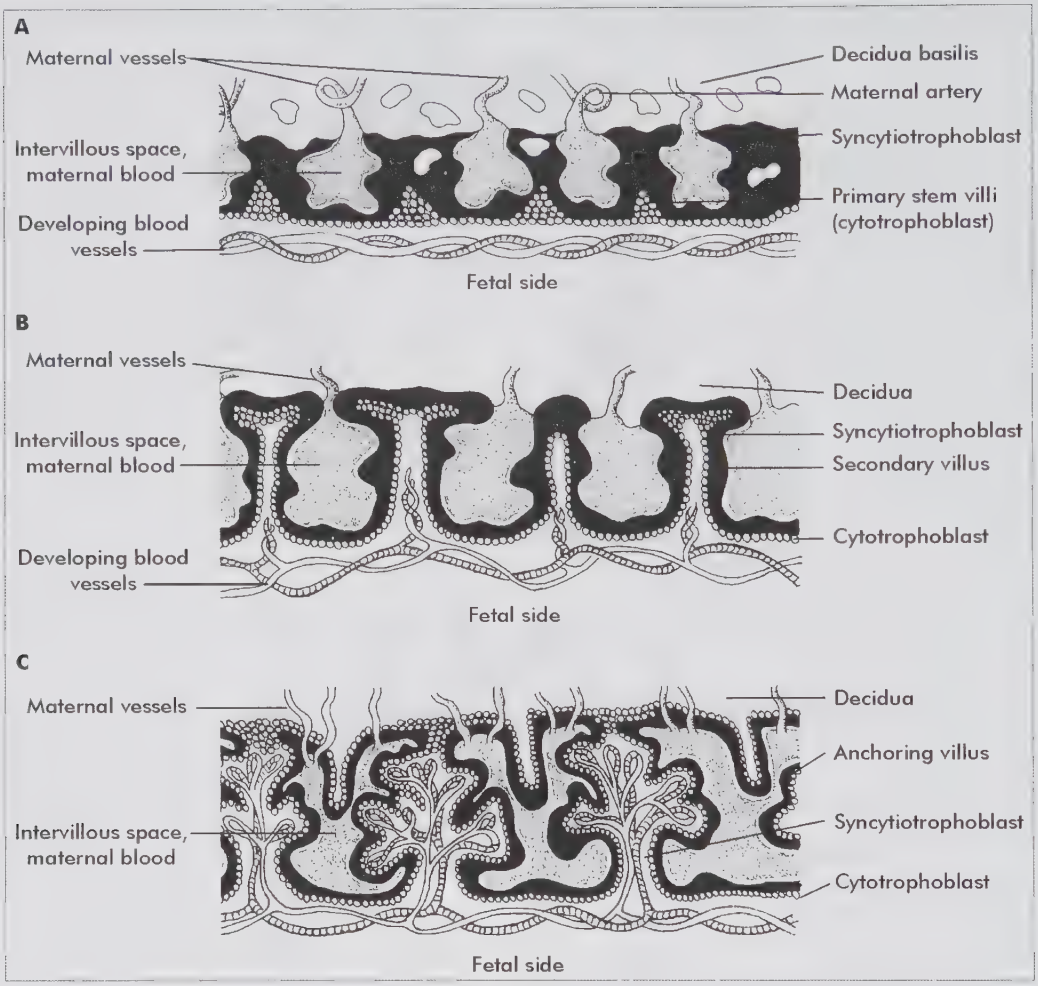

Figure 7.25 Development of intervillous spaces

As these chorionic villi encroach into the maternal decidua, those villi that are situated in the decidua basalis are well nourished and they enlarge, branch out extensively and increase in size. (See colour illustration Figure 7.26, **C5**.) This area of prolific growth of the chorionic villi is known as the chorion frondosum (leafy chorion) and this becomes the fetal portion of the placenta. The actual decidua basalis into which this chorion frondosum embeds itself becomes the maternal portion of the placenta. This maternal side of the placenta is divided into lobules or cotyledons by deep furrows or sulci. However, the chorionic villa, which are embedded in the decidua capsularis are not well nourished, and these villi shrink and atrophy, leaving a bare area, which is known as the chorion laeve (light chorion), and which becomes the chorionic membrane or the chorion. When the decidua is eroded, some of the villi attach themselves firmly to the connective tissue of the decidua and are known as anchoring villi. Most of the villi, however, are not attached to the maternal decidua and the ends of these villi are free-floating.

When the maternal arterioles are eroded, the maternal blood spurts into the spaces between the chorionic villi, the intervillous spaces (see Figure 7.25), and the free-floating villi are bathed in maternal blood, allowing an exchange of materials through the placental membrane. These open maternal blood vessels are known as the *maternal blood sinuses* (see Figure 7.27).

The blood in the intervillous spaces, besides containing oxygen and nutrients from the maternal circulation, also contains fetal waste products, and these are absorbed into the maternal

circulation via the eroded maternal venules. The circulation in these intervillous spaces is slow and sluggish, allowing a free exchange of nutrients and gases by the processes of osmosis and diffusion through the placental membrane. A small percentage of substances is actively transported through the placental membrane by enzymatic reaction and also by pinocytosis (similar to phagocytosis) (see Figure 7.27).

The layers of the trophoblasts

(See Figure 7.13.) From the third week after fertilisation until about 20 weeks, the trophoblasts consists of four layers of cells:

- syncytiotrophoblast or outer layer of syncytial cells
- cytotrophoblast or second layer of cytotrophic cells
- mesoblast cells or connective tissue core, surrounding the fetal capillaries
- endothelium of each fetal capillary.

After the twentieth week, however, the trophoblasts may only consist of two or three layers, as the outer layers, the syncytiotrophoblast and the cytotrophoblast, become progressively thinner.

7.8 The placenta and hypertension in pregnancy

There is growing evidence that the infiltration of the trophoblast or the pathological infiltration of the trophoblast into the desidua is linked to the development of pregnancy-induced hypertension (PIH) after 20 weeks of gestation.

Towards the end of pregnancy, as the placenta begins to age, the surfaces of the villi are covered with fibrinoid material, which may decrease the permeability of the membrane. (See Chapters 22, 23 and 45.)

This membrane allows certain substances to pass through from the mother to the fetus, but also prevents certain substances of larger molecular size from passing through to the fetus and this is known as the placental barrier. The efficiency of the barrier depends upon the permeability of the placental membrane at a given time and on the size of the molecules present at that time.

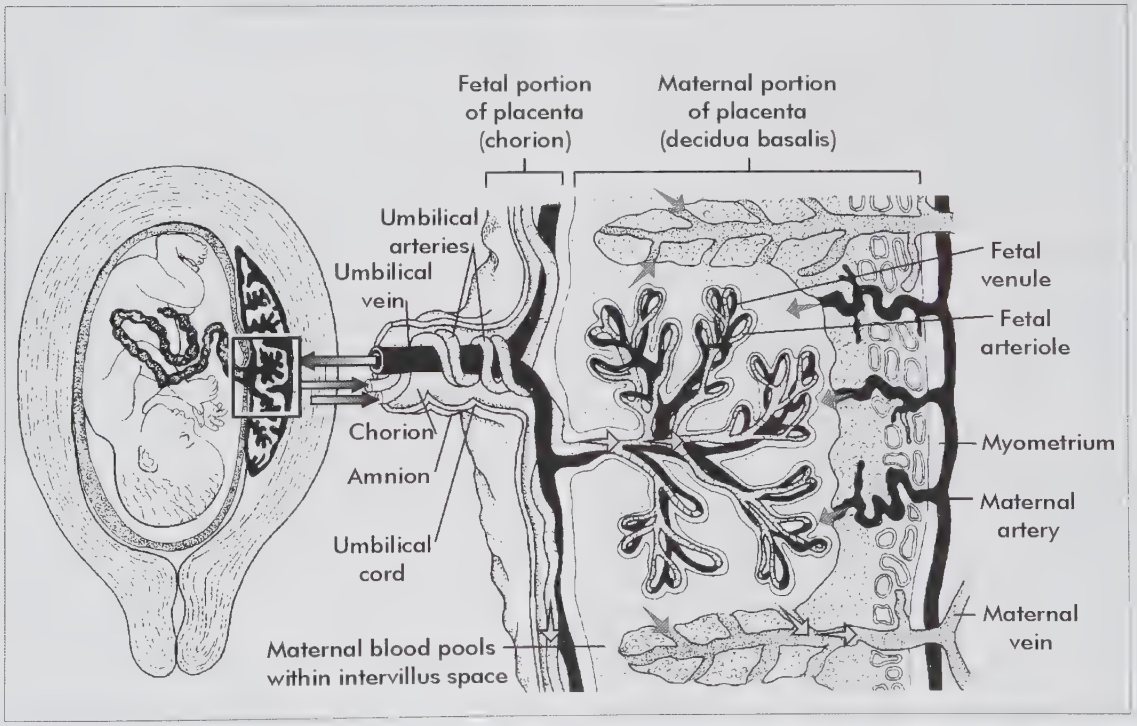

Figure 7.27 Placental circulation

The substances that do pass through the placental barrier may not all be of benefit to the fetus, and some may even cause fetal abnormalities.

Substances that pass through the placental membrane:

- gases: oxygen, carbon dioxide, carbon monoxide
- nutrients: water, glucose, amino acids, vitamins and mineral salts
- hormones: thyroxin, conjugated steroids, testosterone, some synthetic progestins
- electrolytes: these pass freely through the membrane, so that intravenous electrolytes given to the mother will affect the water and electrolyte status of the fetus
- antibodies: IgG gamma globulins reach the fetus and provide passive immunity. However, a woman who is rhesus (Rh) factor negative, whose fetus is Rh positive, will produce antibodies to the fetus's Rh factor, which can cause breakdown of fetal red blood cells
- medications: most medications pass through the membrane and some can adversely affect the embryo and later the fetus. In early pregnancy, the development of the embryo can be affected, for example by thalidomide. Certain sedatives given during labour, for example morphine and barbiturates, can cause depressed respiration of the newborn baby
- alcohol and narcotics
- infectious agents: particularly viruses, which are extremely small, for example the herpes and rubella viruses. *Treponema pallidum*, which causes syphilis, is able to penetrate the placental membrane after the first trimester
- waste products: of fetal metabolism, such as urea.

Placental functions and activities

All the functions and activities of the placenta are not yet fully understood, but a normal, functioning placenta is essential for fetal metabolism and well-being (see Figure 7.27).

Respiration

The placenta acts as the respiratory organ for the fetus. Oxygen is transferred, through the placental membrane, from the mother's blood in the intervillous spaces, to the fetal blood and circulation. This is essential for the development, growth and survival of the fetus. As a result of this anabolism (building-up process) and catabolism (breaking-down process), the carbon dioxide level rises in the fetal blood. The carbon dioxide is then transported by the fetal circulation back to the placenta and transferred across the placental membrane into the maternal blood circulation. It is then exhaled via the maternal lungs.

Nutrition

Nutrients necessary for normal fetal development, growth and survival, such as glucose, amino acids, vitamins and mineral salts, are transferred from the mother, across the placental membrane, to the fetus.

Excretion

Waste products, such as creatinine, urea, uric acid, bilirubin, forming as a result of the metabolism taking place in the fetal body, are transferred from the fetal bloodstream, across the placental membrane, to the mother's blood circulation for excretion.

Endocrine

The placenta is a temporary endocrine organ. The hormones produced by the placenta are essential to the maintenance of pregnancy and are responsible for the preparation of the maternal body for pregnancy, labour and feeding the newborn baby.

The major hormones produced by the placenta are:

- human chorionic gonadotrophin
- oestrogens
- progesterone
- human placental lactogen.

Barrier

The placental membrane is a barrier against harmful agents, especially in the first trimester. However, it is not as effective as was previously thought, and many substances are able to pass from the mother's blood into the fetal blood.

Maternal and fetal erythrocytes are too large to pass through this membrane, although it is thought that a few fetal blood cells do escape into the maternal blood but are instantly destroyed before antigens are made against them. However, during an abortion or in other instances when the chorionic villi are damaged, this barrier can be broken.

Many bacteria are too large to penetrate this membrane.

Enzyme function

The placenta contains all the normal body enzymes. These are necessary for the synthesis of proteins:

- the functioning of fetal tissue, such as respiratory enzymes
- steroid conversion, to produce progesterone and oestrogens.

The placenta at term

(See colour illustration Figure 7.24, **C4**.) After the birth of the newborn, the placenta and membranes are delivered, and it is essential that they are examined carefully to ensure that they are normal and that no part of either the placenta or membranes

has remained behind in the uterus. Should any of this tissue be retained, the uterus would not be able to contract properly and postpartum bleeding could occur. This retained tissue would also make the patient more susceptible to infection.

The midwife must be able to recognise a normal placenta at term and must know what abnormalities can occur.

The umbilical cord connects the fetus with the placenta. It is covered with amnion and is usually inserted into the centre of the fetal surface of the placenta. (See colour illustration Figure 7.29, **C6.**) The length is about 550 mm (55cm). The average thickness of the cord is about 15 mm (1.5 cm). It has three blood vessels. There should be one large, thin-walled vein and two smaller, thick-walled arteries. Wharton's jelly can be seen surrounding the vessels.

A normal placenta is shaped like a disc with an almost even thickness throughout. The diameter is about 200 mm (20 cm). The central thickness is about 25 mm (2.5 cm). It has a mass of approximately one sixth of the baby's mass, averaging 500 g.

It has two surfaces, which are called the maternal and the fetal surfaces:

- *The maternal surface.* (See colour illustration Figure 7.28, **C6.**) This surface is composed of the decidua basalis and has thousands of chorionic villae containing fetal blood, which are embedded in the decidua basalis. Afer maternal blood is present in the intervillious spaces, it has a deep red colour. The maternal surface is divided into 16–20 lobules or cotyledons, which are separated by deep grooves or sulci.

- *The fetal surface.* (See colour illustration Figure 7.29, **C6.**) This surface faces the fetus during pregnancy, and has the umbilical cord inserted into it. It is covered with the amniotic membrane (the amnion), which gives it a smooth shiny appearance. The amnion can be stripped away from the fetal surface, up to the insertion of the cord. Fetal blood vessels can be seen radiating from the insertion of the umbilical cord, out towards the edges of the placenta. These blood vessels are branches of the umbilical vein and the two umbilical arteries, and as they branch, they dip into the placental tissue and become smaller as they approach the placental edge.

  The two membranes attached to the placenta are the chorion and the amnion.

7.8 Abnormalities of the placenta, membranes and cord

From time to time, certain placental, membrane and cord abnormalities are found. Some of these abnormalities are of significance because they pose a danger to the mother or to the fetus. An abnormal placenta may also be an indication of an abnormal maternal or fetal condition.

Placenta

Placenta succenturiate

(See colour illustration Figure 7.30, **C7.**) An accessory lobe of placental tissue has developed separately from the placenta and there are fetal blood vessels running off the edge of the placenta, through the chorion, to and from the succenturiate lobe. This is a relatively common abnormality, where a group of chorionic villi, which should have atrophied and become part of the chorion laeve, have instead been nourished and have grown and hypertrophied.

This abnormality poses a danger, because this lobe may be retained in the uterus after the delivery of the placenta and could cause severe postpartum haemorrhage and infection.

On inspection, a second hole may be noticed in the chorion, and after the amnion has been stripped from the chorion and from the fetal side of the placenta, blood vessels can be seen running off the edge of the placenta, through the chorion and ending at the hole.

If signs of a placenta succenturiate are found, they should be recorded and reported to a doctor immediately.

Placenta bipartite or tripartite

(See colour illustration Figure 7.31, **C8.**) This is a very rare condition, in which the placenta has developed as two or even three separate lobes. The blood vessels from the separate lobes unite at one umbilical cord. Remember: in a multiple pregnancy, there will be a separate cord for each baby.

Placenta circumvallata

(See colour illustration Figure 7.32, **C9.**) The chorion (and sometimes the amnion as well) has folded back upon itself around the edge of the placenta, before continuing over the edge of the placenta to form the fetal sac.

This fold may be firmly attached to the placenta, or the examiner may be able to run a finger around the placenta, under the fold. The danger of this placenta is that the chorion or part of it, can become detached from the edge of the placenta and can be retained in the uterus.

Hydatidiform mole (gestational trophoblastic disease)

This is a developmental abnormality of the trophoblast, occuring in the first trimester where there is a vesicular change in the chorionic villi. The chorionic villi become swollen and cystic, like small grapes, and proliferate greatly. No fetal blood

vessels develop in these cysts and consequently the zygote is not nourished and it dies and is absorbed. The pregnancy usually ends in a spontaneous abortion before 20 weeks of pregnancy.

Placental infarcts

True infarcts of the placenta are areas of necrosis, where the chorionic villi have been damaged, usually due to vasospasm of the maternal circulation and the areas around these villi have become calcified. This makes the affected parts of the placenta incompetent and if severe, causes placental insufficiency. The placenta is usually small and thin and instead of the usual deep red colour, large parts of the placenta have a whitish, anaemic appearance.

Perivillous fibrin deposits may be found in the placenta, due to haemodynamic turbulence within the intervillous spaces. These tend to occur in placentae with a particularly good maternal uteroplacental blood flow and this is part of the normal progressive functioning (ageing) of the placenta. On the maternal surface they are seen as tiny, light-greyish, 'gritty' deposits, while on the fetal surface they appear as small white patches.

The placenta may present with a bruised, hollowed-out area, after the removal of a very dark red blood clot. This indicates that there had been an earlier retroplacental bleed, which could have been caused by either placental abruption or placenta praevia.

Placental colour

A large pale placenta may indicate that the mother has diabetes mellitus. On the other hand, a large pale, watery placenta can be an indication of hydrops fetalis due to Rhesus isoimmunisation or due to some pathological condition of the fetal kidneys or pituitary gland or to maternal syphilis.

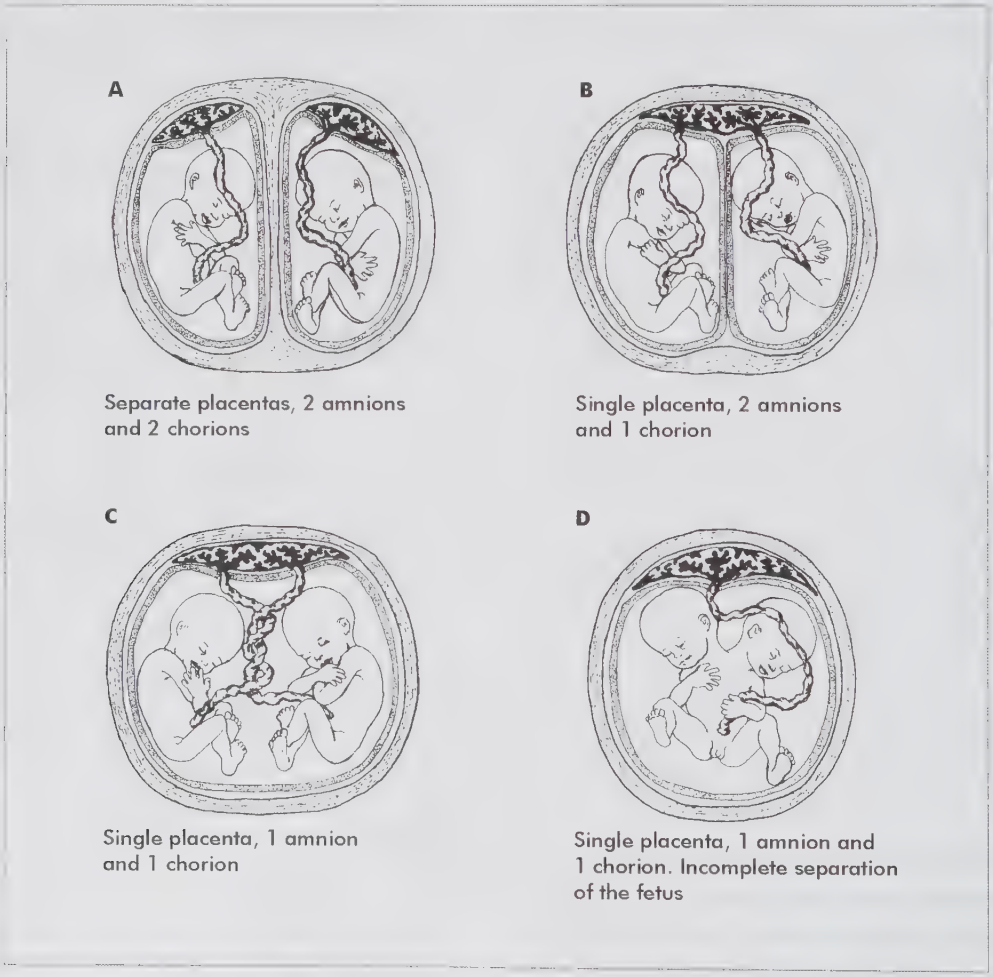

Figure 7.33 Multiple pregnancy

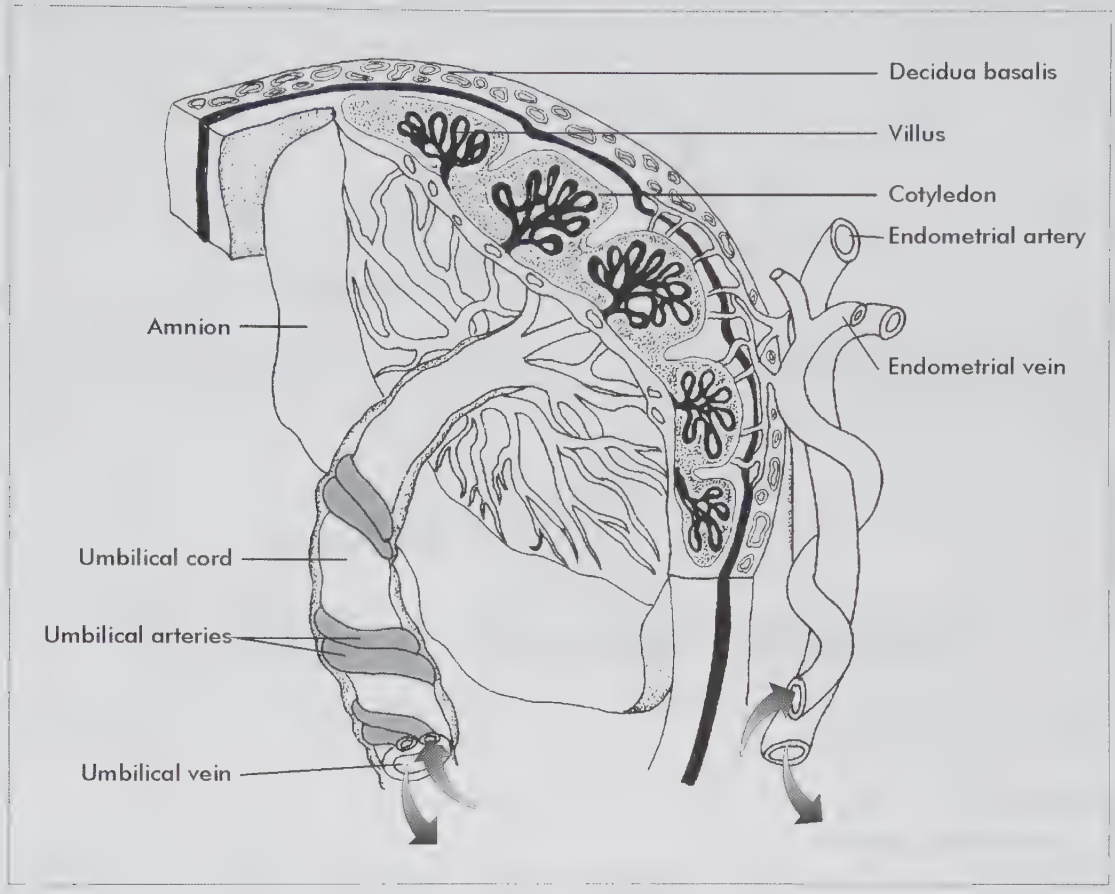

Figure 7.34 The umbilical cord

A meconium-stained (yellow) placenta and cord is caused by meconium being passed *in utero*, for example in intrauterine growth impairment due to a period or periods of fetal hypoxia. Yellow staining can also be due to high levels of bilirubin in the liquor amnii caused by Rhesus isoimmunisation.

Placenta accreta, increta and percreta

This is a condition where the trophoblastic villi have penetrated through the basal layer of the decidua and become attached to the myometrial cells (placenta accreta). In some instances, the villi have penetrated the myometrial cells (placenta increta) or have even penetrated through to the serosal surface of the uterus (placenta percreta). This condition will usually result in retention of the placenta and will necessitate surgical intervention.

Haemangiomata of the placenta

This is the only common non-trophoblastic tumour of the placenta and occurs in about 1% of all placentae. Haemangiomas are usually small and single, but may occasionally be large or multiple. The vast majority are not visible on external examination, but uncommonly large haemangiormas are most frequently seen as bulging protuberances on the fetal surface of the placenta. Occasionally, they are found on the maternal surface where they may replace an entire lobe or they are found in the membranes, where they may be attached to the placenta by a vascular pedicle. Most of the haemangiomata are of no clinical importance, but those measuring more than 5 cm in diameter may be associated with maternal or fetal complications such as polyhydramnios, fetal hypoxia, intrauterine growth restriction (IUGR) and even intrauterine death.

Placenta venestra

In this condition, almost the entire chorionic membrane is covered with thin, but functioning placental tissue. The thickness of the placental tissue is in inverse proportion to its area.

This means that almost the entire decidual lining will be expelled with the placenta after delivery and could therefore

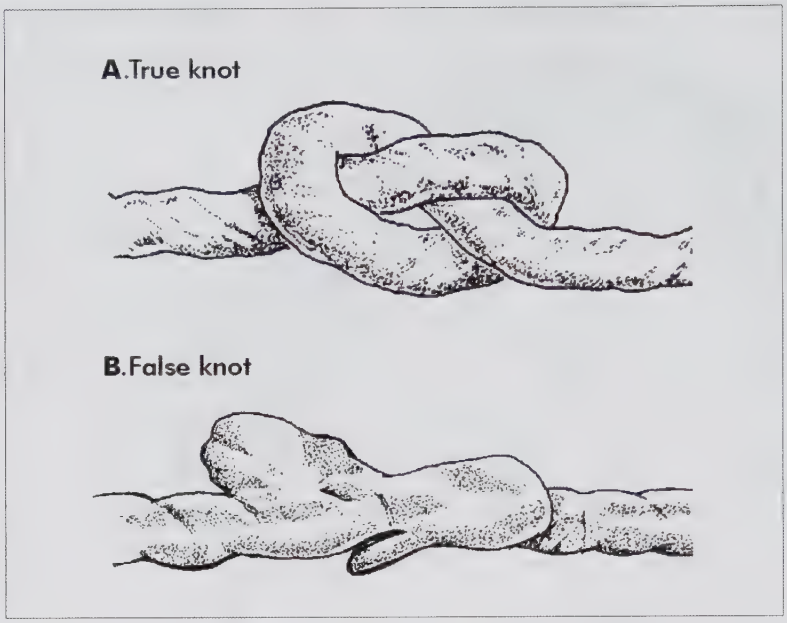

Figure 7.37 True knot (A) and false knot (B)

result in postpartum haemorrhage (see Figure 7.33 for variations of the placenta in a multiple pregnancy).

Abnormalities of the cord

Battledore insertion of the cord

(See colour illustration Figure 7.35, **C9.**) If the cord is not inserted into the centre of the placenta but to one side, it is termed a lateral insertion. However, should the cord be inserted at the very edge of the placenta, it is called a battledore insertion, because it resembles the racquet used in the ancient game of battledore and shuttlecock (the modern version is badminton).

Placenta velamentosa

(See colour illustration Figure 7.36, **C10.**) When the cord is inserted into the membranes instead of into the fetal surface of the placenta, it is known as a velamentous insertion of the cord. In this type of placenta, the vessels branch from the insertion of the cord and then run through the chorion to and from the placenta. This can be dangerous to the fetus during labour, as these vessels may lie over the cervical os and therefore in front of the presenting part of the fetus. This is termed a vasa praevia (vessels in front).

Vasa praevia

With a placenta velamentosa and the fetal blood vessels from the umbilical cord lying in front of the presenting part during labour, the danger is that as the membranes rupture, these vessels may also be torn or severed. This is a very rare condition, but should it occur, it would cause a loss of fetal blood.

Amniotic bands

Owing to a lack of amniotic fluid, the fetus may come into contact with the amniotic membrane. The membrane may then become attached to and form a band of amnion around a limb. This can result in badly deformed limbs and may even result in the amputation of a fetal hand, a foot or a whole limb.

A short cord

A short cord is any cord less than 400 mm, but could be as short as 200 mm. The dangers of a short cord include the possibility that it could delay or even prevent the descent of the fetus during labour, there could be early separation of the placenta, causing fetal anoxia, or the cord may snap, which could result in fetal anoxia, loss of fetal blood and a retained placenta.

A normal or long cord that is wound around the fetus, leaving only a short free end, would present the same dangers as a short cord.

A very long cord

Cords of 1 500 mm have been recorded. Long cords may become wound around any part of the fetus, and may even be wound two or three times around the neck of the fetus at birth. Should the cord be wound tightly around some part of the fetus, this could cause a reduced blood flow to the distal

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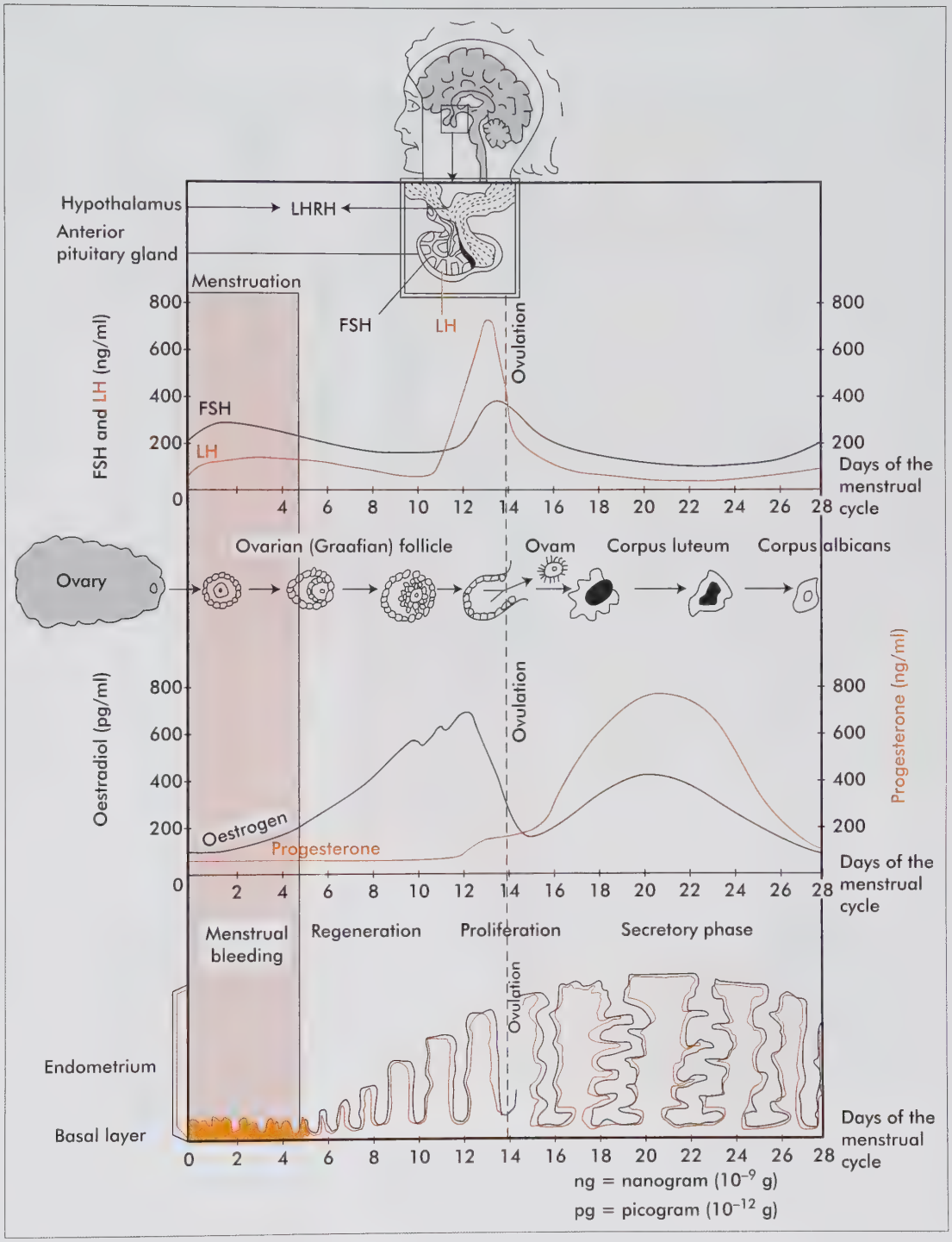


Figure 6.1 The menstrual cycle
Source: Sellers, P.M. *Midwifery*. 1993. Cape Town: Juta & Co

Figure 7.19 Organogenesis and fetal development
Source: Sellers, P.M. *Midwifery*. 1993. Cape Town: Juta & Co

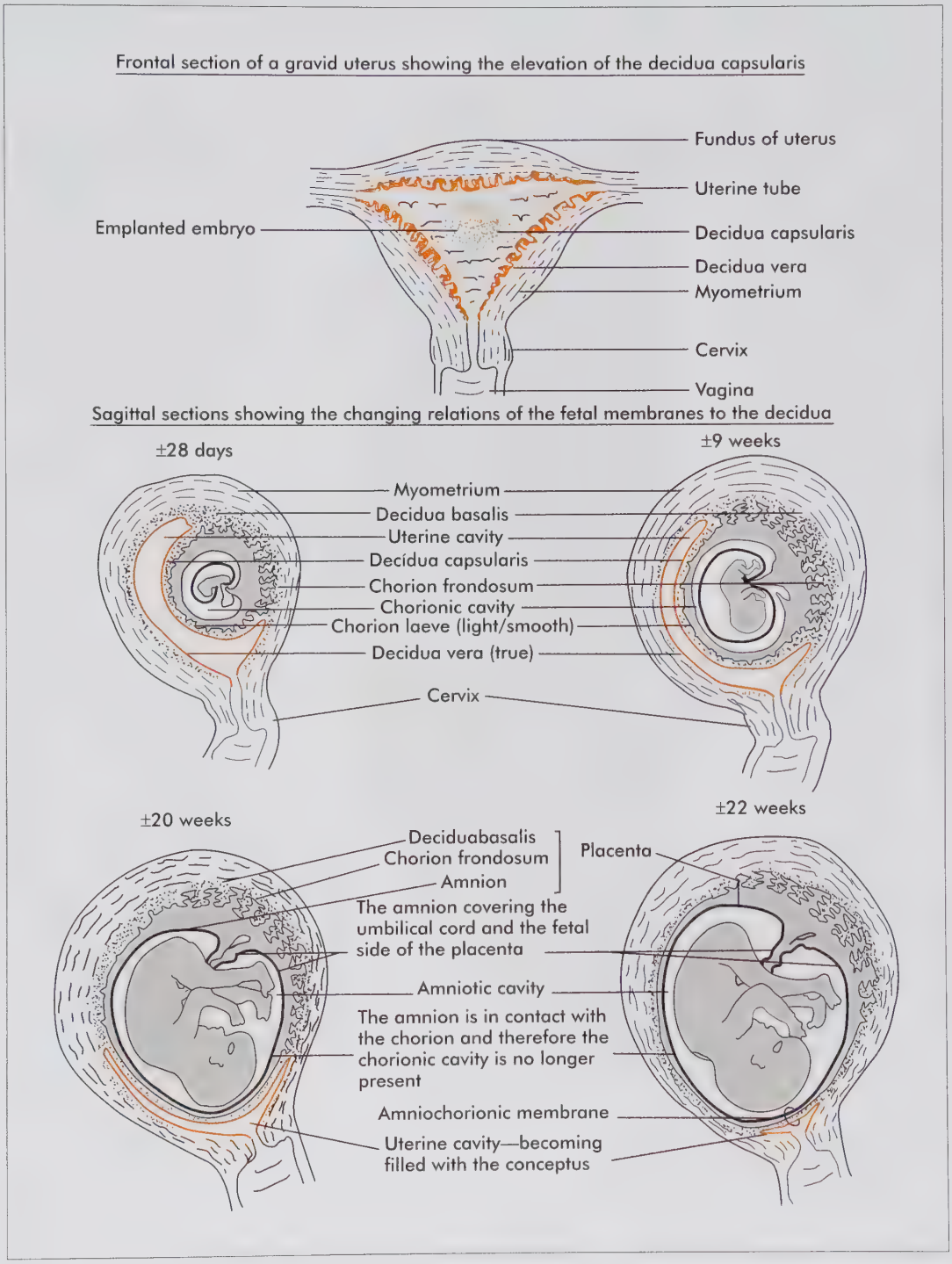


Figure 7.22 A gravid uterus showing the changing relations of the fetal membranes to the decidua
Source: Sellers, P.M. *Midwifery*. 1993. Cape Town: Juta & Co

Schematic drawing of a section through a full-term placenta, showing (1) the relation of the villous chorion (fetal placenta) to the decidua basalis (maternal placenta), (2) the fetal placental circulation and (3) the maternal placental circulation. Maternal blood flows into the intervillous spaces in funnel-shaped spurts, and exchanges occur with the fetal blood as the maternal blood flows around the villi. The inflowing arterial blood pushes venous blood out into the endometrial veins, which are scattered over the entire surface of the decidua basalis. Note that the umbilical arteries carry deoxygenated fetal blood (shown in blue) to the placenta and that the umbilical vein carries oxygenated blood (shown in red) to the fetus. Note that the cotyledons are separated from each other by decidual septa of the maternal portion of the placenta. Each cotyledon consists of two or more main stem villi and their many branches. In this drawing only one main stem villus is shown in each cotyledon, but the stumps of those that have been removed are indicated. (Based on Ramsey, E. M.: The placenta and fetal membranes; *in* Greenhill, J. P. (Ed.): *Obstetrics*, 13th ed. Philadelphia W. B. Saunders Company, 1965.)

Figure 7.24 Placental circulation at term
Source: Sellers, P.M. *Midwifery*. 1993. Cape Town: Juta & Co

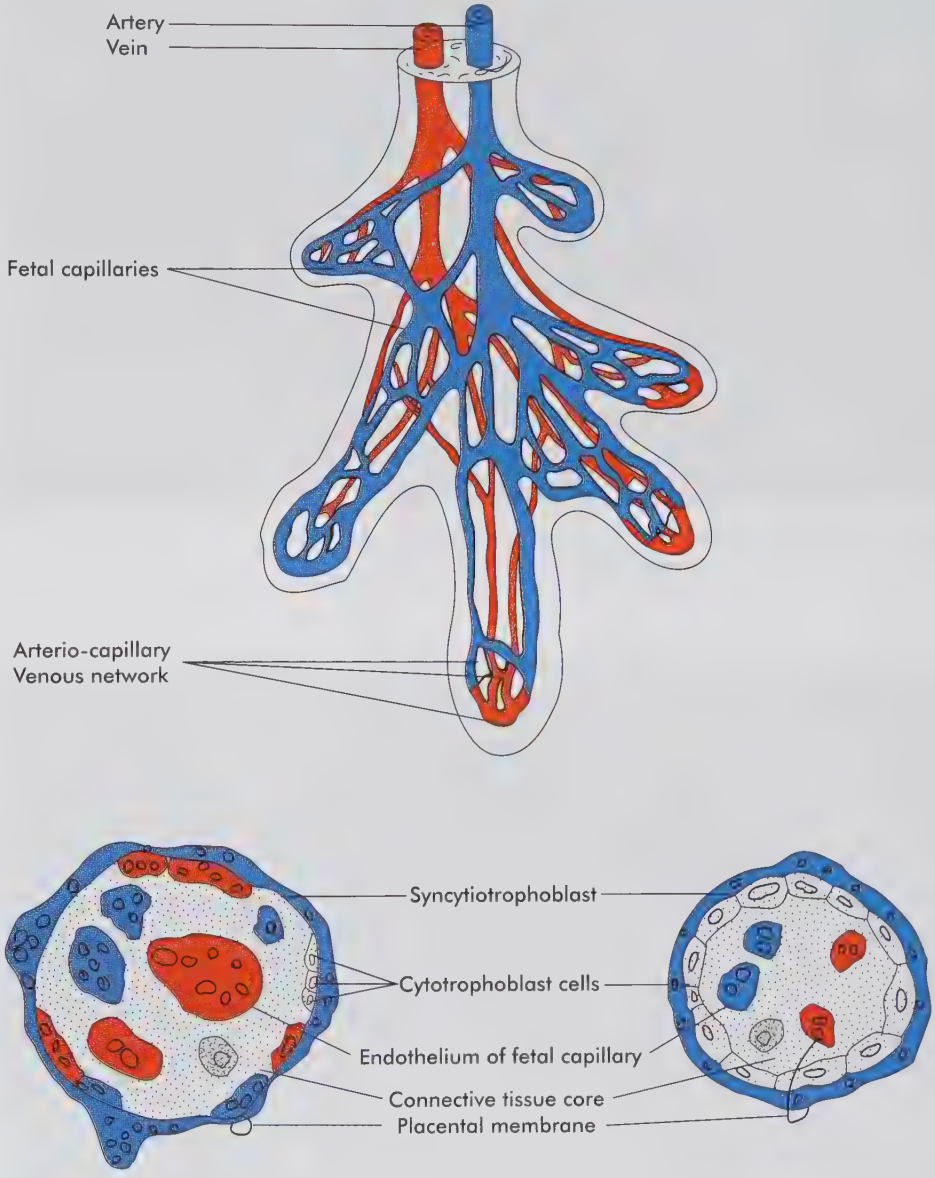


Figure 7. 26 Chorionic villi at term
Source: Sellers, P.M. *Midwifery*. 1993. Cape Town: Juta & Co



Figure 7.28 Maternal surface
Source: Sellers, P.M. *Midwifery*. 1993. Cape Town: Juta & Co



Figure 7.29 Fetal surface
Source: Sellers, P.M. *Midwifery*. 1993. Cape Town: Juta & Co

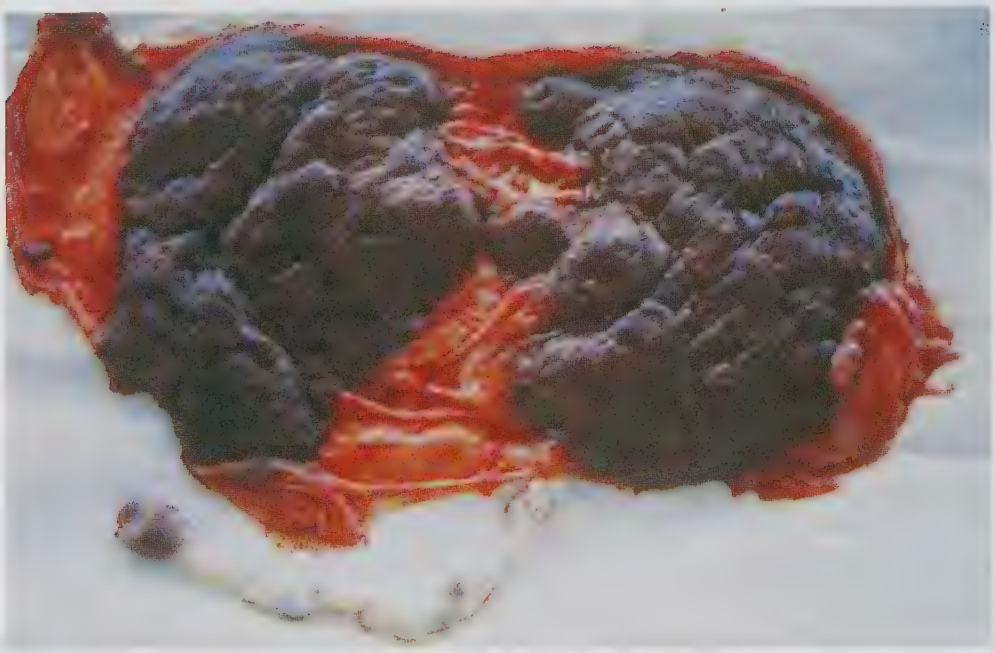


a. Maternal Surface



b. Fetal Surface

Figure 7.30 Placenta succenturiate
Source: Sellers, P.M. *Midwifery*. 1993. Cape Town: Juta & Co



a. Maternal Surface



b. Fetal Surface

Figure 7.31 Placenta bipartite or tripartite
Source: Sellers, P.M. *Midwifery*. 1993. Cape Town: Juta & Co



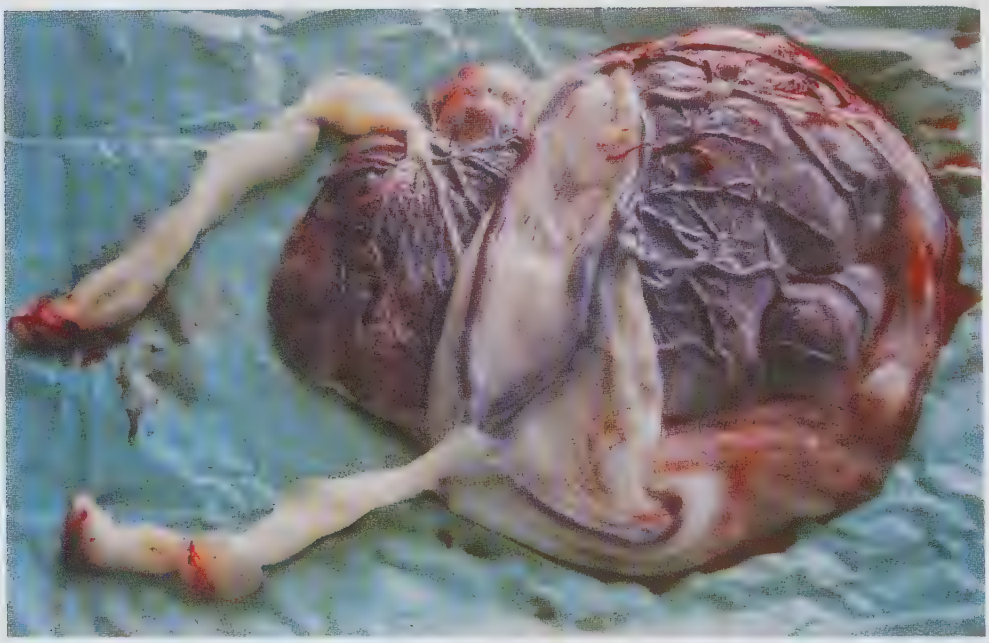
Figure 7.32 Placenta circumvallata
Source: Sellers, P.M. *Midwifery*. 1993. Cape Town: Juta & Co



Figure 7.35 Battledore implantation of the cord
Source: Sellers, P.M. *Midwifery*. 1993. Cape Town: Juta & Co



a. Velamentous placenta



b. Velamentous and twin placenta

Figure 7.36 Placenta velamentosa
Source: Sellers, P.M. *Midwifery*. 1993. Cape Town: Juta & Co

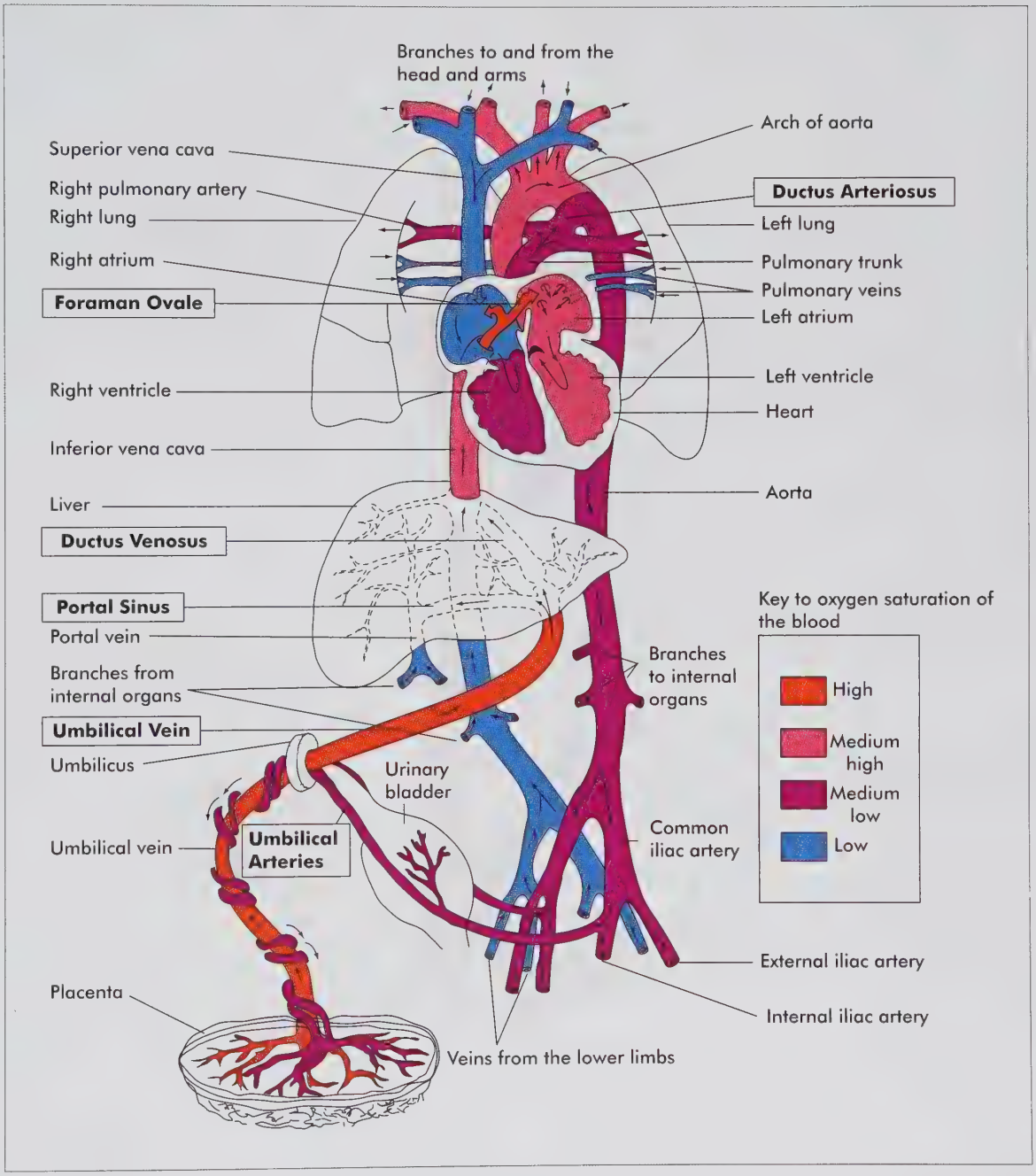


Figure 7. 38 Fetal circulation
Source: Sellers, P.M. *Midwifery*. 1993. Cape Town: Juta & Co

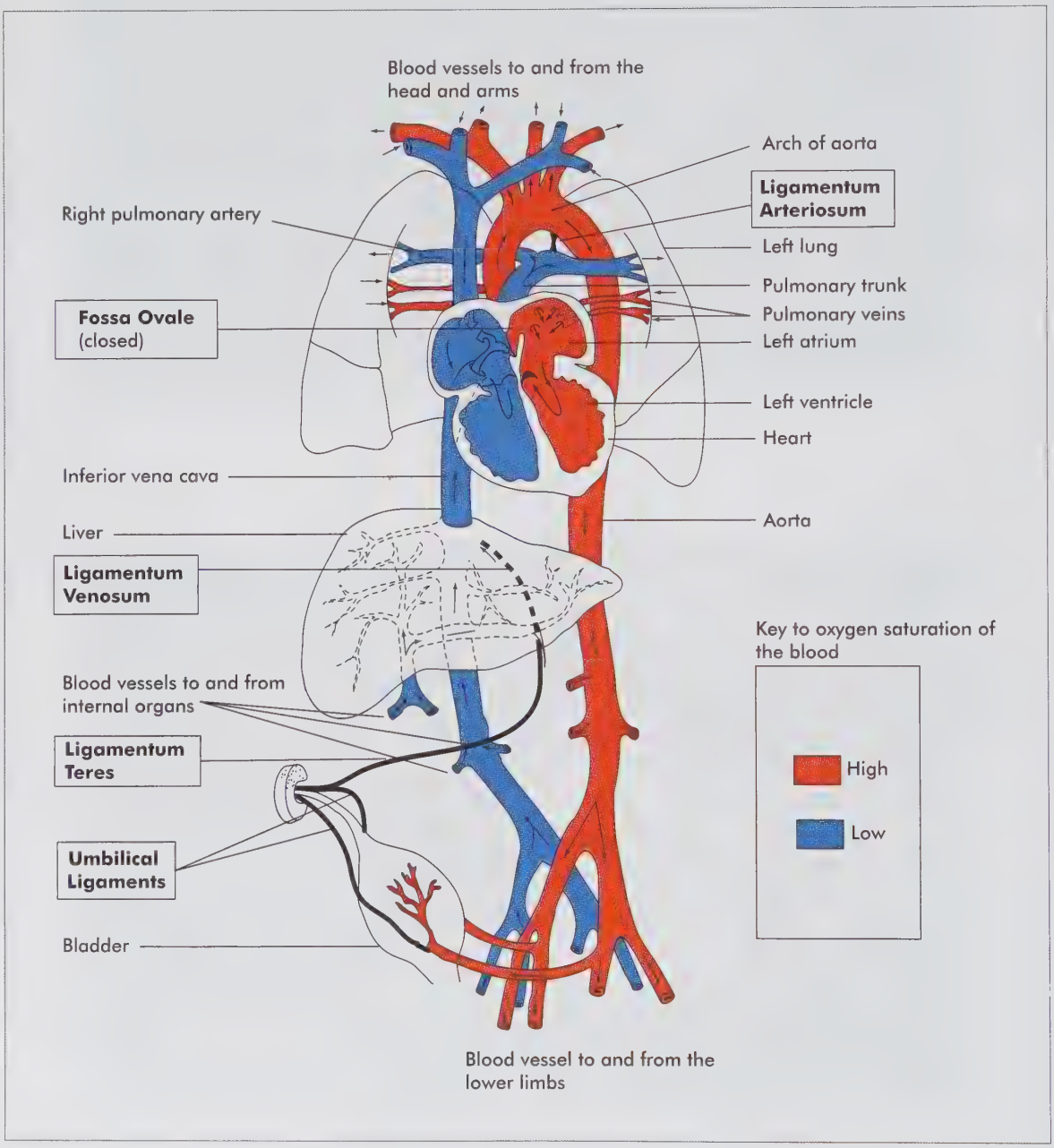


Figure 7.39 The (adult) general circulation of the blood, showing changes which take place at birth
Source: Sellers, P.M. Midwifery. 1993. Cape Town: Juta & Co

tissues, resulting in underdevelopment. It might even stop the blood flow, causing a limb to wither or even fetal death if the cord is wrapped tightly around the neck or body of the fetus.

True knots in the cord

(See Figure 7.37.) This is caused by the fetus passing through a loop of cord and forming a knot. This is most likely to occur with a long cord and during the period of gestation when there is a greater ratio of amniotic fluid to that of fetus – from 16 to 24 weeks. The danger is that, during the delivery, the knot could be drawn tight as the fetus descends, causing anoxia and even fetal death.

7.9 The fetal circulation

The circulation after birth (the adult circulation) must be fully understood and remembered in order to be able to understand the fetal circulation.

In utero, the fetal lungs and gastrointestinal system do not function, because the fetus obtains the oxygen and nutrients necessary for its development and growth from the maternal circulation. The waste products of metabolism pass back into the maternal circulatory system for disposal (see colour illustration 7.38, **C11**).

As a result of these differences, certain modifications are found in the fetal blood circulation that are normally temporary and no longer function after birth. These temporary structures, all but one of which are blood vessels, atrophy and become ligaments, after birth (see colour illustration 7.39, **C12**).

The temporary structures of the fetal circulation

The ductus venosus: the duct from a vein to another vein

This vessel is a continuation of the umbilical vein and conveys 85% oxygenated blood from the placenta to the fetus. As it passes into the fetal abdomen, it gives off branches to the liver (which is a very important and large organ in the fetus). The ductus venosus then joins the inferior vena cava, just above the level of the umbilicus, as the inferior vena cava ascends from the pelvis and lower limbs, conveying deoxygenated blood to the heart. This causes a mixing of oxygenated blood from the placenta, with deoxygenated blood from the lower half of the fetal body. It also causes the blood volume and pressure on the right side of the heart to be greater than that on the left side.

The foramen oval (the oval opening)

This is an opening in the septum between the right and left atria of the fetal heart.

As the fetal lungs are not functioning, it is unnecessary for the blood to be conveyed to the lungs for oxygenation, therefore, most of the blood from the inferior vena cava passes directly from the right atrium into the left atrium, through the foramen ovale. The valve situated at the entry of the inferior vena cava to the right atrium, is constructed in a way that allows it to direct the blood returning from the lower limbs through the foramen ovale.

The foramen ovale is formed with a valve or flap (the septum primum) on the left side of the septum and, as the pressure is greatest on the right side of the heart during the fetal development, the pressure of the blood in the right atrium, against the valve, causes it to remain open and so allows the blood to flow through into the left atrium.

The blood that flows through the foramen ovale into the left atrium is mixed blood, but with a high oxygen concentration, which then passes into the left ventricle and from there into the ascending aorta. This blood, which is reasonably well oxygenated, is directed to the heart, the head and the upper parts of the fetal body.

The ductus arteriosus

This is an opening from an artery to another artery, which is a short vessel that conveys blood from the pulmonary artery to the descending arch of the aorta. This blood is mainly deoxygenated, that is, returning from the head and upper limbs via the superior vena cava. The blood is directed through the right atrium and into the right ventricle from where it is conveyed to the lungs via the pulmonary artery. However, as the lungs are not functioning, most of the blood is diverted via this ductus arteriosus into the descending arch of the aorta to mix with the blood from the left side of the heart. The blood is now only 50% oxygenated.

As the blood passes from the superior vena cava, through the right atrium, it picks up some of the oxygenated blood that is being directed into the foramen ovale, so that a small amount of oxygen is conveyed to the lungs for development, growth and functioning.

The umbilical arteries

These arteries are branches of the internal iliac arteries, returning deoxygenated blood (containing only 50% oxygen) from the fetal pelvis back to the placenta for reoxygenation. As they enter the umbilical cord they become known as the umbilical arteries.

Fetal circulation changes at and after birth

(See colour illustration Figure 7.38, **C11** and Chapter 3.) At birth, the baby is now able to breathe and oxygenate his/her own blood and, therefore, these temporary stuctures are no longer necessary. Some of the changes, caused by muscle constriction, occur soon after birth, but at first they are only functional and may take up to weeks

or months to become anatomical, with the proliferation of endothelial and fibrous tissues. The causes of and the order in which these changes take place, are not yet fully understood, but they occur in the following way:

- When the baby starts to breathe, the lungs expand and this uncoils the pulmonary capillaries, which then results in a great reduction in resistance to the flow of blood to the lungs and causes a fall in pressure on the right side of the heart. In addition, as blood is drawn into these pulmonary capillaries, it is then oxygenated and returned to the left atrium via the now expanded four pulmonary veins.
- This increase in blood flow to the left atrium causes an increase in the pressure on the left side of the heart, now making it greater than the pressure on the right side. This increase in pressure on the left side of the heart causes the one-way valve of the foramen ovale to close by pressing it against the atrial septum.
- The oxygen tension rises in the blood and prostaglandins are released and this causes contraction of the smooth muscle in the wall of the ductus arteriosus. This brings about the gradual closure of the ductus arteriosus, and the closure becomes permanent by the end of two months and a ligament is formed.
- When the umbilical cord ceases to pulsate, or when it is severed, no blood enters the ductus venosus and this further reduces the pressure on the right side of the heart. The ductus venosus constricts several hours after birth and after a few days or possibly weeks, it is permanently closed, forming a ligament.
- The umbilical arteries also constrict, atrophy and form ligaments. The ductus venosus becomes the ligamentum venosum, with the first branch to the liver becoming the ligamentum ceres (round ligament). The foramen ovale closes and becomes the fossa ovale. Should the foramen ovale not close, blood from the left atrium would mix with blood in the right atrium. In addition, if due to some pathological condition, the pressure on the right side of the heart was to become greater than that on the left side of the heart, deoxygenated blood from the right atrium would flow into the left atrium and the child would become cyanosed. An atrial septal defect requires specialised surgery in early childhood.
- The hypogastric or umbilical arteries become the umbilical ligaments.
- The ductus arteriosus becomes the ligamentum arteriosum or cardiac ligament. Should the ductus arteriosus not close, causing the condition of persistent or patent ductus arteriosus.

Persistent (patent) ductus arteriosus (PDA) and non-closure of the foramen ovale have been attributed to factors such as:

- maternal infections (because PDA is the commonest heart defect in congenital rubella)
- the possible effect of medications given to the mother.

Fetal haemoglobin

The diffusion of oxygen from the mother's blood, through the placental membrane and into the fetal blood, occurs in almost exactly the same way as oxygen diffuses through the pulmonary membrane. The dissolved oxygen in the maternal sinuses passes into the fetal blood because of the oxygen pressure gradient from the maternal to the fetal blood. At term, the PO_2 in the maternal sinuses is about 50 mmHg, while it is about 30 mmHg in the fetal blood after oxygenation. This makes the average pressure gradient for the diffusion of oxygen through the placental membrane about 20 mmHg. This low PO_2 of only 30 mmHg in the oxygenated fetal blood, would not supply the fetus with sufficient oxygen under ordinary circumstances. However, there are three reasons why the fetal blood is able to transport almost as much oxygen to the fetal tissues as the mother's blood is able to transport to her tissues. The greater percentage of haemoglobin in the fetal blood is fetal haemoglobin, which has a greater oxygen carrying capacity and at certain oxygen pressures, can carry as much as 20% to 30% more than the maternal haemoglobin can carry (22g/dl).

The haemoglobin concentration of the fetal blood is about 50% higher than that of the maternal blood. The haemoglobin of a newborn is higher than an adult, between 16–22g/dl.

The Bohr shift, which allows haemoglobin to transport more oxygen where there is a low PCO_2, is effective because large amounts of carbon dioxide in the fetal blood are diffused through the placental membrane into the maternal blood, causing a greatly lowered PCO_2 in the fetal blood. In addition, the loss of carbon dioxide makes the fetal blood more alkaline and the increase of carbon dioxide in the maternal blood makes the maternal blood more acidic. This forces more oxygen from the maternal blood and at the same time enhances the oxygen in the fetal blood. This causes a Bohr shift in the opposite direction, which in effect, results in a double Bohr effect. By these three means the fetus is able to receive an adequate amount of oxygen despite the fact that the fetal blood leaving the placenta has a PO_2 of only 30 mmHg.

7.10 Conclusion

This chapter gave an overview of the basic development of the embryo, decidua, placenta and membranes and common pathologies encountered by midwives. Further in-depth reading and study needs to be undertaken by midwives for a thorough knowledge of the physiology of pregnancy as the body of scientific knowledge is constantly growing.

CHAPTER

8 The Ps of labour: passage, passenger and powers

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- explain the Ps of labour and the integrated processes for normal labour
- describe and explain the normal pelvic anatomy and measurements of importance in childbirth
- identify and describe the essential soft tissue structures important in childbirth
- identify and describe the path that the fetus negotiates during normal birth
- describe normal uterine function in pregnancy and labour
- describe the fetal skull, its landmarks and functions in labour.

KNOWLEDGE ASSUMED TO BE IN PLACE

Basic anatomy and physiology of the reproductive system, the pelvis and muscles

KEYWORDS

Obstetric pelvis • Pelvic floor • Perineal body • Fetal skull • Uterine action • Levator ani

8.1 Introduction

The Ps of labour summarise the three critical role players in birth. When these three Ps are within normal parameters, the birth can be expected to proceed uneventfully. In reality each birth has unpredictable outcomes. The three Ps are the passage (including the bony pelvis and soft tissue of the pelvic floor), the passenger (the fetus) and the powers that include the uterus as the birthing organ.

The fetus needs to negotiate the bony pelvis and soft tissue of the pelvic floor to be born. The working of the uterus is influenced by the 'fit' between these two factors.

This chapter explains the Ps of labour, the anatomy of the bony pelvis and the muscles of the pelvic floor and the perineum, the fetal skull and normal uterine action. The pelvis is best studied with a gynaecoid pelvis and a doll in your hand.

8.2 The passage: The bony pelvis

The bones of the pelvis are joined to form the pelvic canal, through which the fetus must pass during birth. The shape and the size of this canal, which depends upon the shape and size of the pelvic bones, determines whether a fetus of average size and shape will be able to negotiate it. The normal female pelvis is called a gynaecoid pelvis and has specific characteristics that make it suitable for childbirth (see Figure 8.1).

The four bones of the pelvic girdle that make up the pelvis are:

- the two innominate bones, each made up of three fused bones, namely the ilium, the ischium and the pubic bones
- the sacrum, made up of five fused vertebrae
- the coccyx, made up of three to five fused rudimentary vertebrae.

(See Figure 8.2.) The pelvic girdle carries the internal organs and the gravid uterus in pregnancy. The two innominate bones, one on either side, make up the greater part of the pelvis. They meet and are joined anteriorly, at the symphysis pubis or pubic joint. At the posterior, they meet and join with the alae (wings) of the sacrum, at the two sacroiliac joints. The coccyx meets and joins with the inferior point of the sacrum at the sacrococcygeal joint.

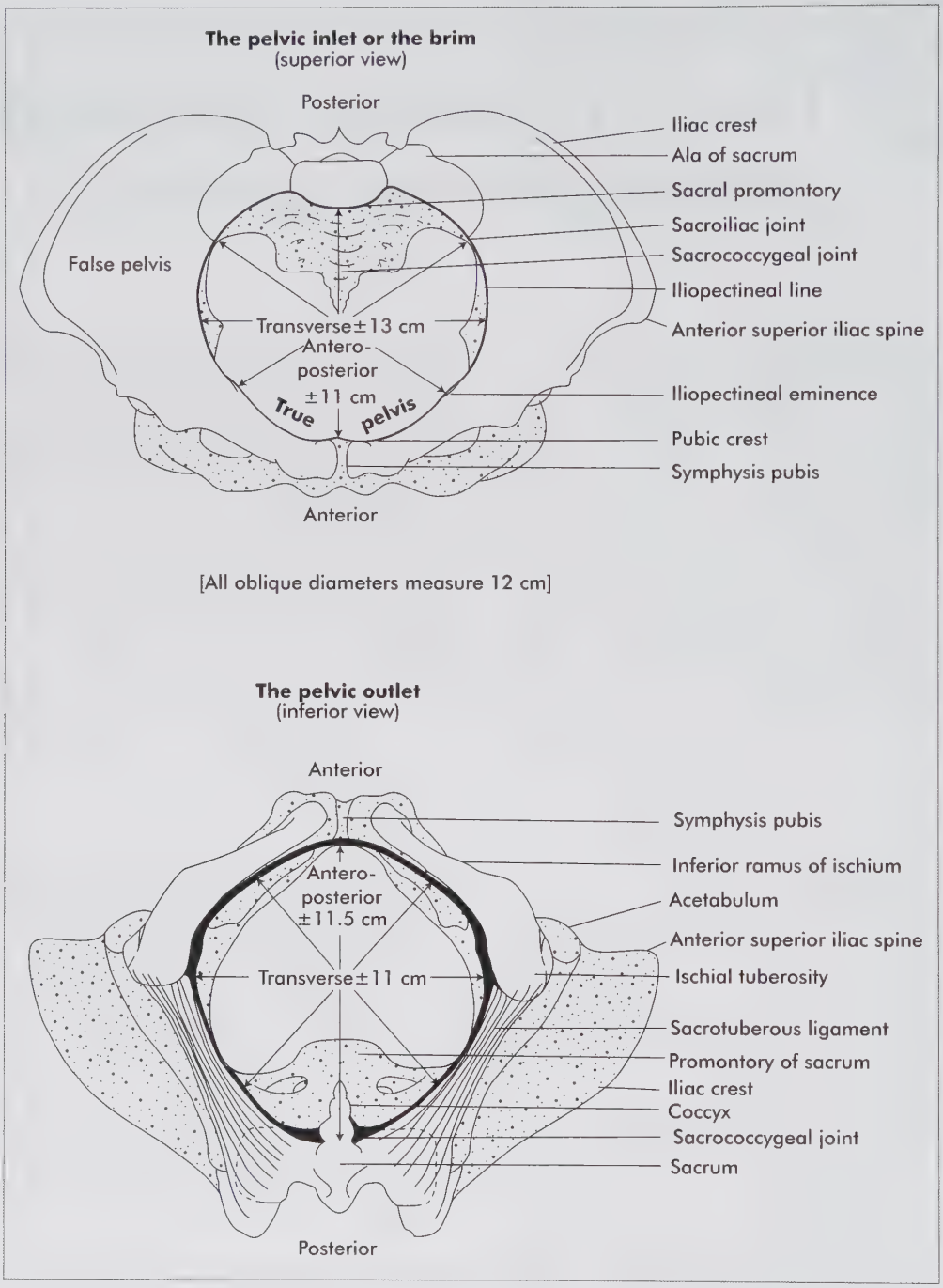


Figure 8.1 The female or gynaecoid pelvis

The innominate bones

There are two innominate bones, each made up of three bones that fuse completely during puberty or early adulthood. The three bones are the ilium, the ischium and the pubis.

These three bones all meet on the outer aspect, in the acetabulum of the innominate bone, and on the inner aspect and in the lateral walls of the midcavity of the true pelvis.

The ilium

The ilium is the strong, heavy superior bone called the innominata. The upper portion of the ilium forms the large flared-out part of the pelvis, known as the false pelvis and its posterior border that meets the ala of the sacrum at the sacroiliac joint. The upper curved border is called the iliac crest, which ends posteriorly in the posterior-superior iliac spine and anteriorly in the anterior-superior iliac spine.

The lower portion of the ilium, which forms the upper part of the true pelvis, meets the inferior border of the ischium posteriorly, and the pubic bone anteriorly.

At the junction of the upper and lower portions of the ilium there is a ridge, which forms the lateral division between the false and the true pelvis, called the iliopectineal line. This iliopectineal line also forms the lateral borders of the brim or inlet to the cavity of the true pelvis.

The ischium

This is the lowest part of the innominate bone. The thickened lower border of this bone is known as the ischial tuberosity. In the sitting position, the full mass of the body is taken on these bones and they also form part of the outlet to the pelvic cavity.

A thin arm, the inferior ramus of the ischium, projects forwards and upwards from the tuberosity, and meets and joins with the inferior rami of the pubic bones, to form the pubic arch. In an average gynaecoid pelvis the arch should form an angle of 90°. Superiorly, the ischium widens and joins the ilium, in the posterior portion of the acetabulum.

Directly above the tuberosity, on the posterior border, a small spine projects posterior-laterally into the pelvic cavity, separating the greater sciatic notch from the lesser sciatic notch, called the ischial spine. This is an important landmark in the pelvis in childbirth.

The pubis or pubic bone

This bone consists of a body and two arms, the superior and the inferior pubic rami. The bodies of the two pubic bones meet anteriorly, to form the joint known as the symphysis pubis.

The upper or superior ramus forms the pubic crest and joins the lower anterior border of the ilium in the acetabulum. The lower or inferior rami, on either side, together make up the pubic arch, which also forms part of the outlet to the pelvic cavity. Where the two arms of the pubic bone meet the ischium inferiorly and the ilium superiorly, they form an oval-shaped window or hole in the anterior pelvic wall, which is known as the obturator foramen.

The sacrum

This is a strong, heavy bone, which forms the posterior part of the pelvis and articulates on either side with the ilium at the sacroiliac joints. The full weight of the body is taken on this bone and transferred via the sacroiliac joints to the acetabulae

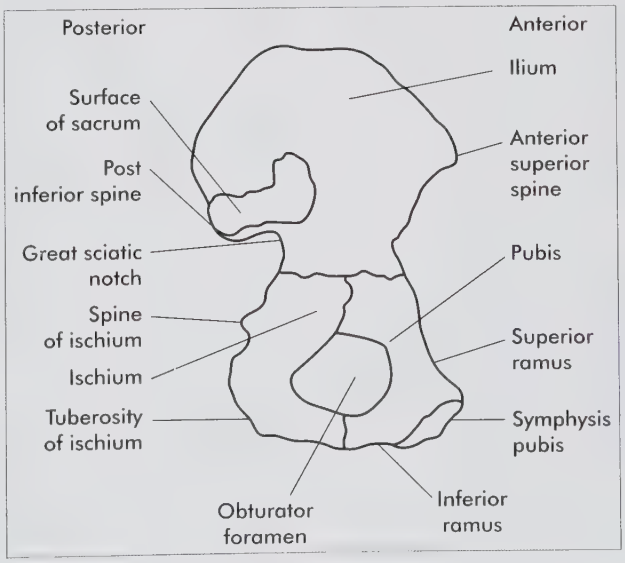


Figure 8.2 Innominate bones

and so to the legs. The forces generated by the legs and trunk converge on this strong bone.

The sacrum is made up of five fused vertebrae and is a wedge-shaped triangular bone. The wide end of the wedge is directed upwards, where it articulates with the fifth (last) lumbar vertebra and where the anterior border forms the promontory of the sacrum. The narrow end of the wedge is directed downward and backward and its inferior border articulates with the upper end of the coccyx. As the sacrum is an extension of the vertebral column, it has a central canal containing nerves, and posteriorly, on either side of the short spinous processes, is a row of inter-vertebral formina through which the sacral and coccygeal nerves pass. The main branch of the sacral plexus is the sciatic nerve, which is the largest nerve in the body. At the inferior end of the canal, there is an opening known as the hiatus, through which the ilium terminale passes and is inserted into the coccyx. The sacrum in the female pelvis is shorter than the sacrum in the male pelvis, it is also wider and is well curved and is called the hollow of the sacrum and measures 15 cm.

The coccyx

This is a small wedge-shaped bone, consisting of three to five fused rudimentary vertebrae. It is situated at the end of the vertebral column. The wide edge of the wedge articulates with the lower end of the sacrum and the coccyx serves as the origin for important muscles of the pelvic floor and the hip.

The pelvic joints

The joints of the pelvis are very strong and the ligaments strengthening these joints are partly cartilagenous and partly fibrous. Normally, there is very little movement in these joints, but in the pregnant state hormones cause softening and stretching of the ligaments, allowing some movement or 'give' in the pelvic joints.

When there is a minor degree of disproportion in size between a woman's pelvis and the head of the fetus (cephalopelvic disproportion), the degree of give in the pelvis can be a factor contributing to a successful birth. The woman's position during labour influences the fetal–pelvic relation.

Women often experience back pain, especially in late pregnancy, as a result of this joint laxity, which may also be carried over into the first few weeks after delivery. Women should be careful about posture and lifting during pregancy.

The sacroiliac joints and ligaments

The joints between the sacrum and the ilium are the strongest joints in the body. The joint formed between the articulation of the ilium and the sacrum on either side of the pelvis are called the right and left sacroiliac joints.

8.1 Symphysis pubis

This is a cartilaginous joint. This joint is formed anteriorly where the two pubic bones join and is strengthened by fibrous tissue. There is a pad of cartilage between the bodies of the two pubic bones and as a result of hormone action, this joint may widen spontaneously during late pregnancy, giving rise to movement of the joint and pain on walking.

Sacrococcygeal joint

This joint is formed where the sacrum and the coccyx articulate and is much looser than the other joints of the pelvis. This enables the coccyx to bend backwards, allowing the fetal head to negotiate the outlet of the pelvic canal. Where there has been a previous fracture of the coccyx or if the joint has become immobilised (the coccyx fused to the sacrum), there may be difficulty during the birth of the fetal head. The woman may also experience pain after delivery, especially when sitting.

The lumbosacral joint

The lumbosacral joint lies at the posterior aspect of the pelvis, between the fifth lumbar vertebra and the sacrum. Exceptionally strong ligaments strengthen this joint, but because of the backward inclination of the sacrum, considerable strain also occurs here during pregnancy and occasionally the fifth lumbar vertebra projects forwards and downwards, reducing the pelvic brim area.

Pelvic ligaments

Besides the ligaments that strengthen the pelvic joints, there are two additional ligaments of the pelvis that are important in childbirth. These are the sacrospinous and the sacrotuberous ligaments and, together with the lower sacrum and the coccyx, they form the posterior aspect of the pelvic outlet. Therefore, the pelvic outlet is only partially encompassed by bone, unlike the pelvic inlet, which is totally encompassed by bone.

The sacrospinous ligament

This ligament runs from the lower sacrum and the coccyx, to the ischial spine and encloses the lower border of the greater sciatic notch. The sacrospinous ligament is covered by the coccygeous muscle of the pelvic floor.

The sacrotuberous ligament

This ligament encloses the lesser sciatic notch and runs from the lower sacrum and the coccyx to the ischial tuberosity.

The birth canal

The word 'pelvis' is derived from the Latin word for basin, referring to its shape. It is also known as hip girdle. There are four types of pelvis identified. The classification of pelvises for birth are based on their anatomical form and shape (see Table 8.1).

The gynaecoid or female pelvis is adapted for birth. Other pelvic shapes may complicate birth because of unfavourable diameters. The midwife, therefore, needs to know the normal to identify the abnormal. Because the pelvis cannot be measured directly, signs and symptoms of pelvic disproportion may provide an indirect method of measuring the pelvis.

The gynaecoid pelvis is divided in two parts, the false pelvis and true pelvis, separated by a ridge, the linea terminalis. The false pelvis is above the line and of little obstetrical interest.

The true pelvis is extremely important in obstetrics, as this is the passage through which the fetus has to pass during labour (the process of birth). In normal labour (when the head presents) the fetal head (skull) is the first part of the fetus to negotiate this passage and has first to enter the narrowest part of the inlet of the pelvis. Second, the fetus has to pass

Table 8.1

Caldwell-Moloy classification of pelvises for birth (see Figure 8.3)

Type	Female pelvis (A) (Gynaecoid)	Male-shaped (B) (Android)	Ape-shaped (C) (Anthropoid)	Flat (D) (Platypelliod)
Incidence	50%	30% white women 60% black women	25% white women 50% black women	< 3%
Inlet	Round oval brim AP diameter 12 cm Transverse 12.5 cm Non-prominent sacral promotorium	Heart-shaped Narrowed AP diameter Tall women with narrow hips Women of African decent	Oval-shaped with large AP diameter and reduced transverse diameters	Kidney-shaped Sacrum displaced forward Narrowed AP diameter
Midpelvis	Shallow with straight side walls Non-prominent ischial spines 10 cm Sacrum concave Coccyx movable Sacrospinous ligament admit two fingers 4 cm	Contracted midpelvis Prominent spines Sacrum straight and long Reduced interspinous diameter	Slightly narrowed intestinal diameters	Shallow pelvis
Outlet	Suprapubic arch 90° (admits 2 fingers) Coccyx is movable Intertuberous diameter is 10 cm	Android outlet Narrowed subpubic arch	Intertuborous diameter is reduced	The diameter of the outlet is increased except for AP diameter
Effect on pregnancy	If the fetus is of average size and in the right position labour should be normal	OP positions are more common Face and brow Deep transverse arrest due to prominent spines Poor progress Obstructed labour Delayed second stage Fetal and pelvic floor trauma	Anterior position is not a problem after engagement Posterior positions may remain in persistent occipitoposterior with prolonged first and second stage and higher incidence of obstetric interventions	High head slow to engage Prolonged and obstructed labour Increased face and brow presentations Once the head has passed the brim no problems are expected in an average size baby

through the narrowest part of the curved cavity of the pelvis and finally it has to emerge from the narrowest part of the outlet. The fetus makes very specific moves to pass through this channel and can get stuck at any point. In obstetrics, therefore, the three different planes or zones of the pelvis are described, known as the pelvic brim or inlet, pelvic cavity or midpelvis and the pelvic outlet.

In the typical or normal gynaecoid pelvis, these areas or zones have average dimensions. (See Figures 8.4 and 8.5.)

8.2 Measures of the gynaecoid pelvis

These measurements apply to white women, while the pelvises of Indian women are from 0.5 cm to 1 cm less in all diameters. They have smaller pelvises, but they also have smaller babies. The pelvises of many black women are of the android type (see Table 8.1), probably due partly to the heavy loads they carry on their heads from a very early age. Farrell (2005:15) reported that Evans (1950) found that black women's pelvises are approximately 20% smaller than white women's.

The landmarks and approximate measurements of each area of the pelvis follow:

- *The pelvic brim or inlet.* The inlet is particularly significant in childbirth because if the fetal head cannot pass through the pelvic brim, labour becomes obstructed and complicated. However, if the *largest* presenting diametres of the fetal skull do pass through the pelvic brim, the fetal head is said to be 'engaged'. The size of this area is difficult to assess, because it is internal and all the landmarks cannot be felt on vaginal examination. The borders of the inlet are:
  - posterior: the promontory of the sacrum, the alae (wings) of the sacrum and the sacroiliac joints
  - laterally: the iliopectineal lines on either side of the pelvis and the iliopectineal eminences where the iliac bones meet the superior rami of the pubic bones
  - anteriorly: the pubic crests on each pubic bone and the symphysis pubis.

8.3 The gynaecoid pelvis

In the gynaecoid pelvis, the brim is almost round, except for the posterior intrusion of the promontory of the sacrum. It is not possible to measure the pelvic inlet satisfactory in a human without ultrasound, X-rays, CT or MRI scans.

The *diagonal conjugate* refers to the distance assessed (using vaginal examination) from the subpubic arch towards the sacral

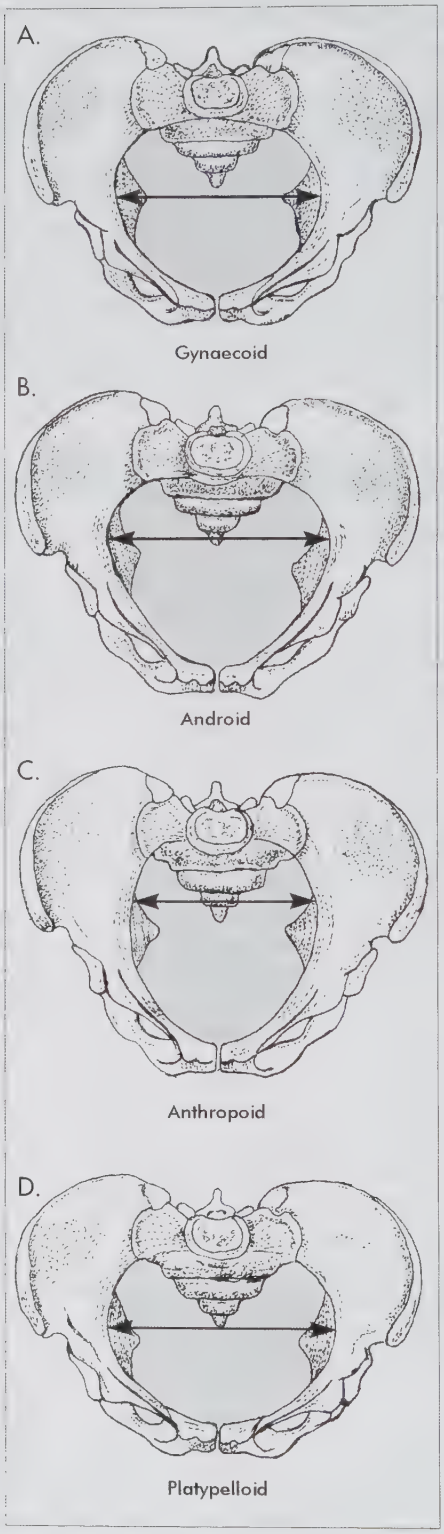


Figure 8.3 Classification of pelvises for birth

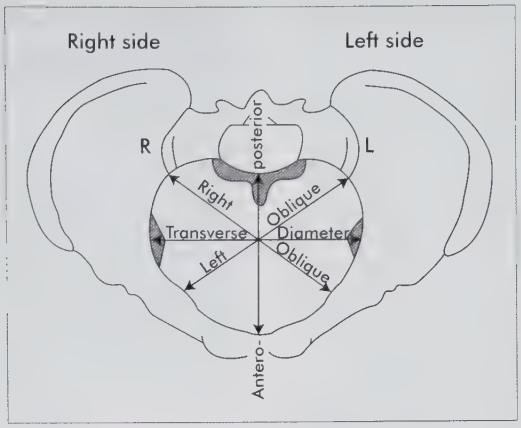


Figure 8.4 Diagram showing the diameters of the pelvic brim and from where they are measured

8.4 Activity

Using a ruler, measure the distance from the corner between the thumb and index finger to the tip of the middle finger. Put together measurements from everyone in the class.

You will see that there is quite a lot of variation in the measurements obtained. However, a skilled midwife will work out his/her own criteria to determine if a woman needs to be referred for further assessment.

promontorium and 12.5 cm is considered adequate. If a fetus's head is not engaged by 36 weeks in a first pregnancy or when labour starts in a second or any subsequent pregnancy this is considered a problem. The true, or *anatomical conjugate*, is between 11–13 cm. The obstetric (true) conjugate is the narrowest point of the pelvic inlet and measures from the back portion of the pubis to the sacral promatory. This can be determined by subtracting 1.5 cm from the diagonal conjugate (about 10 cm).

- *The pelvic cavity or midpelvis.* The pelvic cavity is between the inlet and the outlet of the pelvis. The pubic arch, ischial spines and tip of the sacrum form the borders of the midpelvis.

Because the sacrum has a concave curve from above, looking downwards, and because the pelvic cavity has a short anterior wall, the pelvic canal is curved anteriorly (see curve or axis of the pelvic canal) (see Figure 8.7).

In transverse section the pelvic cavity is almost round and therefore all the measurements are approximately the same.

8.5 The ischial bi-spinous measurement

The most important and narrowest diameter of the mid-pelvis is between the ischial spines and is called the ischial bi-spinous (interspinous) measurement. This measures between 10 cm to 10.5 cm (see Figure 8.7).

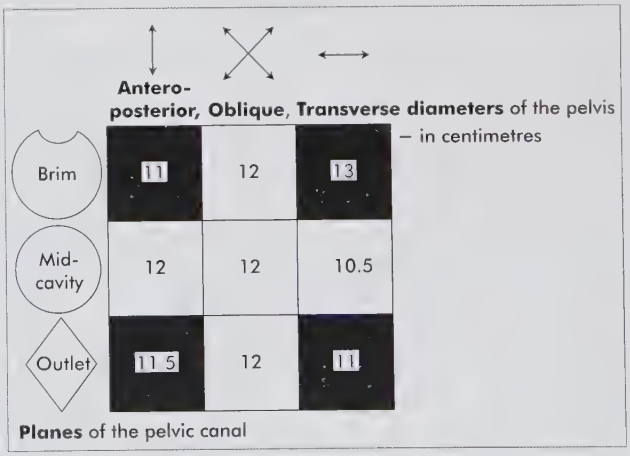


Figure 8.5 The measures of the gynaecoid pelvis
Source: Adapted from Myles MF.

The ischial spines are used as a landmark in labour to determine progress by determining the relation of the fetal skull or breech with the spines.

- *The pelvic outlet.* (See Figure 8.5.) The outlet to the pelvis is diamond-shaped. The landmarks of the pelvic outlet are:
  - posterior: the coccyx and the sacrotuberous ligaments, 4–5 cm
  - laterally: the ischial tuberosities (transverse diameter 11 cm)
  - anteriorly: the pubic arch 90° (anteroposterior diameter from subpubic arch to sacrococcygeal joint 11.5 cm).

Even if the fetus has already negotiated the pelvic inlet and midpelvis a narrowed, funnel-like outlet may be too small for birth.

Only the last two diametres can be measured directly with the hand. Prominence of the ischial spines is noted and if the subpubic arch does not admit two fingers with ease it is considered suspicious.

- *Pelvic inclination.* (See Figure 8.8.) This is the relation of the pelvic inlet to the maternal spine allowing the fetus to enter the pelvis. This is influenced by which position a woman is in. In the standing position the inlet makes a 55° angle with the horizontal. This is the pelvic inclination or the corner that the fetus needs to negotiate when entering the pelvis. The anterior-superior iliac spine and pubis are on the same level when the woman is standing. In the supine position the inlet is 25° below the horizontal. The supine position is not considered to be natural or the best for birth. The Better Birth Initiative advocates that women should be allowed to adopt the position they find most comfortable in birth (as long as it does not compromise the fetus). The supine position can complicate the birth process.

8.6 Important measurements in the pelvis

The three most important pelvic measurements are:

- Obstetric or *true conjugate* of the pelvic inlet (anterior posterior diameter 10 cm)
- Inter-spinous diameter of the midpelvis (10–10.5 cm between the ischial spines)
- the anterior-posterior diameter from the sub pubic arch to sacrococygeal joint (11.5 cm). If the pubic arch is less than 90° this may be less.

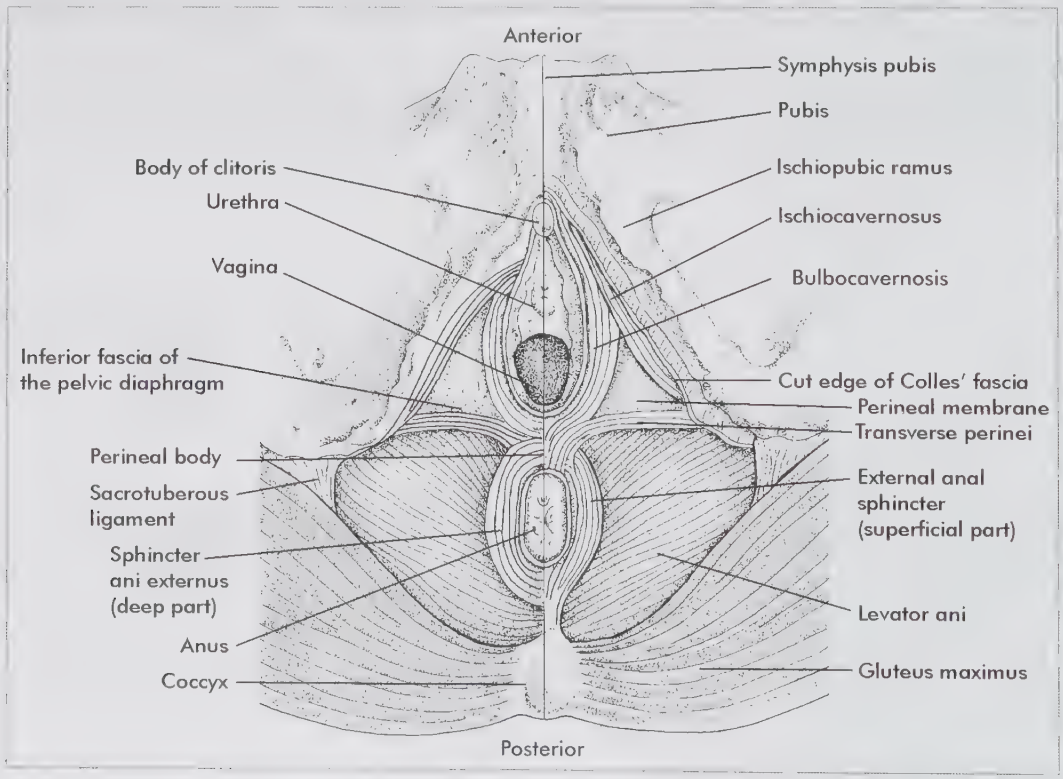


Figure 8.6 The pelvic floor: Inferior view

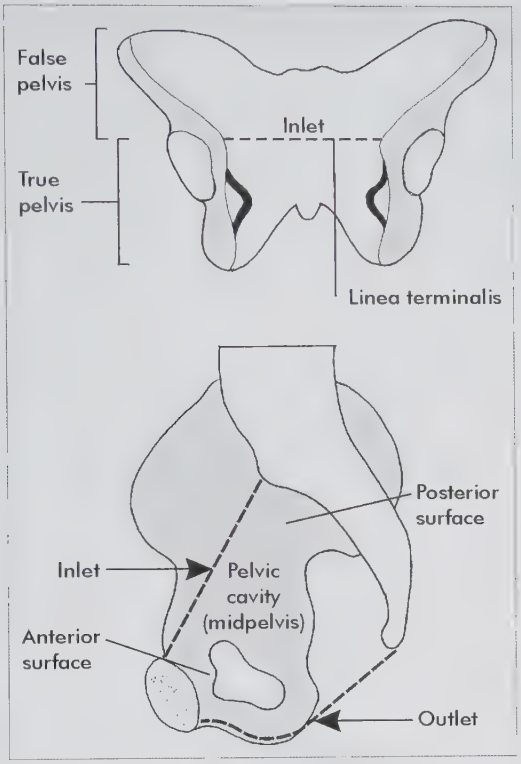


Figure 8.7 The anterior and sagittal view of the pelvic plane

- *The axis of the birth canal.* Theoretically, this is the path followed by the centre of the fetal head as it descends through the birth canal during labour, known as the curve of Carus. It is C-shaped and makes a 90° curve. The anterior border measures 5 cm and the posterior border is 15 cm. The fetus makes the necessary movements, which include curling up (flexion) or stretching (extension) or turning (rotation) to negotiate the canal (see Figure 8.8).

The gynaecoid bony pelvis with its normal measurements is well suited for labour and if the fetus is of average size and in the correct position, birth is uneventful or considered normal. It is the task of the midwife or medical practitioner to identify abnormalities in pregnancy and labour early and to refer the woman for appropriate care. Approximately 20% of births will be complicated.

Abnormal types of pelvis are:

- *The ludo minor pelvis.* This pelvis has the shape of a gynaecoid pelvis, but all the diameters are slightly decreased by 0.5–1 cm. This type of pelvis is found in Indian women, and in women who are under 1.5 m in height, with a small shoe size.

The effects of this type of pelvis on labour depend upon the size of the fetus. Indian women tend to have smaller babies than white and black women and therefore, with this type of pelvis, should not encounter any undue difficulty in labour. However, a black or white woman with this type of pelvis may well present with cephalopelvic disproportion and would require a trial of labour.

- *The rachitic pelvis.* Similar to the platypelloid pelvis but with the diameters greatly reduced. The osteomalacic or malacosteon pelvis is a rare condition caused by a gross deficiency of minerals and vitamins in the diet. All the bones are softened, with the pelvic walls pushed into the cavity, and the brim becomes a Y-shaped slit.
- *Naegele's pelvis.* This may be a congenital abnormality or may follow severe deprivation and disease in infancy. Only one wing or ala of the sacrum has developed, causing the whole pelvis to be asymmetrical and this can also result in scoliosis of the spine.

The pelvic floor

The pelvic floor consists of the soft tissues within the bony pelvis. These tissues enclose the outlet to the pelvis and are part of the birth canal. The function of the pelvic floor is first, to keep the pelvic and abdominal contents in place, including the gravid uterus, and second, at the same time, to allow access to the outside for the bladder, the uterus and the rectum, by way of the urethra, the vagina and the anus respectively.

The pelvic floor consists of three layers or levels of muscle, which are covered by connective and adipose tissue and by skin on the outer body surface as summarised in Table 8.2.

The deep muscle layer of the pelvic floor

The deep layer of muscles of the pelvic floor are highly specialised (levator ani) and are the main muscles that are attached to the inner circle of the pelvis at the front and sides and are inserted into the sacrum and the coccyx posteriorly. The muscles on either side are constructed in such a way that they slope downwards and forwards, and meet and decussate (the interlacing or crossing over of fellow parts) in the midline, to form a gutter or sling.

The formation of this downwards and forwards sloping gutter is of great significance during the birth process, because whichever part of the fetus meets the pelvic floor first, is directed in a downwards and forwards direction, enabling it to follow the axis of the pelvis or curve of Carus, through the pelvic canal. It is these muscles that move the fetus through the pelvic canal in the mechanism of labour.

The levator ani muscles (See Figure 8.9) are made up of the iliococcygeus, (implanted into the illium to the coccyx)

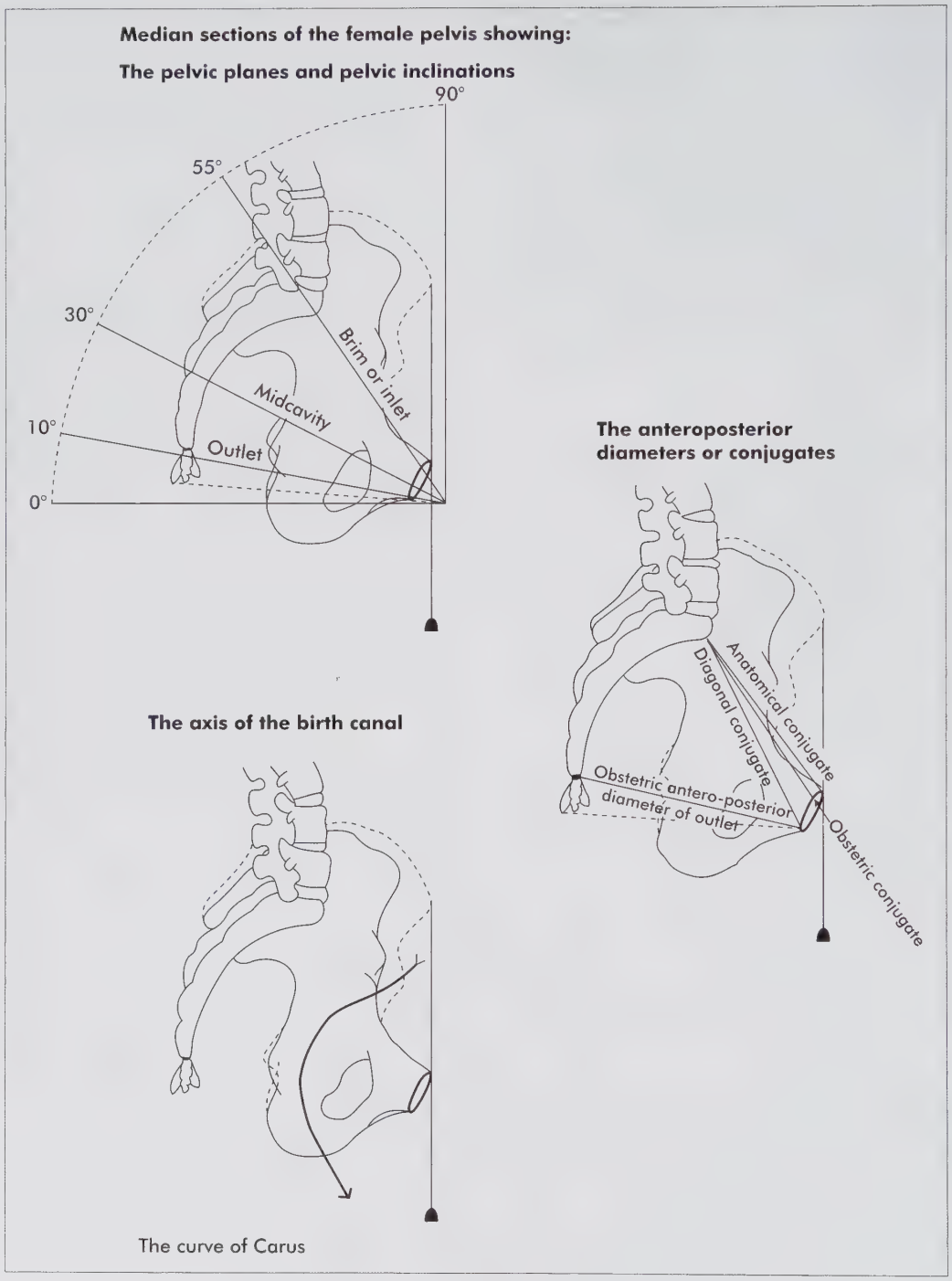


Figure 8.8 Median sections of the female pelvis

Table 8.2

Stuctures in the pelvic floor

Deep layer	Middle layer	Superficial layer

The levator ani
• Ischio coccygens
• Ilio coccygeus
• Pubo coccygeus
  • Pubo rectalis
  • Pubo vaginalis
  • Pubo coccyges
	The deep transverse perineal	The bulbo-cavernosus
		The ischio-cavernosus
		The superficial transverse perineal
		The anal sphincter

The vagina, rectum and urethra pass through the structures Damage to the pelvic floor in birth can cause prolapse and fistulas		These are the structures of the perineum that may be involved in trauma at birth or when cutting an episiotomy

and the pubococcygeus (from the pubis to the coccyx), a highly specialised muscle that works like a sling around the vagina and rectum giving passage to the anal canal, the lower third of the vagina and urethra. The pubococcygeus is divided into the puborectalis (rectum), pubovaginalis (vagina) and pubococcygeus proper. The white line of fascia is a ring of connective tissue that is formed where the muscles implant.

The ischio coccygeus and coccygeus muscles originate from the rami of the ischium, the white facia and the ischial spines. It covers the sacro-spinal ligament on each side and is inserted in the coccyx and lower sacrum.

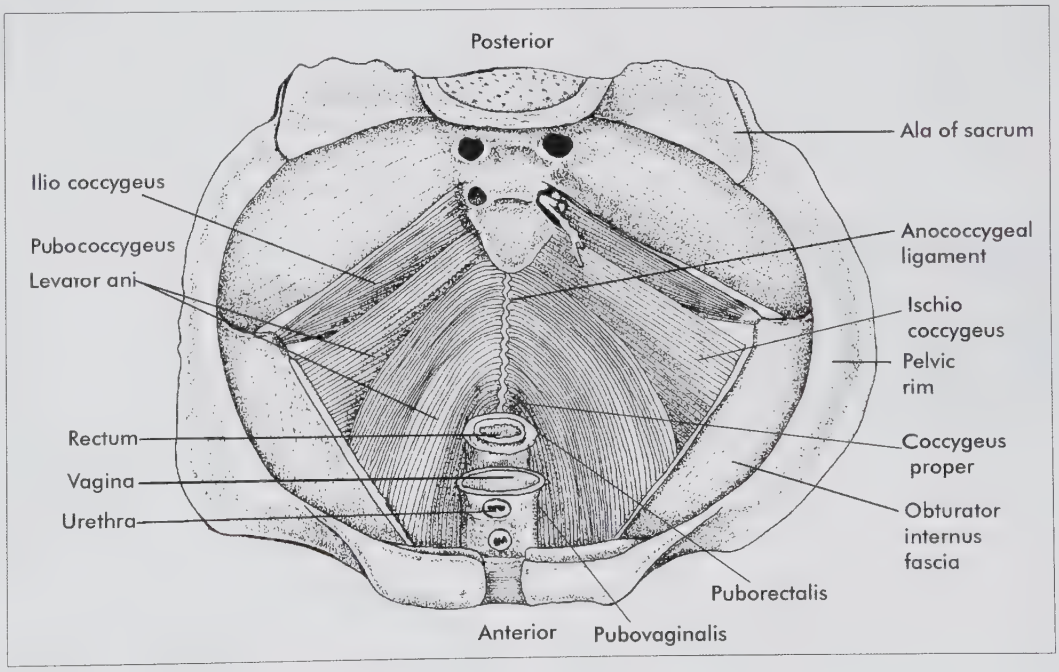


Figure 8.9 The pelvic floor: Superior view

8.7 Kegel exercises

Kegel exercises are a set of exercises designed to strengthen and give voluntary control over the pubococcygeus muscles. These are the best way to avoid postpartum complications. Doing them daily will ensure that the pelvic floor muscles are strong and in good shape. These are the same muscles used to stop urine flow. The exercises prevent or improve the stress incontinence that some women experience after childbirth. The muscles that support the uterus can become so weak that the uterus can sag down into the vaginal opening, called uterine prolapse. In another condition the bladder falls down into the vaginal opening, called cystocele. These conditions need surgical repair.

The middle layer of the pelvic floor

The strong perineal body is below the levator ani muscles, making up the posterior portion of the uro-genital triangle (diaphragm). This body is triangular and is made up of several muscles. The female perineal body is a mass of interlocking muscular, fascial, and fibrous components lying between the vagina and the anorectum. The perineal body is also an integral attachment point for components of the urinary and fecal continence mechanisms, which are commonly damaged during vaginal childbirth. Injuries to the perineal body are caused by spontaneous tears or episiotomy and may need surgical intervention and have serious consequences for women's health.

8.8 Activity

Visit http://www.fistulacare.org/pages/index.php and learn about the fistula project and the results of insufficient care in childbirth. Over 13 000 repairs in eight north African countries improved the lives of women after birth.

The base of the triangle is the superficial area between the vestibule and the anal sphincter and is known as the perineum (the structures commonly involved in tears and episiotomy incision).

As viewed from above and distal to the coccygeus muscles are the deep perineal muscles. The origin of the deep transverse perineal muscles is the inferior ramus of the ischium on either side of the pelvis and they meet and decussate in the midline, where they fix the central tendon. In the female, a portion of these muscles is specialised to form the constrictor vaginae, which acts to compress the vaginal orifice and greater vestibular glands. The deep transverse perinea are not usually involved in the episitomy incision, but may suffer damage in birth, as part of the perineal body.

The perineal body, including the adipose tissue and skin of the perineum, is the area most susceptible to injury and tears during the delivery of the baby (See Box 8.8). This is also the area that is incised when an episiotomy is performed. At the perineum, the pelvic outlet is divided into anterior and posterior sections by the transverse perineal muscles, and the anterior portion is known as the genital triangle (diaphragm), while the posterior portion is known as the anal triangle. The spaces within these triangles are filled with adipose tissue.

The superficial layer of the pelvic floor (perineum)

(See Figure 8.5.) The superficial area of the pelvic outlet, from the symphysis pubis anteriorly, to the sacrum and coccyx posteriorly, is enclosed and strengthened by pairs of muscles interspersed with adipose tissue. The muscles meet and decussate at the midpoint, surrounding the urethra to form the urethral sphincter. They also surround the vagina and meet and decussate between the vagina and the anus at the perineum, forming the base of the strong perineal body. Behind the anus, they meet in the anococcygeal body, after surrounding the anus and forming the anal sphincter.

The following muscles are found in the perineum:

- *The ischiocavernosus muscles.* These muscles arise from the ischial tuberosities of the pelvis and pass upwards and inwards along the pubic arch, to be inserted into the crura of the clitoris. In the female they have a less functional role.
- *The superficial bulbocavernosus and deep transverse perineal muscles.* These muscles arise from the inner surfaces of the ischial tuberosities and are inserted in the central tendon of the perineum where they meet and decussate. These are usually not injured or involved in an episiotomy.
- *The anal sphincter.* The muscle fibres forming the anal sphincter are a continuation of the bulbocavernosus muscle and therefore arise in the perineum, surround the anus, forming the anal sphincter and are inserted into the anococcygeal ligament.

A third degree tear of the perineum is a tear that extends right through the perineum, into the muscle fibers on the anterior border of the anal sphincter and can even extend into the anal mucosa.

8.9 The structures of the perineum involved in a perineal tear or episiotomy

- An outer layer of skin, which also forms the fourchette anteriorly
- The bulbocavernosus muscles
- The transverse perineal muscles (superficial and deep) – the perineal body.

8.3 The passenger: The fetal skull

The fetus is the passenger, who has to negotiate the maternal passages in order to be born. The course of labour, therefore, will be influenced by several factors concerning the passenger such as:

- the number of fetuses
- the gestational age
- the position of the fetus in the uterus and
- the size of the fetus and the relation to the pelvis.

Approximately 95% of all labour starts with the head of the fetus presenting over the pelvic brim, which means that most babies are born head first. The fetal head is relatively large compared with the body and consists of a bony box (skull) that is different from the adult skull, containing the delicate brain.

Once the head is born, the body usually follows without any problem. (The exception to this is the large baby, with large, wide shoulders, where the shoulders can become caught up at the pelvic brim during delivery. Sometimes the mothers of these babies have diabetes mellitus.

The head is the least compressible part of the fetus and whether it is delivered first or last (as in a breech presentation), it is the most difficult stage of the delivery. The fetal head and its contents can be damaged as the head is squeezed through the bony pelvis and any damage to the fetal brain may be permanent. The trauma to which the fetal head is subjected during the birth process can cause the death of the fetus, or if the child should survive, it can result in cerebral damage with mental retardation and/or spasticity.

All these facts indicate that the fetal head is the most important part of the fetus during labour.

The fetal skull

A fetal skull of normal shape and average dimensions is able to pass through an average gynaecoid pelvis with the minimum amount of difficulty, if the presentation is a normal, well-flexed (chin on the chest) vertex presentation. These are the best diameters that present under these conditions in a normal fetus of 37 weeks or more and the head is like a round ball.

However, if the presentation of the fetal head should be other than a normal, well-flexed vertex presentation, then larger diameters will present and this may cause difficulties when the head attempts to enter the pelvic brim and/or during its passage through the pelvic cavity and/or in negotiating the outlet. The round ball effect has been lost.

There are certain areas and landmarks on the fetal head, which are identifiable on abdominal palpation and on vaginal examination, and which enable the midwife to identify and estimate the size, presentation, position and state of flexion of the fetal head. It is necessary, therefore, for a midwife to know

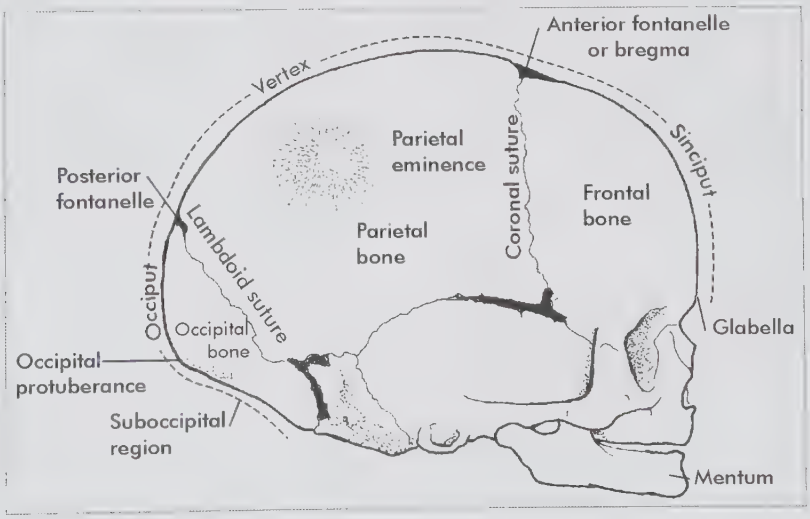


Figure 8.10 Bones, regions and landmarks of the fetal skull

the bones, sutures and fontanelles, and the areas, landmarks and dimensions of the fetal skull.

Regions of the fetal skull

The skull can be divided into three main regions, the base of the skull, the face, and the vault or cranium:

1 The base of the skull is the bony area surrounding the opening known as the foramen magnum. These bones are firmly united in order to protect the vital centres in the medulla.
2 The face extends from the root of the nose to the junction of the chin with the neck. The bones of the face are small and are also firmly united.
3 The vault or cranium is the greater, upper, dome-shaped part of the skull and extends above the face in front, to the base of the skull posteriorly and includes the temporal sutures laterally. The bones of the vault are formed from membrane and not cartilage, and the intermembranous ossification of these bones has started by the tenth week of intrauterine life. The ossification begins at the centre of each skull bone, and as development takes place, spreads slowly outwards towards the periphery.

At term, the ossification is not quite complete, leaving a thin line of membrane between each skull bone, which is called a suture. Where three or four sutures meet, a membranous area exists, which is known as a fontanel.

The skull bones at term are thin, especially at the edges, and are fairly pliable and the sutures allow these bones to overlap or 'override' when the head is compressed, thereby decreasing the dimensions of the presenting diameters. This overriding of the skull bones is known as moulding, and this allows the head to pass through the pelvic canal more easily.

However, if the bones are too soft (as with preterm infants) or if too much moulding takes place during labour (as with a contracted pelvis), then the contents of the skull are compressed and brain damage can occur.

If, on the other hand, the pregnancy is prolonged and the fetus is postmature, then the ossification becomes advanced. This reduces the size of the sutures and increases the hardness of the skull bones and leads to greater difficulty during labour, as the bones cannot overlap and are hard and inflexible.

The sutures are very useful for identifying the position of the fetal head during labour, as they can easily be felt on vaginal examination.

The bones of the fetal skull

(See Figures 8.10 and 8.12.) The cranial bones (from the front of the fetal skull to the back) are as follows:

- two halves of the frontal bone
- two parietal bones
- one occipital bone.

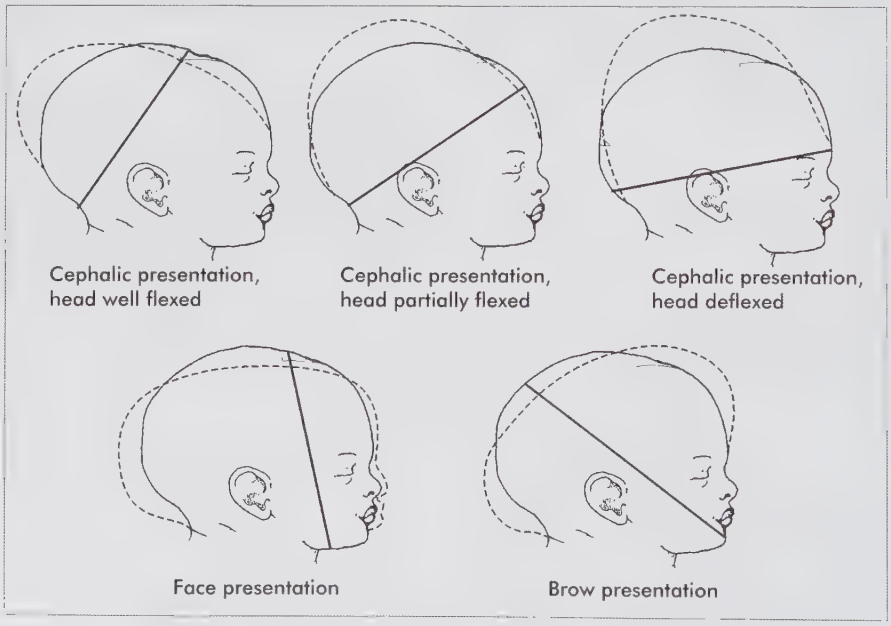


Figure 8.11 Moulding of the fetal skull. The moulding is indicated with a dotted line as it would appear in different presentations

The sutures of the fetal skull

(See Figure 8.12.) These are:

- The frontal suture, which bisects the frontal bones down the centre of the forehead (sinciput) and is a forward extension of the sagittal suture.
- The sagittal suture, which lies between the parietal bones and runs in an anteroposterior direction, dividing the skull into left and right halves.
- The coronal sutures, which separate the frontal bones from the parietal bones. These two sutures run almost at right angles to the sagittal suture and the frontal suture, bisecting these sutures and thereby forming the anterior fontanelle.
- The lambdoidal sutures, which join centrally to form one long suture and which divide the two parietal bones from the occipital bone. These sutures run transversely across the posterior end of the sagittal suture, thereby forming the posterior fontanelle.
- The temporal sutures, which lie on either side of the skull, between the temporal bones laterally, and the frontal and parietal bones above. At the point where the coronal suture meets the temporal suture, on either side of the skull, there is a small temporal fontanelle (the temple). It is between these points that the bitemporal diameter is measured.

The two important fontanelles

The two important fontanelle that lie at the junction of the sutures are:

- The anterior fontanelle or bregma, which is diamond-shaped because it is formed by the junction of four sutures: the frontal, the sagittal and the two coronal sutures. It is situated centrally, or at a midpoint on the top of the fetal skull, where the frontal and parietal bones meet.
- The posterior fontanel or lambda, which is triangular because it is formed by the junction of three sutures: the sagittal and the lambdoidal sutures. It is situated centrally, on the posterior aspect of the fetal skull, where the parietal bones meet the occipital bone.

Anatomical landmarks of the fetal skull

(See Figure 8.10.) Taking a lateral view of the fetal skull and working from the point where the chin meets the neck anteriorly, continuing over the face and over the vault of the skull, to the nape of the neck posteriorly, the following areas and landmarks are identified:

- *The submental area.* This is the area below the chin and extends to the angle where the chin meets the neck. The areas that follow are:
  - the mentum, the chin
  - the face
  - the root of the nose
  - the orbital ridges, which are the ridges above the eye sockets
  - the glabella, which is the elevated area between the orbital ridges
  - the sinciput or the brow or forehead, which is the area bounded anteriorly by the glabella and orbital ridges and posteriorly by the bregma and coronal sutures.
- *The vertex.* This is the top of the cranium, and is the lowest area on the fetal skull to enter the pelvic brim in a vertex presentation. The vertex is bounded by the coronal sutures and bregma anteriorly, the lambdoidal sutures and lambda posteriorly and by the parietal eminences laterally.
- *The parietal eminences.* Each parietal bone has a thickened and raised area in the centre of the bone, where

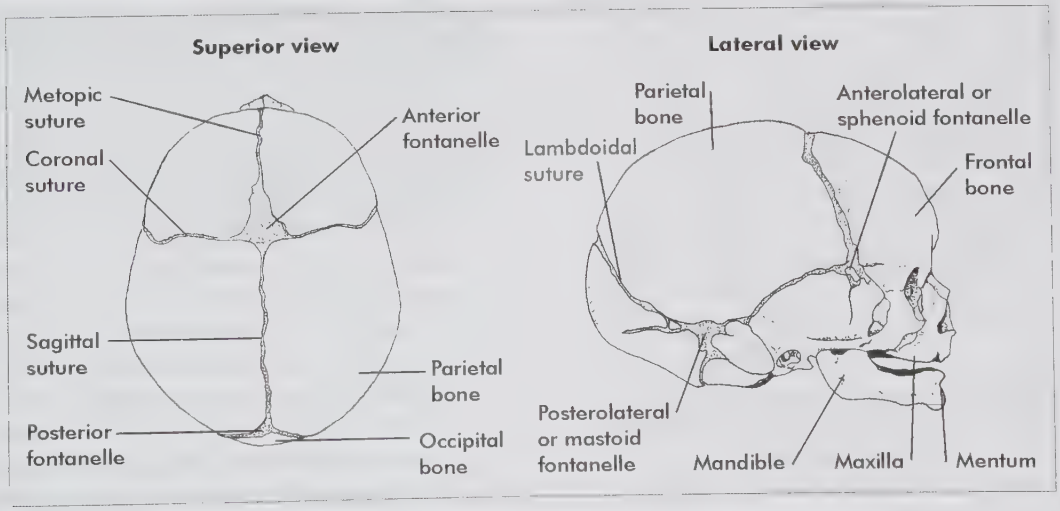


Figure 8.12 Regions of the skull

the greatest amount of ossification has taken place. The diameter between these eminences is the widest part of the skull, and therefore the largest transverse diameter, called the biparietal diameter.

- *The occiput.* This is the area at the back of the head, which is formed by the occipital bone. It is posterior and below the lamboidal sutures and the posterior fontanel. The suboccipital area is the area below the occipital protuberance (the thick, raised area in the centre of the occipital bone). The suboccipital area extends from the occipital protuberance to the nape of the neck.

Measurements of the fetal skull

The diameter of the portion of the fetal skull that lies over the pelvic brim, and which attempts to enter the pelvic brim during pregnancy and labour, is of great importance. This is because the smallest diameters of an average-sized fetal skull will enter the brim of a gynaecoid pelvis with the least amount of difficulty, while the largest diameter of an average-sized fetal skull is too large to enter the pelvic brim and the head could become obstructed.

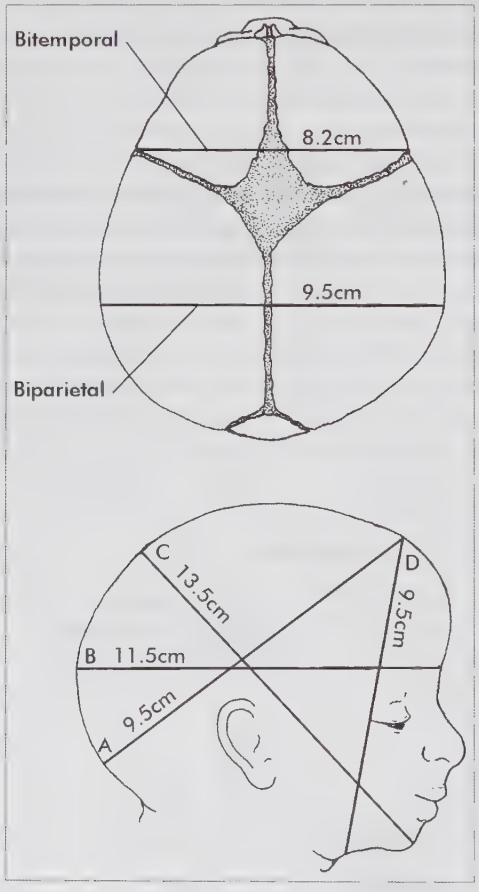


Figure 8.13 Measurements of the fetal skull
A: Subocciput-bregmatic diameter
B: Occiput-frontal diameter
C: Mento-vertical diameter
D: Submento-bregmatic diameter

A midwife should know the measurements of these diameters. These measurements, which are divided into transverse and anteroposterior diameters, are approximate for an average-sized fetal skull:

- *The transverse diameters of the fetal skull.* The biparietal diameter of 9.5 cm is measured between the two parietal eminences. The bitemporal diameter of 8.2 cm is measured between the junctions of the corona and temporal sutures on either side of the skull (between the temples).
- *The anteroposterior diameters of the fetal skull.* The anteroposterior diameters of the fetal skull and their application in cephalic presentations (presentations of the fetal head) are as follows:
  - (See Figure 8.13A.) The subocciput-bregmatic diameter of 9.5 cm is measured from below the occipital protuberance, to the centre of the anterior fontanel. This is the diameter (together with the biparietal diameter of 9.5 cm) that presents in a well-flexed vertex presentation (round ball).
    As all the diameters in this presentation are small and are also equal, the presenting part is an almost perfect circle, which fits well onto the circle of the internal cervical os. This creates an even pressure all round the cervix and brings about an even dilatation of the cervix during labour.
  - The subocciput-frontal diameter of 10 cm is measured from below the occipital protuberance, to the centre of the sinciput.
    This is the diameter (together with the biparietal diameter) that presents a slightly deflexed vertex presentation, usually with the occiput lying posteriorly in relation to the pelvis.
  - (See Figure 8.13B.) The occiput-frontal diameter of 11.5 cm is measured from the occipital protuberance to the glabella. This large diameter (together with the biparietal diameter) presents in a deflexed vertex presentation also known as the 'military attitude', where the spine is straight and the head erect on the spine and the occiput lies posteriorly in the pelvis. This presentation often develops into a persistent occipitoposterior position. In this presentation, this wide diameter will also distend the vulva at birth.
  - (See Figure 8.13D.) The submento-bregmatic diameter of 9.5 cm is measured from the angle of the chin with the neck, to the centre of the anterior fontanel.
    This diameter (together with the bitemporal diameter of 8.2 cm) presents in a fully extended face presentation. Although this diameter is smaller than the subocciput-bregmatic diameter, it is not circular and

therefore does not exert an even pressure on the cervix. In addition, although these diameters may negotiate the pelvic brim, the wide biparietal diameter, which still has to enter the pelvic brim, may become caught up as the face descends into the pelvic cavity.

- The submento-vertical diameter of 11.5 cm is measured from the angle of the chin with the neck, to the highest point on the vertex (about midway between the anterior and posterior fontanel).

  This diameter (together with the bitemporal diameter) presents in an incompletely extended face presentation, particularly common in a mentoposterior position. This wide diameter also distends the vulva during the birth of a face presentation.
- (See Figure 8.13C.) The mentovertical diameter of 13.5 cm. This is measured from the tip of the chin or mentum, to a point on the vertex which is just above the posterior fontanel. This diameter is the largest on the fetal head.

  This extremely large diameter presents in a brow presentation. It is larger than any of the diameters of a gynaecoid pelvis and would usually become obstructed should it attempt to negotiate the pelvic brim.

8.10 Measurements of the fetal head in labour

These diameters can only be inferred in labour unless measured by ultrasound or X-rays. The signs of malpresentation include poor contractions, poor application and failure to engage, descent and/or to feel sutures and fontanels.

8.11 The Ferguson reflex

A well-fitting presenting part on the cervix releases local prostaglandins and stimulates the uterus to contract well and this is called the Ferguson reflex. When absent uterine contractions may be weak or abnormal.

Movements of the fetal head

The fetal head is capable of a wide range of movements and can also rotate on the neck 90°, to either side of the body. The following movements are considered important:

- Flexion, when the head is completely flexed, so that the chin of the fetus is in contact with its chest.
- Extension, when the head is completely extended, so that the occiput is in contact with the fetal back.
- Deflexion, neither flexion nor extension, but somewhere between the two. The fetal back is straight, with the head erect and this is known as the 'Military Attitude'.

Engagement of the fetal head

Engagement of the fetal head has taken place when the widest presenting diameter, the biparietal diameter, has passed through the brim inlet of the pelvis.

This is for the delivery of the head of any fetus, whether the presentation is a vertex presentation or not, or however large or small the fetal head may be.

The engagement of the fetal head is the most important facet in the delivery of the baby, because unless the biparietal diameter is able to pass through the pelvic brim, vaginal delivery cannot take place.

8.12 Clinical assessment of engagement

The clinical assessment of the engagement of the fetal head can be made through abdominal palpation where the part of the fetal head palpable above the pelvic inlet is calculated as fifths above the pelvic inlet and through vaginal examination where with a normal vertex presentation and a normal pelvis, the fetal head can be felt at or near the level of the ischial spines. The station of the presenting part is then 0 with minus 1–5 above spines and plus 1–5 lower than the ischial spines (see Figure 8.14).

Synclitism and asynclitism

- Synclitism exists when the fetal head is aligned with the spine and the sagittal suture line dividing the pelvic cavity in two equal parts, regardless of the position of the head. On vaginal examination the sagittal suture line can be felt in the middle and the applications may be good. Synclitism will provide a better 'fit' or application on the cervix.
- Asynclitism occurs when the pelvis is wide and the fetal head tilts on the fetus's shoulder and is malaligned. The suture line is off-centre and an ear can be felt on vaginal examination with poor application. This may influence application of the presenting part on the cervix (see Figure 8.11).
  - posterior asynclitism (Litzmann's obliquity): ear can be felt posteriorly
  - anterior asynclitism (Naegele's obliquity): ear can be felt anteriorly (see Figure 8.15).

Moulding of the fetal skull

Moulding is the change in shape of the fetal head during its passage through the birth canal due to prolonged compression

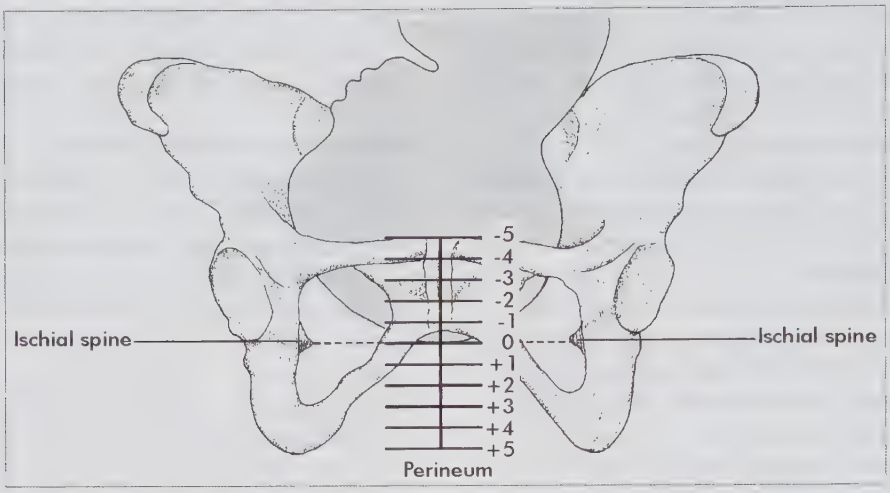


Figure 8.14 Stations of the presenting part in the pelvis

on the presenting diameters of the head, as the head is forced through the bony pelvic canal.

While the presenting diameters are reduced, the diameters at right angles to the presenting diameters are increased. This means that in normal labour, with the average amount of force exerted by the uterine contractions, the actual area of the cranium is not altered. But, where the space is diminished in one direction, it is increased in another direction.

Moulding is of the greatest value in the progress of labour, as it allows the widest presenting diameters of the fetal head to enter the pelvic brim (become engaged) and to negotiate the pelvic canal.

Moulding should be a slow process, occurring as the head passes into and through the pelvis. No damage of any consequence is caused to the brain of the baby as long as the moulding is not excessive. Damage can occur in the following circumstances:

- with prolonged labour, due to cephalopelvic disproportion
- in a preterm baby, due to large sutures and soft skull bones
- with sudden decompression, as in precipitate labour
- in the after-coming head of a breech presentation or assisted delivery
- in a difficult or traumatic forceps delivery or vacuum extraction.

Here the danger is tearing of the falx cerebri or tentorium cerebellum and the adjoining blood vessels in the brain due to sudden compression and decompression.

The change in shape of the fetal skull depends primarily upon the state of flexion or extension of the fetal head. This, in turn, determines which will be the largest presenting diameter, and, when this diameter is diminished, the head increases in size at right angles to this largest presenting diameter.

For example, in a well-flexed vertex presentation, the largest presenting diameter is the subocciput-bregmatic diameter of 9.5 cm and therefore the diameter, which will be increased with moulding, will be the mentovertical diameter (which is at right angles to the subocciput-bregmatic diameter), causing the vertex to become extended outwards.

This change in the shape of the fetal head is possible because the sutures between the bones allow the edges of the bones to override one another, and because the bone edges are thin and pliable. The parietal bones usually override the occipital bone posteriorly and the frontal bones anteriorly. In a normal vertex presentation, the occiput lies over the cervical os and therefore, early in labour, is subjected to the greatest amount of pressure, which causes the edges of the occipital bone to slip under the edges of the parietal bones.
One of the parietal bones then overrides the other parietal bone. The posterior parietal bone is subjected to most pressure during labour, by the sacral promontory, and it is usually the edge of this bone that slips under the edge of the anterior parietal bone.

After delivery, by examining and feeling the overriding of the sutures, it may be possible to determine what the position of the fetus was during the labour (see Figure 8.11).

Caput succedaneum and cephalohaematoma

The name means an accessory or substitute head. The caput succedaneum is a collection of serous fluid between the aponeurosis (muscle sheath) of the fetal scalp and the periosteum (outer covering) of the fetal skull bones.

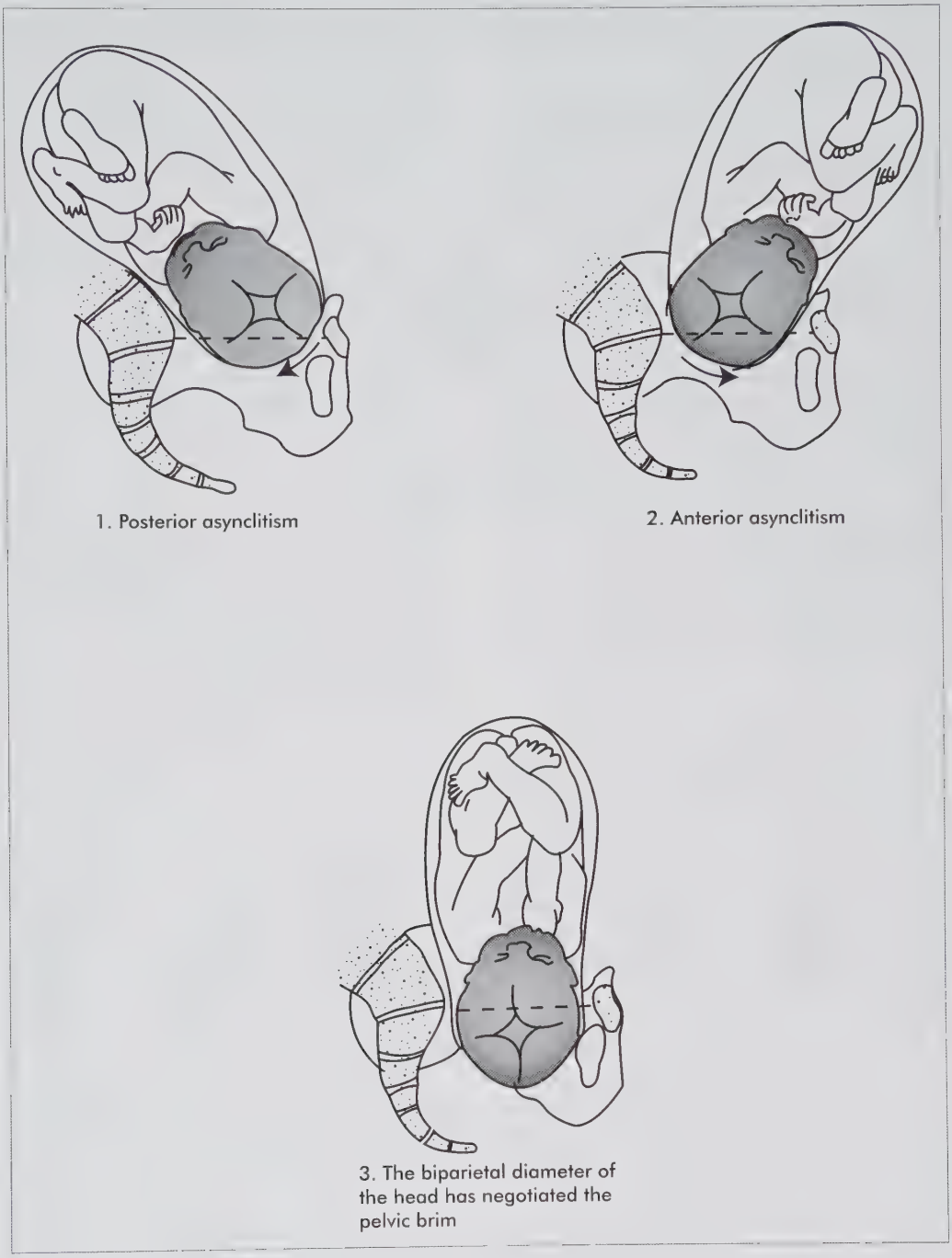


Figure 8.15 Asynclitism

The fetal scalp is pressed against the relatively tight cervical ring during each uterine contraction after the rupture of the membranes at pressures above 200 mmHg. This pressure impedes the venous and lymphatic drainage of the fetal scalp within the area of this ring, and causes an effusion of serous fluid into the subaponeurotic space. The position of the scalp over the cervical ring changes as the head negotiates the pelvic canal, and therefore the site of this swelling is extended accordingly.

A caput is present on the heads of all babies born as vertex deliveries and starts to reduce in size soon after birth and has

disappeared within 12 to 24 hours. If, however, the labour has been prolonged and difficult, the caput will be excessive and may persist for up to 36 hours.

At vaginal examinations undertaken during labour, this caput can easily be felt as a small soft swelling. However, when the labour is prolonged, the caput may become excessive and then it will feel large and harder and the midwife may mistake it for the fetal skull and may think that the head has progressed further down the pelvic canal than it actually has. This is a dangerous mistake as the head may not yet be engaged. The descent of the fetal head should, therefore, always be checked by both abdominal palpation and vaginal examination in order to obviate this mistake. We refer to the caput succedaneum in other presentations, although strictly speaking it is incorrect to use the word caput, meaning head. In breech presentations, the perineal region and genitalia may be swollen and bruised and in face presentations, the eyelids and lips and other facial tissues are affected.

In occasional instances, where labour has been prolonged and difficult, a subaponeurotic haemorrhage may occur where bleeding takes place into the scalp, or a cephalhaematoma develops where bleeding takes place under the periosteum of one or more of the skull bones.

8.4 The powers: Uterine contractions

The uterine contractions are the primary powers in childbirth. The uterus grows by adding numerous muscle fibres with specialised abilities to the uterus muscle. At term, the uterus is the largest and strongest muscle in the body. The uterine muscle (middle-layer myometrium) is very vascular and any myoma present will grow large in pregnancy and turn pink due to the vascular supply. This will return to normal size (degenerate) after birth.

The muscle fibres of the uterus are specialised and can contract and retract. This means that during contraction the muscle becomes shorter and maintains this length while relaxing again instead of returning to its original length (see Figure 8.16). As a result the interior space in the uterus becomes smaller and the baby is pushed out. The uterine muscle fibres are arranged in a longitudinal, circular and diagonal way. The blood vessels that pass through these interlocking muscle layers are constricted when the uterus contracts and bleeding is controlled. During labour the blood supply to the baby is also constricted when the contraction reaches a particular peak.

In obstetrics a contraction is a motion of the uterus and part of the process of childbirth. Contractions, and labour in general, occur when the hormone oxytocin is released into the body. Oxytocin may be released because:

- Increased pressure and volume of the uterus may signal the start of birth (polihydramnios and multiple pregnancy) – mechnical.
- An increased number of oestrogen receptors prepare the uterus for oxytocin. The decreased function of the placenta and decreased hormones may signal the release of oxytocin – endocrine.
- The membrane potential of the uterine muscle is increased through increased ATP in myocytes. Prostaglandins are released when the head engages and stretches the cervix – preparing the cervix for birth.
- The Ferguson reflex occurs when the lower segment is stretched causing a reflective contraction in the upper segment – neurogenic (see Box 8.11).

A well-fitting presenting part is associated with good uterine contractions. Induction of labour can be stimulated in late pregnancy if the cervix admits two fingers (4 cm) with a 'stretch and sweep'. The fingers are placed in the cervix and the cervix is stretched. The membranes are then separated from the lower segment by moving the fingers once clockwise between the cervix and the membranes. This releases prostaglandins and may start labour.

For this reason vaginal examinations are avoided in premature labour as it may stimulate contractions.

The uterus also contracts during menstruation. These contractions may be uncomfortable or even painful, but they are generally significantly less painful than contractions during labour. The semen contains substances similar to prostaglandins that cause contraction of the uterus and vagina during female orgasm to encourage semen to reach the fallopian tubes. These contractions may not be noticed by all women. Pregnant women are more likely to notice these contractions by late second and third trimesters. When a woman is at risk for preterm birth, intercourse is discouraged.

Prior to actual labour, women may experience 'Braxton-Hicks' contractions. These are pre-labour contractions less than 30 seconds in duration, irregular one or two in 10 minutes and less than 40 mmHg in intrauterine pressure. Braxton-Hicks contractions prepare the cervix and may be involved in 'ripening' of the cervix for labour. They are also associated with 'false labour' where contractions are present but the cervix is not dilating.

Under the influence of oxytocin the contractions become regular and stronger or more intense, labour starts and is characterised by the presence of the mucus or 'show', changes of the cervix and decent of the fetal head in a normal vertex presentation.

The dynamics of normal uterine function

When labour starts, the uterus contracts regularly, and reaches a point where labour is irreversible. Although there are variations of uterus action between women, in 90% of cases the uterus functions in a predictable pattern. This has been determined scientifically. 'Normal' uterine contractions in established labour have a specific pattern, strength and number of contractions that can be assessed to determine abnormalities or deviations (see Chapter 30).

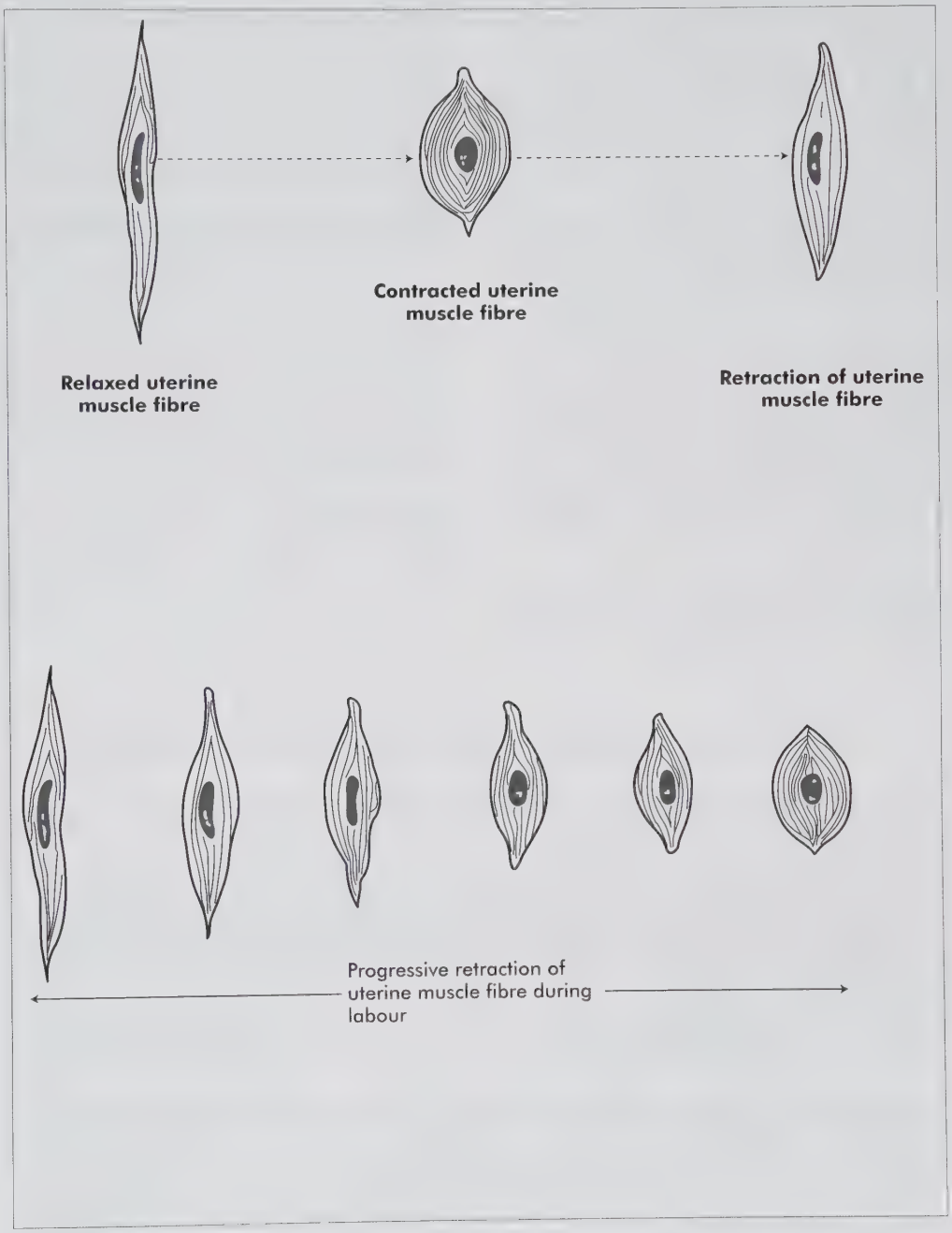


Figure 8.16 Contraction and retraction of the uterine muscle during pregnancy (Braxton-Hicks contractions) and during labour

Quantitative assessment

Figures 8.17 and 8.19 show that true quantitative assessment of uterine actions can only be done by an intrauterine pressure device. The pressure of the contraction is measured in Montevideo units (MVUs). When there is no contraction the resting tone (pressure) of the uterus is 8–12 mmHG. At the peak of a contraction the pressure increases to 60–75 mmHg A sum total of 200 mmHg in 10 minutes is required.

Clinical assessment of contractions is done manually by the midwife and is measured in seconds. The contractions are considered weak, mild or strong based on the duration, strength or intensity in 30 sec, 45 sec or 60 sec respectively and are an indirect estimation of contractions.

The effect of the contractions on the course and progress of labour is the measure of true labour and depends on all the Ps of labour.

Qualitative assessment

This can be observed manually, or with an external toco transducer. The number of contractions in 10 minutes can be determined. In spontaneous labour regular, frequent contractions indicate true, established and effective labour. Descent of the presenting part and cervical changes will result.

Midwives assess contractions manually on the abdomen by placing her finger tips on the fundus of the uterus for a period of 10 minutes every hour. The number (frequency) and duration (strength) of contractions are reported, for example, 3 contractions of 45 seconds each.

Electronic monitoring of the uterine action is useful but cannot replace the midwife's direct observation of labour. It is a supportive tool but can lead to inaccuracy and artefacts.

Women generally experience a contraction when the intrauterine pressure exceeds 30 mmHg. This creates a difference of 20 seconds between the woman's experience and the midwife's observation. Midwives need to be aware of this difference and not only rely on the woman's report. If a woman reports 'pain' before the midwife observes a contraction or after the contraction has gone, it may indicate abnormal uterine action.

Characteristics of normal uterine function

The physiology of labour depends on the relationship between the passage, passenger and powers. When the fetus is in a favourable position and the presenting part 'fits' well on the cervix, it stimulates normal contractions.

Uterine actions are thus always considered in line with the position of the fetus and the application and descent of the presenting part, and the progress of dilatation. The following physiological aspects are considered.

Uterine tonus

There is always pressure in the uterus even when in a state of rest. The resting tone of the uterus is 8–12 mmHg. When the uterus contracts the pressure increases and reaches a peak (See Figure 8.18). During a contraction the pressure on the

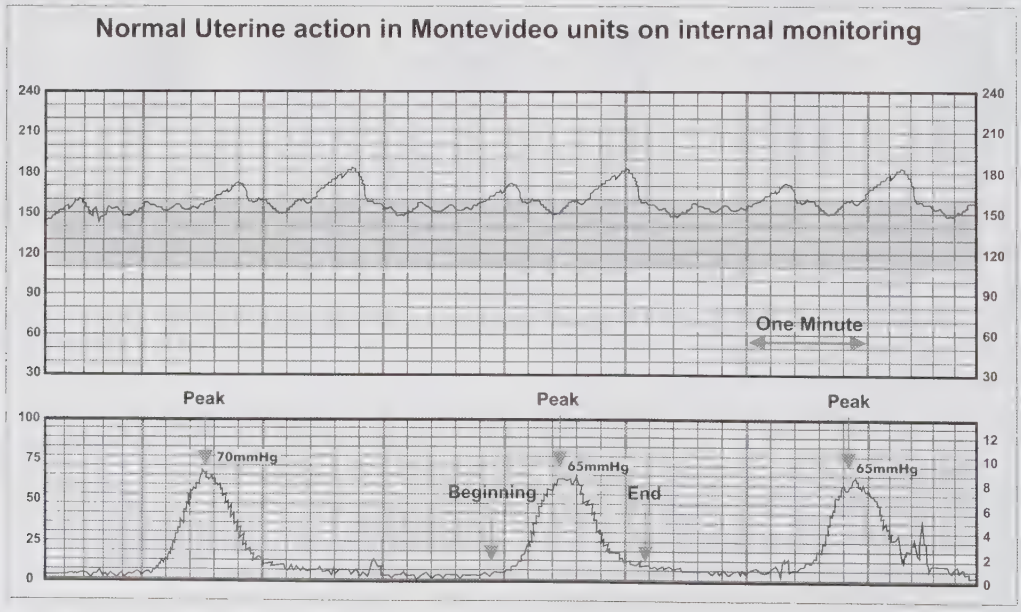


Figure 8.17 Schematic presentation of normal uterine action

fetal head measures up to 200 mmHg. In the second stage of labour the peak is 80 mmHg or more. An increase in the basic resting tone above 12 mmHg is suspect and needs attention; it may indicate a silent abruption.

Hypertonic contractions indicate overstimulation of the uterus by medication in the induction of labour (see Chapter 30).

If the uterus is not stimulated artificially it may indicate obstructive labour.

Fundal dominance

Fundal dominance indicates that the contractions start in the upper segment in the pacemakers of the fundus and spreads over the uterus 2 cm per second to the other pacemakers until the uterus contracts as one unit. This is called the contraction wave (see Figure 8.19). If the contraction starts in the lower segment there will be poor progress.

Polarity

Effective uterine action occurs when the uterus contracts as a unit. This means that there is fundal dominance and that the contractual wave spreads over the uterus and both sides contract together. Apolarity means that some of uterine muscles contract independently. This can be referred to as a colicky uterus.

Normal uterine contractions thus are characterised by a normal resting tone between contractions, fundal dominance (contractions starting in the fundus), polarity (the uterus contracting as a unit) and 2–3 contractions of 45–60 seconds in 10 minutes.

Definitions of normal uterine actions

- *Contraction* is the spontaneous contraction of the uterine muscle measured in Montevideo units.
- *Retraction* is the ability of the uterine muscle to relax and become shorter with each contraction. This diminishes the uterine cavity and pushes the fetus out.
- *Tone* is the basic pressure in the uterus. The normal is 8–12 mmHg. The uterus will be at rest between contractions. Increased basal tone can interfere with placental fetal blood flow.
- *Amplitude* (quantitative assessment) also referred to as intensity or 'strength' of a contraction. Accurately measured with intrauterine monitors but also observed manually or with external monitors.
- *Frequency* (qualitative assessment) is the number of contractions in 10 minutes. Clinically 2–3 contractions are required for labour. Scientifically a total value of 200 mmHg (MVU) (the sum total of all the contractions in 10 minutes) is reached in 90% of women that deliver normally.
- *Duration* is the time from the beginning to the end of a contraction. The observation of the duration of a contraction is

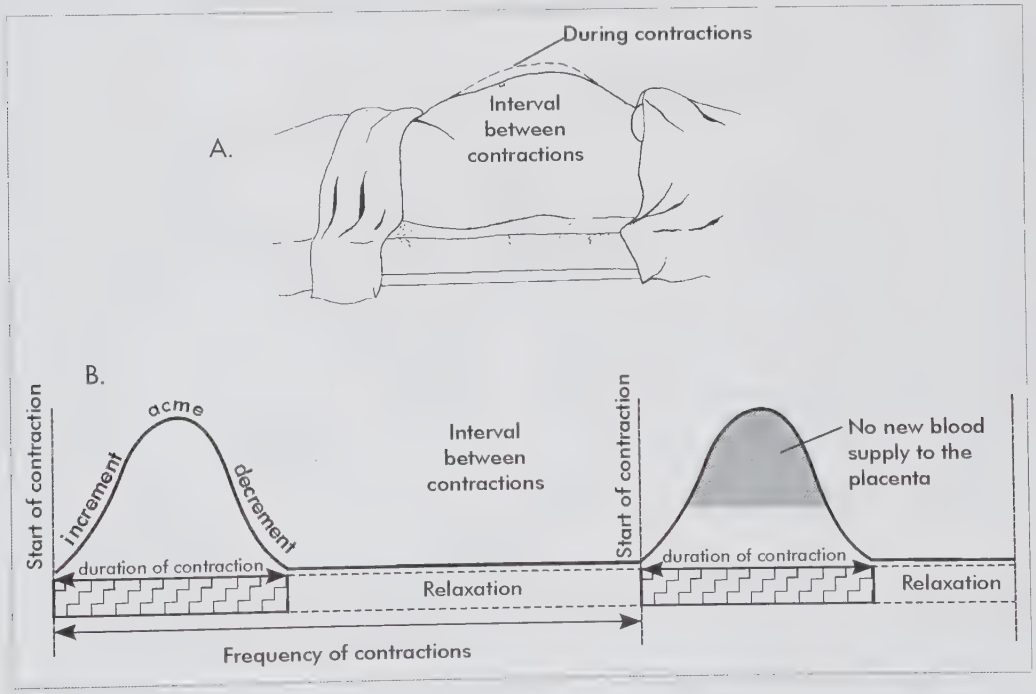


Figure 8.18 Uterine contractions
A: Changing of abdominal contours before and during the contraction
B: Wavelike pattern of contractions

observed as 'pain' by the patient and will differ between the woman's perception and the midwife's findings on abdominal palpation of the contraction.

- *Physiological retraction ring* is when labour progresses, the upper segment of the uterus becomes shorter and thicker and the lower segment stretches and becomes longer. The physiological boarder between the upper and lower segment is the physiological retraction ring.

Synchronised/symmetrical uterine action

Effective uterine action will occur when the uterus contracts as a unit.

Although the science of normal uterine action is described here, the midwife must always be aware of individual differences and other factors that affect labour. The fetus's size, position and presentation affects uterine action. A well-flexed anterior vertex position that presents with 9.5 cm biparietal x 9.5 cm suboccipital-bregmatic diameters are ideal for labour if the baby is of average size and a well-fitting presenting part stretches the lower segment. The Ferguson reflex kicks in and labour should progress with good contractions. The midwife should be able to distinguish the normal from the abnormal.

Obstructed labour/Bandl's ring

A serious and preventable condition in labour is obstructed labour.

This can occur when the fetus is too large, in an abnormal presention or position and/or the fetus does not fit the pelvis due to bony pelvis problems or soft tissue problems such as placenta previa.

Signs and symptoms include risk factors such as a large or pendulous abdomen, a small woman, or a large fetus, an unengaged head at 36 weeks in the primigravida and at the start of labour in the multigravida, a high head on vaginal examination with a curtaining cervix (indicating poor application of the presenting part), formation of caput and moulding in labour, good contractions that become progressively hypertonic and then gradually disappear, prolonged labour and maternal and fetal exhaustion.

The type of pelvis is of importance but is difficult to identify in labour (see Table 8.3).

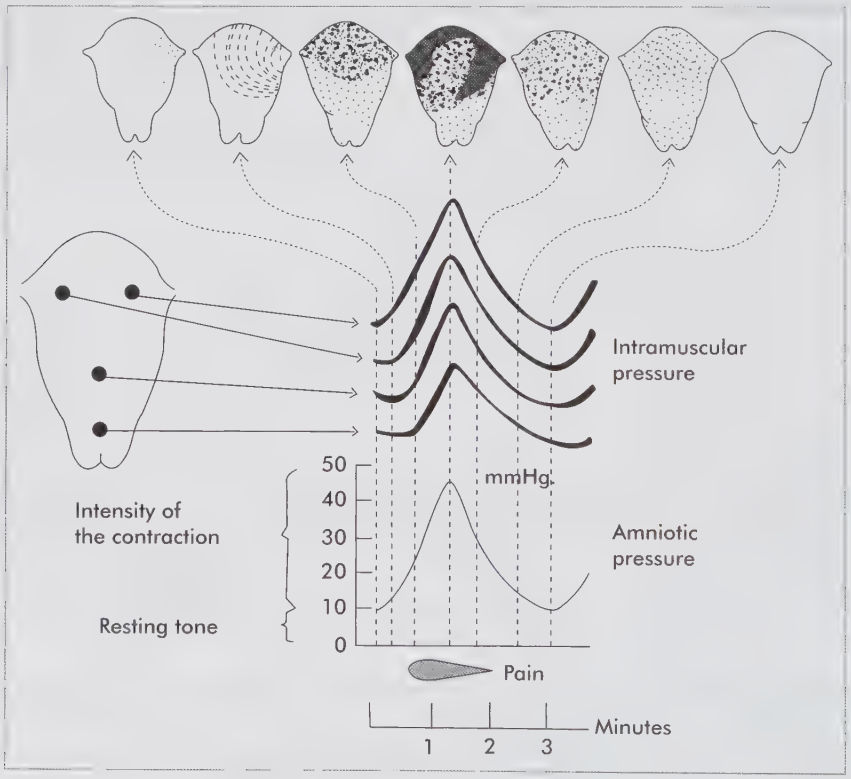


Figure 8.19 A normal contraction wave passing over the uterus indicating the pain experienced

Redrawn from Caldeyro-Barcia (1959), in Llewellyn-Jones, D. 1982. *Fundamentals of Obstetrics and Gynaecology,* Vol1: Obstetrics. London: Faber & Faber

Table 8.3

Some differences in birth between black and white women

ASPECT		Effect on labour	Researcher
Rate of dilatation	The dilatation of black primigravidae is half that of white women	Longer latent phase	Phillpot & Castle (1972) Hendricks, et al (1970)
Rate of dilatation in early active phase	Black women dilate slower after 5 cm in early active phase than white women	Longer active phase Primary and secondary arrest more common	Duignan, et al (1975) 3217 case
Level of presenting part	The level of the presenting part in black multipara is higher than white women on admission		Duignan, et al (1975) 3217 cases Tuck, et al 1993
Uterine pressures	The IUP is 66% higher in black women than white women	Black women need higher uterine pressure to overcome CPD	Steers, et al 1984 Cowen 1982
Second stage	Second stage of labour is significantly shorter in black primi- and multigravidae than any other ethnic group		Tuck, et al 1993
Pelvis	Pelvises of black women are 20% smaller than white women	A higher rate for CPD and caesarean section	Steyn (1994) and Evans (1950)

Source: Farell, in Pattison 2005:15–17. *Intapartum Care in SA MRC*

Pathophysiology

The uterus contracts. With each contraction the upper segment contracts and retracts. This means that the upper segment becomes shorter and thicker and pushes the fetus into the lower segment of the uterus. The lower segment becomes longer and thinner. If the fetus is obstructed by the pelvis, the process will continue until the upper segment reaches its maximum contractile ability and cannot contract any further. The upper segment is now a thick spastic bundle of muscle, the lower segment is overstretched and long and thin. The fetus is jammed in the pelvis and labour is arrested. The difference between the two segments can be seen and felt on the abdomen and is called Bandl's ring (See Figure 24.6). This is also known as the pathological ring. This labour cannot proceed and can result in a ruptured uterus if multigravidae, or obstetric shock, death and postpartum haemorrhage for primigravidae, with possible placental abruption. Only a caesarean section can correct this condition. Early identification and intervention is needed to prevent it. Obstructed labour and the development of Bandl's ring in a woman under observation by health professionals is inexcusable and negligent.

- *Constriction ring.* A circular segment of the myometrium goes into spasm and constricts over the fetus causing a delay in birth.
- *Effacement* is the change of the cervix where it becomes shorter and part of the lower segment of the uterus when the presenting part descends. It starts in pregnancy when the cervix ripens.
- *Dilatation* is the opening of the cervical os due to the descent of the presenting part and is measured in centimetres. Full dilatation is 10 cm.
- *Effective contractions.* True labour is characteristic with contractions that will cause the descent of the presenting part and progress in the effacement and dilatation of the cervix. Labour reaches a stage where birth is irreversible.

Abnormal uterine action is explained in Chapter 30.

8.5 Conclusion

This chapter presented aspects of the Ps of labour, the passage, the passenger and the powers which are considered to be the three major factors in childbirth. An experienced midwife should know the normal from the abnormal. This starts with a thorough understanding of the normal.

CHAPTER

9 The breasts and lactation

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- demonstrate knowledge of the anatomy and physiology of human lactation
- demonstrate knowledge of the strategies for protection and promotion of breastfeeding
- identify advantages of and contraindications to breastfeeding.

KNOWLEDGE ASSUMED TO BE IN PLACE

Basic anatomy and physiology of the female breast

KEYWORDS

Mammae • Lactation • Oxytocin • Hypergalactia • Galactorrhoea • Agalactia • Lactogenesis • Galactopoiesis

9.1 Introduction

The importance of breastfeeding warrants a scientific view of evidence-based findings on breastfeeding and breast milk. To date there is no true substitute for breast milk. Replacement feeding has been adapted to suit various special needs of infants, but can never be as good as the milk produced by a mother, tailor-made for the baby. However, breastfeeding is the mother's choice and the woman needs to be supported in her choice. In places where breastfeeding is universal or the norm it needs to be protected. The midwife must have a thorough knowledge of the anatomy and physiology of the breast and factors that may affect a woman's choice of feeding.

9.2 Protection and promotion of breastfeeding

The WHO and UNICEF support and protect breastfeeding.

If every baby were exclusively breastfed from birth for six months, an estimated 1.5 million lives would be saved each year. Breast milk alone is the ideal nourishment for infants for the first six months of life because it contains all the nutrients, antibodies and hormones that an infant needs to thrive. It protects babies from diarrhoea and acute respiratory infections,

9.1 UNICEF's strategy for infant feeding

UNICEF's strategy for infant and young child feeding is based upon the Innocenti Declaration for the protection, promotion and support of breastfeeding. The Innocenti Declaration was adopted in 1990 and endorsed by the World Health Assembly and UNICEF's Executive Board. The four Innocenti targets in the Global Strategy for Infant and Young Child Feeding adopted by the World Health Assembly in May 2002 include:

1. appointment of a national breastfeeding coordinator of appropriate authority, and establishment of a multisectoral national breastfeeding committee
2. ten steps to successful breastfeeding (the Baby-Friendly Hospital Initiative) practised in all maternity facilities
3. global implementation of the International Code of Marketing of Breast-Milk Substitutes and subsequent relevant World Health Assembly Resolutions in their entirety
4. enactment of imaginative legislation protecting the breastfeeding rights of working women and establishment of means for enforcement of maternity protection http://www.unicef.org/programme/breastfeeding/.

and stimulates their immune systems and responses to diseases and aids the response to vaccination.

Breastfeeding also has many health and emotional benefits for the mother, including decreased blood loss postpartum, delayed return to fertility, and decreased risk of cancer of the breast. Immediate postpartum breastfeeding helps the bonding between mother and child.

UNICEF's goal is that all women exclusively breastfeed for six months and continue breastfeeding, with complementary food, well into the second year and beyond. This requires support systems that will help women achieve this aim.

The midwife is the healthcare worker closest to the mother and infant in pregnancy, birth and the early and late neonatal periods. The midwife needs to guide the practice and promote breastfeeding within the framework of the UNICEF guidelines. Women are not forced to breastfeed but are guided and supported to do so. Midwives need a thorough understanding of the anatomy, physiology, sociology, psychology and pathology of breastfeeding.

9.2 World Breastfeeding Week

World Breastfeeding Week is celebrated every year, on the anniversary of the Innocenti Declaration, 1–7 August.

9.3 Development and anatomy of the female breast

(See Figures 9.1 and 9.2.) The breasts, known also as the mammary glands or mammae, exist in both sexes and are present as rudimentary glands at birth. In the male, they normally remain rudimentary throughout life, unless they are stimulated in some way by female hormones. The breasts are accessory glands of the female reproductive system.

In the female, the breasts are underdeveloped before puberty, but they undergo further development during and after puberty. During pregnancy the breasts develop milk glands under the influence of oestrogen and after birth further development takes place to enable lactation.

The increased development of the glandular tissue of the breasts is stimulated by an increase in the female hormones at puberty and during pregnancy and lactation.

Breast development

During puberty, the breasts form two rounded eminences, one on either side of the anterior chest wall. They are situated within the superficial fascia of the chest wall. They are separated from the chest muscle, the pectoralis major, by the deep fascia and by a zone of loose areolar tissue, the submammary space, which allows the breast some degree of movement on the deep fascia.

The shape and size of the breasts differ in each individual, as well as at different ages in each individual.

Just below the centre of each breast there is a small, cylindrical projection that is harder and darker in colour than the rest of the breast and this is known as the nipple or papilla. In the nulliparous woman, it usually lies at about the level of the fourth intercostal space.

The tissue of each breast extends vertically from about the second to the sixth rib, and horizontally from the side of the sternum to near the midaxillary line. The tissue of the upper, outer quadrant of each breast extends upwards and laterally towards the axilla, forming the tail, which may pass through the deep fascia and lie in close contact with the axillary lymph nodes.

In all mammals in early fetal life, a line of immature breasts extends from the axilla to the inguinal region on either side (embryologic mammary ridges). In humans, the majority of these breasts disappear, leaving only two. However, occasionally, some of these breasts and nipples persist and are known as supernumerary or accessory breasts. They seldom rival the proper breasts in size and function and when only a nipple persists, it can be mistaken for a pigmented mole.

Some women have nipple-lines down one or both sides of the chest and abdomen, and many of these rudimentary breasts also secrete milk in various quantities after delivery.

Anatomy of the female breast

The breast is made up of glandular tissue, fibrous tissue and adipose tissue, and is covered on the outside by skin.

The skin and areola of the breast

The breast is covered with skin and subcutaneous tissue, but at the centre of the breast, around the nipple, the covering consists of primary areolar tissue, which is a specialised form of skin. This areola is pigmented and because it contains more glands, is less smooth than the skin covering the rest of the breast.

During pregnancy and lactation, this primary areola becomes even darker and more extensive, and the areolar glands situated within it become larger and more active and this is then known as the secondary areola. Some of the glands in the areola are sebaceous glands, some a combination of sebaceous and sweat glands and some, Montgomery's glands, are small oil glands. The oily secretion from these glands provides a protective lubricant for the areola and nipple during lactation.

The subcutaneous tissue which encloses the breasts sends numerous septa into the breast, to surround each lobe.

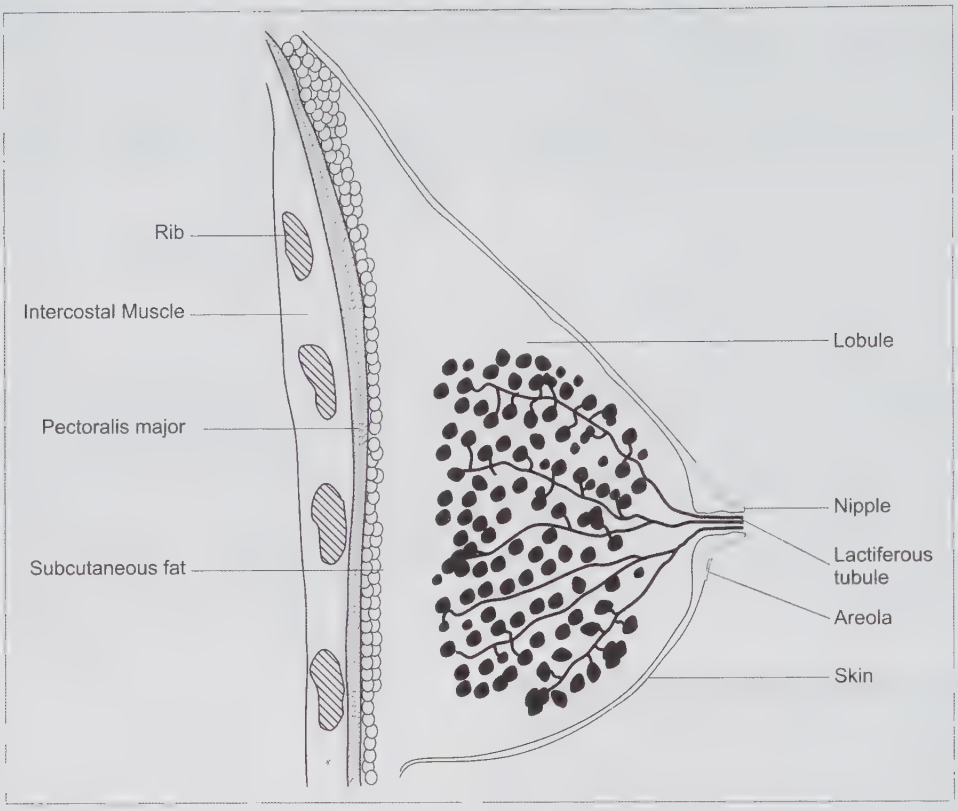


Figure 9.1 Sagittal view of the female breast

The adipose tissue

This forms the bulk of the breast tissue and the amount of adipose tissue present determines the size of the breast.

The fibrous tissue

The fascia on which the breast rests sends out extensions in the form of fibrous processes, from the back of the breast forwards to the subcutaneous tissue underlying the skin and nipple, in order to give support to the breast. These processes are the suspensory ligaments of Cooper.

The glandular tissue of the breast

There are fifteen to twenty lobes in each breast, which are made up of glandular tissue and ducts. Each lobe is made up of thirty to forty tiny lobules, which are connected by ducts, by loose connective tissue and by blood vessels.

Each lobule, when fully developed during pregnancy and in the puerperium, consists of a rounded cluster of between ten and one hundred acini, also called alveoli, which produce milk.

These alveoli open up into tiny ducts, which are the smallest ducts of the breast. These tiny ducts unite to form larger ducts draining each lobule and they in turn, lead into still larger ducts, known as the lactiferous ducts, which drain each lobe. They converge towards the areola, where they become slightly distended, forming the lactiferous sinuses, which will serve as reservoirs for milk during lactation. The lactiferous ducts then continue as narrow, straight ducts, which pass through the nipple and lead to tiny openings at the end of the nipple.

The nipple, which is composed of erectile tissue, is surrounded by smooth muscle fibres and nerve endings, which cause erection of the nipple.

The alveoli and tiny ducts are surrounded by neo-epithelial cells known as myoepithelial (M-E) cells.

The myofibrils of these cells contract under the hormonal stimulation of oxytocin, causing the 'let-down' of milk. When these myofibrils relax under sympathetic stimulation, the 'let-down reflex' is inhibited.

The blood supply to the breast

The arterial supply. Blood supply is increased in pregnancy and lactation. Breast fullness and visible veins of the breasts are early signs of pregnancy. The following arteries supply the breast:

- *The internal mammary artery.* This artery branches from the first part of the subclavian artery above the sternal end

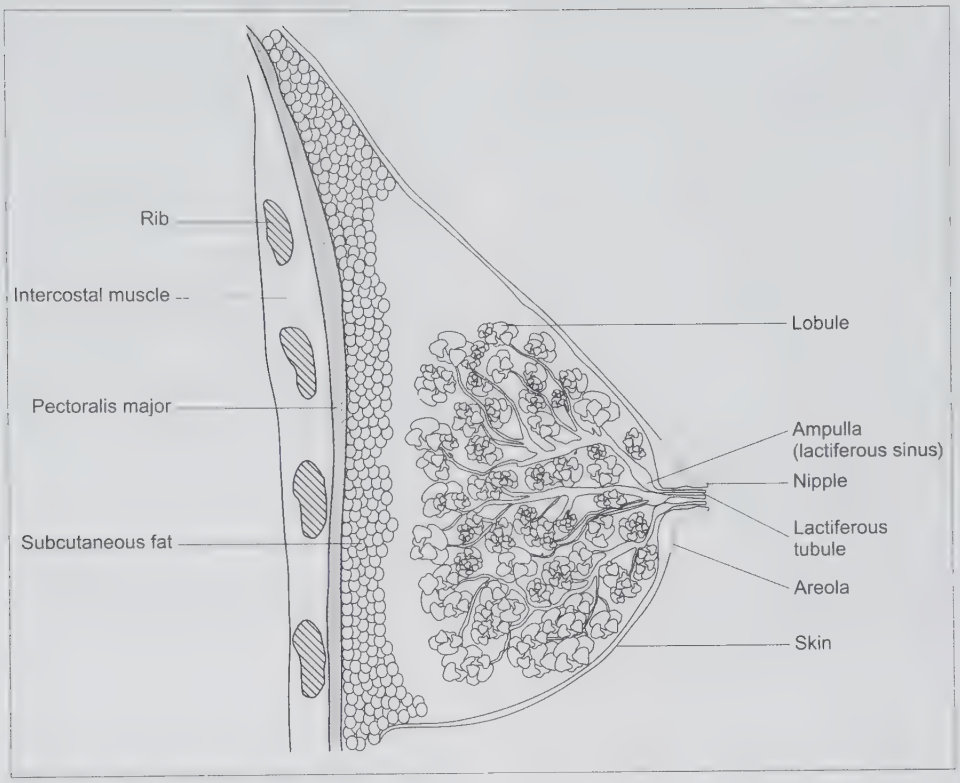


Figure 9.2 A sagittal section through a *lactating* breast and the anterior chest wall

of the clavicle. It descends into the thorax behind the cartilages of the upper six ribs giving off branches to organs and tissues on the way. The anterior intercostal branches are distributed to the upper six intercostal spaces. These branches supply the intercostals and send further branches through them to the pectoral muscles, the breast and the skin.

- *Branches from the axillary artery (external/lateral mammary branches).* The axillary artery is a continuation of the subclavian and begins at the outer border of the first rib. As it descends down the arm, it sends off branches, one of which follows the lateral border of the pectoralis minor to the side of the chest and is called the lateral thoracic artery.

  In the female, the lateral thoracic artery is large and gives off lateral mammary branches, which wind round the lateral border of the pectoralis major to reach the breast.
- *Upper/posterior intercostal arteries.* The descending thoracic aorta gives off branches to the thorax. Arising from the back of the aorta are the posterior intercostal arteries. These are distributed to the intercostal spaces and give off mammary branches to the second, third and fourth spaces. During lactation, these arteries increase considerably in size.

The venous drainage:

- *The circulus venosus:* This is an anastamotic circle at the base of each nipple and drains into:
  - the axillary vein
  - the internal thoracic vein.

Both of these veins drain into the subclavian vein, which becomes the brachiocephalic vein and finally, the superior vena cava.

Each mammary branch of the posterior intercostal artery is accompanied by a corresponding vein and nerve. There is more circulating blood in the breasts during pregnancy and lactation than in the non-gravid state.

The lymphatic drainage of the breast

The lymph vessels originate in a plexus in the interlobular connective tissue and in the walls of the lactiferous ducts. This plexus communicates with a subcutaneous lymphatic plexus beneath the areola surrounding the nipple.

The lymphatics of the two breasts communicate freely with one another.

The lymph drains to the following regional nodes:

- The axillary glands in both axillae: These are the pectoral lymph nodes, which commonly receive more than 75% of the lymph from the breasts.
- Glands in the anterior mediastinum: These are the parastemal nodes which drain the medial halves of the breasts.
- Glands in the portal fissure of the liver.

The nerve supply to the breast

The nerve supply to the nipple is good, but it is poor to the remainder of the breast. There is no voluntary central nerve supply to the breast and no parasympathetic nerve supply.

The nerve supply to the breast is from the autonomous system and of sympathetic fibres only:

- *Sensory (afferent) somatic fibres.* Impulses are transmitted from the nipples, via the spinothalamic tracts, to the hypothalamus and so to the pituitary gland. When the baby suckles on the breast, these fibres transmit impulses to the hypothalamus that are then transmitted from there to the anterior pituitary gland, to release the hormone prolactin into the blood stream, and at the same time the posterior pituitary gland, release the hormone oxytocin into the blood stream.
- *Motor (efferent) sympathetic fibres.* Impulses are transmitted from the brain, via the thoracic prevertebral ganglia, to the breast. These cause reflex erection of the nipple during the suckling of the baby or by tactile stimulation, but can also cause reflex vasoconstriction of arterial blood supply and therefore relaxation of the myoepithelial cells, so causing inhibition of the milk flow (inhibition of the 'let-down reflex'). This comes about as a result of pain, fear, worry, embarrassment or distaste. There is a close relationship between the nerve supply to the breast and hormonal influences on the breast.

9.4 Physiology of lactation

Hormonal influences on the breast

During puberty, the influence of hormones on the breasts increases and persists until the menopause. They respond to cyclical variation in hormonal levels each month, corresponding to the menstrual cycle and also to alterations in hormonal levels during pregnancy and lactation. The hormones that influence the breasts and the manner in which the breasts respond are:

- *Oestrogens and progesterone.* These hormones are produced by the Graafian follicles and the corpus luteum of the ovary under the influence of the hypothalamus and anterior pituitary gland. They influence the breasts during and after puberty and are responsible for the development of these accessory (secondary) glands of the female reproductive system. During early pregnancy, the trophoblast produces human chorionic gonadotrophin, which stimulates the ovary to continue producing oestrogens and progesterone and later the placenta produces oestrogens and progesterone in large amounts. These hormones are responsible for the breast development that takes place during pregnancy and lactation.
  - *Oestrogen.* From the onset of puberty, and during pregnancy, oestrogen causes the duct system to grow and to branch, and also increases the quantity and the deposition of connective tissue and of fat in the breast.

    Oestrogen causes enlargement of the nipple and areola. Four other hormones are also important in the development of the breast: growth hormone, prolactin, adrenal glucocorticoids and insulin.
  - *Progesterone.* Progesterone acts upon the tissues already established by the oestrogens, causing proliferation of these tissues (it also causes premenstrual fullness and congestion of the breasts). During pregnancy, progesterone increases the secretory tissue and develops the secretory characteristics of the alveoli (acini) cells. Both oestrogens and progesterone have the specific effect of inhibiting the effects of prolactin and thereby inhibiting the actual secretion of milk.
- *Prolactin.* This hormone is secreted by the anterior lobe of the pituitary gland. Unlike the production of the other hormones, which are stimulated by the hypothalamus, prolactin production is inhibited by the hypothalamus. Prolactin is carried in the bloodstream during pregnancy when, together with the oestrogens, it increases the development of the duct system of the breasts and is responsible for the secretion of milk, at the initiation of lactation and in the maintenance of lactation.

  The secretory effect of prolactin is inhibited by high levels of oestrogen and progesterone. This means that, although there are high levels of prolactin in the bloodstream towards the end of pregnancy, the secretory effects of prolactin are severely curtailed by the high levels of the oestrogens and progesterone, although a small amount of

colostrum is produced in the breasts. However, the sudden drop in oestrogens and progesterone with the delivery of the placenta at birth allows prolactin to assume its function of promoting milk production.

Hyperprolactinemia can also be present in conditions of severe stress. If a woman suddenly develops engorged breasts or produces milk in pregnancy this may be a sign of decreased placental function.

- *Oxytocin.* This hormone is secreted by the posterior lobe of the pituitary gland under the influence of the hypothalamus. It is mainly stimulated by the baby suckling on the breast, but may also be stimulated by the mother just seeing or hearing her baby, or by an increase in temperature. Oxytocin is carried in the bloodstream to the breasts, where it causes the myoepithelial cells that surround the outer walls of the alveoli to contract, and thereby causes milk to be expressed from the alveoli and into the duct system. At the same time the oxytocin is carried to the uterus, where it causes contraction of the uterine muscles and helps in the involution of the uterus.
- *Other hormones.* The known effects of other hormones on breast milk production are indicated in Box 9.3.

9.3 Hormones affecting lactation

Growth hormone ACTH	Establishes and maintains lactation
Human placenta lactogen	Has mild lactogenic properties and supports prolactin
Thyroxine	Important in the maintenance of lactation
Prolactin inhibiting factor	Controls the secretion of prolactin
Insulin	Supports prolactin in milk synthesis

Lactogenesis

Lactogenesis is the initiation and production of milk by the breasts. Galactopoiesis is the maintenance of lactation. Hypergalactia refers to overproduction of milk and galactorrhoea is abnormal milk production. Agalactia indicates an inability to lactate.

Lactogenesis and volumes of milk secretion

The stages of milk production are colostrum, transitional milk and mature milk.

- Colostrum is present during pregnancy and is the first food for the infant and has a particular function. It is a thick yellowish fluid with a specific gravity (SG) of 1040–1060. (The SG for mature milk is 1030.) The yellow colour is due to high levels of β carotene (vitamin A). It contains over sixty components, thirty of which are exclusive to human milk. Colostrum continues to offer the immunity that was available to the fetus via the placenta. It is high in protein, as well as fat-soluble vitamins and minerals. Colostrum contains high amounts of sodium, potassium, chloride and cholesterol to encourage optimal development of a baby's heart, brain and central nervous system. Colostrum's natural laxative benefit encourages the passage of meconium, which reduces the risk of jaundice in a baby. This fluid is rich in immunoglobulins, which protect an infant from viruses and infections. It continues to be secreted for up to two weeks postpartum. The energy value is 67 cal/100 ml (280 kJ) versus 75 cal/100 ml (313 kJ) of mature milk. The volume varies between first mothers and multigravida and is about 2–10 ml/feed/day for the first three days. Sodium, potassium, chloride, fat, protein, fat-soluble vitamins and minerals are present in greater concentrations than in mature milk. The fats present in colostrum are directly excreted from the mother and are smaller than the fat globuli that will be synthesised in mature milk.

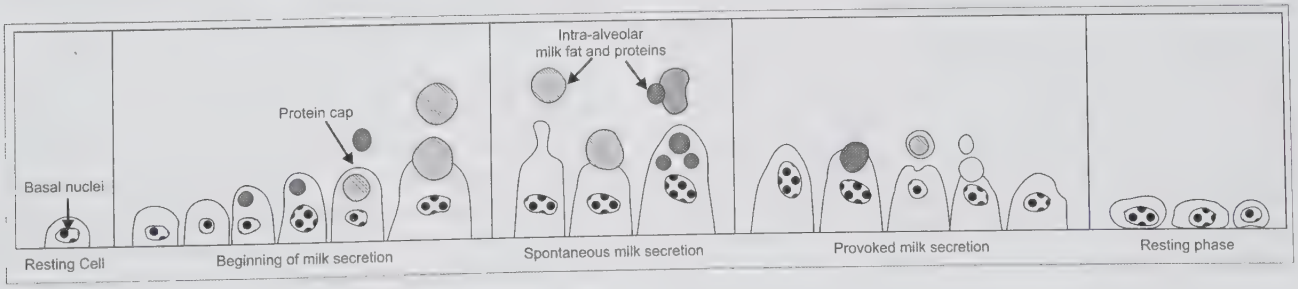


Figure 9.3 Synthesis of human milk at cellular level

- Transitional milk is produced between day 7–10 for two weeks and the composition of milk changes gradually to mature milk.
- Mature milk will be present after 14–21 days and looks watery rather than creamy because of the high concentration of whey. Water is the main constituent of breast milk and is related to the glucose content. It meets the requirement of the baby and no added water is needed. When hormones are released lactation starts and is maintained by the stimulation of the nipple and the emptying of the breast. Milk synthesis is continued, but 80% of milk production occurs during suckling. The rate of milk synthesis is 11–58 ml/hour/breast. Emptier breasts make milk faster than fuller ones. Regular emptying of the breasts is the main way to produce more milk. The 80–20 principle remains. Breasts will make 15–20% more milk than the baby takes. If the baby drinks 80% the milk will fill up. If the baby takes less than 80% the breasts will make less.

The rate at which milk is pumped out of the breast depends on how empty the breasts are at that stage.

Synthesis and properties of human milk

The synthesis of human milk is unique. It makes a tremendous demand on the maternal system, with a marked change in the woman's metabolism. This includes a redistribution of blood, which causes cardiovascular changes in the mother with increased blood flow to the breasts, gastrointestinal tract and liver and an increased cardiac output. The increase in the metabolic rate places a burden on the thyroid gland and the thyroid is enlarged during lactation. Milk production depends on suckling that releases the hormones for milk production.

Breast milk changes during the course of a feed and throughout the day. It is secreted first as foremilk, which satisfies a baby's initial thirst. Hindmilk is secreted as the feeding progresses. It is high in fat and calories to promote growth and development in a baby.

Preterm milk differs markedly from full-term milk by offering premature babies longer access to colostrum, higher levels of IgA and other anti-infective properties. Preterm milk also contains greater concentrations of triglycerides and long-chain fatty acids. It is 20% higher in nitrogen (protein) than milk for term babies, to meet the growth needs of the small baby. These qualities offer the premature infant optimal nutrition for his short-term energy needs as well as for his long-term neurological and visual development. Preterm milk also offers the best protection from necrotising enterocolitis (NEC), an often fatal condition in premature babies.

The composition of mother's milk is influenced by the mother's fluid and food intake. Human milk contains at least one hundred ingredients not found in any artificial infant milk. Milk is produced by apocrine (where the secretion contains part of the cell) and merocrine (where the cell remains an intact mechanism with minimal mitosis) metabolic processes (See Figure 9.3).

9.4 Metabolic processes of the mammary gland

Protein	apocrine
Fat	apocrine
Lactose	merocrine
Ions	diffusion and active transport
Water	diffusion

Milk is synthesised in the alveolar cells of the acini. The epithelial cells of the milk gland contain stem cells and are highly specialised at the terminal duct. They are stimulated by human growth hormone (HGH) and insulin. Prolactin synergises the cells to start activity and is mainly responsible for the synthesis of milk that takes place during suckling. The plasma levels of cortisol are also increased during suckling (See Figure 9.3).

The secretory cells are cubical at the beginning of suckling and change into cylindric cells prior to milk secretion because of increased water uptake. The cell's nucleus is at the base of the cell and moves to the apex before secretion. The cytoplasm is granular but changes to striated as milk secretion begins. The enlarged cell with its thickened apical membrane becomes clublike and the tip pinches off, leaving the cell intact (apocrine). The portion containing fat, protein and a small amount of cytoplasm is free and the baby will drink a freshly secreted cell portion. The following are unique characteristics of human milk:

- *Immunological properties.* Breast milk contains 4 000 cells/ml that have mainly been identified as leukocytes (high in colostrum). The macrophages secrete lysozyme and lactoferrin while lymphocytes produce IgA and interferon. Neutrophils are also present. Breast milk contains macrophages. These cells kill bacteria, fungi and viruses. Lactoferrin coats and protects a baby's intestines. When combined with lysozyme, this has a direct antibiotic effect on bacteria such as *E. coli* and staphylococci. Secretory IgA, along with other immunoglobulins, protects the ears, nose and throat, as well as the gastrointestinal tract against foreign viruses and bacteria. These antibodies are capable of altering their protective qualities to fight any allergens or pathogens that may be present. This action decreases an infant's chances of developing allergies, respiratory infections, otitis media (ear infections) and asthma.

- *Enzymes.* Some enzymes enter mothers' milk from the maternal intercellular fluid and others are broken down in the mammary cells. These include xanthine oxidase, aldolase, and alkaline phosphate. Lipase assists with fat metabolism. Other enzymes like amylase do not seem to contribute to infant digestion.
- *Electrolytes, minerals and water.* Water and electrolytes (sodium, potassium, chloride, magnesium, calcium, phosphate, sulphate) cross the membrane in both directions. The water secretion in human milk depends on the availability of glucose. The sodium and potassium is lower than in plasma with a ratio 1:3. Human milk has lower monovalent ions (sodium and potassium) and higher lactose content than the mother's plasma and this relationship distinguishes human milk from that of other species. Trace minerals are low in human milk. These are zinc, copper, selenium, manganese and iron.
- *Glucose (carbohydrate) metabolism.* This is a key function in milk production, and is the main source of energy. It is critical to the volume of milk produced. Most is derived from blood glucose and the process is regulated by progesterone. Lactose accounts for the majority of carbohydrates in human milk. The concentration is 6.8 g/100 ml versus 4.9 g/100 ml in cow's milk. It enhances calcium absorption and metabolises carbohydrates into galactose and glucose, which supplies energy to an infant's rapidly growing brain. The largest portion of the carbohydrate is monosaccharide, with a low percentage of glucose. The enzyme to metabolise lactose is not present in preterm babies under 30 weeks and it disappears at the age of three years.
- *Fats.* The alveolar cells are able to synthesise short chain fatty acids. Long chain fatty acids come directly from the blood plasma of the mother. Prolactin stimulates the increase of enzymes to assist the capillaries with the production of fats. The fat droplets accumulate in the base of the cell and form larger drops that move to the apex. These are secreted by the apocrine process described (see Figure 9.3). The fat droplets mainly contain polar lipid and phosphatidyl choline. Human milk contains numerous long-chain fatty acids including DHA and ARA. At least 167 different fats have been identified in human milk. These lipids are responsible for cell membrane integrity in the brain, retinas and other parts of a baby's body. If a mother's milk contains 20% fat on day seven postpartum, breastfeeding will most probably be successful. A woman's food intake has a direct influence on the type of fat in her breast milk.
- *Protein (nitrogen).* This is produced by free amino acids in the cells. Protein is 75% of the nitrogen in human milk versus 95% in cow's milk. Prolactin, insulin and cortisol are involved in protein synthesis. Casien, α and β lactoglobulin, glycoprotein and immunoglobulin are the main proteins synthesised by the ribosomes through apocrine secretion. Some proteins are secreted by merocine actions.

  Casein has a specific amino acid composition: methionine/cystein ratio is close to 1:1 in human milk, similar to plants. Taurine (a sulphur-containing amino acid) is present in high concentrations in human milk. It is a neurotransmitter and it plays a role in bilirubin and bile conjugation. The ratio of casein to whey protein in humans is 1:5. Human milk is low in curd due to the high whey content and is easily digested. If expressed breast milk is left standing the clear fluid seen is whey.
- *Vitamin content.* This is dependent on the nutrition and vitamin intake of the mother. This can be critically low if the mother is not well nourished. The vitamin content of mature milk is lower than colostrum for vitamin C, vitamin A, riboflavin, vitamin B6, thiamine, niacin. vitamin D is present and B12 and folic acid abound. Vitamin content varies between fore and hind milk in the same feed.
- *Nucleotides.* Expressed as nucleotide equivalents, the concentration in mother's milk varies between mothers and the period of location and is 55–68µmol/l. They are important in protein synthesis and provide energy for biosynthesis. They play a role in anabolism and growth. Failure to thrive on breast milk, if all other factors are excluded, may be because of low nucleotides in breast milk.

Contamination of mother's milk

Mother's milk reflects the contamination in the environment, therefore it is monitored throughout the world to determine the level of contamination of toxins in the environment (water, food, pesticides and air). For example, pesticides such as DDT may be present in human milk.

Advantages of breast milk

Evidence confirms the advantages and superiority of human milk. Babies who are breastfed have a decreased chance of developing:

- respiratory and ear infections
- allergies and atopic diseases
- asthma
- urinary tract infections
- diarrhoeal infections, gastrointestinal reflux and NEC
- bacterial meningitis
- SIDS (sudden infant death syndrome)

- juvenile rheumatoid arthritis
- childhood lymphomas such as Hodgkin's disease and leukaemia.

Discontinuation or avoidance of breast milk

There are medical reasons for not breastfeeding.

Agalactia (inability to breastfeed)

The significant inhibiting factors for breastfeeding include factors such as breast surgery, retained placenta, Sheehan's syndrome or pituitary shock where women fail to lactate.

Suppression of breast milk

In some cases breast milk production is suppressed by hormonal contraception or if there is a risk of contamination of milk by bacteria or viruses (HIV) or use of drugs or prescription medication that may affect the baby.

Replacement feeding and milk banks

If a mother cannot breastfeed an infant, replacement feeding may be an option. Infants can still get the benefit of mother's milk through certified milk banks. Milk banks exist in many centres where women can get safe breast milk for their baby, particularly for the preterm infant.

Social factors

Rates of breastfeeding differ between cultures and socioeconomic groups. As more women work away from home, the demands of breastfeeding may be too much and such women may opt for formula feeding as a more convenient feeding method. However, more affluent women in developed countries are beginning to opt for breastfeeding and, at the same time, it is accepted practice in less developed countries.

9.5 Breastfeeding rates

USA (2001)	6.7% (at 6 months)
Australia (1995)	47.1% (at 6 months)
Canada	18.2 % (9 months)
India	46% at (4 months)
Japan (2001)	20% (time not stated)
UK	3% (5 months)
Sweden	53% (6 months)
South Africa (DHS 1998)	2% exclusive breastfeeding at 6 months

Compiled from http://www.kellymom.com/writings/bf-numbers.html#Canada.

Working women need support to breastfeed and policies around materinity leave will influence rates of breastfeeding. Women also need support in the form of breastfeeding consultants to help them to continue to breastfeed.

Psychological factors

Motherhood and breastfeeding are learned behaviour. If young women are not exposed to breastfeeding when they grow up or see it in the community, even when they are positive towards breastfeeding, they may find it more difficult than anticipated. Psychological factors that play a role include a woman's relationship with her own mother, her relationship with the father of the baby and whether or not the pregnancy was planned and wanted.

9.6 Psychological factors in breastfeeding

Research shows that the duration of breastfeeding is associated more with psychological than with socioeconomic factors. Psychological factors include an optimistic outlook, feeling comfortable with breastfeeding, faith in breastmilk as a food, expectations of breastfeeding, anxiety and the planned duration of breastfeeding.

The infant may pick up clues from the mother and if the child does not feel contained (bonding) the baby may refuse the breast. Factors that affect successful feeding are the attitude of doctors and other healthcare professionals during pregnancy and birth, and the level of support received. 'Baby-friendly care' improves breastfeeding support.

9.5 Conclusion

Successful breastfeeding is dependent on a range of complex sociodemographic, economic, political, psychological, anatomical, physiological and personal factors. Midwives support a mother within the personal and social framework that exists for each individual mother.

Section Three

Psychosocial and cultural aspects of childbirth

10 Psychology of pregnancy and childbirth

11 Childbirth and the father

12 The mother–infant relationship

13 Mental health, gender-based violence, and loss and grief in pregnancy and birth

CHAPTER

10 Psychology of pregnancy and childbirth

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- explain the psychological adaptation in childbirth
- assess psychosocial factors that affect parenthood
- use the knowledge of the sleep and wake cycle to educate mothers about their babies.

KNOWLEDGE ASSUMED TO BE IN PLACE

Life inventory stressors and basic terminology of developmental psychology

KEYWORDS

Parent • Motherhood • Postnatal blues • Adaptation

10.1 Introduction

Pregnancy is a time of not only physiological change, but also of psychological adjustment. Emotions, thoughts and behaviours go through a variety of changes starting even before pregnancy itself, when conception is merely planned, and continuing until well after the baby is born. Many changes have implications for a person's whole life. For this reason, pregnancy must be viewed as a long-term process affecting not only the woman, but her whole family. How the woman and her family perceive and adjust to these experiences is, in turn, affected by the social, cultural and religious environment in which the family unit lives. While some of the most commonly experienced psychological changes are discussed in this and later chapters, the midwife must constantly be on the alert for idiosyncratic reactions.

10.2 Pregnancy

Some babies are planned, others are not. However, whether a baby is planned or not, it does not automatically imply that the reactions to conception will be simply acceptance or rejection. Not all unplanned pregnancies are rejected and not all planned pregnancies are greeted with enthusiasm. Much depends on the woman's current family situation, her marital happiness, her reasons for wanting or not wanting a baby, the timing of her pregnancy and her cultural context. While it is easy to accept that the news of an unplanned baby may cause shock, it is less easy to understand that planned babies may also arouse negative or ambiguous reactions. The modern career woman, in particular, may experience conflict between wanting a baby but not wanting to lose out at work. A woman can experience the following adaptations in pregnancy (see Box 10.1).

10.1 Psychological adaptations to pregnancy

Acceptance of the pregnancy: Responses can vary between happy, anxious, unsure and denial

Psychological patterns of adaptation:

- First trimester: The woman focuses on herself to try to understand the pregnancy and may experience minor symptoms as 'disease'.
- Second trimester: When the mother feels the baby move the pregnancy becomes a reality and her focus moves to the baby. She fantasises, day dreams, withdraws from her husband and other children and by now she accepts the pregnancy if she had not previously. She becomes closer to her mother for support and re-evaluates her husband as a partner.
- Third trimester: 'Nesting' occurs, to prepare for the baby. She fears the delivery, does not sleep well and wants the birth over. Ambivalent feelings come and go and emotional lability is common.

Common feelings experienced in pregnancy include:

- *Anxiety*. Some level of anxiety during pregnancy is normal. Anxiety levels may be elevated in the early months of pregnancy, partly due to the initial adjustment to being pregnant and partly in reaction to physical discomfort experienced, e.g. nausea and tiredness. However, anxiety is usually lowered during the middle trimester and rises again as labour approaches. Anxiety in this later stage, in particular, may be accompanied by nightmares. While psychological upheaval may be readily expected in the first pregnancy, it is interesting to note that anxiety frequently appears to be even greater with second and subsequent pregnancies. It is possible that the experience of pregnancy and parenthood leads to an increased knowledge and understanding of the possible dangers as well as the commitments of pregnancy and parenthood. Greater awareness with later pregnancies leads to a more realistic and less romantic view of parenthood.
- *Fears*. One of the most common causes of anxiety in pregnancy is fear. Fear is frequent and includes fear of miscarriage or abnormality, of dying in labour, or of the baby dying, of hospitals and doctors, of the mother's illnesses affecting the baby and of pain.

  Many of these fears are not expressed. However, if the woman can express her fears, this may help her to deal with them and to understand exactly what it is that she fears. Women (and their husbands/partners) should be encouraged to talk about their concerns in an environment that allows frank and open discussion: this will take time, but may well lead to an easier adjustment to the pregnancy and parenthood.
- *Sexual activities*. Another major source of anxiety concerns sexuality during pregnancy. Not only may women be concerned about the effects of sexual intercourse during pregnancy, but she may also fear losing her attractiveness.

  Sexual activity during pregnancy for most couples is a matter of personal desire. Unless there are medical reasons for abstaining (such as a history of miscarriage), couples should be encouraged to approach sex during pregnancy as an added dimension to their sexual lives – offering opportunities for exploration and adventure, as physical changes in the woman's body demand alterations in sexual behaviour.

  One common concern is that the man's penis may hurt the baby in some way during intercourse. This fear can often be dispelled by examining pictures of the anatomy of the baby in utero. Talking about the fear in itself often helps. At the very least, acknowledging the concern may help to explain why the husband/partner has perhaps not been so willing to indulge in intercourse during the pregnancy. If unexpressed, the woman may interpret her partner's reluctance as a response to her possible loss of attractiveness or may even imagine that he is unfaithful. Long-term misunderstandings may well be prevented by an opportunity to discuss sexuality within a professional setting.
- *Emotional lability*. One common reaction during pregnancy is mood swings or emotional lability, while hostility or irritability frequently occur. Some women become dependent and insecure, even if normally assertive and independent.

  Many women become increasingly introspective as the pregnancy progresses. Less involvement in the outside world may well be nature's way of ensuring that the woman avoids hazardous situations for herself and her baby. She becomes, in effect, an 'incubator' concerned with monitoring the safety of her baby. Increased emotionality may well be particularly influenced by hormonal changes. Nausea and tiredness in the early months and a cumbersome feeling in the last trimester may easily contribute to emotional 'down' feelings.

  The middle trimester of pregnancy is usually the most comfortable and may well be the period which gives rise to the feeling of 'radiance' often experienced during pregnancy. This period also corresponds with the time at which life is first felt, which is also a pleasurable feeling. It is possible that in this middle period, the woman is most receptive to guidance and advice on motherhood.
- *Siblings*. When siblings are present, they require special care during their mother's pregnancy. All children need preparation for the forthcoming baby, but the nature and method of instruction will differ depending on the age of the siblings. It is particularly important to reassure each child that he or she is loved and wanted and that the coming child will not replace him or her in the parents' affections. While giving time and attention to siblings is possible during the pregnancy, this becomes more difficult after the baby is born. Parents need to foresee this difficulty and to spend time during pregnancy planning possible means of overcoming this problem after delivery. Often solutions will entail involving the father more actively in the care of older children.

  If siblings are much older than the new baby-to-be, the mother's pregnancy offers a wonderful opportunity to learn about pregnancy and parenthood.
- *Grandparents*. The woman's own mother, in particular, may assume an important role during and after pregnancy. Pregnant women often have an increased feeling of dependence. This frequently presents as a need to be

mothered. It may be strongest after the baby is born. It is understandable that at a time of personal challenge as well as threat, a woman's needs for security and care from someone she trusts should be predominant. Grandparents should, in these situations, be included in some of the couple's preparations for parenthood.

- *Friends*. Pregnancy may make the prospective parents realise the the value of friends. Friends in similar positions, e.g. pregnant or with young children provide a marvellous opportunity for learning about babies and baby care and should be cultivated. The loss of the extended family means that many women no longer learn about pregnancy, birth and parenting at home. This makes friends and siblings with young families particularly important. Friends, however, do sometimes pass comments or relate stories (especially horror stories) about others' experiences in pregnancy or during birth. These are often anxiety-provoking and many arouse nagging fears in mothers-to-be. Women will welcome opportunities to discuss these stories or comments with the midwife. Horror stories, however, may provide a woman with a coping mechanism, if such a situation does arise.
- *The role of the childbirth educator*. Preparation for parenthood is becoming increasingly accepted as necessary during pregnancy, provided it is of a good quality and high standard. Preparation should involve both parents and should cover the pregnancy, the various approaches to birth that are possible and the first year or so of life with a new baby. It should also be concerned with both physical and psychological aspects of these experiences.

10.2 ICEA Childbirth education

The ICEA International Childbirth Education Association is an organisation that provides education of midwives as childbirth educators. In South Africa there are 300 childbirth educators that advertise in the expectant mother's guide for South Africa (see Babytalk@mweb.co.za listing: childbirth educators).

The childbirth educator is the major source of information about pregnancy, birth and parenthood and should be well educated. In most cases, a childbirth educator is a midwife.

From the couple's point of view, attending childbirth preparation classes offers them:

- an opportunity to learn about the physical changes that take place in pregnancy, during birth and afterwards
- a means of exploring the psychological reaction to these changes, as well as to consider and plan for the emotional, intellectual and behavioural changes that will occur after the birth of a baby
- a means of obtaining social support from others who are undergoing similar experiences
- a way of learning about parenthood from newly delivered women, if classes are organised in a way that allows new mothers to meet with mothers-to-be and developing confidence in their ability to cope with labour and birth
- an opportunity to talk about concerns that arise during pregnancy and after birth with someone who has more time to listen to them than the often overloaded clinic or hospital staff member
- a way of sharing, as a couple, in the preparation for their new roles as parents.

Childbirth preparation as described above is very much part of technologically sophisticated, usually urban, environments. Preparation for parenthood in less technologically developed situations is often quite different. In traditional, often rural, societies in much of Africa, preparation for birth and parenthood is offered more informally by knowledgeable or trusted members of the family or community.

- *The role of the obstetrician/medical practitioner*. The role of the obstetrician varies considerably. There are not enough obstetricians in public healthcare in South Africa and the 1998 South African Demographic Health Survey (SADHS) indicated that three out of 10 women in the public health sector see a doctor only once in pregnancy and birth. This means that midwives in the public sector carry the burden of care, including health education and support.

  In the private sector those who can afford it use an obstetrician. Others use a private midwife, who will deliver the baby and call in an obstetrician in an emergency.
- *The role of the doula or significant person*. It is desirable that women have a person of her choice with her in labour. This significant person can be her mother, her husband or a friend. The presence of a supportive person reduces the woman's need for pain relief and shortens labour.

  In the public sector in South Africa overcrowding in maternity units makes it difficult to allow more people in. In larger, more controlled units, doulas have been trained to assist during labour. They do not give midwifery care but see to the woman's basic needs and provide support. The presence of the doulas has increased the number of woman who breastfeed successfully and has lengthened the duration of breastfeeding.

- *The role of the midwife.* The role of the midwife is explained in Section 1. The midwife is a trained and skilled practitioner who is closest to the woman when the baby is born and has the capacity to guide, support and teach.

Birth and the postnatal period

10.3 Rubin's psychological maternal adaptations

Directly after birth a woman experiences:

- *The taking-in phase.* The mother is passive and dependent. Focuses on self. Verbalises the need for food and rest/sleep as the main priorities. Relives the birth experience
- *Taking hold phase.* The mother initiates activities. More independent with self-care. Verbalises concern over physical matters including the newborn. Requires information and validation from others and needs support to set realistic goals. Easily discouraged with low confidence levels.
- *Letting go.* Increases dependence in self and infant care. Recognises infant as a separate entity. Grief for new roles and expectations. Adjusts family relations to accommodate infant.
- *Postnatal blues.* About day three the woman may experience an emotional period of unknown unease and upset due to hormonal changes, relief and fear for the responsibility. Physical discomfort and pain add to this feeling of 'being overwhelmed'. This can happen later, but needs to be resolved.

A mother's adaptation to motherhood has been described and follows Rubin's suggested psychological stages (see Box 10.3). Several factors affect adaptation and each woman will adapt at her own pace. Midwives observe and support women considering the following factors:

- *First impressions.* Reactions immediately after birth can vary widely from enthusiastic excitement to dejection, and even rejection of the infant. Chapters 11 and 12 explain the complex process of bonding to the baby by mother and father. Separation of the mother and child is discouraged and should only happen in life-threatening conditions.
- *First hour.* Most maternity units allow parents to spend some time together, as a family, during the first few hours after birth. This is a special time when mother, father and baby can enjoy the excitement of the birth. This recent change in maternity hospital policy is to be applauded and encouraged as it allows time for couples to re-live the experience of birth.

  Although tired, many women have heightened alertness and energy after birth. This is the time to bond with the baby and breastfeeding within the first hour indicates that things are going well.

Supportive versus unsupportive care environments

'Women-centred' or 'humane care' is now the hallmark of midwifery globally. It requires that the midwifery model of care be instituted that will ensure continuity of carer (where one person or a team cares for the woman), and choice (the woman has a choice over where she delivers and who is present during the delivery). This model of care is considered to be supportive and gives one-to-one care and education to a mother and baby.

Table 10.1 summarises different forms of midwifery care globally. These care modalities have not yet been well developed in South Africa, except for midwives in the private sector. Several natural birth units in the private sector give one-to-one care. These units are different from the MOUs (midwifery obstetric units in the public sector), where midwives do not take one-to-one care models. Table 10.1 indicates the outcomes and costs for each supportive midwifery model of care. The aim of these 'models' is to improve support and quality of care for mothers, babies and families.

Mother craft

A new mother may be daunted by the tasks ahead of her and may not have her own mother available or may need to go back to work soon after the birth. Skills to care for the newborn may come naturally or may cause anxiety. Postnatal support classes help mothers to master mothering skills.

Baby-friendly care principles, if instituted, allow for rooming-in that avoids separation of mother and baby and allows the mother to become comfortable with the baby while being supervised. However, no new mother should have a particular system forced on her.

Responsibility

Mothers often only come to realise the full extent of the responsibility of motherhood in the days following delivery. During pregnancy, thoughts are often focused on the delivery itself. The reality of a new baby is difficult to imagine. The new mother may be overwhelmed by the demands of a newborn, particularly if the birth has been difficult, there are feeding difficulties, the baby is not well and/or problems with staff and hospital regimes.

Table 10.1

Supportive midwifery care models

Care models	Characteristics of care models	Evidence of the outcome and value at care
Home births	Hospital births only started in 19th century Incidence of homebirths 5–20% globally 10–25% of births in South Africa are home births More common in poor communities More common in rural areas Increased consumer demand for homebirths (Watts, Fraser, & Munir, 2003:106–12) found in larger centres globally	Rarely covered by medial aid or insurance If covered very low rates paid Official view is that it is unsafe Gives evidence of good outcomes for low-risk and natural birth Victoria (Parrat & Johnston, 2002:16–25) found a 20% risk of being transferred to hospital during homebirth supported by a Cochrane randomised control trial review (Olsen & Jewell 2002:1) The WHO confirms that midwifery is safe and sees the midwife as the expert in care during normal labour in uncomplicated cases
Free-standing birth units (FSBU)	Not attached to hospitals Community-based centres Midwife is the primary caregiver	Homer (2001: 85–93) finds a substantial cost saving in these units even when the caesarian section rate exceeds that of standard care.
Family-centred birthing units	Home-like Family centred Special physical environments Strict policies about medical interventions. (Hodnett, 2002; Cochrane:1) Attached to hospitals Interpersonal collaboration emphasised	Midwifery care is autonomous and independent (Pollard, 2003:113–124.) This is not a private unit but institutionalised care
Midwifery-led care (MLC)	Lower risk and interventions; minimally invasive Lower need for and use of analgesia during labour; minimal pain relief (Petterson, Svensson, Christensson, 2001:102–114) A well-organised first referral level, not favouring homebirths Emphasis is on normal birth (Shallow, 2004:124–126) Consider the environmental influence on labour Support women's preference Empowerment programmes Breastfeeding support Small teams of midwives involved Skilled evidence-based care rendered Philosophy of no harm followed Consider wider aspects of women's life (holistic) 12 recommendations for supportive care accepted	More job satisfaction for midwives Difficult working conditions for caregivers with children Sanders (2003: 278–281) found that in USA 7.3% of all births are MLC based on self-determination and the right to choose.

continued

Table 10.1

Supportive midwifery care models (*Continued*)

Care models	Characteristics of care models	Evidence of the outcome and value at care
Case loading	Each pregnant woman has a named midwife who takes full responsibility for total care (Bennet & Brown, 1999:46) Midwife has an allowed number of cases 45 deliveries per year per midwife (Robertson, 2002:1) Individualised family service Respect rights, values and beliefs Can be a group practice Time and resources flexible with no shifts Attend to women whenever and where-ever needed No barrier between the hospital and community Continuity of care	Benjamin (2001: 234–240) found: More normal births Less interventions More homebirths Earlier discharge
Team midwifery care	For improved continuity of care in state institutions (Bennett & Brown, 1999:46) UK and monolithic systems use this model A team of midwives will give care throughout cycle of childbirth called 'Continuous coordinated women-centred care' 'Know your midwife scheme' exists in the UK Deliveries can be either at home or in hospital (Kinlington) High- and low-risk cases can be included It is people oriented with humanistic values. Teams of 2.5 midwives can take care of 100 confinements per year. (Robertson, 2002:1) In the Monash institution (1996) they use a team of seven midwives to care for 1 000 women in pregnancy and labour Team midwifery is realistically achieved in tertiary institutions (Farquhar, Camilleri-Ferrant, Todd, 2000:35–47 is of the opinion that the smaller the size of the team the better) The Expert Maternity Group 1993 appointed in the UK for team development and funded by the state	Women feel more in control and find it easier to be mothers Team midwifery is very popular with women and midwives The Newcastle community midwifery team reported more patient satisfaction due to reliability, responsiveness, assurance and empathy of the midwife and less ◗ smoking ◗ low birth weight babies ◗ use of analgesia in labour. (Rowley, Hensley, Brinsmead & Wlodarczyk, 1995: 163). A retrospective blind study by Cochrane, found that team midwifery had more antenatal visits, used less pethidine, had less neonatal resuscitation with more maternal satisfaction (Biro, Waldenstrom, Pannifex, 2000:168–73). Sweden reported no difference in outcomes for team midwifery and standard care in terms of the safety of care There was a cost saving in both in- and outpatients. (Waldenstrom, Mclachlan, Forster, Brennecke & Brown, 2001: 257–264.) Monash study confirmed ◗ less use of augmentation ◗ less pain relief, less monitoring ◗ 7 hrs shorter stay after delivery and fewer admissions to neonatal unit

continued

Collaborative care	Models of collaborative or shared care in the healthcare systems Sharing of power in decision-making (Bennett & Brown, 1999 UK:33) One of the models share antenatal care between obstetrician, a GP and midwife, with delivery under the hospital staff or the postnatal care The 'Domino service' includes the GP for antenatal care and the community midwife to deliver the baby (with the obstetrician on stand-by) Community midwives work in hospital alongside other midwives Early discharge is possible with follow-up by postnatal midwives Other options in the UK include GP practices that employ a midwife group for total care of patients in geographical area The midwife is the lead provider of care and liaises with the doctor In Australia models are as follows: ◗ MCO midwives care only ◗ SCO shares care with obstetrician ◗ OCMS obstetrician care, with midwife support ◗ OCO obstetricians care only (Robertson, 2002:1)	Fragmentation of care with inter-professional support Community postnatal midwives lose their clinical delivery skills Funded by state for development Only work in monolithic systems 22% cost deduction found (Stone, Zwanziger, Walker & Buenting, 2000:32) Staff mix and volumes are important with regards to saving costs

Postnatal blues

This describes the emotional lability that many women experience in the first few days to weeks after birth. This is not the same as postpartum depression, which is a potentially serious illness. Baby blues can generally be dealt with by supportive healthcare practitioners, relatives and friends.

The cause is not clear, but may be hormonal, or simply a response to a complete change in lifestyle. Some specific factors that may contribute to the onset of the blues are:

- *The birth experience*. A disappointing birth experience may predispose the mother to feeling upset.
- *Relief after a momentous event*. As with any major, long-anticipated event, there is often a feeling of let down after it is over.
- *Feelings of responsibility for the newborn*. Responsibility and the mammoth undertaking of parenthood may contribute to weepiness.
- *The baby's behaviour*. For example, a crying baby can precipitate feelings of inadequacy, and consequently weepiness in the new mother.

Newborn and early parenthood

Several issues become important in the early months of parenthood and some of these relate to the mother, some to the family and some to the new baby. These will be briefly discussed here, although broader reading on the subjects of child development, child rearing and fathering could benefit any midwife working with new parents.

The midwife may facilitate positive parent–infant relationship by providing opportunities for interaction and enhance it by helping the parent to understand their baby.

Midwives are encouraged to study the Brazelton behaviour scale (BNBAS) for newborns that was developed by T Berry Brazelton. This study suggested that newborns are well equipped for social interaction and that they have the capacity to influence others around them. Babies are not passive but will encourage or discourage caretaking activities. The development of parental love is not without feedback from the baby. The absence of feedback from the baby, associated with separation, may impair development of parental love. The first task of the parent is to become aware of the unique behaviour responses of their baby.

Brazelton showed that normal babies differ in:

- activity
- feeding patterns
- sleeping patterns and
- responsiveness.

These behaviour differences are normal and parents are encouraged not to compare babies, but learn about the unique qualities of their own baby, and adapt care to suit the baby's needs.

Sleep-wake cycle

Table 10.2 shows the sleep-wake cycle and its variations in different babies.

States of consciousness

The state of consciousness of the newborn fluctuates between light and deep sleep, lethargy and irritability.

This can be divided into:

- two sleep states: deep/light sleep
- four awake phases: drowsiness, quiet alert, active alert, crying.

Each stage of consciousness has its characteristics. The quiet alert stage is the optimal state of arousal. During this phase the newborn is:

- focused on external stimuli
- performs active manipulation of the outside world
- can coordinate eye movements
- smiles (later in infancy)
- vocalises
- watches parents' faces and responds.

Other factors that influence the state of consciousness are:

- gestational age. The maturity of the central nervous system (CNS) will affect behaviour. In a premature baby, for example, the whole body will respond to stimuli while a mature infant will withdraw just the foot.
- time of day
- time of last feed
- stimuli and environmental events: bright lights, monitors noise, tension in hospital, tense mothers
- medication, anaesthesia and analgesia given to the mother affects newborns up to fifth day after birth and may inhibit responses.

Table 10.2

The sleep-wake cycle

Phases	Body movement	Eye movement	Facial movement	Breathing	Level of response
Deep sleep	Body action Still, startled	None	None Sucking at intervals	Smooth and regular	Threshold high Intense stimuli required to wake up
Light sleep	Twitches occasionally, some body movements	REM fluttering eyelids Eyes closed	Smiles briefly Fussy sounds	Irregular	More responsive to external stimuli. May stay in light sleep or return to deep sleep or wake up
Awake/ drowsy	Smooth movements Mild startle	Open and closed eyes Dull gazed appearance	Some movement Face appears still	Irregular	Reacts to sensory stimuli Delayed state changes when stimulated
Quiet alert	Minimum	Bright and wide eyes	Bright shining sparkling	Regular	Attentive to environment Focuses attention on any stimuli Optimum state of arousal
Active alert	Much activity and fuss	Open eyes less bright	Facial movement not bright	Irregular	Increasing sensitivity to disturbing stimuli
Crying	Move with colour change	Tightly closed or open	Grimace	Irregular	Extreme response to unpleasant internal/ external stimuli

Newborn responses

The newborn actively responds to his/her environment. At two weeks an infant can distinguish patterns and will start to notice changes in their environment around two months of age.

Hearing

Normal newborns are able to hear at birth and prefer the sound of their mother's voice. An infant's cry is unique and recognised by mothers. They can also turn towards a sound and are more likely to respond to speech sounds than to other kinds of noise.

Babies of mute mothers cry less than other babies.

Touch pathways

Touch is important for the complete myelinisation of nerves and the CNS.

Parents follow a specific pattern when getting acquainted with their babies.

Fingertip→to touch→stroke to face→massage to back.

Trauma and analgesia diminish this interaction between the parent and infant.

Taste

Newborns prefer sweet fluid to sour/bitter. Their facial expression and responses are the same as adults. They use their mouths for nurturing needs and to release tension (sucking a dummy). Within hours after birth they will prefer vanilla, strawberry, and banana flavours to fish and rotten eggs.

Vision

Some senses are well developed at birth, for example the visual sense. Babies can follow slowly moving objects with their eyes and turn their heads if necessary. Some constraints on the visual system also exist, which ensure that social stimuli are responded to. For example, a baby's focus is fixed at about 20 cm away from its eyes – that is about the distance between the baby at the breast (or in its mother's arms) and the mother's face. Babies also show a preference for faces, rather than for less socially relevant patterns. In other respects an infant's visual abilities are similar to an adult's. For example, colours can be seen and sharpness of vision is almost as good as that of the adult.

Smell

Smell is equally well developed. Newborns may turn away from smells that are regarded as unpleasant. In addition, at about 10 days of age, the infant can distinguish the smell of the breast that has fed him, compared to that of another lactating woman.

It is important the parents understand the infant physiological and psychological abilities.

Early discharge

The current patterns of early discharge (within 24 hours) and the lack of a reliable professional and personal support system can affect women's transition to parenthood negatively.

Working mothers

In South Africa women are entitled to 60 days maternity leave. Paternity leave has not yet been instituted. Going back to work requires that a woman either take the baby to a caregiver or hire a caregiver to look after the baby at home. A large portion of the population will leave the baby with their mothers on the farm or rural areas, and see them only over weekends or holidays, which can be stressful. Women are not always in a stable relationship that could assist with a smooth adaptation to motherhood and modern parenthood is constantly under pressure. Women need to be supported in their role as mother for the benefit of the development of the child.

10.3 Conclusion

Although becoming a mother or a parent may be a normal developmental phase, support from the community and health system is needed to help women in this sensitive and important period.

Supporting mothers and fathers through the transition requires midwives to understand the psychosocial aspect of parenthood.

CHAPTER

11 Childbirth and the father

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- explain the five phases of adaptations by fathers during childbirth
- explain the potential positive and negative responses of fathers to pregnancy
- explain aspects of father–child bonding
- explain the role and function of midwives in promoting the father's involvement in childbirth.

KNOWLEDGE ASSUMED TO BE IN PLACE

Social groups, interaction and family structure and dynamics

Normal pregnancy and birth processes

KEYWORDS

Father–infant bonding • Father involvement • Father deprivation • Couvade syndrome

11.1 Introduction

Pregnancy is a time when a couple may develop a different relationship with one another. It is a normal developmental phase but also a transition phase that may make some members of the family feel unbalanced and requires emotional, behavioural and physical adjustments. Each pregnancy is unique and will challenge the couple and individual members to adapt. Men and women experience and respond differently to pregnancy and birth. In this chapter the adaptations to fatherhood are considered. Midwives are encouraged to learn more about fathers in their cultural environment, to improve and develop best practice for the care of fathers in pregnancy and labour.

11.2 Fatherhood and childbirth

Transition to fatherhood demands a role adaptation of men in all cultures. Although this is a normal developmental phase of life it is also a period of adaption and stress.

The level of stress a father will experience during the role transition is determined by the motivation for the pregnancy, his expected role (influenced by culture) and his ability to make changes and adapt to the demands of the new role.

The motivation for the pregnancy

Ambivalent feelings about pregnancy are normal in men and levels of ambivalence may be related to the motivations for the pregnancy, which are divided into:

- rational reasons (being ready for a family, natural development)
- subconscious reasons (cultural and family demands and expectation, wanting an heir)
- conscious reasons (trying to save the relationship, or keep a woman in a relationship).

How fathers adapt to their changed role

When a man has fathered a baby he may not be interested in the pregnancy and choose not to be involved or reject the pregnancy. This may influence his own behaviour and mental health. When a man accepts the pregnancy, the role of father makes emotional and other adaptation demands on him and challenges him, even if it is not a first pregnancy.

How a new or first-time father adapts to fatherhood and his ability to adjust to the changes brought about by pregnancy and birth may depend on many factors. For instance, fathers are required to examine their role, with particular

reference to their role as providers and the financial implications around having a child or another child.

The experience of the man's own childhood and father or lack of a father will influence his perception of being a father. This may create anxiety about his ability to be a father. Boxes 11.1 and 11.2 summarise the potential positive and negative responses.

The five phases of adaptation to fatherhood

There are five phases of normal adaptation to fatherhood that have been observed and described. These are briefly presented.

11.1 Positive adaptations

Physical changes:
- weight gain
- the need to grow a beard/moustache
- shave a beard or moustache if they have one.

These symptoms can be exaggerated by Couvade syndrome, in which men experience the same symptoms as the women in pregnancy in birth, for example nausea, vomiting and the birth pains.

11.2 Negative adaptations

Minor defective behavioural changes:
- nausea and vomiting
- headache
- irritability
- look up old friends
- stay away from home
- anxiety
- depression.

Psychological:
- changed affect
- changed sexual patterns
- loss of interest in the relationship.

More serious defective behaviour patterns:
- alcoholism
- theft
- becoming unemployed
- abscond from work.

Phase 1: Acceptance of the pregnancy

The first, and most important adaptation for the father is to accept the pregnancy. Without this, it may be difficult for the woman to adapt positively. Negative feelings from the father may affect the woman's selfworth and she may feel that she and the child are rejected, which may affect her bond with the child. This may lead to rejection of the pregnancy by the mother leading to termination of pregnancy or abortion, premature birth or intrauterine growth restriction or even abandoning the baby after birth. For the father, acceptance of the pregnancy is the first step to the development of fatherhood. It indicates his commitment to becoming a father.

Phase 2: Awareness of the mother's emotional and physical changes during pregnancy

It is of fundamental importance for the future role of the father that he becomes aware of the mother's physical and emotional changes throughout pregnancy. His emotional and physical involvement will determine his preparedness for fatherhood. Positive adaptations will influence his experience. When the father is involved with the mother and her experiences of the pregnancy, the baby will become real to him and not just exist in his mind. This involvement will reduce his level of anxiety. On the other hand the mother needs his presence and involvement to experience the pregnancy positively and develop her role as mother.

Relationship. When the father shows interest in the pregnancy and is actively involved, the mother feels loved and cared for. It enhances her ability to accept the baby and make positive emotional investments in the baby, which will influence the development of the fetus.

The relationship of the father to the mother is vital and has a dynamic effect on the development of parenthood. There is a positive correlation between the marriage or a couple's relationship and the progress and outcome of pregnancy. This is also a period where couples re-evaluate their relationship. Women who are secure in the relationship are more able to make positive investments in the pregnancy and the baby. They experience pregnancy more positively, are more self-confident and this in turn improves the man's self-confidence and self-image. A problem relationship uses all the woman's emotional resources and she cannot plan effectively for the future. This may lead to depression.

The relationship and develop of fatherhood also influences the man's mental health and wellbeing. He may start to abuse alcohol and develop negative responses if unresolved

issues or the demands of the role are too overpowering, or if he does not have the skills to adapt to the new role demands (see Box 11.2). Two percent of men admitted in mental institutions are there as a result of the demands of fatherhood.

Sexual intercourse is a concern in pregnancy. Men may avoid it because they are afraid of hurting the baby. An open discussion with the midwife may set the man's mind at rest.

Emotional support. The man's main task is to be the emotional supporter of the women in pregnancy and birth.

In the first trimester the experiential gap that exists between the man and woman is due to the lack of physical involvement of the father in the experience of pregnancy. This causes tension in the father and he may find it difficult to support the women in her demands for support. This often leads to the emotional withdrawal of the man from the situation so that he can work through his ambivalent feelings. The father may escape from the situation by reassuming sport activities, starting a new hobby, working longer hours or other behaviour as indicated in Box 11.2. Women often go to their own mothers, sisters or close family for emotional support in this period. Some men experience or initiate physical changes in this period that are viewed as possible positive adaptations to associate with the pregnancy, such as growing a moustache or beard or shaving it off if they had a moustache or beard. Some men gain weight to indicate the bond with the mother and baby.

It is essential that inner conflicts that the father has about fatherhood are resolved so that a satisfactory role division can be developed to ensure that his partner's pregnancy is a healthy developmental phase for him. Midwives need to be aware of the man and his needs in pregnancy and should involve men in the care of the mother and baby in using structured evidence-based guidelines.

In the mid-trimester the women shifts her emotional needs away from her mother and sisters to her partner. The man may experience feelings of unease due to this increased emotional demand. The mid-trimester is the period where the physical changes of pregnancy are obvious. The father can feel the baby moving and the fetal heart is audible. The baby becomes a reality to him particularly when he feels it move. If he attends an ultrasound procedure and sees the baby it can cause a strong emotional response and enhance the adaptation. His involvement starts and this leads to him becoming more involved in developmental tasks and activities of pregnancy. He may show 'nesting' behaviour, which includes preparation for the baby's arrival and future. This involvement is characterised by the redefinition of his role and the acceptance of the emotional impact of the pregnancy through the collaborative planning of a constructive role as indicated in Box 11.3.

The financial burden and responsibilities of fatherhood are important factors that can cause tension. They often work harder and longer hours to plan for the future. Pregnant women are sometimes required to stop working by their partners, with a resultant loss of income which may increase financial stress.

The healthcare professional plays an important role in initiating the involvement of fathers and developing a plan to support them during pregnancy.

11.3 Father's involvement

Involvement of the father is also shown when he takes responsibility for

- childcare activities
- attending antenatal classes
- attending antenatal care and speaking to the caregiver
- improving the income for the family
- improving/enlarging the house
- providing things for the baby.

Phase 3: Anticipating the birth

In the last trimester the father experiences intense anxiety in terms of his partner and baby, the potential problems and the risks of death. He questions his own inability to assist his partner in birth due to his lack of experience. If he has had previous experience of birth, this may influence him positively or negatively. Daydreaming and fantasies are common during this period and are a form of role-play in which the father plans what to do, for example 'when the waters break', when he has to take his partner to the hospital, how to deal with the appearance of the baby, and how he will act and behave towards the baby.

His experience and involvement at this point may become so intense that he develops Couvade syndrome where he experiences all the physical symptoms of pregnancy and birth. This is seen as a positive psychological adaptation for a man.

The fears and anxiety of the father are increased by:

- the strange environment of the hospital
- the attitude of healthcare professionals
- the quality of care of the woman and baby
- uncertainty about how he should act and behave

- uncertainty about what he is allowed to do
- fear of what will happen if the caregiver is not present
- uncertainty about what to do with the pain of birth experienced by his partner.

An unprepared father's fears and anxiety can be transferred to the mother, making her delivery more difficult. The father's self-confidence can be improved by developing realistic goals and anticipating problems that the couple need to solve rationally beforehand. The healthcare professional helps the father develop clear goals to reduce his fears.

Phase 4: Involvement in labour

The experience of labour has an enormous impact on the father and is independent from his experience of pregnancy. The birth of the baby is a special crisis period and his tension level may be very high. However, the mere presence of the father at birth does not indicate his involvement.

The role of the father during birth is that of an active participant giving emotional support to his partner while she is in labour. If the father is sympathetic and actively involved, it is emotionally supportive and the mother tends to rely on him for her emotional needs and the medical personnel and caregiver become the technical helpers and assistants.

The shared experience of birth can influence the future of the relationship, foster father–child bonding, increase the father's self-confidence and encourage him to be more involved in caring for the mother and baby. Fathers who share birth experiences have more positive perceptions if the mother had a positive birth experience. Difficult deliveries on the other hand may leave him with negative impressions and a delayed or negative response to the child. The father has two main fears during birth as shown in Box 11.4.

11.4 The father's fears during birth

The father has two main fears during this time:

- that the mother may die
- that the baby may be abnormal.

No pressure should be placed on him during this period. The father needs to be supported during labour and should be encouraged to be part of the process by supporting the mother through care-giving activities. Therefore all fathers need support, help and guidance during labour. The degree and level of support given may also influence his level of participation with the birth process. Healthcare professionals and institutions are tasked to create a supportive environment that includes and responds to the needs of the father present at birth. The presence of a competent midwife and the quality of care to the woman in birth are strong supportive factors for him. The midwife informs and guides the father by encouraging him, reminding him to eat and drink, showing him what to do, for example how to rub the mother's back or make her comfortable, and to keep him informed of the progress. The father remains the emotional supporter of the mother and this role of emotional supporter will place a high demand on him during labour.

The father's presence during labour seems to have a positive influence on labour in the following ways:

- The labour process is shortened because the woman is more relaxed.
- The woman's pain perception is influenced and less pain relief is required. Women tend to request and use fewer painkillers as a result of the help and support and physical presence of the father.

In some cultures the presence of fathers during birth is a cultural taboo (for instance in the Jewish and Muslim cultures). However, this does not mean that these fathers are less interested in the pregnancy and birth than other fathers. In these cultures women accompany the mother during birth. In the social transition to modern patterns of living it has become a more common phenomenon to make provision for and allow fathers to attend birth.

Phase 5: The father and the postnatal period

The postnatal period in itself is a period of crisis for the man. The pregnancy and the baby are no longer a fantasy but are real and the father is challenged by the reality of events and the direct demands of fatherhood. Directly after birth the father may compare the baby with his expectations and images from his dreams and imagination. He also needs to come to terms with the gender of the baby. His response to and acceptance of the baby's gender will influence the mother's responses. Furthermore, the father must work through the stress of the birth and resolve this, particularly if it was not the way it was anticipated. If the baby is premature, sick or abnormal it may cause an enormous amount of emotional strain and disappointment. The father may not be able to support the woman until he has resolved his own stress, emotional loss, grief and disappointment. Specific intervention and support are needed from health professionals in such a case as described in Chapter 13.

The postnatal period further requires the father to develop skills in order to take care of the baby, for example to change nappies, bath and feed the baby.

Women have special emotional needs, and require reassurance and encouragement in the postnatal period particularly in relation to breastfeeding. The postnatal period, whether for the first or the third child, is unique and it makes special social, emotionally and caregiving demands on the father and mother that require a role change. These are shown in Box 11.5.

11.5 The father and the postnatal period

Role changes in the postnatal period depend on:

- the antenatal adaptations
- his experience of birth
- his opportunity to develop skills
- the available family and caregivers' support and guidance.

Father–infant bonding

Father–infant bonding is the bond that develops between a father and his infant. Father–infant bonding has been proven to be just as strong as maternal–infant bonding, or stronger; babies seem to prefer their mothers to their fathers only when they are hungry. Father–infant bonding already starts in the antenatal period but develops more after birth and is strongly influenced by the development of fatherhood through the five phases described in this chapter. Fathers who assist their partner during labour develop special feelings towards their babies that are visible and permanent. Father involvement through these phases, if positive, creates a strong and lasting bond between the father and the infant.

Fathers are not passive observers of their babies but display the same bonding responses as mothers. Fathers actively seek involvement with their babies. Early contact with the child is the moment the father has been waiting for for nine months and it is the first opportunity to make physical contact. Fathers have been seen to respond to their babies within five minutes after birth by touching them. This early postnatal contact with the father will enhance the bonding and the father will develop strong connections with the infant. Fathers that had early contact with their babies talk more to the children and touch them more often.

The type of delivery and degree of father–infant bonding result in and contribute to continued and intensified father's involvement with the mother and child by taking over some of the childcare activities, such as feeding the baby.

The baby is not a passive recipient of care from the father but a two-way relationship develops; the baby shows great interest in the father by responding to his voice, or following him with his eyes when he leaves.

The effect of the father on the infant

The father's role in the development of the child is fundamental, dynamic and active.

Researchers have found that children need both a mother and a father to realise their talents to the maximum.

The presence of a father who is positively involved in the infant will have a positive influence on the child's development. Interaction with both the father and the mother is thus considered essential for the development of the child. Research found that fathers and mothers influence child development in unique ways and that the absence of a father has a specific negative influence on the development of the child. Boys are more affected than girls.

There is a difference in childcare activities between mothers and fathers. Mothers are more caring and less verbal with babies while fathers are more verbal and engage the child in physical activities and play. Directly after birth the father's activities are more passive, holding the baby, carrying and transporting the baby but soon change and are focused on playing.

The absence of a father in a child's life is called *father deprivation*. Father deprivation (or absence) affects the child in a unique way that differs from maternal deprivation. The effect of the separation will depend on the age of the child and the duration of the separation. Father deprivation can also happen when the father is present if there is an ineffective emotional or unstable father.

There are particularly two areas where the child is most affected by the father:

- *Socialising*. The father–infant bonding lays the foundation for the future social milieu and affects the socialisation of the child positively. Studies have shown that in children with a good father–infant-bonding experience there is less separation anxiety when not with the mother. The father's contact with the infant is the infant's first contact with the world. Children with good father–infant bonding are more curious and explorative in terms of their environment. They respond more positively towards strangers and during complex stimuli. The positive effect of the socialisation also enhances the cognitive development of the child.
- *Cognitive-motor*. Children with good father–infant bonding have more advanced motor development and are more

secure in exploring new situations. Fathers are more tolerant than mothers to explorative behaviour.

The role of the midwife in promoting father involvement

The midwife is well placed and has the knowledge and skill to manage the involvement of fathers in the process of pregnancy and birth.

It has become common practice globally to create more involvement for fathers during pregnancy and birth. In practice though, this has challenges that need to be addressed.

11.6 Activity

Recommended reading:
BABA Men and fatherhood in South Africa, by Linda Richter gives insight in the complexity of fatherhood in traditional South Africa.

In South Africa childbirth has been accessible for fathers in the Western medicine and private health sector for more than 30 years. There is a definite intention to allow men access to women in birth in the public sector, but certain prerequisites need to be met for successful practice. This is a good intention and speaks to the ideal situation.

Such intervention needs to take place within a specific structured programme that considers the principles outlined in Box 11.7.

11.7 Guidelines for involving fathers in childbirth

Policy
There should be a written policy and guidelines to involve fathers in pregnancy, birth and postnatal wards.

Procedures
Specific culturally sensitive guidelines are required to manage men in pregnancy and birth.

Education and training
Midwives need focused education and training on:

- the assessment, implementation and evaluation of the father's involvement in all the phases and birth
- supportive measures
- practical considerations of the environment to protect him and others in the unit
- legal implications
- safety considerations.

11.3 Conclusion

It is the midwife's task to create the environment and conditions that allow and support the involvement of fathers in childbirth, with consideration of the cultural variations and social stressors of poverty, family disintegration and violence against women that are present in society.

Education is a powerful tool to help families in childbirth.

It is essential to develop best practice policies, procedures and the physical environmental that will allow the participation of men in pregnancy and labour.

CHAPTER

12 The mother–infant relationship

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- explain the principles and processes of mother–infant attachment
- explain factors that have an impact on maternal–infant attachment
- explain potential short- and long-term effects of mother–infant separation on the child
- describe the midwife's role in the observation of mother–infant relationship and the promotion of mother–infant attachment.

KNOWLEDGE ASSUMED TO BE IN PLACE

Basic knowledge of psychology, cultural and religious diversity
Normal child development

KEYWORDS

Attachment • Deprivation

12.1 Introduction

The relationship between a mother and her newborn child is dynamic. An unconscious relationship starts during pregnancy and the birth process but when the baby is born a process called 'bonding' begins when the baby becomes a reality.

Mother–infant bonding refers to the emotional bond that is established between the mother and baby. Attachment is the process of establishing the bond. This is not automatic and is dependent on a variety of factors that include the social and physical environment, the healthcare environment, the birth experience, feelings of wellbeing after birth and the support structures that are in place. The early experience of an infant is contained in the process of attachment and bonding and may have long-term psychological and social consequences for the development of the child.

Bonding is a complex process that is more than simply holding and breastfeeding a baby.

This chapter will look at the factors that affect bonding and attachment, the effects on the child, and describe the attributes of maternal containment or 'a good enough mother'. *'Good enough mothering'* is a phrase used to describe the basic (emotional and social) conditions that must be in place for the child to experience normal psychosocial development. It is a complex and ongoing process. The role of the midwife in identifying potential problems in the mother–infant relationship are noted.

Mothering is considered to be learned behaviour with strong cultural roots. Midwives are close to the mother in the sensitive period and are well positioned to identify problems, facilitate bonding and educate and empower mothers to be a 'good enough mother'.

12.2 Motherhood and child health

Motherhood is fundamental to the future physical and mental health of a population and must be considered when planning the provision of maternal healthcare. The human rights approach to healthcare influences the way in which healthcare has developed and increasing attention has been given to the rights of children through UNICEF and the Millennium

Development Goals (MDG). The Children's Act (Act 38 of 2005) in South Africa promotes the protection, development, wellbeing and rights of children. It addresses single parenthood and/or a family that has reached a point of severe breakdown and is unable to stay together as a unit, as well as instances where abuse and neglect are evident. The Children's Act (Act 38 of 2005) sets out principles relating to the care and protection of children and defines parental responsibilities and rights.

The MDGs 4 and 5 are concerned with aspects that impact on childhealth relating to motherhood. Poverty forces mothers to leave their babies with grandmothers, other family members or even caretakers from a very young age. It is still normal practice to send a baby to remote places to be looked after and mothers sometimes see their children only intermittently while working in the city. This practice affects the bond between mothers and infants with predicted outcomes for society. Substitute mothers can meet all the baby's physical needs, when emotional as well as age-appropriate cognitive stimulation for the basic development of the child is needed. In addition, South Africa has many child-headed households as a result of the HIV pandemic.

Single-parent families are also a concern, not only because single mothers are more likely to be poor, but because it is assumed that good mothering requires a partner. Cultural issues need to be understood as well as belief systems, particularly when considering the best interests of the child.

Effective or 'good enough mothering' requires a stable supportive environment in all societies. To this end childbirth preparation, planned parenthood and positive parenthood are initiatives that are valuable resources in technologically sophisticated, usually urban, environments. Preparation for parenthood in less technologically developed situations is often quite different. In traditional, often rural, societies such as in most of Africa, preparation for birth and parenthood is offered more informally by knowledgeable or trusted members of the family or community. While these more traditional approaches to childbirth care may be lacking in some aspects of Western-based medical care, they often appear to be superior to their Western counterparts with regard to good psychological care of the woman during her transition to parenthood.

Transitional phases in the development of the South African society from rural to urban living disturbs traditional patterns and may affect a women's physical and mental wellbeing in pregnancy, which in turn can affect mothering negatively. Innovative support systems are needed to protect children under these circumstances.

In several traditional cultures in which religion retains a central position, it is the father's role to introduce a child to its cultural and religious heritage. The midwife needs to be aware of these cultural issues as identified in Box 12.1

12.1 Cultural aspects of mothering

Midwives need to be able to understand different cultural contexts, as well as the environment in which their patients live, particularly when giving advice about babycare. For example, the mother may not have electricity and a safe water supply.

In addition the ability to speak English does not necessarily imply that a person has a Westernised understanding of psychological issues and Western dress does not imply a grasp of Western ideas, beliefs or systems. Wives/mothers who do not speak in the presence of their husbands, or who walk behind them, are not necessarily timid or unable to exert power at home. Midwives may think that submissiveness and excessive politeness of some patients indicates agreement, if they do not understand this. Midwives should understand that Western ideas about liberation may not be desirable to women from different cultural settings.

Not all health professionals are equally able to deal with cultural issues when planning interventions dealing with cultural, religious, sexual and language diversity. Repeated explanations may be necessary. Sometimes, care decisions about a child by professionals contradicts cultural norms but may be necessary when it is in the child's best interest.

The number of abandoned, abused, missing, sexually abused and murdered children, as well as the numbers of street children, along with high perinatal and child mortality in South Africa, indicate that society and healthcare systems are not supporting mothers and children adequately.

Midwives need to deal with their patients in a way that recognises the patient's own culture, rather than simply imposing their own ideas, as required by the Children's Act (Act 38 of 2005).

Factors influencing maternal–infant bonding

Motherhood is a normal developmental phase for the mother and each pregnancy and birth is a unique experience that affects the mother's mental wellbeing and ability to be a mother even on an unconscious level. Maternal containment is embedded in mothering and starts with maternal–infant bonding. Several factors influence the ability of a mother to bond with the baby and develop maternal containment. Box 12.2 lists the factors that influence mother–infant bonding.

Normally most pregnant mothers have dreams/nightmares late in pregnancy about their inability to care for the baby (such as starving the child or forgetting him in a car/shopping centre) as well as fear and anxiety for the actual process of giving birth.

The birth of the baby can also bring up feelings of their own unmet emotional needs in the mother and/or the father, for instance their own neediness may be so overwhelming that the baby's needs are not noted.

Depending on the underlying fantasies and fears, birth itself may be experienced as a joy, as a wonder, a relief, a loss, a trauma, a discovery and is probably a mixture of all of these. The actual events of the birth also make a significant contribution, in terms of the quality of experience for parents and their babies. The degree of anxiety, discomfort/comfort experienced, the availability of technological interventions, the nature of the birth environment and the amount of stress, danger, or confidence all play a part. The external reality of these events may be beautiful or harsh, but the meaning and extent to which they are felt to be pleasurable, distressing, manageable or unbearable, will be intimately related to the internal, psychological disposition of all concerned. Often, the exhilaration and relief of a safe delivery may be followed by a period of depression and disappointment, and, sometimes, mourning the loss of the baby from within the mother's body. The mother may become passive and demand to be cared for, thus neglecting the baby's needs.

When a woman becomes a mother she reflects back on her own experiences of being mothered. When this was negative or she experienced insecurity, rejection, discomfort or abuse from her primary caregiver, the ability to be a mother may be severely affected and she may even repeat this behaviour with her own baby. The developmental tasks of mothering are influenced by experiences and the relationship she had with her own mother as well as the environment in which she grew up and will include experience of baby care. In extended families young women may be more experienced in baby care, but in urban areas with nuclear families, young women may never have had this experience.

Evidence shows that these patterns are unconsciously repeated. The way the mother has resolved these stages in her own childhood may distort her view of her child and create anxiety that will influence and affect her ability to be an effective mother.

It is normal for women to experience ambivalent feelings towards the baby in pregnancy and after birth. Some women verbalise feelings of distance, unreality, or not knowing a child. Indifference to the child is not uncommon. Bonding can already be strong in pregnancy, but only takes hold at birth when the mother and baby interact – with eye contact, through skin-to-skin contact, through body warmth and through movements. Most women seek contact with their babies within six hours after birth, but sometimes bonding happens over a longer time. Mothers may need to consolidate and reflect on the experience of birth and come to grips with their expectations of the baby. There appears to be a sequence of behaviour involved in bonding (see Box 12.3).

12.2 The factors influencing mother–infant bonding

- The motivation for the pregnancy.
- The woman's experiences and relationship with her own mother.
- Poverty/financial support.
- Support from the community/or environment.
- Support from the father of the child.
- Support from healthcare and healthcare practices.
- Problems experienced in pregnancy and birth.

12.3 Typical bonding behaviour

Typical bonding behaviour and responses of a mother include:

- *Touch*: The mother looks at the baby at first and then follows a sequence of touching beginning with the extremities using the finger tips, starting at the hands and feet and moving towards the trunk, often using stroking movements. When the palm of the hand meets the baby's trunk the sequence is complete. The mother then lifts the baby up to her face for eye-to-eye contact.
- *Verbally*: The mother will ask questions or compare similarities to other members of the family, e.g. 'she looks like'. A typical positive response is when a mother says that 'this is the most beautiful baby I have ever seen'. The mother speaks to the baby in a high-pitched voice. Speaking to the baby and not about the baby is a positive bonding activity.

Mother–infant bonding

The bond between a mother and her infant is not automatic or instinctive. Mothering is practically learned from interaction with a baby, and each mother adapts at her own pace. Each child also places specific and unique developmental demands on a mother. A woman may bond differently with different children.

The first minutes, hours, and days after birth have special significance for the establishment of the mother–infant bond and are important in midwifery care. Certain events may disturb early attachment and possibly have adverse affects on the later maternal–child relationship. The midwife plays an important role in helping the mother to recover from the birth and facilitates the crucial moments in the physical presence of her baby as well as bonding with the baby. The midwife assists mothers to make the necessary adjustments. Evidence-based best practice in maternal care requires the baby to be put to the breast within one hour after birth and 'Baby-friendly care' principles require mothers and babies to be together 24 hours a day through rooming-in.

For most babies the primary caregiver, or 'need satisfier' is the biological mother – the source of food, protection, warmth, stimulation, and affection. The bond, or attachment, that a mother forms with her baby begins during pregnancy, possibly when she first feels the fetus move within her body. It is a gradual unfolding relationship that blossoms with the baby's birth. Not all pregnancies are planned or wanted, and even in wanted pregnancies women experience anxiety and ambivalence towards the infant. A baby may threaten a woman on a variety of levels, for example, her physical body, her relationships, her study opportunities and other future prospects.

Once this initial sequence of bonding has taken place the baby should be ready for breastfeeding. When a baby does not want to latch to the breast it may be that the bonding process has not yet occurred. It is a good idea to take the mother through the process of skin-to-skin contact and eye-contact and encourage her to talk to the baby in the face-to-face position. This encourages breastfeeding. Even if mothers are separated from the infant at birth midwives need to facilitate contact within 24 hours.

Midwives should observe for disturbed bonding, being sensitive to a mother's particular circumstances. Signs of potential faulty, failed or delayed attachment include the woman saying that she did not want the pregnancy and child, not being happy with the gender of the baby, not wanting to look after the baby, complaining about the baby and calling the baby 'it' and not by name (if named).

Clues would be failing to feed the baby, refusing breastfeeding or bottle feeding and not wanting the baby in the room. Kangaroo-mother-care is one way to promote bonding, particularly when mothers and babies are separated for periods due to complications of pregnancy and birth.

The quality of the mother–child relationship is based on the mother's own psychological resources, which can be strengthened by a supportive environment, or weakened by lack of support. Her relationship with the baby will either grow well or become troubled, which could have lifelong consequences for the child.

Maternal containment or 'good-enough-mothering'

Ideally the biological mother should be the primary caregiver because of the biological and emotional bond assumed between the mother and infant. Mothering has a direct influence on the baby and is interactive. The baby is not a passive participant and gives clues to the mother. The mother should be able to identify, interpret and respond to the baby's clues and needs. After birth the mother–infant unit is still seen as one. The baby is totally dependent on the mother.

If maternal–infant bonding is adequate a mother is able to read and interpret the baby's needs and respond adequately to it, this is called *maternal containment*. Maternal containment is needed for good enough mothering. Maternal containment or good enough mothering refers to a set of known conditions that are needed for the normal development of an infant and child. When there is maternal containment the baby feels safe and cared for and the normal development will take place.

Infants are vulnerable and not only dependent on the mother for survival but also for their developmental needs. Failure to meet the individual emotional needs of the infant has long-term consequences for the psychological, emotional and cognitive development of an infant. If the mother is uneasy or troubled, she may not be able to interpret and respond to the baby's clues and fail to respond appropriately leaving the infant's needs unmet. This will have adverse consequences for the infant's development particularly if the mother is severely depressed. Every preoccupation of the mother, her concerns with other members of the family, with work or outside interests, her depressions, illnesses, absences, even her death, are transformed thereby into experiences of rejection and desertion by the child.

If an infant experiences fluctuation between aggressiveness, love and understanding in mother's care during the developmental phases, it may have an adverse affect on his/her development and sense of security. Frustration, discomfort and pain (also seen as persecution) enter into the baby's feelings about the mother and the world, because in the first few months the mother or primary caregiver represents to the child the whole of the external world; therefore both good and bad comes from the mother, and this leads to a twofold ambivalent attitude toward the mother and the world, even under the best possible conditions.

The infant reacts to these persecutory impulses of an unfavourable environment with anxiety, predisposing the child

in later life to behavioural disorders, learning disabilities and personality disorders, including antisocial behaviour, drug and alcohol abuse, insecurity, low self-esteem, eating disorders and depression as well as an inability to form lasting and meaningful relationships.

Maternal–infant bonding, containment and good enough mothering may be absent in cases where mothers are not able to take care of the needs of the baby because of their own physical or social problems, or mental health status. Women with a history of abandoning their children or who were abused themselves are at risk to be abusive mothers. The demands of the care of the baby may revive in the mother her own childhood conflicts and experiences causing a crisis in her own role development as a mother. If a biological mother is sick or absent a foster/substitute mother who meets the needs of the infant can give good enough care.

Midwives and healthcare workers by law are obliged to report cases where babies are neglected or abused.

Attachment and separation

Spontaneous parental attachment behaviour becomes the known world of the infant where his/her needs are met and where he/she finds comfort.

There is consensus that around seven months after birth there is a major developmental shift in the baby, whereby the infant becomes able to experience himself and his mother as whole persons – separate from one another. This is a normal developmental phase and needs to be recognised and managed. The infant will be able to maintain an internal relationship to his mother in his mind while she is externally absent. It is this internal relationship which allows the baby to develop his/her own sense of a person and the mother to be missed.

Maternal deprivation

When an infant experiences lack of maternal containment the infant feels physical discomfort, pain and emotional distress which are powerful and negatively charged experiences, forcing the infant to rely primarily on his own resources and withdraw emotionally. These infants are apathathetic, not interested in the world and avoid eye contact. Children in whom this deficiency is severe seem to grow up lacking the conviction that distress can be tolerated or that it is possible for the human mind to digest, and so bear, distress. This phenomenon seems to have something to do with the mechanism which perpetuates the so-called cycle of deprivation. Deprivation refers to the lack of the experiences/resources in life considered basic for physical, emotional and social development.

The mother's absence or lack of emotional availability may be due to a variety of reasons and leads to maternal deprivation. Children who experience maternal deprivation suffer a loss that influences cognitive and social behaviour and are often also physically affected by 'failure to thrive'.

Battering

Despite all the joys and pleasures of a wanted pregnancy the future mother may also feel for the first time unexpected fears and anxieties which were not part of the original game of mother and baby. She may experience a new unaccustomed core of loneliness. The most devoted mother can experience times of intense loneliness with her baby. Many parents have felt intense rage and an impulse to smack a baby at a time of stress. Assistance is needed to take over some of the functions of care and so relieve the tension between mother and child. If unsupported this may develop into battering.

Signs that a child is at risk of battering include: a personal experience/history of battering in the mother, the unmarried/teenage mother or severe family breakdown. These individuals and families need careful monitoring by the midwife to observe and appropriately refer when child abuse is suspected or when there is doubt about parenting capacity.

The role of the midwife in maternal and newborn care

Psychological aspects of care are an important competency and part of the standards of midwifery practice. Midwives need to understand the emotional, cognitive and psychosexual development of the baby, and should guide the mother/parents/primary caregivers in stimulating these skills as well as making helpful observations in diagnosing problem areas in the mother–child relationship. Midwives are also required by the Children's Act (Act 38 of 2005) to identify and report children that may be in danger. Box 12.4 outlines some critical interactions in mother–infant interaction.

12.4 Critical mother–infant interactions

- *Preparation.* How did the mother prepare for the arrival of the baby?
- *Bonding behaviour.* Did bonding occur and what is the initial response of mother and baby after birth? What were the mother's verbal responses (cooing, soft and friendly or harsh and impatient)?
- *Aspects of care.* How does she respond to the baby's physical needs (temperature of the room, appropriateness of clothing, need for nappy changing, sleep and feeding?)

continued

- *Holding*. Does the mother keep the baby in her mind by holding him and containing him by responding to his needs for comfort and warmth? How does the baby respond – what is his expression? How long does she leave the baby in the pram/cot unattended?
- *Handling*. How is the baby picked up and held? Does the mother handle the baby in a caring and safe way? What is the baby and mother's response to being changed or handled – how does she speak to the baby?
- *Safety*. What does the mother think about safety issues in general and is her attitude appropriate for the baby's age and stage of development?
- *Feeding*. Can the mother recognise that the baby is hungry and respond appropriately? How is the baby held and spoken to and is there eye contact? How does she cope with challenging situations like a dirty nappy, vomiting and wriggling distress? What feeling does this encounter evoke in the midwife?
- *Play*. Does the mother adapt to the baby's mood, playing appropriately and in a friendly, caring way, following cues from the baby? Can she recognise when the baby is tired?
- *Comforting and setting to sleep*. Does the mother recognise whether or not the baby needs to sleep and respond appropriately? Does she talk to the baby? Is she saying goodbye when going back to the nursery – is she too happy to get rid of the baby or does she give loving and caring instructions – how does she negotiate a break for herself and does she ask for help?
- *Relationships*. Does she protect the baby from her own feelings of upset, anger, sadness and its effect on the baby? It remains the responsibility of the midwife to ensure that only positive experiences of motherhood are reflected in her supervision and care of the mother. How do mother and father work as a couple, with the family and the staff – are they forming a positive relationship? Is there consistency of mood and response?

Nursing care plans should include not only physical and obstetric indicators but also mental health and psychosocial aspects of the mother and child, allowing respect and space for the mother to vent feelings and express anxieties while maintaining professional boundaries.

12.3 Conclusion

Midwifery competencies include the understanding of maternal and infant developmental behaviour and an understanding of and ability to support mothering and parenting skills. This includes the recognition of vulnerable mothers, infants, communities and groups in society. There is a need for support groups so that women can be referred where necessary for assistance.

Antenatal and postnatal care are not only focused on the development of healthcare practices but help to empower mothers to understand mothering. In the urban settings and where there is lack of community support, mothers rely on this assistance for support.

CHAPTER

13

Mental health, gender-based violence, and loss and grief in pregnancy and birth

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- assess a woman's mental health status in pregnancy and act according to the risk factors
- show knowledge of conditions and resources to assist women with special mental health needs in pregnancy
- assist and manage the loss of a baby using evidence-based standards, guidelines and protocols
- have a basic knowledge of the management of Female genital mutilation (FGM)
- manage women who are in situations of violence according to with national and international guidelines.

KNOWLEDGE ASSUMED TO BE IN PLACE

Basic knowledge of psychology, cultural and religious diversity

The dynamics and processes of grief

KEYWORDS

Female genital mutilation • Gender violence • Loss and grief • Depression • Psychosis

13.1 Introduction

This chapter will consider the special health needs associated with mental health, social habits, behaviour pathology, and loss and grief during pregnancy and childbirth. Pregnancy and birth are a period of stress even if it is a normal transitional development phase. Even when pregnancy and birth are normal and uneventful, it can affect a person's mental health. Where there are complications, abnormal babies or loss, parents can experience intense stress and this could put their mental health at risk.

13.2 Psychiatric and mental health disorders in pregnancy

Midwives play an important role in mental healthcare promotion. Pregnancy is considered as a life stressor event even when uneventful. One approach to mental health assessment is to use the 'life event stressor inventory' to determine the level of stress experienced (see Table 13.1). A normal pregnancy has a stress level of 40 out of 100 indicating the level of added stress. How a person copes with life stresses depends on their experiences and, according to this inventory, a count of 300 or more puts someone at serious risk of mental health problems.

The main mental health conditions that may first show themselves in pregnancy are depression, bipolar disorders, mood and anxiety disorders. Women who are particularly vulnerable are those with a history of mental health problems, those who are diagnosed and under treatment, and the mentally retarded. The mother's ability to take care of the baby may be affected by these conditions. Some of the more serious existing conditions are schizophrenia, panic disorders, psychosis, addictions and eating disorders such as anorexia. Obsessive compulsive disorders tend to worsen in pregnancy.

The incidence of mental health problems in pregnancy is similar to the incidence of mental health disorders in the general population. The incidence of depression during pregnancy is similar to the overall incidence among women, which is 10–15%.

Table 13.1

Mental Health Assessment **(POPSAMSS)**

P **Psychiatric history**	**O** **Obstetric History**	**P** **Partner relationship**	**S** **Support Network**	**A** **Attitude**	**M** **Mental status GOPATJ**	**S** **Self Concept**	**S** **Suicide risk**
History of mental illness Family history of mental illness On psychiatric treatment Under supervision of the psychiatrist and obstetrician	Obstetric risks Traumatic births Perinatal deaths Caesarean sections	Single Stable relationship Conflict in relationship Nature of conflict Mechanisms to resolve conflict	Material resources Social resources Perception of resources	Quality, intensity and duration of attitude Response to unborn child Feeding method	*General appearance* Grooming Restlessness Sleep patterns Eating habits *Orientation* Confused Disorientated *Perceptual* Hallucinations *Affect (mood)* Mood swings Depressed Anxious Flat *Thoughts* Coherent Delusional Suspicious Bizarre *Judgement* Self awareness of condition	Personality strengths Perceptions Skills in negotiation Use of resources	History of attempts Expression of intent (Direct or indirect) Method planned Risk to the baby

Psychiatric disorders are associated with poor prenatal care, poor nutrition, impulsive behaviour and substance abuse. Depression is associated with a higher risk for preterm birth, lower birth mass, head circumference and Apgar scores.

Women who are on psychiatric medication require counselling because of potential adverse effects during pregnancy. Most psychotropic drugs can cross the placenta and some may have teratogenic effects.

Women with mental health problems will need extensive support systems and follow-up during pregnancy and after birth.

Depression

Depression may already be present in pregnancy but often only presents in the postnatal period as postnatal depression (PND). PND can develop over a period of weeks or months and is a condition recognised in the Diagnostic and Statistical Manual of Mental Disorders (DSM) classification of mental health illness. The actual prevalence of PND is unclear, with rates varying between 5% and 25%. Symptoms include insomnia, irritability, tearfulness, poor concentration, poor appetite, and restlessness, being overemotional, an inability to stop crying, forgetfulness, emotional reserve, antisocial behaviour, tension, disorientation, anxiety, overdependence and suicidal thoughts.

13.1 A useful tool for the identification of PND

A useful tool for the identification of PND is the 'Edinburgh Postnatal Depression Scale' adapted by Liz Mill for use in South Africa. Read more at: www.fresno.ucsf.edu/pediatrics/downloads/edinburghscale.pdf

A thorough antenatal history and early identification with appropriate intervention can result in optimum outcomes for mother and baby (see Table 13.1, Boxes 13.1 and 13.2).

Puerperal psychosis

Puerperal psychosis is a very serious condition and occurs in 1:500 pregnancies. Puerperal psychosis presents within days of the birth and is characterised by insomnia, suspicion, abnormal behaviour, neglect or overprotection of the baby and loss of sense of reality. Women with puerperal psychosis may harm their babies and infanticide is a risk, although rare. This catastrophic outcome can be prevented by early recognition and intervention. A woman with puerperal psychosis will need admission and hospitalisation for treatment and the care is usually long term. They may be advised not to have more children.

13.2 Risk indicators for mental disease

- Previous history of depression.
- Lack of support from the partner.
- Complications of pregnancy.
- Loss of own mother when a child.
- Accumulation of misfortune, bereavement, posttraumatic stress, job loss, housing and money problems.

The primary goals of the treatment of psychiatric disorders in pregnancy are to maintain mental stability while minimising the risk to the mother and fetus, develop support systems and a plan for management of the baby and its needs postdelivery. In some cases, symptom control is the main aim.

The mental wellbeing of a mother may warrant the termination of a pregnancy and is permitted under the Choice on Termination of Pregnancy Act (Act 92 of 1996).

13.3 Gender-based violence

Gender-based violence occurs across the social spectrum. Evidence suggests that this type of violence is preventable since it may result from community, cultural and other external factors. Gender-based violence is a pubic health concern and a violation of human rights. Violence is often from intimate partners and often linked to sexual issues.

13.3 International Day for the Elimination of Violence against Women

In December 1999, the General Assembly of the United Nations adopted resolution 54/134, proclaiming 25 November to be the International Day for the Elimination of Violence against Women. http://www.un.org/womenwatch/daw/vaw/v-inter-day.htm.

Scope of the problem

At the 4th World Conference on Women in Beijing in September 1995 (United Nations) on violence against women and the human rights of women it was recognised that two of the 12 critical areas identified as obstacles in the advancement, equality, development and peace of women in society include violence (see Boxes 13.3 and 13.4).

Kinds of violence

Violence in adult life is often part of a cycle – people who come from a violent upbringing or society/community have learned

13.4 Statistics

- Globally, one in every three women have been beaten.
- The abuser is usually a family member.
- In South Africa a woman is killed by her partner every six hours.
- South Africa has a high incidence of rape of babies and children.
- In the USA a woman is beaten every 18 minutes and raped every six minutes.
- Between 22–35% of women visiting emergency units are abused.
- In Peru 70% of crimes reported involve women beating.
- In Pakistan of 400 cases (1993) reported, 50% ended in death.
- In India five women are burned every day.

13.5 Kinds of violence

- Family violence associated with traditions and economical issues (e.g. son preference).
- Sexual assualt and harassment within marriages.
- Dowry-related violence and early marraige. Custodial violence against women.
- In the community the following are all forms of violence: rape, child trafficking for sex, labour exploitation and female migrant workers, prostitution, women trafficking and pornography, cultural practices such as female genital mutilation.
- The state and government can also commit acts of violence through detention, torture and rape by police and armed forces, armed conflict and refugees and displaced women.

patterns of violent behaviour that will repeat in their own relationships, families and communities. Breaking the cycle of violence requires an intensive effort along with programmes put in place by trained psychologists, psychiatrists or other professionals. There are many triggers for violence (see Box 13.5).

Female genital mutilation (FGM)

The World Health Organization estimates that 85 million to 115 million girls and women have undergone some form of female genital mutilation and suffer from its adverse health effects. Every year an estimated two million young girls undergo this procedure. Most live in Africa and Asia but an increasing number can be found among immigrant and refugee families in Western Europe and North America. This practice has been outlawed in some European countries. In France, a Malayan was convicted in a criminal court after his baby girl died of a female circumcision-related infection. The procedure had been performed on the infant at home. In Canada, fear of being forced to undergo circumcision can be grounds for asylum. A Nigerian woman was granted refugee status since she felt that she might be persecuted in her home country because of her refusal to inflict genital mutilation on her baby daughter. There is a growing consensus that the best way to eliminate these practices is through educational campaigns that emphasise their dangerous health consequences. Several governments have been actively promoting such campaigns in their countries.

The South African population does not practice FGM, but a growing number of women, immigrants and refugees from Africa and the East provide this in the public health sector. South African midwives are not trained to deal with FGM and this should be added on the curriculum of midwives. However, there are guidelines for the management of FGM (see Box 13.6).

13.6 Activity

The International Council for Nurses has a fact sheet on FGM that can be visited at http://www.icn.ch/matters_fgm.pdf

The WHO (2001 & 2008) developed policy guidelines for nurses and midwives, available from http://www.who.int/gender/other_health/en/guidelinesnursesmid.pdf

Global intervention into violence against women

The first global report on Violence and Health by the WHO was released on 2 October 2002, recognising violence as a global health problem. In 1993 the United Nations adopted a Declaration on Elimination of Violence against women. In 1994 a special rapporteur was appointed to investigate causes and consequences of violence against women. This gave violence against women a public face and created a mandate to:

- collect information from governments, agencies and NGOs and respond to it
- recommend measures to be implemented
- work closely with the commision of human rights.

Role of healthcare workers

Healthcare workers should consider their own opinions of and experiences of violence, if they are to help others to resolve issues around violence.

Training and education are important steps in developing knowledge and the skills to manage violence. Midwives will frequently come across women who have experienced violence because of mental health problems associated with pregnancy and birth.

In general, healthcare workers can create awareness, educate and empower the community and help to change beliefs and attitudes. It is important not to ignore violence when it is encountered. Midwives can be guided by the following principles:

- avoid indifference or judgemental reactions
- learn how to ask in ways the patient finds helpful
- give empathy and support
- give the care required, such as medical care or family planning
- offer counselling and refer to a support group
- give options that can empower the woman
- document events and injuries
- reach out to men.

At community, governmental and national level actions include the development of national legislation, providing legal aid and counselling, creating shelters and rehabilitation centres. Through educational programmes, the non-stereotyping of women (through the illimination of pornography and violence on TV and in the media) behavioural change is fostered to modify behaviour.

Women face the highest risk of domestic violence and abuse. Twenty-five percent of women suffer sexual violence from an intimate partner. The Domestic Violence Act (Act 116 of 1998) as amended, offers protection against all forms of violence to women and children in South Africa.

The underlying characteristics predisposing to violence are identifiable. Injured women are often seen in obstetric units because violence frequently occurs during pregnancy. Women who suffer physical violence during pregnancy have a three-times greater chance of dying from future physical abuse. Clinics need to have a policy and a protocol for recognising this abuse, provide counselling and referral, and follow-up these women to prevent future deaths. Midwives can intervene in the cycle of violence by helping women to understand their options and to take appropriate action. Parenting classes, conflict management and social programmes can assist in combating violence in the family and community.

Social behaviour disorders

Substance abuse/dependence

The health of the women and the baby is at risk in drug dependent women. The degree of placental permeability depends on the chemical properties and molecular weight of the drug and whether used alone or in combination with other drugs. Commonly used drugs are alcohol, cocaine, crack, dagga, amphetamines, barbiturates, hallucinogens, heroin, caffeine and nicotine. Dagga/marijuana contains 400 complex chemicals and interferes with the production of hormones that are critical for sexual and reproductive development. Drugs used during pregnancy are often found in the same concentration in the baby and may cause respiratory and cardiovascular suppression in the baby. Drugs such as LSD are also teratogenic. A comprehensive team approach is needed for safe outcomes for mother and baby. The midwife's task involves evaluation of medical, socio-economic and legal aspects, and is aimed at the early identification of cases that are at risk. Fetal surveillance during pregnancy is important because the fetus is affected and at risk. The baby should be delivered in a maternity unit with a neonatal unit attached (Level 3).

The use of traditional substances or medicine is an unknown factor that often has adverse effects and should never be forgotten.

Alcohol in pregnancy

Alcohol abuse during pregnancy is common. There are no determined safe levels of alcohol intake during conception and pregnancy, so current advice is that women should not drink alcohol when pregnant. Fetal alcohol syndrome (FAS) is a preventable condition, which is particularly common in the Western Cape. Midwives need to educate women on the adverse effects of alcohol in pregnancy.

Potential effects of alcohol are illustrated in Box 13.7.

13.7 Potential effects of alcohol use on pregnancy

- Two or more drinks/day: IUGR, decreased placental weight, immature motor activity/tone poor sucking, increased stillbirth.
- Four or more drinks/day: Structural brain abnormalities
- Six or more drinks/day: FAS.
- Women who do not usually drink and start to binge during Christmas, New Year or occasionally while in early pregnancy, or not knowing that they are pregnant, are also at risk of FAS.

Mental retardation is the single most serious problem associated with alcohol use in pregnancy and although babies do not always present with full-blown FAS other effects may be present that affect the child for life.

Nicotine (tobacco)

The number of women smokers is rising and has probably exceeded men. Most smokers start between the ages of 14–19 years and 10% of teenagers in South Africa are smokers. A written health warning on all cigarette products in South Africa alerts the population to the dangers of smoking in pregnancy.

13.8 Effects of nicotine in pregnancy

When smoking one cigarette the blood levels of nicotine peak at between 14–41 ng/ml depending on the way in which women smoke. Depth and length of inhalation will affect nicotine blood levels. Nicotine is then reabsorbed in the fetus with an increase in the fetal heart rate.

Nicotine is also secreted in breast milk for a period of seven to eight hours after smoking the last cigarette.

The most common effect of regular smoking on the fetus is intrauterine growth restriction (IUGR), with an average reduction of 200 g in the mass of a smoker's baby. The relationship is dose dependent – more cigarettes means greater reduction in growth. Smoking 11 or more cigarettes per day increases the risk of spontaneous abortion by 16.7%. The greatest risk of damage to the fetus is during the first trimester, but the effects are most potent in the last trimester when the central nervous system (CNS) develops. Midwives need to encourage pregnant women to stop smoking and utilise effective 'cessation of smoking' programmes that do not include the use of nicotine patches. Positive changes such as improved fetal mass and improved placental function occur when a women stops smoking during pregnancy and positive outcomes include a lower risk of respiratory distress and sudden infant death syndrome (SIDS).

13.4 Perinatal loss and grief

Grief is not only experienced when a woman has lost a pregnancy or has experienced an intrauterine death, but also the loss of a well baby, a premature baby or a baby that is born with congenital abnormalities because the parents grieve for the loss of a normal child.

If not correctly and properly managed, the grief can stay unresolved for a lifetime.

Experience of loss and grief

People differ in the way that they experience loss and grief and how they express this experience. These differences depend on a person's personality, gender and culture.

However, the stages of grieving are similar. Elizabeth Kübler-Ross (1969) observed and described typical behaviour associated with loss and grief that was regardless of age, culture or gender. These are:

- denial
- anger
- bargaining
- depression
- acceptance.

The time a person takes to move through these phases differs.

Forms of perinatal loss

Infertility

Women who fail to conceive go through the same process of grief and are often highly stressed. Women who use artificial means to fall pregnant are generally offered professional counselling.

Early pregnancy loss

A spontaneous abortion, ectopic pregnancy or termination for an abnormal fetus may result in the grief of acute loss. This grief may not be recognised by society as early loss as it is considered an abortion.

The loss of a pregnancy through choice of termination may bring early feelings of relief and grief is often suppressed. This may have long-term effects on the mental health of young women who choose termination of pregnancy and counselling is not always available at TOP clinics in the public healthcare sector. A systematic review of literature did not find evidence that women have long-term mental health problems after abortion on demand. They found that only a minority of women experienced sadness, grief, regret and depression.

Intrauterine death/stillbirth

The loss of a baby *in utero* is usually a period of intense grief and pain. The events that follow the diagnosis may worsen the problem. The choice of delivery, the choice of burial and going home to a room that was prepared to receive a baby can cause great distress.

The experience of stillbirth may be even worse. When a woman is in labour and expects to deliver a well baby that dies during labour, the psychological impact on the mother, father and staff is acute. This woman may be at risk for post-traumatic stress. The delivery may often have been an emergency, without preparation for the events.

CERTIFICATE OF BIRTH IN MEMORY OF OUR BABY

OUR BABY'S NAME IS:

PICTURE OF THE BABY

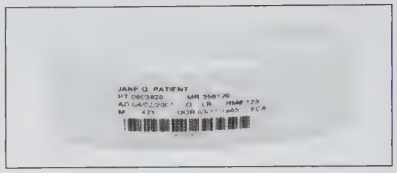


Aspects to remember our baby by:

LOCK OF HAIR



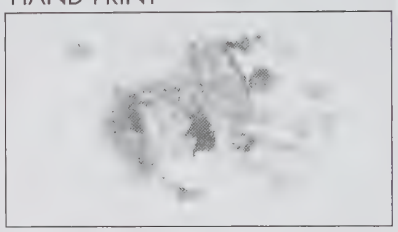
BABY ID BAND



FOOT PRINT



HAND PRINT



Name of mother and father:

.....

Our baby was born on: .....

Our baby was born at: .....

Our baby ..... (boy/girl) was ..... weeks and weighed ..... at birth and was ..... long.

OTHER

Cardiotocograph strip/Sonar picture

Figure 13.1 Certificate of birth in memory of our baby

In the case of a twin or multiple pregnancy a woman can lose one baby *in utero* or may have to choose to terminate one baby to save another. This can cause enormous tension and grief in parents.

Preterm/sick or abnormal baby

The parents of a baby that is sick or abnormal will grieve for the loss of a normal baby. Parents often experience conflict around this event. They may also fear that the baby may die or have long-term health problems and subsequent attachment with the baby may be affected. In addition the time needed to visit and care for the baby may have consequences. Also costs of care can be overwhelming and may add to feelings of stress, guilt and hopelessness.

Giving a baby up for adoption/abandonment/ surrogacy

The decision to give a baby up for adoption may be a relief for a woman who cannot care for the baby. However, some women experience intense grief, while others can let go easily.

Surrogate mothers will carry a baby for another couple and sign an agreement to let the baby go after birth. This can also result in grief.

Caring for the bereaved family

The care of a family that has experienced any of the above-mentioned losses requires skill, maturity and time to guide a women and her family through this traumatic experience.

Several principles need to be considered when caring for a woman after a perinatal loss.

It is important to have a written policy on how to manage perinatal loss, abnormalities and stillbirths:

- Breaking the news. A woman may know that something is not right and come for advice. The main complaint is that the baby is not moving. A midwife must always be honest and involve the woman and her family in the process. It is

best that the woman is not alone. A skilled midwife needs to be appointed to take care of the family. If possible the medical doctor needs to make or confirm the diagnosis. An ultrasound is usually sufficient, which also allows the parents to see that the fetal heart is absent.

- After the loss of a baby a woman is NEVER placed with other woman with babies.
- Early discharge is only in order if the woman does not need medical care.
- If possible a vaginal birth is better than a caesarean section in cases of intrauterine death.
- Women need to be allowed time to express their fears and needs. The midwife is the stand-by (not actively involved but present and observant) while being available for support. The physical presence can be supportive to the woman but should not invade her space.
- Communicate and repeat the message, as people in shock do not take messages in. Give enough information. Give time for questions and answer them honestly. Appropriate verbal and non-verbal communication is a key to comfort using periods of quietness, therapeutic touch and body language.
- Assistance can be sought from other professionals such as social workers, psychologists and psychiatrists if the risk factors warrant this.
- Consider genetic counselling if required. In most cases the cause of the death is not obvious, and parents want a reason to help them understand. If there is an obvious cause of death point it out.
- Cultural diversity. Observe and respect cultural wishes and practices. Hindus, Moslems, Christians, Jewish and indigenous groups all have different ways of dealing with grief and have different rituals. Ask what they prefer and, as long as it is within the law, assist them. A baby that was viable cannot be removed from a clinic or hospital without a death certificate. Only the police can give permission for a body to be transported by family rather than by a registered undertaker. Jewish and Muslim parents need to have the body prepared by the priest and burial before the sun sets.
- Legal issues. Explain all the legal issues to the couple. The need for a birth certificate and a death certificate is explained to the parents. The authorities are informed of the baby's birth through the notification of birth, accompanied by a death certificate. If a baby is viable it has to be buried or cremated by a registered institution. Abortions or babies of less than 1 000 g can be incinerated on the wishes of the parents, following hospital protocol of the hospital. Two people should be present.
- Showing the baby. One of the most important aspects in grief is to allow parents to live through the event. Allow the parents and family to see and to hold the baby. This process is never forced. Parents are told that they have a right to see and hold their child and that there will be opportunity to do so in the next 48 hours or until the baby is taken to the undertakers. Initially parents may be shocked, surprised, refuse, or confused, but eventually most people want to see and hold the baby even when the baby is severally malformed or macerated.
- Creating memories. It should be the hospital's policy to create the memories of a lost child to assist the grieving process. With the parent's permission the following can be done:
- Take a photo of the baby or allow them to take a photo (memories fade fast and they cannot hold onto the brief moment).
- Make a foot print or hand print.
- Give the baby a name (if culturally appropriate).
- Give a name tag with the full details of the date, time, mass, length and so on.
- Cut a piece of hair and put it in a booklet for deceased babies.
- Most institutions have a specific booklet to put together the information and evidence that can be completed and given to the parents. This is most helpful in the grieving process.
- Follow-up. It is important to prepare the mother and family for the aftermath of the event. Often women want to talk about the experience and the family and friends avoid it. This leads to emotional discomfort and a break-down in communication. One way to assist parents is to refer them to services that support women who lose a child or other services in the community (see Table 18.1).

It is also important not to forget about the physical care, the wound, the breasts, the haemoglobin, family planning and all the normal postnatal care.

13.5 Conclusion

Pregnancy and birth are emotionally charged events. Women who are already compromised through a history of mental disorders or substance dependence or violence need to receive care that suits their needs. Failure to give appropriate care will worsen their condition.

Section Four

Pregnancy

14 The physiology of pregnancy

15 The signs, symptoms and diagnosis of pregnancy

16 Evidence-based antenatal care

17 Assessment, diagnosis and treatment in pregnancy

18 Childbirth education

19 Common minor disorders in pregnancy

20 Medical and surgical conditions associated with pregnancy

21 Obstetric haemorrhage

22 Pre- and post-term birth

23 Pregnancy-related complications

CHAPTER

14 The physiology of pregnancy

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- describe the anatomical and physiological changes of pregnancy
- apply this knowledge to the care of a woman during pregnancy.

KNOWLEDGE ASSUMED TO BE IN PLACE

The anatomy and physiology of human reproduction

KEYWORDS

Physiological anaemia of pregnancy • Hegar's sign • Hydraemia of pregnancy

14.1 Introduction

Dynamic changes take place in the body of a pregnant woman in order to maintain the pregnancy and accommodate the growing fetus, nourish the fetus during the periods of development and growth, provide the woman with energy for the delivery and prepare the woman's body for lactation. These take place throughout pregnancy, but the greatest changes occur in the first weeks and are caused by the action of hormones from the trophoblast.

The woman's whole body is affected by the pregnancy, and her endocrine balance and metabolism are also altered. It is these changes that create the signs and symptoms (clinical features) of pregnancy, and form the basis for the diagnosis of pregnancy. Because these changes occur at consistent stages throughout a normal pregnancy, they can be used as a guide for formulating a programme of antenatal care. In this way, abnormalities occurring during a pregnancy can be detected and treated early.

Although most of the changes are reversible, some anatomical changes remain and will give testimony of previous pregnancies.

14.2 The physiological changes in the reproductive organs during pregnancy

The endocrine system

Review Chapter 6.

The reproductive organs

Physiologically, it is the reproductive organs that are predominantly affected by pregnancy. A review of Chapter 5 is suggested.

The uterus

The uterus is the organ that contains and nourishes the conceptus and is, therefore, the organ most affected by pregnancy.

Functions of the body of the uterus and of the cervix

The uterus consists of a body and a cervix (neck). During pregnancy, the body of the uterus must relax and grow to form new muscle fibres to accommodate the conceptus, while the cervix must remain firm and become part of the uterine cavity in order to maintain the pregnancy. During labour, the body of the uterus must contract and retract in order to expel the fetus, while the cervix must relax, stretch and dilate to allow the fetus to pass through the cervical canal (See Chapter 7).

The size of the uterus

There is a huge increase in size, weight and volume of the uterus during pregnancy. The approximate increases from the non-gravid state to those at term are as follows:

- increase in size: 7.5 × 5 × 2.5 cm to 30 × 23 × 20 cm
- increase in weight: 50–60 g to 900–1 000 g.
- increase in volume: 6 ml to 5 000 ml (holding capacity of the cavity).

At eight weeks the uterus can be easily felt on bimanual vaginal examination. In the first 20 weeks of pregnancy, the increase in size is due mainly to an increase in the number of muscle fibres (muscular hyperplasia) and also to an increase in the size of the muscle fibres (muscular hypertrophy).

In the second half of pregnancy the increase in size is due mainly to the mechanical stretching of the uterus by the developing and growing conceptus, which has filled the uterine cavity by about the 12th week.

The body of the uterus

(See Chapter 5). The uterus is functionally divided in pregnancy into the upper and lower uterine segments (see Figure 14.1).

During normal pregnancy, the upper portion of the body of the uterus (from the upper border of the isthmus to the fundus) containing the blastocyst, enlarges uniformly and is called the upper uterine segment.

The lower portion, which is that part adjacent to the cervix and called the isthmus, softens and lengthens in early pregnancy and this forms the basis for Hegar's sign of pregnancy (see Diagnosis of pregnancy, Chapter 15). After the first trimester, as the fetal sac begins to fill the uterine cavity, the elongated isthmus is gradually drawn up and this forms the lower uterine segment that develops mainly after three weeks of pregnancy. The lower segment is less vascular with fewer muscles fibres.

Braxton-Hicks contractions

(See Figure 14.2.) Contractions of the uterine muscles occur throughout pregnancy and are known as Braxton-Hicks contractions. These painless contractions bring about the formation of the lower uterine segment and play a role in the blood circulation in the uterus. In early pregnancy the contractions are mild and irregular, but although they remain painless, they increase in frequency and intensity as the pregnancy nears term. Before 30 weeks gestation, the intrauterine pressure remains below 5 mmHg. After 30 weeks the intrauterine pressure may rise intermittently to about 12 mmHg, which is still below the pain threshold of 25 mmHg. The stronger contractions are now thought to be brought about by the progressive release of prostaglandins, derived from the uterine decidua, towards the latter part of pregnancy and by the fact that the uterine muscles become increasingly sensitive to oxytocin as labour approaches. (Nipple stimulation during pregnancy will bring about uterine contractions releasing oxytocin.)

Contractions prepare the uterus for labour. Once the contractions are regular, increasing in intensity and not more than twenty minutes apart labour may start. Labour is only positively diagnosed when it has been determined that the cervix is starting to dilate (see The first stage of labour, Chapter 25).

Position of the uterus

The uterus is a pelvic organ in anteversion and anteflexion (see Figure 5.5). At 12 weeks the uterus can be felt above the pelvis. The uterus moves up in the abdomen and displaces the abdominal organs as it moves up. The round ligaments grow longer and become soft. At 20 weeks of pregnancy the uterus is dextroverted, turning to the right side to lift from the aorta and inferior vena cava. This places pressure on the right ureter and it is this side that is most prone to pyelonephritis. These changes of the uterus can be measured between 20 and 35 weeks to determine the gestational age (the SF measure: symphysis – fundal); 1 cm equals one week.

An abnormal position of the uterus such as retroversion or retroflexion, multiple pregnancy and polyhydramnios will influence these measurements. A grand multipara may also have an over-stretched uterus and ligaments that can cause the uterus to take any position. The growing uterus displaces the abdominal organs, which may cause the signs and symptoms of disease in abdominal organs to be misleading, for example the appendix may lie in an abnormal position.

False labour

These contractions can become quite intense and frequent in the last two weeks of pregnancy and some pain may be experienced, especially by anxious women, and by primigravidae who have not previously been in labour. This may lead to what is called false labour, which can lead to further anxiety. This may happen more than once in the final weeks of pregnancy. However, the woman and her family should be reassured and the signs of true labour made clear to them. It is important that they are then advised to wait for the start of true labour. False labour is distinguished from true labour by lack of 'show' and the absence of changes of the cervix. If the membranes rupture prematurely the women will be managed differently.

(See Induction of labour, Chapter 32.)

The cervix

The cervix, particularly in primigravidae, maintains a relatively constant length of about 2.5 cm during the first two trimesters and remains firm until the end of the first trimester.

In the second trimester, the cervix widens and softens and there is a marked proliferation of cervical mucosa glands, resulting in increased glandular activity. The mucus secreted at this time is thick and viscid and forms a mucus plug, which occludes the cervical canal. This plug, known as

the operculum, acts as a barrier against ascending infection. The softening process is accentuated as the pregnancy reaches term and labour approaches and is known as *ripening of the cervix*. In the latter weeks of pregnancy, the cervical canal becomes partly effaced or taken up into the lower uterine segment also as a result of the Braxton-Hicks contractions.

The cells of the cervix change and a Pap smear can only be done until 28 weeks of pregnancy and again at six weeks postpartum (see Figure 14.1).

The ripening of the cervix and the effacement of the cervical canal prepare the cervix for labour and make it favourable for dilatation. (See Physiology of the first stage of labour, Chapters 24 and 25 and Induction of labour, Chapter 32.)

The cervix changes from pink to a dark purplish colour during pregnancy, due to the increased vascular supply to the uterus and this change is diagnostic of pregnancy. The cervical changes can be used to predict the success of induction of labour using the Bishop score and will also predict the progress of labour. A posterior closed cervix

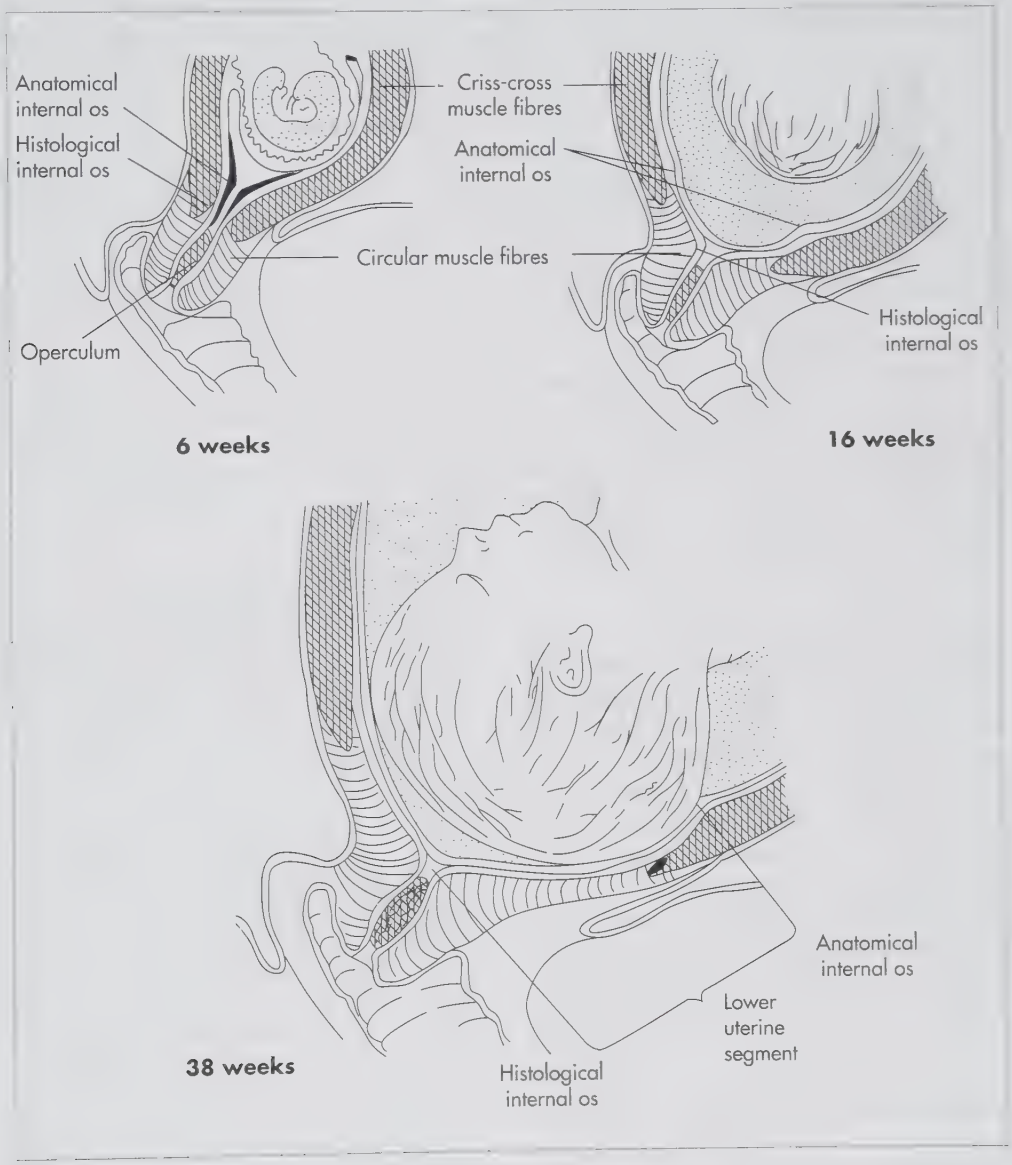


Figure 14.1 Formation of the upper and lower segments of the uterus
Redrawn from Lewellyn-Jones D. 1982. *Fundamentals of Obstetrics and Gynaecology* (3 ed.). London: Faber & Faber.

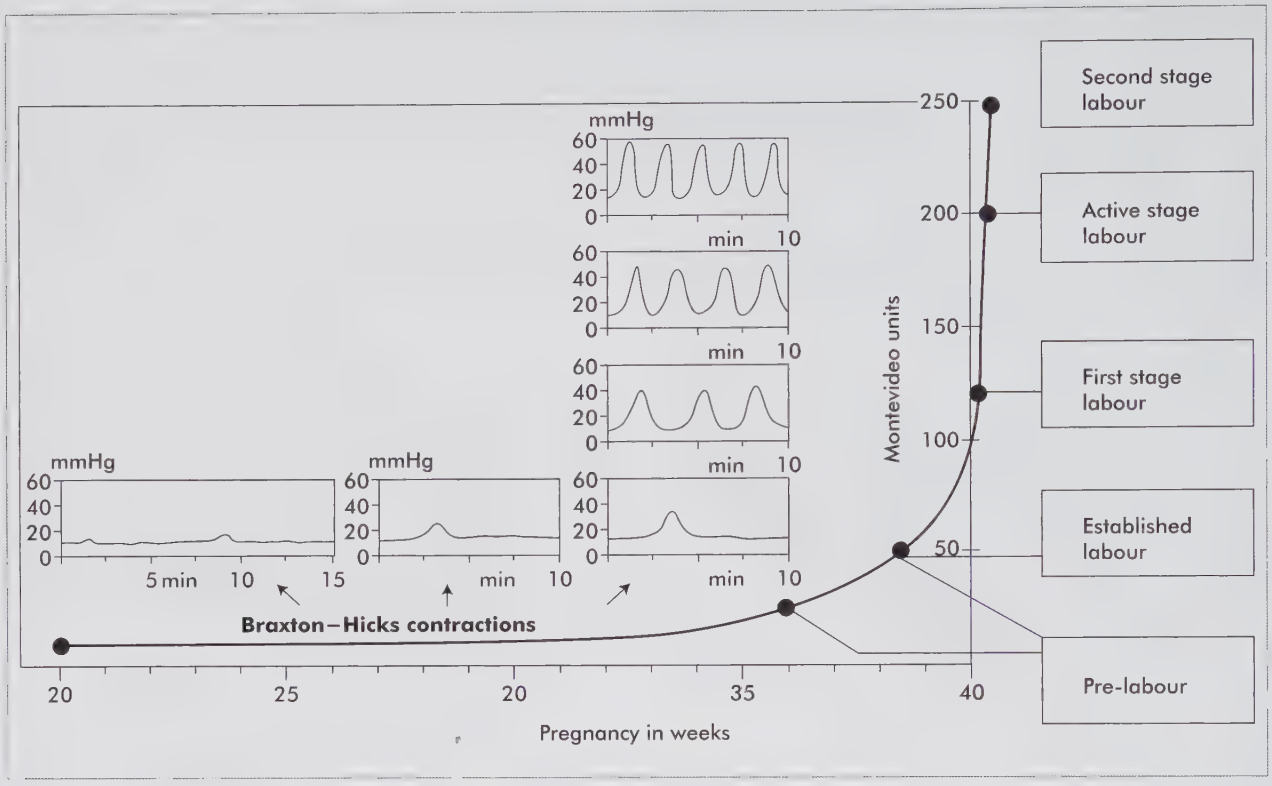


Figure 14.2 Schematic presentation of uterine activity in pregnancy and birth
Adapted from Llewellyn-Jones. 1992.

when labour starts can predict a long labour in a primigravida.

The blood supply to the uterus

The volume of blood to and from the uterus increases with uterine growth and the tortuous blood vessels straighten out. The uterine blood flow at term ranges from 500 ml to 700 ml per minute. This greatly increased blood supply to the uterus is vital to fetal development, growth and wellbeing.

During systole, the blood at the placental site is forced from the endometrial arteries under pressure, causing it to spurt into the intervillous spaces and against the chorionic plate. The streams of blood being forced against the chorionic plate are dispersed like fountains, thereby allowing the blood to circulate around the chorionic villi, which are floating freely in the maternal blood. The velocity of the blood flow slows and this allows for the transfer of nutrients and exchange of oxygen and carbon dioxide to and from the fetus across the placental membrane, before the blood drains away via the endometrial veins during diastole. This procedure is repeated with the following systole. The blood supply in labour can be cut off in hypertonic uterine contractions.

The vagina

The muscle fibres of the vagina hypertrophy during pregnancy and there is softening of the connective tissue, causing the vagina to develop a larger lumen and increasing the stretching ability of the vaginal walls. The vagina becomes very vascular and assumes a dark purplish colour.

Owing to the influence of the extra oestrogens in pregnancy, the mucosa becomes thicker and there is a larger amount of glycogen in the squamous cells. This leads to an increased desquamation of the superficial vaginal mucosal cells and consequently to an increased vaginal discharge. The Ph of the vagina changes in pregnancy as a result of hormonal changes, predisposing the woman to vaginal infections. There is also increased vaginal discharge, which may become infected with pathogens such as bacteria, fungi (*Candida albicans*) or parasites (*Trichomonas vaginalis*). The resultant vaginitis can be troublesome during pregnancy.

The vulva

There is an increased vascularity of the vulva, resulting in a darker colour. Varicosities of the vulva veins may occur.

The fallopian tubes

The uterine tubes, together with the broad and round ligaments, hypertrophy and become more vascular and pliable. As the uterus grows and becomes an abdominal organ, the fallopian tubes are also lifted out of the pelvis.

The ovaries

The blood supply to the ovaries is also increased and they are drawn up into the abdominal cavity with the uterus and uterine tubes. At term, the ovaries are situated posteriorly in the abdomen, just below the costal margins.

During the first 12 weeks of pregnancy, under the influence of HCG, the corpus luteum increases in size to almost 20 mm in diameter. However, from the third month (second trimester), there is a regression of the corpus luteum as the placenta starts to take over the function of producing oestrogens and progesterone.

The breasts

The breasts undergo extensive changes during pregnancy in order to be prepared for the nourishment of the infant at birth.

The breast changes are often the first signs of pregnancy that a woman notices and are as follows:

- At three to four weeks, there is a prickling and tingling sensation. The duct and alveolar systems of the breasts enlarge under the influence of oestrogen and progesterone respectively.
- From six weeks the breasts gradually increase in size. On examination, the breast tissue changes from being soft and smooth, to having a tense, nodular feel.
- There is an increased vascularity of the breasts from about eight weeks, which can be seen under the skin as a network of subcutaneous veins. This vascularity increases until, near term, the veins have ramified over the whole anterior aspect of the thorax.
- By the twelth week, the nipples have enlarged and become more prominent. Together with the primary areola, which has become raised and moist, the nipples have become more pigmented to a brownish colour. The darker the woman's complexion, the darker the pigmentation becomes.
- By the twelth week, the modified sebaceous glands in the primary areola enlarge and become more prominent and are known as Montgomery's follicles or tubercles. Their secretions keep the areola and nipple soft and pliable during pregnancy and lactation.
- By the sixteenth week, the areola has extended over a larger area of the breasts and is known as the secondary areola. This is more noticeable in brunettes and dark-skinned women.
- From about 16 weeks, colostrum can be expressed from the nipples. This colostrum will only change to milk on about the third day after the birth of the baby. The milk supplied by a woman's breasts provides exactly the correct form of nourishment for her baby, no matter at what period of gestation the baby may be born.

The skin

Owing to high hormonal levels, there is an increase in pigmentation during pregnancy. This is more pronounced in brunettes and dark-skinned women and can be noticed on the breasts, the abdomen, the vulva and the face. When present on the face, this pigmentation is called chloasma or the *mask of pregnancy*. It is usually present on the cheeks and forehead.

The linea alba, a thin white line extending from the symphysis pubis to the umbilicus, may darken appreciably and is then known as the linea nigra (black line).

This increased pigmentation of the skin gradually fades after pregnancy.

The high levels of circulating hormones and the rapid stretching of the skin of the abdomen, thighs and breasts are probably responsible for small pinkish-brown streaks or scars that develop in these areas. They are known as striae gravidarum and may become quite dark in multigravid brunettes and dark-skinned women. These striae gravidarum or 'stretch marks' fade after the pregnancy and later appear as silvery streaks on a white skin or as shiny dark streaks on a dark skin.

The cardiovascular system

The cardiovascular system in pregnancy is hyperdynamic. The changes of the cardiovascular system are reversible and are mediated by the circulating hormones and the demands of the enlarged vascular bed. In most pregnancies these effects do not compromise the mother. However, if the mother has underlying health problems she or the fetus may be compromised. These changes include modification of the blood volume, plasma volume, red blood cell volume and cardiac output. Anatomically the heart is displaced upwards by the enlarged uterus and moves into a more horizontal position. The heart is slightly enlarged.

The heart

Pregnancy places a high demand on the cardiovascular system:

- *The cardiac output.* This increases by 30–50% by eight weeks, steadily increasing until the 3rd trimester due to the

increase in blood volume and venous return. Most of the increased output is managed by an increase in the stroke volume (the amount of blood ejected per beat), but there is also an increase in the heart rate of about 10 to 20 beats. Extra beats are normal. In late pregnancy the cardiac output is affected by the woman's physical position. Twins and triplets affect cardiac output more than singleton pregnancies.

- *Heart rate*. The normal range for heart rate in pregnancy varies by 20–60 beats. Both heart rate and venous return are increased in pregnancy.

  In women with small hearts, the rate can be increased to 90 or 100 beats per minute and they have difficulty dealing with cardiovascular changes in pregnancy. Pregnancy places an added burden on the heart. For example, in hypertensive disorders in pregnancy where there is marked vasospasm, the burden on the heart is greatly increased.
- *Blood pressure*. Blood pressure, especially the diastolic pressure, decreases in early pregnancy due to the enlarged vascular bed and a drop in peripheral resistance. It drops by between 10–15 mmHg. Both parity and age have an effect on blood pressure, which gradually increases from 20 weeks of pregnancy.

  Increased parity is associated with a decrease in diastolic pressure, whereas an increased age is associated with an increase in diastolic pressure.

  The woman's position (standing or sitting) is associated with a gradual drop in diastolic blood pressure in pregnancy until the third trimester, which means that the woman's blood pressure must always be measured when she is in the same position.
- *Systemic vascular resistance*. The increased blood volume, together with vasodilatation, causes a decreased vascular resistance in peripheral vessels. Late in pregnancy the gravid uterus may contribute to poor venous return, which may cause distension of the veins and oedema of the legs, vulva and anal canal and varicose veins and haemorrhoids are quite a common problem.

The supine hypotensive syndrome

This is caused by the pressure of the enlarged uterus on the dilated inferior vena cava when the pregnant woman lies on her back. The uterus blocks the return of blood to the heart and results in the patient feeling faint, and becoming pale and sweaty. The blood pressure may be low or even unrecordable. This can also have an adverse effect on the fetus, because of a reduction in the oxygen supply to the placenta. This is managed by turning the woman onto her side and then the uterus will no longer obstruct the blood flow to the heart. Pregnant women should never lie in the supine position (on their back) but always on the left lateral side.

Distribution of blood flow

The greatest proportion of the increased blood flow goes to the uterus, in order to nourish the enlarging uterus and its contents. At term the blood flow to the uterus is 500–600 ml/min which is 10–20% of the cardiac output. There is also increased blood flow to the lungs, to the skin and mucous membranes and particularly to the kidneys.

The uterine spiral arteries undergo marked changes in pregnancy and are completely dilated and are not responsive to the pressures of the autonomic nervous system.

Total blood volume (TBV)

The blood volume increases by about 1.5ℓ, (30%) to supply the enlarging uterus and the placenta (hydraemia of pregnancy). There is a rapid increase of the plasma volume from the tenth to about the thirty-fourth week of pregnancy to reach about 3 800 ml, which is about 30–50% more than in the non-gravid state. There is a direct correlation between the blood volume increase and the weight of the fetus. This hypervolaemia of pregnancy is substantially greater in twin (65%) and multiple pregnancies (more than 65%) placing a greater demand on the cardiovascular system. There is increased total body water and increased plasma renin, which causes intracellular fluid retention and an increased cardiovascular distensibility. Body fluid distribution changes and in the supine position blood accumulates in the legs and may cause swelling in the feet and varicosities. There is a slow plasma volume increase in women with pre-eclampsia.

Red blood cells

The red cell volume increases to 18% more than in the non-gravid state (200–450 ml). The increase in the red cell volume is not equal to the increase in the plasma volume, and causes haemodilution, which is called the *physiological anaemia of pregnancy*, reflected in a lower haematocrit and haemoglobin levels.

The haemoglobin drops by 2 g/dℓ in pregnancy, reaching the lowest level when the plasma volume peaks at 32 weeks. The lowest acceptable Hb in the third trimester is 10.5 g/dℓ. The mean haematocrit is 33.8%.

The white blood cells (WBC)

The total white cell count increases slightly in early pregnancy. The total WBC is $4.8–10.8 \times 10^9/\ell$. Changes are minimal.

Platelets

There is a slight decrease in platelets in pregnancy. The acceptable range for platelets in pregnancy is $130–400 \times 10^9/\ell$. Mild to moderate thrombocytopenia is present in 6% of healthy women.

Plasma components

The serum protein drops by 10–14%. It is a contributing factor in oedema in pregnancy. Total protein, albumin and gamma globulin levels fall in the first trimester and then rise slowly to term. Beta globulin and fibrinogen fractions rise by 50–80% and this causes a fourfold increase in the erythrocyte sedimentation rate (which cannot be used as a diagnostic measure during pregnancy). Alterations in plasma protein affect the pharmacokinetics of substances such as calcium and other drugs. Note that the dosages of some drugs may need to be altered during pregnancy.

Serum electrolytes reduce the osmolarity of the plasma due to the hypovolaemia.

Serum iron decreases in the plasma. The stored quantity of iron is withdrawn for maternal and fetal use. The greatest drop is between 12–25 weeks when the number of red blood cells increase.

Serum lipids increase by 40–60%, especially cholesterol, which is the oestrogen and progesterone precursor, and phospholipids, a major component of cell membranes.

Coagulation factors

Pregnancy is an acquired hypercoagulable state, resulting in an increased risk of thrombosis and coagulopathies such as disseminated intravascular coagulation (DIC). There is an increase in coagulation components such as fibrinogen and Factors VII, VIII, IX, and X and a decrease in the anticoagulation components – the fibrinolytic system.

The hypercoagulable state of pregnancy is further magnified during labour. This protects the woman against excessive blood loss, providing rapid haemostasis after delivery of the placenta. These changes in the cardiovascular system increase the risk of superficial thrombophlebitis and also deep vein thrombosis during pregnancy and in the puerperium.

Immune system and defence mechanisms

Defence mechanisms consist of immunological and non-immunological factors. Non-immunological factors include skin, mucosal barriers, digestive enzymes, pH, temperature, proteins, enzymes, lysozymes, transferrin and interferon.

Adaptive immunity involves the specific immune responses of cells and antibodies.

The immune system and defences are altered in the pregnant woman.

Pregnancy requires a balance between the mother's tolerance of the products of conception while maintaining the normal defences against micro-organisms.

Serum levels of IgG fall as pregnancy progresses, except in intrauterine death (IUD) and intrauterine growth retardation (IUGR). IgA and IgM decrease or remain stable in pregnancy. IgE changes little and IgD increases to term. Hormones and prostaglandins appear to suppress immunity in pregnancy. Pregnancy zone protein (PZP) appears to inhibit inflammatory processes. This is a glycoprotein produced by the mother and it is found in phagocytosis near the decidua trophoblast. Pregnancy-associated plasma proteins (PAPPs) are produced by the syncytiotrophoblasts and have an inflammatory regulating function and altered levels have been associated with complications in pre-eclampsia, diabetes and multiple pregnancies.

The respiratory system

Bio-mechanical factors

Changes in respiration in pregnancy include a relaxation of the muscles in the thorax that broadens the ribcage by about 6 cm. This increases the air volume by 50% per minute. The increased intra-abdominal pressure pushes the diaphragm up and breathing becomes diaphragmatic.

During pregnancy breathing remains diaphragmatic, but due to pressure by the enlarged uterus, the movement of the diaphragm is reduced. To counteract this, pregnant women breathe more deeply (due to the effect of progesterone on the respiratory centre), so increasing the tidal volume.

Biochemical factors

There is greater mixing of gases during pregnancy and an increased oxygen consumption of 20% occurs at term. The effect of progesterone, dilating the pulmonary vasculature, and the increased blood volume, causes engorgement of the pulmonary vessels, which can clearly be seen on chest X-rays taken during pregnancy.

Pregnant women are in a state of compensatory respiratory alkalosis.

The results of these changes are an increased oxygen tension (PaO_2) and a decreased carbon dioxide tension ($PaCO_2$). These are both beneficial to the fetus; the raised PaO_2 causes more oxygen to be transferred across the placental membrane to the fetus, and the low $PaCO_2$ helps the fetus to dispose of carbon dioxide across the placenta to the maternal circulation.

Clinical implications

Dyspnoea may be experienced by some pregnant women, and this may be due to pulmonary capillary engorgement causing a heightened pulmonary stretch reflex, combined with the pressure from the enlarged uterus.

Upper capillary engorgement may result from progesterone causing swelling of the nasopharynx, larynx, trachea and bronchi. This may be uncomfortable, with an increase in inflammation and nose bleeds.

Women may be more prone to upper respiratory infections and viral pneumonia.

Asthma is the most common respiratory problem in pregnancy (0.4%). It may improve, remain the same, or worsen in pregnancy.

The renal system

The kidneys are critical in the maintenance of body homeostasis. Structural and functional alterations in pregnancy affect the normal function of the renal system. Pregnancy is characterised by sodium retention and increased extracellular volume, altering renal functioning. Normal parameters and values for renal function are altered in pregnancy.

A number of changes affect the urinary tract during pregnancy. The renal length increases by about 1 cm and the capacity increases from 10–40 ml. This is partly due to the increase in vascularity, and partly due to the effect of progesterone, as relaxation of the smooth muscle leads to dilatation of the renal pelvis and the ureters. Pregnancy is characterised by physiological hydroureter and hydronephrosis with marked dilatation of the renal pelvis as early as seven weeks of pregnancy. The kidneys enlarge by 1 cm and renal volume increases by 30%. The dilatation of the ureters may result in kinking in the middle portion, because of loose support in this region. The bladder muscle becomes relaxed as a result of the effect of progesterone and this, together with the dilatation of the renal pelvis and the ureters, can lead to stasis of urine. The result of these changes is an increased risk of urinary tract infection. With the growth of the uterus, the bladder is pulled up and also becomes an abdominal organ. However, the neck of the bladder, which is not carried right out of the pelvis, is pushed forwards against the symphysis pubis. In late pregnancy, the enlarged uterus can compress the ureters at the pelvic brim also causing a reduced flow of urine. At 20 weeks dextroversion of the uterus affects the right kidney. Because of the increased blood volume, there is an increase in the renal blood flow and the glomerular filtration rate until, by the 16th week of pregnancy, they have increased by 40%–50%, which is then maintained throughout pregnancy. This results in increased urine production by the kidneys and causes frequency of micturition, particularly in early pregnancy.

Although there is an increased blood flow and glomerular filtration rate, tubular reabsorption remains unaltered. As a result, the capacity of the tubular cells to reabsorb certain substances is exceeded, and there is an increased clearance of certain substances, particularly sugar, amino acids, folic acid, water soluble vitamins, iodine and waste products such as urea, uric acid and creatinine. This accounts for the frequency of glycosuria found during pregnancy (lowered renal threshold).

Protein in the urine may be due to vaginal discharge.

The increased glomerular filtration rate could also lead to the excessive loss of sodium and chloride, but there is a compensatory mechanism that causes increased reabsorption of sodium and chloride from the renal tubules and so preserves maternal electrolyte homeostasis. This is a consequence of increased production of steriod hormones by the placenta and the adrenal cortex during pregnancy. Protein in the urine after 20 weeks of pregnancy is of diagnostic value for pre-eclampsia.

The alimentary system

The gastrointestinal and hepatic systems are altered to accommodate essential maternal and fetal nutritional demands in pregnancy.

The first effect is an increased appetite and alteration in the type of food desired, including cravings and pica. Food intake increases by 15–20% in early pregnancy. The alteration in insulin and glucagon, combined with oestrogen and progesterone, influences food intake.

Pregnancy does not demineralise teeth. Fetal calcium is withdrawn from maternal body stores. Gingivitis and tooth decay during pregnancy are caused by hormones in the saliva. Gingivitis occurs in 30–100% of women. The gums become highly vascular, oedematous and hyperplastic. Bleeding while tooth brushing is more common in pregnancy.

Saliva becomes more acidic in pregnancy. Saliva does not increase in pregnancy but some women may experience ptyalism, which is excessive salivation of up to 1ℓ per day. The cause is unknown.

The relaxing effect of progesterone on the musculature of the alimentary system causes delayed emptying of the stomach, intestines and colon. This permits greater absorption of foodstuffs, but also leads to constipation. Relaxation of the cardiac sphincter may also lead to oesophageal reflux and heartburn.

The liver

The enlarged uterus displaces the liver superiorly and posteriorly. The liver's production of protein, bilirubin and enzymes are altered. Spider angioamata and palmar erythema (found in liver conditions) due to high oestrogen are common in

pregnancy. These appear after two to five months and disappear after pregnancy.

Weight gain in pregnancy will be discussed in Chapter 52.

Neuromuscular and sensory systems

The effects of the changes of pregnancy on the sensory system are well documented. Discomfort and pain are common in pregnancy and birth.

In pregnancy ocular changes include oedoema of the cornea in late pregnancy, a thickening of the cornea that may change refraction and a slight fall in intraocular pressure. Women with contact lenses may find they cannot wear them anymore due to the changed shape of the eye ball. These changes are dependent on hormonal changes and blood pressure changes. The composition of tears changes slightly.

Otolaryngeal changes are associated with fluid dynamics and increased vascularity. Nasal congestion and stuffiness and increased snoring and sleep disorders are more common. The sense of smell may be altered. Pregnant women may also complain of ear stuffiness that is not relieved by swallowing and there may be a transient mild hearing loss and vertigo. Sleep patterns are altered. Insomnia, dreams and nightmares are common in the third trimester. Hormonal changes decrease REM (rapid eye movement) and increase non-REM sleep. Pregnancy-associated sleep disorders have been described. (See Common disorders of pregnancy, Chapter 19.)

Musculo-skeletal system

Pregnancy is characterised by changes in posture and gait. External rotation of the femurs cause a 'waddling' gait to compensate for the redistribution of body mass. The symphysis pubis may widen by 10 cm. Lower limb pain may develop due to increased load on the lateral side of the foot and many women need to wear a bigger size shoe. The risk of ligament injury increases in pregnancy and muscle cramps are common in the third trimester and at night. Compensatory lordosis develops due to the shift in the centre of gravity. Diastasis of the rectus abdominus may occur and if this persists in the postnatal period it may need to be corrected surgically.

Calcium balance remains normal during pregnancy if the diet contains adequate dairy products. The bones and teeth, therefore, are unchanged in normal pregnancy. These changes may give rise to discomfort and backache in advanced pregnancy.

General metabolism

Metabolism comes from the Greek word meaning change. Principles of human metabolism are:

- the maintenance of plasma glucose
- optimal supply of protein for enzyme function and muscular mobility. Excess protein is stored as fat and nitrogen is excreted in the urine.

The basal metabolic rate increases in pregnancy. This varies among women because of differences in pre-pregnant nutritional status. The total energy needs are divided into the demands of the fetus, placenta, uterus and breasts, energy for maternal fat storage, and energy for new tissue and body functions. If a woman is well nourished the fetus accounts for 25% of her weight gain, while in an undernourished woman the fetus accounts for 60% of her weight gain. Nutrition and weight gain are explained in Chapter 52.

Carbohydrate metabolism

Glucose production remains sensitive to insulin and increases by 15–30% in pregnancy. Blood glucose levels in a pregnant woman are 10–20% lower than in a non-pregnant woman, so there is a tendency towards hypoglycaemia and ketosis. The fetus is dependent on the mother for glucose and this is actively transported across the placenta. In early pregnancy insulin secretion increases leading to 'accelerated starvation'. Accelerated starvation is a drop in blood glucose and metabolic processes to counteract the effects of the hypoglycaemia. The mother compensates by breaking down fat for energy. This draining of glucose and amino acids by the fetus may lead to increased maternal appetite. Dieting and carbohydrate restriction in pregnancy are dangerous for the mother and the baby. The 'diabetogenic' state of pregnancy is caused by increased resistance to insulin. This means that the blood sugar does not drop when insulin is excreted. This is a protective measure to make sure that glucose is available for the fetus even when the mother is fasting. This effect is mainly present in the second and third trimester. Human placental lactogen, progesterone and cortisol are involved in the maintenance of glucose.

Protein metabolism

Decreased serum protein and amino acid levels are found in pregnancy. During the first half of pregnancy maternal protein storage increases, with a retention of 1.3 g/day (nitrogen). Most is transferred to the fetus but some is stored. In the second half of pregnancy protein utilisation is more economical, with less urinary excretion.

Lipid metabolism

Marked alterations in lipid metabolism occur in pregnancy. Triglycerides increase 40% by 18 weeks and 250% by term.

Phospholipids and cholesterol also increase. Maternal fat stores are most prominent between 10–30 weeks before the peak of fetal demand. In the third trimester fat is broken down into free fatty acids and glycerol, associated with the fetal demand for increased glucose and amino acid.

Calcium metabolism

Maternal serum levels fall progressively after fertilisation by an average of 1–1.5 mg/dl, with the lowest levels between 28 weeks and term. Calcium absorption doubles in pregnancy with storage to meet the later demands of the fetus. Bone mass is not normally lost in pregnancy.

Thermoregulation

The amount of heat produced in pregnancy increases by 30–35%, with an increased tolerance for cooler temperatures and intolerance for heat. Peripheral vasodilatation is increased four to seven times, with increased activity of sweat glands. The mother's temperature increases by 0.5 °C. The fetus cannot control its temperature independently of the mother. The fetus's temperature must be higher than the mother's for heat to move from the fetus to the mother. High maternal temperature can affect the fetus, causing hypoxia, altered haemodynamic teratogenesis and preterm birth.

Thyroid function

Serum thyroglobulin increases in the first trimester but is most marked in late pregnancy with an associated enlargement of the thyroid. The degree of hyperplasia depends on iodine intake. Nausea and vomiting in pregnancy are associated with altered thyroid function. Untreated hyperthyroidism will complicate pregnancy. Women with hypothyroidism have a high incidence of infertility and spontaneous abortion. The fetal thyroid is not dependent on the mother for development but the neurological development of the fetus in the first trimester may be affected.

14.3 Conclusion

The anatomical and physiological changes of pregnancy are complex and changes in the mother are to favour fetal development. However, the wellbeing of the mother is important. Antenatal care and education involve the assessment of maternal and fetal wellbeing.

CHAPTER

15 The signs, symptoms and diagnosis of pregnancy

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- identify the signs and symptoms of pregnancy
- use a scientific process to diagnose pregnancy
- select and use diagnostic tests to confirm pregnancy.

KNOWLEDGE ASSUMED TO BE IN PLACE

Knowledge of the anatomical and physiological changes of pregnancy

KEYWORDS

Hegar's sign • Human chorionic gonadotrophin (HCG) • Amenorrhoea • Quickening • Osiander's sign • Jacquemier/Chadwick's sign

15.1 Introduction

The diagnosis of pregnancy is an important event for a woman. The accurate determination of the beginning of pregnancy can influence the progress and care that follows.

15.2 The diagnosis of pregnancy

The diagnosis of pregnancy is based on:

- symptoms experienced by the woman
- physical signs found on examination
- special investigations.

The signs and symptoms are based on the physiological changes that take place in a pregnant woman's body. These changes are brought about by the effects of human chorionic gonadotrophin (HCG), which is secreted into the woman's bloodstream when the trophoblast embeds and later by the hormones produced by the placenta. These effects, together with the development and growth of the products of conception (the embryo which later becomes the fetus, the placenta, the membranes and the liquor amnii), give rise to the symptoms and signs of pregnancy. (See Hormones of pregnancy, Chapter 6, Embryology, Chapter 7 and Physiology of pregnancy, Chapter 14)

Although there are many symptoms and signs of pregnancy, only a few of these are diagnostic. Most of these diagnostic signs are only present after 20 weeks of pregnancy. However, with the development of modern technology and the use of ultrasonography in obstetrics, it is possible to obtain a conclusive diagnosis of pregnancy as early as the seventh week from the first day of the last menstrual period, when the fetal heart can be seen beating. (See Embryology, p. 62.)

Most women suspect that they are pregnant, and either visit the antenatal clinic, their doctor or the midwife to confirm the diagnosis. Women living in remote areas may not be able to visit a clinic or be seen by a midwife or a doctor and have to rely on the traditional signs and symptoms of pregnancy. These include the cessation of menstruation, enlargement and pigmentation of the breasts, the presence of colostrum, the presence of chloasma and food cravings. Pregnancy in these circumstances is usually confirmed at between four and six months (12–24 weeks).

Subjective signs and symptoms of pregnancy

Each of these signs and symptoms is subjective and non-specific and could sometimes be caused by conditions unrelated to pregnancy.

Amenorrhoea

Pregnancy is the commonest cause of cessation of menstruation in young women.

However, amenorrhoea may also occur in times of emotional stress and change of environment, in some endocrine disorders or in anaemia. After the use of the contraceptive pill, a period of amenorrhoea may occur and women should be informed of this. Poor nutrition may cause amenorrhoea. Young women with anorexia nervosa do not menstruate.

On the other hand, in a few women, scanty vaginal bleeds can occur during pregnancy. More frequently, however, a small vaginal bleed may take place during the time of implantation of the zygote and it is, therefore, important when estimating the gestational period, to ask the woman if her last period was of normal amount and duration.

Breast changes

From three to four weeks early symptoms and signs such as tingling of the breasts, and breast heaviness and enlargement may be the first indications of pregnancy.

However, these features may also be experienced by non-pregnant women, particularly immediately prior to menstruation, due to high hormonal levels.

Morning sickness

More than 50% of pregnant women experience nausea and some vomiting between the fourth week and the fourteenth week after the beginning of the last menstrual period. This usually occurs first thing in the morning, but may continue throughout the day. The cause is thought to be due to the high blood levels of HCG and oestrogens. (See Common disorders of pregnancy, Chapter 19.)

Should the vomiting persist after 14 weeks, or if there is excessive vomiting, then it would no longer be considered normal.

Bladder irritability

Frequency of micturition, without any signs of infection such as burning or pain, often occurs in early pregnancy, particularly between the eighth and fourteenth weeks. This is due to the increased blood volume, causing increased renal blood flow and glomerular filtration rate, with an increase in urine production, together with pressure from the enlarging uterus on the bladder. (See The physiology of pregnancy, Chapter 14.)

Quickening

When the pregnant woman first notices fetal movements within the uterus, it is called quickening. It is recognised earlier in the pregnancy by women who have already had children. In multigravidae, it is often recognised as early as 16 weeks, and in primigravidae, at about 18–20 weeks.

Temperature elevation

When fertilisation and implantation have taken place, a woman's temperature is elevated.

In some instances, the woman is advised to take her temperature regularly throughout a normal menstrual cycle to establish her basal temperature, which usually rises at ovulation and then gradually returns to normal about 10 days after ovulation. If in subsequent cycles, the woman's temperature remains elevated after ovulation, there is a strong likelihood of her being pregnant. This method is a particularly useful guide to pregnancy when a woman comes off the contraceptive pill.

It has also been observed that, from the fourth week of pregnancy, the skin temperature over the breasts is about 0.7 °C higher than the temperature of the skin over the sternum, probably because of the increased vascularity of the breasts. This can be detected by a sensitive infra-red thermometer. An elevated temperature could, of course, be due to almost any infection.

Changes in body shape

A woman may report that her clothes do not fit, and her abdomen feels full.

Objective signs of pregnancy

These signs are more reliable than the subjective signs and symptoms, but could still be caused by conditions other than pregnancy.

Skin changes

Pigmentation of the skin often occurs during pregnancy and chloasma is usually noticeable from the sixteenth week. (See The physiology of pregnancy, Chapter 14.)

The linea alba changes to the linea nigra on the midline of the abdomen. The nipples may be darkened and the secondary areola is present.

Breast changes

From eight to 12 weeks, subcutaneous veins become noticeable and there is an increase in the size and pigmentation of the nipple and areola, and Montgomery's follicles/tubercles appear.

From 16 weeks, colostrum can be expressed

Changes in the pelvic organs

These signs are demonstrated during vaginal examination. All pregnant women, including those being attended by a

professional midwife or attending antenatal clinic, should be referred to and seen by a doctor at least once during her pregnancy. The doctor will usually perform a vaginal examination to exclude any abnormalities and if the visit is early in the pregnancy, the following signs would help to confirm the pregnancy:

- *Hegar's sign*. At six to 12 weeks the embryo still only occupies the upper part of the uterus and the isthmus has softened and elongated. On bimanual examination, with two fingers of one hand in the vagina and the fingers of the other hand pressing downwards and backwards on the anterior abdominal wall, the fingers of both hands feel as though they meet because of the soft, elongated isthmus, which is in contrast to the rounded, full, upper segment above and to the much harder cervix below.

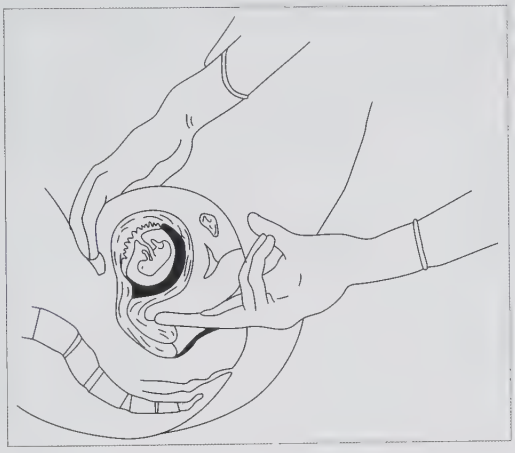


Figure 15.1 Hegar's sign

- *Jacquemier's/Chadwik's sign*. From the eighth week, there is a dark purplish discolouration of the mucous membranes of the cervix, vagina and vulva, which is caused by increased blood volume causing congestion of these tissues. The vagina is warm and blue and the cervix is soft.
- *Osiander's sign*. From the eighth week, increased pulsation is felt in the lateral fornices of the vagina, due to the increase in vascularity.
- *Uterine enlargement*. On vaginal examination the uterus is the size of an orange at about eight weeks. This is a very accurate diagnostic sign because in the early stages of pregnancy uterine size does not vary much between women. From the eighth week, the uterus increases in size and becomes more globular in shape. From about week 12, the fundus can be palpated abdominally, just above the symphysis pubis and with the gradual increase in size, the uterus becomes an abdominal organ. From week 12, the cervix begins to soften. This 'ripening' process continues gradually, until, at term, the cervix is ready or 'favourable' for dilatation. From 16 weeks, the uterus becomes more ovoid in shape.
- *Abdominal enlargement*. From week 12, as the uterus grows and becomes an abdominal organ, the height of the fundus rises and the abdomen enlarges.
- *The uterine souffle*. From week 16, a soft blowing sound that synchronises with the pregnant woman's pulse (normally about 80 beats per minute) can be heard on auscultation. It is the sound of the maternal blood coursing through the enlarged uterine vessels. It must not be confused with the sound of the fetal heart, which is a much more definite and rapid double-beat (normally about 140 beats per minute).
- *Braxton-Hicks contractions*. From week 20, these painless contractions are present.

15.3 Diagnostic procedures

The basis for all pregnancy tests is the presence of human chorionic gonadotrophin (HCG). During the first 60 days of a singleton pregnancy the HCG doubles every two days. There is a relationship between the level of HCG and the gestational age. Urine is used in most of these tests. However, maternal blood is used in the sensitive serum assays, which are the latest tests available.

Biological tests for pregnancy

Urine tests

These immunological tests are the most frequently used tests, because they are reliable and easy to use. They are available in kit form and contain reagents that are added to a woman's urine.

The object of these tests is to detect HCG in the urine. The two main techniques currently in use are:

- *The latex particle test – slide test*. This test is simple, cost efficient and can be read after only two minutes. It is 97% accurate when the pregnancy has progressed beyond 40 days (six weeks) after the last menstrual period (LMP).
- *Haemaglutination inhibition test – tube test*. This test is more sensitive than the slide test, but it is slightly more costly and can only be read after two hours.
- *Latex particle test (immunological test for pregnancy)*. This is an example of one type of urine test for pregnancy. It is about 97% accurate when the pregnancy has progressed beyond 28 days after the LMP.

The urine specimen used for these tests should be 15 ml of the first early-morning midstream specimen, which should be

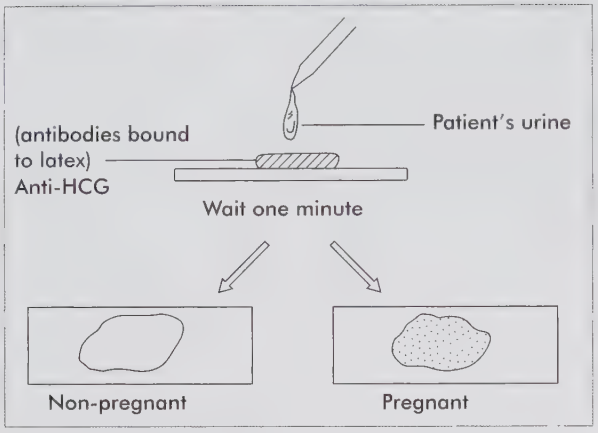


Figure 15.2 Immunological test for pregnancy

as free as possible from any contamination, particularly blood and protein.

False negatives

A negative pregnancy result may be obtained if the test is done earlier than 14 days after the LMP and should then be repeated after at least a seven-day interval, when the HCG levels in the urine have increased. A false negative pregnancy result may also be obtained if the urine is contaminated with protein, which may coat the particles carrying the immunological reagent and should also be repeated as above.

Urine and reagents used straight from the refrigerator may result in delayed agglutination.

Conditions such as hydatidiform mole and choriocarcinoma will give a strong positive pregnancy reaction due to high levels of HCG in the urine. A positive pregnancy test eight days after the first missed period indicates that the woman is probably pregnant. However, if the woman denies the possibility of pregnancy, the test should be repeated after seven days.

Sensitive serum assays (blood tests)

The principle of these tests is similar to that of the urine test, which is the detection of HCG, but instead of urine, blood is tested. These tests are much more sensitive than the urine tests, but are also much more expensive and require a specialised laboratory. Very reliable results are possible, even before the first missed period, and the results can be read within 15 minutes if the equipment is available.

These expensive tests are reserved for special conditions that need greater sensitivity, such as ectopic pregnancy and threatened, missed and tubal abortion. They could also be used in cases of rape. Quantitive tests which give the exact amount of HCG in the blood may be performed.

Radio-immunoassay (RIAs)

This is the most sensitive of all the pregnancy tests and uses the beta-subunit of HCG. Very low levels of HCG can be detected, which means that pregnancy can be detected several days after conception.

15.4 Conclusive diagnostic signs

These signs cannot be mistaken for any other condition and give conclusive proof of pregnancy. However, those signs that are not dependent upon modern electronic technology can usually only be demonstrated after 20 weeks of pregnancy.

Fetal heartbeat

Auscultation: with the use of Pinard's stethoscope, an experienced examiner can hear the fetal heartbeat from 20 weeks after the LMP.

Ultrasonic detectors: these machines use ultrasound to detect and 'hear' the sound of the fetal heartbeat. The fetal heartbeat can be detected as early as 12 weeks, but is only 100% reliable from 15 weeks after the LMP.

Electro-cardiotocograph: using the electro-cardiotocograph machine and an abdominal (fetal) transducer, the fetal heart can be detected from about 15 weeks.

Fetal parts

On abdominal palpation the fetal parts can be felt from about 28–30 weeks of pregnancy and the lie and presentation can be defined in most instances.

Fetal movement

Fetal movements can usually be felt on abdominal palpation by 22 weeks after the LMP. (This should not be confused with quickening, which is movement of the fetus experienced by the pregnant woman.)

Ultrasonic evidence

The fetal sac can be outlined using ultrasound from five weeks, and the heart can be seen beating by seven weeks after the LMP in 95% of cases.

X-ray evidence

The fetal skeleton can be demonstrated by 15 weeks of pregnancy. However, because of the danger of radiation, this method is only used where there are indications of fetal death, and alternative methods are not available to determine the fetal position or the presence of suspected multiple pregnancy or fetal abnormality.

Signs of previous pregnancies/deliveries

For personal reasons, a woman may not admit to a previous pregnancy. There are signs, however, which give some indication that a woman may have had a previous pregnancy.

This may be useful to the labour ward staff because if a woman has had a previous vaginal delivery, both the first and second stages of subsequent labours are usually very much shorter than those of the first labour.

The following signs are not positive, but together with the woman's attitude, they may suggest the probability of a previous pregnancy:

- The breasts may be flabby, with prominent nipples and persistent pigmentation of the areola.
- The abdomen muscles may be stretched, the skin loose and silver (old) striae gravidarum may be seen.
- The fetal parts are often easier to palpate than in primigravida.
- The vulval pigmentation may have persisted with gaping of the labia and the vaginal introitus. The hymen may be torn and replaced by small tags (carunculae myrtiformes), and scarring of the perineum from an episiotomy or tear may be present.
- The vagina may be lax and roomy, or there may be signs of a cystocele or rectocele.
- The cervix usually provides the most conclusive sign. On speculum examination, the external cervical os is a transverse slit, which easily admits at least one finger. In nullipara the cervical os has a small round opening.
- There may be scars of an episiotomy on the perineum or a ceasarean section.

Pseudocyesis

Pseudocyesis is a false or phantom pregnancy, and is usually the result of an intense desire for a child. This may cause stimulation of the hypothalamus, with the release of gonadotrophic hormones. Sometimes, this intense desire may be associated with a deep-seated fear of pregnancy or of parenthood.

Many of the signs and symptoms of pregnancy are demonstrated, such as amenorrhoea, fullness of the breasts together with the secretion of fluid from the nipples, and an enlarged abdomen (usually due to flatus). Examination and tests, however, fail to reveal any positive signs.

(Sellers was present when a woman in her mid-forties, who badly wanted a baby, was seen at an antenatal clinic. She believed that she was pregnant for the first time. She was referred to the obstetrician, who admitted her to the labour ward and she was given a short general anaesthetic. During the anaesthetic, her enlarged abdomen gradually deflated, like a balloon in which the air is slowly released. Arrangements had been made for her husband to be present, so that he could see that no baby had been delivered. This precaution was taken so that the staff could not be accused of malpractice. On her recovery from the anaesthetic, she and her husband were very upset, and the staff spent much time comforting them and explaining the phenomenon.)

Today, ultrasound is used to diagnose false pregnancy. The husband should be present.

These women and their partners should be referred for psychological counselling, both to cope with the experience and to find out, and if possible remedy, the cause of the condition.

15.5 Conclusion

Diagnose pregnancy by taking a history, doing a physical examination and requesting diagnostic tests to confirm the history and results of the physical assessment.

CHAPTER

16 Evidence-based antenatal care

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- demonstrate competency in antenatal care using the BANC programme
- use scientific processes in midwifery care
- explain the aims and principles of antenatal care
- explain evidence-based principles of effective antenatal care
- identify possible risk factors in pregnancy and institute interventions to prevent complications.

KNOWLEDGE ASSUMED TO BE IN PLACE

Knowledge of the physiological changes and common problems of pregnancy
Knowledge of healthcare systems

KEYWORDS

Evidence-based care • Nursing process • Basic antenatal care (BANC)

16.1 Introduction

The midwife needs to be skilled and competent in the basic assessment of women during pregnancy.

During antenatal care the midwife uses a scientific nursing process, which is a problem-solving framework to assess and plan care for each woman on an individual basis. This is a dynamic and ongoing process. This assessment follows a structured process to gather information, take a history, perform a physical examination that includes abdominal examination and order special investigations when needed. Each parameter is equally important. Without a scientific method of caring, effective practice is accidental at best and haphazard or harmful at worst. A scientific method allows for control of care and it permits self-correction. It guides practice and makes care measurable and fosters accountability.

The Safe Motherhood Initiative, which was started in 1987, is a worldwide programme aimed at multiple care providers who are involved in care during pregnancy, birth and the postpartum period. This multi-professional approach is directed towards a global effort to reduce maternal mortality by half by the year 2012. The midwife is integral to this approach because midwives are the main caregivers to women in childbirth. The Safe Motherhood Initiative (SMI) is not only about avoiding death and morbidity but also about improved healthcare outcomes and concern for the health of mother and baby. This includes the physical, mental and social wellbeing of the childbearing woman before, during and after childbirth, to facilitate the birth of a healthy baby, which will be able to thrive and grow into a healthy childhood. This approach is in keeping with the constitution of the World Health Organisation which defines health as 'a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity'.

It is now understood that many of the factors that may lead to maternal death are not always identifiable. A more realistic approach to the provision of pregnancy care is to provide a woman with the necessary care and services to help her stay on the road to health and to remain watchful over the health status of every woman. This is referred to as the primary care approach to maternity care, or the 'alternative path'.

16.2 Safe motherhood strategies

The Safe Motherhood Initiative sees the midwife as the preferred primary caregiver of healthcare to women and families

in childbirth. Strategies for health of a mother and her baby before, during and after pregnancy are summarised in Table 16.1.

A commitment to safe motherhood by midwives and all other members of the heathcare team is needed for the improvement of the quality of care (see Box 16.1). There is a urgent need in South Africa for research into new methods of practice, and the critical analysis of traditional approaches and gaps in clinical care, particularly in midwifery.

16.1 Values and principles of perinatal care

Care for normal pregnancy and birth should involve women in decision-making and should be:

- demedicalised
- based on the use of appropriate technology
- regionalised
- evidence-based
- multidisciplinary
- holistic
- family-centred
- culturally appropriate.

Birth as a normal physiological process

The focus of care for women and children acknowledges childbirth as a *normal physiological process*. There is a global move to demedicalise birth. Demedicalisation should be aimed at considering pregnancy as a physiological event rather than a disease – in other words, birth and newborns should not be regarded as a problem and a 'patient', respectively. An uncritical approach to demedicalisation should be avoided, and safe demedicalisation should always ensure skilled attendance during pregnancy, at birth and after birth for each birth at each level of care. Healthcare systems are challenged to adopt this approach while increasing the quality of care and reducing maternal and perinatal mortality.

Technology and childbirth

The use of technology in healthcare is important. It saves time and can provide accurate findings that can influence care. In the developing world, appropriate technologies are defined as methods, procedures, techniques and equipment that are scientifically valid, adapted to local needs and acceptable both to those who use them and to those for whom they are used, and which can be maintained and used by the community with resources the community can afford. The incorporation

Table 16.1

Safe motherhood strategies

Factors	Strategies
Infrastructure/environmental	◗ ensuring access to safe water ◗ appropriate systems of support that address the socioeconomic and psychological needs of women and their families ◗ providing an infrastructure with readily available emergency obstetric care ◗ providing a clean environment for the birth.
Organisational	◗ providing access to appropriate maternity care ◗ referral to specialist care ◗ providing easy access to family planning services.
Norms and standards of care	◗ screening women for complications ◗ educating and informing women about their pregnancy and birth and about warning signs of emergencies, so that they know what to expect and can participate in their own care ◗ setting protocols (guidelines to be followed) for dealing with major problems ◗ providing tetanus immunisation after delivery (where tetanus is a problem locally).
Norms and standards of staff	◗ ensuring the availability of a skilled birth attendant (a skilled midwife, with life-giving skills, is the primary care provider for most deliveries) ◗ provision of a basic education programme for midwives, which balances academic credibility with clinical excellence ◗ provision of a continuing education programme for all healthcare professionals, which combines clinical excellence with academic credibility.

of appropriate technology in maternal care is essential to improve care.

Accessibility of care

Making healthcare accessible for all is another challenge. Effective and safe maternal and perinatal care should be available at each level of care in an integrated network between the primary (minimal), secondary (intermediary) and tertiary (intensive) levels of care. This will ensure that regionalisation of perinatal care takes the place of the previously centralised, out-of-date and non-functional system.

Evidence-based care

Common practices, professional skills, protocols and policies should be based on scientific evidence and be regularly updated. Care should be able to satisfy the physical, emotional and psychosocial needs of mothers, newborns, fathers and families in a holistic way. Care and interventions, therefore, have to be centred on the information, motivation and participation of the whole family and local community.

Culturally sensitive care

Culturally sensitive care incorporates and respects all the acceptable traditional practices of care after they have been tested for safety and efficacy. Each intervention in the new initiatives should be evaluated in the national context for its impact on cultural attitudes and an effort should be made to facilitate its acceptance through information and discussion.

Civil society collaboration

Women's participation in decision-making, implementation of the initiatives and advocacy should be enhanced and encouraged in South Africa. Thus far most of the changes in maternal healthcare have been driven by healthcare professionals with minimal input from civil society. Midwives need to partner with women to give care that will satisfy the community.

16.3 Evidence-based healthcare

Evidence-based care requires healthcare professionals to constantly ask:

- What am I doing?
- Why am I doing it?
- Does it achieve its aim?
- Is there evidence of better/more effective ways of achieving this aim?

It is now clear that same practices in healthcare are not supported by evidence of efficacy. Many actions/interventions are now being carefully re-assessed and as a result much of what we have been doing is being shown to be unnecessary, wasteful of resources and frequently harmful. Midwives need to:

- use a process of practising evidence-based practice
- know where to find the best evidence
- understand what is meant by the terms sensitivity, specificity and randomised controlled trial
- be able to critically appraise research
- appreciate that care should be evidence-based and individually tailored.

What is meant by evidence-based healthcare

Evidence-based healthcare has been defined by Sackett et al. (2000) as the integration of best research evidence with *clinical expertise* and *patient values*.

Best research evidence is described as that which is clinically relevant. The evidence may be obtained from basic sciences but is usually from patient-centred clinical research addressing the following questions:

- What is the accuracy and precision of the diagnostic tests (including clinical examination) used?
- What is the power of the prognostic markers – is the evidence about prognosis valid and if valid, how important is it for the patient you are looking after? (Is the prognosis valid over time and how precise is it?)

Clinical expertise is defined as the ability:

- to use clinical skills and experience to identify each patient's health state accurately
- to diagnose the individual risks and benefits of any potential intervention for that person
- to identify the patient's values and expectations.

Patient values are identified as the unique preferences, concerns and expectations each patient brings to a clinical encounter and which must be integrated into clinical decisions.

Steps in the practice of evidence-based medicine

There are five steps in the practice of evidence-based healthcare, which are as follows:

1. The need for information must be converted into an answerable question, e.g. in a woman admitted at 38 weeks pregnant with severe hypertension and convulsing, the question might be 'what is the best treatment for the management of eclampsia at 38 weeks of pregnancy?'
2. It is then necessary to track down the best evidence for the management of eclampsia known at this stage and in the applicable circumstances.

3 The next step is to appraise the evidence critically in order to determine its validity (how likely the evidence of the success of the treatment is true and that improvement has not just happened by chance), impact (size of effect) and applicability (usefulness in the clinical practice of the clinician undertaking the appraisal of evidence).
4 The findings of the clinical appraisal must then be linked to the patient's values.
5 The final step is to evaluate the effectiveness (does the treatment work and how well does it work?) and efficiency (does it work more quickly than other treatments? Is it less expensive than other treatments, i.e. what is the best output for the least input?) of the treatment by auditing practice, making changes if indicated and auditing again.

The scientific process of care

Midwives should use a scientific process to assess, diagnose and treat women in childbirth. The scientific process of care follows a specific pathway that begins with the gathering of information, analysis and interpretation of the information, conclusions through special examinations and the plan and execution of care and the evaluation of care. This assessment and care is comprehensive and includes all the woman's healthcare needs, including physical, psychological and social.

Antenatal psychological health assessment (ALPHA)

Antenatal and maternal healthcare are expanded beyond technical care that focuses mainly on physical health. The mental and psychological health of women and families should also be assessed. Antenatal psychological problems may be associated with unfavourable healthcare outcomes. Specific questions are suggested to inquire about psychological health. Issues of high concern to the woman, her family or the caregiver usually indicate a need for additional support or services. When some concerns are identified, follow-up and/or referral should be considered.

Guidelines for the process of care

Step 1: Taking a history

In this step the midwife will ask the woman specific questions about her problems so that he/she can draw conclusions about the woman's psychological needs.

It is crucial that the midwife considers several factors prior to starting the history interview to ensure that the interview will proceed with minimal disruption. There are two types of history-taking:

- Taking a routine history – this type of history is taken for every woman coming in for routine first or follow-up antenatal, postnatal, family planning, etc.
- Taking a targeted history – this is taken when a woman comes with a complaint. The midwife will tailor the questions she asks around the complaint raised.

Step 2: Physical examination

Examine the areas of the woman's body that relate to the information gathered in step 1.

Inspection is the art of looking. This allows the midwife to look at the whole person, stance, mood, posture, gait and general hygiene. Characteristics of shape, size, position, colour, texture and symmetry can all be seen. The senses of sight, hearing, touch and smell allow the midwife to see scars, striae and feel fetal movements, hear hyperactive bowel sounds and wheezing, feel temperature and texture, and smell the difference between amniotic fluid and urine.

Palpation is the art of touching, which allows the midwife to determine characteristics such as size, shape, texture, pulsation, position, consistency, vibration and mobility that can be examined. The midwife's hands are the tools of palpation.

There are two types of physical examination:

- a routine physical examination – this may also help to find problems that the woman herself has not recognised
- a targeted physical examination – the midwife will tailor the physical examination around the woman's complaints and these will help the midwife to get the information that will help to identify problems or make a diagnosis.

Step 3: Special examinations

There are two types of special examination (laboratory tests or investigations) in antenatal care:

- The midwife may perform routine special tests as standard screening (blood tests, RPR, haemoglobin, urine test).
- The midwife may perform special tests to obtain more information about an observed problem or complaint (Triple test or FISH test).

Step 4: Identify needs and problems

Using the information from steps 1, 2 and 3 the midwife will identify the woman's needs and problems. These may be physical (general or obstetric), psychological and/or social.

Step 5: Drawing up a care plan

In the final step the midwife will decide what should be done to solve each problem or meet specific needs. Here are some

appropriate actions the midwife might write in the plan of care:

- *Medical treatment*. Choose the correct medicine or procedure by following clinical protocols.
- *Education*. Help the woman learn to care for herself well.
- *Counselling*. Help the woman understand her problems or needs. Work with her to develop the plans.
- *Referrals*. Use other resources in the area, such as medical practitioners, hospitals, social workers to help meet her needs.

Step 6: Documentation

The midwife records the information about the woman's problems and how they were managed.

16.4 Basic antenatal care (BANC) quality improvement programme

Antenatal care should start when pregnancy is diagnosed. The earlier a woman visits the clinic the more accurate the information that will be gathered and the sooner interventions can take place to identify factors associated with adverse outcomes for mother and fetus. Ultrasounds at 12 weeks and 20 weeks are able to identify most fetal abnormalities, for example. The triple test or FISH test at 16 weeks can screen for open neural tube abnormalities and Down's syndrome. Other conditions such as syphilis, multiple pregnancy and medical conditions can be identified early and the appropriate care can be instituted.

The WHO recommends that a woman with low risk should visit the clinic four or five times in pregnancy. Women with an identified problem will be scheduled for appropriate care, which may be multidisciplinary or at a higher level.

The Pretoria University and the Medical Research Council (MRC) piloted a programme to standardise and improve the quality of antenatal care. This is called the basic antenatal care (BANC) programme.

The programme is focused on the integrated primary healthcare approach: the principles of good antenatal care put forward by the WHO have been adapted for South Africa. Facilities receive a package containing:

- manual used for training trainers
- facility managers notes, referral hospital notes
- BANC task book
- protocols and audit
- PMTCT (of HIV)
- training posters.

16.2 Objectives of BANC

- Save time.
- Reduce workload.
- Improve the chances of good outcome of the pregnancy.

The visits

At the first visit the pregnant women are divided into two groups according to preset criteria:

- those qualifying for the BANC programme
- those requiring a higher level of care who are referred for medical care.

The principles of the basic antenatal care programme are:

- to start antenatal care for all women *before* 16 weeks and to have at least four follow-up visits
- to identify women with special health conditions and/or those at risk of developing complications using a simple checklist
- to institute appropriate care at the appropriate level by appropriate skilled caregivers for those women with special health conditions
- to time the visits so that the maximum benefit can be obtained, without wasting human resources
- to perform only examinations and tests that have been shown to be beneficial, and at the most appropriate time
- to use rapid easy-to-perform tests at the antenatal clinic or in a facility close to the clinic. The results should be available the same day so treatment can be initiated at the clinic without delay
- to improve the access and quality of experience of care at clinics and make it more women friendly. Healthcare providers should make all pregnant women feel welcome at their clinic. This implies opening hours of the clinics should be as convenient as possible to the women to come to the clinic.

Priority considerations

Conditions that are screened as priority in the programme include (and can be detected and treated in pregnancy) are:

Maternal:

- anaemia
- hypertension and pre-eclampsia
- medical conditions, diabetes mellitus, epilepsy, cardiac conditions
- HIV
- chronic TB

- UTI (urinary tract infections)
- vaginitis and STD (sexually transmitted disease)
- malnutrition.

Fetal:
- poor fetal growth
- postmaturity
- congenital syphilis
- congenital abnormalities
- twins
- abnormal lie
- Rh incompatibility.

Appropriately trained nurse-midwives and midwives can deliver effective quality of care. Effective intervention follows the clinical process of:
- checking the antenatal card
- look, listen and feel (assess)
- record findings
- classify the findings
- treat or advise.

The following are checked with each visit:
- iron and calcium supplementation
- nutritional advice
- warning signs appropriate for the gestational age and risk profile
- birth plan (where?)
- transport arrangements
- complete checklist
- follow-up appointment.

The programme requires a close collaboration between the referral hospitals and the clinics. The BANC programme has 22 protocols for antenatal care to be signed and agreed upon between clinics and referral hospitals. These need to be updated regularly and signed by all parties. This includes improved communication between levels of care.

Protocols

The protocols are designed locally to suit a local context. They address a problem, offer preventive measures, show screening criteria and procedures and give evidence-based treatment and intervention.

Treatment regimes

There is a hierarchy of treatment regimes:
- Policy guidelines are developed by the Department of Health.
- Management guidelines are developed by evidence-based principles and research (WHO).
- Institutional protocols use these guidelines to add details suitable to the area and context.

The basic antenatal programme has a checklist that needs to be completed, which will guide and direct decisions. The first clinical checklist and follow-up checklists are designed to focus on specific conditions with specific protocols to manage the women, based on the results.

Auditing

Auditing of care is used within the BANC programme to determine and improve quality of care.

The name of the MCHW coordinator is on the first visit document. The province is indicated on the form, as well as the name and contact number of the woman. The card stays in the clinic. The follow-up visit is scheduled according to the findings of the checklist. The woman is categorised for basic care or referred.

Referral

The following referrals are indicated:
- routine referral to a medical practitioner
- non-acute referral
- referral to a social worker
- referral for food supplementation.

All nurses and midwives must be trained in the BANC programme when working in the primary or district heathcare systems.

16.5 Standards, protocols and regimes

The South African healthcare system has developed 'Guidelines for maternity care in South Africa'. These are regularly updated and published by the Department of Health. Institutions can use the guidelines to develop protocols and regimes to improve care. Generic protocols and guidelines are printed on posters and are visible in all clinics and clinical areas.

Guidelines and protocols are evidence-based and are reviewed. These include the obstetric emergency care drills. Midwives are updated on these skills and receive a certificate of competency.

Beside these national guidelines, midwives should develop protocols for 'caring', which are not specified in the national guidelines. The particular hallmark of midwifery is 'being with women' and 'caring' in pregnancy and birth and the postnatal period. Caring is the domain of the midwife and

expands beyond technical care. Specific guidelines for caring should be reflected in protocols of caring. The 'midwifery model of care' is the best practice model for midwifery that intends to put caring back in midwifery.

The antenatal record

The antenatal record is a scientific tool used to assist the professional to gather and interpret information during pregnancy, and to communicate the findings to the rest of the team for decision-making for best outcomes during pregnancy, birth and the postnatal period.

It calls for a systematic process of gathering and communicating information (generic). It is part of a process of quality improvement and allows for an audit to measure the quality of care. The information gathered is only as good as the skill of the user. Complete records should be maintained at all times. The record is started with the first visit and the woman keeps the record with her and produces it at any point of entry into the healthcare system. She is required to bring her record with her to any clinic for recording health information until birth. After birth the record is used until after the six week postnatal visit. The record is used to relay information on the health status and antenatal period to the next level of care during referral, birth and the postnatal period.

Clinics do not keep a record of the document but only statistics of the number of first visits before 20 weeks, number of first visits after 20 weeks, and the total number of follow-up visits. All women in the public healthcare system in South Africa are tested for syphillis and records are kept of the number of women positive and the number who completed treatment.

To improve communication between caregivers and the different levels at care within the system, the patient carries her antenatal record with her (called patient-carried record). The disadvantage of this is that there are no antenatal records kept within the system. Once the patient has given birth the antenatal records are audited for quality purposes.

The BANC programme includes structured tools to gather and store information for evidence-based assessment and evaluation of improved quality decision making and care.

16.6 Conclusion

The lack of norms and standards for staffing and equipment have been identified as the factors that reduce the quality of care in midwifery. These norms and standards need to be developed and implemented in collaboration with the best practice model in midwifery care.

CHAPTER

17 Assessment, diagnosis and treatment in pregnancy

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- take a complete history in pregnancy
- use a scientific process to diagnose pregnancy
- select and use diagnostic tests to confirm pregnancy
- give evidence-based care in pregnancy
- perform the needed physical examinations in pregnancy
- identify and perform special examinations in pregnancy
- identify and refer women to a higher level care
- plot information correctly on a growth chart and keep accurate records.

KNOWLEDGE ASSUMED TO BE IN PLACE

Knowledge of the anatomical and physiological changes of pregnancy
Knowledge of the nursing process
Basic antenatal care (BANC) and auditing

KEYWORDS

Human chorionic gonadotrophin • Amenorrhoea • Quickening • Pelvimetry • Biometry • Ultrasound

17.1 Introduction

The aim of antenatal care is to observe the progress of pregnancy to ensure the wellbeing of the mother and fetus. A complete history and physical examination is done to determine this and the progress of the pregnancy. The first day of the last normal menstrual period (LMP) should be recorded and the expected date of delivery (EDD) calculated. Screening tests and special examinations are used to identify factors associated with adverse outcomes as well as factors present during pregnancy that may indicate problems. Women with identified problems are referred for higher levels of care.

17.2 The initial visit

Ideally, women should come for pre-pregnancy counselling before conception. In reality most women come for antenatal care when pregnancy is suspected. A history of the period of amenorrhoea and other physical signs and symptoms are used to guide the process. A pregnancy test or an ultrasound can be done to confirm the pregnancy. If the woman is less than 10 weeks the first visit can be delayed until after the pregnancy is confirmed, unless there are problems such as bleeding. If the woman is more than 10 weeks pregnant the full antenatal admission is done at the first visit.

If the woman wishes to terminate the pregnancy, the midwife has a legal obligation to refer her to a facility where termination can be carried out, without delay.

17.3 The admission visit

Women should be advised to seek care before 16 weeks of pregnancy or earlier. Many women, however, only make their first appearance at an antenatal clinic after 20 weeks of gestation or when they experience problems, or even when they are in labour. This limits the number of appropriate interventions that are available, for example in the case of Down's syndrome and open neural tube defects and structural abnormalities of the fetus which could have been detected before 20 weeks. The admission visit (after the confirmed diagnosis of pregnancy) may coincide with the initial visit or may be a follow-up visit. Early contact with the healthcare provider or services is recommended.

An examination before the 16th week provides:

- more accurate date of conception and therefore
- more accurate estimation of the delivery date (EDD)
- more accurate baseline information with which to observe and assess the progress of the pregnancy.

A visit to the antenatal clinic early in pregnancy could also disclose complications/abnormalities that could then be treated before there are any detrimental effects to the woman and/or the fetus. This would also apply to women who consult a specialist obstetrician or a medical practitioner or midwife in private practice.

Standards of care for the antenatal admission visit

These include:

- a welcoming attitude by the staff (admission personnel, midwives, medical practitioners, etc.)
- personal information is obtained in an effective and confidential manner and prescribed records are completed
- a detailed history is taken and recorded on the antenatal card that the woman carries and the BANC records that stay in the clinic
- baseline information is gathered using a standard process.

After the confirmation of the pregnancy the duration of the pregnancy is determined.

Estimation of gestational age

The first day of the last normal period is used to determine the gestational age. This is only valid if the woman is sure of her dates, and where palpation of the uterus and SFH measurement are compatible with the given dates. Gestational age must be calculated from the first day of the last normal menstruation period. However, most women are not sure of their dates. The longer time between the last period and the clinic visit the more inaccurate this date becomes.

Calculation of expected date of delivery (EDD)

Several methods can be used to calculate the expected date of delivery:

- The obstetric calendar is easy to use. Once the LMP (last menstral period) is determined the EDD (expected date of delivery) can be read on the next line.
- The obstetric wheel is easy to use and gives both the EDD and the current gestational age based on the LMP.
- EDD can also be determined by Naegele's rule.

The classical calculation of Naegele's rule

The duration of pregnancy in humans is nine lunar months or 37–40 weeks (WHO) or 266 days (38 weeks). Forty weeks is nine months and six days calculated from the first day of the last *normal* menstrual period plus seven days (when implantation occurs) plus nine months or minus three months.

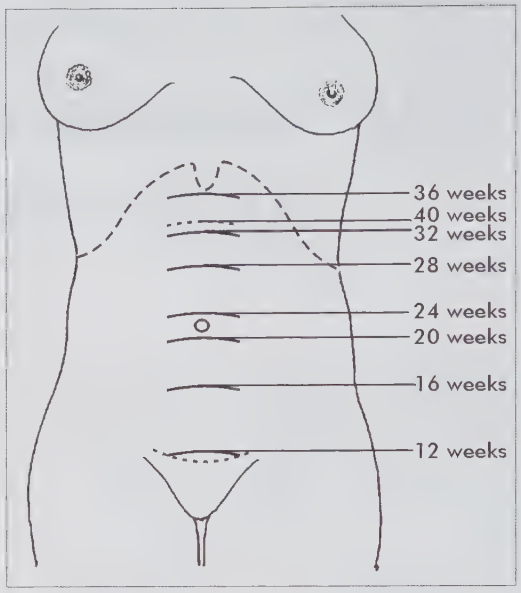


Figure 17.1 Duration of pregnancy on estimated abdominal measures

Example: The LMP is 10 April + 7 days = 17 April

April is the fourth month add 9 months = January

The EDD (expected date of delivery) is 17 January

Alternatively three months can be deducted: April (fourth month) – 3 months 4 – 3 = 1 (17 January).

The following rules make the calculation easy:

- LMPs January to March: add seven days and nine months
- LMPs between April to December: add seven days and deduct three months.

Once the EDD is determined the duration of the pregnancy can be established.

If the woman is less than 12 weeks pregnant the uterus will not be felt on abdominal examination.

All other women are examined to determine the size of the uterus.

Determining the size of the uterus

(See Figure 17.1.) Before 10 weeks the uterus is still a pelvic organ and the size of the uterus can be determined by bimanual vaginal examination. Hegar's sign is a positive sign of pregnancy. A soft cervix and blue discolouration of the vagina also indicate pregnancy. The uterus is the size of an orange at 10 weeks.

After 12 weeks the uterus is an abdominal organ that can be felt above the symphysis pubis. The fundus of

the uterus is measured with the fingers above the pubis. The uterus reaches the umbilicus round about 18–20 weeks. The symphysis-fundal height (SFH) measure can now be used to determine gestational age.

Symphysis-fundal height (SFH) measurement

SFH cannot be used as a once-off measure to determine gestational age and is used between 20–35 weeks to determine expected fetal growth. Take three measures two to three weeks apart. Measure in centimetres, where 1 cm is one week. In non-obese singleton pregnancies 30 cm will indicate 30 weeks. This is useful after 24 weeks, if the dates from the last menstrual period are unknown or wrong, in the presence of a normal singleton pregnancy. The measured SFH is plotted on the 50th centile on the SFH graph (See Figures 17.3 and 17.4), allowing the corresponding gestational age to be read from the graph.

The SFH is considered to be accurate between 24–35 weeks of pregnancy in a singleton pregnancy (See Figure 17.2).

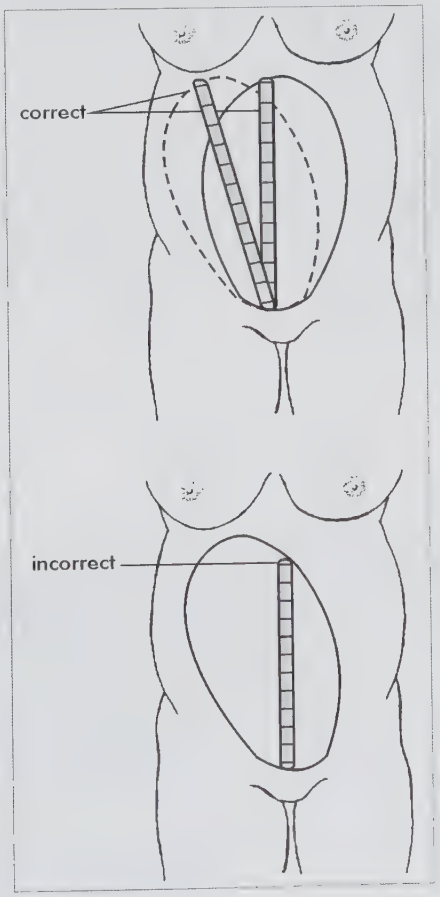


Figure 17.2 SFH measurement

A measure of 40 cm in a singleton pregnancy after 36 weeks can be an indication of a risk for shoulder dystocia in the absence of polyhydramnios and a multiple pregnancy.

Gross deviations may indicate multiple pregnancy. Confirmation of the gestational age can be made by ultrasound.

For further information, see *Juta's Clinical Guide for Midwives.*

The following factors may influence the accuracy of findings:

- Only one measurement. Serial measurements are needed to make an accurate assessment. This means that the information is plotted on a graph at each visit and can be compared.
- Lack of comparable information. All criteria should be in line with one another, the LMP, date of quickening, abdominal measures and ultrasound for an accurate estimation.
- Obese women, multigravidae with lax uteruses and ligaments, polihydramnios, multiple pregnancy, tubal pregnancy, extra-uterine pregnancy, pseudo-pregnancy, and retroverted uterus may give confusing information.

When a midwife is not sure of her findings, it is best to refer a woman for medical opinion.

An ultrasound or HCG test can be done to determine the true nature of the condition.

Taking a history

History-taking is an art, and a competency skill required in midwifery practice.

It is an extremely important aspect of antenatal care which needs to be mastered and serves as a screening procedure, which can identify factors that may be detrimental to the normal course of pregnancy and birth. The basic antenatal care (BANC) checklist is also completed. It will indicate the factors that need further attention and give the actions to be taken.

Table 17.1 summarises the information that should be obtained during a full history.

Terminology

A midwife needs to know the terminology used in obstetrics in order to summarise the woman's obstetrical history.

The ICD 10 classification of disease has categorised all conditions. The codes most often associated with the primary diagnosis in obstetrics and comorbidities are given in Annexure A. It is thus possible to categorise woman according to the ICD 10 codes.

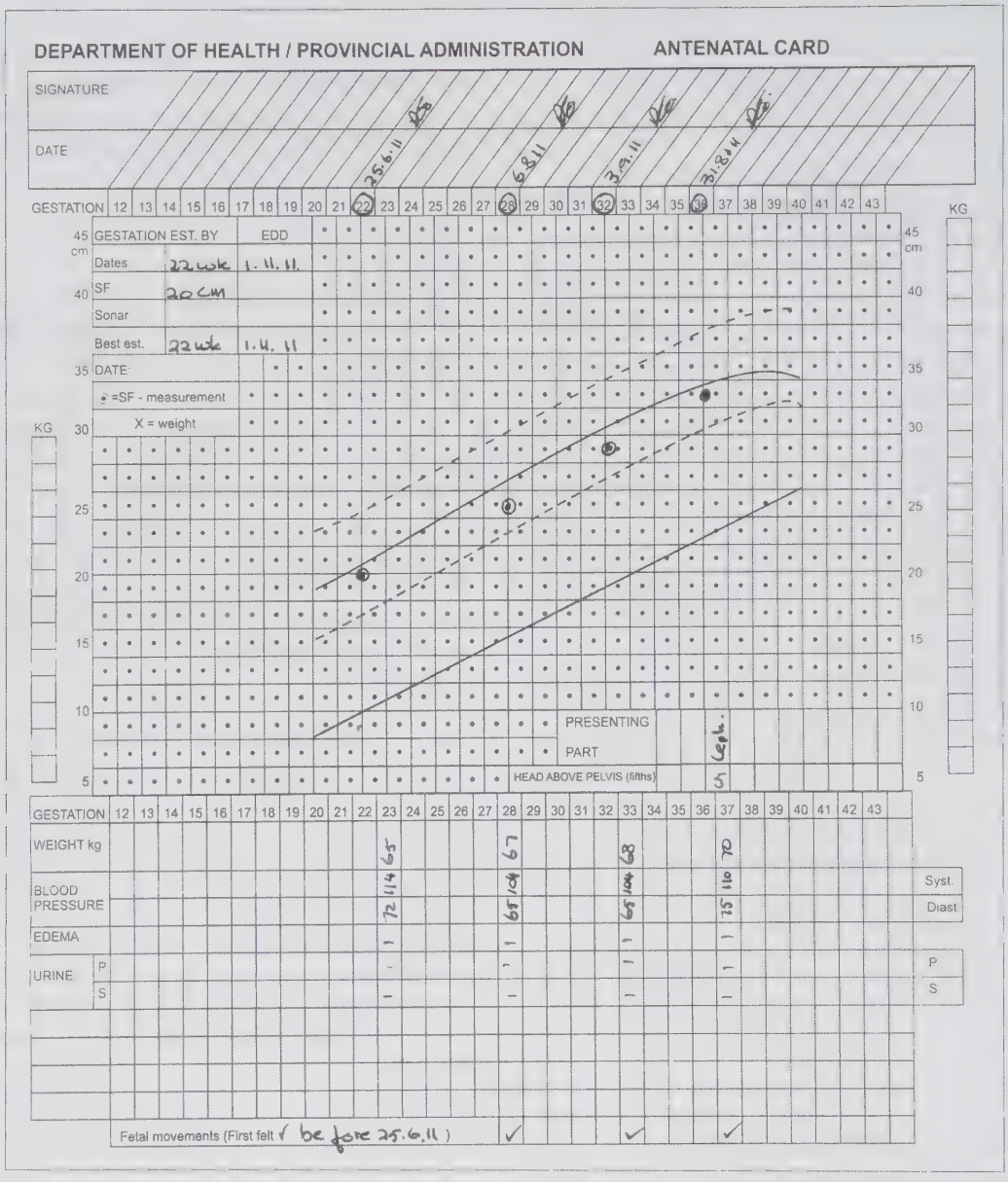


Figure 17.3 SFH graph of a woman with correct menstrual dates

The general obstetric status of a woman is expressed as follows:

- *Gravidity* is the number of times a woman has been pregnant (including fetal deaths, still births and live births) including the present pregnancy.
  - *Primigravida* is a woman who is pregnant for the first time (Gravida 1).
  - *Multigravida* is a woman who has had at least one previous pregnancy (Gravida 2, 3 or more).
- *Parity* is the number of previous viable births (infants stillborn or alive). Parity refers to the number of viable births and not the number of babies born. Therefore multiple pregnancies count as one birth. Births after 28 weeks are counted.
  - *Nullipara* is a woman who has not carried a pregnancy to viability (Para 0).
  - *Primipara* is a woman who has had one viable pregnancy (Para 1).
  - *Multipara* is a woman who has had two or more viable pregnancies (Para 2, 3 or more).
  - *Grande multipara* is a woman who has had five or more viable pregnancies (Para 5, 6 or more).

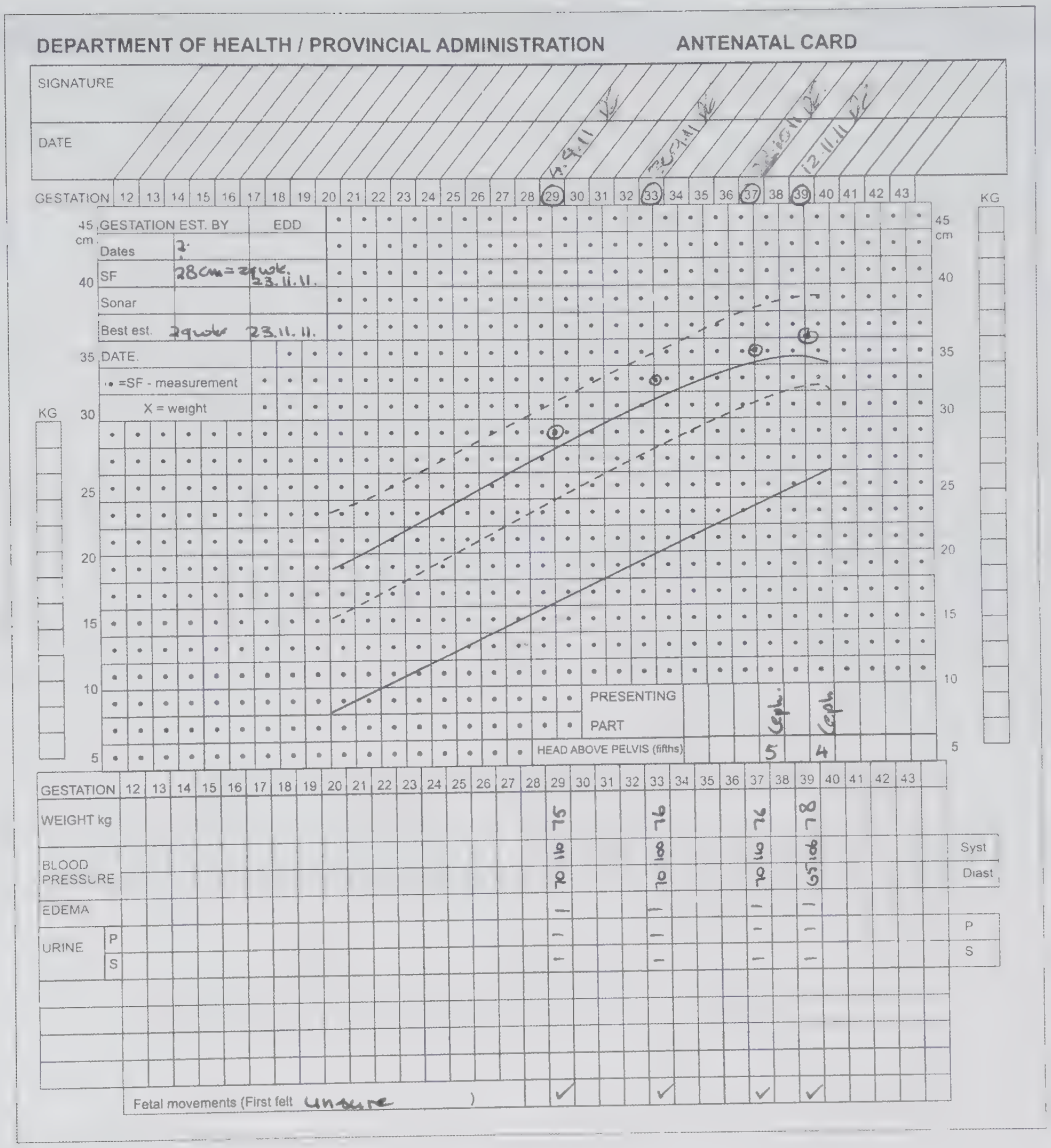


Figure 17.4 SFH graph of a woman whose menstrual dates are unknown

17.1 Viability

In South Africa a fetus is considered viable at 28 weeks of gestation (1 000 g). The WHO definition of viablity is 500 g and 24 weeks. Viability is determined according to lung maturity or the ability to survive based on respiratory development and function.

- *Abortions*. Abortions are the number of pregnancies that have terminated spontaneously before reaching viability (24–26 weeks or 500 g).
- *TOPs* (termination of pregnancy) are the number of pregnancies that were terminated by choice or due to complications of the mother or abnormalities of the fetus usually before viability (24–26 weeks or 500 g), also expressed as abortions.

If the woman is a primigravida over 35 years of age, or if she is a teenage primigravida (under 17 years) or if she is a grande multipara, she is considered to be at risk for complications in pregnancy.

Health assessment

The health assessment includes a full history (See Table 17.1), interpreting the obstetric status and a physical examination. The aim is to screen the woman for any existing abnormalities or factors that may complicate pregnancy and birth.

Table 17.1

Information gathered from a full history

Personal information	Full name Full address Telephone number Date of birth Population group Occupation (in detail) Religious affiliation (if any) Husband/partner's full name, address, occupation and business address and telephone number Name, address and telephone number of closest relative Name of healthcare provider
Social history	Level of education Financial situation and employment (the woman may have difficulty attending the clinic if she is employed) Support systems: including aftercare for mother and baby Age <16 and > 35 yrs (higher morbidity and mortality) If unmarried possibly less support. If married is the husband employed and supportive? Note address: if in poor socioeconomic area, find out details such as overcrowding or poor sanitation and financial situation Determine the distance to the clinic and means of transport. This plays a role in the accessibility of care and clinic visits Nutritional habits, food security and safe water Alcohol, drugs or tobacco use? If the woman is employed, what maternity leave arrangements are in place? What is the nature of the work? Are there occupational health hazards such as high temperatures, long hours standing, working with chemicals? Any cultural or religious affiliations that may affect the birth process (e.g. women from northern Africa may have had female circumcision)? Any other information that the woman believes to be of importance Should her social history reveal any problems, then a social worker should be consulted
Family history	Important for possible genetic conditions, include family of father of the child Any history of multiple pregnancy, particularly on the maternal side Family history of: hypertension, diabetes, rheumatic fever, cardiac conditions, haematologic (blood) disorders Any congenital diseases or deformities such as: Down's syndrome, haemophilia, muscular dystrophy, cystic fibrosis, phenylketonuria, albinism, Tay-Sachs disease (if Jewish), albinism, achondroplasia, dwarfism, giantism, talipes, deafness, blindness, cleft lip and palate, etc.
Medical/surgical	Past medical/surgical history Immunisations, such as rubella, hepatitis B and tetanus toxoid Childhood diseases Operative procedures such as: abdominal or spinal surgery or surgery for varicose veins, etc. Accidents, especially involving the spine, lower limbs or pelvis Any previous diseases or abnormal conditions, such as: poliomyelitis, rheumatic fever, hypertension, renal disease, cardiac disease, respiratory disease, diabetes mellitus, anaemia, malignancy, asthma, thrombosis, endocrine dysfunction, psychiatric disorders, sexually transmitted infections Any medications, current or previous: cortisone, insulin or oral medication for diabetes, other hormones, anticoagulants and anti-epileptic therapy, etc. Bleeding tendencies and previous blood transfusions

continued

Current history	Pre-pregnant weight Any current gain or loss of weight over six months Blood group and Rh factor Current medication Smoking, snuff or alcohol intake Current complaints, e.g. recurring urinary tract infections/vaginal infections
Gynaecological history	Age at menarche (first menstrual period, if after 16 yrs consider congenital abnormalities) Type of menstrual cycle (such as: 28 day cycle and whether regular) Any menstrual problems such as: dysmenorrhoea, periods of amenorrhoea, profuse menstruation Any vaginal discharge (give the name if known or otherwise the description) Sexually transmitted infections: gonorrhoea, syphilis, herpes 2, HIV status Any previous surgery to the birth canal, such as caesarean sections/myomectomy, colpoperineorrhaphy (surgical repair of torn vagina and perineum), etc, previous cone biopsy, shirodkar stitch Contraceptive history: type of contraceptive used, the date of removal of an IUCD (Intrauterine contraceptive device) or when contraceptive pills were last used
Past obstetric history	Infertility? Any treatment? Number of sexual partners/are the babies from the same father? History of previous pregnancies: number of normal pregnancies (pregnancies that have continued to term and had no serious problems) The dates and spacing of pregnancies Any abnormalities during pregnancy, such as: pre-eclampsia and eclampsia, early or late bleeding during pregnancy, intrauterine growth retardation (IUGR), polyhydramnios or oligohydramnios, etc. The history of previous labours: type of delivery and reason for interventions (forceps, caesarean sections), abnormalities and complications, precipitate labours, prolonged labours, perineal tears or episiotomies, primary postpartum haemorrhages, fetal distress, pain relief methods/spinal/epidural anaesthetics Experience of labour (presence of significant person at birth) The history of previous postnatal periods (the period from the end of labour to six weeks): any abnormalities, such as, subinvolution of the uterus, bleeding or secondary postpartum haemorrhage, thrombosis, etc. Infections: general, of the perineum, the birth canal or the breasts History of breastfeeding and duration of breastfeeding/infant feeding Any psychological problems The history of viable children born to the woman: number of viable children and their birth weights, in detail If any children have died, give the age at and cause of death The number of live children remaining and their health (state any abnormal conditions which they may have) Perinatal deaths/stillbirths (still-born infants) Preterm or postterm babies
Present obstetrical history	The date of the first day of the last normal menstrual period. Was this period a normal period, in amount and length? What is the woman's attitude to this pregnancy? Was it a planned pregnancy? If not, explain Has the pregnancy been normal and without complications? Has she been sleeping and eating well and doing antenatal exercises? Any common disorders: feeling faint, nausea and vomiting, constipation, heartburn, itching of the skin or pruritis, varicose veins, haemorrhoids, backache (explain in detail) Any serious disorders, such as: bleeding, excessive vomiting, severe headaches, high temperatures (explain in detail) Any infections, particularly: viral: rubella, cytomegalovirus, influenza, herpes, HIV status Other: syphilis, toxoplasmosis, or any other treatment or exposure, particularly to X-rays, cytotoxic treatment or any accidents, any surgery or anaesthetics Current medication

The information also acts as a baseline for examinations at future visits to the antenatal clinic and is the basis for planning the level and content of care. Abnormalities can, therefore, be detected early and treatment started immediately,

17.2 Obstetrical status

Gravidity indicates the number of pregnancies (Grav) and parity the number of pregnancies that went to viability (Para). Consider the following example:

A woman who has had three previous pregnancies and is now pregnant for the fourth time, will be Grav 4.

If only two of her previous pregnancies were viable (lasted 26 weeks or longer) then she will be Grav 4 Para 2 (G4P2).

If one of her viable pregnancies produced twins (alive or stillborn) then she will still be Grav 4 Para 2 (G4P2).

If the first viable pregnancy produced twins and the second viable pregnancy produced quadruplets, then she will still be Grav 4 Para 2 (G4P2).

and these can then be evaluated and treated as the pregnancy progresses.

It is, therefore, very important for the examination to be thorough and accurate and for all information to be carefully recorded. The checklists of the BANC programme are structured guides that assist the examiner in collecting the correct information.

The examination must be carefully explained to the woman. The midwife should encourage the woman to talk to her during this time. This helps the woman relax and can provide the midwife with information about the woman's emotional state.

Table 17.2

Measurement of mid-upper arm circumference (MUAC)

MUAC > 33 cm	MUAC of ≤ 23 cm
◗ Suggests obesity ◗ Is associated with an increased risk of pre-eclampsia and maternal diabetes ◗ Is associated with an increased risk of delivery of a larger than normal infant ◗ Indicates that blood pressure measurement with a normal sized adult cuff may be an overestimation	◗ Suggests under-nutrition or a chronic wasting illness ◗ Is associated with delivery of a smaller than normal infant

The examination also gives the midwife the opportunity to advise and teach the woman about posture, body movements and breast examination.

General examination

The general assessment of a pregnant woman includes a physical and psychological assessment. She may be aware, co-operative and communicative, or dull and unresponsive, calm or agitated and anxious, happy or depressed. These are observed and noted.

17.3 How to measure MUAC

- Measure the MUAC immediately after checking the blood pressure.
- Use a soft tapemeasure, as for symphysis–fundal height.
- Measure the MUAC at any gestation, or during or after labour.
- Measure the arm circumference in either the right or left arm, midway between the tip of the shoulder (acromion) and the tip of the elbow (olecranon).
- Record the measurement to the nearest 1 mm.
- The arm should hang freely (elbow extended).
- Record the MUAC on the antenatal card or in the labour ward admission notes.

The woman is weighed and assessed as being under- or overweight according to her height. The recommended mid-upper arm circumference (MUAC) is measured and plotted on the antenatal card. This gives a good indication of the nutritional status of the woman (See Table 17.2 and Box 17.3).

Mid-upper arm circumference (MUAC)

The National Committee on Confidential Enquiries into Maternal Deaths (NCCEMD) included the MUAC in the national Maternal Death Notification. The MUAC is recorded in a number of African countries and gives useful information on nutritional status and pregnancy risk and is easily done during the antenatal period or during labour. MUAC is better than the body-mass index because height does not need to be measured, accurate scales are not required, the woman does not have to stand up straight, no calculation is needed, and MUAC, unlike weight, does not normally increase significantly during pregnancy.

On its own, an abnormal MUAC:

- Is not a reason for more frequent antenatal visits.
- Is not a reason for referral to a higher level of care.
- Does not require special investigations, e.g. chest X-ray, glucose testing.

Table 17.3

Physical examination

System	Normal	Abnormal
Skin	Normal: The natural colour depends upon the woman's racial background; the condition and texture or feel of the skin should be smooth and elastic, with no or little oedema (50%–70% of women have a small amount of oedema in late pregnancy). No rashes or other lesions should be present	Pallor: may be natural, but can be due to anaemia or other blood disorders, or to inborn errors of metabolism such as phenylketouria Dark pigmentation: can be normal in pregnancy due to secondary areola, chloasma, or linea nigra; or may be due to birthmarks or moles (naevi); or may be abnormal and a sign of neurological or immunological disorders Jaundice: hepatitis or other conditions causing hyperbilirubinaemia Cyanosed or dusky: cardiac and respiratory conditions Roughness: hypothyroidism, malnutrition and vitamin deficiencies Inelasticity: dehydration, malnutrition, advancing age Oedema: pre-eclampsia, cardiac or renal disease Rashes or other lesions: infections, STIs, parasites Bruises or petechiae: trauma, bleeding tendencies
Hair	The colour and texture should be consistent with the racial background and distributed normally	Abnormalities of texture and distribution may be due to malnutrition; hypothyroidism Loss of hair can be genetic
Eyes	Generally bright, alert and clear; the sclera should be white; the pupils should be round, equal and respond to light; there should be no swelling of the eyelids; the conjunctivae should be pink, glasses or contact lenses noted	Deformities, strabismus, ptosis; lesions; sight impairment; nystagmus; discharges Yellow pigmentation of sclera indicates jaundice; red sclera may indicate infection Dilated or pinpoint pupils may indicate the use of drugs: dagga and heroin respectively Oedema of the eyelids and surrounding areas may indicate pre-eclampsia; renal disease Pale conjunctivae may indicate anaemia
Nose/sinuses	Unrestricted and silent nasal breathing Normal sinuses	Blocked nose; broken nose; rhinitis and discharge; bleeding Sinuses blocked, headaches and postnasal drip/ cough
Mouth/teeth	Lips, gums, tongue, buccal mucosa, palate and pharynx are pink and free of lesions Teeth even and without dental caries; breath of a normal odour Tonsils removed or present	Lips: oedema; lesions; pallor; deformities Gums: pallor; lesions; bleeding Tongue: large may indicate hypothyroidism; speech difficulties; tongue-tie Buccal mucosa: pallor; jaundice; lesions. Palate: cleft, which may cause speech difficulties Pharynx: enlarged, inflamed or septic tonsils; inflamed, ulcerated throat Teeth: broken; dental caries Breath: offensive; other odours such as alcohol, dental decay (A throat swab can be taken if necessary)

continued

Table 17.3

Physical examination (*continued*)

System	Normal	Abnormal
Neck/thyroid	Should be mobile with good muscle tone and no stiffness; the thyroid gland should be of normal size; the carotid pulses should be palpable	Stiffness: may indicate spinal or neurological conditions Poor muscle tone: may indicate muscular dystrophy Enlarged thyroid: may indicate hyperthyroidism Carotid pulse: diminished or absent, may indicate cardiovascular disease Rolls of fat: indicating obesity
Shoulders/arms	The shoulders, arms and hands should be relaxed with good muscle tone and neither fat nor thin; all the joints of a normal size and mobile; the hands and all the fingers present, no extra digits; radial pulses good; hands and fingers pink, warm and slightly moist; nail beds pink and firm. MUAC ≤ 33 cm. Pulse clearly felt both sides regular and full	Tension of muscles; lack of muscle tone Obesity or excessive thinness Rings very tight: may indicate oedema and pre-eclampsia Enlarged joints: may indicate arthritis Clubbing and cyanosis of fingertips: may indicate cardiac or respiratory disease Spoon-nails: may indicate iron-deficiency anaemia Chipped nails; mineral deficiency Carpel tunnel syndrome MUAC ≤ 23 cm
Chest/heart and lungs	Normal shape and symmetrical; sternum and ribs not prominent Normal lung and heart sounds	Barrel or pigeon chest: could indicate asthma; emphysema; chronic pulmonary or cardiac disease Pulse irregular, skipping beats Abnormal lung and heart sounds/murmurs
Breasts	Skin smooth: in primigravidae, the breasts firm and supple; in multigravidae, the breasts less firm and old striae may be seen The areola pigmented and veins prominent from 8 weeks The nipples and Montgomery's follicles enlarged by 12 weeks Secondary areola appears and colostrum can be expressed from 16 weeks The nipples should be supple and prominent, and they should not retract when gently squeezed between the fingers, just behind the nipple	Lumps and/or coarse or 'orange-peel' appearance of skin may indicate carcinoma Tender lumps, or areas of redness and heat may indicate infection Nipples that are flat; depressed; inverted; bifid (cleft), or have any cracks or lesions Supernumerary/auxiliary breasts may be present The midwife can give advice on preparation for breastfeeding, nipple care and self-examination of breasts
Abdomen	See abdominal palpation	
Legs	Good muscle tone; the legs straight and of the same length and circumference; the skin colour normal; no lesions; no varicose veins; the joints of normal size and mobility; the feet and toes normal and all the toes present, but no extra digits; the femoral pulses present; no oedema	Stiffness of joints or poor muscle tone: may indicate arthritis; muscular dystrophy The legs crooked and/or not the same length or width: may indicate poliomyelitis; congenital deformity; spinal disorders Lesions or sores: may be due to infections; bites; STIs; varicose ulcers Lack of sensation: may be caused by neurological disorders Enlarged and stiff joints: may be due to rheumatism; arthritis, or may be due to oedema

continued

		Abnormalities/deformities of feet and toes: may be due to congenital disorders; accidents Very small feet: may suggest a small pelvis Oedema of feet and/or legs (pitting on digital pressure): if oedema is present, note how extensive it is. Varicose veins present
Back	Normal spinal curves, with possible increased lumbar curve in late pregnancy and therefore often some backache	Spinal deformities; abnormal curves; spina bifida Severe backache, especially in early pregnancy
Vulva/perineum	Normal appearance. No lumps or lesions; the vulva should be moist, with normal secretions. The perineum should be of normal length and thickness	Any anatomical abnormalities: may indicate congenital deformities; cystocele or rectocele; prolapsed uterus Any rashes, lumps, warts or lesions: may be due to infections; diabetes mellitus; abscesses; STIs; carcinoma Abnormal, vaginal discharges and offensive odours: may indicate infections such as monilia; trichomonas, or STIs such as gonorrhoea A very wide or very thick, rigid perineum Any perineal scars, and if present, is the wound healthy; how much scar tissue is there; was the wound well-sutured?
Buttocks and anal area	Normal appearance	Any abnormalities such as: congenital deformities; haemorrhoids; anal fissures; rectal prolapse Sacral pilonidal sinus Rashes, lumps, tenderness, excoriation, etc., may be due to allergies; infections; abscesses; diarrhoea Bleeding/heamorrhoids

General observations

Observation of all the vital signs are made as a baseline information and plotted on the antenatal card:

- temperature (normal 37 °C)
- pulse (normal 80 or less).
- respiration (normal 20 breaths per minute).
- blood pressure (normal during pregnancy 100/60 to 130/80 mmHg). If it is elevated, it should be taken again in six hours. Hypertension is a serious complication during pregnancy and the woman should be referred to a medical practitioner immediately.

Physical examination

A full physical assessment is performed. The examination is performed systematically from head to toe without exposing the woman unnecessarily. Table 17.3 provides a summary of the necessary physical observations. A full breast examination is performed and the woman is instructed how to examine her breasts for lumps.

Heart and lung auscultation

The skilled midwife or medical practitioner will assess the woman's heart and lungs for abnormalities.

Abdominal examination

The abdominal examination is an important basic competency of midwifery and will be discussed in more detail later.

Special investigations

Routine investigations in pregnancy are required for all women.

Wards tests or side-room tests are quick and inexpensive and do not require laboratories or specialised staff. These tests are used for screening and more accurate testing is done if a problem is suspected. Box 17.4 gives the routine/standard tests in pregnancy and Box 17.5 gives special tests currently available in the public sector in South Africa.

Vaginal and cervical investigations

Vaginal examinations are not routinely done in pregnancy but it may be necessary for the medical practitioner or the midwife to take the following specimens for laboratory investigation:

- Pap smear (before 28 weeks)
- a high vaginal swab if there is an undiagnosed vaginal discharge.

17.4 Routine screening tests in pregnancy

These may be side-room tests or blood may be sent to the laboratory. These include:

- Urine for protein, sugar and ketones (each visit)
- Haemoglobin. If within the normal range, this is repeated at about 32 weeks gestation. If below 12 g/dl, then it is repeated more frequently.
- RPR (rapid plasma reagin) test, for syphilis, primary or secondary. If the RPR test is positive, this should be confirmed with TPHA (Treponema pallidum haemagglutination test), especially for false-positive results from RPR and also for tertiary syphilis.
- ABO blood grouping.
- Rhesus factor. If the woman in Rh negative, a medical practitioner is advised and blood is tested for the antibody titre, and repeated at specified intervals. The husband or partner's blood is also tested for Rhesus factor.
- Hepatitis B antigen.
- Anonymous antenatal HIV screening in some centres.

17.5 Special tests in pregancy

- triple test for abnormalities at 16 weeks
- FISH test for selected abnormalities after 18 weeks
- ultrasound at 12 and 20 weeks to exclude fetal abnormalities
- rubella testing before 20 weeks if exposed
- blood glucose screening if indicated
- Pap smear: all pregnant women need a Pap smear before 28 weeks or at 6 weeks postpartum
- urine MC&S in women with history of preterm labour and urinary tract infections.

(DOH Guidelines for Maternity Care in South Africa, 2002.)

Special assessments

If there are indications of specific problems the woman may be referred for a higher level of care or specialised care. Special assessments may include:

- nutritional assessment if the MUAC is more than 33 cm or less than 23 cm
- psychological assessment if there is a history of mental health problems or previous postnatal depression or psychosis
- HIV counselling and testing. The latest guidelines from the DoH require universal testing of pregnant women
- genetic counselling if there is a history of congenital abnormalities or if the woman falls into a risk category.

The action plan

After the woman is assessed the action plan will depend on:

- the gestational period
- factors present that place the woman in a category that requires a higher level of care/or specialised care.

All pregnant women receive basic iron and folic acid supplementation and tetanus toxoid immunisation. All other interventions will be planned according to the antenatal protocols for specific conditions. Women who are categorised for higher level care are referred for the follow-up at that level. Women who are categorised as 'low risk' are scheduled for basic antenatal care.

Follow-up visits

The initial visit is aimed at the identification of factors in the history, current physical status or basic screening of a woman. The BANC checklist will categorise woman in two groups after assessment:

- those qualifying for the BANC programme
- those requiring a higher level of care, who are referred for medical care.

Women who qualify for basic antenatal care or 'low risk' care will be scheduled for four further visits, depending on the stage of the pregnancy. Women who do not qualify for basic antenatal care will be referred and a specific programme or plan will be developed for them, including the specific interventions and the number of visits needed.

The purpose of the follow-up visits for 'low risk' basic antenatal care is to provide appropriate care for the woman and to monitor growth and development of the fetus and observe for danger signs.

The following are included in the follow-up visit:

- Revisit the history, and take a history of any problem that the woman may have experienced since the last visit.

- Assess the woman's needs and refer for antenatal education and exercises and birth preparation.
- Do a routine assessment that includes basic vital data (maternal wellbeing), urine test (evaluate the results from previous tests and repeat or follow up tests, e.g. mid-stream urine for microscopy, culture and sensitivity (MC&S)), and fetal surveillance to monitor the progress of growth and development.
- Complete the BANC checklist and institute the required actions.
- Give appropriate health education.
- Monitor the continuation of the oral supplementation and haemoglobin levels.
- Do specific observations for the level of pregnancy.

Monitoring the progress of the pregnancy

Monitoring the fetus requires careful determination of the duration of pregnancy and parameters of growth and development. The accurate determination of the LMP and EDD are used as guides for the growth and development of the fetus.

Duration of the pregnancy

This is valid if the woman is sure of her dates, and where palpation of the uterus and SFH measurement are compatible with the given dates. Gestational age must be calculated from the first day of the last menstrual period or by carrying out early ultrasound before 20 weeks, which is more accurate.

Palpation

The SFH measurement is of little value for estimation of gestational age at <20 cm and ≤35 cm (corresponding to <20 weeks and term respectively). In early pregnancy, bimanual and abdominal palpation can be used, and after 29 weeks, palpation of the fetal head is useful. Assessing gestational age by palpation requires skill and experience.

Symphysis-fundal height (SFH) measurement

This is used for estimation of gestational age after 24 weeks, if the dates from the last menstrual period are unknown or wrong, in the presence of a normal singleton pregnancy. The measured SFH is plotted on the 50th centile on the SFH graph, allowing the corresponding gestational age to be read from the graph (see Figure 17.2).

Interpreting the symphysis-fundal height growth chart

The growth of the average uterus is shown by a solid curved line known as the 50th percentile line – average fetal growth will follow this line.

The 90th percentile means that 90% of fetuses will fall below that line – if the measurement falls above this line then the fetus might be growing too much, or else a multiple pregnancy is a possibility.

The 10th percentile means that 10% of fetuses fall above this line – if the measurement falls below the 10th percentile then the fetus may be growth restricted (see Figures 17.3 and 17.4).

Abdominal palpation

The abdominal palpation is a clinical skill that is used to determine the number of fetuses in the uterus, the size of the fetus, and the position of the fetus. The relationship between the fetus and the pelvis can be estimated. The findings are compared with all other information gathered in pregnancy. The abdominal palpation is valuable after 28 weeks when the fetal skull begins to calcify. Breech presentation between 30–34 weeks is common. The fetus should take the final position for labour by 36 weeks. In a primigravida the presenting part should be engaged by 36 weeks. It is unusual for a fetus to change position during labour.

The relationship between the fetus and pelvis

The relationship of the fetus to the uterus and pelvis determines which part of the fetus will enter the pelvic brim first and will therefore also determine the mechanism by which the fetus will pass through the birth canal during labour. In most instances this relationship will, to a large extent, determine the outcome of labour.

It is also important to know what is normal and what is abnormal in this relationship, so that an assessment can be made after palpation. This assessment is necessary to ensure the normal continuance of pregnancy and labour, and is an integral part of antenatal care.

The terms used to describe this relationship of the fetus to the uterus and pelvis, and the definitions of these terms are:

- *Lie.* The lie is the relationship of the long axis of the fetus (spine) to that of the long axis of the mother (spinal column) (see Figure 17.5). The lie may be longitudinal, transverse or oblique, with either the head or the breech occupying the lower pole of the uterus. If the head is in the lower pole, the lie is cephalic and if the lie is breech, it is podalic.

  In a transverse or an oblique lie, the long axis of the fetus (spinal column) lies across (either perpendicular to or at an oblique angle to) the maternal spinal column in the uterine cavity. A shoulder usually occupies the lower pole of the uterus and lies over the pelvic brim,

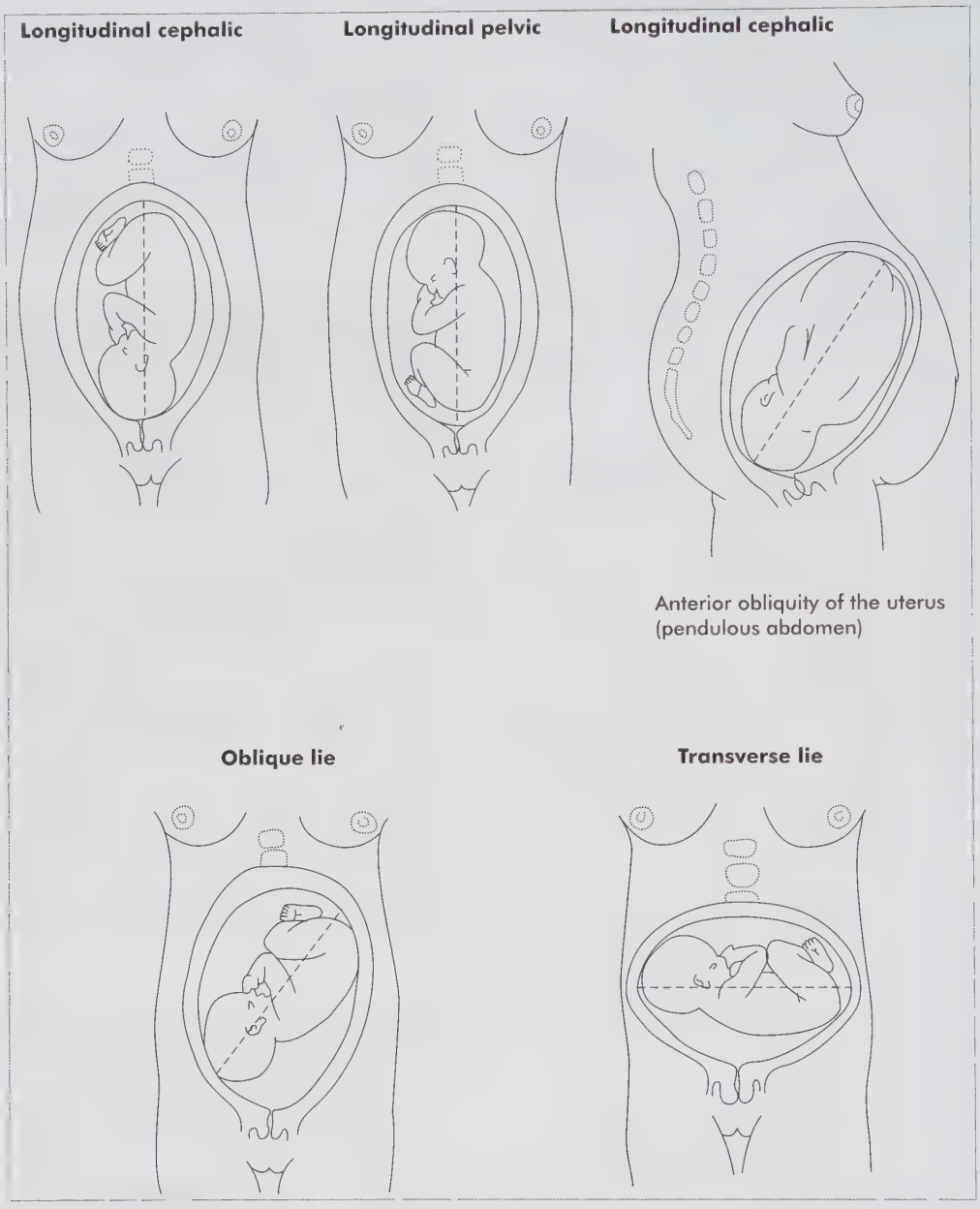


Figure 17.5 Variations in the lie of a fetus

but in rare instances an arm or some part of the trunk may present at the pelvic brim. Transverse lie is an extremely serious condition, because the fetus (unless very small) would be unable to pass through the pelvic canal and an obstructed labour would result.

In conditions such as grand multiparity, multiple pregnancy and polyhydramnios, where there is overstretching of the uterine muscles and a reduction in muscle tone, the uterus becomes round instead of ovoid and cannot support the fetus in a longitudinal lie.

- *Attitude*. The attitude of the fetus is the relationship of the fetal parts to one another: that is, the relationship of the fetal limbs and head to the fetal trunk. The attitude positions can be flexion, deflexion or extension.

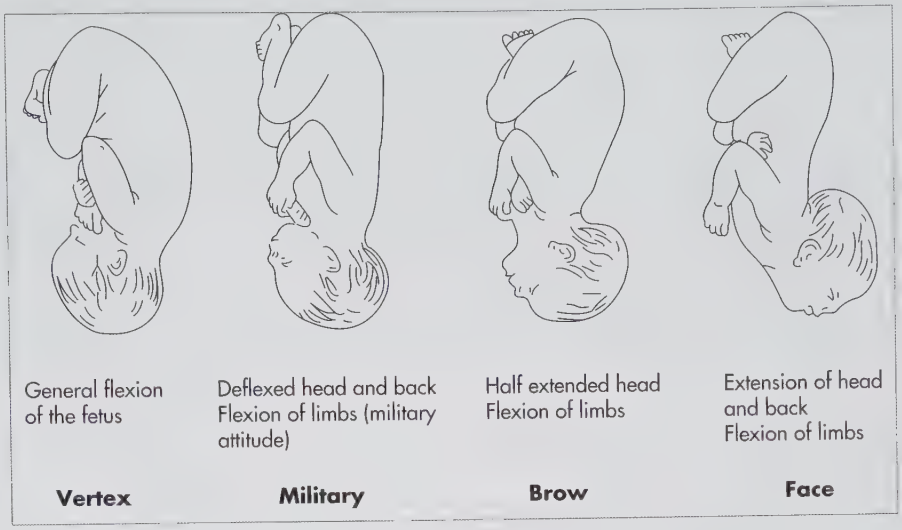


Figure 17.6 Attitude

- *Flexion.* Normally, the fetus adopts the attitude of full flexion (fetal position). The fetus usually lies with its back curved slightly in a 'C' shape, so that the head is bent forward or flexed with the chin on the chest, and the buttocks bent forward with the thighs flexed onto the abdomen. The lower legs are flexed onto the thighs and the arms are bent and flexed onto the chest.

  This well-flexed, ovoid fetal shape fits well into the ovoid shape of the uterus, with the head fitting into the smaller, lower pole of the uterus and the bulkier buttocks and legs being accommodated in the larger upper pole of the uterus. In this attitude of general flexion, the occiput lies at the opposite pole to the buttocks and one of the smallest and most symmetrical circumferences of the head will enter the pelvic brim. The diameters of the fetal head that presents in flexion are most favourable for passing through the pelvis. The biparietal of 9,5 and the suboccipit bregmatic 9,5 presenting in this case gives a round circle. This facilitates application on the cervix, with good contractions due to the Ferguson reflex.
- *Deflexion.* (See Figure 17.6.) In this attitude, the fetal back is straight, with the head deflexed and upright on the spine (military attitude). The limbs remain flexed on the fetal trunk. Larger diameters of the head will lie over the pelvic brim.
- *Extension.* (See Figure 17.6.) With extension, the upper spine is curved backwards, with the head bent backwards so that the occiput approaches the spine. The face of the fetus lies at the opposite pole to the buttocks and in a cephalic presentation the face will engage at the pelvic brim. The limbs remain flexed on the fetal trunk.

- *Presentation.* (See Figure 17.7.) The presentation is that part of the fetus that lies in the lower pole of the uterus and which presents at the pelvic brim.

  The presentation may be a vertex, a breech, a face, a shoulder or a brow presentation. 96% of presentations are cephalic (vertex, face and brow), 3–4% of fetuses that present as breech are podalic (pelvic). The shoulder presents in less than 0.5% of presentations.
  - *Vertex position.* The largest diameters of the head that present in a well-flexed vertex presentation are the suboccipito bregmatic diameter of 9.5 cm, and at right angles to and bisecting this diameter, the biparietal diameter which is also 9.5 cm. This means that the circumference of that part of the head that is presenting is round and symmetrical; and the largest diameters of the head are smaller than the narrowest diameters of the pelvic canal.
  - *Breech presentation.* When the lie is longitudinal and the buttocks of the fetus present at the pelvic brim, this is called a breech presentation. Breech presentation is often present between 26–34 weeks, because the small fetus is able to move freely in the plentiful liquor amnii and the uterine walls are, as yet, not able to confine the fetal form. The attitude of the fetus can be that of general flexion with the buttocks and the feet presenting, or one or both legs may be extended at the knee.

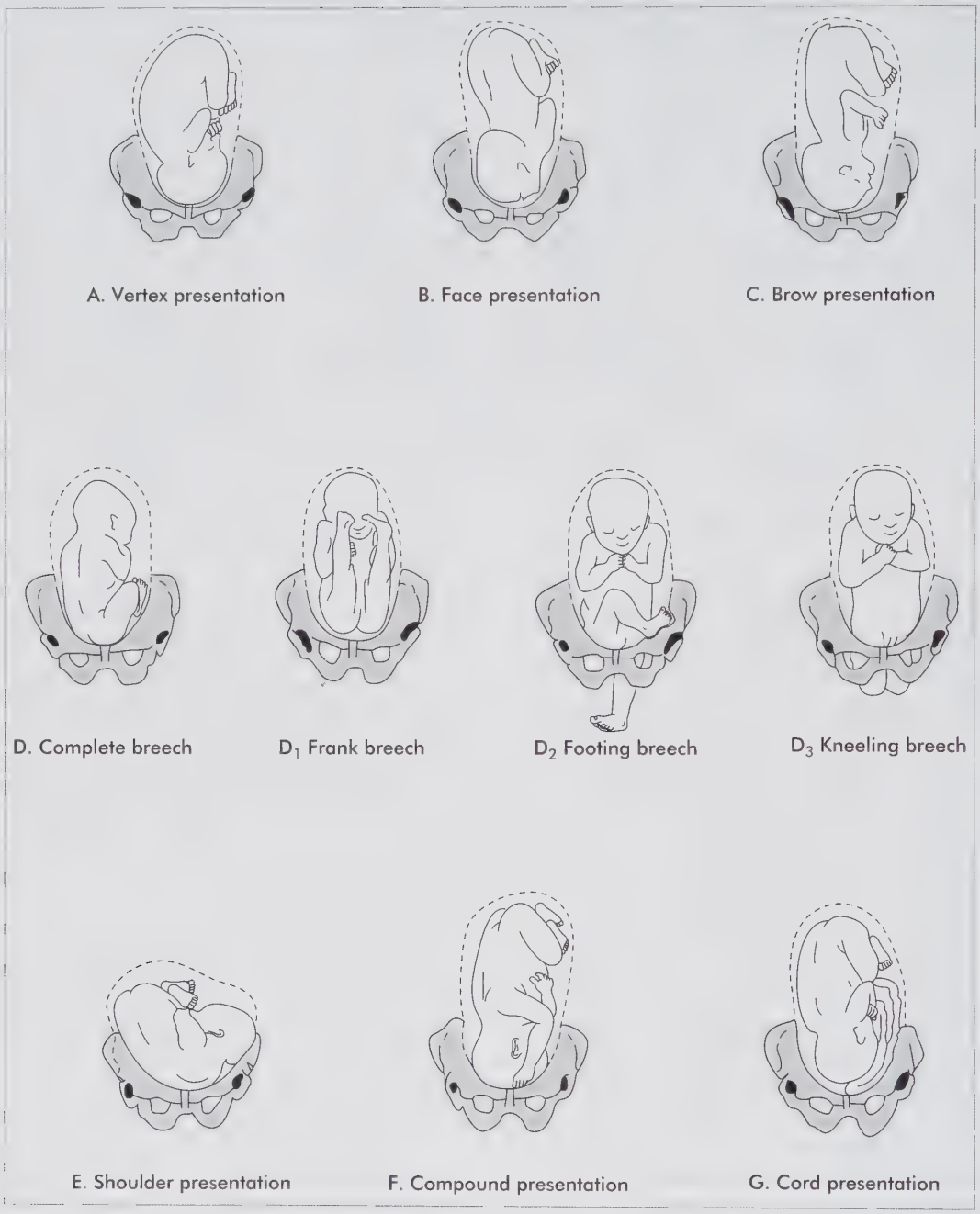


Figure 17.7 Variations in presentation of the fetus

If both legs are extended it is a frank breech and on abdominal palpation, the fetal form would feel longer and thinner than would be normal for the gestational period. These extended legs would also cause splinting of the fetal body, possibly preventing it from turning spontaneously or from being turned into a vertex presentation. A breech presentation in the second half of the third trimester is a serious condition, because a breech delivery holds many potential hazards for the baby, and the woman must be seen by a medical practitioner. Breech presentation may be an indication of cephalopelvic disproportion. Very rarely, a foot or a knee may present, mainly in preterm birth, and is considered a complicating factor.

- *Face presentation.* In a face presentation the lie is longitudinal and the presentation cephalic, but the attitude of the fetus is one of complete extension of the head and the face enters the pelvis. This rare presentation may deliver vaginally when the fetal chin is anterior (mentoanterior) as the diameters are similar to those in the vertex presentation. However, mentotransverse and mentoposterior presentations will usually cause prolonged labour or obstructed labour. For this reason, all face presentations must be referred immediately for medical intervention.
- *Brow presentation.* A brow presentation is very rare. The brow presents at the pelvic brim when the head of the fetus is half-way between flexion and extension in a longitudinal lie of the cephalic type.

  The diameter that attempts to enter the pelvic brim in a brow presentation is larger than any of the diameters in an average-sized pelvis and the fetal head may become caught up in the pelvic brim, causing obstructed labour. This presentation is usually only diagnosed when the woman is in advanced labour and the woman must be seen by a medical practitioner immediately.
- *Shoulder presentation.* The shoulder may present at the pelvic brim in a transverse lie. As the fetus is unable to negotiate the pelvic canal in this presentation, the labour will become obstructed. As this is an extremely serious condition and the life of both the fetus and the mother are at risk, the woman must be referred immediately to a medical practitioner. Very rarely, a hand may present.
- *Compound presentation.* A compound presentation is extremely rare. Here, a prolapsed hand and/or foot may present together with the head, or a hand may present with the breech. This could be diagnosed on vaginal examination.

  A cord presentation occurs when the umbilical cord is found to be lying over the cervical os, with the membranes intact. This could be diagnosed on vaginal examination. (If the membranes have ruptured, it is known as a cord prolapse.)

- *Denominator.* The denominator is that part (landmark) of the presentation that indicates the position of the presentation in relation to the pelvic brim and gives the position its name. This is the part that is felt first on vaginal examination (see Figure 8.10 in Chapter 8).

  The occiput becomes the leading part in a normal vertex presentation, and the mentum (chin) in a face presentation.
  - The occiput is the denominator in a vertex presentation.
  - The sacrum is the denominator in a breech presentation.
  - The mentum is the denominator in a face presentation.
  - The acromiom process is the denominator in a shoulder presentation.
- *Position.* The position of the fetus is indicated by the relationship of the denominator to six points or landmarks on the pelvic brim.

  The landmarks on the pelvic brim are:
  - *anteriorly*: the left and right iliopectineal eminences
  - *laterally*: the mid-point of the iliopectineal line on either side of the pelvis. In a gynaecoid pelvis this is the widest diameter of the brim
  - *posteriorly*: the left and right sacroiliac joints.

  In a vertex presentation, with the occiput as the denominator, the position may be:
  - Left occipitoanterior (LOA) where the occiput lies adjacent to the left iliopectineal eminence.

    The sagittal suture of the fetal skull will lie in the right oblique diameter of the pelvis, with the posterior fontanelle lying anteriorly and to the left of the pelvis and the anterior fontanelle lying posteriorly and to the right of the pelvis.

    The oblique diameters of the pelvis are always named from the posterior, that is, from the sacroiliac joint on the left or right of the pelvis, which correspond to the woman's left or right hand.
  - Right occipitoanterior (ROA), where the occiput lies adjacent to the right illopectineal eminence.

    The sagittal suture of the fetal skull will lie in the left oblique diameter of the pelvis, with the posterior fontanelle lying anteriorly and to the right of the pelvis and the anterior fontanelle lying posteriorly and to the left of the pelvis.

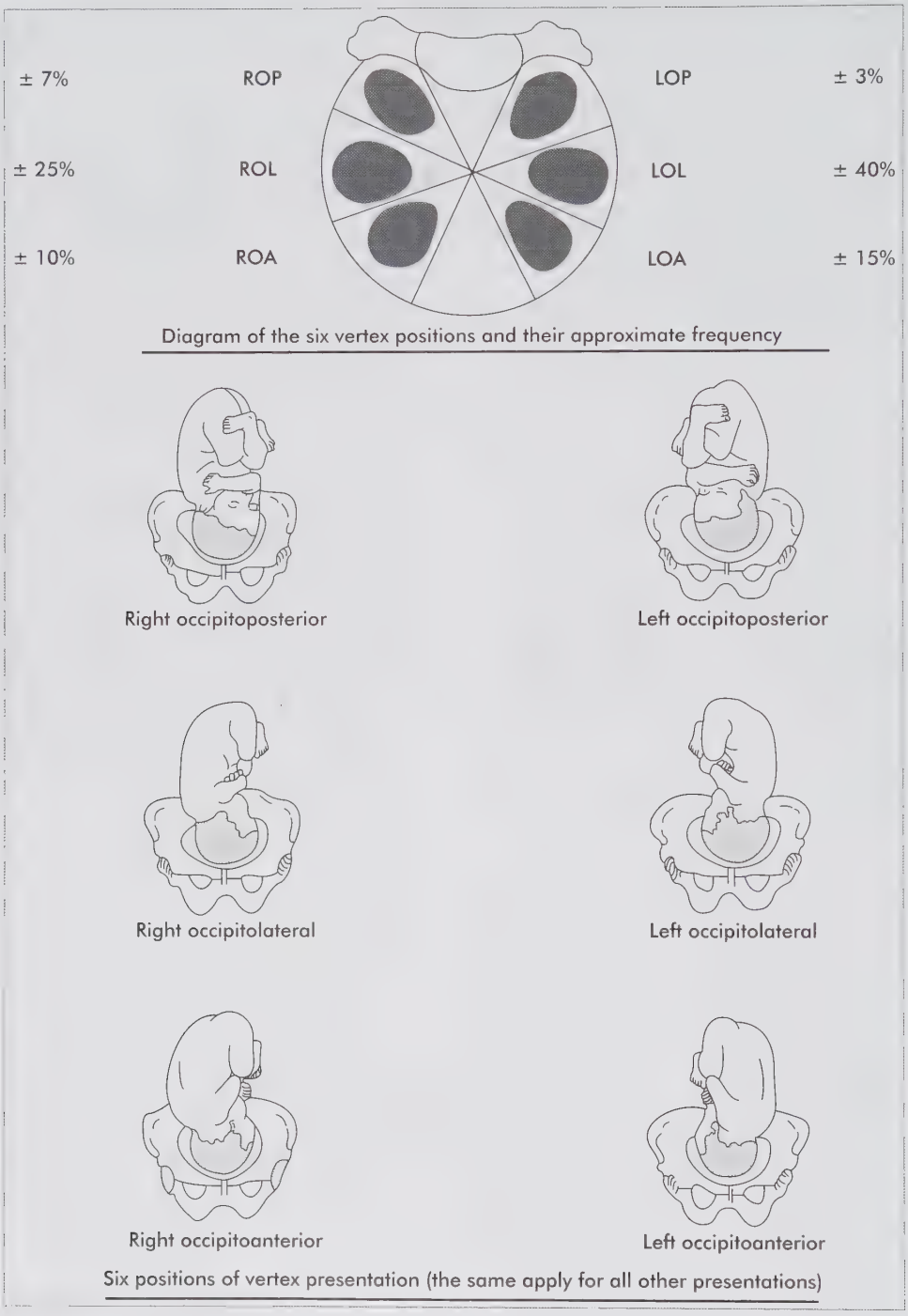


Figure 17.8 Six positions of the fetus in a vertex presentation

- Left occipitoposterior (LOP), where the occiput lies adjacent to the left sacroiliac joint.

  The sagittal suture of the fetal skull will lie in the left oblique diameter of the pelvis, with the posterior fontanelle lying to the left and posteriorly and the anterior fontanelle lying to the right and anteriorly in the pelvis.
- Right occipitoposterior (ROP), where the occiput lies adjacent to the right sacroiliac joint.

  The sagittal suture of the fetal skull will lie in the right oblique diameter of the pelvis, with the posterior fontanelle lying to the right and posteriorly and the anterior fontanelle lying to the left and anteriorly in the pelvis.

The lateral and anterior positions occur more frequently in the vertex presentation, because the curved fetal back is more easily accommodated against the concavity of the woman's abdomen, rather than against the rigid spine. There is also more room in the lateral and anterior portions of a gynaecoid pelvis for the broad bi-parietal diameter of the fetal head. The left occipitoposterior position (LOP), is the least frequent position in vertex presentations, because the descending colon takes up a large part of this area in the pelvic cavity.

In a vertex presentation, when the abdomen is palpated, the back of the fetus will be found on the same side of the abdomen as the denominator (the occiput). This will also apply in the breech presentation, but will not apply in the face presentation.

- *Positions in breech and face presentations.* In breech and face presentations, these positions will correspond to those of the vertex presentation, with only the denominator changing. In the breech and the face presentations, the sacrum and the mentum respectively take the place of the occiput in the vertex presentation:
  - LSA and LMA correspond to LOA
  - RSA and RMA correspond to ROA
  - LSL and LML correspond to LOL
  - RSL and RML correspond to ROL
  - LSP and LMP correspond to LOP
  - RSP and RMP correspond to ROP
- *Presenting part.* The presenting part is that part of the presentation that lies over the cervical os during labour and therefore it is upon this portion of the presentation that the caput forms.
  - *Descent of the presenting part.* The amount of descent of the presenting part (fetal head or sacrum) into the mother's pelvis is assessed on abdominal examination and is calculated as fifths of the fetal head above the pelvic brim (see Figure 17.9).

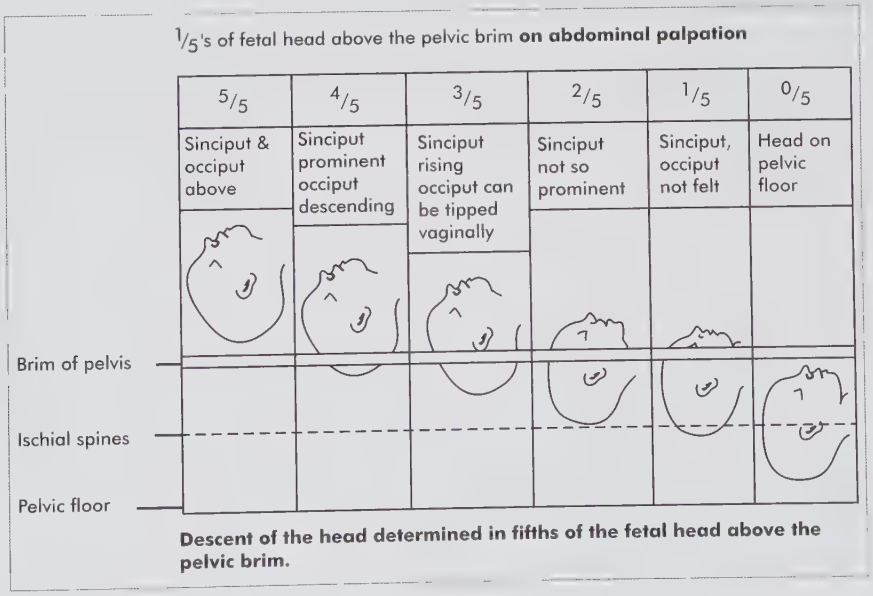


Figure 17.9 Engagement of the fetal head

At 36 weeks of pregnancy, there is a slight descent of the fetus in the uterus. This is known as lightening. The descent of the fetal head within the uterus is brought about by the increased pelvic vascularity causing softening of the cervix, and by the taking up of the cervical canal, due to the action of the Braxton-Hicks contractions.

In multiparous women who often have lax abdominal muscles, which are unable to give good support to the uterus, the fundus of the uterus usually settles slightly forwards when the woman is standing and the abdomen becomes more prominent. In these women, the fetal head seldom engages in the pelvis before the onset of labour.

- *Engagement of the presenting part*. In a longitudinal lie of the cephalic presentation, engagement of the fetal head takes place when the largest presenting diameter *and* the biparietal diameter have passed through the brim of the pelvis.

In a longitudinal lie an engaged breech occurs when the bitrochanteric diameter has passed through the pelvic brim, but this does not guarantee that the presenting diameters of the after-coming head will also be small enough to enter the pelvic brim.

Engagement of the fetal head is crucial to the delivery of the fetus, because unless these diameters have negotiated the pelvic brim, delivery cannot take place. The size of the fetal head (diameters), the presentation, the position, the moulding of the fetal head (with pliability and overriding of the fetal skull bones), together with the size of the pelvis, the degree of 'give' of the pelvic joints and the inclination of the pelvic brim, will all be factors in enabling the fetal head to engage. Once engagement has taken place, delivery is usually possible, but there are instances where problems can still arise in the mid-cavity and the outlet of the pelvis (see Chapter 8).

During abdominal palpation in the last few weeks of pregnancy, the midwife should check for engagement of the fetal head, especially in the primigravida or nulliparous woman, and if the head is not engaged, this should be recorded on the antenatal case notes. Non-engagement of the fetal head at term is important in white and Asian primigravid women, and could denote some cephalopelvic disproportion with possible prolonged and difficult labour. In black women however, it is not as significant, as a very much lower percentage of fetal heads are engaged before the onset of labour, possibly due to the shape of the pelvis. Nevertheless it should not be ignored.

Non-engagement of the fetal head

If the fetal head is found not to be engaged during palpation of the abdomen of the pregnant woman at term, a test should be done to determine if the head will engage temporarily in the pelvis. If the head does not appear to engage during this test, then the degree of overlap should be assessed by the Chassar Moir method and the woman should immediately be referred to a medical practitioner for the assessment of cephalopelvic disproportion. At the same time, the woman's records should be re-checked for any history of disproportion and/or for any disproportion found on pelvic assessment.

Causes of non-engagement of the fetal head

It is important to know the different causes of non-engagement of the fetal head in order to be able to make a correct assessment during abdominal palpation. These include:

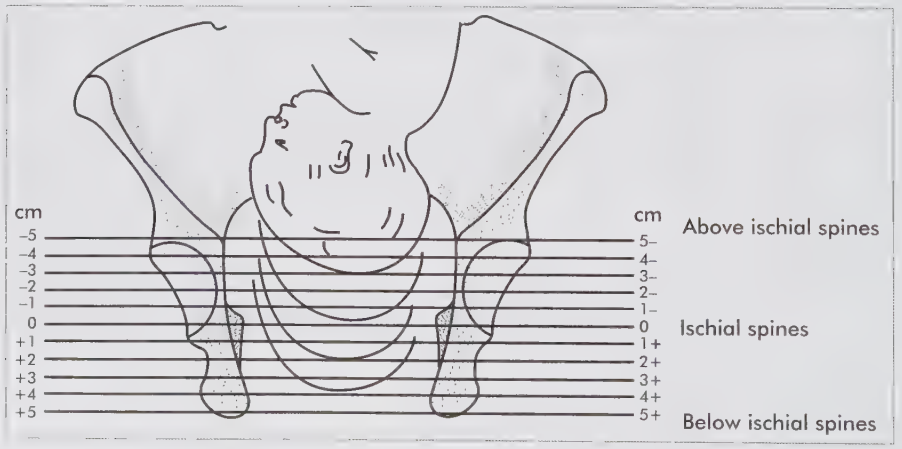


Figure 17.10 Station of presenting part on vaginal examination

- inaccurate calculation of EDD: the pregnancy is not as advanced as had been calculated
- full bladder: this may prevent the fetal head from entering the pelvis and therefore should be emptied before examination
- large presenting diameters: a deflexed head, brow presentation, a large baby, hydrocephalus
- contracted pelvis
- polyhydramnios
- multiple pregnancy
- breech presentation or transverse or oblique lie
- placenta praevia
- tumors or abnormalities of the uterus, ovaries or pelvic structures
- pendulous abdomen/anterior obliquity of the uterus
- unknown causes.

The station of the presenting part

The findings on abdominal palpation can be verified by vaginal examination. Usually the fetal head is engaged when the bony skull of the presenting part (not caput succedaneum) has reached the level of the ischial spines: station 0.

The descent of the presenting part within the pelvis (on vaginal examination) and in relation to the ischial spines, is known as *the station of the presenting part* (see Figure 17.10).

The abdominal examination – practical aspects

The abdominal examination described here is a guide to be used during pregnancy (after 28 weeks) at all subsequent antenatal examinations and also during labour.

This abdominal examination determines the relationship between the fetus and the uterus and pelvis (the positioning of the fetus within the mother's abdomen). It is patricularly important in ensuring the continuance of a normal pregnancy and labour. This examination is possibly the most important part of antenatal care, and is critical to determine the wellbeing of the mother, and growth and development of the fetus. Any abnormalities found during abdominal examination are referred to a medical practitioner at the earliest opportunity and the necessary adjustments made in time to prevent further and more serious problems.

The woman should empty her bladder before the abdominal examination is performed.

Abdominal examination is only possible when the woman is in the supine position (lying flat on her back), her arms at her sides and with *one or two pillows supporting her head*. Because of the problem of supine hypotensive syndrome, the examination should be done as quickly and efficiently as possible. The woman is asked to say if she feels faint, and she is then turned onto her side for a while and her blood pressure and the fetal heartbeat should be checked.

The bed linen or drapes should be adjusted so that the whole abdomen can be easily seen and palpated without undue exposure of the woman's body. The midwife stands on the right side of the woman, as for all procedures, unless the midwife is left handed.

The procedure is carried out in the following order:

- determine EDD and estimated gestational age (using the obstetric wheel or Naegele's rule)
- inspection
- assessment of the fundal height
- palpation
- auscultation of the fetal heart.

Inspection

The midwife must be very observant during inspection of the abdomen and the following features should be noted and any abnormalities recorded:

- skin changes are observed as they are objective/probable signs of pregnancy
- striae gravidarum: extensive distribution and deep pigmentation are related to excessive size of the abdomen and therefore to excessive stretching of the skin; old striae gravidarum would indicate a previous pregnancy
- linea alba and nigra
- rashes or skin lesions
- sores or any evidence of trauma, e.g. bruises, knife or gunshot wounds
- separation of the rectus abdominis muscles
- surgical scars on the abdomen: enquire about the reason for the operation/s and record.

The size of the abdomen. On inspection of the abdomen, a rough estimate can be made as to the period of gestation, at the same time bearing in mind the estimated date of delivery originally calculated.

Shape of the abdomen. The general contour of the abdomen is noted. An oval-shaped abdomen would indicate a longitudinal lie, with the fetus well flexed. A rounded abdomen would suggest polyhydramnios and/or multiple pregnancy. A narrow, elongated abdomen would suggest a frank breech (extended legs). A heart-shaped abdomen would suggest a bicornuate uterus. This would be substantiated on

palpation, by finding an unusual bulge in one or other side of the abdomen, or by finding an oblique lie of the fetus. An abdomen that is wider than it is long would suggest a transverse lie. A very flabby and shapeless abdomen would suggest grande multiparity. A saucer-shaped depression in the centre of the abdomen near term, may indicate that the fetal back is lying posteriorly in the mother's abdominal cavity (occipitoposterior position). The depression would coincide with the space between the upper and the lower fetal limbs.

Fetal movement. The observation of fetal movement indicates the side of the small part and is positive affirmation that the fetus is well.

Abdominal palpation

Step 1. Assessment of fundal height. All the measurements taken will only apply if the lie of the fetus is longitudinal. Figure 17.1 and 17.2 illustrates abdominal assessment strategies. Measuring with the hand is useful until 20 weeks and after 35 weeks. The tape measure method is only accurate between 20–35 weeks. These measurements are taken with the woman lying in the supine position and are as follows:

- *12 weeks*: Just above the symphysis pubis.
- *16 weeks*: Half-way between the upper border of the symphysis pubis and the lower border of the umbilicus. Quickening or fetal movements can now be felt by the mother.
- *20 weeks*. The lower border of the umbilicus. Fetal parts and fetal movements can be felt on palpation. The fetal heartbeat can be heard on auscultation (without the Sonicaid).
- *22 weeks*. The centre of the umbilicus.
- *24 weeks*. The upper border of the umbilicus.
- *30 weeks*. Half-way between the upper border of the umbilicus and the lower border of the xiphisternum.
- *36 weeks*. The lower border of the xiphisternum.
- *38 weeks to the onset of labour*. As the uterine ligaments and the pelvic viscera become more vascular and soften, and due to ripening of the cervix and partial effacement of the cervical canal, the presenting part descends and may even pass through the pelvic brim (inlet) into the pelvic cavity, causing the height of the fundus to drop about 2 fingers' breadth and to remain at the level at which it was at about 32–34 weeks. This is known as lightening.
- *Lightening*. This usually takes place in primigravidae, but may occur in multigravidae with tight abdominal muscles. With lax abdominal muscles the height of the fundus, with the woman lying on her back, remains near the xiphisternum until term. Where the abdominal muscles are extremely lax, the fundus of the uterus may fall forward between the rectus abdominis muscles, when the woman is standing upright. This is called anterior obliquity of the uterus or a pendulous abdomen.

Measuring the height of fundus of the uterus can give an indication of fetal growth. If the height of the fundus increases too rapidly, the cause could be hydatidiform mole, multiple pregnancy, polyhydramnios or fibroids. Should the height of the fundus not increase with the progress of pregnancy, this could be an indication of transverse lie of the fetus or of intrauterine growth retardation or of fetal death.

An alternative way to assess fundal height is the SFH measure. The plotline of serial measurements on the antenatal card (see Figures 17.3 and 17.4) will indicate abnormalities. The SFH measure is only valid when used in between 20–35 weeks (see Figure 17.2)

The palpation should be carried out methodically as set out further in the text and should always begin with the palpation of the lower uterine pole. This is because the head of the fetus is the part that is most easily distinguished on palpation and because it is the presentation in over 90% of pregnant women. In addition, the abdominal and uterine muscles tense up with continued handling, especially in the lower abdomen, making it more difficult to distinguish the fetal parts later in the palpation. Once the head has been established as being the part of the fetus lying over the pelvic brim, the lie will be established as cephalic and longitudinal.

The findings at history taking, on inspection and on assessment of the fundal height, must be related to the findings on palpation. Obesity and/or an excessive amount of liquor will make the palpation more difficult. Palpation as a diagnostic means is of great value, but is not infallible, and if any doubt exists, then a medical practitioner should be informed and further tests, such as an ultrasound, should be utilised.

Step 2 What is in the pelvis? The first step is to find out what part of the fetus is in the pelvis using Pawlik's grip or manoeuvre (pelvic grip I) (see Figure 17.11). The midwife stands on the woman's right side, facing the woman's abdomen. The right hand is placed slowly and gently over the lower part of the uterus, just above the symphysis pubis, with the fingers on the left and the thumb on the right of the woman's abdomen.



Figure 17.11 Pawlik's grip (What part of the fetus is presenting?)



Figure 17.12 Combined grip: fundal palpation and Pawlik's grip (What is in the fundus?)

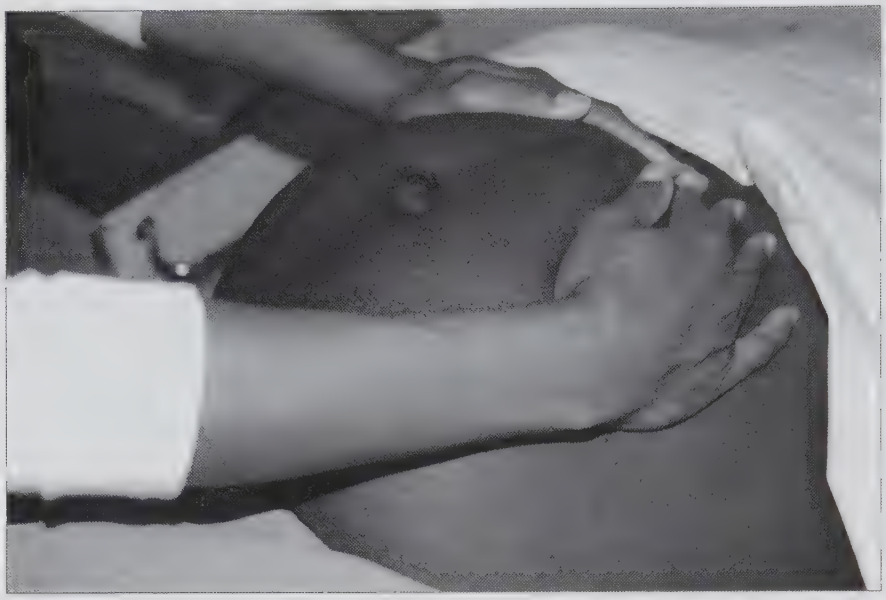


Figure 17.13 Bimanual fundal palpation (How many poles in the fundus?)



Figure 17.14 Lateral uterine palpation (Where is the back and the small parts?)



Figure 17.15 'Walking' the fingertips over the abdomen (Where are the small parts?)



Figure 17.16 Deep pelvic palpation (Level of engagement or descent)

The space between the index finger and the thumb is stretched to its maximum and the lower pole of the uterus is gently grasped between the fingers and the thumb. The left hand is placed on the fundus to steady the uterus. The pads of the thumb and mainly the middle finger are used to determine which part of the fetus is lying over the pelvic brim, and are used to feel and scan the presentation. It is important that no roughness, force or pressure is used in abdominal palpation as this will cause the woman pain and distress. The woman can be asked to bend her legs slightly to relieve the pressure on the ligaments.

The head will feel hard and round and if it has not entered the pelvic brim, it will be mobile and ballotable. Ballotement is the rebound or 'bounce back' of the fetal head when it is given a slight tap by the fingers or thumb, and a slight impact is then felt when the head floats back in the liquor to its original position. The head will be found to move independently from the body. The size of the head is assessed as to whether it is appropriate for gestational age or not. (The fetal head can be felt and identified from 30 weeks as it is ossified.)

The head has a characteristic feel, which will become familiar with experience. The thumb and middle finger explore the head in order to define the occiput on the one side and the sinciput on the other side and also to determine which one is the most prominent part of the head. In the well-flexed vertex presentation the most prominent part of the head will be the sinciput, which should be higher in the abdomen than the occiput in relation to the pelvic brim and, on lateral palpation, is found to be on the opposite side to that of the fetal back. In a deflexed vertex presentation, the occiput would be the cephalic prominence and would be more or less on the same plane as the sinciput and would also be on the same side as the fetal back. These findings, therefore, help to determine both presentation and attitude.

In a vertex presentation, the detection of the occiput (the denominator), will also help to determine the position of the fetus in relation to the brim of the pelvis. However, if the fetus is lying in a posterior position, the occiput will be difficult to feel and the location of fetal limbs on both sides of the midline of the uterus during palpation may help to determine position.

In a complete breech presentation, the mass in the lower uterine segment would feel bulky and the consistency would be less hard than that of the head. The mass would not be ballottable and would be less mobile than the head. In a frank breech, the mass in the lower segment would feel more like a head than would the complete breech, or may give the impression of shoulders at the pelvic brim when the head is deeply engaged.

In a transverse lie, the lower segment is difficult to grip and gives the impression of no part of the fetus being present in the lower uterine pole.

The next step is to ascertain which part of the fetus lies in the fundus of the uterus and in this way to also verify the findings made during Pawlik's manoeuvre.

Step 3 What is in the fundus? (See Figure 17.12.) There are two ways in which the fundus can be palpated, and it is as well to use both of these when doing a routine palpation, so you can be more certain of the findings. Fundal palpation is carried out in combination with Pawlik's grip (combined grip) in the following way. The right hand steadies the lower pole of the uterus with Pawlik's grip, while the left hand is spread widely over the highest part of the uterus, with the fingers on the mother's left and the thumb on the mother's right side.

In this way, a simultaneous comparison is made of what is in the lower and the upper uterine segments and this is more likely to lead to a correct diagnosis of lie and presentation. When the mass in the fundus is moved, the whole fetal body will also move. If these are the findings, then the diagnosis of a head in the lower uterine segment will probably be correct.

If the head is in the fundus, it is harder and rounder than the breech, but the landmarks may be more difficult to distinguish, especially if limbs are in the way. The head is more mobile and ballottable than the breech, unless it has become tucked up beneath the mother's ribs. If no head can be demonstrated, then it may be because it has become tucked up under the mother's ribs or it may be an abnormal fetus. If the head is in the fundus, the woman complains of greater discomfort and tenderness in the fundal region than is usual.

In a transverse lie, the mass in the fundus of the uterus may be either too large to grasp, when it is the fetal back, or there may be an indentation at the fundus if the limbs are situated there, which is the demarcation or indentation between the upper and lower limbs.

The next manoeuvre is a bimanual examination (see Figure 17.13) – using two hands on the fundus. The midwife turns the upper part of his/her body towards the woman's face. A hand is placed on either side of the fundus of the uterus with the fingers almost touching at the tips. In this technique, the whole hand is used to palpate the uterus but slightly more pressure is exerted by the palmar surfaces of the fingers in order to scan the fetal outline. The hands are then moved gently all over the fundus of the uterus in order to verify previous findings or to try to make out what is in the fundus when there is doubt about the presenting part. Fetal limbs and feet may be felt and this will help to verify that the breech is in the fundus; these will also be felt on the opposite side of the abdomen to the fetal back. It may also be that there are two poles in the fundus indicating twins.

Step 4 Where are the back and the small parts? The lateral grip and 'walking' manoeuver is used to locate the fetal back, and in a vertex and a breech presentation this will confirm the position of the fetus. It is a continuation of the bimanual palpation of the fundus and the hands are moved to half way down the uterus on either side of the mother's abdomen. Use both hands to ballot the fetus to feel which side gives the most resistance. Use the palms of the hands, together with the palmar surfaces of the fingers. One hand is used to steady that side of the uterus, while the other hand scans the opposite side and the procedure is then reversed (See Figure 17.14).

The pads of the fingers are then used to 'walk' over the abdomen in order to locate the limbs and the anterior shoulder or, in the case of a breech presentation, the anterior buttock. The side where small parts can be felt is less solid and has less resistance. When this has been completed, the whole of the uterus will have been palpated. With lateral uterine palpation, the fetal back should have been located, either by direct palpation, or by deduction. If only fetal limbs have been felt on one side of the uterus, then it can be deduced that the fetal back is on the opposite side to that of the limbs in an anterior position. When the fetus is in a posterior position fetal small parts can be felt on both sides of the uterine midline and the back is low in the flanks (see Figure 17.15).

In a vertex presentation, the back of the fetus should be on the same vertical plane as the occiput. Therefore, locating the fetal back will help to verify the position of the occiput in relation to the pelvic brim, found on Pawlik's manoeuvre.

Step 5 Method to determine the level of descent of the fetal head or presenting part. The deep pelvic palpation is used in late pregnancy or during labour when the head is entering or has entered the pelvic brim, but it can be useful at any stage when additional information is required regarding the cephalopelvic relationship. It is of great value in verifying which part of the fetus lies at the pelvic brim. It also helps to determine the degree of descent of the fetal head, whether the fetal head is deeply engaged or not, and if there is any cephalopelvic disproportion.

The midwife turns the upper portion of his/her body towards the woman's legs and places his/her hands one on either side of the lower pole of the uterus, with the fingers just above the pelvic crests on either side. The right hand is placed on the right side and the left hand on the left side of the woman's abdomen. When the back has been identified, one hand follows the back. The occiput should then be lower in the pelvis if the head is in good flexion and the sinciput should be higher in the pelvis. The palm of each hand encircles the lower, outer part of the uterus on either side at the level of the umbilicus, and the pads and the tips of the fingers are moved downwards to explore the area just above and just within the pelvic brim. This exploration can be uncomfortable and even a little painful for the woman and therefore, before proceeding with this manoeuvre, the woman should be asked to bend her knees slightly and to breathe deeply in order to relax her abdominal muscles (see Figure 17.16).

The findings should coincide with the assessment made during Pawlik's manoeuvre, but they could also help to clarify uncertainties and to add additional information.

Deep pelvic palpation is also used to determine the attitude of the fetus, in deflexion, brow or face presentation.

Descent of the head is determined in fifths of the head above the pelvic brim (see Figure 17.9).

These fifths also coincide more or less with the width of an average hand at the level of the proximal phalanges; that is, at the upper parts of the four fingers and the top of the thumb (five fingers). The numbers of finger widths of head that are measured above the brim can, therefore, be used to roughly calculate the numbers of fifths of head above the pelvic brim.

When both the parietal eminences have passed through the brim of the pelvis, the head is engaged, which means that the *widest circumference* of the head has negotiated the pelvic brim and the remainder of the head will have no trouble in following. When two-fifths of the head have entered the pelvic brim, the parietal eminences will be at the brim and the head will definitely be engaged when three-fifths have passed through. This means that when two-fifths of the fetal head remain above the pelvic brim, the head can positively be assessed as being engaged.

When the head is deeply engaged (no-fifths above the pelvic brim) and cannot be felt on abdominal palpation, the tips of the fingers are pressed down into the pelvis during deep pelvic palpation and with an extra slight tap of the fingertips, the hard head may be felt. The woman should be warned of this beforehand and asked to breathe deeply, and to relax and breathe out as the fingers are pressed into the pelvis.

A vaginal examination is performed, if the woman is in labour, to confirm what has been detected by abdominal palpation, such as the presentation and position of the fetus, and the engagement and station of the fetal head.

Auscultation

Fetal heart. (See *Juta's Clinical Guide for Midwives* for further details.)

The fetal heart can be heard from 20 weeks of gestation if the Pinard's stethoscope is used, or from 14 weeks if ultrasonic fetal pulse detectors are available (Doppler ultrasound).

Hearing the fetal heart with a Pinard stethoscope is a skill that needs to be developed through experience.



Figure 17.17 Auscultation of the fetal heartbeat with Pinard's stethoscope

It is useful to know the position of the fetus because you then know where to find the fetal heart. When the Pinard's stethoscope is used, the ear must be firmly pressed to the flat ear-piece, while the wider end of the tube is pressed firmly and at right angles to the abdomen at the point of contact, approximately where the shoulder of the fetus is palpated. The hand must then be removed and no other object should come into contact with the stethoscope. The fetal heartbeat has a soft but precise, rapid, double beat, almost like the ticking of a watch. The normal rate of the fetal heartbeat is between 120 and 160 beats per minute, usually about 140 beats per minute (see Figure 17.17).

When ultrasonic fetal detectors are used, the transducer should be smeared with a recommended contact jelly and then placed so that it is flush against the abdominal wall, so enabling the fetal heart pulse to be transmitted through the loudspeaker (see Figure 17.18).

In the anterior position the fetal heart is heard through the posterior thorax of the fetus. In a posterior position, the fetal heartbeat may be heard on the opposite side of the abdomen to that of the fetal back, but as the sound will be transmitted through the amniotic fluid, it will be a more muffled sound and can be heard on the umbilicus.

Hearing the fetal heart is a positive sign of pregnancy and also indicates that the fetus is alive. As a principle the fetal heart is compared simultaneously with the maternal pulse rate. In multiple pregnancy, an attempt should be made to auscultate and count each fetal heart simultaneously. There should be a difference of at least 10 beats between heart beats of twins. The fetal heart can be used as a diagnostic tool to confirm fetal position.

Funic souffle. This is a high-pitched but muffled sound, which is occasionally heard and which synchronises with the fetal heart rate. The pulsating umbilical cord is heard.

Uterine souffle. This is a muffled sound that is heard strongly, but the beat corresponds with maternal pulse. The placental souffle is the sound of the uterine arteries and placental blood flow. If the placenta is implanted anteriorly in the uterus it may hide the fetal heart. It is vital that the midwife only records factual and accurate fetal heartbeat data.

17.4 Fetal health, growth and wellbeing

One of the aims of antenatal care is to monitor the wellbeing of the fetus *in utero*.

The fetus and placenta are one, that is the fetoplacental unit. An embryo divides from two cells to 64 in one week. After four weeks it is 500 cells, then there is a 40-times increase in cells in four days (4 000% at 15 days).

At eight weeks all major organs are formed, the heart beats and ovae are formed in the female ovaries. By 20 weeks

organogenesis is completed. The last structural change is the palate, which closes at 20 weeks. From here the organs must mature. The lungs are not able to function independently by 28 weeks because they lack surfactant and collapse on exhaling. The last trimester is the period of fastest growth. The fetus gains 200–250 g/week or 10% per week. This is the same mass the fetus will gain after birth per week (see Chapter 7).

Most of the measurements of fetal growth and development are indirect and subject to misinterpretation and error. Problems that may lead to inaccurate monitoring are late booking, inconsistent clinic attendance and change of staff. Serial measurements allow for the detection of deviations. This includes maternal weight gain, volume of amniotic fluid, fetal movement (kick chart), uterine enlargement, SFH measurements between 20–36 weeks and feeling the fetal parts on abdominal palpation after 28 weeks. Placental function tests and cardiotocograph tests are also indirect measures of fetal wellbeing.

Fetal wellbeing, growth and development can be done by serial ultrasound assessments, biophysical profile and Doppler studies.

The wellbeing of the fetus is linked to the wellbeing of the mother. Any disease or infection of the mother will put the baby at risk.

Maternal weight gain

Overall, women should gain 8–12 kg mass in pregnancy. (See Chapter 52, Nutrition.)

In addition women's nutritional status can be determined by MUAC measurements. A diameter of ≤ 23 cm suggests that the fetus is at risk. The most important period for mass gain is the third trimester.

SFH measures

The SF measurements taken between 20–36 weeks must show constant growth of the uterus that correlates with all the other parameters, the LMP, EDD and ultrasound.

Abdominal palpation

Abdominal palpation can determine the size of the fetus, the number of fetuses in the uterus, fetal parts and the amniotic fluid. Fetal movement and the fetal heart rate are important aspects of fetal wellbeing.

Fetal movements

Fetal movements are one of the reliable signs of fetal wellbeing and are subjective. Mothers are taught to observe the fetal movements and to report on the movements with each visit. A simple method is 'count to ten'. From 26 weeks a woman is asked to start counting fetal movements daily. If she reaches 10 she can stop counting for the day. If there are not 10 movements in 24 hours she needs to report to the clinic or maternity section. Fetal movements are also one of the criteria in the non-stress test (NST) and the biophysical profile and indicate neurological wellbeing of the fetus.

Non-stress test (NST)

(See Figure 17.18.) The non-stress test is a useful non-invasive method to indirectly determine fetal wellbeing *in utero*. It requires expensive technology (cardiotocograph) and a skilled midwife. The test is usually performed after 28 weeks in cases that are suspect. Before 28 weeks the fetus is not sufficiently developed to respond to the test protocols, and the fetal heart rate of preterm fetuses is tachycardic and flat. The woman should be in a semi-Fowler's position or on her left side during the test. Her blood pressure is taken during the test to exclude the IVC effects. The woman should have had something to eat or drink prior to the test and her bladder should be empty. The midwife should take observations over 20 minutes. Make sure that both the transducer for the fetal heart and the probe for the uterine contractions are attached and working. The speed of the paper can be set at three. Explain to the woman that she needs to press a button that will make a mark on the tracing paper every time she feels the baby move. The cardiotocograph is then interpreted by an experienced midwife.

Prerequisites are:

- the blood pressure must be stable throughout the test
- the tracing must be clear for both the fetal heart and uterine activity
- the fetal movements should be indicated
- no contractions must be present.

A non-stress test requires conditions of 'no stress', thus no contractions. The presence of contractions must be eliminated by monitoring uterine activity. The presence of fetal movements and the reaction of the fetal movements are crucial in the interpretation of the test.

Findings can be categorised as:

- reactive or reassuring: two movements with acceleration in 20 minutes
- non-reactive or non-reassuring or suspect: no movements or movements with no accelerations in 20 minutes.

If the test is non-reactive or suspect it can be repeated because the fetus might have been asleep. A fetus has a sleep-wake cycle of 20 minutes *in utero* so sleeps for 20 minutes and then is awake for 20 minutes.

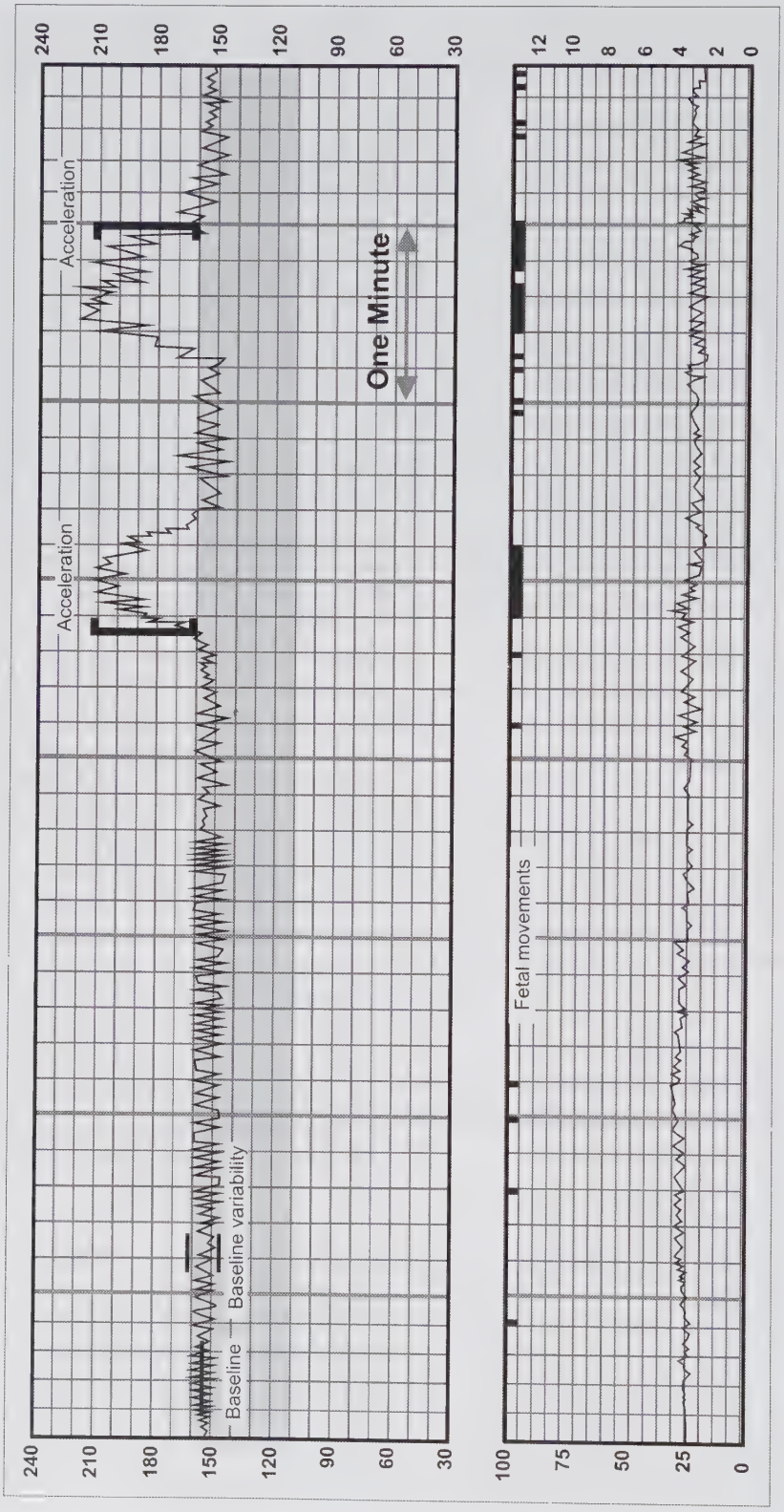


Figure 17.18 Non-stress fetal heart rate patterns

Table 17.4

Biophysical profile

Biophysical parameter	Normal score = 2	Abnormal score = 0
Non-stress test	Reactive pattern: at least 2 FHR accelerations of > 15 BPM and > 15 seconds in duration, associated with fetal movement in a 20 minute period.	Non-reactive pattern: < 2 FHR accelerations of > 15 BPM and 15 seconds duration associated with fetal movement in 40 minutes.
Fetal breathing movements	Present: Presence of at least 1 episode of fetal breathing of > 60 seconds duration within a 30 minute period of observation.	Absent: Absence of fetal breathing movements or the absence of an episode of fetal breathing of 60 seconds duration during a 30 min period.
Gross fetal body movement	Presence of at least 3 discrete episodes of fetal movement within a 30 minute period. Simultaneous limb and trunk movements are counted as a single movement.	Two or fewer movements in 30 minutes.
Fetal tone	Upper and lower extremities in full flexion. Trunk in position of flexion and head flexed on chest. At least one episode of extension of limb with return to position of flexion or extension of spine with return to flexion.	Decreased: limbs in position of extension or partial flexion. Spine in extension. Fetal movement not followed by return to flexion. Fetal hand open.
Volume of amniotic fluid	Fluid evident throughout the uterine cavity. Largest pocket of fluid >1 cm in vertical diameter.	Decreased: Fluid absent in most areas of uterine cavity. Largest pocket of fluid measures <1 cm on vertical diameter.
Normal 8–10	**Equivocal 4–6**	**Abnormal 0–2**

If there is a abnormal pattern or fetal movements with deceleration the woman is referred for medical care.

The cardiotocograph test is a legal document. It should be clearly marked with the patient's details, the findings and actions taken should be documented and filed.

Under normal circumstances in a 'non-stress' situation (no contractions) the fetus will have an increased heartbeat with fetal movement or external stimulation. If this is not present the woman is admitted or referred. The full NST interpretation is given in *Juta's Clinical Guide for Midwives*.

Biophysical profile

This is a non-invasive test that can only be performed by a skilled medical practitioner or a midwife trained in sonography. It is time consuming and can easily take 45 minutes (excluding the NST).

A fetus with an abnormal biophysical profile will be referred for Doppler studies (see Table 17.4).

Doppler ultrasound

The Doppler studies are done with ultrasound. This is the observation of the umbilical artery and the rate of blood flow, which indicates if the blood flow from the placenta to the fetus is sufficient. If the umbilical artery resistance is below the 95th centile placental insufficiency is unlikely. When placental insufficiency is present the diastolic blood pressure to the fetus drops and is shown by an increase in the resistance index in the umbilical artery to above the 95th centile. The implication is a malfunctioning placenta with decreased blood flow to the fetus. The cerebral flow and venous ductus arteriosis can show the redistribution of blood to safeguard organs.

Doppler ultrasound is a highly sophisticated procedure done only by specialists. Fetuses with non-reassuring NST, biophysical and Doppler Studies *in utero* are not likely to withstand the stress of labour.

Ultrasound

Ultrasound is sound waves. The frequency of ultrasound is 20 000 Hz (human hearing range is 20–20 000 Hz).

Table 17.5

Ultrasound in obstetrics

Period	1st trimester	2nd trimester	3rd trimester	Postpartum	Other
Use of ultrasound	Diagnosis of pregnancy Duration of pregnancy Determination of threatening abortion Diagnosis of ectopic pregnancy Hydatidiform mole Ovarian mass Multiple pregnancy	Fetal abnormalities Fetal growth and development Cervical incompetence Position of the placenta	Placental localisation and maturity Fetal position Amniotic fluid Biophysical profile	Haematoma Neonatal complications Brain haemorrhage	Chordiocentesis Fetal Doppler studies Amniocentesis
Observation	Volume of amniotic sac 9 days Crown-breech length 3–5 days Femur length 6–9 days Fetal head 6–9 days Abortion Sac must be attached to the uterine wall with fetal heart heard Blighted ovum: 3 cm sac with no embryo Hydatidiform mole: snow appearance	Serial measures are required Biparietal, after 34 weeks 1 mm/week femur length, abdominal circumference Mass 18 weeks: 95% of congenital abnormalities can be diagnosed Structural umbilical arteries Neural tube Anencephaly Hydrocephalic Spina bifida Encephalocele Microcephaly Palate and lip Heart Skeletal Gastro-intestinal Cordially, Urinary system Genitalia Tumors	Placental Maturity: 4 grades. 0 = homogenic 1= proliferation maternal side 2 = small spaces in placenta 3 = proliferation and calcification 4 = lobule appearance Level 4 + lung maturity	Retained products of conception Haematoma Congenital abnormalities and fetal brain haemorrhage can be detected	Amniocentesis: localisation of placenta and cord Amniotic pool identified
Error margin	1st trimester + 1 week	+ 2 weeks	+ 3 weeks		

Ultrasound uses a transducer that produces sound waves that can penetrate liquid. The transducer is connected with the skin through contact gel and penetrates through an area of liquid in the womb and reflects back a real time image of the structure of the fetus and its organs.

The indications for the use of diagnostic ultrasound in obstetrics are shown in Table 17.5.

The margin of error in interpreting ultrasound increases as the pregnancy progresses. In the third trimester estimations can vary within three weeks if not compared with other parameters. Gestational age estimations are more accurate when done before 20 weeks. The position of the placenta and fetal abnormalities can be detected accurately at any time.

Intrauterine fetal growth restriction (IUGR)

Preterm and small for gestational age infants are one of the major causes of perinatal deaths. Those who survive may have life-long problems as a result of poor development *in utero*, including cerebral palsy and neurological defects and learning disabilities. This condition should be detected early in pregnancy and appropriate interventions put in place.

Definition

Intrauterine growth restriction (IUGR) refers to a fetus whose estimated weight is below the 10th percentile, *in utero* or at birth.

Classification

Intrauterine growth restriction can be classified as:

- *Symmetric IUGR.* Symmetric growth restriction refers to a fetus whose body is proportionally small, i.e. there is symmetrical reduction of the fetal body and head because the restriction started early in the second trimester, possibly due to fetal chromosomal disorders
- *Asymmetrical IUGR.* This refers to a fetus who is undernourished and is directing most of its energy to maintaining growth of vital organs, such as the brain and the heart, at the expense of the liver, muscle and fat, i.e. the condition started in the late second and third trimesters and is usually due to placental insufficiency. The body is thin but the growth of the head is according to norms for the gestational age.

Indicator

The most sensitive sign of both types of IUGR is a fetal abdominal circumference below the 25th percentile on ultrasound.

Diagnosis

History. A detailed history is done, looking for high-risk factors such as:

- *Fetal.* Perinatal infections and congenital abnormalities.
- *Maternal.* Smoking, nutrition and physical exercise and manual labour or maternal disease.
- *Placental.* Maternal hypertension, auto-immune disease (lupus) and vascular disease or diabetes mellitis.

Ultrasound and biometry. The measurements most commonly used are:

- biparietal diameter
- head circumference
- abdominal circumference
- femur length.

NB: This should be performed not later than 20 weeks, ideally at 8 and 13 weeks as it is only accurate during this time. Do not make the error of changing the patient's due date based on third trimester ultrasound. Serial measures are done for comparison.

Assessment of potential problems in labour

This involves assessment of fetal wellbeing with a combination of the NST and the following parameters:

- Doppler ultrasound
- maternal weight gain.

A meticulous record of maternal weight gain or mid-upper arm circumference is essential. The normal MUAC is 23–33 cm.

The early detection and identification of growth restriction is an important function and competency of midwives. Referral to a higher level of care is needed for more sophisticated care.

Factors that suggest problems in labour:

- previous stillbirth
- previous perinatal deaths
- poor weight gain
- poor abdominal growth (SFH)
- reduced fetal movement
- non-reassuring NST.

Pelvimetry

(See *Juta's Clinical Guide for Midwives* for further details.)

It is difficult to know if the pelvis is adequate for birth until labour starts. Clinical pelvimetry is the clinical assessment of a pelvis to determine if it is adequate for birth.

Differences in pelvises also affect the outcome of labour. A pelvic inlet may be adequate but have a narrowing in the midpelvis or outlet. In most women, the size of the pelvis is adequate for the safe passage of an average-sized fetus.

However, if the pelvis is contracted in any way and/or if the fetus is over-sized, then difficulties must be anticipated and the woman referred to a medical practitioner as soon as possible. The fetal head may have difficulty negotiating the pelvic brim (see Figures 17.9 and 17.10), and/or the difficulties may occur in the pelvic cavity (mid-pelvis) and/or at the outlet.

In order to be able to recognise an abnormal pelvis, the measurements of an average pelvis must be known and the pelvis of each woman should be assessed and recorded, as this would help the midwife to recognise cephalopelvic disproportion. The size of the fetus must also be assessed, because a large baby may well have difficulty negotiating an average-sized pelvis, while a small baby may quite easily negotiate a slightly contracted pelvis. Radiography in the from of X-ray and CAT scan pelvimetry is the most accurate way to assess the pelvis, but because of the dangers of radiation to the mother and the fetus, this is seldom used.

Ultrasonography can be used to estimate the size of the fetal head and the fetal weight.

Clinical assessment of the pelvis

In most instances, an assessment of the pelvis is made when a vaginal examination has to be done, so that the woman need only undergo one, instead of two internal examinations.

The pelvis can be assessed at 36 weeks so that the woman can be referred for admission if necessary. If there is possible cephalopelvic disproportion in any pregnant woman near term or in labour the midwife must do a pelvic assessment.

It is very important that the woman is prepared for the internal examination and the procedure explained beforehand.

Indications

Reasons for performing a pelvic assessment at 36–38 weeks:

- The hormone relaxin is present, which softens and relaxes joints, ligaments and floor muscles.
- The presenting part has started to enter the pelvis.
- The fetal head is almost the size it will be at delivery.

Aims of a pelvic assessment are:

- to detect any abnormalities of the bony pelvis
- to measure the diameters of the pelvis
- where possible, to prevent complications such as obstructed labour, uterine rupture and fetal distress or death
- to predict the mode of delivery
- to decide upon the place of delivery.

The prerequisites for performing a pelvic assessment:

- This procedure is performed using an aseptic technique.
- Know the concise history of the patient.
- Explain the procedure and reassure the patient.
- Collect the necessary equipment.
- Make sure the bladder is empty.
- Perform an abdominal palpation.
- Provide maximum privacy.

The position of the patient will be either lithotomy or dorsal position with flexed legs and thighs.

Method

(See Figure 17.19.) The midwife or medical practitioner should know the measurements of his/her hand, as the hand becomes the tool for assessment.

Knowledge of the normal measurement of the pelvis is important.

Step 1 Estimate the pelvic inlet. The diagonal conjugate extends from the inferior margin of the symphysis pubis to the centre of the sacral promontory and should measure 12.5 cm.

The index and first fingers, vertically side by side, are gently introduced into the vaginal orifice, first, in a downward and backward direction and then in an upward and backward direction. The tip of the middle finger then feels for the centre of the sacral promontory. The site where the bottom of the pubic arch meets the hand is marked or noted.

The distance from the tip of the middle finger to the point where the thumb meets the hand should have been measured and memorised beforehand. If the hand measurement is less than 12.5 cm, the sacral promontory should not have been reached in an average-sized pelvis.

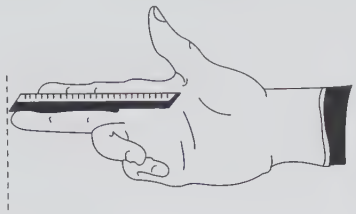
If the examiner has very small hands, measuring the diagonal conjugate is of little value, unless the sacral promontory is reached, which would then signify a contracted antero-posterior diameter of the pelvic brim (as would any measurement of less than 12.5 cm).

The obstetrical conjugate of the pelvic brim can be calculated by subtracting 1.5 cm from the diagonal conjugate, for example: 12.5 – 1.5 cm = 11 cm

The pelvis is considered to be mildly contracted if any diameter is reduced by 1 cm, moderately contracted if reduced by 1–2 cm and severely contracted if reduced by 2 cm or more.

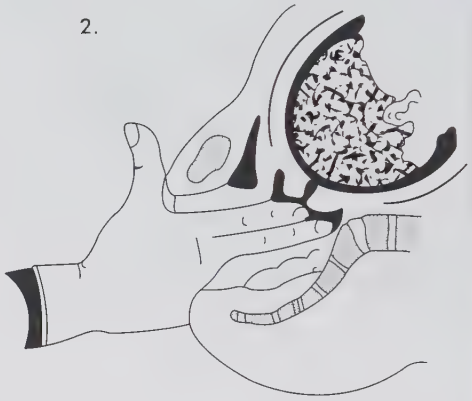
The diagonal conjugate cannot be measured if the presenting part has entered the brim of the pelvis.

1.



Measuring the length of the 3rd finger.

2.



Attempting to feel the promontory of the sacrum with the 3rd finger.

3.

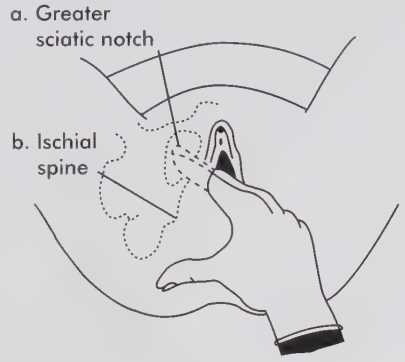


Feeling the mobility and prominence of the coccyx.

Figure 17. 19 Clinical pelvic assessment

continued

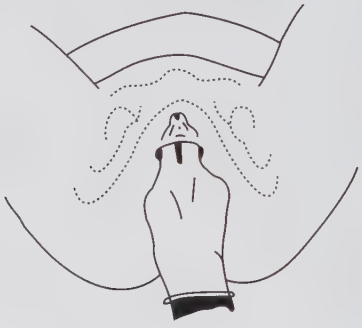
4.



a. Measuring the approximate size of the greater sciatic notches.

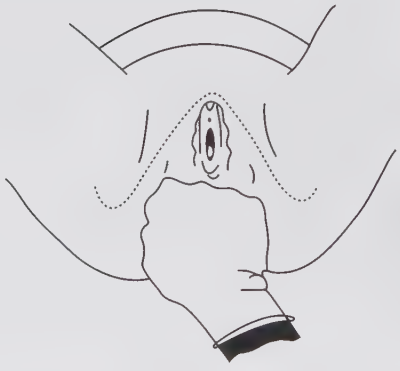
b. Noting the prominence of the ischial spines.

5.



Measuring the approximate angle of the sub-pubic arch.

6.



Measuring the approximate width of the ischial tuberosities.

Figure 17.19 Clinical pelvic assessment (continued)

Step 2 Determine if the sacrum is curved or flat. The tip of the middle finger is then run gently down the curve of the sacrum. The sacrum should be smooth and broad (15 cm), and should have a rounded concave curve. It should not be long, narrow or straight as this would indicate a narrowing of the pelvic cavity or canal.

The end of the coccyx is then gently pressed. The coccyx should be slightly mobile and not prominent. It should not be fixed, or projecting unduly into the anteroposterior diameter of the outlet of the pelvis, as this would indicate a narrowing of this diameter. (Prior to this, the woman must be warned that this is a painful procedure.)

Step 3 Determine the mid pelvic cavity size. Fit two fingers on the ligament between the sacrum and the ischial spines.

The greater sciatic arch on either side of the sacrum should admit at least two fingers on the ligament. The fingers are moved to the ischial spines. They should not be easily palpated, in other words, they should not be prominent in a normal gynaecoid pelvis. Prominent ischial spines can be the cause of delay or obstruction in the second stage of labour.

Step 4 Estimate the outlet. As the fingers are slowly removed, the width of the sub-pubic arch is estimated by turning the fingers horizontally and pressing them gently upwards, against the lower border of the arch. The arch should accommodate the two fingers and should have an angle of about 90°. If the angle is less than 80°, this indicates that the transverse diameter of the outlet is diminished and the head would have difficulty escaping from the pelvic outlet and would be directed posteriorly, causing trauma to the perineum.

The distance between the tuberosities is an indication of the shape of the pelvis. The bituberous or intertuborous diameter should admit a fist easily. This is a rough measurement only and if the width of the hand at the knuckles is able to fit comfortably between the ischial tuberosities, then the transverse diameter of the outlet is considered adequate. The average measurement is 10.5 cm.

17.6 Pelvic differences

Farrell in the MRC report (2005) indicated that Evans and Steyn (1950) found that pelvises of black woman are 20% smaller than white women, thus explaining the higher rate of CPD and caesarean section in black women (2005:15)

A competent midwife will assess this information in comparison with other clinical signs and symptoms and refer the woman with a borderline or obvious pelvic narrowing for a medical opinion or to a higher level of care. Observations of the woman in pregnancy and birth can include:

- presenting part that remains high
- premature rupture of membranes
- poor application of a presenting part
- unripe posterior cervix
- post dates
- caput moulding
- uterine malfunction
- prolonged labour.

17.5 Conclusion

The assessment, diagnosis and treatment of women in pregnancy requires knowledge, skill and competence from all healthcare professionals. While most women have uneventful pregnancies and births, a number of women will need intensive and specialised care. It is the task of the midwife to identify women with healthcare needs beyond the normal and refer them for appropriate care. This chapter considered the basic principles of assessment of a pregnant women and highlighted aspects that are the core function of a midwife. Some clinical procedures are included in *Juta's Clinical Guide for Midwives*.

CHAPTER

18 Childbirth education

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- explain evidence-based health education
- demonstrate competency in individual and group education in pregnancy
- identify common problems that affect exercise in pregnancy
- explain the general and specific principles of exercise in pregnancy
- know the important information that a midwife needs to provide to a woman in pregnancy.

KNOWLEDGE ASSUMED TO BE IN PLACE

Knowledge of the physiological changes and common problems of pregnancy

Principles of health education and presentation of a health talk

KEYWORDS

Childbirth education • Relaxation • Doulas • Significant person • Health literacy

18.1 Introduction

Preparation for parenthood and support during pregnancy and birth are very important along with specialist aspects in child birth education. All are important parts of a midwife's role and function. This preparation, support and education extends to the father and family where requested.

18.2 Childbirth education as specialist care

Childbirth education has become a speciality field in midwifery. Midwives can obtain a certificate in childbirth education. The International Childbirth Education Association (ICEA) has developed an accredited programme for childbirth educators to ensure evidence-based information and care for women during pregnancy and birth. South Africa is associated with the ICEA through the childbirth educators' resource group. Midwives and other professionals can join this group and complete a special programme in childbirth education.

Ideally midwives who are offering childbirth preparation, support and postnatal support services need to receive further training and education. The Department of Health, in collaboration with the Childbirth Education Resource Group, (CBERG), has declared a national pregnancy education week annually in February. In addition, CBERG conducts annual workshops countrywide to educate pregnant women and educators. A magazine called *Baby Talk* is available with information for health educators and an annual publication *The expectant mother's guide for South Africa* is available in retailers with the names of childbirth educators and other supportive services for pregnant women.

Table 18.1 gives a selection of categories of support groups available in South Africa. Full information can be obtained online at Babytalk, http://www.babytalk.co.za/.

These are useful resources for midwives and most of the services are free of charge.

18.1 Activity

Obtain a copy of *The expectant mother's guide*.

Visit the online journal *Babytalk* available at: http://www.babytalk.co.za/.

Visit the ICEA's free online journal for childbirth educators at www.icea.org or http://www.icea.org/content/journal-archives, and learn about childbirth education.

Table 18.1

Selected support groups available in South Africa

Abortion	Neo-Birth Pregnancy Crisis Centre (Free and confidential counselling on pre- and post-abortion, miscarriages and still births): http://www.neobirth.org.za/ Emergency number 084 740 5418
Adoption	Gift of Life: http://www.giftoflife.com/Adoption_SA.aspx Adoption South Africa: http://www.adoptionsa.co.za/ Adoption reconnect: http://adoptionreconnect.org Department of Social Services 021 483 5045
AIDS	AIDS helpline 0800012 322
Autism	Autism South Africa: http://www.autismsouthafrica.org/ 011 484 9909
Bereavement	Compassionate friends: http://compassionatefriends.org.za/ 011 440 6322
Breastfeeding	Le Leche League: http://www.llli.org/SouthAfrica.html Breastfeeding.com: http://www.breastfeeding.com/
Cerebral palsy	KnowCP: http://www.cerebralpalsy.org.za/ 041 583 2130
Child welfare	Child Welfare South Africa: http://www.childwelfaresa.org.za/ 0861 4CHILD 0861 424453
Cleft lip and palate	The South Africa Inherited Disorders Association: http://www.saida.org.za 011 489 9213
Cystic fibrosis	The South African Cystic Fibrosis Association: http://www.sacfa.org.za/main.asp 071 602 2966
Deafness	Deaf Federation of SA: http://www.sanda.org.za/about-sanda 011 331 6390
Down's syndrome	Down's Syndrome Association: http://www.downsyndrome.org.za/ 0861 – DOWNSA 0861-369672
Genetic counselling	University of the Witwatersrand: http://web.wits.ac.za/Academic/Health/Pathology/HumanGenetics/ResearchGroups/
Haemophilia	South African Haemophilia Association: http://www.haemophilia.org.za/
Marfan syndrome	South African Marfan Syndrome Association: http://www.marfan.org.za/
Multiple births	SAMBA (SA Multiple Birth Association): http://www.samultiplebirth.co.za/ 0861 432 432
Poison Information Centre	24 hours service (qualified personnel in the day). For the public seeking emergency advice on the treatment of poisoning. 021 931 6129
Postnatal Depression	Postnatal Depression Support Association Office: http://www.pndsa.org.za/ National help-line: 082 882 0072
Single Parenting	Single Parent Centre: http://www.singleparentcenter.net/single-parenting/single-parenting-in-south-africa.html

18.3 Health education as the role of the midwife

Midwives who are not accredited childbirth educators still have an obligation to give health education to all the pregnant women they encounter at all levels of care. If possible women are referred to structured antenatal and parenting classes that are accredited and in line with the philosophy of the hospital or institution. Women who have initiated their own care are supported and accommodated.

If no such services are available, institutions that care for women in pregnancy are obliged to develop and create supportive programmes for women before and after birth. These programmes must be evidence-based, supportive and meet the needs of women in the community.

Supportive programmes can take many forms:

- a structured programme for couples
- health literacy (a range of written pamphlets that help women to access all the forms of care available)
- call centres for postnatal support
- incorporation of midwives to supply breastfeeding support and care before, during and after birth
- online programmes (medical aid programmes and private clinics)
- special services (Stork nest in private clinics)
- alternatively women can use a private midwife who will provide one-to-one care.

When starting a childbirth preparation course, it would be ideal for the midwife to see the woman in a group of newly diagnosed pregnant women and also for the midwife to see the couple individually.

The midwife should try to give the highest standard of care at all times and should make sure that all the information he/she provides is evidence-based, accurate and not conflicting.

One of the main complaints of women of maternal healthcare is the conflicting advice they receive from various healthcare professionals. It is therefore important to have consensus in a given institution. Women feel more secure when they work with small teams. In many healthcare systems the 'know your midwife' campaign is geared to create conditions where midwives are allocated to specific women to support them in pregnancy. Ensure confidentiality and listen to the concerns and problems of women and their partners and give appropriate care and advice.

The educators should, where possible, make contact with all the healthcare workers, midwives, or medical practitioners concerned in order to keep lines of communication open and to ensure continuity of care. If independent, the midwife should also have a good relationship with all the hospitals or clinics in his/her area and, where possible, give support before and during the delivery.

The needs of the parents must be considered, bearing in mind their socio-economic, cultural and religious backgrounds, and the programme should be carefully structured to meet individual needs as far as possible.

The midwife should evaluate the woman's experiences of the programme at the end of each course. The midwife needs to keep herself well informed and up-to-date and to reassess the course at regular intervals and make changes if necessary.

18.2 Doulas

Doulas are trained lay people who support women in labour to relieve the burden of care of midwives and the healthcare system and to make the birth environment more supportive for women. Some public institutions use trained doulas in South Africa.

18.4 Ante- and postnatal exercises

People have known the value of physical exercises in the birth process and recovery after birth since 1912. Grantly Dick-Read's theory on the fear, tension and pain cycle in childbirth (1930) focused on relaxation in childbirth. In the 1950s psychoprohylaxis became popular in birth preparation and many methods were taught and used to prepare women for motherhood, including breathing and preparation for childbirth. All the psychoprohylactic and physical exercise preparations are combined today. Currently, each member of the multidisciplinary health team has a unique contribution towards preparation for childbirth. Physiotherapists and occupational therapists also provide help with physical exercises as well as child and family relations and development.

Physical fitness and health can be promoted through safe stretching and muscle-toning exercises for the demands of pregnancy, labour, breastfeeding, carrying the baby and parenthood.

Exercise and relaxation programmes are designed to:

- help women to adjust physically and psychologically to the stresses of childbirth
- advise on physical activity
- adapt work and leisure
- gain or maintain fitness
- give pelvic floor education
- prevent back problems

- teach relaxation and breathing
- teach healthy body posture.

The physiotherapist can, in addition, treat back problems and perform therapeutic ultrasound and laser treatment, particularly postpartum for wound care, perineal swelling and breast engorgement.

The midwife needs a thorough knowledge of the anatomy and physiology of pregnancy, the pelvis and the pelvic floor and the effects of pregnancy on the rectus abdomini, the levator ani and the perineum. He/she should understand the effects of hormones on the endocrine and cardiovascular systems, and the effects of the enlarged uterus on the lower extremities and back, and should be able to help the woman to have a more comfortable pregnancy.

More than 50% of women experience lower backache in pregnancy. The effect of relaxin on the ligaments, combined with weight gain, postural changes, multiparity and multiple pregnancies are causes of lower backache.

All pregnant women should be given advice on:

- wearing comfortable shoes with a low heel or no heel
- making sure that posture is correct, with lordosis minimised (See Figure 18.1)
- checking work surfaces and body mechanics
- contracting the abdominal muscles before changing position
- bending knees and rolling on her side with her knees together when getting up
- avoiding lifting heavy things, including other children
- sleeping with a pillow under the waist to support the back
- sitting in a supportive chair.

Posterior backache may develop due to pressure on the sacroiliac ligaments. Only 1% of women will have true sciatica. Advice includes:

- sleeping with a pillow between legs
- wearing a pelvic support girdle
- not sitting with crossed legs
- keeping the knees and shoulders in line
- not twisting the body.

Symphysis pubis dysfunction and discomfort occur in 1:800 women. There is a 35 mm relaxation between the pubic bones in pregnancy. When the pubis is unstable the gait is affected and the pain is worse when standing on one leg.

Advise women with symptoms to:

- Rest as much as possible.
- Avoid weight-bearing exercises, climbing stairs.
- Keep knees together when getting out of bed.
- Avoid squatting.
- Deliver the baby in the side-lying position.

Diastasis recti is a condition where the rectus abdominis muscles separate or herniate by more than 2.5 cm, sometimes 10 cm (largest 23 cm) in late pregnancy. There is a 66% incidence in cases of constant backache. The separation of the muscles is clearly visible on abdominal examination and when a woman is asked to lift her head in the supine position two columns of muscle are visible on the side of the uterus and in severe cases the uterus and baby are felt very clearly because the muscle is pulled away. Advise women to:

- avoid curl ups
- when sitting up from a lying position, the woman should support the abdomen, bend the legs and turn on the side first and then get up
- when the woman is in the supine position she must always bend her legs and tilt to the side to relieve strain on the back and abdomen and to prevent the inferior vena cava syndrome
- a gap of 3–4 cm will resolve over a week postnatally, larger gaps may still be present at 12 weeks or until six months or may need surgical intervention.

Pregnancy-associated osteoporosis is poorly recognised and can lead to fractures in pregnancy. Symptoms start in the third trimester. Pain of unknown origin may be a symptom. It can only be diagnosed by ultrasound and X-rays or bone density measurements. Older women may be more affected and pain is experienced when lifting something up. Lactation may be contraindicated if the diagnosis is made.

Pelvic floor dysfunction may include urinary incontinence and uterine prolapse. Urinary incontinence is a common problem in 40–60% of pregnancies. Supervised antenatal exercises improve this condition in 70% of affected women and 66% of women show improvement or cure after eight weeks of intense exercise. Uterine prolapse after normal birth may benefit from exercise of the pelvic floor in mild cases but surgery is needed for more severe cases.

It is clear that universal antenatal exercises cannot be offered to all women due to a wide range of differences in women's bodies in pregnancy. General principles to adhere to when antenatal exercises are considered are:

- avoid standing for long periods
- link pelvic floor exercises to daily activity and do it in any position (Kegel's exercise)
- do abdominal exercises for the deep abdominal muscles, do not arch the back, keep knees together (Pilates)
- the transversus abdominis need exercise
- practise pelvic rocking
- teach women to use correct lying, getting up, lifting and body mechanisms for household tasks.



Figure 18.1 Correct postural positions before and after delivery

Principles for exercising in pregnancy are:

- Women can continue with their usual exercise programme with adaptations.
- Sit ups and double leg raise are excluded.
- Jumping and riding or any speeding exercises are risky when pregnant.
- Tennis, hockey, skiing, cycling are risky when pregnant.
- Any cardiovascular exercise that raises the core temperature should be avoided.
- Women who do not already have a regular programme of exercise should do gentle exercise such as walking and swimming, which are safe in pregnancy.

Women are encouraged to do exercises that will strengthen the back, upper arm muscles for postdelivery and abdominal muscles. Gentle exercise will prevent constipation and help with improved sleep and rest (Table 18.2 and Figure 18.2).

Relaxation and deep breathing

Several relaxation and breathing methods have been found to be helpful in pregnancy and birth. These include body massage, aromatherapy, imagery and suggestion, hypnosis and yoga.

Women are often already using a method of their own choice and the midwife should support the women's choice.

Women who do not have their own programme may be directed to accredited services where they can learn about relaxation techniques that will improve their feelings of well-being, reduce levels of stress and reduce anxiety and fear of labour. Men are often encouraged to attend antenatal relaxation classes.

Relaxation exercises

The following relaxation drill is a basic training for women to learn to concentrate on themselves and to be able to identify tension. This teaches women the importance of 'self-awareness'.

- The midwife must show the women and their partners different positions that can be used for the relaxation drill. She should, if possible, have rugs or mattresses with pillows for each woman and partner during the class. If these cannot be supplied, then the couples should be asked to bring in their own for each class.
- Soft, relaxing music may be played in the background.
- Lights can be dimmed where possible.
- The midwife instructs in a soft, low and pleasing voice. He/she should try to talk slowly with distinct pauses at appropriate places during the drill. Intervals of silence are important, to enable the women to continue to concentrate by themselves on body awareness and body rhythms.
- These positions are practised while lying on the floor during the classes, but must be adapted for each particular circumstance in the labour situation.

Instructions. Lying on your side is often the most comfortable position, especially in late pregnancy. Lie with the upper arm and leg bent and the other (lower) arm down by your side. Place a pillow under the thigh and knee of the bent top leg and have the other (lower) leg slightly bent. Do not use a high pillow under your head as this makes your spine bow. Relax your shoulders, do not tighten or hunch them but rather pull them down, away from your ears. Sit in a comfortable chair, with your feet raised on a stool, or sit on a bed supported by pillows, and allow your arms to rest on cushions with your palms facing upwards. Support the small of your back well with cushions and also place a cushion behind your head, neck and shoulders for comfort.

It is very important to spend time discovering what position is most comfortable for each one of you, and you may find you need to change this position when you become heavier and more uncomfortable as your pregnancy advances.

If your partner is going to be with you in labour, then it will be most helpful for both of you to practise this relaxation drill together. Because it will help to have the same person instructing you, you may want to record the instructions on a tape which will enable you to practise your relaxation drill at home accompanied by a running commentary.

If you have not done a session of exercise before starting relaxation, try to take a brisk walk around the garden or the house, walk as tall as you can, swing your arms, take a few deep breaths in and out to expand your chest, do a few pelvic rocks, dance to some music if you feel like it, stretch and relax your hands and fingers, shake them well and generally try to identify and then release tension all over your body.

Relaxation drill

1 All lie down and make yourselves as comfortable as you can. Make sure your breasts are comfortable. Ensure that your 'tummy' is comfortable. Use a cushion under your tummy and bend the knee of your lower leg if you need extra support while lying on your side.
2 Release all existing tension that you are aware of because if you are not really comfortable, then tension will exist in the area of discomfort and this must be released.

continued

Table 18.2

Recommended antenatal exercises (illustrated in Figure 18.2)

	Exercises and starting position	Movement and instruction	Reason for exercise and muscles involved
1.	Correct posture: stand with feet comfortably apart.	Bottom tucked in and under, tummy pulled in, shoulders back but comfortably relaxed.	A supple lengthened spine helps prevent many aches and pains that poor posture can cause. It also allows for maximum room for the baby and for the woman's breathing. Correct posture involves most of the main muscles of the body.
2.	Side-bends: stand with feet comfortably apart, legs straight, shoulders back and arms at sides (as in correct posture).	Be careful not to lean forward, but to bend sideways and reach down the side of leg towards the knee. Repeat 5 times each side.	For posture and beauty. Works muscles at the sides and front of waist.
3.	Side leg swings: stand in correct posture position, hold lightly (for balance) onto the back of a chair.	Swing leg gently and slowly forwards and back and across and out, away from body. Repeat 5 times with each leg.	Improves circulation in hips and legs. Hip abductors are involved.
4.	Hands, wrists and arms: sit with legs crossed, back straight, arms stretched out straight in front.	Rotate wrists, turning hands in one direction and then the other. End off by flicking fingers out. Repeat 5 times.	Stretches and strengthens biceps and triceps, loosens and warms up hands, fingers and wrists.
5.	Breast exercise: sit with legs crossed, back straight.	Raise arms to just above shoulder height, clasp opposite wrist with opposite hand. Squeezing wrists, push skin towards elbows. Contract and relax rhythmically. Repeat 10 times.	Strengthens pectoral muscles and improves circulation to breasts.
6.	Thigh strengtheners (Tailor Sitting): sit on the floor with soles of feet together.	Hold ankles and bring pelvis as close to heels as possible. Keep back straight. Press thighs down gently towards the floor. Repeat 5 times.	Useful for preparation for labour as it loosens groin and hips, and stretches the muscles of the inner thighs.
7.	Neck rolls: this exercise may be done sitting or standing.	Start with left ear to left shoulder, roll head round with chin on chest, until right ear is on right shoulder. Lift head across, left ear to left shoulder and back again. Then right ear to right shoulder. Roll head around with chin on chest until left ear and shoulder meet. Repeat twice. Do this exercise slowly and carefully.	Helps relieve stiff necks, headaches and tension. NB: Do not do this exercise if any pain is experienced.
8.	Shoulder lifts: sit with legs crossed, back straight.	Relax arms and hands, raise shoulders to ears, hold and relax. Repeat 5 times.	Releases tension in shoulders and across the back of neck.
9.	Pelvic rock/tilt: lie down on back with knees bent up. (Crook Lying)	Breathe in, blow out, pull in abdominal muscles and press the small of the back firmly onto the floor. Squeeze buttock muscles together, to tilt the bottom upwards. Hold to the count of three. Relax and repeat 5–10 times.	Mobilises lumbar spine and prevents and relieves backaches.

continued

10.	Pelvic uplift: lie down on back with knees bent up.	Do a pelvic tilt but continue to push hips up off the floor, pushing hips until back is in a straight line from shoulders to knees. Do not lift any higher or this will 'over-arch' the back. Repeat 5 times. Do not arch the back.	Strengthens thighs, pelvic floor, abdominal and buttock muscles.
11.	Hips and thighs: lie on right side with head resting on right hand and legs stretched out straight.	Keep hip leaning forward and abdominal muscles pulled in firmly. Lift leg straight up as high as is comfortable, hold for three counts and then lower. Repeat 10 times with each leg.	Strengthens thighs and hips.
12.	Oblique abdominal muscles: lie on back with knees bent up.	Keep back and shoulders relaxed, tilt pelvis to flatten hollow of back, pull in abdominal muscles firmly and raise head and shoulders, bringing right hand towards the left knee. Hold to the count of three, lower back onto floor, repeat with left hand to right knee. Repeat alternating sides, 5 times each side, slowly and gently.	Strengthens oblique abdominal muscles. NB: Do not do this exercise if any pain is experienced.
13.	Straight abdominal muscles: lie on back with knees bent up.	Do as in exercise number 12 but raise head and shoulders, reaching both hands up to knees. Hold for the count of 5, lower and repeat 5 times.	Strengthens straight abdominal muscles. NB: Do not do this exercise if any pain is experienced.
14.	Hips and waist: lie on back with knees bent up.	Keeping shoulders flat on the floor and knees together, rock the knees from side to side as far as they will go. Repeat 5 times.	Mobilises lumbar spine and sacro-iliac joints. Relieves backache.
15.	Hug knees: lie on back with knees bent up.	Bring knees onto chest and hold with hands (hug knees to chest). Feel the stretch in the back. Repeat 5 times. Add – bringing one leg at a time, pulling knee to 'armpit' around the side of abdomen.	Stretches muscles of the back. Relieves pain in sacroiliac joint.
16.	Arm strengthener: kneel on all fours. Keep back well rounded.	Bend elbows out to sides and drop body to floor. Lift up slowly. Repeat 5 times.	Strengthens biceps and triceps.
17.	Back strengthener: kneel on all fours, with weight evenly distributed.	Lift left arm and right leg and stretch out away from the body. Stretch forward with fingers, and backwards with heels. Keep arm and leg parallel to floor and in a straight line with body. Look down at the floor. Repeat 3 times and then change to do the other arm and leg.	Lumbar stretch and strengthener.
18.	Legs and feet: sit with legs stretched out straight, leaning back on hands.	Rotate ankles in big circles, turning feet in one direction and then the other direction. End with stretching and flexing feet. Repeat 10 times.	Improves and enhances circulation in legs and feet.

continued

Table 18.2

Recommended antenatal exercises (*continued*)

	Exercises and starting position	Movement and instruction	Reason for exercise and muscles involved
19.	Pelvic floor pinching: sit as in exercise number 18.	Cross ankles. Squeeze thighs together as firmly as possible to the count of 5. Keep that squeeze and 'pinch and tuck' pelvic floor muscles (vaginal wall muscles) and hold to the count of 5. (Pinch as if popping to go to the toilet to urinate.) Keep 'pinching' and end by squeezing buttock muscles and muscles surrounding the anus tightly to the count of 5. Relax all 3 'areas' and repeat 5 times.	Tones inner thigh muscles and especially pelvic floor muscles. Do this exercise as often as possible during the day.
20.	Thighs: sit as in exercises 18 and 19.	Bend knees slightly. Place a cushion between knees, pull in abdominal muscles firmly, 'pinch and tuck' pelvic floor muscles and then squeeze knees together as tightly as possible. Hold for 10 slow counts. Relax and repeat 5 times.	To tone inner thigh muscles and pelvic floor muscles. NB: Exercises number 19 and 20 are essential to do to regain and maintain tone in these muscles that have been stretched during pregnancy and birth. Prolapse and stress incontinence will result from weak, poorly toned muscles.

3 Close your eyes. By closing your eyes you are shutting out your immediate surroundings, and you should try to close out all the previous events of the day as well as anything that lies ahead of you. Try to learn to concentrate only on yourself and on each moment as it occurs.

4 Now very quietly become aware of your breathing: you breathe every day of your life without even thinking about it. Listen to and feel the rhythm of your breathing as you breathe in and as you breathe out.

5 Think deeply about your breathing: about how breathing in fresh oxygen and exhaling carbon dioxide keeps you alive and well and how it has supported your baby in all the months your baby has developed and grown inside your uterus. Marvel at the mechanism of respiration. While you are tuning-in to the rhythm of your breathing, you will slowly become aware of the rhythm of your heartbeat. All these rhythms are your very own personal body rhythms, unique to you.

6 Now, become aware of your little toe on your left foot, and 'pull' tension into your foot through your little toe, (if you get cramp, rather pull your toes up to your nose than point them). Continue to pull this tension from your foot into your calf, past your knee and into your thigh. Be aware of your own sense of control and do not allow the tension to go into your buttocks. Keep the tension in your left leg all the way up to your thigh, hold as tight as you can for a few seconds, and feel the effort and the discomfort that are associated with tense muscles – and now relax.

7 Release all the tension as quickly as you can, relax your whole left leg. Feel how the tension drains down the length of your leg and out through the tips of your toes and feel how the muscles become warm and tingling when relaxed. Repeat this twice with the left leg. (This means: tense and relax the left leg a total of three times.)

8 Now do the whole exercise with the right leg (three times). It is important to remember to tense the muscles hard, and to hold that tension for a few seconds and then to release the tension quickly. When working with the right leg, the left leg must remain completely relaxed. Muscle groups often tense in sympathy with each other. As one group of muscles is finished with, it should then be completely relaxed as you move on to the next group.

continued



Figure 18.2 Recommended antenatal exercises

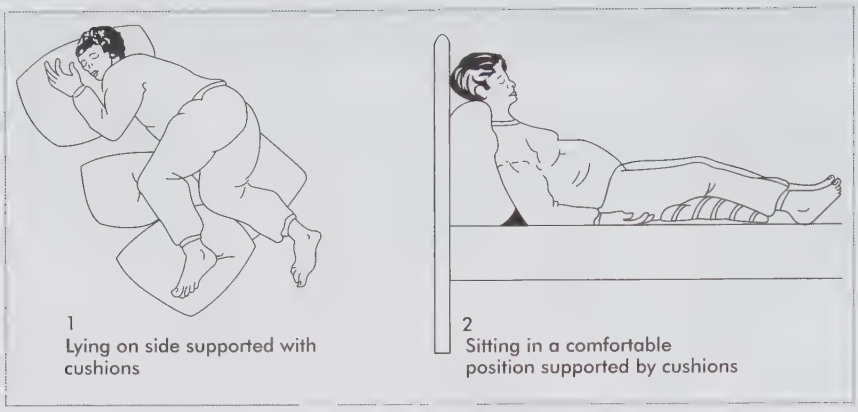


Figure 18.3 Positions for relaxation

9 Now become aware of your buttock or 'bottom' muscles. Pinch your bottom together as tight as you can, pull your pelvic floor up and hold. (Although a certain amount of movement will occur in your thighs, do not tense them at all.) Relax, allow your buttocks to become soft, release your pelvic floor and in so doing you can feel the muscles relaxing in the openings to the urethra, to the vagina and to the anus. Repeat this twice, contracting as tight as you can, and 'flop release' each time.

10 Continue to be conscious of your breathing all the time, keeping it rhythmic and relaxed. Try not to alter the rhythm of your breathing, or hold your breath when contracting or tensing muscle groups, as this is the instinctive reaction to pain. Become aware of your abdominal or tummy muscles, and pull them in as tight as you can, hug your baby tight, hold, and release, now really let go, allow your abdominal muscles to relax completely. Now and when you are asleep are the only times that the abdominal muscles should be relaxed; at all other times they should be firmly supporting the growing uterus. Repeat this twice. It is very easy when tensing abdominal muscles to hold your breath, therefore, be careful to keep your breathing rhythmic and relaxed.

11 Become aware of the muscles of your back. To tense these muscles pinch your shoulder blades together and tense as tight as you can across your shoulders and at the base of your neck. Hold, and release, relaxing completely. Repeat this twice.

12 Now become aware of your left hand, make a tight fist, feel your nails cutting into the palm of your hand, feel the intense discomfort, and 'pull' that tension into your lower arm, up past your elbow and into your upper arm. Do not take this tension into your shoulders, but hold, and release. Repeat this twice. Repeat the same procedure with the right hand and arm.

Continue to be conscious of your breathing, all the time, keeping the breathing relaxed and rhythmic.

13 Now relax your forehead. It may help you if you frown and tense your forehead first and then release and relax. Stretch your jaw wide open in a silent scream, then close your mouth and allow your teeth to be comfortably closed, your lips to be closed and relaxed. Relax your tongue, just allow it to flop in your mouth until it becomes thick and relaxed. Relax your eyes in their sockets, let them be still and relaxed, relax your eyelids, allow them to droop and become comfortably closed and relaxed on your cheeks. Relax the skin over your scalp, at the base of every hair follicle and down the back of your neck.

14 Now your whole body should feel completely relaxed, you should feel floppy, heavy and relaxed. You have no desire to move whatsoever. If, however, you sense discomfort somewhere in your body, relax and release the tension in that area. Do a complete body check. (This means: check over your whole body for any areas of discomfort, which will indicate tension, and release and relax those areas.)

15 Learning to relax your mind is a lot more difficult to do because of the intense and constant amount of activity that goes on in your mind, 24 hours a day. Try to learn to quieten down and eventually completely relax yourself mentally, by channelling your mental energy in one direction. To achieve this, use dreams, images (using your imagination) or fantasy.

Dream or fantasise about somewhere you would really like to be, or something you would love to do, or concentrate on the rhythm of your breathing, repeating

continued

the words in and out, over and over again. Some women find that saying a short verse or rhyme repeatedly to the rhythm of their breathing also works well. Now just relax, drift off, continuing to be aware of your body and your breathing, just relax, relax . . . relax. I am now going to leave you for five whole minutes, so just relax, relax . . . relax.

Five minutes later (or however long the midwife deems necessary) continue as follows:

16 Slowly and without opening your eyes or moving, bring yourselves back to reality, become aware of the noises going on around you and picture yourself on the mat here in this hall. Take a deep breath in and then breathe out, take another deep breath in . . . and out . . . and continue until you feel aware again. Then in your own time slowly stretch your arms and your legs and sit up. There is no hurry.

When the exercise is done correctly women may fall asleep during the process. Women are allowed to rest for five to 10 minutes and feel refreshed (See Figure 18.3).

The midwife must try to be aware of each individual in the group and this awareness will grow as she gets to know and interact with each woman. Therefore, depending on her experience and skill, this awareness or getting to know the women could take one or two classes to establish.

After each relaxation session, the midwife should get feedback from each woman as to:

- how each woman felt during the relaxation
- if she had managed to relax physically and mentally and
- if she had managed to remain relaxed and comfortable during the relaxation session.

Explain that in the reality of labour, there may be times when they may feel like giving up or times when they just do not cope with relaxation and the controlled breathing as taught in class. With encouragement from the partner or the staff, the woman should find that she is able to again collect herself and continue. However, unforeseen circumstances, like difficult or prolonged labour, do actually make the breathing techniques and the ability to relax difficult to apply, and the woman must not feel that she has failed in any way, if she does not keep up.

Breathing techniques

Women are anxious about labour. It is important to teach the full range of breathing techniques that women can use at different times during labour, all of which help her to relax, to conserve energy, to be in control of her own body and to help her to work through the pain. This also helps to calm her and prevent her from becoming tense and afraid. When women have been taught that they can, with practice, have a high degree of control over their own bodies, by concentrating on the breathing techniques, they will soon become confident in facing labour and will look forward to applying these techniques.

Methods of breathing in the first stage of labour

This technique is useful in the following instances:

- from the beginning to the end of each contraction, throughout the first stage of labour
- whenever an uncomfortable or anxiety-producing procedure is being done
- to overcome feelings of nausea.

Method

The following controlled, rhythmic breathing is explained:

- The woman is taught to place her hand on her abdomen and the hand must lift when she inhales. Breathing is abdominal to relieve the pressure on the uterus. As soon as a contraction starts, the woman should breathe in deeply through her nose, feeling the abdomen rise upwards; this is followed by a slow, deep exhalation through her mouth. It is important for the midwife to stress that each woman finds a depth and rhythm of breathing that is comfortable for her. The main principle behind this method of breathing is to keep the breathing rhythmic and controlled, which produces a calming effect and is ideal for the beginning and the end of each contraction. With each breath out, the woman should relax her entire body and try to remain as relaxed as possible throughout each contraction.

  As the contraction strengthens, the deep breathing may change to a shallower, lighter and slightly quicker rhythm of breathing, and the midwife stresses the importance of the woman concentrating on her breathing only. Instead of allowing the pain to envelop her, she will be able to achieve a high degree of relaxation and control. This helps the woman to 'ride out' each contraction.
- *The sense of hearing*. During a contraction the woman must listen to her breathing and thus keep her sense of hearing in control.
- *The sense of sight*. When a woman closes her eyes she retreats into a 'dark and pain-filled cocoon', or if she gazes around wildly she feels out of control and her fear and anxiety increase. If, however, she fixes her eyes on someone or on some object at which she was looking as the contraction started, she should experience a better sense of control, enabling her to concentrate on her breathing.

- *The sense of touch.* A woman in labour should keep her hands relaxed and free. If she clutches onto someone or something else, such as a blanket or the sides of the bed, she will be tensing her whole body and this will increase the pain and also waste oxygen.

The woman can also use her hands in the following ways.

- *Effleurage* is a French word describing a light type of massage, and may be done by the woman herself. She gently runs the tips of her fingers over her abdomen. She starts with both hands just above the pubic bone, using only the finger tips, she then runs her fingers up towards her sternum. She then parts her hands, and runs them around the uterus and down, to meet above the pubic bone. This roughly traces the shape of a butterfly. These actions sensitise the peripheral nerves below the skin surface and are very soothing (counter-stimulation). The woman can learn to do this to the rhythm of her breathing.

  The woman may find that having her hands at her sides and using her fingers to tap out the rhythm of her breathing is very helpful. The woman may find that by holding her hands very lightly over her abdomen during a contraction, she can keep in touch with the rhythm of her breathing.
- *The sense of taste.* Obviously, the sense of taste cannot be controlled, but here the midwife can tell the woman that to prevent her mouth from becoming dry during labour (with all the deep breathing), she should move her tongue up and down, and this will stimulate the secretion of saliva. The husband/partner can give her sips of iced water or ice to suck and should apply lip-ice to her lips at regular intervals during labour to help prevent her lips from drying and cracking. The midwife should stress to each woman the importance of being able to be flexible, that is, being able to adapt or adjust any of the breathing techniques and/or suggested 'sense control methods' at any time during labour. The woman must only do what really helps her to cope and not use breathing techniques or the suggested methods simply because it was what she was taught in class. Emphasising the importance of this will help the woman to understand that as long as she has a good understanding of what is actually happening during the stages of labour, she will be able to cope. This will also help to dispel any fear of forgetting what to do, but will rather reassure her that what she learnt in class may be adapted or adjusted to work with the labour as it progresses. The doulas, husband, significant person or midwife can be the 'birth coach' guiding and supporting the woman in labour.

Methods of breathing in the transitional and the second stages of labour

- *Controlled breath-holding and pushing, bearing-down.* This technique is used in the second stage of labour with the urge to push or bear-down.

  (N.B. For delivery positions, see Management of the second stage of labour Chapter 27).

  Women are advised to bear down when the contraction reaches its peak. The best position for labour is squatting. The woman is allowed to assume a comfortable position during the second stage.

  When bearing down, her head should be forward with her chin on her chest. Her mouth should be closed and her eyes should be closed. She should push or bear-down into her perineum, which is a similar action to that used for defaecating.

  She should use one or two long, sustained, strong pushes during the duration of the contraction, and *not* short, frequent, ineffective pushes. This is known as the 'Valsalva manoeuvre'.
- *Between contractions.* The woman can lie back and relax, either on the cushions or against her husband/partner, but should remain in a sitting position if the delivery is to be undertaken in the dorsal position (modified dorsal position). She should conserve her energy as much as possible.

  If a woman delivers in this upright position she will be able to see her baby emerge and possibly be involved with the final stage of delivery, by placing her hands under the baby's armpits and delivering her baby onto her tummy. This can be a very exciting experience, but she should not feel guilty if she is feeling too tired and does not wish to do this, or if her medical practitioner does not allow her to.
- *Panting or fast light breathing.* This technique is used during the period of transition from the first into the second stage of labour, to stop the woman from bearing-down before the cervix is fully dilated or during the second stage of labour when the baby's head is crowning. The woman has to overcome the urge to push, in order to give the perineum time to stretch slowly to accommodate the baby's head. The midwife should stress the importance of this and explain that pushing when the baby's head is crowning can cause unnecessary tearing of the perineum. The woman must be reassured that she will be getting a tremendous amount of support and encouragement throughout the second stage and that she needs only to listen to any guidance given to her and to do what is required of her.

The woman is taught to take shallow breaths (similar to a dog panting). For example: 'pant, pant, . . . blow'. Thus a number of short, sharp pants followed by a long exhalation every 5–10 pants, in order to prevent hyperventilation. The women uses her chest and lungs to make short shallow breathings. This type of breathing is not used for any length of time, but only to allow slow crowning and delivery of the head.

Hyperventilation

The signs of hyperventilation are dizziness, light-headedness, tingling sensations in the tips of fingers and/or lips and eventual fainting. Too much oxygen enters the system and carbon dioxide falls. In order to prevent over-breathing, or hyperventilation, the woman should be taught to recognise and report any early signs of hyperventilation and she should then be given or should ask for a paper bag, which she holds closely over her mouth and nose and takes slow breaths in and out of, for a short period, until the dizziness passes.

In labour, holding the breath and bearing-down causes a slight rise in the maternal levels of PCO_2 because less CO_2 is exhaled. On the other hand, deep breathing during contractions has the opposite effect, and causes PCO_2 levels to fall, resulting in the symptoms of hyperventilation if the levels fall below 16–18 mmHg.

Preparation for birth and parenthood

Women are educated about what may happen in pregnancy, labour and postnatally.

The programme will focus on:

- *Pregnancy*. Common problems, nutrition, preparation of the breasts and nipples, prevention of stretch marks, signs of labour, when to go to the hospital, danger signs of pregnancy, kick chart, exercise, sleep, relaxation and labour drills. Include practical aspects such as maternity leave, wearing a seatbelt, travelling by plane, going on holiday, having a hair perm and colouring, mouth hygiene, gingivitis and going to the dentist, emotional adjustments and time and financial planning.
- *Birth preparation*. This deals with positions in labour, woman-friendly care, development of a birth plan, management of pain, choice of birthplace, birth method and providers, the presence of the significant person of the women's choice at birth, the use of a doula, scenarios where complications may occur, maternal child bonding and early breastfeeding, the role of the healthcare providers in labour and the costs of care.
- *Postnatal education*. This looks at the changed roles of the couple, the development of skills of baby care (e.g. fathers are taught to bath the baby). (In many institutions the father is given the opportunity to do the first bath of the baby under supervision.) Breastfeeding and kangaroo-mother-care, abilities of the newborn, mother care including baby behaviour, crying, stools, jaundice, care of the cord and eyes, hygiene, immunisation, growth and development, introduction of solids and safety aspects, such as how to carry and transport a baby, where baby must sleep.

18.3 Activity

Compile a programme that covers relevant topics and gather evidence-based information in a file on each aspect. Design an information brochure. Form a health education group and give a presentation on any topic of your choice to a class or a group of pregnant women. Let the group or mothers evaluate the talk.

18.4 Seatbelts

Both the American Academy of Family Physicians (AAFP) and the National Highway Transportation Safety Administration (NHTSA) agree that pregnant women should always wear seat belts.

The ward visit

In most birth units women are given an opportunity to visit the unit (ward round) to familiarise themselves with the place where they will give birth. This is often done by the childbirth educator once a month as a standard programme in the institution.

Fathers are encouraged to come as well. Couples are allowed to ask as many questions as they want to and are introduced to the ward's staff.

A typical birth is explained and the delivery rooms, theatre and nursery or neonatal unit are shown and discussed. The philosophy and protocols of the unit (and the limitations) are explained as well as the mother- and baby-friendly principles and how these are applied in the particular unit. Women are encouraged to develop a birth plan and discuss it with caregivers before or on admission. The birth plan should clearly indicate wishes such as choice of birth, pain relief, significant person to attend birth, feeding method, and any other wish or desire. The birth plan may include coping mechanisms for labour pain and anticipated birth experiences and birth outcomes.

This may help to allay fears and uncertainty. Women are encouraged to book the bed, usually completing all the needed paperwork beforehand to avoid emergency situations when in labour and are instructed what to bring to the hospital, where to keep emergency numbers for transport and what to do in case of an emergency. Women are usually instructed to come straight to the ward and not to go to admissions when in labour.

The woman is then taken through a series of exercises where the birth may be viewed on a video and the birth and the relaxation drill are done to prepare her for birth.

18.5 Conclusion

Childbirth education and preparation are important supportive processes but need to be evidence-based and have accepted norms and standards that are congruent with current practices, add value and are not conflicting. Midwives need to update themselves, work well with others and evaluate the effectiveness of their actions. There are currently 300 childbirth educators listed in *Baby Talk* who mainly work in the private sector. It would be a positive step if the public sector were able to match or improve on this number.

CHAPTER

19 Common minor disorders in pregnancy

LEARNING OBJECTIVES

On completion of this unit the leaner must be able to:

- identify common minor disorders of pregnancy
- demonstrate competency in evidence-based interventions for each condition
- explain the advice to give women for each condition.

KNOWLEDGE ASSUMED TO BE IN PLACE

The anatomical and physiological changes of pregnancy
The normal progress of pregnancy

KEYWORDS

Morning sickness (emesis gravidarum) • Insomnia • HCG Human placental lactogen • Micturition • Carpal tunnel syndrome • Pruritis • Heartburn

19.1 Introduction

The anatomical and physiological changes that take place during pregnancy were discussed in Chapter 14. It is largely due to these changes that some women experience discomfort. Certain conditions may interfere with the woman's diet and nutrition, and/or with her exercise and sleep and may eventually undermine her general health. If some of these common (minor) disorders are not attended to promptly, they can become serious.

19.2 Common disorders

While taking the history at each antenatal visit, the midwife should tactfully ask the woman if any of these conditions are troubling her. Some women are reticent about complaining of these very personal conditions and do not know whether they are worth mentioning if they are not troubling her too much. During the physical examination, the midwife may notice or pick up signs of some of these disorders. She should treat and/or give advice for each disorder, but if the condition does not respond to the midwife's treatment, or if the condition is or has become serious, then the woman should be referred to a medical practitioner.

Fainting

Dizzy spells and/or fainting in pregnancy can be worrying to the pregnant woman and her family. When this condition arises early in pregnancy, it is probably caused by the progesterone induced, general vasodilation of pregnancy, which has not yet been counterbalanced by the increase in blood volume. Fainting may occur when the woman has been standing for a while, especially in a hot, confined or crowded place. Tight clothing, over-exertion, lack of sleep, excitement and shock may also be contributing factors.

Fainting may occur in late pregnancy, as a result of pressure on the aorta and/or on the inferior vena cava by the enlarged uterus. (See Chapter 14, The supine hypotensive syndrome.)

Care and advice

When fainting occurs in early pregnancy, the woman and her family should be reassured that the condition usually resolves itself after the first trimester.

History. The midwife takes a history to make sure that there are no serious problems. Pay specific attention to the woman's weight and daily intake of food for energy.

Physical examination. Take the blood pressure.

Special examination. Check haemoglobin.

Advice. If no other conditions are identified the woman is advised to:

- not stand for long periods. The blood accumulates in the lower parts of the body and the diastolic blood pressure drops
- lie down at once if she starts to feel dizzy (left lateral), or to sit down and put her head between her knees
- avoid sitting or standing up quickly from a lying position The cardiovascular system cannot accommodate sudden changes
- eat five small regular meals a day as blood sugar may be low.

The woman might have supine hypotensive syndrome. The treatment for this is for the woman to turn onto her side. She should try to avoid lying in the supine position for more than 15 minutes at a time during the third trimester. If she suffers from hypotension she needs to see a medical practitioner.

Nausea and vomiting (morning sickness/ emesis gravidarum)

During weeks 4–14, most women experience some nausea and about 50% will vomit. The cause of the nausea and vomiting in early pregnancy is not completely understood, but it is probably related to the increasing levels of oestrogen and/or high levels of HCG in the bloodstream, which stimulates the chemoreceptor trigger zone in the brain and initiates nausea and vomiting. However, the body becomes accustomed to the high levels of oestrogen and/or HCG. There is thought to be changes in the thyroid function as well. The altered carbohydrate metabolism, low blood sugar and effects on the thyroid influence the basal metabolic rate and cause changes in food preferences and may cause cravings. The nausea usually occurs immediately after rising in the morning, as does vomiting. When aggravated by other factors, such as large meals, rich foods or car, sea or air travel, vomiting can occur during the day. This morning sickness is not considered to be serious and has usually abated by the end of the first trimester.

If the vomiting extends into each day and is becoming excessive, preventing the woman from being able to digest and absorb food, the condition is no longer normal and the woman should be referred to a medical practitioner. This is also the case if the morning vomiting continues after the first trimester.

If the woman experiences nausea most of the time, and vomiting occurs throughout the day, then she should be seen by a medical practitioner immediately. Timely treatment can, in most instances, prevent the condition from deteriorating into hyperemesis gravidarum. Excessive vomiting in early pregnancy may suggest a multiple pregnancy or hydatidiform mole (high hormonal levels). If no nausea or vomiting is experienced in early pregnancy, there is a raised incidence of spontaneous abortion and preterm labour (low hormonal levels). (Beisher and Mackay 1986:305.)

Care and advice

History. Determine the extent, duration, time and periods when vomiting occurs.

Physical examination. Observe signs of weight loss and dehydration.

Special examination. Check urine SG and ketones.

If there is no sign of dehydration or ketones the woman is supported and advised.

If the woman cannot function or ketones are present refer for medical attention.

Advice. The following advice can be given:

- Reassure the woman that morning sickness is transient and explain that the condition usually disappears after the first trimester.
- Reorganise her daily nutritional programme and routine. Low glucose levels seem to aggravate the nausea and vomiting and are also not good for the fetus, the woman should have a high calorie drink (milk) before going to sleep and dry biscuits again before getting out of bed in the morning.
- A woman with morning sickness should have more frequent, smaller meals, with plenty of protein and she should not eat rich, fatty, spicy foods or large meals. She should eat the kind of food that best agrees with her condition and which she feels like, provided that she gets a balanced diet.
- If the woman tends to experience nausea and vomiting when she is worried or anxious when not pregnant, the anxieties, fears and added responsibilities of pregnancy may aggravate her problem.
- The woman should not take over-the-counter medication or self-medicate. The doctor may prescribe anti-emetic medication, of which meclozine appears to be the safest. Meclozine 25 mg is often combined with pyridoxine 50 mg, two tablets at night. Other antihistamine/anti-emetics such as promethazine may also be prescribed. These medications may cause drowsiness and the woman should be warned about this if she drives a car.
- If the woman is unable to tolerate any food, and if she has shown a significant loss of weight within a short period and/or if there are ketones in her urine, she will usually be admitted to hospital for observation and treatment.

Breast tenderness

During pregnancy, the duct and alveolar systems of the breast enlarge under the influence of oestrogen and progesterone. Breast tingling and tenderness are some of the earliest symptoms of pregnancy. Later in pregnancy there is an increased vascularity, together with a general enlargement of the breasts, and the woman may experience tenderness and discomfort.

Care and advice

History. Take a history of breast health, previous breastfeeding and care of breasts.

Physical examination. Do a full examination of the breasts and nipples to feel for any lumps.

Special examinations. No special examination is required if all is normal. If a lump is present, an ultrasound may be needed.

Advice. The woman is reassured:

- that breast discomfort and enlargement are natural occurrences in preparation for breastfeeding
- she is advised to buy and wear a good supportive brassiere
- the application of local warmth may help relieve the tenderness
- this is an ideal time to teach the woman on preparation of the nipples for breastfeeding and to teach self-assessment of the breasts.

Frequency of micturition

There is an increased urine production by the kidneys in early pregnancy, leading to frequency of micturition particularly at night. The muscle-relaxing effect of progesterone causes stasis of urine within the urinary tract, which increases the risk of urinary tract infection. Pressure on the bladder from the enlarged uterus, particularly in late pregnancy when the presenting part enters the pelvis, may also lead to frequency of micturition and a retention of residual urine.

Care and advice

History. Determine the pattern of the problem as well as the history of urinary tract infections.

Physical examination. Take the temperature to exclude infection. Consider the possibility of multiple pregnancy or an abnormal position of the uterus. Palpate the abdomen.

Special tests. Test the urine (clean catch midstream specimen) for clarity, pH, protein and leukocytes.

Advice. If no abnormality is present:

- Reassure the woman that the uterus is pressing on the bladder and this should be better after 20 weeks.
- The woman is advised to reduce her intake of fluids in the evenings and before bedtime.
- She is also advised not to stand for prolonged periods, particularly before bedtime, as the tissue fluids return to the vascular system when the woman lies down and this leads to nocturia.
- Empty the bladder regularly.

In later pregnancy:

- Residual urine can be more easily voided if the pregnant woman leans forward during the final stage of passing urine.

Fatigue

The metabolic processes of pregnancy and the hormones circulating may interfere with sleep, causing fatigue in combination with relative hypoglycaemia. This is now seen as nature's way of ensuring that the woman slows down, both physically and mentally, in these early stages of pregnancy and it is sometimes known as the 'incubating' or 'nesting' phenomenon. During pregnancy, a woman needs more sleep than in her non-pregnant state and fatigue may also result from the cumulative effect of too little sleep. The effort of carrying around the increased weight of the enlarged uterus may also cause fatigue in late pregnancy.

Care and advice

History. Determine the daily activity and sleep pattern of the woman including diet pattern and mental health status.

Physical examination. Check the physical condition, body and facial expression and emotional status.

Special examinations. Complete the Edinburgh scale for depression with the woman's permission and check the haemoglobin level.

Advice. If no serious problems are identified advise the woman as follows:

- that gentle exercise is needed daily
- to refer for antenatal classes and support groups
- to take rest and sleep periods in the day
- to eat a balanced diet.
- to identify disturbances in sleep and give her advice on sleep positions
- advise her not to take over-the-counter or self-medication.

Headaches

Headaches are a fairly common complaint in early pregnancy and are probably due to the effects of oestrogen and progesterone on the circulatory system, and in particular on the intracranial vascular system. They are very similar to premenstrual tension headaches and they usually disappear after the first trimester, although occasionally the condition may persist throughout pregnancy.

Care and advice

History. Take a neurological history of headaches and other problems.

Physical examination. Take the temperature and blood pressure and check for oedema.

Special examinations. Check urine for protein.

Advice. If no serious problems are found:
- reassure that headaches will pass after the first semester
- if headaches are severe or continue she should see a medical practitioner
- advise her to only take prescribed medication.

Epistaxis

Epistaxis or nosebleeding is usually also due to the effects of oestrogen and progesterone on the circulatory system, causing engorgement of the vessels lining the nasal passages. Bleeding may be spontaneous, or may be brought about by overheating or forceful nose-blowing.

Care and advice

History. Determine risk factors and nasal stuffiness and the pattern of nose beelding.

Physical examination. Check for generalised oedema.

Special examination. Check haemoglobin.

Advice. If no serious problems are found:
- Reassurance is necessary.
- Advise the woman to pinch her nostrils hard while hanging her head over a basin. Firm pressure for a few minutes should stop the bleeding.
- Saline nose spray can be used on a regular basis to keep the nasal mucosa soft.
- Do not blow the nose hard or forcefully.
- Refer to a medical practitioner if recurrent or severe.

Varicose veins

The effects of oestrogen and progesterone on the circulatory system, causing increased growth and dilatation of the veins, together with an increased blood volume, are the main causes of varicose veins. The condition is further aggravated by the pressure of the enlarging uterus and a probable inherited tendency to poor veins, coupled with long periods of standing, can lead to incompetence of the veins in the legs. Between 10–20% of pregnant women suffer from varicose veins in the legs, and the condition is more common with an increase in parity and age. The woman complains of tired, aching legs, which may become oedematous as the day progresses. At night she often has cramps in her leg muscles. The veins may become distended and tortuous and very unsightly. The varicose veins usually improve after the pregnancy, but it may take up to three months before the veins subside. However, the condition is aggravated by each subsequent pregnancy. Varicose veins of the vulva and vagina are less common.

Care and advice

History. Identify women with risk factors, e.g. multiple pregnancy, polihydramnios, previous thrombosis. Take a history of daily activities.

Physical examination. Observe both legs and vulva and consider haemorrhoids.

Special examinations. Check Homan's sign and haemoglobin.

The complications are:
- haemorrhage and ulceration
- thrombophlebitis (inflammation of superficial veins of the leg, with thrombosis)
- phlebothrombosis (deep vein thrombosis of the leg).

These complications can lead to thromboembolism.

If the woman has varicose veins, she should be referred to a medical practitioner.

Advice. The advice and treatment are as follows:
- Women with a history or risk factor are advised to see a medical practitioner.
- Women with work that requires sitting and standing are advised not to cross the legs and not to maintain the same position for more than half an hour.
- Women should not continue to work after 32 weeks of pregnancy.
- Rest in the left lateral position.
- Do gentle exercises.
- Rest, with legs and hips elevated for an hour, twice a day at least.
- Wear supporting antithrombosis stockings (elastic stockings).

- Garters and other tight garments around the legs should be avoided.
- The surgical excision of incompetent veins may be necessary, but if possible, should be left until about three months after pregnancy.
- Prophylactic medication may be prescribed.
- During delivery, great care should be taken not to incise or tear vulval or vaginal varicosities, as they can bleed profusely.

Haemorrhoids

Haemorrhoids are varicose veins of the anal canal and therefore the cause is the same for both conditions. They can be internal and/or external, and the condition is further aggravated during pregnancy by constipation, causing straining during defaecation and also by prolonged bearing-down in the second stage of labour.

The complications are similar to varicose veins, although bleeding is more common and thrombosis is rare.

Care and advice

History. Take a history of risk factors such as multiple pregnancy and constipation.

Physical examination. Observe the heamorrhoids.

Special examinations. Rectal examination by a medical practitioner if necessary.

Advice. Give the following advice:
- Prevent constipation and straining.
- Soothing ointments and suppositories may be ordered by the medical practitioner.
- For prolapsed haemorrhoids, the woman should rest for about half an hour in the left lateral position, with the foot of the bed raised, and then, after lubrication, the haemorrhoids may be gently replaced.

For bleeding, cold astringent packs can be applied to the area, using either hypertonic saline, magnesium sulphate or zinc sulphate solutions.

Haemorrhoids, like varicose veins, also take up to three months to improve after delivery, and surgery is best left until then, if possible. The management is mainly directed towards preventing bleeding and relieving pain and discomfort.

Heartburn and oesophageal reflux

Oesophageal reflux occurs in over 60% of pregnant women and is the reflux or regurgitation of the gastric juice into the oesophagus, or into the mouth, when it is commonly known as waterbrash. It is caused by the relaxing effect of the hormones of pregnancy, which results in incompetence of the cardiac sphincter (cardia), combined with the pressure on the stomach from the enlarging uterus. It usually occurs in the second and third trimesters of pregnancy, when the woman complains of heartburn, which may be experienced as discomfort, burning or pain in the epigastrium. The acid gastric juice causes irritation of the lower oesophagus and oesophagitis may occur. The condition is worse at night when the woman is lying down and it may prevent restful sleep. Incompetence of the pyloric sphincter can result in bile being present in the gastric juice.

Care and advice

History. Take a history of gastrointestinal problems and nutritional habits.

Physical examination. Check the size of the abdomen.

Special examination. No special examination required.

Advice. The following may help to relieve the symptoms:
- Small, fairly frequent meals should be taken, so that the stomach can empty easily.
- The type of food is important. The meals should not consist of rich, fatty, oily, spicy or indigestible foods and the last meal should not be taken after 6 pm.
- The woman is advised to use an extra pillow or pillows when resting or sleeping.
- The woman is advised to stop smoking, or if that is not possible, to reduce smoking and also not to smoke after the last meal of the day.
- If the acid gastric juice is causing the problem, an antacid such as magnesium trisilicate or aluminium hydroxide may be prescribed by the medical practitioner.
- If the condition does not respond to the above advice and treatment, the medical practitioner may do further investigations.

Although not a serious condition, it can be very distressing and is not easy to treat. Refer the woman if the condition is continuous.

Constipation

There is a tendency to constipation in pregnancy, but the woman should be reassured that if she follows the advice given to her by the midwife at her antenatal visits, this should not be a problem. Constipation can be either the infrequent emptying of the bowel, the passing of hard faecal matter, or both.

Care and advice

History. Take a history of the bowel action and diet patterns.

Physical examination. Observe general appearance.

Special examinations. Check haemoglobin.

Advice. When constipation does occur, give advice on diet and hygiene. Constipation can be combated by adding fibre to the diet and taking balanced regular meals. Advise in the following way:

- Emphasise the importance of a good balanced diet.
- Discuss foods, high in roughage/fibre and low in carbohydrates/sugars.
- Explain that drinking plenty of fluids, particularly plain water also helps to keep the bowel contents soft and easier to evacuate.
- Recommend high-bulk bran, which can be bought from health shops, and bran biscuits, wholewheat cereals and wholewheat bread.
- Suggest exercise, such as a short walk around the block, especially just before or just after breakfast.
- The woman should be given advice on bowel training: to use the toilet at specific times, such as after breakfast each morning.
- Aperients and laxatives are not recommended.

Pruritis

Itching may be experienced during pregnancy. The high circulating oestrogen and inability of the liver to metabolise it can cause itching. Itching of the skin of the abdomen and breasts may be caused by stretching or, if there is a generalised itching, it could be hormonal. Pruritus vulvae may also be hormonal.

In some instances, pruritus may be caused by cholestasis, which may even result in a mild jaundice. No treatment is necessary, but the woman should be reassured.

Care and advice

History. Check for any allergies. Itching can be caused by scabies which the midwife should easily be able to recognise.

Physical examination. Observe for the type of rash and the distribution.

Special examinations. Check urine for bilirubin.

Advice. Give the following advice:

- The woman is again advised about good hygiene, such as daily bathing, exercise, etc. and about a balanced diet.
- She should not wear clothing against her skin that could be irritating and should use cotton, rather than nylon underclothes.
- Soothing lotions such as calamine lotion can be applied.
- It may also be related to pathological conditions such as jaundice.
- Persistent itching should be referred to a doctor for further investigations and treatment.

Pruritus vulvae may be related to diabetes, or may be due to vaginal and/or vulval infections such as *Candida albicans*, *Trichomonas vaginalis*, condylomata lata (syphilis) or condylomata acuminata (vulval warts).

Oedema

Oedema of the feet and ankles is a common condition in late pregnancy, occurring in about 40% of pregnant women. The increased blood volume, together with the distension of the veins and the added mechanical pressure of the enlarged uterus, may cause oedema of the feet, ankles, vulva and anus. Standing for prolonged periods aggravates the condition, but the swelling usually subsides after a good night's rest.

Care and advice

History. Check the history for cardiac problems.

Physical examination. Check the blood pressure and for generalised oedema.

Special examinations. Check the haemoglobin. Test urine for protein.

Advice. The woman is reassured and advised:

- She should not stand for long periods, but should take frequent rests with her legs elevated.
- The foot of her bed should be elevated. This will facilitate the return of fluid in the tissues of the legs, to the general circulation.
- If the oedema is troublesome or extends beyond the ankles, the woman should see a medical practitioner.
- Diuretics should not be used.
- If the oedema does not subside after a good night's rest or if the fingers or face are swollen she should be referred to a medical practitioner.

Carpal tunnel syndrome

Swelling of the hands may cause a carpal tunnel syndrome where the nerves to the hand are compressed as they pass under the flexor retinaculum at the wrist. About 28% of pregnant women experience this condition. This results in severe pain in

the hand and in muscle weakness. It is often worse in the morning and may become extremely painful and debilitating.

Care and advice

History. Take a history of daily activities and nutrition.

Physical examination. Observe for generalised oedema.

Special examination. No specific tests.

Advice. Reassure the woman:
- Studies have shown that resting the fingers, hand and wrist in a neutral position is the most effective way to reduce pressure in the carpal tunnel.
- Splinting may be a treatment in pregnancy.
- An orthopaedic surgeon may inject cortisone in the wrist.
- An operation to relieve the compression may be necessary.
- Avoid repetitive work, take rests.
- Take a low salt diet.

Backache

Backache is a common complaint in late pregnancy, and is caused by the increased lumbar curve (lordosis) that occurs when the woman has to hold her shoulders back in order to counterbalance the enlarged uterus in front. This causes strain on the muscles of the back and results in backache and fatigue.

Lax abdominal muscles and a pendulous abdomen (anterior obliquity of the uterus) will further aggravate the condition.

Care and advice

History. Take a history of skeletal events such as accidents and previous problems.

Physical examination. Abdominal palpation, observe size of the uterus and effect on the body.

Special examinations. No specific tests.

Advice. Advise the woman:
- To rest frequently and not to stand for long periods.
- She should not wear high-heeled shoes, as this will aggravate the condition.
- Suggest antenatal exercises and referral to a physiotherapist for body posture.
- A supportive maternity corset may be required.
- If the backache is troublesome, then the woman should see a medical practitioner.

Muscle cramps

Muscle cramps affect about a third of all pregnant women. These occur in late pregnancy, especially at night, but are not usually troublesome more than three or four times in each pregnancy.

Care and advice

History. History of cramps and nutritional patterns.

Physical examination. No specific observation. In late pregnancy the presenting part can cause leg cramps when moving through the pelvis.

Special examination. No specific investigations.

Advice. Do the following:
- The woman is reassurred and advised to rest frequently during the day.
- During the spasm, the foot should be flexed by pulling/pushing the toes up and the calf muscles should be gently massaged.
- Muscle cramps may respond to calcium or magnesium supplementation.
- Rest in the knee chest position to lift pressure from the pelvic floor and nerves.

Insomnia

Sleep and rest are essential during pregnancy, but there are many conditions, both psychological and physical, which may cause disruptions in sleep patterns. Many of the common disorders in pregnancy also tend to disturb or prevent sleep.

Care and advice

History. Observe the woman's sleeping patterns, fatigue levels and verbal responses.

Physical examination. No specific examination.

Special examination. No specific investigations.

Advice. Advise the pregnant woman on the following:
- a good balanced diet
- adequate amounts of exercise and rest
- sleeping disorders are common in late pregnancy
- if the woman is severely affected refer to a medical practitioner

NB do not take medication not prescribed by a medical practitioner.

19.3 Conclusion

The midwife must understand the common minor disorders of pregnancy and be able to advise women appropriately.

CHAPTER

20

Medical and surgical conditions associated with pregnancy

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- recognise the medical and surgical conditions that complicate pregnancy
- demonstrate competence in preventing complications in pregnancy and birth
- demonstrate competence in the treatment and specific care of conditions that complicate pregnancy and birth.

KNOWLEDGE ASSUMED TO BE IN PLACE

The knowledge and ability to assess and care for low-risk pregnant women

KEYWORDS

Pregnancy-induced hypertension • HELLP syndrome • Peripartum cardiomyopathy (PPCM) • Haemaglobinopathies in pregnancy

20.1 Introduction

Pregnancy is complicated in about 20% of cases. Early identification of factors that indicate problems is essential. Early contact with a pregnant woman makes it possible to gather base-line information that will assist in identifying health problems in pregnancy and labour.

The age of the mother and number of pregnancies (gravidity and parity) are factors that may lead to complications in pregnancy. In addition pregnancy can be complicated by infections and medical or surgical conditions. This chapter will focus on the five main causes of maternal mortality in South Africa and some other common problems.

Other medical and surgical problems, trauma and malignancies that are non-obstetrical can also occur in pregnant women and are not discussed in this chapter. HIV is discussed in Chapter 52, and other infections in Chapter 51.

20.2 Obstetric risk assessment

Reduction in maternal mortality depends on the healthcare system working effectively as a whole. One single factor cannot be identified as the most important.

Midwives are specialists in normal birth and refer women to obstetricians and other specialists when there are complications. The availability of medical practitioners has a significant influence on maternal mortality. In areas where medical practitioners are unavailable, midwives may be called on to practise outside the scope of normal.

New approaches to understanding risk provide a more liberal approach to care during pregnancies. The traditional methods of classifying women as low risk, moderate risk and high risk have been shown to be an ineffective means of predicting complications in pregnancy or birth. Sanders (2003) found that labelling women as 'high risk' affects the psychological state of women. The way in which risks are documented and communicated needs revision according to Stahl and Hundley (2003). All women should be considered as having normal pregnancies until there is clear evidence to the contrary. No single instrument has so far proved effective (sensitive) in predicting outcomes in pregnancy and birth. The Safe Motherhood Initiative (SMI) moved from risk screening as a way to reduce maternal deaths to setting criteria for Essential Obstetric Care (EOC) and other facilities (focusing on the quality of the environment, see Table 20.1).

In South Africa 'guidelines for referral of cases' have been developed as a response to the 1998 maternal mortality report (DoH 2000 and 2008). The 2001 Maternal Mortality Reports demonstrated a shift of high-risk cases to a higher level of care, with unchanged maternal mortality, as women still died at a different level of the healthcare system under medical supervision. The development of norms and standards of the environment is particularly important in South Africa.

A history of a previous abnormal birth does not mean that the next birth will also be abnormal, or that a normal birth is always followed by another normal birth. Complications can also develop suddenly. Because of this, there are few reliable predictors of the risk of obstetrical problems.

If a classification of risk is used, the woman's care should still be individualised, but she should also be referred to a medical practitioner or higher level of care for assessment.

Table 20.1

Factors to consider as risks in the antenatal history

Demographic	**General**
Maternal age younger than 15 or older than 35	Nutrition: > 20% overweight, massive obesity, more than 10% underweight
Parity: Nullipara, grand multipara	Poor nutrition
Race: non-white	Inadequate weight gain
Marital status: single woman	Excessive weight gain
Economic status: Dependent on public transport	Smoking
Prenatal care: 1st visit after 27 weeks or < than 5	Drug or alcohol abuse: history of and/or in this pregnancy
Obstetrical	**Medical and surgical**
Infertility factors < 2 years, > 2 years	Anemia: Hb 8–10 g/dl
Previous abortion: one or more	Anemia Hb < 8 g/dl
Premature or low birth weight: history of 1, 2 or more	Sickle cell trait
Previous large infant: 1, 2 or more	Sickle cell disease
Previous perinatal loss: 1, 2 or more	Hypertension mild
Post-term in this pregnancy	Hypertension severe
Previous caesarian section	Heart disease Grade 1 & 11
Previous congenital abnormality	Heart disease Grade 111 & 1V
Incompetent cervix	Heart failure
Uterine abnormality	Diabetes gestational
Contracted pelvis	Diabetes overt
Abnormal presentation: history of and/or in this pregnancy	Thyroid disease: history of and/or in this pregnancy
RH negative sensitised	Sexually transmitted infections
Polihydramnios	Syphilis: history of and/or in this pregnancy
Pre-eclampsia: history of severe, mild and/or in this pregnancy	HIV positive
Multiple pregnancy: history of and/or in this pregnancy	Urinary tract infection: in this pregnancy
	Psychiatric problems: history of and/or present in this pregnancy
	History of other medical conditions
	Other medical conditions in this pregnancy

Obstetric triage

Specialist midwives perform obstetric triage after taking a history, doing a physical examination and ordering appropriate special investigations (where these are available). The women are admitted for 24 hours for assessment and then only referred further if necessary. Medical practitioners may be consulted using telemedicine in rural areas where transport is a problem. Cases in which specific complications have been identified are then referred for medical care in a larger centre.

20.3 Hypertensive disorders in pregnancy

In normal pregnancy, blood pressure will decrease in the first semester and will gradually rise from 20 weeks until the end of the pregnancy.

Pregnancy-induced hypertension (PIH) that develops into eclampsia (life threatening) accounts for 2% of all maternal deaths in developing countries. In South Africa it is the single most common direct cause of maternal death (besides HIV). The incidence in large studies of several countries was between 0.5 to 6.7% for pre-eclampsia and 0.1 to 0.7% for eclampsia.

This complex condition needs special attention in South Africa to reduce maternal deaths.

Definitions

Hypertensive disorders of pregnancy include conditions such as pre-eclampsia, essential hypertension, eclampsia and the HELLP syndrome (haemolytic anaemia, elevated liver enzymes, low platelet count) and can present with any of the following:

- Pregnancy-induced hypertension (PIH). Women develop hypertension for the first time after 20 weeks. Globally 1–8 million women will develop pre-eclampsia and 250 000 will develop eclampsia, 90% of whom will be in developing countries.
- Hypertension in pregnancy (without proteinuria).

- Proteinuria with hypertension (pre-eclampsia).
- Chronic hypertension and renal disease. (Hypertension existed before the pregnancy.)
- Chronic hypertension without proteinuria.
- Chronic renal disease (proteinuria with or without hypertension).
- Chronic hypertension with superimposed pre-eclampsia.
- Unclassified hypertension/proteinuria. (Combination of above.)
- Eclampsia: convulsion/coma. Hypertensive crisis/shock.
- HELLP syndrome.

Aetiology and pathology

20.1 Aetiological factors that predispose to PIH

- *Nutritional deficiencies*. Protein and calories, calcium iron and vitamins.
- *Genetic disposition*. Higher risk for daughters of mothers who had the condition.
- *Uterine ischemia*. Not enough blood flow through uterus.
- *Immunological response*. Abnormal protein.
- *Parity*. Mainly primigravida or with a new husband.
- *Age*. <.18yrs > 35 years 3 x higher in women < 15 years of age.
- *Environmental factors*. There is a relationship between pre-eclampsia and the weather. Fewer convulsions in dry season.
- *Altitude*. A higher incidence at 3 100 m above sea level.
- *Smoking*. A lower incidence among smokers.
- *Obstetrical and medical conditions associated with placental pathology*. Multiple pregnancy, hydrops fetalis, diabetes mellitus and hydatidiform mole.

Placental factors

Owing to the prompt resolution of the disease following delivery, most attention is being focused on the placental pathalogy and the thromboblastic invasion of the spiral arteries in the deciduas. There is vasoconstriction, which will lead to decreased placental perfusion, which may ultimately lead to early placental hypoxia. The muscular walls and the endothelium of the spiral arteries are eroded and replaced by trophoblast, to ensure a suitable environment for the developing blastocyst. A second phase of this erosion process occurs between 16 and 20 weeks. This is when the trophoblast erodes the endothelial cells of the spiral arteries.

There is growing evidence that suggests that these pathological processes of abnormal placentation are linked to the occurrence of PIH. This may be a genetically predetermined maternal immune response to fetal antigens, derived from the father, and expressed in normal placental tissue. This maternal immune response triggers the release of factors that damage the endothelial cells. When these cells are damaged the following occurs:

- There is increased vascular sensitivity to the angiotension II.
- The coagulation cascade is also activated.
- There is production of the thromboxane (causing vasoconstriction, leading to increased blood pressure).
- There is increased production of lipid peroxides and the antioxidant production is decreased. This is known as oxidative stress. The combined effects of these events will cause vasospasm which will lead to the following pathological changes:
  - *Haematological changes*. Capillary permeability is affected by the hypertension and endothelial cell changes.

    Plasma proteins leak from the damaged blood vessels causing a decrease in the plasma colloid pressure and an increase in oedema within the intracellular space. The reduced intravascular plasma volume causes hypovolaemia and haemoconcentration, which is reflected in the elevated haematocrit.

    In severe cases the lungs become congested with the fluid and the pulmonary oedema develops, oxygenation is impaired and cyanosis occurs. With vasoconstriction and disruption of the vascular endothelium the coagulation cascade is activated.
  - *Coagulation system*. Increased platelet consumption produces thrombocytopenia and may be responsible for the development of disseminated intravascular coagulation (comprising low platelets, prolonged prothrombin time and low fibrinogen levels). As the process progresses fibrin and the platelets are deposited, occluding the blood flow to many organs, particularly the kidneys, liver and the placenta.
  - *Renal system*. In the kidneys, hypertension leads to vasospasm of the afferent arterioles, which results in a decreased renal blood flow, which then produces hypoxia and oedema of the endothelial cells of the glomerular capillaries. The glomerular endothelial damage allows the plasma proteins, mainly in the form of albumin, to filter in the urine producing proteinuria. Renal damage is reflected by the reduced creatinin clearance and the increased serum creatinin and uric

acid levels. Oliguria develops as the condition worsens signifying the severity of the condition and kidney damage.

- *Hepatic system.* Vasoconstriction of the hepatic vascular bed will result in hypoxia and oedema of the liver cells. In severe cases the swelling of the liver causes epigastric pain and can lead to intracapsular haemorrhages and in very rare cases the rupture of the liver. Altered liver function is reflected by the falling albumin levels and the rise in the liver enzyme levels.
- *The central nervous system.* Hypertension, combined with the cerebrovascular endothelial dysfunction, increases the permeability of the blood-brain barrier resulting in cerebral oedema and microhaemorrhaging. This will be clinically characterised by the development of headaches, visual disturbances and convulsion.
- *The placenta.* Owing to the vasospasm, there is reduced blood flow through the decidual arteries causing hypoxia. In an attempt to overcome this hypoxia there is hyperplasia and swelling of the layers of the chorionic villi (the syncytial and cytotropic layers) causing more branched villi, there is swelling of the villi and thickening of the basement membrane.

  As these small branched villi are fragile and not well anchored, there is detachment of these villi, causing tiny emboli to be released into the mother's circulation. These emboli are destroyed with the release of thromboplastin, which initiates the process of disseminated intravascular coagulation.

Nutritional factors

There is no evidence that dietary restrictions of any sort (water, salt, etc.) are of any benefit to pregnant women. High-protein dietary supplementation should be avoided.

Deficiency in calcium may cause increased activity in the vascular angiotensin by stimulating prostacyclin synthesis, thus triggering pre-eclampsia. Women who are at high risk of pre-eclampsia and have low dietary calcium intake should receive calcium supplementation during pregnancy.

Magnesium is known to cause vasodilatation. A deficiency may therefore be associated with pre-eclampsia.

Low plasma zinc levels are associated with pre-eclampsia. Zinc competes with cadmium at various biochemical binding sites. Lack of zinc therefore exposes the pregnant woman to cadmium toxicity which can cause vasospasm and endothelial cell damage.

Immunological factors and abnormal placentation

The aetiology is still unknown and no definite cause has been identified.

Clinical picture

The clinical picture and signs and symptoms of PIH can be misleading. The diagnosis is based on a raised diastolic blood pressure of 90 and above after 20 weeks of gestation.

The three cardinal signs of PIH are hypertension, proteinuria and oedema.

A change in blood pressure is the essential diagnostic criteria for the hypertensive disorders of pregnancy. Accurate measurement and interpretation is important.

Measuring blood pressure in pregnancy

The following are the guidelines for the evaluation of blood pressure by the WHO. The diastolic may be taken at the fourth or fifth Korotkoff's sound. (The WHO recommends the fourth sound.) Since vasoconstriction is the pathological feature in late pregnancy the diastolic pressure is the important measurement. The diastolic pressure indicates peripheral resistance and systolic cardiac output. In 15% of women the fifth sound cannot be heard. The systolic pressure is measured at the systolic sound one.

A woman is placed in a 15–30° degree tilt to the side when the blood pressure is measured to avoid the inferior vena cava syndrome effects. Use the largest possible cuff. If sitting up straight the upper arm must be at the same level as the heart. A falsely high reading is obtained if the cuff does not encircle at least three-fourths of the circumference of the arm; a wider cuff should be used when the diameter of the upper arm is more than 30 cm.

The blood pressure must be taken while the woman is resting. Repeat the measurement in three to four hours.

Calculate the mean blood pressure using the following:

$$\text{MABP} = \frac{\text{BP} + \text{pulse pressure}}{3}$$

Diastolic blood pressure

A cut-off of 90 mmHg has been determined since perinatal mortality is significantly increased at this level. The blood pressure drops by 15 mmHg in early pregnancy with its lowest values midtrimester. It should remain low for the first half of pregnancy. In the third trimester the blood pressure rises to the same levels as in the first trimester.

Before a diagnosis is made the blood pressure should consistently measure 90 mmHg for two consecutive readings taken four to six hours apart. At a diastolic blood pressure of

110 mmHg the fetus is in severe danger and needs immediate attention and intervention.

It is generally agreed that the amount of proteinuria correlates with the actual level of diastolic blood pressure and not the magnitude of the elevation. This means that a rise in blood pressure should be a warning sign of hypertension.

20.2 The roll over test (level 1)

The roll over test is recommended as a routine test for every pregnant patient between 28 and 32 weeks gestation for the early diagnosis of hypertension in pregnancy. This non-invasive test is particularly of value in primary healthcare settings. A false positive test may occur in 10% of cases, while a false negative is very unlikely.

Guidelines

Take blood pressure for a minimum of 15 minutes until stable in the lateral position. At this point the patient is rolled over onto her back. The blood pressure is taken after one minute. If the diastolic pressure increase is less than 20 mmHg the test is negative. An increase of more than 20 mmHg in the diastolic is a positive test. Repeat after five minutes to confirm the test. In a study of 700 women 76% with a positive test developed PIH.

Proteinuria

This may appear before hypertension, in which case it may be a result of infection or renal disease.

Proteinuria without a blood pressure of 95 mmHg is usually associated with infection, anaemia or renal conditions. Studies have shown that there is a clear correlation between diastolic blood pressure and proteinuria. Proteinuria changes the diagnosis from pregnancy-induced hypertension to the more serious condition of pre-eclampsia

Proteinuria is defined as 300 mg of protein in a 24 hours collection of urine.

Using a dipstick the following criteria can be used as a guideline:

- 1 + = 0.3 — 0.45 gr/ℓ
- 2 + =0.45 gr/ℓ
- 3 + = less than 3 gr/ℓ
- 4 + = more than 3 gr/ℓ

Fetal mortality is significantly increased when the diastolic BP is 95 mmHg with 2 + proteinuria. It is the combination that is important.

Oedema and weight gain

Villous oedema appears to be the most frequent cause of fetal and neonatal morbidity before 35 weeks of pregnancy. Villous oedema is intracellular.

Oedema is no longer a diagnostic sign of PIH but is still regarded as a significant symptom. The mechanism of water retention in a normal pregnancy differs from that in hypertensive disorders. Pre-eclamptic women are hypovolaemic.

Primigravida who develop generalised oedema with a weight gain of more than 0.57 kg/week between 20–28 weeks are at greater risk of developing hypertension, with or without proteinuria. Primigravida with a low mass gain of 0.34 kg/week are less likely to develop blood pressure problems. Rapid gain in mass is also significant.

Classification of oedema:

- *Hands*: ring does not fit.
- *Feet*: swollen in the morning.
- *Face*: peri-orbitral puffiness that can easily be seen.
- *Body*: fetal stethoscope leaves a mark.
- *Dependent oedema*: develops when standing/walking.
- *Pitting oedema*: leaves a mark. Should disappear within 30 seconds.

The following guidelines can be used when pressing on the lower leg:

- A dent measured in mm can be interpreted from 1+ – 4++
- 1 + = 2 mm
- 2 + = 4 mm
- 3 + = 6 mm
- 4 + = 8 mm

If a woman is on bed rest she is checked for sacral oedema. In severe cases ascites and pulmonary oedema may develop. Both are serious complications. Deep tendon reflexes can be affected by severe oedema (See *Juta's Clinical Guide for Midwives*).

Pre-eclampsia

Pre-eclampsia is a multi-system disease. Women with pre-eclampsia do not feel unwell until the condition is severe. Then the disease is life threatening. The insidious nature of the disease is one of the reasons why it is so dangerous. Early detection by regular antenatal monitoring and careful follow-up of those with mild pre-eclampsia is therefore essential for the early diagnosis and treatment of severe eclampsia. Mild pre-eclampsia can progress to severe pre-eclampsia and

eclampsia very suddenly, with little or no warning. This is called fulminating pre-eclampsia and is very dangerous for both mother and fetus. Antenatal care:

- recognise severe pre-eclampsia and eclampsia
- provide an effective response to a woman with severe pre-eclampsia or eclampsia.

20.3 Principles of care for a woman with PIH

The cure for pre-eclampsia and eclampsia is the delivery of the fetus and placenta. However, a rushed delivery in an unstable patient is risky. Deliver only after severe hypertension has been corrected and the woman is haemodynamically stable.

- Treat hypertension with rapid acting agents if systolic BP >160 mmHg, or diastolic >110 mmHg and patient is symptomatic. Aim to reduce BP to 130–149/90–95 mmHg.
- If the blood pressure drops by more than 15 mmHg, diastolic placental perfusion is impaired. Commonly used rapid antihypertensive drugs are hydralazine, nifedipine and labetalol. In addition, prescribe methyldopa 1 g stat and 500 mg 6 hourly per os.
- Take blood for FBC including platelets, urea and electrolytes, and liver function tests as prescribed.
- Give steroids (betamethasone) to promote lung maturity in a fetus of gestational age of < 34 weeks.
- Consider the need for $MgSO_4$ if eclampsia seems imminent and/or there is significant hyperreflexia and clonus (> 3 beats) on clinical examination. $MgSO_4$ is given in all cases of eclampsia (fitting/convulsions). $MgSO_4$ more than halves the risk of eclampsia and probably reduces the risk of maternal death. It does not improve outcome for the baby in the short term (Duly et al. *Cochrane* 2003).
- Mode of delivery is decided at senior level after vaginal examination to assess the possibility of induction of labour. Always consult with your referral hospital.
- Ensure that monitoring of vital signs occurs at frequent intervals during antenatal, intrapartum periods, and following delivery for up to 72 hours. Also ensure that monitoring is continued, if the patient is going to be referred and is waiting for transport.
- All health facilities must establish an 'eclampsia box' for the management of severe pre-eclampsia/imminent/impeding eclampsia.

20.4 Eclampsia box

An eclampsia box contains:

- $MgSO_4$ in sufficient quantities for the loading dose
- infusion set (standard set)
- appropriate strapping and appropriate size syringes
- calcium gluconate (10 ml of a 10% solution = 1 g IVI over 10 minutes) – for $MgSO_4$ toxicity
- 200 ml normal saline
- flow/drip controller
- Venflows or equivalent for venapuncture
- Foley catheter 5 ml bulb plus sterile water and syringe
- methyldopa (1 g)
- rapid-acting antihypertensive agent: either hydralazine or nifedipine.

Management of pre-eclampsia

Prevention of pre-eclampsia

There is no evidence that pre-eclampsia can be prevented. The lower incidence in developed countries is associated with improved standards of living and nutrition coupled with evidence-based care protocols in an effective healthcare system.

Weight gain and salt intake do not appear to have any influence on the development of pre-eclampsia.

Do not use diuretics in pre-eclampsia. The woman is already hypovolaemic and these drugs may be dangerous.

Control of hypertension

The role of anti-hypertensive medication in mild or moderate pre-eclampsia is controversial. The important point to remember is that treatment of the hypertension does not prevent the progression of the condition in other respects (e.g. renal or hepatic dysfunction) and it may not in any way interfere with the progression to eclampsia. Anti-hypertensive medication may also interfere with placental blood supply. The woman should be admitted to hospital if there are signs that she will progress to eclampsia so rapidly that normal outpatient monitoring would not be safe, or if she lives far from medical help. Any antihypertensive treatment is prescribed by a medical practitioner.

Referral to a major obstetric unit

Controlling blood pressure, although not treating the cause of pre-eclampsia, may reduce the severity of complications of late second and third stage pre-eclampsia. Generally blood pressure of 170/110 mmHg or above should be controlled keeping diastolic blood pressure in the range of 90–100 mmHg.

Bed rest

Total bed rest is important in the control of blood pressure. Women with signs of raised blood pressure may be allowed to go home on treatment provided that they stay in bed, only getting up to go to the bathroom. If this is not possible the woman may be admitted to hospital.

Medication

Short-acting antihypertensive drugs

Hydralazine dilates arteries thus reducing resistance to blood flow. It has unpleasant side-effects in approximately 50% of users, including severe headaches, palpitations, restlessness and anxiety side-effects which mimic the symptoms of impending eclampsia. It also must be given by injection, usually in a saline drip.

Nifedipine (a calcium channel blocker) reduces blood pressure and can be taken orally. Unfortunately headaches are even more common than with hydralazine. Intravenous administration of Labetolol is also an option instead of nifedipine.

Slower acting antihypertensive drugs

Methyldopa suppresses the hypertensive activity of the sympathetic nervous system and controls elevated blood pressure within 6–12 hours. Although it causes extreme sleepiness for the first 48 hours, methyldopa is effective and is the only hypertensive drug known to have little effect on the fetus after initial sedation.

Beta-blockers such as oxprenolol, labetalol and atenolol interfere with sympathetic nervous system activity and cause fewer side-effects than methyldopa. Their short-term safety for the fetus is established.

Delivering the baby

The condition improves once the baby is delivered, although the improvement may be delayed by a few hours or, more rarely, days. The essential decisions to be made are whether induced delivery is necessary, and if so:

- when and how to deliver (i.e. vaginally or by caesarean section)
- whether any specific medication is required.

The answers to these questions will depend on the facilities available locally. Delivery of premature infants will be hazardous in circumstances where supplies and technological assistance are limited.

The diagnosis of pre-eclampsia is important but difficult to make. All women presenting with increased blood pressure after 20 weeks need to be referred for medical assessment. A rise in blood pressure before 20 weeks may indicate multiple pregnancy, hydatidiform moles, kidney problems and essential hypertension.

Box 20.5 gives the signs and symptoms that will indicate imminent eclampsia.

20.5 Signs and symptoms of severe gestational hypertensive disease

Signs and symptoms of severe gestational hypertensive disease:

- systolic blood pressure >160 mmHg
- rapid rise in BP
- diastolic blood pressure 110 mmHg
- increased liver enzyme levels or jaundice
- platelets < 100 000 per mm^3 ($100 \times 10^9/\ell$)
- oliguria < 400 ml in 24 hours (16 ml/hr)
- proteinuria 3 g/ℓ or 4+
- epigastric pain, nausea, vomiting
- scotoma and other visual disturbances, severe headaches
- retinal haemorrhage
- pulmonary oedema
- coma
- drowsiness.

Eclampsia

Eclampsia is a serious condition most commonly defined as seizures or coma in a patient with other indications of pregnancy-induced hypertension. Eclampsia was once thought to be the endpoint of progressively worsening pre-eclampsia, but this is no longer the case. Instead, it is now recognised that some patients can develop eclampsia – or 'eclamptic symptoms' – directly, without first developing any symptoms other than high blood pressure.

About 20% of cases occur between 20 and 31 weeks of pregnancy; about 80% occur at term during labour or 48 hours prior to labour. Eclampsia is extremely rare before 20 weeks of pregnancy.

Eclampsia is more common in young (teenage) women and those older than 35. Regardless of age, eclampsia is more common in women who have never before been pregnant. Patients with severe pre-eclampsia are at greater risk of seizures. Twenty-five percent of patients have symptoms consistent with mild pre-eclampsia prior to the seizures.

Signs and symptoms

The signs and symptoms that most commonly pre-empt eclampsia are:

- headache (83%)
- hyperactive reflexes (80%)
- marked proteinuria (52%)
- generalised oedema (49%)
- visual disturbances (44%)
- right upper quadrant pain or epigastric pain (19%).

More than 75% of eclampsia occur prior to delivery, 25% occur before labour (antepartum), 50% occur during labour (intrapartum) and 25% occur after delivery (postpartum within 72 hours).

One or more seizures may occur and generally last 60–75 seconds. The face initially may become distorted with protrusion of the eyes and foaming at the mouth. Respiration ceases for the duration of the seizure.

The seizure may be divided into two phases:

- Phase 1 lasts 15–20 seconds and begins with facial twitching. The body becomes rigid, leading to generalised muscular contractions.
- Phase 2 lasts about 60 seconds. It starts in the jaw, moves to the muscles of the face and eyelids, and then spreads throughout the body. The muscles begin alternating between contracting and relaxing in rapid sequence.

20.6 The Glasgow Coma Scale

Test	Response	Score
EYES OPEN at the following:	– Spontaneously – To speech – To pain – Do not open	4 3 2 1
BEST VERBAL response:	– Orientated – Confused – Inappropriate words – Incomprehensible sounds – None	5 4 3 2 1
BEST MOTOR response:	– Obeys commands – Can localise pain – Non-purposeful – Flexion to pain – Extension to pain – None	6 5 4 3 2 1
TOTAL		3–15

A coma or a period of unconsciousness follows phase 2. Unconsciousness lasts for a variable period and the patient may regain some consciousness (see Figure 20.6). The patient may become combative and very agitated and cannot recall the event. Hyperventilation follows the seizure stage. This compensates for the respiratory and lactic acidosis that develops during the apnoeic phase. Seizure-induced complications may include tongue biting, head trauma, broken bones.

Management

There are South African Guidelines for the treatment of pre-eclampsia and eclampsia and midwives and obstetricians should understand the management of the two conditions.

Treatment of seizures

$MgSO_4$ is recommended as prophylaxis for eclampsia in women with severe pre-eclampsia and can be given IMI and IVI.

20.7 Evidence based regime $MgSO_4$

Magnesium sulphate remains the drug of choice for both prevention and treatment of women with eclampsia. Regimens for administration of this drug have not yet been formally evaluated. There is strong evidence from systematic reviews of randomised trials to support the use of magnesium sulphate for the prevention and treatment of women with eclampsia but insufficient reliable evidence indicating the minimum effective dose, best routes of administration (intravenous or intramuscular), or the ideal duration of therapy. Effective regimes are based on the Eclampsia Trial (Collab Trial 1995), and the largest study, the Magpie Trial (Magpie Trial 2002).

These studies used the same regimens for intramuscular (IM) and intravenous (IV) magnesium sulphate (IV: 4 g loading dose over 10 to15 minutes followed by infusion of 1 g/hour over 24 hours. IM: 4 g IV and 10 g IM as loading dose followed by 5 g IM every 4 hours for 24 hours).

The SA guideline: A total dosage of 14 g **initial** dosage; 4 g IV in 20% solution and 5 g in each buttock deep IMI. Follow with **maintenance** dosage of 5 g IMI 4 hourly after seizure for 24 hours.

Toxicity: Monitor for levels of toxicity urinary output, respiratory depression, drowsiness, loss of consciousness and patelar reflexes. Serum levels of >3.5 mmol/ℓ indicate toxicity.

Antidote: 10% calcium gluconate (1 g in 10 ml) administered over a 10 minute period.

Side effects: Flushing, nausea, vomiting, muscle weakness, dizziness and discomfort at area of injection.

Duly, et al. (2010 Issue 8) (http://www.thecochranelibrary.com Accessed 28 April 2011)

The use of $MgSO_4$ more than halves the risk of eclampsia and reduces the incidence of first seizure when compared with other agents.

Emergency protocol:

- Prevent injury using cot sides.
- Turn the patient on her side; do not constrain.
- Suction, to prevent aspiration (use covered metal tongue spatulas and NEVER your fingers) and ensure an open airway.
- Give oxygen.
- Start IV infusion.
- Give medication (see $MgSO_4$ regime).
- After the patient has settled, assess labour and insert an indwelling catheter.
- Listen to the fetal heart.
- Do observations/high care.
- Transfer to the appropriate level (Multi-professional team).
- Deliver the baby. This can be through IOL, ventouse delivery or caesarean section depending on the duration of pregnancy and the status of the cervix.

Complications

Maternal complications of eclampsia may include death, permanent CNS damage from recurrent seizures or intracranial bleeds, disseminated intravascular coagulopathy (DIC), renal insufficiency, acute pulmonary oedema, hepatic failure or subcapsular haemorrhage, transient blindness, aspiration, cardiopulmonary arrest, injuries and death.

Obstetric complications may be placental abruption due to the high blood pressure.

Neonatal death includes factors such as prematurity, placental infarcts, intrauterine growth retardation, placental abruption and fetal hypoxia.

HELLP syndrome

The HELLP syndrome (haemolysis, elevated liver enzymes and low platelets) is a life-threatening condition that may be associated with pre-eclampsia but is often misleading, presenting with diffuse symptoms in pregnancy.

Clinical picture

The diagnosis of HELLP syndrome is frustrating and difficult. About 90% of patients present with generalised malaise, 65% with epigastric pain, 30% with nausea and vomiting, and 31% with headache, with or without proteinuria, mostly in the third trimester. The aetiology is unclear. Because early diagnosis of this syndrome is critical, any pregnant woman who presents with malaise or a viral-type illness in the third trimester should be evaluated with a full blood count and liver function tests. Because of the variable nature of the clinical presentation, the diagnosis of HELLP syndrome is generally delayed for an average of eight days. Many women with this syndrome are initially misdiagnosed.

The three main abnormalities found in HELLP syndrome are:

- *Haemolysis.* The haematocrit may be decreased or normal and is typically the last of the three abnormalities to appear.
- *Elevated liver enzymes.* The serum transaminase (GOT) levels may be elevated to as high as 4 000 U/ℓ, but milder elevations are typical.
- *Low platelets count is the best diagnostic criteria* (130×10^9). Class I (severe) - under 50 000/mm^3, Class II (moderately severe) - under 100 000/mm^3, Class III (mild) - above 100 000/mm^3. A positive D-dimer test in the setting of pre-eclampsia has recently been reported to be predictive of patients who will develop HELLP syndrome. The D-dimer is a more sensitive indicator of subclinical coagulopathy and may be positive before coagulation studies are abnormal.

Unless DIC is present, the prothrombin time, partial thromboplastin time and fibrinogen level are normal in patients with HELLP syndrome. In a patient with a plasma fibrinogen level of less than 300 mg per dL (3 g per ℓ), DIC should be suspected, especially if other laboratory abnormalities are also present.

Protein in the urine is of no value in HELLP syndrome but bilirubin may be present.

Two classification systems are used for HELLP syndrome:

- partial (one or two abnormalities)
- full syndrome (all three abnormalities) based on the number of abnormalities that are present.

Women with the full syndrome should be considered for delivery within 48 hours, whereas those with partial HELLP syndrome may be candidates for more conservative management.

Management

Women with class I HELLP syndrome are at higher risk for maternal morbidity and mortality than patients with class II or III HELLP syndrome. Laboratory abnormalities typically worsen after delivery and peak at 24 to 48 hours postpartum. The peak lactate dehydrogenase level signals the beginning of recovery and subsequent normalisation of the platelet count. The incidence of haemorrhagic complications is higher when platelet counts are less than 40 000 per mm^3.

Patients with HELLP syndrome who complain of severe right upper quadrant pain, neck pain or shoulder pain should be considered for hepatic imaging regardless of the severity of the laboratory abnormalities, to assess for subcapsular haematoma or rupture. Prompt recognition of HELLP syndrome and timely initiation of therapy are vital to ensure the best outcome for mother and fetus. Recent research suggests that morbidity and mortality do not increase when patients with HELLP are treated conservatively.

The treatment is immediate delivery of the baby. The risk is intra- or postpartum haemorrhage and the woman will receive platelets before or during the delivery (usually caesarean sections). The woman will be admitted to ICU until stable.

20.4 Hormonal disturbances in pregnancy

Diabetes mellitus (DM) in pregnancy

Definition

Diabetes mellitus (DM) is a metabolic disorder of insulin deficiency, which interferes with carbohydrate, fat and protein metabolism in the body. It is characterised by inappropriately elevated blood glucose levels (hyperglycaemia and glycosuria) and results in complications of physiology and organ function. The course of the condition is variable and depends upon both hereditary and ongoing environmental factors.

Classification of DM in pregnancy

In pregnancy DM can be classified as women with known DM or a family history of DM and women with gestational DM (a transient condition).

Gestational diabetes

This is diabetes mellitus that is diagnosed for the first time during pregnancy. Most cases are asymptomatic at first and therefore diagnosis can be difficult until later on or after the pregnancy.

Pregnancy, carbohydrate metabolism and diabetes

Pregnancy alters carbohydrate metabolism. Pregnancy is considered as a state of accelerated starvation or a diabetogenic state. The increased levels of oestrogen, progesterone and the human placental lactogen (HPL) present during pregnancy, produce resistance to insulin in the maternal tissues, therefore the blood sugar levels remain raised longer than in the non-gravid state. The fetus is dependent on the mother who actively transports glucose to the fetus. Insulin does not cross the placenta and the fetus produces its own insulin and metabolises glucose.

During pregnancy, there is normally a drop in the maternal fasting glucose level, from 4 mmol/ℓ at around 10 weeks gestation, to 3.6 mmol/ℓ at term. During the third trimester, the mother's body mobilises and utilises fat stores, which have been laid down in the first and second trimesters. This increases the circulation of free fatty acids and the woman becomes ketotic more easily than in the non-gravid state.

High levels of blood sugar in early pregnancy (before 20 weeks) are associated with fetal abnormalities and spontaneous abortions. In a woman with diabetes, the amount of glucose transferred is increased, the fetal insulin response is rapid, resulting in increased fetal insulin production and lower fasting blood glucose levels, which is thought to be the cause of macrosomia (large for gestational age). The fluctuation of blood sugar can cause sudden intrauterine fetal death in the third trimester.

Although oestrogen in particular causes increased insulin output, this is counteracted by Human placental lactogen (HPL) which is the major insulin antagonist in pregnancy. (It reduces the cellular utilisation of insulin.)

At term, therefore, when the placental hormones are at their highest levels, the body has difficulty in mobilising glucose for itself and for the fetus, even when the maternal blood glucose levels are low (hypoglycaemia).

Effects of DM on the pregnancy

Prior to the use of insulin women with DM used to be infertile or had habitual abortions. Often women were only diagnosed with DM after a period of infertility, habitual abortions or previous congenital abnormalities of the fetus or a history of intrauterine uterine death (IUD) or large babies (> 3.6 kg).

Fluctuations in blood glucose in pregnancy leads to a higher incidence of *Candida albicans*, macrosomia (a large fetus with immature lungs and liver), placental pathology such as large placentas with polihydramnios, sudden intrauterine death after 36 weeks and the risk of premature birth, hyaline membrane disease, respiratory distress, jaundice and infections in the newborn.

The woman has a higher incidence of pre-eclampsia and obstetric interventions and/or birth trauma due to the large fetus.

Pathophysiology

Control of DM is difficult due to the increased placental hormones, oestrogen and cortisol (which are insulin antagonists) that constantly increase as the pregnancy progresses and the placental function increases. There is also a loss of glucose in the urine throughout pregnancy, due to an increased glomerular filtration rate and a lower glomural ceiling for the re-absorption of glucose.

In early pregnancy the insulin requirements may drop. There is often increased early morning nausea and vomiting (hyper emesis gravidarum), which could lead to hypoglycaemia in a diabetic woman receiving insulin. There are reduced insulin and fasting blood glucose levels.

From 20 weeks there is a gradually increased requirement for insulin. As the fetus grows, the mother requires more carbohydrates and breaks down her own fat stores, resulting in ketosis.

There is an increased requirement for insulin after 30 weeks of pregnancy.

The fluctuation in blood sugar cannot be accommodated by the fetus who is dependent on the mother for glucose and sudden IUD is a common complication of DM even when under strict control.

There are extra demands on the glucose and therefore also on insulin during labour.

Altered carbohydrate metabolism throughout pregnancy can change dramatically after labour. The insulin requirements drop drastically as soon as the placenta is delivered and the dosage must be reduced or hypoglycaemic coma will result. Conditions of physical activity destabilise blood sugar control.

Identification and diagnosis of DM

History. This includes:

- ethnicity: DM is more common in the Tamil Indian population
- family history of DM
- history of infertility or abortions
- unexplained stillbirths or congenital abnormalities
- previous polihydramnios
- previous macrosomia/large babies: over > 4 kg
- previous infections or history of *Candida albicans* infections
- polydipsia.

Physical examination. This includes:

- glycosuria
- obesity/weight loss.

Special examinations/tests. These include:

- Routine urine test at each antenatal visit. If glycosuria is present in two consecutive visits, further tests are warranted.
- Random fasting blood glucose or modified glucose tolerance test can be done for cases under suspicion.
- Screening after birth. All women should be tested if infertile, have aborted, have a baby with congenital abnormality, or IUD of unknown cause, or had a macrosomic baby over > 4 kg. A HbA_{1C} (glycosolated haemoglobin) gives a retrospective history of the blood sugar over a period of a month. The blood sugar remains high for weeks postdelivery making it useful for diagnosis.

Modified glucose tolerance test

For three days before the test, the patient is instructed to have no alcohol or coffee and to increase her carbohydrate intake to 300 g per day. The patient then starves from 10:00 pm the previous night. In the morning, a fasting blood sugar is performed and the urine is tested for glucose. Thereafter, a glucose load of 75 g (as suggested by the WHO) is given orally and blood is taken at one, two and three hours. (The amount of glucose ingested varies from centre to centre.)

At three hours a blood sugar of > 8.1 mmol/ℓ of glucose in the blood is abnormal.

If the blood sugar is raised by 1:5 in the first trimester the risk for congenital abnormalities is increased.

Elevation of blood glucose levels in the third trimester is associated with macrosomia.

Care of the diabetic woman in pregnancy

Specialised care is required for a diabetic woman. The following are important:

- A team approach is most important in this condition. The team includes the specialist physician, the specialist obstetrician, the patient, the midwife, the paediatrician, the dietician and the social worker.
- If DM is present and recognised it is important to reduce blood sugar to a normal level before the patient becomes pregnant. Management should ideally start before conception.
- During pregnancy, maintain strict control of blood glucose in order to prevent complications. The aim of the treatment is to control the blood sugar level so that it never rises above 7 mmol/ℓ and never goes below 3.5 mmol/ℓ (prevent fluctuations).
- Carefully monitor fetal wellbeing in pregnancy. Early ultrasound will confirm that the fetus is normal and exclude the possibility of a multiple pregnancy. Follow-up ultrasounds monitor the growth and development of the fetus.
- Prevent or treat complications/ UTI and pre-eclampsia promptly.
- Decide upon the time and the mode of delivery in advance.
- Care for the newborn baby in a neonatal unit.
- Ensure postdelivery contraception.

Health education is extremely important, and this must include both partners, so that the woman and her husband/partner can understand the importance of strict control of the condition, particularly during pregnancy and longterm implications.

It is important that the patient wait for six to 12 months to stabilise the condition before becoming pregnant. She must also understand that she will need insulin therapy during pregnancy.

Nutrition is the single most important way to control the blood sugar. Daily activities and the home environment should be investigated. The patient should visit the dietician in hospital. The protein intake should be 100 g, the carbohydrate intake 200 g and the fat intake 60–89 g per day. The patient's weight gain should not exceed 10–12 kg in total. Meals should consist of three main meals a day, with snacks at 10:00 am, 3:00 pm, and 10:00 pm. Constant intake is important, but with no refined sugars. All food should be weighed. There should be increased fibre intake to prevent constipation and weight gain.

Teach the woman to monitor her blood sugar and give herself insulin, as well as the signs and symptoms of hypo- and hyperglycaemia and observations of the wellbeing of the fetus (kick chart after 26 weeks of gestation).

Insulin therapy

Human insulin is the therapy choice during pregnancy, as the mother does not produce antibodies to this type and it does not cross the placenta.

There are two types of insulin that can be used during pregnancy:

- Short-acting insulin (Actrapid®) which lasts from half an hour to six hours.
- Intermediate insulin (Monotard®) which lasts from two hours to 12 hours, and is given twice a day (in the morning and again in the evening).

Oral hypoglycemics are not given during pregnancy, because of their teratogenic properties (fetal malformation) and because they cause lactic acidosis.

The insulin requirements are determined and prescribed by the specialist who changes the regimen depending on the woman and fetus's requirements.

While in hospital, the woman's blood sugar is tested one hour before a meal/snack and two hours after each meal/snack. Long-acting insulin is given twice a day and short-acting insulin is given on a sliding scale. When the woman's blood sugar is stable she is allowed home but she needs to be warned that because she will be more active at home this will influence her insulin requirements. The patient must monitor her own blood sugar and work according to the sliding scale to inject herself.

The following factors may influence the blood sugar and warrant a readmission:

- unstable blood sugar may be caused by infections such as urinary tract infection or changed activities or lifestyle
- the development of pre-eclampsia.

Fetal compromise

From 32 weeks, ultrasound is done weekly, including the fetal biophysical profile. Fetal kick counts are carried out by the patient at home. If the fetal movements are reduced, a cardiotocograph non-stress test is carried out at 32 and 34 weeks. The medical practitioner may decide to do an amniocentesis to check the fetal lung maturity before delivery. Lecithin sphingomyelin ratio is not accurate in DM and the phosphatidylglycerol ratio (PGR) gives a more accurate result.

Critical periods: It is recommended that the blood sugar is checked fortnightly up to 28 weeks' gestation and weekly up to 34 weeks' gestation and then twice weekly up to delivery. Women are often readmitted for the period 34–36 weeks for control and observation when unexplained IUD usually occurs.

The time and mode of delivery

This is decided upon by the obstetrician and the physician, and depends upon the general condition of the woman and the fetus.

Caesarean section is avoided because of the risk of infection and poor wound healing in DM. The maturity of the fetal lungs is particularly important and corticosteroids are administered between 32–34 weeks. If the phosphatidylglycerol result is positive labour can be induced. If complications should arise before term, the baby is delivered at about 38 weeks' gestation. If there is little or no control of the diabetes, the baby is delivered as soon as lung maturity is confirmed.

Successful delivery depends upon:

- the control of pre-eclampsia if present
- the degree of polihydramnios
- the severity of the diabetes
- the age of the woman
- the obstetrical history.

Specific protocols during labour

Labour is physically demanding. This places demands on the glucose metabolism. If birth is planned, the long-acting insulin is discontinued in labour and the blood sugar is controlled by:

- an intravenous infusion of dextrose and saline
- blood sugar laboratory tests hourly
- administration of short-acting insulin on a sliding scale.

The first stage. An intravenous infusion with 5% dextrose is in place during labour. Hourly blood sugar levels are taken. The goal is to try to keep the blood sugar levels between 4.4–5.5 mmol/ℓ, 2–4 hourly. The intermediate insulin is discontinued the day before and short-acting insulin is given on a sliding scale in labour. Constant monitoring of the labour and fetal condition in essential.

If labour is induced, it may be necessary to ripen the cervix first with prostaglandins. Labour is not allowed to last longer than eight hours.

The second stage. The perineal phase must be shortened. The woman is delivered in the lithotomy position to manage any possible shoulder-girdle dystocia occurring with the large infant. A wide episiotomy is performed because of the large baby expected. Assisted delivery will be performed by the medical practitioner where necessary.

There is active management of the third stage.

Neonatal care

The fetus and neonate of a woman with DM is at risk. A paediatrician is present at the delivery. At delivery, the baby's blood glucose is checked, which is repeated every three hours after delivery until the baby's condition is stable. The baby is at risk of hypoglycaemia and hypothermia. Hypoglycaemia occurs because of the increased insulin that has been produced by the baby's pancreatic beta cells during intrauterine life, in response to the high maternal blood glucose levels, which are now no longer received by the baby.

Early feeding is commenced, and the mother may breastfeed. The baby may have an intravenous infusion with dextrose until the blood sugar stabilises.

The baby is admitted to high care and observed for potential complications that are increased in DM such as hyaline membrane disease, jaundice, infection, hypothermia, hypocalcaemia, hypomagnesaemia and macrosomia.

Other potential problems are congenital abnormalities (an enlarged heart due to myocardial hypertrophy, enlarged liver and adrenals), immaturity, macrosomia (large, overweight baby), flabbiness, lethargy, neuromuscular excitability, difficulty in feeding.

Postnatal care of the mother

There is a sharp reduction in maternal insulin requirements. The insulin requirements are re-assessed by the doctor after delivery.

A diabetic who is poorly controlled does not lactate adequately, so the neonatal progress must be carefully assessed. The patient must be monitored for hypoglycaemia and shock, by checking for sweating, drowsiness, tachycardia, disorientation, slurred speech and coma.

The mother must be given health education. She is prone to infections and any pyrexia must be noted.

Before discharge, the patient must be stabilised on insulin therapy and diet control.

When discussing contraception remember that the combined hormonal contraceptives may not be suitable and the risk of infection with IUD is increased.

The woman with DM needs to continue to visit the diabetic clinic after delivery, so provide a follow-up date. The woman is given advice on baby and self-care to prevent infections.

20.5 Thyroid disease in pregnancy

The physiological and hormonal changes in pregnancy alter thyroid function. Thyroid function tests should be interpreted carefully in pregnancy because an increase in plasma protein increases TSH while the free T3 and T4 remain the same. Thyroid function in pregnancy is normal when all the thyroid tests are normal.

The thyroid may enlarge 10–15% in pregnancy (not clinically noticed) but goitres are mainly associated with iodine deficiency. An ultrasound examination will identify abnormalities.

In the first 12 weeks the baby is totally dependent on the mother for thyroxin. By the end of the first trimester the fetus will start to produce its own thyroid hormones. The fetus remains dependent on the mother for iodine.

Graves' disease (hyperthyroidism)

The most common (80%) disease of the thyroid is hyperthyroidism that occurs in 1:500 pregnant women. Very high levels of human chorionic gonadotrophin (HCG) associated with hyperemesis gravidarum may cause hyperthyroidism. The diagnosis is made on history, clinical examination and blood tests as thyroid scanning is contraindicated due to the low radioactivity.

Effects on the mother

Beside the associated hyperemesis gravidarum, the woman is at risk of developing early onset pre-eclampsia. They can also develop an acute crisis called a 'thyroid storm'. The condition improves in the third trimester and worsens postnatally.

Effects on the fetus

Uncontrolled maternal hyperthyroidism has been associated with fetal tachycardia, prematurity, stillbirths, congenital malformations and intrauterine growth restriction.

Antibodies called thyroid stimulating immunoglobulin (TSI) cross the placenta and interact with the fetal thyroid. This can cause fetal hyperthyroidism. A test in the third trimester will indicate the condition.

When the mother is on treatment the fetus will be normal. In cases where the mother has a history of previous radioactive treatment the condition may be missed and the fetus will be affected. Drug therapy in pregnancy is safe and beneficial for the fetus. The mother on treatment can breastfeed but the baby needs to be tested from time to time.

Hypothyroidism in pregnancy

This autoimmune disease is called Hashimoto's thyroiditis. Approximately 2.5% of women will have a slightly elevated TSH of > 6 and 0.4% will have a TSH > 10 during pregnancy.

Effects on the mother

Untreated, or inadequately treated, severe hypothyroidism has been associated with maternal anaemia, myopathy (muscle pain, weakness), congestive heart failure, pre-eclampsia, postpartum haemorrhage, placental abnormalities and low birth weight infants. Most women with mild hypothyroidism may have no symptoms.

Effects on the fetus

The thyroid hormone is critical for brain development in the baby. Children born with congenital hypothyroidism (no thyroid function at birth) can have severe cognitive, neurological and developmental abnormalities if the condition is not recognised and treated promptly. These developmental abnormalities can largely be prevented if the disease is recognised and treated immediately after birth. Consequently, *all* newborn babies need to be screened for congenital hypothyroidism so they can be treated with thyroid hormone replacement therapy as soon as possible.

Clearly, woman with established hypothyroidism should have a TSI test once pregnancy is confirmed. Once hypothyroidism has been detected, the woman should be treated with levothyroxine to normalise her TSH and Free T4 values.

20.6 Cardiovascular system conditions

Anaemia and haemoglobinopathies in pregnancy

The cardiovascular changes in pregnancy are hyperdynamic. The blood volume of a women increases gradually in pregnancy with a peak volume at 32 weeks of pregnancy. The red blood cells also increase but not to the same degree. This has a diluting effect on the blood and a drop in haemoglobin known as the physiological anaemia of pregnancy. The ideal Hb in pregnancy is between 12.0 g/dℓ–14.0 g/dℓ (see Box 20.10).

20.8 Normal haematological values in pregnant women

Haemoglobin range: 12–16 g/dℓ
Platelets: 130 000–400 000 × 10^9/ℓ
Serum iron: 11,6–31,3 μmol/ℓ

Fifty percent of women are anaemic in pregnancy. The physiological changes in pregnancy predispose a woman to anaemia. Conditions that cause pathological processes include infections, poor nutrition, pregnancies that follow too soon (less than two years apart), ante- and postpartum haemorrhage and inherited blood disease.

20.9 Complications of anaemia in pregnancy (irrespective of cause)

An Hb of 6 g/dℓ is associated with a high mortality and cardiac failure.

Other complications include:

- preterm labour
- premature rupture of membranes
- fetal distress
- infections
- antepartum haemorrhage
- postpartum heamorrhage
- placental abruption.

Anaemia increases the risk of maternal mortality fivefold and the incidence of stillbirth increases sixfold. It is important to identify anaemia early to prevent complications.

Prevention of anaemia

The most common cause of anaemia in pregnancy is iron or folate deficiency. This is compounded by short birth intervals, HIV infection, hookworm, schistosomiasis or other parasitic diseases.

Iron and folate deficiencies are mainly nutritional in origin, so it is very important that midwives and other health professionals give correct, culturally sensitive nutritional advice. Midwives must encourage the pregnant mother to take appropriate iron and folate supplements if needed.

Table 20.2

Classification of anaemia in pregnancy

Degree	Haemoglobin (g/dℓ)	Haematocrit (packed cell volume) (%)
Moderate	11	24–37
Severe	Less than 10	13–23
Very severe	< 7	< 13

Table 20.3

Anaemias in pregnancy

Classification	Iron deficiency	Folic acid (megoblastic) B12	Sickle-cell anaemia	Beta–thalassaemia (minor) (Cooley's anaemia)	G6PD deficiency (Glucose-6-phosphate dehydrogenase)
Definition	Anaemia due to depletion of iron	Deficiency of folic acid	Inborn genetic defect. 1:5 000	Autosomal recessive condition	Sex-linked red blood cell enzyme
Cause	Malabsorption Breastfeeding and children too close < 2 yrs apart Infections Blood loss Depleted iron stores	Poor diet over 18 week period Malabsorption Intake of folic acid antagonist	Inherited Common in West Africa 1:10 carries the gene. Sickle-cell trait (carrier) 0.3% of black people Begins in childhood and is lifelong. One-third of all indigenous inhabitants of sub-Saharan Africa carry the gene.	A high incidence among Mediterranean people 1:25 is a carrier. 1:2 500 have the disease	Genetic
Pathology	A mature women has total body content iron 3 500–4 500 mg in haemoglobin 20% in body stores (ferritin) 5% in muscle and enzymes Iron status is not static. The life of an erythrocyte is 100–120 days. Non-pregnant women need an intake of 2 mg of iron/day. 27 mg needed to replace dead skin and cells daily. Non-anaemic women need 2 mg per day. Pregnant women need 425 < mg over 40 weeks (4.5 mg/day). Fetus needs 300 mg and placenta 25 mg. Most in last 10 weeks. Diet of animal products gives 12 mg/day.	Folic acid and vitamin B are needed for the formation of haeme, the pigmented, iron-containing portion of the haemoglobin in red blood cells (erythrocytes). A deficient intake of folic acid impairs the maturation of young red blood cells, which results in anaemia. The disease also is characterised by leukopaenia (a deficiency of white blood cells, or leukocytes), by thrombocytopenia (a deficiency of platelets), by ineffective blood formation in the bone marrow.	Haemoglobin *S* causes erythrocytes to take a sickle-cell shape. Capillaries become occluded and lack of oxygen to tissue takes place. Some are without symptoms, others have life-long complications. During stress, hypoxia, acidosis, high fever, dehydration, emotional and physical stress.	Alpha thalassaemia (affected fetus has one gene from each parent) cannot synthesise Hb = hydrops fetalis. Only one gene (carrier with mild symptoms). In Beta thalassemia the baby will be anaemic and require blood transfusions to survive. Problems throughout life. Paleness, degrees of jaundice, hepatosplenomegaly with retarded growth and development.	RBCs depend on G6PD for sole pathway to mature. RBCs are most susceptible to insufficient G6PD. This results in acute haemolytic anaemia. Drug-induced haemolysis affects older cells. Younger cells have adequate enzyme levels to survive. G6PD mutations occur on distal long arm of C chromosome. Usually asymptomatic.

continued

Management	WHO recommends 120–240 mg iron and/500 g folic acid. Prophylaxis: Routine supplementation of pregnant women with oral iron. Ferrous sulphate 320/day with Vit C 500 mg (Fefol) Nutrition NB Best absorption when taken with orange juice in-between meals. Average women cannot manage more than 600 mg/day Ferrous gluconate 600 mg 3 x/day.	NB prophylactic to all mothers in pregnancy. Begin 3 months prior to pregnancy. Reduce the risk of open neural tube defects by 50%.	Hb – varies between 6–8 mg%. Management is symptomatic. Higher risk for abortion, stillbirth, neonatal deaths and preterm labour 10–20% of women have an acute crisis in pregnancy due to anaemia. Cardiomegaly/cardiac failure may occur. Mortality 25%.	Iron intake contraindicated. Not responsive to routine treatment. Higher risk for infection.	Nutrition supplementation and avoiding certain drugs are important. A list of drugs needs to be avoided. It haemolyses RBS Aminophylin Nitrodantin Quinine Sulphas Vit K
Treatment	Oral iron treatment to raise Hb in 4 weeks. Intravenous or intramuscular iron treatment in last trimester. Blood transfusion of packed cells in last trimester.	Folic acid 5 mg per os	Blood transfusions may be needed for the mother. Children born with sickle-cell disease will undergo close observation by the pediatrician and will require management by a haematologist to assure they remain healthy. These patients will take a 1 mg dose of folic acid daily for life. From birth to five years of age, they will also have to take penicillin daily due to the immature immune system that makes them more prone to early childhood illnesses. Bone marrow transplants have proven to be effective in children. Folic acid therapy for life.	Repeated blood transfusion is needed to maintain life. Removal of spleen seems to be beneficial.	No iron supplementation

The following WHO protocol is recommended:

- Midwives and other healthcare professionals should be trained to give advice on dietary intake and to recognise anaemia for appropriate action.
- Facilities should be available for estimating haemoglobin concentration levels accurately.
- Iron, folate and vitamin C (where appropriate) supplements should be available for pregnant women.
- Facilities should be available for screening for malaria and other parasitic diseases.
- Malaria should be controlled in affected areas.
- Appropriate referral systems should be in place.

Anaemia is a deficiency in either quality or quantity of red blood cells. There is some debate about the level of haemoglobin below which anaemia may be diagnosed in pregnancy. However, WHO guidelines (2006) use > 11 g/dℓ as indicating that there is no clinical anaemia, 7–11 g/dℓ mild anaemia and < 7 g/dℓ as severe anaemia. These guidelines are used in conjunction with clinical signs such as pallor, breathlessness and fatigue (see Box 20.11).

Assessing haemoglobin concentration

Haemoglobin levels may be difficult to estimate in developing countries, making clinical screening for anaemia extremely important. Although clinical signs may be considered subjective and less sensitive, they can still aid clinicians in their diagnosis. Signs include paleness of conjunctivae, skin and nail beds, and symptoms of severe anaemia might include tiredness and shortness of breath. Two quick and simple tests are the Tallquist test and copper sulphate method. These tests use finger-prick blood. They are easy to carry out and results are rapid, visible and suitable for clinicians working in rural areas. Major obstetric units use more sophisticated and expensive methods, but the technology used may not be applicable to developing countries as the instruments may require skilled technicians to provide frequent maintenance and to ensure correct calibration. However, it is clear that successful management of anaemia in pregnancy depends on reliable techniques for the detection of anaemia, with subsequent reliable monitoring of the response to treatment.

Diagnosis and management of anaemia in pregnancy

All pregnant women are given routine iron and folic acid supplements in pregnancy and need to understand how to take these and the importance of the daily dose. The role of the midwife is the early identification of anaemia and risk factors for anaemia. History taking will reveal women at risk for anaemia in pregnancy. All women need to have a Hb test at first visit. A low Hb in first or early second trimester needs to be rechecked by a laboratory full blood count test. The Hb test is repeated in the second trimester.

If a patient does not respond to oral therapy, further investigations are needed for accurate diagnosis. Refer the woman for medical intervention.

Blood tests for iron studies, folic acid and other genetic conditions may be needed. Treatment of the anaemia is specific to the type of anaemia diagnosed. The aim is to have a Hb of not less than 9 g/dℓ at birth. Every woman's Hb is tested on admission for labour and compared with previous results. A woman with a low Hb may receive a blood transfusion prescribed by the medical practitioner. There is a high risk of placental abruption, ante- and postpartum haemorrhage and fetal distress in labour. A pregnant woman is never given whole blood in pregnancy unless she is bleeding and hypovolaemic. Packed cells are the treatment of choice.

20.10 Physiological changes in the cardiovascular system in pregnancy

Blood volume:

- Plasma gradually increases by 50% by end of second trimester and reaches peak volume at 32 weeks.
- This provides an increased vascular bed for mother and baby.
- In a multiple pregnancy, there is a similar increase for each fetus.
- Red blood cells increase (18%) but not at the same rate as plasma, predisposing women to physiological anaemia.

20.11 A guide to laboratory values indicating anaemia in pregnancy

- Haemaglobin 11 g/dℓ
- Haematocrit < 0.37 l/ℓ
- Mean cell volume (MCV) < 70 fl (hectolitres): possible thalassaemia, further tests needed
- MCHC (mean cell haemoglobin concentration): < 33
- Serum ferritin: < 50 μg/ℓ indicates that anaemia is likely to develop, < 10 μg/ℓ indicates severe depletion.

Cardiac conditions in pregnancy

Woman with known cardiac problems are usually under supervision from the beginning of pregnancy. However it is not uncommon for cardiac problems to be identified for the first time during pregnancy because the pregnancy places a demand on the cardiovascular system.

The changes in the cardiovascular system during pregnancy are described in Chapter 14.

During labour 500 ml of blood is forced back into the heart and vessels with each contraction during the third stage of labour and there are further haemodynamic shifts during delivery of the placenta.

These cardiovascular changes can be accommodated by a woman with a healthy heart, but not by a woman with cardiac disease.

20.12 The classification of cardiac disease (The New York Classification)

The classification of cardiac disease is made by a cardiologist or a team of cardiologists based on symptoms and functionality:

- Grade I

There are no symptoms of the cardiac disease. Although cardiac damage is present, there is no limitation on physical activity.

- Grade II

The person is comfortable at rest (and on slight exertion). Normal (ordinary) physical activity causes tachycardia, dyspnoea and fatigue.

- Grade III

The person is comfortable at rest. Slight exertion or any activity causes tachycardia, dyspnoea and angina.

- Grade IV

The person has dyspnoea at rest and symptoms of cardiac insufficiency.

Some authorities consider any patient who has had cardiac surgery as having grade IV cardiac disease in pregnancy.

The effects of cardiac disease on pregnancy

Cardiac disease is extremely important in pregnancy, because it raises maternal morbidity and mortality rates. Fetal and neonatal death rates are also higher in women with cardiac disease.

Two-thirds of the deaths occur in the first 48 hours after delivery. Three-quarters of the deaths are from:

- congestive cardiac failure
- acute pulmonary oedema (this is the main cause of death in the puerperium and occurs mainly in the first 24–48 hours after delivery)
- bacterial endocarditis
- rheumatic fever prior to pregnancy and resulting in valve incompetence (mitral stenosis)
- peripartum cardiomyopathy (PPCM).

The effects of cardiac disease on the fetus

The adverse fetal conditions associated with cardiac disease in pregnancy are due to maternal hypoxaemia, especially if cyanotic heart disease is present, causing:

- intrauterine death, or intrauterine growth retardation and small for gestational age babies, asphyxia neonatorum, and possibly neonatal death
- pre-term labour and pre-term babies, with all the associated complications.

In rheumatic heart disease, the clinical deterioration is slower and more predictable, whereas in other cardiac conditions the change can be dramatic (from any grade, to sudden cardiac failure and death).

In addition, a patient who has congenital heart disease has a 2–4% chance of delivering a baby with a congenital heart abnormality.

The effects of pregnancy depend to some extent upon the grade of cardiac disease before pregnancy.

Causes and incidence

The physiological condition of pregnancy alone can burden the heart and result in cardiac problems.

Congenital cardiac abnormalities account for 75% of cardiac problems in pregnancy. Congenital anomalies include patent ductus arteriosis (PDA), ventricular septal defect (VSD), atrial septal defect (ASD), tetralogy of Fallot, pulmonary stenosis (PS), VSD with an over-riding aorta, and hypertrophy of the left ventricle, and Eisenmenger complex (PS, VSD and ASD). Not many patients reach childbearing age with untreated congenital heart disease.

Other cardiac conditions include:

- rheumatic heart disease 25%
- endocarditis (including damage to the mitral valve and/or disease of the mitral valve) and carditis
- myocarditis: viral infection associated with malnutrition (congenital endomyocardial fibro-elastosis, found in black women)
- bacterial endocarditis
- cor pulmonale: hypertensive cardiac disease
- peripartum cardiomyopethy (PPMC) found in women without a cardiac problem (primigravidae and young women) from the last month in pregnancy and first six months postpartum with a 15% mortality.

Factors that aggravate cardiac conditions are:
- anaemia
- respiratory infection
- febrile disease
- excessive exercise
- emotional upset
- hypertension
- pre-eclampsia
- other infections.

Diagnosis in pregnancy

In pregnancy women with a known cardiac condition are under specialist care of a cardiologist.

The midwife needs to be able to recognise new or previously undiagnosed cardiac symptoms.

Cardiovascular assessment in pregnancy

Often pregnancy is the first time that possible cardiac disease is suspected, noted and diagnosed. A history of previous rheumatic fever, tiredness, low blood pressure, or shortness of breath should alert the midwife.

The physical examination includes vital signs, blood pressure, body mass and the maternal upper arm circumference (MUAC). Investigations include urine testing.

The skilled midwife with post basic training is trained in specialised history taking and general examination of the chest and lungs and will be able to detect and refer appropriately.

Medical diagnosis. When cardiovascular problems are suspected the woman is referred to an obstetrician and a cardiologist. The diagnosis will be made on the following:

History. This includes:
- previous heart failure, with syncope during exertion
- previous heart failure during pregnancy
- age, parity, socio-economic status, type of work and the type of cardiac lesion.

Physical examination. This includes:
- any murmurs
- any extra sounds (third heart sound)
- displaced apex beat (from the fourth intercostal space and to the left).

Other signs and symptoms. These include:
- oedema
- crepitations in lung bases
- cough and haemoptysis
- orthopnoea (breathlessness, particularly when lying down)
- progressive dyspnoea on effort (progressive difficulty in breathing)
- paroxysmal nocturnal dyspnoea (attacks of breathlessness occurring at night, caused by fluid in the lungs when lying down at night)
- fatigue
- cyanosis
- chest pain.

Cardiac observations. These include:
- bounding pulse or thin, thready pulse
- irregular pulse
- tachycardia (at rest 100 beats per minute or more)
- clubbing of fingers (chronic cardiac disease)

Specific heart abnormalilties. These include:
- specific heart murmurs
- irregular heart rhythms
- heart enlargement.
- pulsation or thrill in chest
- signs of congestive cardiac failure, which include: cyanosis, turgid neck veins, and enlarged, tender liver, due to engorgement.

Special investigations. These include:
- electrocardiogram (ECG)
- chest X-ray
- echocardiography
- exercise tolerance test
- respiratory gases
- cardiac reserve test.

Assessment is more difficult in the second half of pregnancy, therefore, it is better to try to assess the condition early in pregnancy.

Treatment and care

Women with diagnosed cardiac problems and newly identified cases in pregnancy are under the supervision of a multidisciplinary team with a cardiologist or specialist obstetrician as supervisor.

Ideally, the cardiac patient should have preconception counselling. Before becoming pregnant, the patient is advised to see a cardiologist. Surgery will be advised in selected cases. Some women are advised against pregnancy altogether.

The aims of treatment in a pregnant woman with a cardiac condition are:
- to prevent congestive cardiac failure
- to assess the need for prophylactic treatment against subacute bacterial endocarditis

- to prepare the patient for labour
- to provide the correct treatment throughout pregnancy, labour and the puerperium
- to return the woman to at least the cardiac grade she was in before pregnancy.

The woman attends antenatal clinic every two weeks until 28 weeks. Thereafter, she attends every week until hospitalisation is necessary.

A careful watch is kept for:

- hypertension (superimposed pre-eclampsia or any rise in blood pressure)
- anaemia
- infection of any kind
- emotional stress, such as fear and anxiety
- multiple pregnancy
- polyhydramnios
- pre-term labour
- tachycardia
- cardiac arrhythmias
- oedema.

A watch is kept for signs of congestive cardiac failure and/or pulmonary oedema, which can be sudden and dramatic. These include:

- *Congestive cardiac failure.* Increasing dyspnoea and cyanosis, oedema and tachycardia. Abdominal discomfort (due to liver engorgement as a result of blood backing up in the hepatic veins) may be present with cold clammy skin, fatigue and a distended jugular vein.
- *Pulmonary oedema.* This is usually as a result of left-sided heart failure. Signs and symptoms include cyanosis, dyspnoea and orthopnoea, frothy sputum and haemoptysis, grunting and wheezing, paryoxysmal nocturnal dyspnoea.

Women with dental caries and poor mouth hygiene (which could result in bacterial endocarditis) must be referred to a dentist.

All infections are treated promptly. An antibiotic is prescribed if required. Any surgical procedure is dangerous, such as dental extraction or amniocentesis, because of infection and bacterial endocarditis. In some cases women are on lifelong prophylaxis with penicillin. Women are hospitalised for any infection, for example a urinary tract infection.

Grade I and II cardiac patients are assessed every two weeks and pre-term labour is excluded by assessing the cervical score.

Grade III and IV cardiac patients are usually hospitalised throughout pregnancy and certainly from 28 weeks' gestation.

Pharmacological treatment

All medication is prescribed by the cardiologist or specialist obstetrician and will include medication specific to this pregnancy and chronic cardiac medication.

Principles and protocols of midwifery care

The midwife must pay attention to several factors:

Health education. It is particularly important that the patient knows and understands her condition and the health consequences, the importance of regular antenatal attendance and the signs and symptoms of congestive cardiac failure. She should report to the clinic immediately if any of the following occur:

- dyspnoea (progressive)
- cough
- symptoms suggesting anaemia
- haemoptysis
- palpitations
- fainting (syncope)
- paroxsymal nocturnal dyspnoea
- orthopnoea
- any infection.

Rest. The patient is encouraged to get 10–12 hours' rest at night and two hours in the afternoon. She will require reassurance, understanding and support from the midwife. Relaxation should be encouraged and she is advised to avoid any strenuous effort or work.

Assessment of the woman's personal circumstances. The home circumstances, the financial status, help at home, transport facilities, the nearest clinic and the woman's occupation must all be assessed.

Nutrition. A dietician will help the woman with advice on a balanced diet and weight control.

Medication. Stress the importance of taking prescribed medication and highlight side-effects so that the woman can seek help if these occur.

Exercise. The level of exercise depends on the severity (grade) and type of the disease. The woman should avoid undue exertion at 28–32 weeks, because of the peak in blood volume during this period and the risk of cardiac failure. Women are hospitalised if circumstances at home will not allow for bed rest and support.

Compression stockings. These can be prescribed and must be worn to improve venous return and cardiac stability and to prevent deep vein thrombosis.

Admission. The woman is admitted near term because women with cardiac disease often deliver very quickly when labour starts.

The fetuses in women with cardiac disease may be small. The patient should deliver in hospital under specialised medical and obstetrical observation and care.

Ideally women with cardiac disease are hospitalised if diagnosed with Grade III and IV and if any complications occur, such as: cardiac symptoms and bacterial endocarditis, infections such as urinary tract infection, vaginal infections or chorioamnionitis, HIV or other sexually transmitted infections, pre-eclampsia, or obstetric problems such as multiple pregnancy or placental insufficiency, intrauterine growth impairment and placenta praevia.

Care. The patient is kept on total bed rest in Fowler's position. In a cardiac patient the heart must always be higher than the rest of the body. Medication is given as prescribed. The patient is encouraged to get plenty of sleep and rest.

Observations are those specific to cardiac failure and pulmonary oedema and infection:

- pyrexia
- tachycardia
- tachypnoea, dyspnoea
- sore throat
- any local inflammation
- pain
- oliguria.

Risk. The patient is at risk of cardiac decompensation if she develops an infection. She is particularly at risk from commensals (normal bacterial inhabitants) of the genital tract, such as Gram-negative anaerobic streptococci. Routine septic workups include urine MC& S, vaginal and throat swabs, RPR, HIV status and full blood count.

Constipation is prevented through a balanced diet and prescribed medication.

The risk of thrombosis is increased with bed rest, therefore compression stockings should be used.

The birth processes. A vaginal delivery is the safest way for a woman with a cardiac condition to give birth, as long as there is expert obstetrical, medical and nursing management available and there are no obstetrical complications.

Obstetrical complications such as cephalopelvic disproportion, intrauterine growth retardation, placenta previa and breech presentation may warrant a caesarean section, if possible under epidural/spinal anaesthesia. Specific complications of caesarean section in women with cardiac disease include: infection, post-operative thrombosis and pulmonary complications due to difficulty with coughing and breathing post-operatively, as well as the after-effects of general anaesthesia, which also causes increased pulmonary complications.

First stage care protocol

Type of delivery. Labour is allowed to start spontaneously. Induction is not advised.

Analgesia and sedation are given to reduce pain and anxiety. Epidural analgesia is ideal. However, it can also be dangerous in certain cardiac conditions due to the vasodilatation and drop in blood pressure. The epidural/spinal anaesthesia is performed by a qualified anaesthetist. Anaemia must be treated before birth and ideal Hb is ≥ 10 g/dℓ.

Fluid balance. An intravenous patent line is established but remember that fluid is restricted in labour. A micro-dropper and buretrol are used to monitor fluid intake (with a dial-a-flow or device to control fluid intake), particularly if oxytocin is administered. A central venous pressure (CVP) catheter may be passed so that pulmonary arterial and wedge pressures and left atrial pressures can be monitored.

Medication. Pulmonary oedema should be prevented by controlling and limiting intravenous fluids and giving diuretics early in labour if there is any suspicion of the condition. The medications used are furosemide, morphine, aminophyline and digoxin.

Antibiotic prophylaxis is used in prolonged labour, manual removal of the placenta, caesarean section, and in women who have prosthetic valves.

Women on anticoagulants have usually been admitted at 37 weeks and started on intravenous heparin therapy. Heparin is stopped at the start of labour (or two hours before caesarean section). Anticoagulant therapy is started again with warfarin or heparin 12 hours after delivery unless there is excessive bleeding.

Anticoagulants may be administered, particularly with previous valve surgery, prosthetic valves, presence or incidence of thrombosis in pregnancy and tachyarrhythmias. Heparin is used in the first trimester and at 36 weeks. It is discontinued a few hours prior to delivery.

Observations. Standard observations of labour and the fetus are carried out (see *Juta's Clinical Guide for Midwives*). Additional observations include intake and output, a cardiac monitor to measure the apical pulse beat and to watch for arrhythmias in serious heart conditions, plus oximetry for oxygenation observation. *Fluid management is essential.* A microdropper, infusion pump or dial-a-flow is used to control fluids in labour.

Position in labour. The woman should be in an upright position in bed or in a high Fowler's position and the heart is always higher than the rest of the body. The woman cannot lie flat for abdominal palpation or vaginal examination.

Good pain relief is needed to prevent exhaustion. Epidural may be valuable if not contraindicated.

Vaginal examinations and the early artificial rupture of membranes are restricted and are only performed when indicated due to the risk of infection.

Oxygen is administered by face mask at 4–6 ℓ per minute.

The emergency trolley is on hand and the woman is cared for in the second stage room (delivery room) ready for the birth with a midwife in constant attendance. The woman is never left alone.

Second stage care protocols

The second stage places an extra burden on the heart as it is overloaded with each contraction of the uterus, as well as during bearing-down, and trauma, shock, and haemorrhage need to be prevented. A paediatrician is usually present for the delivery.

The labour is very carefully monitored and assessed, and prolonged labour is avoided.

In the second stage, adequate analgesia (if no epidural is performed) such as a pudendal nerve block, or local anaesthetic (without adrenaline) is infiltrated into the perineum, after which an episiotomy is performed.

Forceps delivery is usually indicated to minimise bearing-down and to shorten the second stage.

The woman is never placed in a lithotomy position. A high Fowler's is maintained in second stage and the knees must always be lower than the heart to prevent venous return that overloads the heart.

If a women needs fluid replacement in case of haemorrhage a haematologist should be involved. The haemoglobin, haematocrit and coagulation are carefully monitored as well as the central venous pressure. Packed cells are preferred to whole blood administration.

Third stage care protocols

The third stage of labour has the highest risk of cardiac failure when the uterus contracts and 500–1 000 ℓ of blood is pushed back into the cardiovascular system after the delivery of the placenta.

The active management of the third stage of labour only uses oxytocin and no postdelivery ergometrine is given. After delivery the uterus contraction is maintained with intravenous infusion on 20 IU oxytocin.

NB: A diuretic is sometimes given very slowly intravenously postdelivery on prescription.

Postpartum care

The woman is under strict observation for the fourth stage (six hours) and is nursed in the intensive care unit (ICU) for 48 hours after delivery because of the danger of acute pulmonary oedema, cardiac failure and death.

There is increased venous return to the heart, caused by the removal of vena caval compression, and from the extra blood and vascular fluid in the general circulation from the contracted and retracted uterus.

The woman is on bed rest and encouraged to get as much sleep and rest as possible. The patient is nursed in Fowler's and semi-Fowler's position and given oxygen.

Deep breathing and passive exercises are encouraged, to prevent pulmonary complications.

Early ambulation after 24 hours is also encouraged once the patient's condition is stable, to prevent thrombosis.

The intake and the output of fluids are carefully measured because of the risk of pulmonary oedema.

Breastfeeding is encouraged unless contraindicated in Grade IV or in cardiac failure.

Contraception: Grades I and II who are well compensated after delivery may use contraception. However, Grades III and IV are discouraged from using contraceptives, and may be advised to consider tubal ligation. If the patient chooses a tubal ligation and has an epidural, the operation can be performed while the epidural is *in situ*, to avoid a second anaesthetic.

It may be necessary to refer the patient to a social worker. Help at home must be arranged to allow the patient to rest as much as possible.

Women are only discharged when cardiovascular stability is confirmed.

20.13 Peripartum cardiomyopathy (PPCM)

Peripartum cardiomyopathy (PPCM) is a condition presenting in late pregnancy and after birth in which women may develop life-threatening cardiac failure. The cause is unknown but it is thought to be autoimmune damage to the left ventricle. The redistribution of blood to the breasts after birth places a burden on the heart and breastfeeding is contraindicated in these cases. Symptoms of cardiac failure develop in the last month of pregnancy and five months after birth in women who have never had cardiac problems. This often starts with a cough and flu-like symptoms and is overlooked. PPCM can occur in any woman, at any age during reproductive years, and in any pregnancy.
The incidence is 1:1 000 in South Africa and is genetic. The mortality in a study (2005) in Soweto of 100 cases was 15% and only 23% of women fully recovered after six months of standard treatment. Midwives need to have a high index of clinical suspicion and screen women appropriately during the antenatal period focusing on the third trimester and early postnatal period.

Women are referred for follow-up care to the cardiac clinic for observation and re-evaluation of medication, treatment regimes and surgery if needed.

NB: Midwives in primary healthcare centres need to look out for PPCM in women without previous cardiac problems for six weeks postnatally.

20.7 Surgery during pregnancy

Pregnant women may need general surgery for nonpregnancy-related conditions that may arise. If the condition is life threatening, the surgery will be carried out during pregnancy. The fetus is usually not affected by the general anaesthesia but the use of medication, infections and hypovolaemia may carry a risk for the fetus.

Brummer, Cronje, Grobler and Visser (1990:223) suggest the following principles to be considered for surgery in pregnancy:

- The mother's life always takes preference over that of the fetus.
- Changed anatomy and physiology can mask the diagnosis. The organs are in a new relation, masking symptoms.
- Under stress the maternal homeostasis will favour her wellbeing at the cost of the fetus.
- The fetus is completely dependent on the mother and hypotension and hypovolaemia must be corrected fast and effectively.
- Owing to the hyperdynamic cardiovascular system and enlarged blood vessels, bleeding will be profuse and fast.
- After 20 weeks the enlarged uterus will cause the inferior vena cava syndrome, which will complicate matters.
- The changes of the sphincters and the displacement of the stomach increase the risk of aspiration during induction of anaesthesia. The stomach takes 12 hours to empty in pregnancy. Induction of anaesthetics must be adapted in pregnancy.
- The fetal heart rate must be determined before any operation, because its absence may modify the procedure.
- The effect of emergency medication on the fetus must be considered.
- Women might not always know that they are pregnant when presenting with problems. X-rays are to be avoided or the abdomen screened.

Pre- and postoperative care needs to be adapted for pregnant women. The woman will be in a gynaecological ward if under 14 weeks. The woman needs to be observed for contractions and the fetal heart should be observed. In late pregnancy the women may be in high care depending on the surgery risks.

20.8 Epilepsy in pregnancy

An epileptic seizure is a paroxysmal discharge of the cerebral neurons, resulting in a clinical event, which may or may not be apparent to the subject and/or an observer.

The more the disease is controlled prior to pregnancy, the less likelihood there will be of further deterioration during pregnancy. If the patient suffers from seizures, a neurologist is consulted.

The effect of pregnancy on epilepsy

Women with known epilepsy will consult the neurologist for a reassessment of medication for the condition while pregnant.

Those women with secondarily generalised and partial complex seizures are most likely to have an increase in seizures during pregnancy.

The effect of pregnancy on the condition varies greatly and depends on the degree of control.

Drug absorption

Drug absorption from the bowel may be reduced during pregnancy. The fluid retention in pregnancy increases the available volume for distribution of anticonvulsant drugs. Therefore, the dilution tends to lower the serum levels of the drug. The liver develops an increased capacity for hydroxylation of some anticonvulsants, for example phenytoin. Therefore, increased clearance and changes in volume of distribution may result in a fall in serum levels.

Epilepsy medication may cause lowered serum folate concentrations, and occasionally megaloblastic anaemia (folic acid deficiency) occurs.

The long-term use of phenytoin and phenobarbitone induce clinical osteomalacia and rickets, although hypocalcaemia is more common, because these drugs increase the hepatic metabolism of vitamin D.

Those patients requiring medication should be given as low a dose as possible and serum and/or salivary levels of the drugs are checked during pregnancy. The patient must be carefully observed for status epilepticus.

Pre-pregnancy management

It is advisable that a person with epilepsy consult a medical practitioner before pregnancy. Supplements of folate (folic acid) and vitamin D may be necessary due to the effect of the medication on the absorption of the vitamins. Pre-pregnancy,

the medical practitioner can start with a slow withdrawal of anticonvulsants if the patient has had no attacks for about three years. There is a significant risk of teratogenesis with some of the drugs used to control seizures. The fetal abnormalities include:

- cleft lip
- cleft palate
- congenital heart disease.

The effect of the seizures on pregnancy and on the fetus

These include:

- low birth weight (LBW) babies
- reduced circumference of the head
- increased stillbirth rate
- fetal hypoxia due to the trauma of the seizures, especially with prolonged seizures or when status epilepticus occurs
- increased risk of pre-term birth.

The effect of drugs on the newborn

There is an increased incidence of haemorrhagic disease. This is due to deficiencies in clotting Factors II, VII, IX, and X, as well as in vitamin K, caused by the epileptic drugs. Vitamin K given to the mother in pregnancy could prevent this.

Impaired suckling occurs with drug withdrawal.

Other effects include:

- hyper-excitability
- occasional seizures
- tremulousness
- slower weight gain
- failure to thrive
- increased perinatal mortality.

Phenytoin should be avoided in pregnancy, as the baby develops fetal phenytoin syndrome which includes:

- craniofacial anomalies
- IUGR
- mental retardation
- digital hypoplasia.

The children of women with epilepsy have an increased risk of developing epilepsy in later life, except in cases where the epilepsy is caused by head trauma or infection.

Care of a women with epilepsy

The care during fits is very similar to that given during an eclamptic fit (see Chapter 20).

The differential diagnosis of an epileptic fit:

- eclampsia
- hypoxia
- hypernatraemia
- hypoglycaemia
- tetany
- drug withdrawal.

The woman can give birth normally unless there is an obstetric problem and she is allowed to breastfeed provided that her condition is well controlled. Barbiturates can cause drowsiness in breastfed babies. The patient requires reassurance, encouragement, support and a positive outlook.

20.9 Tumours in pregnancy

Tumours of the breast

Incidence

Fifteen percent of women of 40 years and younger develop tumours in the breast, and 1% of women do so during pregnancy.

Clinical picture

Itching, pain, nipple discharge or bleeding, lumps in the breast or under the arm.

Diagnosis

All women should have a bilateral breast examination during pregnancy and are encouraged to do self-examination on a monthly basis (See *Juta's Clinical Guide for Midwives*).

Check for a family history of breast cancer, parity and previous breastfeeding. Examine the breasts on each visit and in the postnatal ward.

Ultrasound can be done if a lump is detected.

Medical management

This depends on the type of tumour and whether or not it has already spread. Fine needle aspiration biopsy is carried out, with further investigations if the lump is malignant.

Treatment may be by lumpectomy or mastectomy with removal of axillary nodes. Further treatment includes radiotherapy and chemotherapy, which may be delayed until after birth.

Cancer of the cervix

Cervical cancer is found in 1:3–5 000 women at routine Pap smear. One in 200 women attending antenatal clinic will show abnormal cell changes of the cervix.

Clinical features

A watery, bloodstained discharge from the cervix, and frank bleeding.

Medical management

All women should have a Pap smear in pregnancy before 28 weeks of pregnancy or at the six week postnatal examination.

Pregnancy is an ideal time to screen women for cancer of the cervix. The hormones of pregnancy affect the cells of the cervix after 28 weeks and abnormal cells will be found.

If the Pap smear is suspect, a repeat test is done.

Thereafter, colposcopic assessment may be done by an experienced colposcopist.

A punch biopsy can be done, and the following results could be found:

- normal epithelium
- dysplasia
- carcinoma-in-situ
- invasive carcinoma.

The patient must be assessed by a specialist. The treatment depends on many factors and is individualised. The patient and her partner require counselling.

If cervical intra-epithelial neoplasia (CIN) is *in situ*, it is usual to wait until after pregnancy to treat it. (The degree of CIN is determined by the extent to which the neoplastic cells involve the full thickness of the cervical epithelium.)

Other treatment includes:

- cryotherapy
- diathermy
- laser or cone biopsy.

If the cancer is invasive, radical treatment with radiotherapy is given. The woman and her family need empathy, support, information and encouragement. A postpartum follow-up is essential.

Complications

The abortion rate is 20%. There is an increased incidence of preterm labour. Haemorrhage from the cervix occurs in 15% of cases, sometimes immediate, sometimes delayed until the later stages of the disease.

Vulval and vaginal cancer

These forms of cancer are rare in the reproductive age group. Very occasionally the intra-epithelial type may occur.

Ovarian cancer

The occurrence is 1:1 500. This is also uncommon in the childbearing period, but is slightly more common in the older primigravida. There are many types of ovarian cancer and an accurate diagnosis can be difficult.

The size of the tumour is unaltered in pregnancy. Displacement is evident on palpation. Tortion may occur.

During pregnancy and labour the tumour may be incarcerated in the Pouch of Douglas as well as tortion. It may cause an obstruction at delivery. There is a risk of pre-term labour.

The diagnosis is difficult and when diagnosed the oncologist will determine the options of care.

20.10 Conclusion

Certain conditions such as anaemia, diabetes mellitus, thyroid disorders, cardiac disease, epilepsy and cancers may complicate pregnancy. Women with established conditions will generally be managed by specialists, but midwives need to be able to recognise these diseases and refer appropriately.

CHAPTER

21 Obstetric haemorrhage

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- classify obstetric haemorrhage
- identify signs and symptoms and conditions of life-threatening blood loss in all stages of pregnancy, birth and postdelivery
- show competence in preventing life-threatening obstetric haemorrhage in all stages of pregnancy, birth and postnatal periods
- show competence and skill in managing life-threatening obstetric haemorrhage in all healthcare settings.

KNOWLEDGE ASSUMED TO BE IN PLACE

Knowledge of the pathophysiology of haemorrhage.
Understand how to manage blood loss
Knowledge of the management of the third stage of labour
Knowledge of the physiological processes that prevent blood loss in birth (study in collaboration with Chapter 33)

KEYWORDS

Ectopic pregnancy• Abortion • Termination of pregnancy • Ante-, intra- and postpartum haemorrhage

21.1 Introduction

Maternal obstetric haemorrhage is the leading cause of preventable maternal death worldwide and includes early obstetric, antepartum, intrapartum and postpartum bleeding. This chapter highlights factors that predispose to severe bleeding, its management, and the most recent treatment and guidelines.

Advances in obstetric care have provided physicians with the diagnostic tools to detect, anticipate, and prevent severe life-threatening maternal haemorrhage in most patients who have had prenatal care. In an optimal setting, patients at high risk for haemorrhage are referred to tertiary care centres where multidisciplinary teams are prepared to care for and deal with known potential complications. However, even in the face of the best prenatal care, unexpected haemorrhage occurs.

Obstetric haemorrhage can happen in pregnancy, during labour and 42 days after birth and includes all bleeding related to the placenta and uterus, ante-, intra- and postpartum. A 500 ml blood loss in the third trimester is considered serious. In early obstetric haemorrhage the amount of blood loss can cause maternal death even if less than 500 ml.

21.2 Early (first trimester) obstetric haemorrhage

Definition and classification of early obstetric haemorrhage

Early obstetric haemorrhage is the term used for bleeding from the genital tract occurring before 26 weeks of pregnancy (or in South Africa, before viability).

This bleeding can be the result of many conditions, but the main condition that presents as bleeding from the genital tract in early pregnancy is related to implantation bleeding, threatening abortion or spontaneous abortion, ectopic pregnancy, cervical lesions and placental abnormalities such as hydatidiform mole.

Implantation bleeding

Implantation bleeding is bleeding that occurs at the time that the syncytial layer of the trophoblast (of the fertilised ovum) embeds into the endometrial lining of the uterus. The bleeding usually occurs a few days before the menstrual period is due and can easily be mistaken for a period, thus confusing

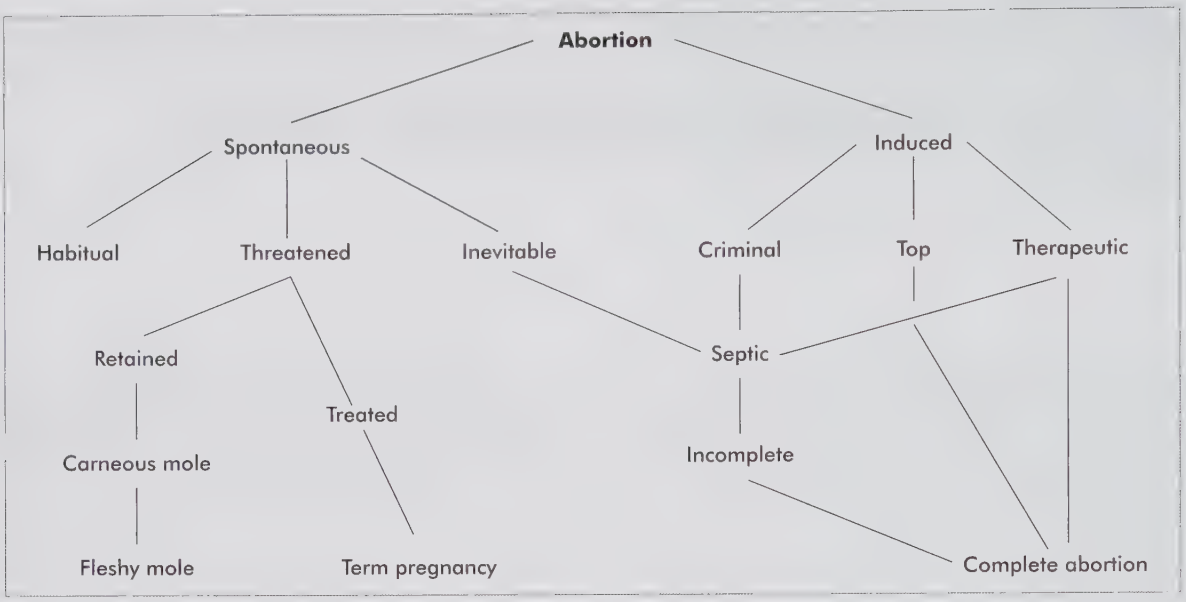


Figure 21.1 Classification and algorithms of outcomes of abortions

the expected date of delivery. Careful history-taking should avoid this problem.

This condition usually settles down quickly, within three to four days, once the blastocyst has completely embedded and is covered by endometrial cells.

Spontaneous abortion

The incidence of spontaneous abortion is not truly known because not all women who abort will see a medical practitioner or will be admitted to a hospital. Although underreported, the incidence is estimated at 12% of all pregnancies.

Abortion is the interruption of pregnancy before 26 weeks, after which the fetus is said to be viable.

The peak time for abortions is between 6–10 weeks of pregnancy.

Classification of abortions

(See Figure 21.1.) There are:

- spontaneous first trimester and second trimester abortion
- inevitable abortion (vaginal bleeding and pain with cervix dilatation)
- threatening abortion (vaginal bleeding with closed cervix and no pain)
- incomplete abortion (only part of the products of conception is expelled)
- complete abortion (complete expulsion of the products of conception)
- habitual abortion (three or more consecutive spontaneous abortions)
- missed abortion (the fetus dies and is retained *in utero*, together with the placenta and membranes)
- septic abortion (infection of the uterus following abortion)
- induced abortion (interruption of pregnancy)
- therapeutic abortion (for medical reason(s))
- termination of pregnancy (on demand)
- tubal abortion (termination of a tubal pregnancy).

Causes of abortion

The causes of abortion are unknown but are related to abnormal uterine environment (including hormonal problems). Contributing factors are:

- Abnormal development of the embryo. The incidence of abnormal embryo development is about 36%. In a blighted ovum no embryo develops in the sac, and the fertilised ovum will abort even if implanted. The fetus may be malformed. In 40% of abortions in the first trimester chromosomal anomalies have been identified.
- Abnormalities of the placenta such as hydatidiform mole.
- Maternal causes such as hormonal insufficiency of progesterone to support the implantation of the ovum.
- Maternal infections, which are a common cause of maternal death and abortion. These include toxins, microorganisms that cross the placenta, high temperatures, and hypoxia.

- Endometritis and abnormalities of the decidua, which are common causes of abortions.
- Retro-flexion of the uterus, which may cause abortion in rare cases.
- Thyroid disease, which may also interfere with the ability to conceive and carry a fetus to term.
- Abnormalities of the uterus and cervical incompetence.
- Extreme emotional stress, which releases pituitary hormones, which affect uterine function and may cause abortion related to an episode of severe pain, grief, fright or after accidents.
- Multiple pregnancy. The more fetuses in the uterus the higher the risk for complications.

A therapeutic abortion is an induced abortion for medical reasons that includes mental or physical danger for the mother or the fetus, with congenital abnormalities of the fetus as the main reason.

Termination of pregnancy is the legal abortion before 20 weeks of pregnancy requested by the mother.

The mechanism of abortion

In the first six to eight weeks the whole ovum covered by the decidua is expelled if the cervix is dilated (see Chapter 7). During the third and fourth month of pregnancy the fetus in an intact sac and placenta may be expelled with minimal bleeding. Intervention is not needed. If the membranes are ruptured, the cervix is closed and the placenta is retained, bleeding may be profuse and intervention is needed.

In abortion the contractions are the same as in labour and the dilatation of the cervix is the same. Lactation can also follow.

Signs and symptoms of abortion:

- vaginal bleeding
- uterine contractions (low abdominal or back pain)
- pain and shock (ectopic)
- septic shock (septic abortion)
- pre-eclampsia before 20 weeks of pregnancy.

Obstetrical management

The management and care will depend on the gestational age, the gravity and parity, and the cause and extent of the vaginal bleeding.

Ultrasound is used for diagnosis in early pregnancy. The diagnosis of the condition of the ovum, placenta, implantation, bleeding and cervix will determine the path of care.

If there is a blighted ovum (empty sac) partial or full separation of the placenta or hydatidiform mole or an ectopic pregnancy, intervention is required. If the products of conception are partially retained, intervention is needed. The interventions are aimed at stopping bleeding, contraction of the uterus, pain relief and removal of the products of conception.

Abortion with intact or ruptured membranes

The surgical evacuation of the uterus may be needed in abortion before 12 weeks of pregnancy.

Inevitable abortion

An abortion is inevitable when the pregnancy can no longer continue. An inevitable abortion may be complete or incomplete. The intervention is evacuation of the uterus.

Habitual or recurrent abortion

In this case the patient has experienced three or more consecutive spontaneous abortions, usually after 14 weeks' gestation. These may be interspersed with normal deliveries. However, this condition is also associated with late or midtrimester abortions occurring between 22–24 weeks' gestation. There is no warning, but the sudden rupture of membranes and expulsion of a fresh abortus occurs after gradual painless dilatation of the internal cervical os.

The cause of habitual abortion is usually mechanical, such as uterine abnormality or cervical incompetence. However, there may be a psychological, immunological, infective, or a chromosomal underlying cause, all of which would require specialised care.

Medical intervention includes making the diagnosis of the cause of the pregnancy loss. Treatment may include total bedrest, hormonal treatment to maintain the pregnancy and the insertion of a Shirodkar or McDonald stitch in the cervix. Hospitalisation may be needed.

Specific nursing care in case of abortion

The nursing management will largely depend upon the duration of pregnancy, gravity and parity, loss of blood and condition of the patient.

The aims of the management include:

- determining the cause of the bleeding
- preserving the life of the mother, stopping the bleeding and administration of pain relief if needed
- maintaining the fetal life if possible, bedrest amd suppression of contractions.

The principles of management

The principles of care include stabilising the maternal condition, determination of the gestational age and the condition of the fetus (is the fetus safe or expelled?), stopping the vaginal bleeding, preventing infections and collaborating with the medical practitioner for the appropriate

diagnosis and intervention. This may include bed rest and treatment, surgical evacuation or removal of the Fallopian tube in case of ectopic pregnancy. Remember about emotional and psychological care, lactation, and Rh factor. Prevent complications from infection and think about infertility, depression, and choriocarcinoma in case of hydatidiform mole.

Assess maternal condition. Determine the gestational period. Observe loss of blood, pain, temperature, blood pressure.

Note the general appearance of the patient – her colour, hydration and any signs of shock. All blood loss and expelled products are saved for the medical practitioner's inspection. A consent form for operation is obtained and completed, should this be necessary. An intravenous infusion is started if the patient's condition is unsatisfactory. The patient is kept warm and is prepared for the operating theatre. Pain relief is given per medical prescription.

Assess the fetal condition. If under 12 weeks pregnant, an ultrasound will be done. If more than 16 weeks the fetal heart may be determined using a Doppler.

After the abortion and/or surgery vulval toilet is carried out four hourly by the midwife, for the first 24 hours at least. When the patient has sufficiently recovered, she is taught to continue her own vulval toilet or Sitz baths.

Support the mother and her family. It is very important that the midwife is aware of the emotional condition of the patient at this time. An abortion can be a devastating occurrence in a woman's life. She can experience feelings such as depression, anxiety, guilt, shame, a sense of failure and of worthlessness and she may feel she is no longer capable of providing her husband with a child.

These women need counselling and support. The midwife who is aware of these problems should be able to provide support, encouragement, understanding and empathy when caring for women after abortion. The midwife should be a good listener, and should allow the patient to express her feelings, her fears and her anxieties.

Complications of abortions

These include:

- hypovolaemia when maternal death may occur
- sepsis after missed abortion, retained products of conception or illegal abortion
- depression after loss of pregnancy
- complications of surgery, perforation of the uterus
- choriocarcinoma following hydatidiform mole
- mummification of fetus
- Rh sensitisation in case of Rh-negative mother.

Ovulation returns within four to six weeks after an abortion in 90% of women and the risk of pregnancy is very high after an evacuation.

Hydatidiform mole

A hydatidiform mole is the abnormal development of the primitive chorion where hydropic or cystic degeneration of the centre of the villi occurs.

These distended chorionic villi form vesicles of variable size. The chorio-decidual spaces are obliterated and there is no circulation of the maternal blood. The products of conception resemble a large bunch of grapes. The embryo is absorbed, and no fetus or placenta can be identified.

The proliferation of the trophoblast results in large increases in the level of human chorionic gonadotrophin (HCG), large amounts of which are excreted in the urine.

Stimulation of the ovaries by the high levels of HCG may result in the formation of large lutein cysts. If HCG remains in the bloodstream after the abortion or if the levels rise, choriocarcinoma is suspected.

The incidence of hydatidiform mole is 1:2 000 pregnancies. The age of the woman does not appear to be important and any pregnancy could be susceptible.

Signs and symptoms

The pregnancy rarely reaches 18 weeks. Problems develop round about three to four months.

These include: Excessive nausea and vomiting (due to high circulating HCG in the blood) and pre-eclampsia may develop before 20 weeks of pregnancy for the same reason.

The uterus is large for the period of gestation, soft and bulky. No specific fetal parts can be palpated and no fetal heart heard. The mother cannot feel any fetal movements.

The clinical features of this condition are often not recognised until the second trimester, because it is during this time that the fetal heart can best be heard but the fetal parts and movements cannot be felt.

Vaginal bleeding may be the first sign of the condition.

Diagnosis is confirmed through a blood test and ultrasound.

Medical care

An evacuation of the uterus is performed as soon as possible after diagnosis is confirmed.

If the pregnancy is less than 12 weeks, dilatation and curettage are performed. If the pregnancy is more than 12 weeks, oxytocics are first used to expel the mole and then an evacuation by suction is performed.

A strict follow-up regime is carried out because of the possible complication of choriocarcinoma.

Serum HCG levels are monitored postoperatively. The HCG levels usually only return to normal after eight weeks. The tests are continued and performed every month for a year, and then at three-monthly intervals for another year.

Complications

Choriocarcinoma is a malignant growth of the trophoblast that may sometimes follow hydatidiform mole. It can also follow an early abortion.

This rare condition can be fatal, because of the rapid growth of the trophoblast. The growth invades the uterus and the vagina, and eventually, via the bloodstream, also invades the liver, the lungs and the brain.

If the HCG levels remain high after the abortion, choriocarcinoma is suspected. Women are therefore advised to continue with the blood test until it is normal.

A follow-up pregnancy is postponed for two years.

The prognosis

Previously, the final outcome was frequently the death of the patient and, without treatment, this took place very shortly after the choriocarcinoma was first diagnosed. However, with treatment, this carcinoma is often successfully cured.

A cure is defined as complete absence of all clinical evidence of the disease for five years.

Ectopic pregnancy

An ectopic pregnancy is a condition where the fertilised ovum embeds outside the uterus when it has failed to reach the uterus before implantation takes place. The pregnancy, therefore, develops in a Fallopian tube, or, in extremely rare occasions, occurs in the abdomen (extra-uterine pregnancy or abdominal pregnancy).

Incidence

Ectopic pregnancy occurs in about 1:150 pregnancies.

The possible sites of implantation:

- the fimbriated ends of the fallopian tubes: 17%
- the ampulla of the fallopian tubes: 55%
- the isthmus of the fallopian tubes: 25%
- the interstitial portion of the fallopian tubes: 2%
- the ovary: 0.5%
- the abdominal cavity: 0.1%

Aetiology

The ovum only implants when the zona pellucida is completely or almost completely shed. Therefore, any factor that slows the passage of the ovum along the tube to the uterus can result in an ectopic pregnancy. The implantation may occur at any point along the tube.

If the ovum dies, it is either re-absorbed completely, or forms a tubal mole, or is aborted into the abdominal cavity.

If the ovum survives, the trophoblast enlarges and erodes into the tissues of the Fallopian tube. The endometrium thickens, the uterus enlarges, the muscles of the tubes thicken and the ovarian and uterine arteries become tortuous (as in a normal pregnancy). The tube stretches as the ovum develops and enlarges and as a result, there are repeated bleeding episodes. Eventually, the Fallopian tube can stretch no further and the tube ruptures. The ovarian artery and vein can be torn as a result of the rupture and this will cause severe internal and external bleeding.

The rupture can either be subacute, which is difficult to diagnose immediately, or acute, in which the signs are dramatic and which results in collapse due to internal haemorrhage and excessive pain.

Causes include:

- congenitally narrowed Fallopian tubes
- pelvic inflammatory conditions
- chronic salpingitis
- endometriosis
- tuberculosis
- progesterone dominant contraception
- tubal surgery
- intrauterine devices.

The classical symptoms of an ectopic pregnancy are:

- amenorrhoea 75%
- lower abdominal pain (occasional sharp, stabbing pains) 95%
- vaginal bleeding 78%
- nausea and vomiting.

When tubal rupture occurs there is:

- sudden excruciating abdominal pain
- fainting
- signs of shock, which include pallor, cold clammy skin, tachycardia, and vomiting.

Management and care

Women generally present at the medical practitioner's rooms or at emergency units with signs and symptoms of abdominal pain or discomfort. Women may also come to primary care clinics with signs and symptoms that are diffuse. This may be missed or misdiagnosed with serious consequences.

If signs of shock and pain are present the woman will be treated as an emergency.

Accurate diagnosis can be made using ultrasound.

Midwives and nurses need to refer all women with a history of amenorrhoea and pain or vaginal bleeding for medical care. The following are routine medical interventions:

- Assess the patient's condition.
- Take an accurate history.
- Examine the patient thoroughly for rigidity, guarding and rebound tenderness.
- Special investigations Hb, PCV, WCC, ESR, pregnancy test.
- Urine: a full urine test is performed, looking particularly for urobilinogen (checking for decomposition of blood).
- Ultrasound scan can be performed.
- Intravenous therapy. Blood is taken for cross-match. Blood or replacement therapy is given if necessary.

Abdominal pregnancy

An abdominal pregnancy is a rare condition that occurs if the conceptus develops in the distal end of the uterine tube and becomes attached to the fimbriated ends of the tube, or is aborted into the abdominal cavity, where it attaches itself to the ovary and/or abdominal organs.

The fetus can die and calcify (a lithopaedion), or it can grow to term, usually suffering from compression deformities and growth retardation.

This condition is diagnosed on ultrasound scanning and a laparotomy is performed to deliver the baby. The pregnancy rarely reaches term. If the pregnancy reaches term the fetus will be delivered by laparotomy. The placenta and membranes are left *in situ* to avoid haemorrhage, and these are reabsorbed by the body.

The diagnosis of an abdominal pregnancy is made by findings on abdominal palpation and confirmed by ultrasound. On abdominal palpation the fetus is not in the uterus and may be in an unusual position and is felt more clearly due to the lack of abdominal wall.

Other causes of vaginal bleeding in early pregnancy

When a woman presents with vaginal bleeding in early pregnancy it is important to identify the cause and severity of the problem and assess the risk of abortion. The most accurate investigation is ultrasound. If the fetus is intact and in the uterus other causes for the vaginal bleeding are considered.

Other possible causes of vaginal bleeding include:

- *Cervicitis.* Infammation of the cervix may cause vaginal bleeding after coitus.
- *Cervical or uterine polyps.* These are small, bright red, fleshy, pedunculated, benign growths (which may become malignant, causing bleeding) originating in the cervical canal.
- *Cervical cancer.* 1:200 mothers will have abnormal cell changes when cervical cytology (the Papanicoloau smear) is performed routinely in the antenatal period.
- *Trauma.* The vagina is very vascular in pregnancy. Trauma of the vagina can happen during rough sexual intercourse and high vaginal tears may occur.

21.3 Antepartum haemorrhage

Antepartum haemorrhage is defined as bleeding from the genital tract after 24 weeks of gestation and has an incidence of 2–5% of all pregnancies beyond 24 weeks. Currently it is the third most important cause of maternal death in South Africa. The highest risk of death is the first 24 hours after birth.

Haemorrhage in pregnancy can be classified according to two major causes: a placenta that is partially or totally implanted in the lower segment and accidental haemorrhage where the placenta has separated partially or completely from the uterine wall (when normally implanted in the upper segment). The causes of antepartum haemorrhage range from cervicitis, vasa previa, and, more commonly, placental abnormalities, placenta praevia or placental abruption. A low haemoglobin in particular plays a role in placental abruption. A proactive approach should be used for patients at high risk of haemorrhage since pre-operative preparedness can improve outcome. Complications of antepartum haemorrhage include maternal shock, a greater risk of premature delivery, fetal hypoxia, and sudden fetal death, making antepartum haemorrhage an even greater risk to the fetus than to the mother.

Placental abruption/accidental heamorrhage

Haemorrhage arising from the premature separation of a normally situated placenta is known as placental abruption.

Abruption complicates about 1% of pregnancies and is the leading cause of vaginal bleeding in the latter half of pregnancy. Known risk factors include hypertension, pre-eclampsia, advanced maternal age, multiparity, polihydramnios, maternal/paternal tobacco use, cocaine use, trauma, premature rupture of membranes and chorioamnionitis. Placental abruption can happen any time in pregnancy and during the intrapartum period. Sometimes a woman can have a small abruption in pregnancy that went unnoticed in pregnancy and the pregnancy recovers and continues. The baby might have had an episode of stress *in utero* and old meconium is present or there is evidence of old meconium.

About 20% of cases have no symptoms. Vaginal bleeding may be present or hidden. The nature of the bleeding when visible is dark clots, which is due to the body trying to clot the blood to control the haemorrhage.

Table 21.1

Haemorrhage in pregnancy (see Figure 21.2)

Criteria	Placental abruption/ accidental	Placenta praevia	Vasa praevia	Other
Incidence	4% depending on population	0.5%	1.8%	
Pre-existing factors/ causes	Often hypertensive Pre-eclampsia (13%) Often anaemic Short cord (30 cm) Trauma Decompression of uterus (polyhydramnios) Multiple pregnancy Uterine abnormalities Poor nutrition and social status Smoking Coitus	Multiple pregnancy Previous c/s Maternal age Placenta implanted in lower segment Grand multipara	Often low-lying placenta Velamentous insertion of the cord	Vaginal infection Cervical lesions Hydatidiform mole
Onset	More common after 28 weeks Sudden and stormy Retroplacental clot may develop over a period of time	After 28–31 weeks 10% 31–35 weeks 30% > 36 weeks 60% Warning bleeding small Second episode severe	During third trimester or onset of labour Blood vessels over internal os	Any time during first/second trimester
Symptoms	Pain with or without external or concealed vaginal bleeding Shock not related to visible blood Increased pulse and drop in blood pressure	Painless vaginal bleeding Clear fresh blood Fetal movement normal Can coincide with the onset of labour	Fetal bradycardia associated with vaginal haemorrhage	Fresh bleeding or spotting with or without pain
Examination	Pain: uterus hard and tender Increased tone Large for expected dates Difficult to feel baby or hear fetal heart Anaemia not related to loss	No pain Tone of uterus normal Malpresentation or high presenting part Anaemia related to loss Fetal heart present	No maternal problems Baby prognosis poor Vessels may be damaged with PV and amniotomy Compression from presenting part	No uterine tenderness Stable vital signs Usually from cancer If pain is abortion threatening?
Nature of bleeding	Dark clots if not concealed bleeding	Bright red blood from low-lying placenta	Bright red blood from the cord/ vagina APT test (fetal haemoglobin test)	Spotting/old or fresh blood from cervix or abortion

continued

Table 21.1

Haemorrhage in pregnancy *(continued)*

Criteria	Placental abruption/ accidental	Placenta praevia	Vasa praevia	Other
Ultrasound	Fetus may be dead Retroplacental clot Placenta normal implantation	Placenta implanted in lower segment GR 1–4	Ultrasound may reveal abnormalities	Normal or signs of abortion/ hydatidiform mole
Intervention	IV therapy O_2 Pain relief Strict observation Deliver if mother or baby is compromised vaginally or by c/s	NO VAGINAL EXAMINATION until position of placenta has been confirmed Speculum examination in theatre ready for c/s At home: transfer to hospital as emergency Depend on amount of bleeding, grade of placenta preavia and duration of pregnancy	c/s if baby is in danger If baby is dead preferred route is vaginal delivery	Treat according to cause Hydatidiform mole – surgical curetage
Complications/ outcomes	Perinatal death 30–52% Maternal death 11–14% Only 17.5% of children in a study were neurologically normal at school age Couvelaire uterus (blue discolouration of uterus) due to bleeding in myometrium Sheehan's syndrome Clotting defects Atonia of uterus PPH Hypovolaemic shock Low fibrinogen and factors II, V and VII	PPH Hysterectomy if bleeding cannot be controlled Prematurity	Fetal distress or death of the newborn	Abortion if contraction was present Sepsis Choriocarcinoma in hydatidiform mole

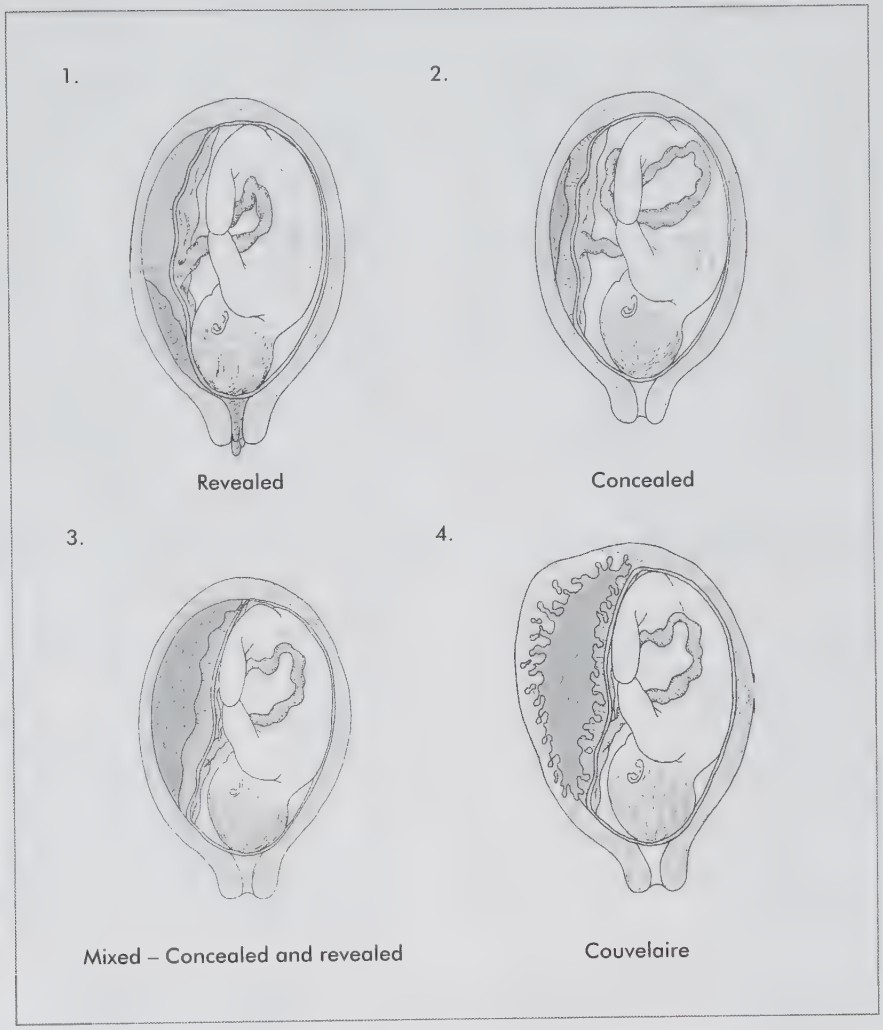


Figure 21.2 Classification of placenta praevia 1: Marginal separation with revealed haemorrhage, 2: Central separation with concealed haemorrhage, 3: Complete separation, 4: Couvelaire uterus

Uterine tenderness, and abdominal pain is severe. The uterus is hard and contracts to control the bleeding. Rapid contractions may be present but are difficult to feel because of the tone of the uterus. The fetal heart rate is abnormal but difficult to hear (Figure 21.2 shows the cause and types of haemorrhage).

General principles of the management of obstetric haemorrhage

Care for the patient with obstetric bleeding should follow an algorithm that goes through a rapid and successive sequence of medical and surgical approaches to stem bleeding and decrease morbidity and mortality.

Although specific interventions will be required depending on the underlying cause of the haemorrhage, several basic steps are essential in the initial and continued management of any patient with obstetric haemorrhage.

Guidelines for the management of massive obstetric haemorrhage are: (i) organisation of the multidisciplinary team; (ii) restoration of blood volume via a large canulla for access using fluid and blood; (iii) correction of defective coagulation with blood products and factors; (iv) evaluation of response to treatment by haemodynamic and laboratory assessment; and (v) remedying the underlying cause of the bleeding.

Another therapeutic goal in the treatment of severe postpartum haemorrhage(PPH) is avoidance of myocardial ischaemia

by increasing the myocardial supply–demand ratio (see Chapter 33). A significant percentage of patients with haemorrhagic shock experienced electrocardiographic signs of ischaemia and decreased contractility that correlate with the severity of haemorrhage. Given that most maternal morbidity and mortality is due to underestimation of blood loss, inadequate volume replacement, and delay in intervention, a management protocol for treatment of obstetric haemorrhage should be available at every delivery unit that initiates a sequence of conservative and operative interventions. Success of each treatment should be rapidly assessed with the swift institution of the next intervention if it has failed. Prompt communication between anaesthesiology, obstetric–gynaecology, nursing, laboratory, and blood bank is essential for effective evaluation and management of excessive blood loss.

Guidelines for the management of obstetric haemorrhage

Specific preventive measures include the following:

- Identify all women with antepartum haemorrhage and risk factors for PPH for delivery at referral hospital (e.g. women with multiple pregnancies, polyhydramnios, grande multiparous women, history of previous caesarean section and previous postpartum haemorrhage that required blood transfusion).
- Iron supplementation should be routinely provided during pregnancy. Anaemia needs to be detected, treated, and followed up during pregnancy.
- The third stage of labour must be actively managed. This has been shown to reduce postpartum haemorrhage. High-risk cases should receive an intravenous administration of 20 IU oxytocin for at least 24 hours after birth.
- Early detection of PPH by routine monitoring after delivery and after caesarean section, especially of high-risk patients, is essential.
- Facilities at all levels of care must take steps to ensure that they are prepared for the emergency care of a woman with massive obstetric haemorrhage. A standard protocol for managing postpartum haemorrhage must be known by all healthcare providers at institutions that provide care for pregnant women. Where deliveries are infrequent and postpartum haemorrhage is consequently rare, fire drills should be performed to ensure that staff are familiar with what to do when a postpartum haemorrhage occurs. Being prepared also entails ensuring adequate supplies of intravenous fluids, oxytocic agents and emergency blood, and that there are appropppriately skilled personnel available.
- An effective and functional ambulance transport infrastructure must exist in all provinces. Obstetric haemorrhage must always receive the highest priority for emergency transport.

Resuscitation

(See Figure 33.1) Any patient with signs of shock (tachycardia, low blood pressure and oliguria) due to haemorrhage, requires two intravenous infusions with large-gauge needles (at least size 14), and rapid infusion of rehydration fluid (Plasmalyte B, Ringer's lactate) and/or crystalloids (Haemacel or Volvulen). Details of all fluids given with times specified must be documented on an input/output chart. The resuscitation is extremely important and ideally requires a staff member to take primary responsibility, whilst others are assessing the cause of the haemorrhage, measuring blood loss and performing measures to arrest the bleeding.

In level one hospitals, emergency blood can be given. Frozen dried plasma should also be available. In level two and three hospitals, cross-matched blood can be given, and additional blood products. When estimated blood loss is greater than 1 500 ml, a central venous pressure (CVP) line is useful for monitoring fluid balance and blood volume.

Clinical management of placental abruption

This is an emergency and action depends on the clinical assessment of the women and if the baby is still alive or not. The priority is to deliver the fetus as soon as possible, without putting the mother's life at risk.

Active resuscitation and prompt referral to a level two or level three hospital is mandatory after the diagnosis of placental abruption with an intrauterine death. O-negative blood and frozen dried plasma can be administered.

The route of delivery in the event of placental abruption with an intrauterine death should be vaginal, unless there are obstetric indications for caesarean section. If the fetus is confirmed to be alive, an emergency caesarean section is indicated. With the addition of potent uterotonic agents and the advent of minimally invasive interventional radiological techniques such as angiographic embolisation and arterial ligation, definitive yet conservative management is now possible in an attempt to avoid hysterectomy in patients with severe peripartum bleeding. If these interventions are inadequate to control the bleeding, the decision to proceed to hysterectomy must be made expeditiously.

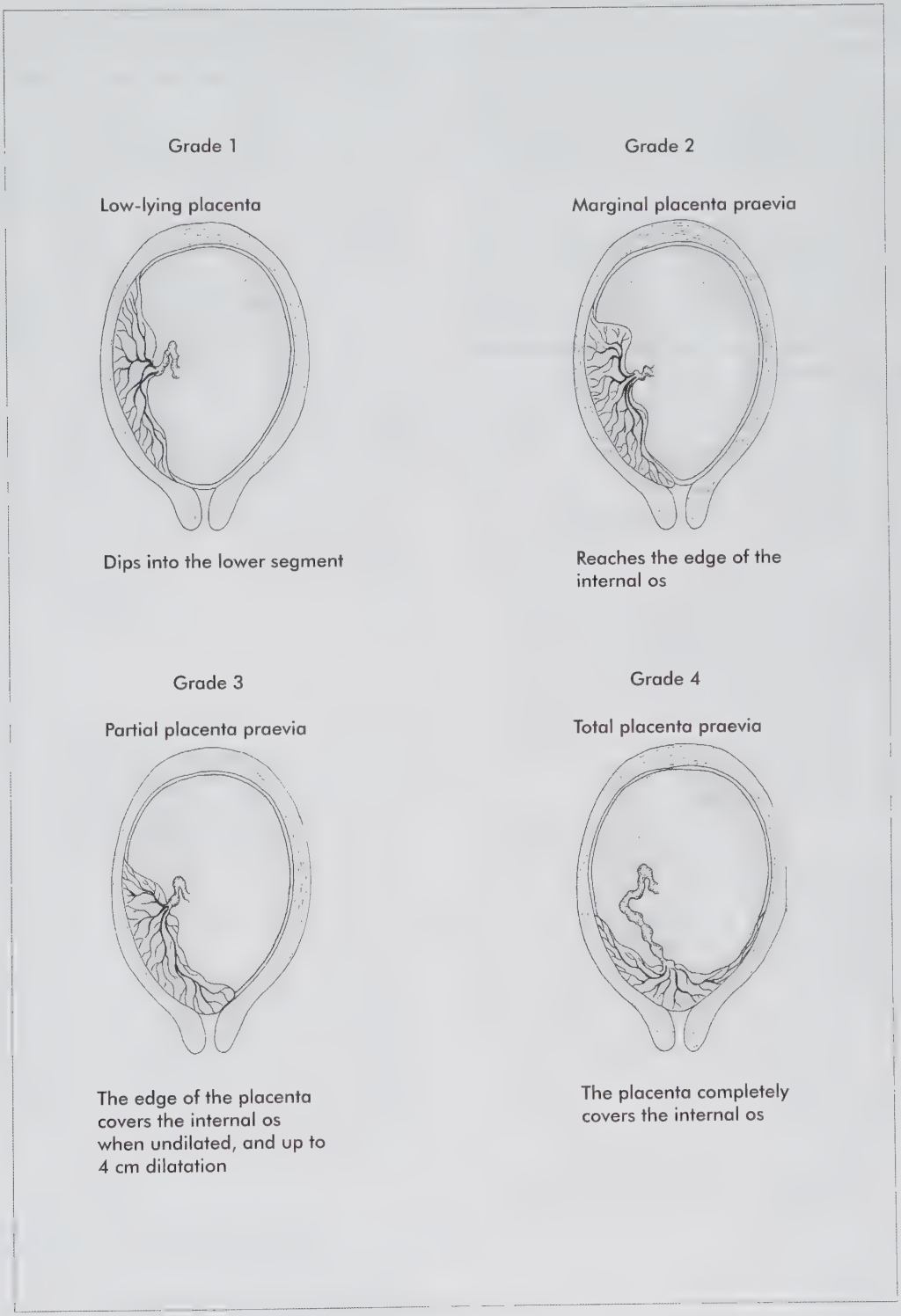


Figure 21.3 Grades of placenta praevia

Placenta praevia

This is the implantation of the placenta in the lower segment of the uterus. It is classified as placenta praevia Grade 1–4. The anterior, lateral or posterior position of the placenta can further complicate the outcomes.

The reasons for, and symptoms of placenta praevia are given in Table 21.1.

The bleeding is clear and painless and occurs after 28 weeks of pregnancy. There is usually a warning bleed before the serious bleeding starts. The lower segment starts to develop after 28 weeks of pregnancy and pulls away from the placenta.

Management of bleeding in pregnancy associated with low-lying placentas

The principles for the management of placenta praevia bleeding in pregnancy are:

- admission
- bed rest
- assess the degree of shock and treat (replace blood loss as appropriate)
- identify the cause of the bleeding. The uterus is soft and the presenting part is high because the placenta is in the way. *No* vaginal examination is performed until the position of the placenta is known by ulrasound
- treatment will depend on the type of placenta praevia, gestational age and the amount of blood loss. The baby is not in the same danger as in the case of placental abruption. Treatment can be conservative to give the baby a chance to grow to maturity. Bed rest in or out of hospital is in order if the placenta is Grade 1 or 2. Women with placenta praevia Grades 3 or 4 are hospitalised and delivered if the condition warrants intervention.
- corticosteroids are administered to mature the baby's lungs to prevent hyaline membrane disease. The pregnancy seldom reaches 36 weeks in Grades 3 and 4 placenta praevia.
- the mode of delivery is usually by caesarean section. Grades 1 and 2 may deliver vaginally if the baby is in the right vertex position and the presenting part engaged normally
- in Grade 4 or in malpresentation (breech or high head) caesarean section is indicated.

Complications of antepartum haemorrhage

The following are complications of antepartum haemorrhaging:

- death
- hypovolaemic shock (see Chapter 33)
- perinatal mortality
- morbidity: hypovolaemic shock
- morbidity: maternal – the mother can suffer conditions such as Couvelaire uterus in placental abruption where the myometrium is full of blood and cannot contract. This may lead to a hysterectomy.
- A postpartum haemorrhage usually follows an antepartum haemorrhage.
- Hypovolaemic shock can result in Sheehan's syndrome (pituitary gland necrosis due to lack of blood flow).
- A serious complication is the development of disseminated intravascular coagulation (DIC). Clotting factors are depleted and the patient will bleed.

All pregnant women should be informed early in their pregnancy that any amount of bleeding is abnormal, except for the 'show'. Therefore any bleeding requires referral to someone with midwifery skills. A midwife should be called or the pregnant woman taken to the nearest health centre where maternity services are available. Speed is required even when only a small amount of blood is being lost – particularly in late pregnancy – since some of the haemorrhage may have been concealed (*see under* placental abruption). It is important to keep the woman calm, as anxiety may raise the blood pressure and cause further bleeding. She should not be given any food in case she has to have an anaesthetic later.

Vasa praevia

This is the presentation of umbilical or fetal blood vessels that run in the membranes and lie in front of the cervical os. The incidence is 1:2 500 pregnancies. This can be a complication of placenta praevia. When they rupture, clear blood is visible and the fetus may lose blood fast. The fetal mortality is 95%. There is no mechanism to control the blood loss.

Intrapartum haemorrhage

Any of the above-mentioned conditions can occur or present during labour. Placental abruption may occur with induction of labour and overstimulation of the uterus. A sudden decompression of the uterus in polihydramnios may cause a placental abruption. A short cord may cause a placental abruption when the fetus descends in the pelvis. The treatment will depend on the condition of the mother and fetus, the amount of blood and the stage of the delivery.

21.4 Postpartum haemorrhage (PPH)

PPH is defined as excessive vaginal bleeding after delivery until 42 days postpartum.

It can be classified as primary postpartum bleeding, if within 24 hours of delivery, and secondary postpartum bleeding, if after 24 hours but within 42 days of delivery.

Primary postpartum haemorrhage is divided into:
- atonic postpartum haemorrhage
- traumatic postpartum haemorrhage
- uterine rupture – usually catastrophic.

Postpartum haemorrhage is defined as the loss of 500 ml or more blood postpartum (within 24 hours).

The following factors need to be considered:
- blood loss in the ante- and intrapartum periods
- haemoglobin levels and haematocrit
- cardiovascular competency or compromise
- woman's physical condition and body weight
- other factors such as coagulation defects
- contextual factors, staff, skill and equipment available.

It is important to develop a standard to measure blood loss in a unit that is accurate. Blood loss should be measured and calculated over a 24-hour period after birth. Blood loss in the theatre should also be recorded. Accumulated blood loss may exceed 500 ml.

A soaked pad changed every two hours postnatally indicates heavy blood loss.

Types of PPH

There are two major types of PPH.

Atonic PPH

This condition exists mainly after birth and within the first 24 hours and is characterised by clear blood gushing from the vagina and a relaxed uterus caused by:
- an overstretched uterus of grand multipara, multiple pregnancy or polihydramnios and/or a uterus that is tired after a long or obstructed labour
- abnormalities of the uterus such as myomata and bicornuate uterus
- congenital factors such as women with red hair and women with blood coagulation defect conditions
- retained products of conception and placental pathology
- obstetric interventions such as induction of labour, anaesthesia and caesarean section
- a low haemoglobin causing and complicating postpartum haemorrhage. Postpartum haemorrhage usually follows antepartum haemorrhage
- a full bladder can also play a role.

Traumatic PPH

This condition may be masked at the beginning. The signs and symptoms are a well-contracted uterus with clots coming from the vagina. Bleeding is not active. Predisposing factors include forceps, ventouse, large baby and precipitate labour. Traumatic postpartum haemorrhage includes high vaginal tears, cervical tear, incomplete uterine rupture and inversion of the uterus.

Prevention of PPH

Good antenatal care with improved nutrition status of pregnant women and routine supplementation of iron, folic acid and vitamin A can prevent PPH. All women at risk for postpartum haemorrhage should be delivered in a safe place (at least level one). Any women who has had a previous PPH or retained placenta are at risk, as well as women with low haemoglobin, a large baby, and abnormalities of the uterus and placenta. All women at risk for PPH should routinely have an intravenous line during labour. Assure an empty bladder. Carry out routine management of the fourth stage of labour with strict observation of the uterus and blood loss. Putting the baby to the breasts can be useful in mild cases. An intravenous infusion with 20 IU of oxytocin in 1 000 ml Ringer's lactate is continued for 24 hours postdelivery or until stable.

The following standards of staff and equipment are needed for effective care:
- appropriate ratio and skill mix (medical assistance is needed)
- necessary equipment/theatre, light and suture material
- PPH protocol displayed and competent staff (skill drills)
- adequate supply of IV fluid and emergency blood, frozen dried plasma and colloids
- blood bank (Level 2 and 3)
- adequate drugs (oxytocin, prostaglandins)
- PPH sterile pack with all the needed instruments.

Diagnosis of PPH

The diagnosis is made if there is 500 ml of blood loss from the genital tract post-delivery. The importance of the volume of blood loss depends on the woman's haemoglobin level. With a low haemoglobin, the loss may be fatal irrespective of the amount of loss. The cause and stage of the condition needs to be determined and acted upon. Life-threatening haemorrhage occurs in 1:1 000 deliveries.

Clinical manifestations

The clinical picture may vary depending on the severity of the loss and the ability to compensate (See Table 33.4). Aggravating factors are:
- the presence of antepartum haemorrhage
- low haemoglobin
- cardiac conditions
- pre-eclampsia.

The following progression of the condition can occur if it is not arrested (all are compensatory responses) [Grade I + II]:

- vasodilatation to increase blood volume to the heart
- restlessness and anxiety
- increased pulse rate
- increase in diastolic BP
- decrease in urine output
- nausea and vomiting.

Progressive state: 1 500–2 000 ml (30–40%) [Grade III]:
- compensatory responses overwhelming
- severe dysrhythmia and myocardial ischemia
- hypotension is a late sign of shock.

Refractory stage: more than 2 000 ml (40%) [Grade IV]:
- compensatory mechanisms fail
- kidneys shut down
- low blood pressure causes tissue necrosis
- pituitary gland necrosis (Sheehan's syndrome)
- air hunger.

Management of PPH

The management of postpartum haemorrhage follows the progression of the condition in steps. Always check the placenta and membranes for completeness and report. A Foley catheter may be inserted to keep the bladder empty.

Step 1. Grade I has 15% blood loss of 500–750 ml. Compensatory mechanisms are adequate and the woman may be symptom free. Interventions:
- institute measures to contract the uterus
- physical rub of uterus
- put baby to the breast
- measure blood loss.

Step 2. Grade II compensatory stage blood loss of 750–1 500 ml (15–30%). Compensatory responses are present when the cardiac output drops. Intervention:
- rapid IV fluid with 20 IU of oxytocin.

NB: These two steps are always done irrespective of cause of PPH.

Up to 30% of blood loss (1 500 ml) can be replaced by a colloid solution (the haematocrit is reduced to 30%). The replacement of fluid is now essential. Matched whole blood is the choice.

Step 3. Grades III and IV progressive stage: loss of 30–40% (1 500–2 000 ml):
- empty bladder
- lift the foot and of bed to improve venous return
- give oxygen 6–10 litres
- IV ergometrine or syntometrine 0.5 mg (except for cardiac, pre-eclamptic and bicornuate uterus) OR misoprostol 600 micrograms rectally

Step 4. Suture vaginal or cervical tears if present.

Step 5. Refractory stage more than 40% (2 000 ml). Refer to next level if bleeding persists.

NB: An atonic PPH that does not respond within step 1–4 needs bimanual pressure while being transferred (see Figure 21.5). Paramedics need to be trained to give the appropriate care.

When the placenta is still *in utero* resuscitate the patient first before the removal of the placenta (see Figure 21.4) if it is in the os. If the placenta has not separated a manual removal is indicated under general or spinal anaesthesia. Morphine can be used on medical prescription if anaesthesia is not possible. Intravenous oxytocin 20 IU is administered in 1ℓ of Ringer's lactate. Antibiotics are administered and the woman is transferred to high care until stable.

Persistent bleeding:
- If bleeding continues it should be managed by skilled staff in a level two or three facility.
- Bimanual compression of the uterus can be done when the uterus is not contracting (see Figure 21.5).

Step 6. Review the diagnosis (potential conditions are intractable uterine atoni, retained products, rupture tears or coagulation disorders).

Step 7. Cross-match blood, order and administer.

Hypovolaemic shock in obstetrics

(See Chapter 33.) Whenever blood or plasma is lost from the body, accidentally or during planned surgery, the possibility of shock should be considered. Death due to loss of blood is caused by lack of intravascular circulation rather than a deficit of red blood cells. *The first priority is the replacement of fluid.* Haemacel (1 000 ml) (a volume expander) increases the cardiac output by 45% and central venous pressure by 35%. It does not draw fluid from the interstitial spaces. Alternatively Voluven or colloid fluid (Ringer's lactate or Plasmalyte B can be used).

The level at which an individual becomes compromised varies depending on age, gender, body mass, Hb and haematocrit (> drop 10%) condition of the cardiovascular system and the volume of loss of plasma/blood (above 500 ml).

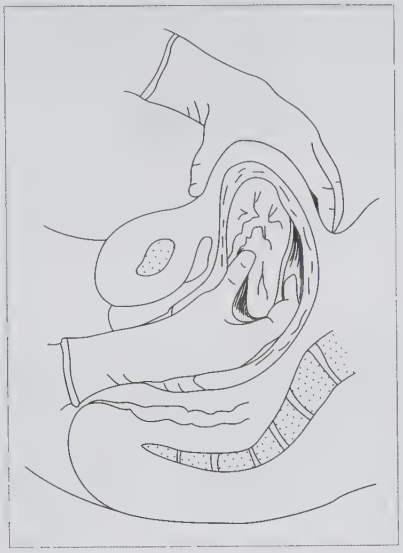


Figure 21.4 Manual removal of the placenta

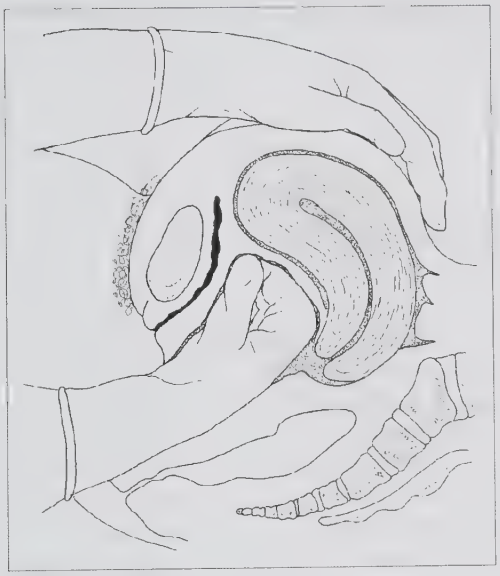


Figure 21.5 Bimanual compression of the uterus

Pathological processes in acute hypovolaemic shock include increased blood viscosity, which results in tissue hypoxia due to decreased blood flow. Coagulation and haemostatic changes occur. Reflex cardiovascular mechanisms reduce the flow to the kidneys and a drop in blood pressure and sympathetic vasoconstriction leads to oliguria and anuria.

In obstetrics the defibrination syndrome (Factor II, V, and VII) develops. Fluid is shifted from the interstitial space to the intravascular space. The blood pressure drops.

Death in obstetrics can occur with frightening speed. Principles to consider are:

- accurate estimation of blood loss and replacement
- prompt recognition of clotting disorders
- early involvement of a haematologist/Hb and haematocrit
- involvement of an anaesthetist/resuscitation
- adequate size of cannula
- close monitoring of venous pressure.

The clinical status of the woman is assessed by monitoring:

- cardiac rate (ECG)
- arterial pressure/blood pressure
- central venous pressure
- respiratory function (risk of pulmonary oedema)
- temperature of the extremities that indicates blood perfusion and vasoconstriction
- level of consciousness
- urine and blood electrolytes.

Danger signs

The following are warning signs of progressive obstetric haemorrhagic shock:

- persistent significant bleeding
- mother says she is light headed, seeing stars, fainting or is acting in a strange way
- acts anxious with air hunger, wants to sit upright
- colour changes to ashen or greyish
- skin temperature is cool and clammy
- raised pulse combined with a dropping blood pressure.

Complications

Complications of hypovolaemia include:

- death
- acute renal failure
- pituitary necrosis (Sheehan's syndrome).
- disseminated intravascular coagulation.

21.5 Conclusion

Obstetric haemorrhage remains the main cause of maternal death globally. A woman's highest risk of death is in the first 24 hours after birth and is related to blood loss. Midwives and obstetricians can underestimate blood loss during birth by 100%. It is thus of the utmost importance to have standards for blood loss estimation, evidence to establish the loss and interventions to prevent, or manage if this occurs. (See Obstetric Shock Chapter 33.)

CHAPTER

22 Pre- and post-term birth

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- define pre- and post-term birth
- demonstrate competency in identifying the risks for pre- or post-term birth
- demonstrate competency to provide care in pre- and post-term birth using 'best practice' guidelines
- demonstrate knowledge of and skill in the use of drugs related to the suppression of uterine contractions
- demonstrate the knowledge and skill to prevent/manage complications related to pre- and post-term birth.

KNOWLEDGE ASSUMED TO BE IN PLACE

The management of normal pregnancy and birth
The assessment of gestational age and fetal surveillance
How to take a detailed history from a pregnant women
Identify risk factors in pregnancy

KEYWORDS

Preterm birth • Post-term birth • Betamimetics • Low birth weight • Corticosteroids • Surfactant • Tocolytics

22.1 Introduction

Complications related to pre- and post-term birth add considerably to adverse outcomes in the infant. Preterm birth is the single most important cause of perinatal morbidity and mortality. The care of preterm infants has financial implications for healthcare planning, with health risks for the child that may continue into adulthood. One of the main objectives of antenatal care is the prevention, early detection and evidence-based intervention of cases where preterm birth occurs. Post-term birth is less common but also has a high incidence of complications. These two conditions are related to the accuracy of the determination of duration of pregnancy. In many cases determination of the duration of pregnancy may need more sophisticated investigations such as an ultrasound to make a better diagnosis. In the absence of ultrasound investigations the clinician relies on the history, antenatal visits and the clinical findings. The symphysis fundal height (SFH) measurement of the uterus is only reliable between 20–36 weeks, when multiple pregnancy and polyhydramnios are excluded.

22.2 Preterm birth

Preterm birth is defined as birth before 37 completed weeks of pregnancy.

Currently many infants survive after 20 weeks gestation as a result of sophisticated intervention. Almost all fetuses under 500 g are considered unviable. Viability is considered from 500 g in developed countries (22 weeks) and 1 000 g (28 weeks) in developing countries. Preterm birth can also be defined as birth that occurs after fetal viability (in South Africa 28 weeks of gestation is still the legal period acknowledged for viability) but before 37 completed weeks of pregnancy. Birth can be spontaneous or induced before term if the mother's health is threatened.

The survival of a preterm infant depends on the developmental stage, weight, presence of complications such as placental abruption or infections and the care received.

The 2008 DoH guidelines for neonatal care differentiate between the care of preterm infants 32–36 weeks (1 500–2 000 g)and low birth weight infants less than 32 weeks or < 1 500 g.

Preterm rupture of membranes (PROM)

PROM refers to the rupture of membranes before 37 weeks of pregnancy.

The incidence of preterm birth

Accurate information on the incidence of preterm birth is not available. Besides HIV/AIDS it remains the main cause of perinatal morbidity and mortality. In 25% of cases the cause of preterm birth is unknown.

The overall mortality for infants 500 g and above is 55/1 000 with a difference between urban and rural areas: urban – 35/1 000 and rural 100/1 000. The general mortality is 50/1 000 with an average of 33/1 000 in South Africa. In developing countries the mortality for infants with a mass of 1 000 g is 7/1 000.

In South Africa 59% of births occur at the community healthcare (CHC) or district level and have the highest perinatal mortality. The perinatal mortality rate (PNMR) is the highest district level for immature infants and attention should be focused on prevention and improved standards of care for preterm birth, with a particular focus on improved intrapartum care.

Factors contributing to preterm labour/birth

The following are conditions that may contribute to preterm birth. Contributing factors can be maternal, fetal, obstetrical and/or iatrogenic:

- Maternal causes are associated with known and unknown infections that increase the risk of preterm birth.
- Infections that cause pyrexia such as urinary tract infection, appendicitis, pneumonia or amniotic fluid infection syndrome.
- Conditions such as pre-eclampsia, diabetes, cardiac conditions and antepartum haemorrhage.
- Causes related to the feto-placental unit include over-distension of the uterus as in multiple pregnancy or polyhydramnios. Congenital abnormalities of the neonate often lead to preterm spontaneous birth or birth by intervention.
- Obstetric causes are associated with antepartum haemorrhage, abruptio placenta and asphyxia, which are the second most common causes of perinatal death.
- Previous preterm births.
- Cervical incompetence or previous cervical surgery or cone biopsy.
- Idiopathic or unknown causes.

The diagnosis of preterm labour/birth

Preterm birth is diagnosed when there is a history of regular, rhythmic uterine contractions before 37 completed weeks of pregnancy. Occasionally there is an accompanying descent of the presenting part and dilatation of the cervix.

The diagnosis can be very difficult. Generally three factors are involved:

- documentation of prematurity
- regular, rhythmic uterine contractions
- progressive changes in cervical effacement and dilatation and occasionally descent of the presenting part.

The diagnosis of preterm birth is confirmed by the observation of the presence of uterine contractions through abdominal auscultation or the use of the electronic uterine activity assessment using a cardiotocograph to confirm the presence of contractions.

Vaginal examinations are usually not performed because these stimulate contractions. The performance of a vaginal examination will be indicated if a woman has strong contractions, and there is no medical practitioner available or the woman is in a primary healthcare unit and needs to be transported to a higher level of care. Vaginal examination is avoided if the membranes are ruptured and the contractions are mild.

22.1 Special investigations in preterm labour

Special investigations that may be needed include:

- Ultrasound scan to determine condition of the fetus and amount of amniotic fluid to guide the management.
- Full blood count to exclude the presence of infection.
- High vaginal swab to rule out infection or a culture and sensitivity in case of infection.

Clinical signs and symptoms of preterm birth include:

- Spontaneous onset of regular, rhythmic uterine contractions as in normal labour.
- Membranes may or may not rupture spontaneously; if ruptured this is usually followed by onset of painful regular contractions.
- History of vague backache or low-grade abdominal discomfort. The same symptoms can be caused by urinary tract infection, hence it is important to rule out urinary tract infection.

Best practice guidlines for preterm labour/birth

The best practice for preterm labour/and birth starts with the identification of risks and the prevention of the condition:

- Early identification and referral of women at risk for preterm birth including: women with a history of previous preterm births, multiple pregnancies, polyhydramnios,

placenta praevia, anaemia and infections such as urinary tract infections.

- Assessment and care of preterm birth. When a woman presents with preterm birth provide active management of preterm labour. The aim of the care is to arrest labour if the gestation is less than 37 weeks and the cervix is less than 3 cm dilated in the absence of a threatening medical condition such as pre-eclampsia or fetal distress. The woman is put on bed rest and assessed.

  The assessment of the woman will determine if the woman is in labour. If the cervix is fully dilated and the baby's head has descended and is well applied on the cervix or there are bulging membranes, birth may not be arrested. The co-morbidities may also warrant the delivery of the baby. These may be maternal, (e.g. pre-eclampsia) or fetal, such as intrauterine growth restriction (IUGR) or meconium liquor with fetal distress or obstetrical, such as incompetent cervical os or abruptio placenta. The following observations are made after the antenatal history has been checked, and include general and obstetrical history, history of this pregnancy in terms of anaemia, infections, blood pressure, growth and development, weight gain and treatment so far.
- Vital signs should be checked to exclude pre-eclampsia.
- Urinalysis to exclude albumin, ketones and glucose.
- Assess the general state of the mother.
- Observe for uterine contractions and check fetal heart.
- Check if there is drainage of meconium-stained amniotic fluid.
- A speculum examination may be performed prior to a digital examination to assess the state of the cervix.
- Inform the medical practitioner where possible about the findings so that he or she can determine further management.

Indications for suppressing labour

Preterm labour may be suppressed using tocolytics. Labour can be suppressed if:

- The membranes are intact and the cervical os is less than 3 cm dilated.
- No major congenital abnormality is present.
- The fetus is alive and no fetal distress present.
- Gestational age is less than 36 weeks and the risks of prematurity exceed those of infection.
- There is no infection or severe maternal disease present.
- There is no intrauterine growth restriction.

Tocolytic drugs are administered to stop contractions.These are prescribed by a medical practitioner and may include the following:

- Beta$_2$ adrenoreceptor antogonist causing relaxation of the uterus. This is used mainly if it is clear that the fetus will stay *in utero*. It is not effective if labour is likely to progress. Salbutamol® is the drug of choice, administered intravenously initially, followed by oral therapy. The main side-effect is tachycardia of the mother and the fetus. (For side-effects see Chapter 54, Pharmacology.)
- Calcium-channel blockers are increasingly used to promote tocolysis, such as nifedipine 30 mg oral stat dose, followed by 20 mg 6–8 hourly for seven days.
- Antiprostaglandins (e.g. Indomethacin®, a non-steroidal anti-inflammatory drug) have been used as a tocolytic. This can be given orally (25 mg) or as a suppository (100 mg). *Caution.* A total daily dosage of 200 mg should not be exceeded in 24 hours. Caution is taken because the administration of Indomethacin® is known to cause premature closure of the ductus arteriosis in the more mature fetus.

Other drugs administered are:

- Prophylactic antibiotics should be administered to prevent infection in the neonate (see Chapter 51).
- Pethidine 50–100 mg IMI. As a rule the use of narcotics is avoided in preterm birth but a stat dosage of pethidine 50–100 mg IMI may be prescribed by a medical practitioner for pain relief if needed.

If labour is not arrested despite use of tocolytic drugs, the labour is allowed to progress and closely monitored to exclude fetal distress. The aim is to deliver the baby at the appropriate level of care for the gestational age, where a paediatrician and a neonatal unit are available with specially trained neonatal staff. Transport of the mother is only advised if she will not deliver on the way. It is a requirement in South Africa that all staff working in maternity should be able to intubate a preterm baby. This requires training and certification.

- Labour should be monitored using a partograph.
- An IV line should be in place.
- Delayed cord clamping by 30–120 seconds seems to be associated with less need for blood transfusion and less intraventricular haemorrhage in the neonate.

Contraindications to the use of tocolytics

The following are some of the contraindications to the use of tocolytics to arrest preterm labour:

- evidence of fetal maturity
- intrauterine infection (evident by raised temperature and raised pulse rate)
- intrauterine death
- intrauterine growth restriction

- severe pre-eclampsia
- active antepartum haemorrhage except in placenta praevia
- cardiac disease is an absolute contraindication
- diabetes mellitus as this condition is aggravated and keto-acidosis results
- preterm rupture of membranes.

Side-effects of the use of tocolytics

The following potential side-effects need to be observed with the use of tocolytics:

- tachycardia
- palpitations
- feelings of anxiety and nervousness
- hypotension
- pulmonary oedema if tocolytics are administered with steroids
- hypokalaemia
- fetal tachycardia
- neonatal hypoglycaemia and hypokalaemia.

Tocolytics should be discontinued if any of the following occur:

- hypertension
- tachycardia of more than 120 bpm
- chest pain
- pulmonary oedema.

Fetal assessment and care

The risks to the fetus are linked to the gestational age, whether corticosteroids were given in time and if there are comorbidities such as multiple pregnancy, growth restriction, placental pathology, or maternal disease, or fetal distress.

The fetal heart should be continuously monitored using a cardiotocograph (CTG) to assess base rate, variability and response to uterine contractions. If a CTG is not available you can use a fetoscope. If the membranes are intact they must be left intact until the time of delivery to minimise infection. The membranes also serve to put even pressure on the cervix for dilatation.

Use of steroids

The administration of cortiosteriods to the mother to prevent hyaline membrane disease is an evidence-based intervention that is accepted as best practice globally. Any mother at risk for preterm birth should receive corticosteroids intramuscularly in two dosages one week apart.

Corticosteroids are given IMI (e.g. Celestine Soluspan® 3 mg/ml, betamethasone disodium phosphate, dexamethasone phosphate 4 mg/ml) to stimulate lung maturity if the gestation is less than 34 weeks. Steroids appear to be of benefit only from 28–34 weeks' gestation. Corticosteriods take 24 hours to be effective in the fetus and suppression of labour is often aimed at getting the full value of the corticosteroids. The dosage is repeated in 24 hours. Dexamethasone 5 mg six hourly IV has been used to stimulate lung maturity for 24 hours prior to delivery if the gestational period is < 34 weeks. It can also be given in two dosages 24 hours apart.

Steroids are indicated in the management of preterm labour if:

- the gestational age is less than 33 weeks and membranes are intact
- the lecithin/sphingomyelin ratio is less than 2:1 (in a non-diabetic women).

The following investigations should be performed prior to administration of steroids:

- urinalysis
- full blood count
- blood glucose.

22.3 Preterm birth in remote settings

The management and treatment of preterm birth depends on making an accurate diagnosis of preterm labour and the comorbidities that are present. In 70% of cases in South Africa the midwife will be the person to identify the condition in the primary healthcare setting or in the maternity community care clinic. Early recognition and swift intervention are the keys to successful management of this condition. Prompt referral to the appropriate level of care can improve outcomes. It is important to establish the gestational age of the fetus and a diagnosis of labour.

If in a remote setting arrangements are made to transfer the patient to a health facility that offers emergency obstetric care only if the birth is not imminent.

General midwifery care

The care of a woman in preterm labour by a midwife involves not only general clinical care but a great deal of support, comfort and information. It is a period of great distress and a woman may be stressed and not hear or take in what she is told. Midwives need to be present, assist and stay with the woman until she is comfortable and the diagnosis is made and the course of action is mapped.

General principles of care include:

- Total bed rest in hospital until the threat is over.
- Sedation in order to allay anxiety and pain.

- Drugs are administered per medical practitioner's prescription or protocol. (Some form of pain relief may be needed.)
- No digital vaginal examination except a speculum examination to note the state of the cervix.
- Accurate diagnosis and appropriate intervention based on the diagnosis.
- Monitor uterine contractions half-hourly or continuously until danger has passed.
- Observe for presence of show or rupture of membranes.
- Monitor vital signs as per protocol of the institution (blood pressure, pulse, temperature and respiration).
- Monitor fetal heart by CTG or intermittent auscultation half hourly.
- If labour is successfully suppressed, allow the woman to go home and give health advice.

Indications to allow labour to continue and delivery to take place:

The woman is usually allowed to deliver if:

- The cervix is 3–4 cm dilated or the woman is in active labour.
- The fetus is more than 36 weeks gestation, as the chance of survival is good.
- There is infection or severe maternal comorbidities such as diabetes mellitus.
- There is intrauterine growth restriction.
- Membranes have ruptured and liquor is draining or has drained out.

In addition to the standard care of women during birth the following need to be observed when a woman is in preterm labour:

- Membranes should be preserved and remain intact until the second stage of labour to minimise ascending infection.
- Adequate pain relief is essential, preferably non-pharmacologic or an epidural to prevent preterm bearing down.
- Narcotics should be avoided by all means *and only administered on medical practitioner's prescription.*
- Close fetal heart monitoring and an emergency caesarean section should be performed in the presence of fetal distress.

Mode of delivery

Preterm delivery is associated with high perinatal mortality and morbidity, therefore a team of skilled attendants should be available at delivery which includes midwives, an obstetrician and a paediatrician to provide care for both the mother and the baby.

Normal vaginal delivery is encouraged unless there are other complications such as multiple pregnancy or breech presentation, in which case a caesarean section will be performed.

Resuscitation equipment should be prepared. A resuscitiare or a warm environment should be prepared. The staff in the special baby nursery unit should be asked to prepare for admission of a preterm infant. If the woman has delivered in a remote facility, transport equipped with resuscitation equipment and a warm environment should be ready and available to transfer the preterm infant to the appropriate level of care. It is preferable to transport the mother and baby together and not to separate them.

The following is essential and should be provided for the baby:

- warmth as the baby is prone to hypothermia
- gentle handling as the baby is preterm and hence fragile
- oxygen – some babies will not require oxygen
- airways should only be cleared if necessary
- the baby should be transferred to a special baby unit as soon as possible.

22.4 Complications of preterm labour

22.2 Spontaneous preterm labour

Spontaneous preterm labour and premature rupture of membranes are associated with higher perinatal mortality and morbidity and maternal problems emanate mainly from the interventions carried out to stop the contractions.

The following are some of the possible complications in babies weighing 1 000 g or less:

- The birth process in a preterm baby may be complicated because the soft parts of the baby do not put enough pressure on the cervix and there is slow dilatation. Preterm birth can be complicated by malpresentations, breech, prolapsed cord. It may take longer to be fully dilated and the breech may prolapse before full dilatation.

  After birth the baby may have the following problems: (The DoH guidelines for neonatal care (2008) gives norms and standards of neonatal care for South Africa.)
- birth asphyxia
- respiratory distress syndrome (RDS)
- jaundice
- hypoglycaemia

- hypothermia
- feeding problems
- infections (septicaemia, pneumonia or meningitis)
- intraventricular haemorrhage
- congenital malformations.

(See Chapter 41 for care of the preterm baby.)

22.5 Prolonged (post-term) pregnancy and postmaturity

Pregnancy is usually considered to be prolonged when it exceeds 42 weeks, or 294 days from the first day of the last normal menstrual period. An average pregnancy is 40 weeks or 280 days.

The term 'post-dates' means that the patient has gone past her estimated due date for delivery, that is, she is 'post-term'.

Incidence

The incidence of prolonged pregnancy is high; approximately 12% of all pregnancies exceed 42 full weeks.

The effect of prolonged pregnancy on the pregnant woman

Psychological

The woman begins to worry about the health and condition of the baby. As her anxiety increases, she begins to worry about her pregnancy. She begins to lose morale, and becomes depressed as the days go by and labour has not begun. Arrangements which have been made for delivery are disrupted, causing possible extra expense and inconvenience. The patient becomes ungainly, depressed and tired.

Physical

The uterus increases in size, causing more discomfort to the woman. She does not want to move and does not sleep well at night. Often she develops oedema of the ankles. Later, in labour, there is often inefficient uterine action.

There is also an increase in traumatic delivery and intervention, because the fetal skull becomes ossified and the ability to mould decreases.

There is a greater incidence of occipitoposterior positions and malpresentation, further prolonging labour and causing greater risk to the fetus.

Effects on the fetus

The functional capacity of the placenta decreases after term. The placenta deteriorates from 36 weeks of pregnancy, causing intrauterine growth restriction, due to placental insufficiency.

The liquor decreases, the fetus enlarges, leaving very little space within the uterus for the fetus to move around. This may possibly delay the progress of labour.

In all conditions that are associated with placental dysfunction, prolonged pregnancy is an added risk, resulting in possible fetal anoxia and intrauterine death.

Perinatal mortality and morbidity are increased. The increased size of the fetus may result in prolonged and/or obstructed labour, from cephalopelvic disproportion.

There is less fetal haemoglobin after term, the oxygen saturation decreases, and these result in the real danger of intrauterine hypoxia or anoxia.

Fetal anoxia can lead to polycythaemia.

There is a high incidence of meconium-stained liquor. Meconium aspiration may occur.

There is a high incidence of cord compression, leading to fetal distress and to alterations in the fetal heart-rate patterns, that is, tachycardia and variable decelerations.

There is a relatively high incidence of neonatal respiratory distress at birth.

Developmental and behavioural disturbances can occur after birth and later in life.

The fetal mortality rate is doubled after 42 weeks, and trebled after 43 weeks.

About 20–40% of babies have the 'postmaturity syndrome'.

There is a possibility of meconium aspiration syndrome either in labour or at delivery, resulting in pneumonitis, respiratory distress syndrome and pneumonia. There is often injury to the fetus as a result of traumatic delivery, for example, shoulder-girdle dystocia.

Diagnosis

The accurate diagnosis of the duration of the pregnancy is dependent on accurate information from the mother and early measurements (history, serial SFH measures and ultrasound before 20 weeks).

This can be a problem, because many patients have poor memories regarding dates and these are often incorrect. They also have irregular menstrual cycles and lactational amenorrhoea.

The midwife, therefore, can do much by taking an accurate and detailed history from the patient at the very first antenatal visit before 20 weeks of gestation. This enables a good baseline reference when the dates appear to be post-term.

Ultrasound

The history of previous ultrasound is important. When was this performed in her pregnancy?

Was it an early scan? (Before 20 weeks, as these are accurate to within seven days.) The crown-rump length can be measured from 6–14 weeks and the biparietal diameter from 9–28 weeks. This is then plotted on a graph and serial scans will reveal the rate of growth and the gestation estimation. (See Chapters 7 and 17).

If no previous ultrasound was done the following information is important:

- the biparietal diameter
- placental maturity indicates gestational age. Doppler studies can be done to determine placental function and fetal wellbeing. One of the purposes of an ultrasound is to look for fetal abnormalities and malpresentations. The fetus plays a role in the onset of labour and prolonged pregnancy may be due to conditions such as anencephaly or other neural tube conditions
- NST: Serial non-stress tests are done to determine fetal wellbeing.
- Bishop's score is done to determine the status of the cervix for induction of labour.
- Amniocentesis can be done to determine lung maturity.

Management

The delivery of the fetus after 42 weeks of pregnancy depends on the condition of the fetus and the cervix.

The pregnancy can be managed conservatively, but induction of labour is usually done (by a medical practitioner) if the condition of the fetus allows it and the Bishop's score is favourable.

There is strict monitoring of the fetal condition with cardiotocography throughout the labour.

Manage the mother by:

- providing intravenous 5% dextrose water
- preventing supine hypotensive syndrome
- preparing for possible resuscitation of the infant
- epidural analgesia is the preferred analgesia in labour
- additional reassurance, support and encouragement during labour.

A caesarean section is considered if:

- the patient is more than 30 years old, particularly with a history of previous large babies
- the baby is large, that is, over 4.0 kg
- the cervix is unripe
- there is insufficient placental reserve
- there is gestational proteinuric hypertension
- the non-stress test or Doppler study indicates fetal distress or reduced placental blood flow.

Special consideration is given to the baby after birth for hypothermia and hypoglycaemia.

If meconium is present in the liquor care is taken to clear the airways.

The increased incidence of fetal distress in post-term infants requires immediate intervention and management of asphyxia in the newborn. (See Chapter 41 for care of the baby).

22.6 Conclusion

Neonatal immaturity or postmaturity are major causes of perinatal mortality and morbidity in South Africa. This is aggravated by the comorbidities that complicate perinatal health outcomes, in particular the HIV pandemic. The Saving Babies Report in 2008 indicated that the highest level of perinatal mortality occurs at district level. This warrants an improvement of the skills and competencies of nurses and midwives and medical practitioners as well as the improvement of the quality of care, specifically intrapartum care.

Standard 'best practice' protocols for the care of immaturity and hypoxia intrapartum have been set and should be part of each professional practitioner's competencies. In addition the norms and standards of staffing and equipment need enforcement for quality of care (as suggested by the DoH neonatal guidelines 2008).

Lastly the organisation and administrative processes in healthcare must support care.

CHAPTER

23 Pregnancy-related complications

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- recognise pregnancy-related conditions that complicate pregnancy
- show competency in identifying and diagnosing pregnancy-related factors that complicate pregnancy and birth
- show competency in preventing pregnancy-related complications
- show competency in the treatment and specific care and evidence-based protocols/regimens of medical care for obstetric conditions that complicate pregnancy and birth.

KNOWLEDGE ASSUMED TO BE IN PLACE

The knowledge and competency to assess and care for 'low risk' pregnant women

KEYWORDS

Hyperemesis gravidarum • Fetoplacental unit • DIC/IUD • Elderly primigravida • Adolescent pregnancy • Multiple pregnancy • Rhesus haemolytic disease • ABO incompatibility • Amniotic fluid abnormalities • Parity • Gravity • Obesity

23.1 Introduction

This chapter will focus mainly on common obstetric complications such as Rhesus haemolytic diseases, hyperemesis gravidarum, disorders of the amniotic fluid and placenta, prolonged pregnancy, intrauterine death, multiple pregnancy, and abnormalities of the female reproductive organs. The effects of age and parity are also mentioned because of their importance as contributing factors in maternal deaths in South Africa.

23.2 Rhesus (Rh) haemolytic disease

This is also known as Rh isoimmunisation and Rh incompatibility.

In the past, Rh haemolytic disease in the newborn was a very serious problem, and the cause of much misery and distress for many Rh negative (Rh–) women.

Prior to the use of Rh (D) immune globulin (human) or anti-D as it is more commonly known, 1:200 pregnant women were affected. However, the introduction of Rh prophylaxis has caused a sharp decline of the occurance of this condition.

Today, haemolytic disease of the newborn occurs when Rh (D) immune globulin is not given postdelivery or postabortion, or failure of protection due to the development of anti-D before delivery, as occasionally occurs in mismatched blood transfusions and in ineffective or inadequate prophylaxis.

Greatly improved obstetric management and neonatal intensive care facilities have reduced the number of deaths from Rhesus incompatibility by about 90%. The disease can also be caused by other antibodies such as an ABO incompatability, anti-C, or anti-Kell antibodies or other factors in the blood.

The inheritance of the Rhesus (Rh) factor

The Rh factor refers to the D antigen of the Rh blood group system. Those people who have the D antigen are known as Rhesus positive (Rh+). People either do or do not have this antigen. Rhesus positive (Rh+) indicates that the person has the D antigen, Rhesus negative (Rh–) indicates that the person does not have the D antigen.

The Rh factor is transmitted by a genetic factor denoted as D for Rh+ and d for Rh–. People have a pair of these genes. If they have two dominant genes – DD – then

they are Rh+. If they have one D and one d, that is they have Dd (heterozygous), then the dominant gene means they will test Rh+.

If they have both dd genes then they are Rh–. If both parents are Dd, then they will test Rh+, but they can produce children who can have the combination of DD, Dd or dd.

The chance of such parents having a dd child who will test Rh– is one in four.

Rhesus factor pathology

(See Figure 23.2) Rh incompatibility develops as a result of antibody formation in an Rh– person. In midwifery, we are concerned with the pregnant woman who is Rh–. If her husband/partner is also Rh–, there is no problem. However, if the husband/partner is Rh+, then problems can arise.

During her first pregnancy, and if the baby she is carrying is Rh+, small haemorrhages, known as 'fetal leaks' can occur, which will result in fetal Rh+ blood entering the circulation of the Rh– mother. These haemorrhages may also occur during procedures such as amniocentesis, during antepartum haemorrhage and during the separation of the placenta when the maternal sinuses are left open in the third stage of labour, and/or after an abortion or an ectopic pregnancy.

Once the fetal blood enters the maternal circulation in significant amounts, it stimulates an antibody response in the maternal circulation, resulting in the formation of maternal serum Rh antibodies. These Rh antibodies remain in the mother's blood, and also make a template or memory of the antibody response.

During a subsequent pregnancy, maternal Rh antibodies can cross the placenta. This results in the haemolysis (breaking up) of the fetal red blood cells. The mother's Rh antibodies attack the baby's red blood cells, and this causes anaemia in the fetus and leads to erythropoietin increase, especially in the fetal liver and the spleen. This may disrupt the fetal hepatic circulation, leading to portal hypertension, reduced production of albumin, and in cases of severe haemolysis, a condition known as hydrops fetalis (cardiac failure) develops.

These haemorrhages can vary from small leaks to as much as 50–400 ml of red blood cells. Very small haemorrhages may not produce an antibody response, whereas a large bleed is more likely to result in a more intense antibody response with clinical consequences.

Prevention

Rh incompatibility can be prevented today.

Routine blood specimens are taken from all women attending antenatal clinics to ascertain their blood group and Rh factor at the first visit. If the woman is Rh–, the husband's/partner's blood is taken for grouping and the genotype is identified.

23.1 Hydrops fetalis

There are various degrees of severity of Rh isoimmunisation, and hydrops fetalis is the most severe form of this condition of Rh haemolytic disease.

The clinical features include:

- a large pale infant
- subcutaneous oedema
- ascites
- pleural and pericardial effusions
- anaemia
- hepatosplenomegaly
- petechial haemorrhages
- cardiac failure.

The placenta is large, pale, oedematous, the liquor is golden yellow and the vernix caseosa is also a golden yellow colour.

If the woman is Rh– and has no antibodies, the test is repeated at 30 and 36 weeks' gestation. If a woman is Rh– a direct antiglobulin (Coomb's) test is done to look for antibodies. Blood is taken at 24 weeks and then every two weeks thereafter, to determine whether the antibody titre is rising or not.

All women's Rh status must be known at birth. If not, maternal and cord blood is taken and tested. All Rh– women's blood is taken after birth, along with a cord sample to test the baby's blood type, Rh factor, bilirubin and antibodies (Coomb's). A positive Coomb's indicates sensitisation.

All Rh– women who have not been sensitised should receive high titre anti-Rh globulin within 72 hours after an incident (abortion, amniocentesis or birth). This must be given after each incident or pregnancy. The serum destroys fetal cells that cross the placenta into the maternal blood circulation. The failure rate is 1–2% because sensitisation occurs in pregnancy rather than at birth. Therefore all pregnant Rh– women with a negative Coomb's should receive a 300 µg dosage of anti-D at 28 weeks that will protect them for six months. In addition anti-D will be repeated after birth if the baby is Rh+.

Prophylactic anti-D immunoglobulin 100 µg can be given at 28 and 34 weeks' gestation, at least in the first pregnancy, as antenatal prophylaxis.

Sensitised women

Titres indicating Rh incompatability are of limited use in already sensitised women but of use in women at risk but not yet sensitised. If the titre is 1:32, amniocentesis is indicated to determine the bilirubin concentration in the amniotic fluid

every two weeks from 28 weeks. If a woman is already sensitised, amniocentesis is done from 26–30 weeks to determine the severity of the disease in the newborn. If the baby is affected, intrauterine exchange transfusion can be done at two week intervals or the baby can be delivered as soon as it is safe.

If untreated, the breakdown of red blood cells leads to anaemia. The fetal bone marrow releases immature red blood cells. The red blood cell lysis releases bilirubin that builds up in the fetus. Dangers of high bilirubin *in utero* include: hearing loss, mental retardation and kernicterus for the neonate.

23.2 Rh Immune Globulin (anti-D)

Rh immune globulin (anti-D) is given to the following women:

- those having given birth to a Rh+ infant
- after abortion: spontaneous, threatened or therapeutic abortion
- after ectopic pregnancy
- after chorionic villus biopsy
- after abruptio placenta and/or abdominal trauma
- after intrauterine death
- after external cephalic version
- after manual removal of the placenta
- after amniocentesis.

IV anti-D can also be issued from the blood bank, once they have cross-matched with a fresh specimen of the patient's blood.

Dosage: Less than 20 weeks' gestation 50 µg (250 IU). More than 20 weeks' gestation 100 µg (500 IU).

The effects on the fetus and neonate

If Rhesus haemolytic disease is not prevented, it results in serious consequences:

- intrauterine death
- hydrops fetalis (See Box 23.1)
- icterus gravis neonatorum (grave jaundice of the newborn) which manifests within 24 hours of birth and can result in kernicterus and death if untreated
- haemolytic anaemia.

23.3 ABO incompatibility

The most common blood groups are the ABO groups. There are four main blood groups, namely: A, B, AB and 0 (there are 200 subgroups that can cause incompatability):

- Blood group A has the antigen A on the red blood cells.
- Blood group B has the antigen B on the red blood cells.
- If neither of these antigens are present, the blood group is 0.
- If both these antigens are present, the blood group is AB.

These antigens, also known as polysaccharides are situated on the outer membrane of the red blood cells.

ABO antibodies:

- People with blood group A, develop anti-B antibodies in the plasma.
- People with blood group B, develop anti-A antibodies in the plasma.
- Group AB people, develop no antibodies in the plasma.
- Group O people develop both anti-A and anti-B antibodies in the plasma.

The pathophysiology of ABO incompatibility

This type of incompatibility is common if the mother is of the O blood group, and the fetus is group A, B, or AB. The fetus can inherit one or more group factors from the father, which are absent in the mother. ABO factors cause the greatest number of incompatibilities, three to four times greater than Rh incompatibility.

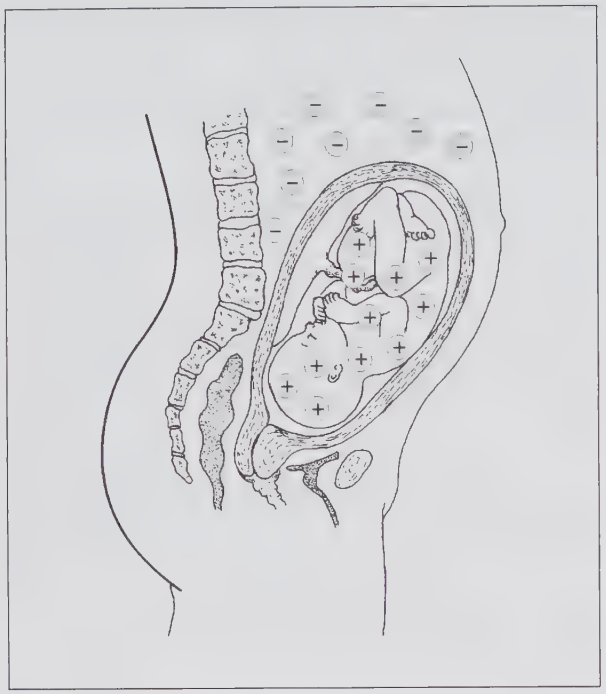
Group O mothers have anti-A and anti-B antibodies in their serum. If the fetus is group A or group B, and any of the fetal red cells leak into the maternal circulation, they are coated with an antibody in the reticulo-endothelial system, and destroyed by the maternal anti-A and/or anti-B haemolysins.

The chances of sensitisation are reduced because haemolysins anti-A and anti-B antibodies do not normally cross the placenta, because they are too large. However, immunoglubulins such as IgG can cross the placenta from the maternal to the fetal circulation. If IgG does cross the placenta, it attaches itself to the fetal red blood cells and destroys them, causing haemolytic disease. Therefore, first-born babies can be affected in this way, as can babies born in subsequent pregnancies.

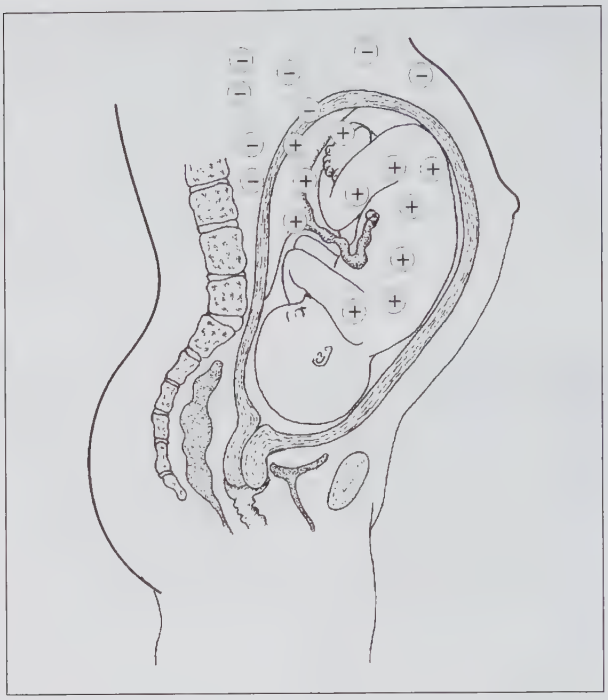
ABO incompatibility is now the most common cause of isoimmune haemolytic disease of the newborn, since prophylaxis with anti-D gamma globulin has reduced the incidence of Rh incompatibility (See Figure 23.1).

Effects of ABO incompatibility on the fetus

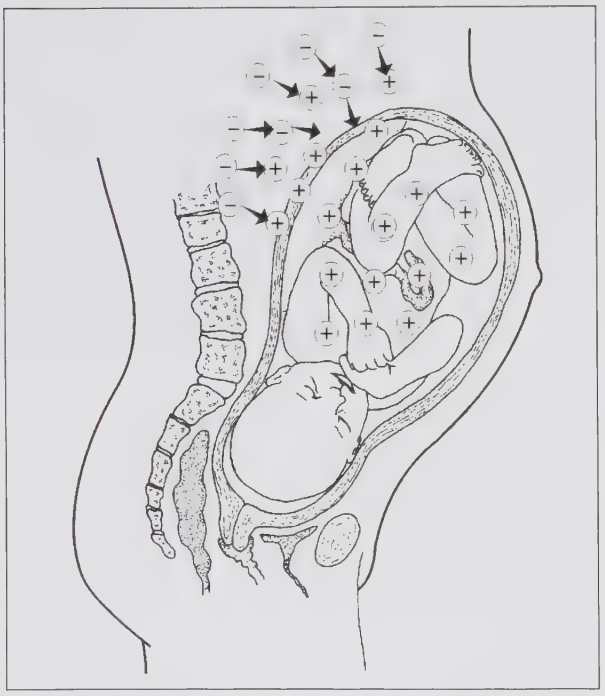
At birth, the baby is usually healthy. Soon thereafter, the baby becomes jaundiced (that is, on the day after delivery). The jaundice is progressive and can be unpredictably severe in some cases. Direct Coombs' antiglobulin test is positive. Haemoglobin is normal. Free anti-A or anti-B antibodies are seen in the fetal serum. Nucleated red blood cells and spherocytes and reticulocytes are seen in the blood smear.



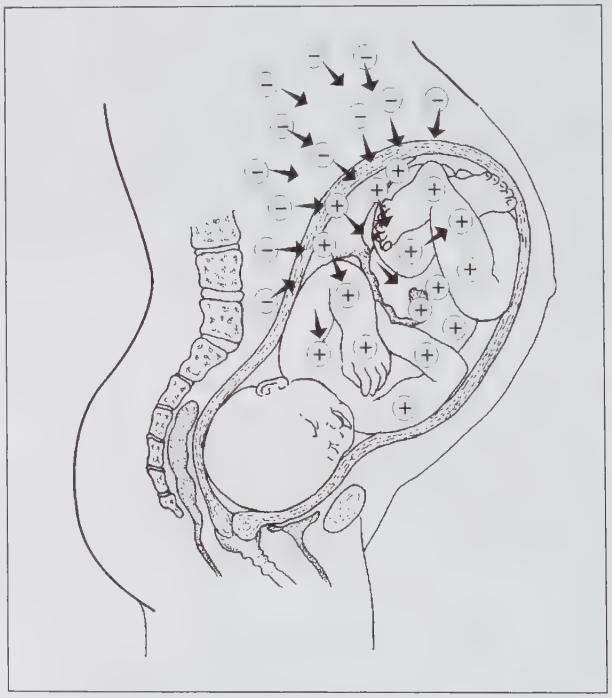
A: Mother not sensitised against baby's blood type.



B: First exposure of mother to baby's blood after an incident



C: Maternal antibodies formed against baby's blood type



D: Maternal antibodies cross placenta and haemalyse fetal blood if any contact with fetal blood occurs (second exposure)

Figure 23.1 Schematic diagram of development of ABO/Rh incompatibility during pregnancy

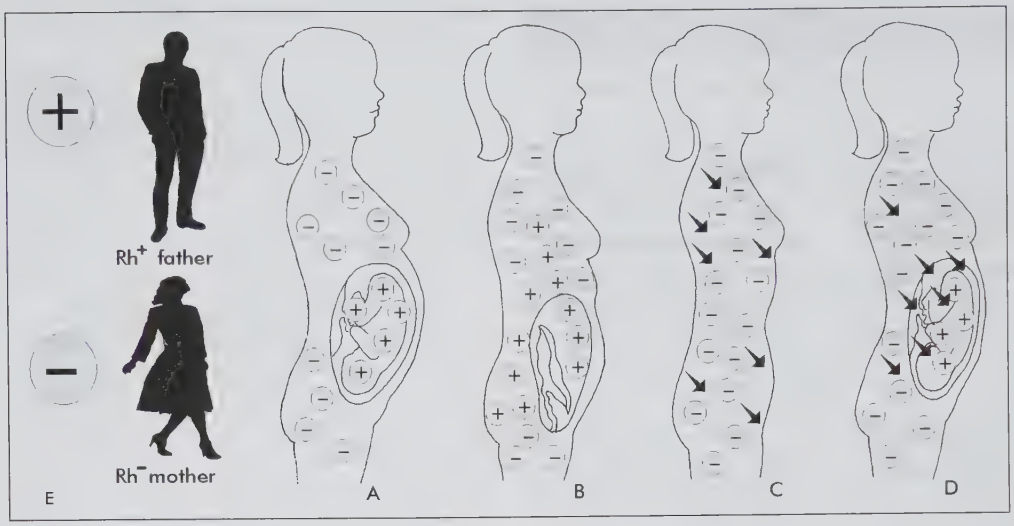


Figure 23.2 Schematic diagram of development of ABO/Rh incompatibility in follow-up pregnancy A: Mother and baby's blood is incompatible, without contact during pregnancy, B: Positive fetal blood enters maternal circulation at birth, C: Mother develops antibodies, D: First contact with incompatible fetal blood during any of the following pregnancies results in release of antibodies that cross the placenta and haemalyse fetal blood

Diagnosis

- The infant is jaundiced within 24–36 hours.
- The mother's blood group is O.
- The baby's blood group is A, B or AB.
- The direct Coombs' test is positive.

Care

- Phototherapy (see Chapter 43 and *Juta's Clinical Guide for Midwives*)
- Exchange transfusion only if the serum bilirubin reaches danger levels. That is:
  - 340 µmol/l (20 g/dl) in a term baby
  - 260 µmol/l (15 g/dl) in a preterm baby.

Table 23.1 compares ABO and Rh incompatability.

23.4 Hyperemesis gravidarum

Hyperemesis gravidarum is defined as severe vomiting that persists after the first trimester and becomes excessive and pathological. However, hyperemesis can occur before 14 weeks.

Incidence

Hyperemesis gravidarum occurs in less than 2:1 000 pregnancies. Twenty-five percent of women have a re-occurrence in the next pregnancy.

Aetiology

The cause of hyperemesis gravidarum is unknown, but certain conditions are associated with this condition:

- primigravidae are more often affected than multigravidae
- a previous unsuccessful pregnancy
- associated with hyperthyroidism
- psychogenic elements (certain personality types): for instance: women who are nervous and anxious, women with emotional stress at home.

It is more common in conditions with increased HCG such as:

- multiple pregnancy
- hydatidiform mole
- pyelonephritis.

Pathophysiology

Vomiting is controlled by two centres in the brain, which are sensitive to the rise in oestrogens and HCG levels.

Diagnosis

The diagnosis is clinical and the sign is vomiting, which becomes increasingly persistent and severe. The vomiting occurs at any time of the day or night, and persists after 14 weeks' gestation. There are signs of dehydration including a dry furred tongue, cracked sore lips and mouth, sunken eyes and a loss of 5% of mass or more than 2 kg.

Blurred vision is a serious sign indicating decreased intraocular pressure. Headaches and depression are common followed by diplopia, nystagmus, delirium, coma and oliguria with concentrated urine with proteinuria, ketones

Table 23.1

Differential diagnosis of ABO incompatibility and Rh incompatibility

	ABO Incompatibility	Rhesus Incompatibility
1	Antibodies may not be detected during pregnancy	Antibodies are detected during pregnancy
2	Mother and baby may be Rh–	The mother is Rh–, the baby Rh+.
3	Amniotic fluid and placenta are normal	Amniotic fluid and placenta are abnormal
4	Infant of first pregnancy can be sensitised and may manifest the condition	Infant of first pregnancy is not usually sensitised
5	Coombs' test is positive, but may be negative	Direct Coombs' test is positive
6	The disease is milder	The disease is more severe

or bilirubin. Liver damage occurs, due to a reduction in vitamin B absorption. The woman may also show tachycardia (weak, rapid pulse) with symptoms of hypotension. There is increased urea in the blood (uraemia), with some renal damage.

Treatment and care

- Identify the cause of the vomiting.
- Treat and stop the vomiting.
- Reverse the metabolic effects of starvation and dehydration.
- Provide a calm atmosphere.

The interventions depend on the severity of the condition:

- Medical care is needed in most cases. Hospitalisation is needed in some cases.
- Visitors are restricted. A private room or side ward is used for the woman.
- In the beginning the woman is nil per mouth until she is stabilised. Mouth wash is given.
- An intravenous infusion 1 000 ml saline dextrose 125 ml per hour is started with an antiemetic and sedation. Intake and output is measured.
- The electrolytes are checked and corrected. Vitamin B complex and vitamin C are given with calcium gluconate, to protect the liver.
- There is a gradual return to oral fluids, and when food is tolerated, intravenous therapy is discontinued.
- Special diet includes small, frequent, attractive meals. Fatty, spicy foods should be avoided.

Take a full history and do a thorough physical examination. Provide reassurance and arrange psychotherapy if required.

Investigations

- Urine is taken for microscopy, culture and sensitivity (MC&S), specific gravity, ketones and bilirubin. Any urinary tract infections must be treated.
- Blood tests may include electrolytes, and liver function tests.
- Ultrasound excludes hydatidiform mole or multiple pregnancy.

Complications

If the condition is very serious and there is no improvement with treatment, a termination of the pregnancy may be considered in the following circumstances:

- persistent severe jaundice
- persistent albuminuria
- pyelonephritis
- neurological symptoms, such as delirium and coma
- rising temperature and tachycardia
- cardiac symptoms
- death.

23.5 Amniotic fluid abnormalities

Polyhydramnios

Amniotic fluid gradually increases in pregnancy to 1 000 ml at term. The normal amount of liquor at term is between 400 ml–1 500 ml, and is usually about 600 ml. Approximate amounts at given gestation periods are as follows:

- at 10 weeks = 30 ml
- at 20 weeks = 300 ml
- at 30 weeks = 600 ml
- at 38 weeks = 1 000 ml
- at term = 600 ml.

Amniotic fluid is produced by the amniotic epithelium and its volume is related to the fetal weight in the first trimester. It is the same concentration as fetal intracellular fluid and is a filtration of maternal plasma also containing fetal urine. At term the fetus swallows the same amount as the feeding requirements after birth (500 ml per day).

Amniotic fluid is not static. There is a rapid turnover of amniotic fluid in the third trimester; about 500 ml is exchanged each hour.

Definition

Polyhydramnios is a pathological condition, characterised by an excessive amount of amniotic fluid for the period of gestation. The liquor can increase to 2 000–3 000 ml.

In very severe cases, the liquor may increase to 15 ℓ. Once the volume reaches 3 000–4 000 ml there are abnormal clinical signs.

Incidence

The incidence is 1 in 3 000 pregnancies.

Aetiology

Polyhydramnios is caused by any condition that is involved in overproduction of amniotic fluid, or which prevents the circulation of amniotic fluid through the fetus, for example if the gastrointestinal canal is blocked (cystic fibrosis), or in neurological conditions such as those in which the fetus may not be able to swallow.

Classification

Polyhydramnios may develop gradually or acutely.

Clinical features and diagnosis

The clinical features will depend upon the period of gestation, the amount of amniotic fluid and the rapidity of the accumulation of the fluid.

There is often a history of exaggerated minor disorders of pregnancy such as nausea and vomiting, abdominal discomfort, abdominal distension, pain and oedema, dyspnoea and orthopnoea and oedema of the vulva and legs.

Table 23.2

Causes of polyhydramnios

Maternal	Diabetes mellitus 25%; Rh incompatibility 10%; Liver and kidney disease; Infections (syphilis)
Fetal conditions	Congenital abnormalities 20% Neurological: anencephaly, open neural tube, spina bifida, encephalocele, meningocele, meningomyelocele. Gastro-intestinal: gastrocysis and oesophageal atresia Tumours of the neck Cystic fibrosis
Obstetrical	Multiple pregnancy 10% (uniovular twins) large placenta, pre-eclampsia
Idiopathic	35%

Table 23.3

Classification of polyhydramnios

Acute polyhydramnios 2%	Chronic polyhydramnios
2nd trimester onset Rapid increase > 2 000 ml Pre-term labour is common Abdominal pain, dyspnoea, oedema of abdomen and lower extremeties, nausea and vomiting, amniocentesis to relieve maternal discomfort	Develops late in pregnancy 32–42 weeks. Is a gradual increase causing discomfort if abnormalities are present with poor perinatal outcome

On examination the following may be observed:

- the uterus appears large for dates
- the uterus is globular in shape
- the skin of the anterior abdominal wall is taut, stretched and shiny.

On palpation:

- The uterus is tense and tender.
- A 'fluid thrill' can be demonstrated. (The palm of one hand is placed against one side of the abdomen, while the fingers of the other hand flick the uterus on the other side. Waves of movement are transmitted through the excess fluid and are felt on the palm of the hand against the abdominal wall on the opposite side.)
- The whole fetus is ballotable. Fetal parts are not easily felt.
- It is difficult to palpate the fetus, because the uterus is filled and overstretched with amniotic fluid making it impossible to grasp or feel the parts.

On auscultation:

- The fetal heart is muffled.

On ultrasound:

- Amniotic fluid is excessive and evident throughout the uterine cavity. Large pockets of fluid, more than 1 cm in vertical diameter, indicate polyhydramnios. Fetal abnormalities may be detected.

Complications

The complications of polyhydramnios are associated with the cause of the condition, the gestational period and the classification. Common complications are preterm labour, abruptio placenta, due to the overstretching or rapid decompression when the membranes rupture, and maternal distress from discomfort and symptoms.

In labour there is a high risk of prolapse of the cord with the rupture of membranes due to malpresentations and the poor application of the presenting part. Abnormal uterine action and prolonged labour occur due to the overstretched atonic muscles. Postpartum haemorrhage (due to ineffective contractions, caused by an atonic uterus from overstretched muscles).

In the postnatal period subinvolution and infection may occur.

The fetal complications are those of the preterm neonate and those with congenital and genetic abnormalities The woman is referred to medical care.

Treatment and care

- The patient is admitted to hospital on bed rest or semi-bed rest.
- Any associated condition is determined and treated.
- If the fetus is mature, labour is induced.
- If the fetus is abnormal, termination or delivery depends on the kind of defect.
- If the fetus is normal and premature labour can be suppressed, beta-sympathomimetics may be used to reduce uterine activity.
- Draining amniotic fluid is not without risk. Amniotic fluid is quickly replaced and the risk of infection is increased.

Midwifery care

- The woman is nursed with bed rest, in an upright position.
- She is made as comfortable as possible and reassured and supported emotionally.
- All her personal hygiene is attended to.
- The symptoms of polyhydramnios are treated and relieved where possible.
- If there is a need for genetic counselling, this is arranged.

Oligohydramnios

Oligohydramnios is a rare condition in which the amount of liquor is grossly deficient and can be reduced to an amount of less than 300 ml of liquor, and can even be reduced to a few millilitres of dark thick fluid.

Aetiology

The cause is not clearly understood, but certain conditions are associated with oligohydramnios such as renal agenesis, or obstruction in the fetal urinary system. Babies with renal agenesis often present with Potter's syndrome.

Prolonged pregnancy for reduced placental function and a postmature fetus can result.

There may also be intrauterine growth restriction (IUGR) and placental failure, and all the conditions associated with IUGR.

Complications

Early oligohydramnios can result in:

- Fetal damage, caused by amniotic bands, winding around a part of the fetus, as there is little liquor to keep the amnion away from the fetus (amniotic band syndrome).
- Maldevelopment or amputation of toes, fingers, limbs.
- Cord constriction and obstruction causing fetal hypoxia or anoxia.
- Pressure deformities due to the extremely confined intrauterine space.
- Pulmonary hypoplasia. This is due to compression by the uterus on the chest wall, preventing expansion of the chest wall. This will also inhibit lung growth and cause intrinsic lung defects.
- The lack of liquor results in the fetal skin becoming dry, leathery and wrinkled.

These deformities are severe and often result in intrauterine death, or neonatal death, or in severe irreversible deformities of the child.

Late oligohydramnios results in pressure deformities:

- pressure or obstruction of the cord
- signs of fetal distress/compromise, with abnormal heart rates and rhythms, and thick meconium in the sparse liquor
- the fetus becomes squashed in the uterus and this can result in a distorted face, the flattening of the nose, micrognathia, and squashing of the limbs resulting in talipes, dislocated hips, scoliosis.

Most of these deformities improve with time and may return to the normal shape and function.

Clinical signs and symptoms

The uterus is irritable on palpation. The uterus appears small for the gestational age.

Palpation is difficult as the uterus is moulded around the fetus, and the head cannot be ballotted. There are reduced fetal movements.

Investigations

Ultrasound will show reduced liquor. Fetal abnormalities and features of intrauterine growth retardation may be visible.

Treatment and care

During pregnancy.

- The woman is referred for medical attention. Admission to hospital is needed to investigate causes, fetal status and treatment plan.

- Tests for placental function: oestriol values (seldom performed now) and/or cardiotocograph tracings for placental reserve are performed.
- If no abnormalities or if only slight abnormalities are shown, the pregnancy is allowed to go to term under close observation of fetal status.
- If there are gross abnormalities, the pregnancy may be terminated or delivered based on the gestational age, fetal status and placental function.
- If the fetus is distressed deliver by caesarean section in a level of care where neonatal care is available.

During labour.

- The fetal condition is carefully observed through continuous electronic monitoring.
- Constriction rings may be present and may cause problems during delivery, therefore an obstetrician should deliver the baby.
- The mother needs explanation, extra support and reassurance during labour.
- If fetal abnormalities are present a paediatrician is involved to carefully explain to the parents about the abnormality, management and prognosis of the baby.
- The patient requires reassurance but firmness, kindness and understanding.

23.6 Intrauterine death (IUD)

Definition

Intrauterine death is the death of the fetus after viability and before or during birth. This is called a *stillbirth*. If the fetal heart was present at the start of birth it is called a *fresh stillbirth*.

Incidence

The stillbirth rate is included in the perinatal mortality rate (PNMR), but when considered separately it is estimated at 32/1 000 live births in developing countries versus 5/1 000 live births in developed countries.

Causes and predisposing factors

Early intrauterine death, that is, before 20 weeks' gestation, usually leads to a spontaneous abortion. However, occasionally the dead fetus is retained and this is called a *missed abortion*.

The predisposing causes of intrauterine death can be divided into those during pregnancy and those during labour.

During pregnancy.

- *Maternal*: Chronic conditions such as gestational diabetes, chronic nephritis, infections (TORCH), HIV and others, for example sexually transmitted infections, typhoid, malaria, cholera, Rhesus incompatibility (isoimmunisation), medication.
- *Obstetric*: Chorioamnionitis, accidents or trauma during pregnancy.
- *Placental pathology*: Antepartum haemorrhage, placental abruption, oligohydramnios and amniotic bands, placental insufficiency.

During labour.

- *Cord factors*: Short cord, cord around the neck, cord prolapse, true knots.
- *Complications:* Prolonged and obstructed labour, malpresentations, anaesthetics, uterine rupture, and maternal death.

Pathology

The fetus dies when the placental blood circulation to the fetus ceases and the fetal heart stops. Stasis of the blood at the placental site causes the clotting of blood and fibrinogen is activated to protect the mother from the clots. Eventually the fibrinogen will be exhausted and disseminated intravascular coagulation (DIC) may develop within a period of weeks.

Maceration of the fetus starts within six hours after intrauterine death. Aseptic autolysis takes place, and pockets of dark-coloured fluid accumulate under the skin of the fetus. The tissue gradually disintegrates, causing the skin to peel off the tissue. The placenta and fetus may be green due to the presence of meconium. Fluid gradually accumulates in all the tissues and gas accumulates in the circulatory system. The longer the fetus remains *in utero*, the more grossly macerated it becomes. The skeleton of the fetus collapses as there is no longer any tissue to hold it together, and the fetal skull bones begin to overlap one another.

At some stage during the three weeks after intrauterine death has occurred, in 70–90% of cases labour starts spontaneously, and a macerated fetus is expelled. If spontaneous labour does not occur within four weeks, there is an increased risk of maternal disseminated intravascular coagulation (DIC), which can result in severe maternal bleeding.

Prevention

The aim of antenatal care is to identify the women and fetuses at risk and intervene in time to prevent IUD (see Chapter 17). Quality antenatal care protocols, early access, standard screening, referral for medical care, and vigilant monitoring of fetal wellbeing is needed to prevent stillbirths. In spite of the highest

quality of antenatal care fetuses sometimes die for unknown reasons in pregnancy. When a fetus dies in labour and is a fresh still-birth this generally indicates poor quality care.

The mother needs to know early warning signs and is asked to come to the clinic immediately if any of these occur. Woman at risk are admitted to hospital under medical supervision.

Diagnosis

History

- History of decreased or no fetal movement (Kick chart).
- Sometimes a brownish vaginal discharge is present.
- Presence of predisposing factors such as pre-elampsia, infections, and congenital abnormalities.
- Non-reassuring NST.

Clinical findings

- The size of the uterus is less than that suggested by the expected date of delivery (EDD).
- The uterine size (the height of the fundus) fails to increase from the previous visit (no increase in abdominal girth around the umbilicus).
- Depending on the period of death the fetus may not be felt on abdominal palpation.

Confirmation of death

- No fetal heart can be heard with the Pinard fetoscope.
- If the fetal heart is not audible in cases where intrauterine death (IUD) is suspected ultrasound is indicated.

The use of sonicaid and cardiotocograph to hear the fetal heart creates enormous anxiety in the woman and is not conclusive. It is better to use a method that can be conclusive. If ultrasound is not available X-rays will be diagnostic.

Ultrasound

A diagnosis is made when:

- The fetal heart is not detected, there is no fetal breathing and there is no fetal movement.
- The biparietal diameter shows no increase in growth at weekly intervals after 30 weeks.
- There is a 'fluffy' contour and/or a double skeleton outline.
- There is loss of fetal structure, with a collapsed thorax and misshapen skull.
- Multiple intracranial echoes appear; a double skull.
- There is an abnormal reduction in liquor.
- Gas is seen in the fetal circulatory system, commonly in the heart, the aorta, the portal veins and the umbilical veins. This may be seen as early as 12 hours after intrauterine death. The nature and the origin are uncertain, but the gas is probably carbon dioxide. This is known as Robert's sign. The gas can also be seen in the heart, the liver, the cord, the abdominal cavity and the large blood vessels.
- There is loss of muscle tone and the fetus appears 'rolled up', with either hyperextension of the head or angulations of the fetal spine. This is known as Ball's sign – the collapse of the thoracic cage, the ribs concertinaed together, hyperflexion of the spine and the softening of the ligaments.

X-rays

- A positive Spalding's sign is seen on X-ray. There is overlapping and angulation of the cranial bones. This may also be apparent after a week of intrauterine death. Later there is gross overlapping of the skull bones due to shrinkage of the brain.
- The 'halo' sign may be seen on X-ray, where a halo is evident around the skull of the dead fetus, but this may also be seen in erythroblastosis fetalis in a live fetus.
  The cause of this image on X-ray is the infiltration of fluid beneath the scalp. There is gas visible in the gastrointestinal system.

Treatment and care

The patient must be referred for a medical opinion immediately when intrauterine death is suspected. The doctor can diagnose and confirm the death. The midwife does not tell the woman that the fetus is dead, but supports her and suggests that the only way to be sure is to see a doctor and have an ultrasound. Once the patient has been seen by the doctor and the doctor has told her of the death of the baby, the midwife must follow the protocol and the medical management. At the same time, she will have to provide the patient and her husband/partner with all the psychological support they might need (see Chapter 13).

Obstetrical management

The medical practitioner diagnoses intrauterine death and the possible cause and will consider the risk factors and decide on the time and the mode of delivery.

If no risk factors are present such as hypertension, there is no medical urgency for the delivery of the fetus. If the woman is near term or the cervix is favourable, induction of labour can be done. A caesarean section is seldom performed for a dead fetus unless the mother's life is in danger. A woman can be given the choice of waiting for birth to start spontaneously. If she does not go into labour within the first three weeks after the fetus dies, however, the medical practitioner will

terminate the pregnancy because of the danger of a severe clotting defect arising.

Allowing the woman to go into labour spontaneously may have the psychological advantage of giving the mother time to mourn the loss of the baby. The disadvantage is the risk of DIC and the maceration of the fetus making it difficult to see the fetus at birth. A fetus delivered within 24 hours of death may still look normal.

Blood is taken for fibrinogen levels. If the fibrinogen level is less than one (100 mg/dl) it is abnormal. If there is a defect, whole, fresh compatible blood is given before the pregnancy is terminated.

In most instances, the doctor will induce labour by first giving prostaglandins to ripen the cervix.

Misopostrol is used to start labour. The midwife must monitor the patient very carefully because large doses may be necessary and there is a danger of uterine rupture.

If a fetus is dead the birth is more painful. The presenting part collapses on the cervix and does not open the cervix fully. A part of the fetus may be expelled before the woman is fully dilated.

The membranes are not ruptured until the patient is in well-established labour, to avoid the risk of infection, because these patients often have long labours and this keeps the pressure on the cervix equal.

Antibiotics are given if the membranes have been ruptured for more than 6–12 hours.

General management and care

All the normal care in labour still applies. The significant person or husband is allowed to attend the birth if they wish to do so.

After delivery, the baby is removed, examined and weighed, as are the placenta and membranes.

The baby, if viable by definition, will be treated as a stillbirth and all the necessary forms will have to be filled in and signed, and the baby will have to be buried.

If the baby is not viable by definition, it does not have to be buried unless the parents wish to do so, but can be incinerated. The parents must give permission and complete the legal forms. The parents are offered the chance to see the baby, with support from the staff.

The medical practitioner may require histological examination of the fetus and the placenta for the cause of death. The baby and the placenta are sent in suitable containers to the nearest laboratory for investigation.

The placenta and membranes are examined for completeness. If incomplete the woman needs to go to theatre. The cervix and perineum are inspected for any tears.

The mother can be discharged within six hours if her condition is satisfactory. Lactation should be suppressed. The woman is told of the importance of attending a postnatal examination in six weeks' time, when she can also discuss family planning and if necessary, be referred for genetic counselling.

The local health clinic is notified about the stillbirth, so that they can visit the mother and see that she is all right.

23.7 Multiple pregnancy

Multiple or plural pregnancy is two or more fetuses in the uterus at the same time. Twin pregnancy (two fetuses) is the most common.

Incidence

The incidence of multiple pregnancy is relatively constant, with variation between different demographic groups:

- Black: 1:50 viable pregnancies (1:40 in Zulus in South Africa)
- White: 1:85–100 viable pregnancies
- Asian: 1:150 viable pregnancies.

Infertility and the use of substances to stimulate ovulation also influence and increase the incidence of multiple pregnancies in most developed countries.

Triplets occur in 1:7 600 pregnancies. More babies are usually associated with infertility treatment.

23.3 Highest record number of babies in multiple pregnancies

The official record of number of children born naturally to a woman is 69 for a woman in Moscow who bore 16 sets of twins, seven sets of triplets, and four sets of quadruplets in 27 pregnancies, of which 67 children survived. Guinness Book of Records, 1988:13.

Whether the multiple birth is natural or caused by infertility treatment, it is imperative that the midwifery/nursing personnel are completely conversant with the care of a mother with multiple pregnancy and with the management of twin delivery, particularly as this type of pregnancy has an increased risk of perinatal morbidity and mortality, related to the risk of premature birth.

The perinatal morbidity and mortalilty rates increase considerably with each extra fetus. There is also increased risk during delivery of the second and every subsequent baby.

Types of multiple pregnancy

Multiple pregnancy can be:

- twin (two babies)
- triplet (three babies)
- quadruplets (four babies)
- quintuplets (five babies)
- sextuplets (six babies)
- septuplet (seven)
- octuplet (eight).

For every extra baby in the womb the risk for complications increases. Quadruplets are rarely conceived normally. The most common natural multiple pregnancy is the twin pregnancy.

There are two main types of twins, uniovular and binovular twins.

Uniovular twins

Uniovular twins are also referred to as monovular, monozygotic or identical twins. These names are self-descriptive, because in uniovular twins, only one ovum is fertilised (by one sperm). During its early development, the zygote divides into two or more similar, separate zygotes. The reason for this separation is not known, but may be environmental or genetic (see Figure 23.3).

The babies who develop from these zygotes are very similar in appearance and are the same gender, with very similar or even identical fingerprints and electro-encephalograph patterns.

In most instances (64%), they share one placenta and one chorion, but each has its own amnion. Less often, they will each have their own placenta, chorion and amnion, less often still they will share all three. The circulations of the fetuses may anastamose to a greater or lesser degree, and this can be seen on the fetal surface of the placenta after delivery. This can result in the cardiovascular system of one twin developing disproportionately more than the other twin.

Conditions such as inherited disorders will affect each one, but the time of appearance of the disorder may depend on environmental factors.

Developmental anomalies are more common in monozygotic twins, resulting in a high abortion rate, and if the zygotes do not separate completely, conjoined twins can result.

Uniovular twins are usually of a more closely similar mass, unless there is an anastamosis of the circulations, when one could be much bigger and heavier than the other. Even when the pregnancy goes to term, the weight of each twin is almost always less than that of a normal singleton baby, and this is the result of intrauterine growth retardation in the third trimester due to placental insufficiency. This occurs in both uniovular and binovular twins, although, on the whole, the combined weight of uniovular twins is less than that of binovular twins.

Binovular twins

Other names for binovular twins are dizygotic or non-identical twins.

In this type of multiple pregnancy, two or more ova are each fertilised by a separate sperm. (This may also occur on different time periods and it can happen that the fetuses are not of the same gestational age.) The babies may be the same sex or may be of a different sex. The incidence of binovular twins is three times greater than that of uniovular twins.

There is a definite familial background with binovular twins, although older mothers also tend to have a greater incidence of dizygotic twins. As already mentioned, drugs for infertility also produce multiple ova.

Although binovular twins each have their own placenta, chorion and amnion, the placentae may fuse and appear as though only one is present. However, with careful examination after delivery, two chorions and two amnions (four layers of membrane) can be demonstrated. The fetal circulations do not mix (see Figure 23.3).

Conjoined (Siamese) twins

Conjoined twins arise when the separation in uniovular twins is not complete. The degree of union can vary greatly, from joining of the skin only, to sharing the thoracic cage and even the internal viscera. The success of the separation of conjoined twins by surgery depends upon the degree of union and the involvement and sharing of internal organs, as well as the degree of expertise and the equipment available. The survival of the twins depends on the time of separation and the organs that are shared. There are documented cases of conjoined twin who were never separated and survived for more than 50 years.

Aetiology

The causes of multiple pregnancy are:

- *Inherited*. There is a trend in families for twins usually from the mother's side.
- *Demographic group*. Black women have a higher incidence of twins.
- *Maternal age*. There is an increased risk with age.
- *Parity*. There is in increased risk with increasing parity.
- *Other factor*. These include nutrition, use of substances and infertility treatment (chlomifene and gonadotrophins).

Infertility

Infertility is the inability to fall pregnant after one year of regular coitus. Primary infertility refers to the inability to fall

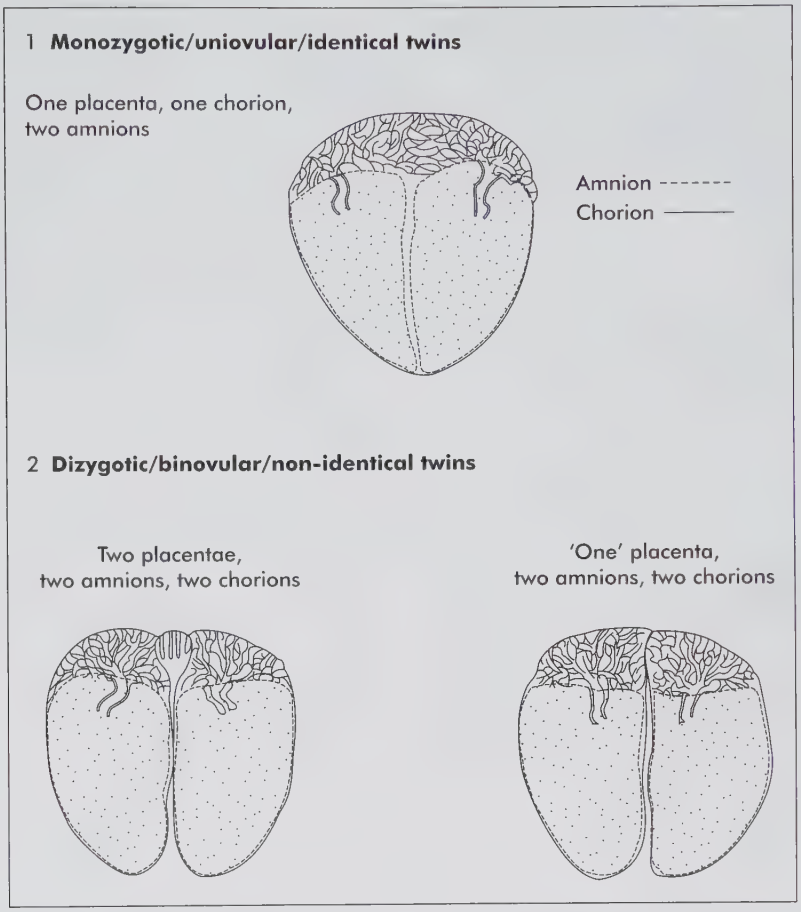


Figure 23.3 Multiple pregnancy – placentae of monozygotic and dizygotic twins

pregnant at all and secondary infertility refers to a woman who has had previous pregancies and fails to fall pregnant again.

Delayed fertility can be due to infertility or sterility. Couples may resort to advanced reproductive technology to conceive a genetic child or a child genetically related to one of the parents through donor sperm, or surrogate pregnancy.

When advanced technology is used to stimulate pregnancy there is always a high risk of multiple pregnancy.

The effects of multiple fetuses on pregnancy

For every extra fetus in the womb the risk of complications is increased. The following general risks are increased for multiple pregnancies:

- The minor disorders of pregnancy are accentuated, such as morning sickness, heartburn, backache.
- There is an increased incidence of hyperemesis gravidarum due to the increased chorionic gonadotrophin.
- There are often increased pressure symptoms in the third trimester, such as:
  - varicose veins in the legs and the vulva
  - haemorrhoids
  - oedema of the lower limbs
  - difficulty in breathing
  - sleeplessness because of the inability to get comfortable with the grossly distended abdomen.
- There is an increased abortion rate.
- The incidence of pre-eclampsia and eclampsia is greatly increased in multiple pregnancy.
- Placental abruption and antepartum haemorrhage are increased. Placenta praevia is increased because of the large placenta, with resulting antepartum haemorrhage.
- Polyhydramnios is greatly increased, both acute and chronic, with the resultant complications.
- Fetus papyraceous. When one twin dies *in utero* as a result of twin transfusion syndrome, or because the heart and the

circulation have not developed normally, the fetus shrinks, becomes flattened, compressed, pale and paper-like, and is known as a fetus papyraceous (see Figure 23.4).
- Umbilical cord prolapse occurs.
- There is an increased risk of intrauterine growth restriction and twins are usually smaller than singleton babies, although the combined mass is more than a singleton.
- Preterm labour occurs.
- Anaemia is prevalent because of the increased fetal demands for iron, and the hemoglobin is below 10 g/dl in many instances of twin pregnancy.
- There is a high percentage of fetal abnormalities and malpresentation.

There is great variety in the lie and presentation that can arise in twins (see Figure 23.5). The main ones are two vertex presentations (in 40% of twins), then a vertex and a breech presentation. Some of these abnormal lies and presentions can cause serious complications in labour.

Locked twins are also a serious problem, when the first twin begins to descend down the birth canal. This could arise, for instance, when the first twin is a breech and the second is a vertex, and the head of the second twin prevents the head of the first twin from entering the pelvis.

When more than two fetuses are in the womb the complications in presentation increase.

Twin transfusion syndrome

This condition occurs in uniovular twins, and is due to the anastomosis of the fetal circulations when a placenta is shared. The one twin derives most of the blood and therefore also the nourishment while the other is deprived of blood and nourishment. There is a great disparity in mass (weight). Both twins are at great risk of fetal demise, but for different reasons. At birth, the recipient twin may present with the following features:
- Is bigger and weighs more.
- Suffers from polycythemia.
- Is plethoric.
- May have congestive cardiac failure.
- May have respiratory distress.
- Is prone to arterial thrombi.
- Has a high mortality rate, both intrauterine and neonatal.

The donor twin may present with the following features at birth:
- This is the smaller, lighter twin, who is very small for the gestational age.
- Is anaemic.
- Has hypoglycaemia.

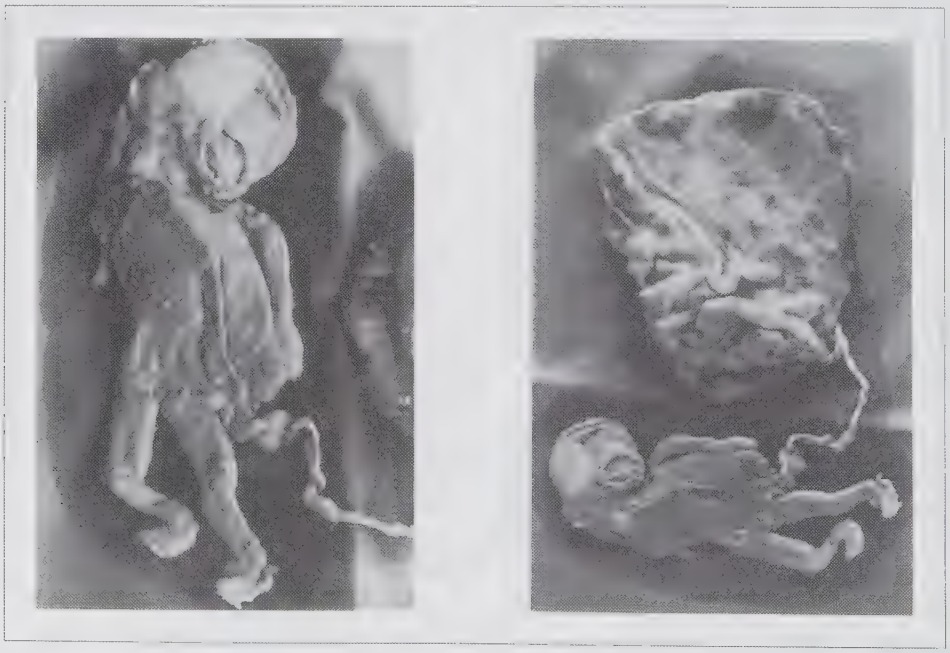


Figure 23.4 Fetus papyraceous

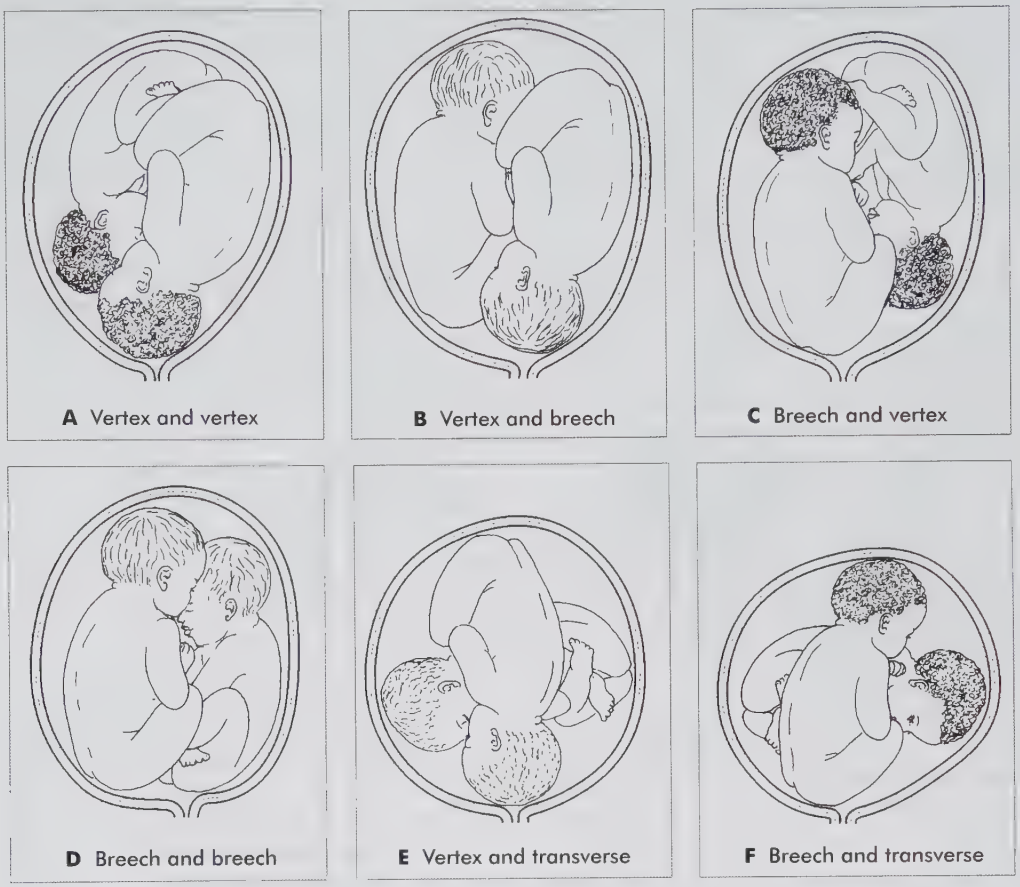


Figure 23.5 Presentation of twins before delivery

- Has a high mortality rate, both intrauterine and neonatal. If the amount of blood is seriously diminished, the deprived fetus will die *in utero*, but the remaining twin can survive if the circulation has not been too grossly overloaded.

Women may become very anxious about having more than one infant to care for and often need special psychological support.

The effects of multiple pregnancy on labour

Multiple pregnancies have serious effects on labour, with each subsequent baby providing greater problems, and some emergency situations may easily arise. Some of the problems are:

- undiagnosed twins or multiple fetuses
- preterm labour is very common.

There is a high incidence of caesarean section, and in some communities this has almost become the accepted way of delivering twins because of the complications involved. However, in developing countries, where a uterine scar can be dangerous in subsequent pregnancies, caesarean section is only resorted to in the following conditions:

- previous caesarean section
- severe pre-eclampsia
- antepartum haemorrhage, due to both placenta abruptio and placenta praevia
- malpresentation, particularly transverse lie
- conjoined twins or locked twins
- umbilical cord presentation or prolapse
- gross pelvic deformity and cephalopelvic disproportion
- inevitable preterm labour with breech presentation, as there is the danger of the breech slipping through a not fully dilated cervix
- any other condition where the mother or the baby may be endangered during labour.

There are increased stillbirth and neonatal morbidity and mortality rates, especially for the second twin, due to a



Figure 23.6 Locked twins

reduction in the placental circulation when the volume of the uterus is reduced after the birth of the first twin, and due to early separation of the placenta.

Uterine inertia may occur before the birth of the second twin because of atony of the uterus due to the distended uterine muscles, particularly if the first stage has been prolonged. This may cause a delay in the birth of the second twin. The cervix may start to close, causing the woman to undergo a second labour before the second twin is able to be delivered.

Malpresentation and the accompanying complications, particularly of prolonged labour, frequently occur. The incidence of obstructed labour is greatly increased.

If the second twin is not in a longitudinal lie, obstructed labour could result (see Figure 23.6). Fetal abnormalities are often present, with the accompanying difficult and prolonged labours.

Intrapartum haemorrhage from early separation of the placenta, after the birth of the first and before the birth of the second twin can occur.

Postpartum haemorrhage is common, due to:

- uterine atony and inertia
- anaemia
- previous antepartum haemorrhage
- a large placental site.

A uterine constriction ring may develop after the birth of the first twin, causing active retention of the second fetus.

The effects of multiple pregnancy on the babies

Certain abnormal fetal conditions occur only in multiple pregnancy and the incidence of other conditions is greatly increased:

- high perinatal mortality rate related to preterm birth
- twin transfusion syndrome
- asphyxia neonatorum
- small for gestational age babies, and the accompanying complications
- birth injuries, particularly due to manipulations which may be necessary for malpresentations
- fetal malformations, conjoined twins and locked twins.

Diagnosis of multiple pregnancy

Until the use of ultrasound in obstetrics, multiple pregnancy was often undiagnosed until labour had started and the first baby had been born. The diagnosis of multiple pregnancy remains difficult

in developing countries, where ultrasound is not available for scanning every woman in labour. It is important, therefore, that in developing countries, pregnant women are seen early in pregnancy in order to take a good history, and to establish an early baseline of signs and symptoms.

Without ultrasound, the diagnosis of multiple pregnancy is made almost entirely on a good history and on the clinical examinations at each antenatal visit. Therefore the necessity for women, especially in black communities where the incidence is so high, to attend antenatal clinics early and regularly must be stressed. The importance of this must be emphasised by health education in the communities and the whole family should be included.

In high-risk communities, if any of the preceding abnormal conditions (often found in multiple pregnancy) are present, twins should be expected and further investigations done. The woman can be sent to the nearest hospital for ultrasound, or for X-ray if ultrasound is not available.

History

The following are important:

- The demographic group and the home situation.
- Are there twins in the family?
- Has the woman had a previous twin pregnancy?
- The history of the present pregnancy:
  - A very careful history is taken so that a correct estimated date of delivery (EDD) can be arrived at.
  - The woman may complain of increased minor disorders of pregnancy, or later in pregnancy, the woman may complain of the abdomen being larger than expected and of excessive pressure symptoms.
  - Hyperemesis gravidarum may be present.

Abdominal examination

The abdominal inspection is extremely important and may, in early pregnancy, be the only real lead to twins. Serial measures of the symphysis fundal height (SFH) are needed to determine the gestational age between 20–36 weeks.

Inspection

- The uterus will be broad and round (rather than oval).
- The uterus will look larger than expected for the estimated date of delivery (EDD).
- More than the usual amount of fetal movements may be seen.

Palpation

- The fundal height is measured and found to be higher than the period of gestation warrants (this is particularly so in the first and the second trimester, before intrauterine growth restriction (IUGR) occurs). There is a correlation between the gestational age and the fundal height.
- Two heads may be felt, and this is diagnostic of twins. The heads could be at any place within the uterus. In 40% of twins, both fetuses are vertex presentations. (Fetal head is usually identified by 30 weeks of gestation.)
- If the second twin is a breech presentation, the head could be tucked up under the maternal ribs and very difficult to palpate.
- If only one head is palpated, it will feel small in comparison with the size of the (enlarged) uterus.
- An unusual number of limbs may be felt.
- In many twin pregnancies, polyhydramnios is present and this could make the palpation and a positive diagnosis very difficult (see Table 23.4).

Auscultation

- Two fetal hearts may be heard, but there should be a difference of at least 10 heart beats, with a silent area between, in order to be reasonably sure there are two different heart beats. This is not a reliable sign of twins.

Vaginal examination

- Vaginal examination is of no diagnostic value in multiple pregnancy.

Special examinations

It is recommended that all women should have at least one ultrasound during pregnancy, in order to detect any possible abnormality. The optimal time is 12 weeks and 20 weeks:

- A positive diagnosis of multiple pregnancy would then be possible in each instance.
- Two fetal sacs can be distinguished at eight weeks' gestation.
- Two heads can be seen at 15 weeks.
- The position of the placenta is important.
- The fetuses are checked for congenital abnormalities at 20 weeks of gestation.
- If complications are present such as twin transfusion syndrome the women will receive specialised care and serial ultrasounds will be done to safeguard the fetuses. If this is not possible, the woman will be sent for X-ray after 32 weeks' gestation.

Obstetrical and midwifery management of multiple pregnancy

Normal antenatal care applies with additional specific medical and midwifery care.

Table 23.4

The comparison of factors present in polyhydramnios and multiple pregnancy

	Polyhydramnios	**Multiple Pregnancy**
History	None None None None None Diabetes, PIH Congenital abnormality	Excessive fetal movements Twins in family One of a pair of twins Exaggerated minor disorder Drugs used for infertility Not necessarily Not necessarily
Physical	Exaggerated pressure symptoms Oedema Dyspnoea – acute Palpitations Distressed	Exaggerated pressure symptoms Oedema Dyspnoea Palpitations Uncomfortable at 24 weeks, not distressed
Abdominal inspection	Round, globular No movements seen Skin shiny, taut and over-stretched Appears as a 'tumour' tilted to one side	Large, irregular Multiple movements seen Muscles relaxed Appears as a pregnant abdomen and a fibroid
Abdominal palpation	Small fetus Difficult to feel parts Two poles felt, unstable lie Abdominal girth enlarged Malpresentation common Fluid thrill Height of fundus enlarged Small head Ballottement can be easy or difficult	Uterus large for dates Many fetal parts, multiple limbs present Three or more poles present Abdominal girth enlarged Malpresentation present No fluid thrill Height of fundus enlarged Two small heads felt Ballottement difficult
Abdominal auscultation	Difficult due to amniotic fluid volume Fetal heart difficult to hear	Two fetal hearts heard at different sites by two midwives (at least difference of 10 bpm.
Ultrasound	One baby seen	Two babies seen
X-Ray	One baby	Two babies

The most important factors to be addressed in multiple pregnancy are:

- Early diagnosis of the condition.
- Screen patients at risk and refer to the nearest hospital and an obstetrician.

Women are seen more often to identify potential problems early such as:

- The high incidence of intrauterine growth restriction (IUGR) and how to diagnose this.
- The high incidence of preterm labour and how to prevent this.
- The high incidence of anaemia, pre-eclampsia, polyhydramnios, fetal abnormalities, abnormal presentations, antepartum haemorrhage and the complications that result from all these conditions. Most of the above-mentioned conditions are interrelated and affect one another. (See the individual chapters for the diagnosis and management of these conditions.)

It is essential that the diagnosis of a multiple pregnancy be made early, in order to have a baseline from which to work. The baseline will assist the obstetrician in making an early diagnosis of IUGR. The obstetrician will also try to assess

the degree of IUGR and the rate of degeneration of the fetus (the diagnosis and assessment of IUGR are very difficult to estimate), in order to decide the optimum delivery date. It is essential, therefore, that health education by the midwife and the social worker should stress the necessity for each pregnant woman to present herself at the antenatal clinic as early in the pregnancy as possible. In developing countries, because of the lack of expensive equipment and laboratory investigation, the diagnosis of IUGR has to be made entirely on the clinical skills of the obstetrician and on meticulous antenatal care and recording.

The obstetrician must decide whether it is best for the patient to have bed rest in hospital (which is very expensive) or to allow the woman to return home. Home help is a necessity, so the home environment must be investigated and help arranged wherever possible. Unless there are complications, the patients are treated as outpatients at antenatal clinics because of the disruption of family life and the expense involved.

The obstetrician will prevent or treat any of the complications which can be treated, and prescribe diet supplements such as vitamins and iron, and advise the woman on diet. She is also advised to reduce activites at home, to avoid enemas and laxatives and to avoid coitus or at least avoid deep penetration, because both the physical irritation and the natural prostaglandins may induce preterm labour. The woman is told that she must attend the antenatal clinic regularly.

The woman and her husband/partner are warned of the danger of preterm labour, and are told of the signs of preterm labour and advised that the woman must come to the hospital immediately these are noticed. Once a date for delivery is decided, the obstetrician decides on the type of delivery. The woman is usually told to come to hospital at about 38 weeks, in case of early labour. If complications arise, she is admitted immediately.

Care and birth plans are developed in collaboration with the mother and the multi-disciplinary team or a skilled midwife. These include:

- regular haemoglobin checks
- observe for pre-eclampsia and urinary tract infections
- the abdominal girth is checked at the level of the umbilicus (the fundal height is not reliable after 32–34 weeks)
- Fetal wellbeing is monitored through NST (simultaneously for two fetuses with different NST machines), ultrasound and biophysical profiles
- a very gentle vaginal examination, using only one finger, is done at every visit from 28 weeks to determine the cervical Bishop score.

Delivery of multiple fetuses

The decision to have a vaginal birth depends on the lie and presentation of the fetuses, size of the fetuses, previous deliveries, and the parity of the woman. If complications like anaemia, pre-eclampsia and placenta praevia are present or the fetuses are compromised, vaginal delivery is contraindicated (see Figures 23.5 and 23.6).

In a percentage of women the second baby may only be diagnosed after the first one is born.

If it is a known twin pregnancy it is advisable that the woman deliver in an institution where medical assistance is available, with a theatre and a neonatal unit.

In case of triplets or more fetuses, special care is required, with a pediatrician and midwife for each baby.

The first stage

It is essential that the delivery takes place *in a hospital*, where all the necessary personnel and equipment are at hand should any emergency arise. Induction of labour is usually avoided. The position and presenting part of the leading twin is important if a vaginal birth is considered. The uterine contractions may be hypotonic due to the overstretched uterus yet dilatation may be good if the presenting part is a vertex and it is well applied.

Common complications include:

- delay in the delivery of the second twin
- transverse lie of the second twin
- intrapartum haemorrhage; haemorrhage between the delivery of the first twin and the second twin
- cord prolapse.

Because of these possible complications, the following should always be done:

- The midwife and the medical practitioner must carefully palpate the patient and make sure that the lie of both twins is longitudinal.
- There should be continuous fetal monitoring.
- Blood should be sent for cross-match.
- An intravenous infusion is started, and the type and the amount of fluid are given according to the medical practitioner's orders. (A vacolitre of intravenous fluid with oxytocin is erected 'piggy-back' so that it is available if and when it should be necessary.) Oxytocin is avoided, if possible, before the birth of the first twin.
- The operating theatre should be available at all times for a possible emergency caesarean section.
- A medical practitioner and at least one paediatrician should be present at the delivery. In emergency situations, advanced or specialist midwives are qualified to deliver twins.

- Large doses of analgesia and heavy sedation are to be avoided. Epidural analgesia is the best means of analgesia in this instance, as any necessary manipulations can then be easily carried out.
- Very careful observations are made frequently, using a partograph and any abnormalities are immediately reported to the medical practitioner.
- Position to avoid inferior vena cava syndrome.
- A vaginal examination must be done when the membranes rupture:
  - to exclude cord prolapse
  - to determine the presenting part, and
  - to determine the effacement and dilatation of the cervical os.
- Preparations are made for the delivery and the following extra equipment is made available: All the necessary equipment for extra babies, which may very well be preterm and/or small for gestational age. This includes: resuscitation equipment, suction and oxygen, incubators and name tags, midwife and paediatrician per baby.
- The woman is prepared mentally and physically for the delivery. She is reassured and the procedure is carefully explained to her.
- Consent is obtained for operation, should this be necessary. The patient is carefully put into a wedged lithotomy position and the bladder is emptied, if she has been unable to pass urine.
- In twin delivery, the labour is usually shorter than normal, about six hours. If the progress is slow, the cause must be identified and remedied.

The delivery

An obstetrician or skilled midwife should deliver multiple pregnancies, but if no medical practitioner is available, the midwife must know exactly what to do:

- An episiotomy is performed for preterm or breech delivery.
- The first baby is delivered and the time is noted.
- The baby is identified as number one, and the name is checked with the mother.
- The umbilical cord is immediately clamped in two places and cut between the clamps. This is very important should there be uniovular twins.
- Immediately the first baby is satisfactory, the mother's abdomen is palpated to determine the lie of the second twin.
- If the lie is longitudinal, the presentation and position are determined.
- The fetal heart is checked.
- The patient is kept warm and the conditions of the mother and fetus are carefully observed, while waiting for the contractions to recommence.
- The contractions usually recommence soon after the first baby is born, but if, after five to seven minutes they have not recommenced, the mother's abdomen is again palpated to make sure the lie is still longitudinal. A delay in the onset of the contractions of the second twin may be as long as two hours as long as the fetal heart is normal. If the presenting part is not decending, the bladder is emptied and the doctor will turn on the intravenous oxytocic infusion, and this will cause the uterine contractions to recommence.
- A vaginal examination is done to make sure of the presentation and the membranes are ruptured carefully, to ensure the cord does not prolapse. This should also stimulate the uterus to contract.
- The second baby is delivered and the time noted. This baby has been deprived of some oxygen while *in utero* after the birth of the first twin and, in addition, this twin has passed rapidly through the dilated cervix and down the distended birth canal, so the staff should be prepared for an asphyxiated baby. The second twin is nearly always at greater risk than the first twin and, therefore, receives special attention and care during and after the delivery.
- The baby is identified as number two, the cord is cut, the airways cleared and respiration established.
- A final abdominal palpation should be done to ensure that there are no further babies before the active management of the third stage is undertaken.
- In Rh– mothers, the end of each baby's cord must be clearly identified (ligature and clamp) to enable identification of the cord blood of each baby after delivery.

The third stage

Postpartum haemorrhage is a very real danger and the third stage must be actively managed. A very careful watch is kept for bleeding in the first 24 hours, as there is a very large placental site and at least part of the placenta is often in the lower segment, where there are fewer criss-cross muscle fibres to control postpartum bleeding. Any episiotomy or perineal tears are sutured. If more than two babies are in the womb or in case of abnormal presentation the birth is usually by caesarean section.

Care of the babies

The following special care is given in line with the standard care of newborns:

- These babies are frequently small for gestational age as well as preterm and therefore must be nursed in a high-care unit until their condition is satisfactory.
- A full examination is carried out on each baby for any birth injury and for any congenital abnormality.
- A full examination is also made of the placenta and the membranes, to try to determine whether the twins are uniovular or binovular.
- If the babies are preterm at birth, the use of artificial surfactant may be necessary, for hyaline membrane disease.
- The mother will require extra care when breastfeeding or when bottle feeding these babies.

Emergency care in case of an undiagnosed or unplanned delivery of twin pregnancy

If no doctor is available or if the mother should present at the clinic in labour with the first twin almost delivered as either a vertex or a breech, and with the second twin as a transverse, the first twin should be delivered, and immediately after, if a spontaneous version to a longitudinal lie has not taken place, an external cephalic version must be attempted at once, taking great care not to rupture the membranes. Once the lie is longitudinal, a vaginal examination is performed to make sure of the presentation and if it is a vertex (or a breech), the membranes are then ruptured and the head allowed to enter the pelvis. If external cephalic version is unsuccessful and the lie is still transverse, the midwife should send for a doctor urgently, or immediately transfer the woman to hospital. If the membranes have ruptured while attempting the external version, but the version is unsuccessful and the baby is still a transverse lie, the midwife should immediately do an internal podalic version and deliver the baby as a breech.

Intrapartum haemorrhage

When intrapartum haemorrhage occurs, the object is to deliver the second baby as quickly as possible, both for the sake of the baby, which will suffer from a lack of oxygen and for the mother's sake, as she could bleed to death.

The first baby has already been delivered, the placenta has started to separate, and the second baby is preventing the uterus from contracting and retracting in order to control the bleeding:

- If no medical practitioner is available, the midwife must make sure the lie of the second twin is longitudinal and then rupture the membranes immediately. The woman bears down and the baby is delivered.
- The patient is encouraged to bear down and fundal pressure may have to be used to help get the baby out quickly, if the bleeding is excessive.
- IMI ergometrin is given immediately after the birth and the active management of the third stage is performed.
- An oxytocin infusion 20 IU in 1ℓ Ringer's solution is *in situ*.
- Alternatively misopostrol 600 mcg can be administered rectally.
- In very rare instances, the birth of the first twin is immediately followed by the birth of the placenta. This will result in extensive bleeding as the uterus will be unable to contract, and the second baby must be delivered immediately.

23.8 Parity, gravity, obesity and teenage pregnancy

Grand multiparity

Grand multiparity refers to women who have had five or more viable babies and is also known as the dangerous multipara which is part of the high-risk group of patients. These women are susceptible to a series of serious complications, which are often unsuspected. It is extremely important, therefore, that they deliver in hospital under expert obstetric and midwifery care.

The complications of grande multiparity

Antenatal period.

- *Age*. These are often older women, who are more likely to develop complications and genetic disorders, for example babies with Down's syndrome.
- *Obesity*. These patients can be obese, making assessment of the estimated date of delivery difficult. Physical examinations are difficult. Obesity leads to lordosis and, together, these problems carry increased risks.
- *Social conditions*. These women are more likely to be poor, overworked, tired, anaemic and malnourished. They often neglect themselves and subsequently suffer from dental caries, infections, etc.
- *Medical problems*. These women are at great risk of developing hypertensive disease in pregnancy, diabetes, chronic renal disease, thromboembolism and cardiac disease.
- *Abortion*. There is an increased risk of abortion due to malnutrition.
- *Placenta problems*. Placental abruption and placenta praevia occur more frequently in this group of women.
- *Preterm birth*. They are at great risk of going into early or preterm labour.
- *Disorders*. The minor disorders of pregnancy are often exaggerated.

- *Multiple pregnancy.* Multiple pregnancy is more common, greatly adding to the risks.
- *Anaemia.* Anaemia occurs more frequently due to poor diet, and repeated hydraemias of pregnancy, as well as to advancing maternal age and to poor spacing of pregnancies.
- *Cephalopelvic disproportion.* Cephalopelvic disproportion occurs as babies tend to grow larger with each pregnancy.
- *Malpresentations.* Malpresentations are common due to a pendulous abdomen. This can lead to premature rupture of the membranes.
- *Older age group.* These women, in the older age group, are susceptible to cancer of the cervix.

During labour.

- *Malpresentations.* Brow, face, and transverse lie are common and lead to prolonged and obstructed labour.
- *Premature rupture of the membranes.* This is a result of malpresentation and can lead to prolapsed cord and to acute fetal distress, thus increasing the perinatal mortality rate.
- *Precipitate labour.* This may occur, leading to traumatic postpartum haemorrhage, and possible cerebral damage to the fetus if the delivery is uncontrolled.
- *Shoulder-girdle dystocia* occurs because of large babies (on the whole, each successive baby is a little bigger than the last).
- *Haemorrhage.* Postpartum haemorrhage can occur due to tired, overstretched, atonic uterine muscles.
- *Obstructive labour.* Large fetuses and pendulous abdomen with malpresentations.
- *Rupture of the uterus.* The uterus can rupture as a result of strong contractions and of obstructed labour, leading to an increased maternal mortality rate.
- *Placenta.* Adherent placenta is common.
- *Surgical interventions.* There is an increased caesarean section rate due to cephalopelvic disproportion, with the large babies.

In the puerperium.

- *Infection.* Sepsis is common due to the complications and the consequent interference and manipulations in labour.
- *Breastfeeding.* There is a reduced ability to breastfeed successfully, due to tiredness, anaemia and the complications of pregnancy.
- *Maternal mortality.* There is an increased maternal mortality rate due to complications such as shock and postpartum haemorrhage, etc.

Care and management

Women who are grande multipara need to be seen regularly during pregnancy to exclude complications associated with grande multiparity.

The women are referred to deliver in a hospital with a medical practitioner, a theatre and a neonatologist, due to the high perinatal mortality and morbidity.

The patient is taught possible danger signals (without alarming her unduly) and she is encouraged to watch for these and to report promptly at the clinic should she be concerned at any time. Friendly, helpful, caring and concerned midwives will help to allay this patient's fears, and to build up her confidence in the midwife's ability to care for her and the family.

Specific considerations in labour include:

- Intravenous therapy is started once the patient is in labour. The medical practitioner may want to take blood for cross-match in case a blood transfusion should be necessary, depending on how the labour progresses.
- Careful, accurate monitoring of the mother and continuous electronic monitoring of the fetus are essential.
- Oxytocin is seldom administered to a multigravid woman in labour due to the risk of the uterus rupturing. However, should the need arise, great care must be taken to monitor the contractions. A low dosage of 2 IU oxytocin in 1ℓ is used and controlled by the use of an infusion pump.
- Labour is monitored using the partograph. Any problem, or suspected problem, must immediately be reported to the medical practitioner.
- Caesarean section is performed if there is no progress in labour, or if cephalopelvic disproportion develops.
- The third stage of labour is actively managed, and careful observations are carried out with regard to postpartum haemorrhage. An infusion with 20 IU oxytocin is maintained for 24 hours.

Management in the puerperium

Specific considerations include:

- Observation for postpartum haemorrhage. Check for anaemia before discharge.
- Observe for thrombosis.
- Help, advice and support with breastfeeding and with baby care are necessary. Plenty of sleep and rest, followed by exercises are encouraged.
- Family planning is discussed. If consent is obtained, tubal ligation can be performed while the patient is still in hospital.

Elderly primigravida

First-time pregnancy is always considered as a risk regardless of age and other contributing factors. All primigravida should be encouraged to deliver in a hospital. Primigravida have a higher risk for long labour, may require more pain

relief, experience more abnormal uterine activity and have more surgical interventions.

The elderly primigravida is a woman who is having her first child when she is over the age of 35 years. Advanced maternal age refers to women giving birth at an advanced age. Advanced maternal age carries several risk factors.

This pregnancy is usually very important for a number of reasons. One of the main reasons is that she is less likely to fall pregnant subsequently, so that this pregnancy is important to her and to her partner. This woman is part of the high-risk pregnancy group of women. Women have their first baby late in life for two main reasons:

- infertility
- delayed motherhood due to late marriage or because the woman chose to develop her career first.

The complications associated with the elderly primigravida

Antenatal period.

- *Age.* As previously stated, there is a reduced chance of her having more pregnancies, due to her advancing age.
- *Placenta problems.* There is an increased risk of placental insufficiency, resulting in intrauterine growth retardation.
- *Medical problems.* These women are at risk for developing hypertensive disease in pregnancy.
- *Disorders.* There is an increased risk of chromosomal or genetic disorders resulting in a congenital abnormality, for example Down's syndrome (see Box 23.4).
- *Uterine fibroids.* These are more likely to be present.

During labour.

- *Risk.* There is an increased risk of operative deliveries and manual removal of the placenta.
- *Cephalopelvic disproportion.* Cephalopelvic disproportion is common, resulting in an increased incidence of caesarean section.
- *Prolonged labour.* This is more common due to joints not being able to give well during labour.
- *Uterine inertia.* This is more likely to occur in the elderly primigravida.
- *Postions.* Persistent occipitoposterior positions of the fetus occur more often in these patients.
- *Birth injuries.* Owing to the increased risk of operative deliveries, and/or manipulations, there is also an increased risk of birth injuries to the baby.

In the puerperium.

- *Breastfeeding.* There is a reduced ability to breastfeed, and this is associated with increased breast and breastfeeding problems in the puerperium.
- *Maternal factors.* If the pregnancy was delayed due to career choices the risk of postnatal depression may exist.

Care and management

It is important that these women are identified early in pregnancy, and that a careful watch is kept on their progress antenatally.

Specific attention is given to the 16 weeks Triple test or Fish test at 20 weeks or amniocentesis to rule out Down's syndrome or other abnormalities.

23.4 The risk of a Down's syndrome child

The risk of having a Down's syndrome child increases with maternal age. A woman 45 years of age is 100 times more likely to have an affected child than a 19 year old. The global incidence for Down's syndrome in 1:800 births.

Ideally ultrasound is done at 12 weeks or 20 weeks to rule out fetal abnormalities.

Any complications must be identified promptly so that they can be assessed and treated by the medical practitioner as early as possible.

Amniocentesis is often carried out at 16 weeks to check for fetal abnormalities.

At 36 weeks the decent of the presenting part is determined to ensure that the presenting part engages.

This elderly primigravida should not be allowed to go postdates and needs to be referred for medical care if birth has not spontaneously commenced.

Care during labour

The elderly primigravida should always deliver in hospital. Since the elderly primigravida are not allowed to go postterm they are often induced (if no contraindications exist) to avoid additional risks to the mother and the fetus. Labour is monitored in the usual way. Analgesia is provided according to the woman's wishes, as is a birth companion.

Care after birth

The elderly primigravida should be encouraged to breastfeed and be provided with support where necessary.

Gross obesity

Obesity is a body mass of 20% in excess of normal weight for the height. However, during pregnancy a prepregnant weight

of 90 kg or more is considered to be obese. There is no evidence of increased maternal or perinatal mortality related to obesity but there may be several difficulties with the birth and the postnatal period (see Chapter 52).

The complications of gross obesity

The risks associated with obesity relate to medical complications and complications in birth and during the postnatal period.

There is the possiblity of miscalculation of the estimated date of delivery in obese women, due to:

- irregular menses
- difficulties with accurate abdominal palpation and pelvic assessment due to adipose tissue
- malpresentations are increased, and the obesity makes diagnosis difficult
- difficulty hearing the fetal heart
- hypertension and pre-eclampsia
- diabetes mellitus
- babies are usually large and therefore the incidence of prolonged labour is increased
- the increased risk for surgical interventions is complicated by the risks of general and regional anaesthesia difficulties
- because these women are relatively immobile, the risk of thrombo-embolism is increased
- obese women may fail to lactate adequately
- if complications of diabetes mellitus and infections are present poor wound healing can occur
- hypoxia, because of soft tissue obstruction and difficult endotracheal intubation.

Obstetrical management risks

- The patient is referred to a dietitian for nutritional counselling. Carefully explain to the woman that she should gain no more than 0.25 kg a week.
- An assessment is made to make sure that the date of the last menstrual period (LMP) and therefore the estimated date of delivery (EDD) are accurate.
- An early ultrasound is performed if possible at 18–20 weeks, to confirm the diagnosis of pregnancy and to confirm the EDD.
- A glucose tolerance test is done to eliminate the possibility of diabetes mellitus.
- A thorough examination is made frequently to identify complications.
- A repeat ultrasound is done at 32 weeks.
- Advice is given on diet and eating habits, to re-enforce the counselling of the dietitian.

It may be necessary to admit the patient to hospital and place her on a diet.

- Re-evaluate eating habits, encourage, support and reassure the patient.
- Check the woman's social history and deal with any problems with hygiene.

Management risks in labour

- Palpation and auscultation are difficult in labour. There is often soft tissue dystocia, with uterine inertia, leading to prolonged labour.
- Delayed diagnosis can lead to rupture of the uterus and shoulder-girdle dystocia because of large babies.
- Start an intravenous line.
- There is an increased incidence of Mendelson's gastric aspiration syndrome because of increased volume and acidity of the gastric juices and difficulty intubating if required.
- There is often prolonged recovery from general anaesthetic.
- There may be protracted post-anaesthesia analgesia, due to fat solubility of anaesthetic agents.
- There are technical difficulties with spinals and epidurals.

Management risks in the puerperium

- The third stage of labour must be actively managed to prevent postpartum haemorrhage.
- Early ambulation is encouraged to prevent complications such as thrombosis.
- Referral to a physiotherapist may be necessary for deep-breathing exercises.
- Specific attention is given to breastfeeding.
- If surgery occurred, give attention to wound care and be alert for thrombophlebitis, pulmonary embolus, postoperative infections, postoperative atelectasis, pneumonia, a longer recovery period and wound dehiscence.

Teenage pregnancy (early motherhood)

The ideal period physiologically for reproduction is between 19–35 years of age (see Chapter 52).

Definition

Early motherhood, also referred to as adolescent pregnancy, is pregnancy before 18 years of age.

Incidence

The incidence of teenage pregnancy in South Africa is 35% or 350:1 000 births, varying between urban and rural populations.

Risks of early motherhood

Teenage women have a higher risk of hypertension and pre-eclampsia. Caesarian section is also more common in this group (12.5% or 1.2:1 000 deliveries). Emotional immaturity may also place the young woman at risk psychologically and her financial status and support systems are often poor.

Management of teenage pregnancy

The management of teenage pregnancy is that of any normal (or abnormal) pregnancy. However, prevention is important and family planning advice needs to be given while the woman is at the clinic or in hospital.

23.9 Conclusion

The common conditions that can complicate pregnancy were presented in this chapter. All pregnancy-related risks need to be referred for medical assessment, supervision and care or supervision.

Section Five

Birth

24 The physiology of the stages and processes of birth

25 Management and care during the first stage of labour

26 Pain management and comfort in labour

27 Physiology, management and care of the second and third stages of labour

28 Care and management of the fourth stage of labour and newborn care

29 Malposition, malpresentation and dysfunctional labour

30 Dysfunctional uterine functions

31 Obstetric emergencies

32 Obstetric interventions

33 Obstetric shock

CHAPTER

24 The physiology of the stages and processes of birth

LEARNING OBJECTIVES

On completion of this unit a learner must be able to:

- explain the physiology of the birth processes
- explain the onset of labour
- explain the physiology of the second and third stages of birth.

KNOWLEDGE ASSUMED TO BE IN PLACE

Physiology of pregnancy and normal reproductive physiology (Study in collaboration with Chapters 5 and 8)

KEYWORDS

Spontaneous onset • Show • Engagement • Latent phase • Active phase • Fundal dominance

24.1 Introduction

Labour and childbirth herald another developmental phase in the life of the woman and her family. The processes that occur are both physiological and psychological and women anticipate labour differently and so behave differently during labour.

Labour and childbirth have a special meaning for every culture; the woman herself and the partner and the family. In some cultures labour and childbirth are accompanied by particular rituals. Therefore, the midwife should be sensitive to the individual woman's needs in order to render holistic care that is culturally sensitive.

When woman think, desire and plan for natural birth, the role of the skilled birth attendant, whether midwife or medical practitioner, is supportive, intervening only when circumstances demand it.

In reality, not all babies are born the same way. A number of deliveries may be accompanied by medical intervention or technological assistance of some kind particularly those that take place in hospitals or clinics. Women's reactions to the events surrounding childbirth can vary widely depending on their preparation for and expectations of their birthing experience. Some of these experiences are discussed in this section.

The transition from pregnancy to motherhood is an enormous and unique physiological and psychological change in each woman. Every woman going through labour and childbirth must receive individualised, holistic care. Many women experience stress and physical pain, so midwives need to provide an environment that allows the woman to go through labour and the birthing process safely and with dignity. The woman should be provided with adequate and relevant information, which allows her to make relevant informed decisions. Good communication among the healthcare providers, including communication between the midwife and the woman, is important because most women feel anxious about labour. Feelings can vary from excited anticipation to fearful expectancy. (see Box 24.2: Psychological comfort.)

24.1 Views on normal birth

The Royal College of Midwives defines normal birth as one where a woman commences, continues and completes labour physiological at term (RCM position paper, 1997).

The Canadian policy statement on normal birth (2008) include spontaneous onset, a low risk at the start and throughout birth, a vertex position (37–42 weeks), skin-to-skin holding and breastfeeding.

Normal birth in this context includes evidence-based interventions such as augmentation, artificial rupture of membranes (AROM), non-pharmacological pain relief, active management on the third stage, intermittent fetal auscultation. It does not include elective induction of labour, spinal analgesia or general anaesthesia.

South Africa does not have an official policy statement on normal birth as yet (see ICD10 classfication in Annexure A).

24.2 Psychological comfort

Women who are pregnant for the first time (primigravida) experience fear of the unknown, while multigravida might have bad memories from previous births. This may result in fear and anxiety, which may affect the smooth progress of labour. As a preventive measure midwifery care should focus on providing emotional support, alleviating labour pain, provision of comfort and allowing the significant person (husband/partner or other relative mother, sister or friend) to be present during the labour process and childbirth if the environment and policy of the health facility allows.

Onset of labour

All expectant mothers must be prepared for labour and helped with a birth plan. Preparation should include information on the physical process of labour, place of delivery, type of delivery, including what to bring to hospital (clothes for both the mother and baby) and the strategies the woman can use to cope with labour pain and the process of child birth. All this information forms part of the birth plan.

Figure 24.1 illustrates the typical functional divisions of labour within the normal parameters. A well-fitting presenting part stimulates contractions (Ferguson reflex). This facilitates the descent of the presenting part and the dilatation of the cervix which follows a typical/predicted pattern (Cervicogram). This scientific observation forms the basis of the partogram. The latent phase may differ in duration but in the active phase the cervical dilatation rate is a minimum of 1 cm per hour.

24.2 The physiology of normal labour

The process of normal labour

Labour is a process in which the products of conception (fetus, placenta and membranes) are expelled from the birth canal. The process is expected to occur at term though occasionally it may occur before term (preterm) or after term (post-term).

Defining normal labour

Normal labour is of spontaneous onset, occurs between 37 completed weeks and 42 weeks with the fetus presenting in the vertex, and is completed within 18 hours with both the mother and the infant in good condition. This definition also considers the physical and psychological wellbeing of the mother. Various factors determine the duration of labour. Currently normal delivery is considered as the physiological natural process of birth with limited or no intervention.

Stages of labour

There is a typical time-related biological process in all normal labour (see Figure 24.1). This scientific observation assists with the interpretation of the process of labour and is the basis for the partogram. Normal dilatation is predictable and inexpensive. It is important that midwives are able to competently assess that the phases and stages of birth are progressing normally (see Box 24.1). The use of the partograph to monitor

24.3 Ps of labour

The **p**assage: the bony pelvis and related soft tissues should be adequate to accommodate the fetus.
The **p**assenger: the size of the fetus in relation to the type of pelvis and degree of flexion (in cephalic presentation).
The **p**owers: the nature of uterine contractions (contractions should be rhythmic and must increase in duration and intensity).
The **p**syche/**p**ain: previous labour and childbirth experiences may affect the emotional wellbeing of a women and tension can interfere with birth.
Physiological wellbeing of the mother and fetus: risk factors can alter the course of labour.
Professional assistance: appropriate assistance of care skilled midwife/medical practitioner = Skilled attendance, and a well-resourced environment) that matches the level of risk will determine the outcome of care.

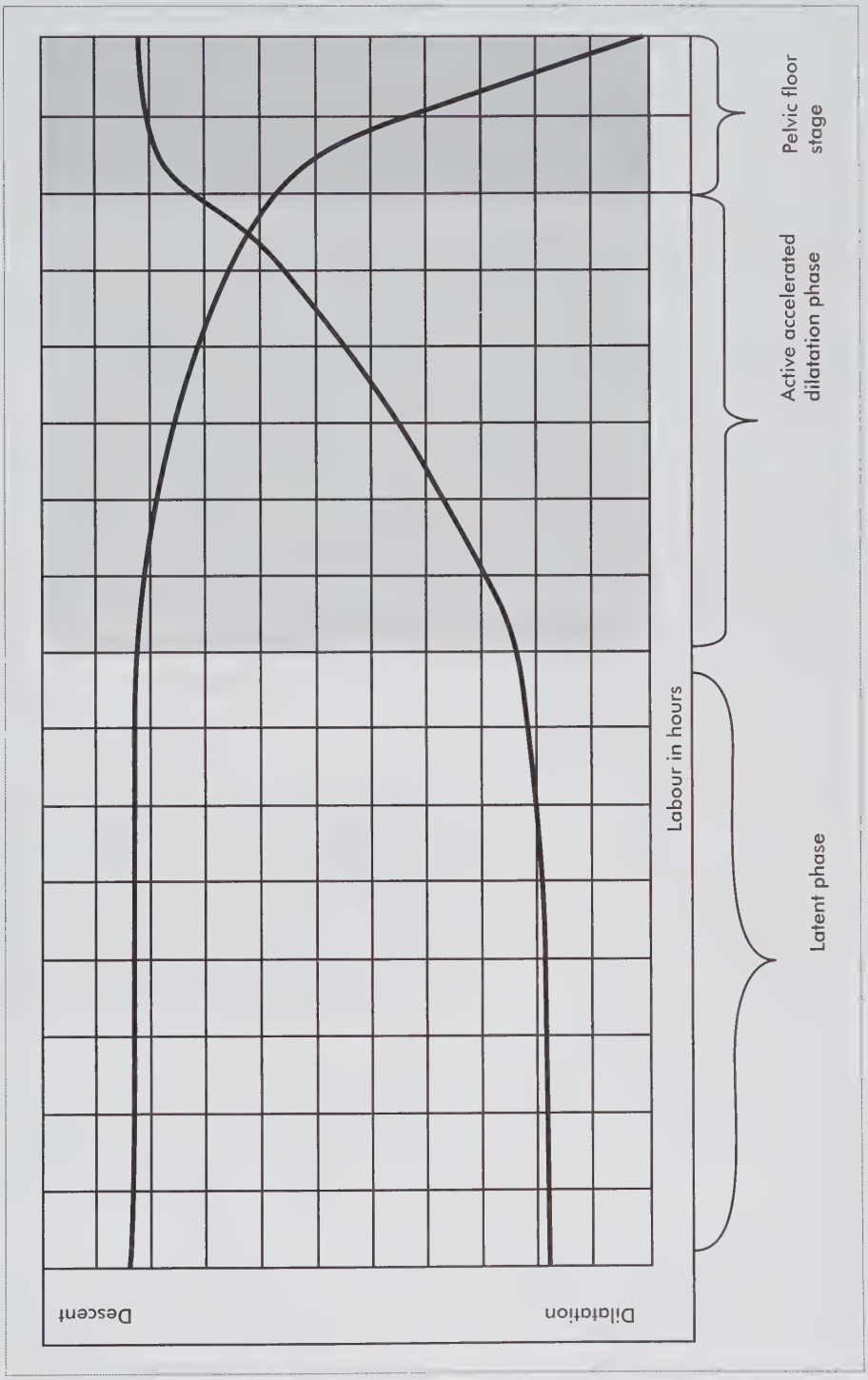


Figure 24.1. The typical parameters and functional divisions of labour illustrated on a time scale
Adapted from Greenhill and Friedman, 1974

labour assists midwives and other skilled birth attendants to identify deviations such as prolonged and obstructed labour early. Three to four stages of labour are described, depending on the literature reviewed (see Box 24.4). Defining stages of labour allows midwives and other skilled attendants to identify whether progress of labour is normal or delayed (see Figure 24.1).

The first stage of labour

The first stage of labour begins from the onset of labour up to the time the cervix is fully dilated. The onset of labour starts from the time when the woman experiences regular and rhythmic contractions, which are accompanied by dilatation of the cervix. Occasionally some women complain of lower abdominal pain or backache and regular rhythmic uterine contractions. The dilatation of the cervix is expressed in centimetres (0–10 cm).

The first stage of labour is divided into two phases, the latent phase and the active phase. The latent phase is the period between the onset of labour up to 3–4 cm dilatation of the cervix and the cervix becomes fully effaced during this period. Cervical effacement (taking up of the cervix) is a process in which the cervix shortens and becomes incorporated into the lower uterine segment. Taking up of the cervix starts towards the end of pregnancy in a primigravida and is only complete by the end of the latent phase, while in multiparous women effacement and dilatation of the cervix may occur simultaneously. Therefore progress of cervical dilatation in nulliparous women is only possible when the cervix is fully effaced. In a primigravida, the latent phase lasts between 3–8 hours and is shorter in multiparous women.

The active phase starts from the time the cervix is 4 cm dilated up to the time the cervix is fully dilated, which is 10 cm. During this phase the cervix dilates more rapidly, at a rate of 1 cm per hour in a primigravida and 1.5 cm in multipara. Dilatation of the cervix is accompanied by increased descent of the presenting part. The contractions become stronger in intensity and duration, which increases to between 40–60 seconds and the frequency from two to three contractions in ten minutes.

The second stage of labour

The second stage is transitional and begins from the time the cervix is fully dilated up to the time the fetus is completely expelled from the birth canal. Two phases of the second stage of labour are identified. The first phase (pelvic floor phase)is when the cervix is fully dilated, the head is not yet on the perineum and there is no urge to bear down. Bearing down at this stage is discouraged as there is no evidence that it may expedite delivery. The uterine ligaments, vaginal and perineal muscles may become strained and damaged due to premature bearing down.

The second phase is the expulsion (perineal phase) phase. The head is pressing on the sacral nerves to the rectum and there is a desire to bear down. The fetal head becomes visible at the perineum and the woman will experience a compulsive urge to bear down. The midwife may also encourage the woman to bear down and advise her on when to push and when not to push. Factors that determine the duration of the second stage of labour include the nature of contractions, the maternal and fetal condition and the degree of descent.

Descent of the presenting part is made possible by the combination of the increased intensity of the uterine contractions and intra-abdominal pressure. The duration of the second stage of labour is 45 minutes for multiparous women and up to two hours for primigravida. In South Africa the primigravida is allowed 45 minutes while the multipara is allowed 30 minutes as the duration of the second stage of labour. The limitation of the duration of the second stage of labour must not be limited to time alone but must also consider the progress of labour, the condition of the mother and the condition of the fetus.

The third stage of labour

The third stage of labour begins from the time the baby is delivered up to the time the placenta and membranes are completely expelled and haemostasis achieved. The events include separation and expulsion of the placenta and membranes as well as control of bleeding. With active management, the third stage of labour lasts between 5–15 minutes, and up to 45–60 minutes, with passive management (spontaneous delivery of the placenta).

The fourth stage of labour

The fourth stage of labour is referred to as the period after delivery of the placenta up to one hour postdelivery. During this period the mother's vital signs are checked and recorded and any abnormalities managed appropriately. Breastfeeding is initiated within the hour following childbirth. The placenta is examined for abnormalities and the baby is examined to exclude any abnormalities and congenital malformations.

Factors that influence the onset of labour

The onset of labour is the most important phase in the management of labour since it is on the basis of this that decisions are made that will guide the appropriate management of labour. A combination of hormonal and

Table 24.1

Stages of labour (Also see Figure 24.1)

Stages of labour	Duration
Stage 1 This is the period between the onset of labour up to full dilatation of the cervix. Divided into two phases	
Phase I Latent phase Time labour starts up to the time the cervix is fully effaced and 3–4 cm dilated.	Primigravida: Lasts between 3–8 hours Multipara: This is shorter.
Phase II Active phase From the time the cercix is fully effaced to the time the cervix is fully dilated.	Primigravida: At a rate of 1 cm per hour Multipara: 1.5 cm per hour.
Stage 2 Begins from the time the cervix is fully dilated until the time of the delivery (before floor and perineal phases)	Primigravida: Up to two hours. Multipara: Up to 45 minutes (30 minutes bearing down effort).
Stage 3 Begins from the time the baby is delivered up to the time the placenta and membranes are completely delivered including control of vaginal bleeding.	Duration varies with the method used to manage the third stage. With active management between 5–15 minutes and up to 45–60 minutes, with passive management
Stage 4 The fourth stage of labour is referred to as the period after delivery of the placenta up to one hour post delivery.	One hour

Adapted from Greenhill and Friedman, 1974

24.4 Signs of true labour

Signs of true labour include regular rhythmic contractions accompanied by cervical effacement (in primigravidae) and dilatation of the cervix with or without rupture of membranes.

mechanical factors are involved in the onset of labour. The midwife has an important role to play in providing women with information that will help them to recognise the signs of true labour (see Box 24.4).

Once the woman recognises the onset of labour she must make contact with the skilled attendant.

Hormonal effects

Certain hormones are involved in the onset of labour. The placenta produces progesterone and oestrogen during pregnancy. Progesterone has a relaxing effect on the uterine muscles thereby inhibiting contractions. As pregnancy reaches term, biochemical changes cause a decrease in the availability of progesterone to the uterine muscles and there is an increase in oestrogen, which has an effect on uterine contractions. Oestrogen increases the sensitivity of the myometrium to oxytocin and stimulates production of prostaglandins, which in turn will cause irritability and contractions. Synthesis of prostaglandins in the decidua, amnion and chorion is promoted by oestrogen, resulting in stimulation of uterine contractions because of the effect of prostaglandins on the smooth muscles.

Emotional and physical stressors stimulate the maternal hypothalamus, triggering the release of oxytocin. The mutually coordinated effects of oxytocin and prostaglandins on the smooth muscles initiate the rhythmic uterine contractions of true labour.

Cortisol and the release of prostaglandins

The fetal adrenal glands secrete large quantities of cortisol, which possibly cause the release of prostaglandins. Large quantities of prostaglandins are found in the amnion and are thought to originate from the membranes as well as from the decidua.

Mechanical stimulation

Uterine activity also occurs as a result of stimulation of the uterus and cervix. Smooth muscles usually contract when stretched; hence the uterine muscles become sensitive to distension and contract. The increased stretching of the uterine muscles by the increased intra-amniotic volume (enlarging fetus, placenta and the increased amounts of amniotic fluid) must have its effect as pregnancy progresses. The uterine muscles become more sensitive in the case of multiple pregnancy, polyhydramnios or when the presenting part is well applied to the cervix. Twins are often born two to three weeks earlier than a single fetus and this could partly be due to the increased stretch of the smooth muscle of the uterus as well as the double feto-placental factors.

Cervical irritation and stretch

It is thought that cervical irritation and stretch of the lower segment play an important part in starting uterine contractions. When the presenting part is pressing onto the cervix and dilatation of the cervix is taking place, impulses are conducted to the neuro-hypophysis, causing the release of oxytocin (the Ferguson reflex).

When artificial rupture of membranes is performed, either to induce or accelerate labour, the presenting part is brought into direct contact with the cervix. This usually stimulates uterine activity. A well-fitting presenting part, exerting an even pressure and therefore a greater area of pressure on the cervix, appears to cause the best stimulation of uterine contractions.

False labour

Many women may experience strong, frequent, but irregular painful contractions. These are Braxton-Hicks contractions which are real but have not yet settled into the rhythmic pattern of true labour, but do cause discomfort to the woman. The contractions are not accompanied by effacement or dilatation of the cervix. Earlier in pregnancy all women should be told about these contractions so that they will not mistake them for true labour (see Table 24.2). Women who experience false labour should be reassured and they should be advised on when to report to hospital.

The mechanism of labour

The fetus has to undergo a series of movements in order to pass through the birth canal and this is known as *the mechanism of labour*. Knowledge of the female pelvis, the pelvic floor, the fetal skull and physiology of normal labour is essential to understand the mechanism of normal labour. The midwife should also have knowledge of the different terms used to describe the fetus in relation to the pelvis during pregnancy and childbirth. Labour progresses normally in most women and the mechanism follows a set pattern of movements. In the mechanism of normal labour, the lie is longitudinal, the presentation is cephalic, the attitude is that of complete flexion and the denominator is the occiput.

In certain circumstances there is a variation in this set pattern of movements, and this results in an abnormal mechanism of labour. This is attributed to an abnormal relationship of the fetus to the uterus and pelvis.

The series of movements that constitute the mechanism of labour (see Figure 24.1) are a continuous process, but for convenience they are divided into different stages, depending upon the different movements that the fetus undergoes. These stages are described under this section.

Engagement

Engagement occurs when the widest part of the presenting part enters the pelvic brim. In a primigravida engagement occurs at 36 weeks of pregnancy and in a multigravida it usually occurs after onset of labour. In cephalic presentation the widest diameter is the bi-parietal diameter (9.5 cm). Engagement demonstrates that the pelvis is likely to be adequate for the size of that particular fetus to allow for vaginal delivery (see Figure 24.1).

Descent

In each plane of the pelvis the fetus turns to take advantage of the largest available space, e.g. the transverse diameter at the pelvic brim and the anteroposterior diameter at the outlet. Descent of the fetal head begins before the onset of labour in a primigravida, when the head becomes engaged into the pelvis.

Descent usually occurs in primigravida during the latter weeks of pregnancy as a result of tight abdominal muscles, while in multigravida it may not occur until the onset of labour. Descent occurs when there is softening of the cervix and other pelvic organs, as well as some effacement of the cervical canal. Contraction and retraction of the uterine muscles aid descent during the first stage of labour. The descent is more rapid in the second stage of labour, because with the woman 'bearing down' the abdominal muscles and the diaphragm assist the muscle action of the uterus.

Flexion

With descent, increased flexion of the fetal head takes place throughout labour. At the beginning of labour the fetal head is in an attitude of natural flexion. There are several theories as to how this increased flexion comes about. One theory suggests that in a normal vertex presentation, the long axis of the fetus lies parallel to the long axis of the mother and the fetus

Table 24.2

Signs of true and false labour

Signs of true labour	Signs of false labour
The contractions are regular, rhythmic and painful and increase in intensity.	Contractions may be painful but not regular and do not increase in intensity.
While contractions increase in intensity the intervals between contractions shorten gradually.	The interval between contractions varies.
Contractions intensify when the woman is up and about.	Pain from uterine contractions is often relieved by walking.
Show is present as the operculum is shed.	Show is absent.
Effacement of the cervix takes place, accompanied by progressive dilatation of the cervix.	Effacement of the cervix takes place but there is no accompanying dilatation of the cervix.

is already in an attitude of general flexion, with the occiput slightly lower than the sinciput.

As the fundus of the uterus presses against the fetal buttocks in the upper uterine pole, the vertex meets the resistance of the now cone-shaped cervical canal, and the head is further flexed. In conjunction with this, the lever theory states that as the spinal column is articulated to the head nearer to the occiput than to the sinciput, any force transmitted through the spine to the head of the fetus will cause the short occipital protuberance to dip down in advance of the sinciput.

In a normal vertex presentation, the suboccipito-frontal diameter of 10 cm lies at the pelvic brim before labour. With increased flexion of the head, the smaller sub-occipito bregmatic diameter of 9.5 cm (together with the bi-parietal diameter of 9.5 cm) enters the pelvic brim and the occiput becomes the leading part of the fetal head.

Internal rotation of the head

The rule is that whatever reaches the pelvic floor first rotates forwards due to pressure from the contractions and muscular diaphragm coupled with resistance of the pelvic floor muscles. The resistance from the pelvic floor causes the occiput to glide forwards. In vertex presentations, when the head is well flexed the occiput leads and meets the pelvic floor first and rotates. The occiput rotates anteriorly one-eighth of a circle along the left side of the pelvis towards the symphisis pubis. This causes a slight twist in the neck of the fetus (Figure 24.1). The antero-posterior diameter (AP) of the head lies in the AP diameter of the pelvic outlet (13 cm).

The distance which the occiput rotates in a vertex presentation depends upon its position at the pelvic brim at the onset of labour:

- In an occiptoanterior position, the occiput will rotate forward one-eighth of a circle along the side of the pelvis (45°).
- In an occiptolateral position, it will rotate forward two-eighths of a circle along the side of the pelvis (90°).
- In an occiptoposterior position, it will rotate forward three-eighths of a circle along the side of the pelvis (135°).

Crowning

Crowning occurs when the occiput escapes under the symphisis pubis. The biparietal diameter is born (9.5 cm). The head no longer recedes between contractions. If flexion is maintained the suboccipito-bregmatic diameter distends the vaginal orifice. Crowning of the head refers to the stage at which the largest presenting diameter of the fetal head passes through the vulval orifice.

Extension of the head

The movement of extension is the opposite to that of flexion. Following crowning, the fetal head becomes extended on the neck releasing the sinciput, face and chin. The sinciput, face and chin sweep the perineum and the head is delivered by a movement of extension. In a normal vertex presentation, the suboccipto frontal diameter (10 cms) distends the vulva and the head is born by a movement of extension.

Restitution

Restitution is the untwisting of the twist in the fetal neck that occurred during internal rotation of the head. A slight untwisting movement of the head occurs to correct the previous internal rotation of the head. In a normal vertex delivery the occiput moves one-eighth of a circle back along the side of the pelvis (from which it came before internal rotation of the head) and so undoes the

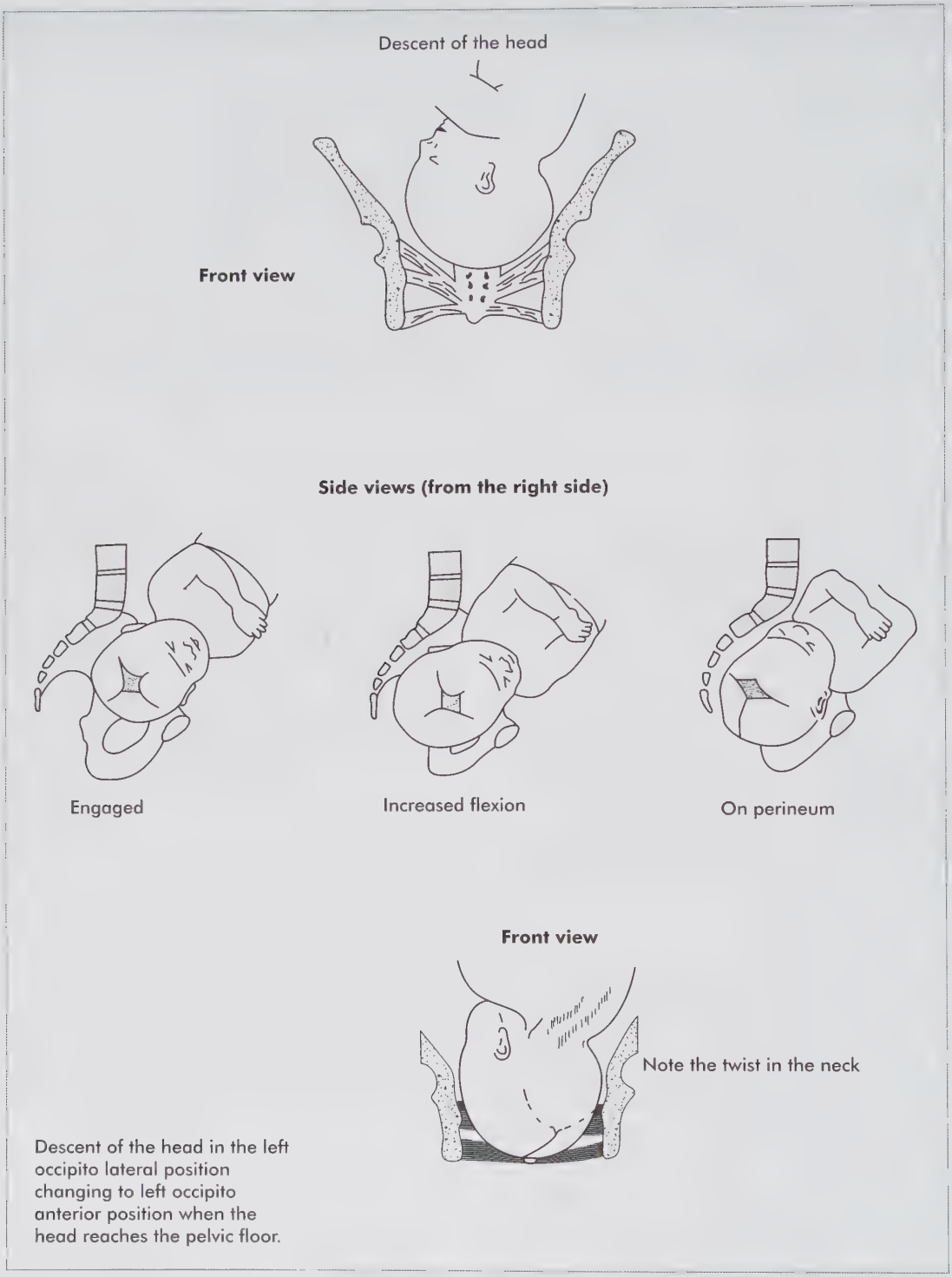


Figure 24.2 Mechanism of labour: Descent of the head with increased flexion
Redrawn from: Garrey et al. 1974. *Obstetrics Illustrated* 2 ed. Edinburgh: Churchill Livingstone

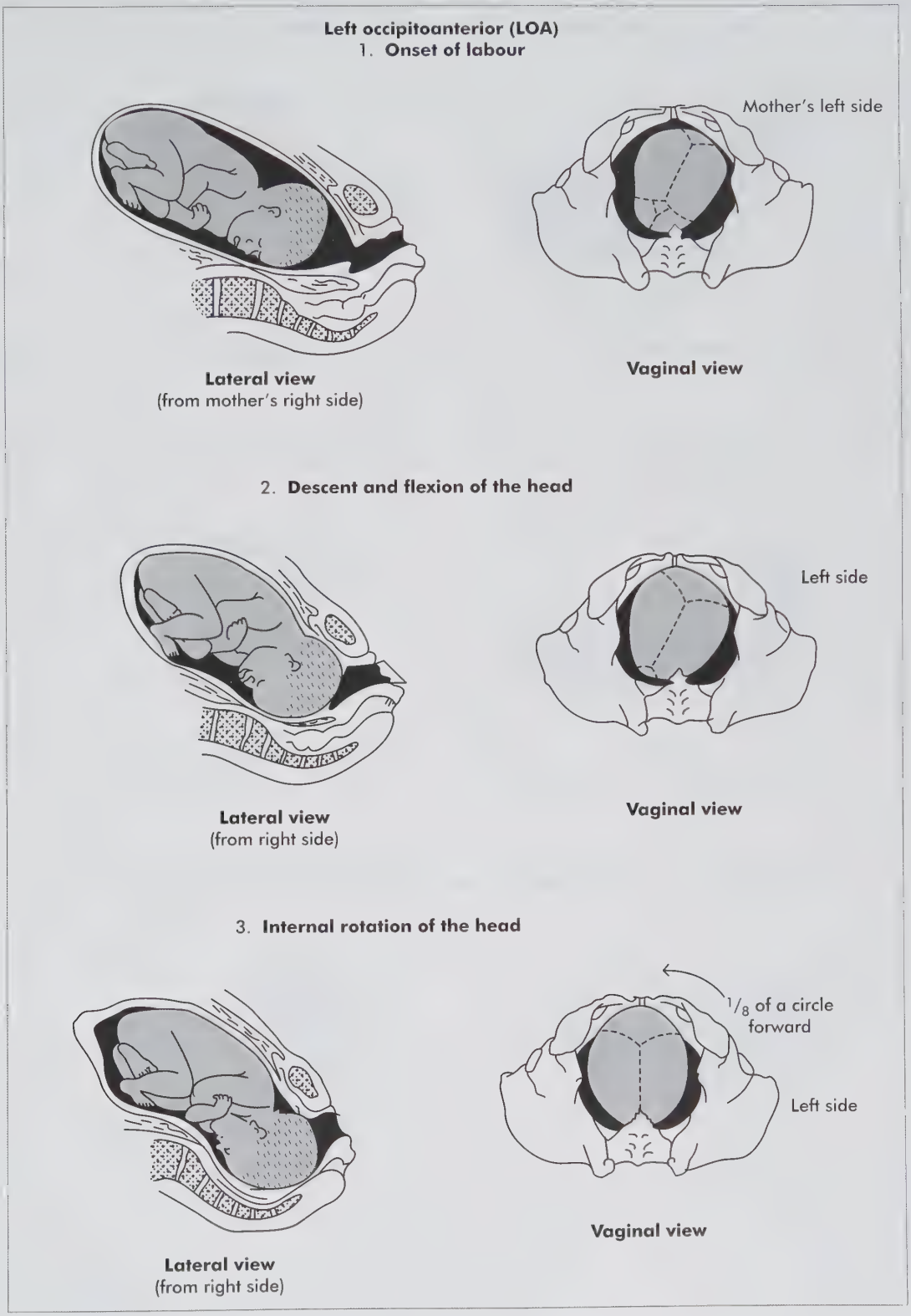


Figure 24.3 Mechanism of normal labour: Left occipitoanterior position (LOA)

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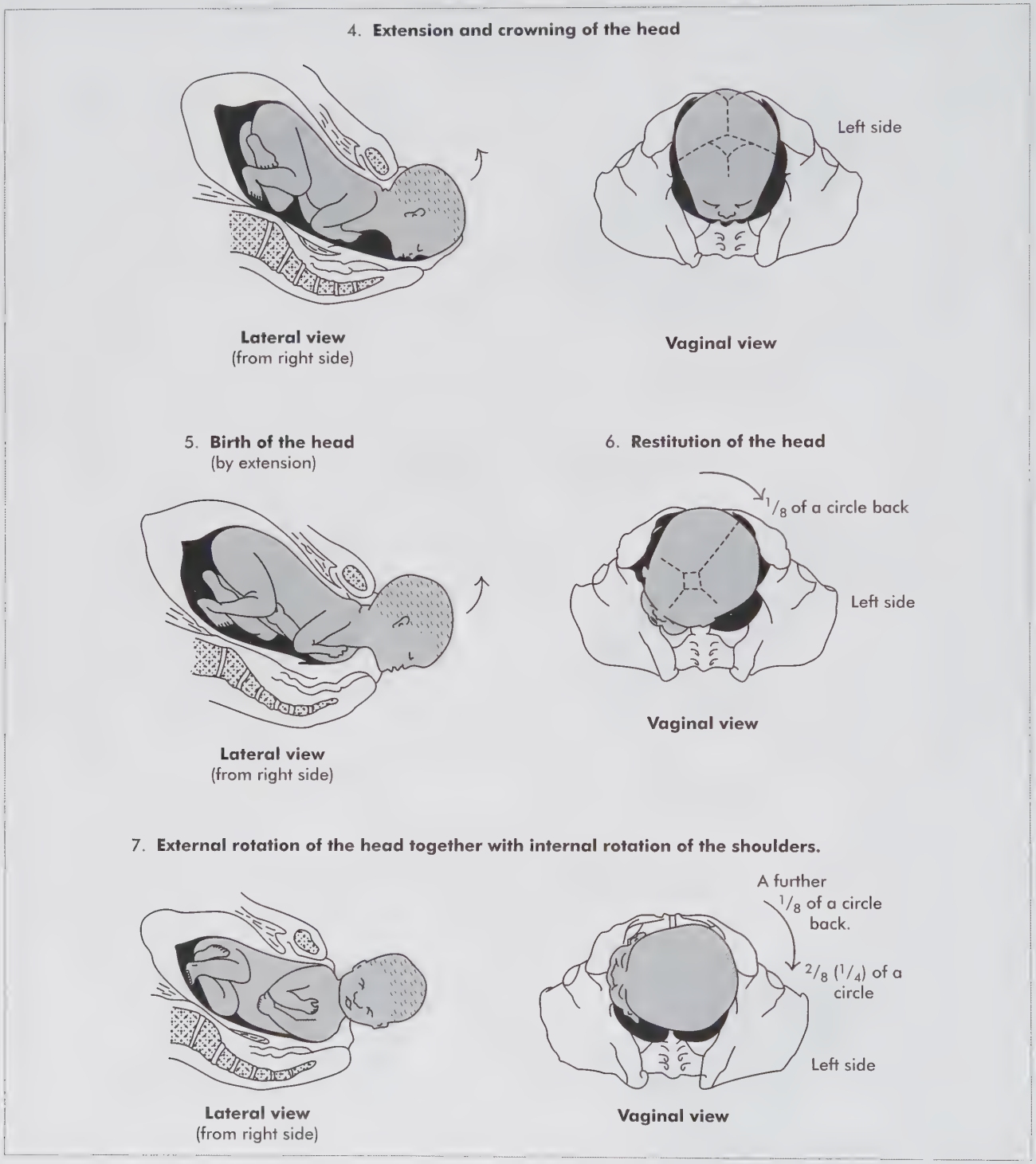


Figure 24.3 Mechanism of normal labour: Left occipitoanterior position (LOA)

continued

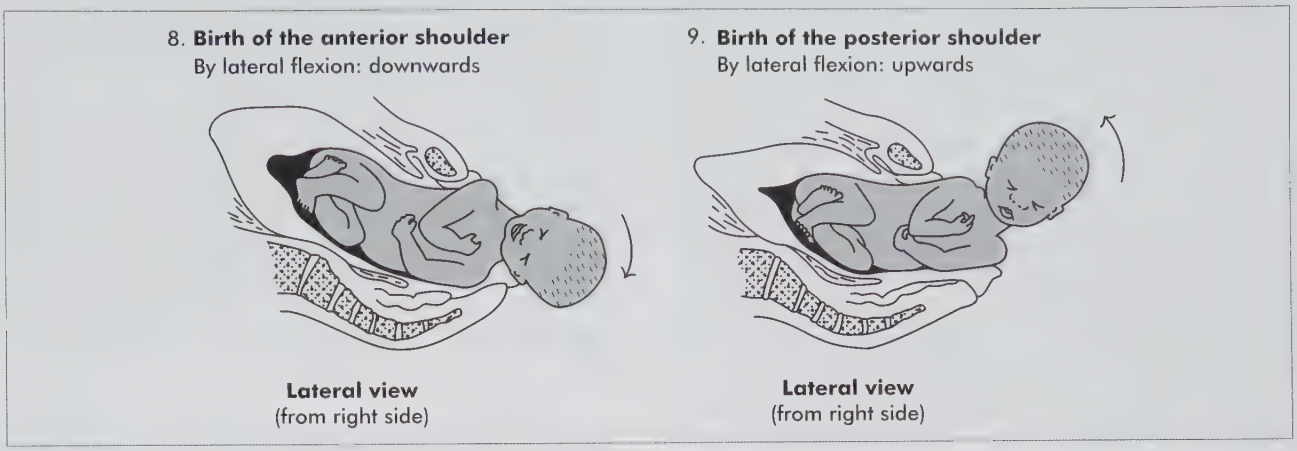


Figure 24.3 Mechanism of normal labour: Left occipitoanterior position (LOA) (*continued*)

twist in the neck. During delivery, it is very important that the midwife who is delivering the baby waits for restitution to take place. This will indicate the position of the fetus and will first, prevent turning the fetal head in the wrong direction, which may result in large diameters presenting and cause trauma to fetal tissues, and second, it will help to prevent both shoulders from passing through the vulva simultaneously, and so decrease the risk of perineal lacerations and reduce the incidence of shoulder dystocia.

Internal rotation of the shoulders

Internal rotation of the shoulders takes place in a similar way to the head, except that the rotation will be on the opposite side of the pelvis. The shoulders are at right angles to the sagittal suture. The anterior shoulder reaches the pelvic floor first and rotates anteriorly to lie under the symphisis pubis. This means the long axis of the shoulders is now lying in the antero-posterior diameter of the pelvis. As the shoulders rotate anteriorly, this movement is accompanied by external rotation of the head. The movement occurs in the same direction as restitution and the fetal occiput now lies laterally. This allows for smaller diameters of the fetus to present at the outlet.

External rotation of the head

At the same time as internal rotation of the shoulders takes place there is external rotation of the head. This is because the long axis of the head has to be at right angles to the long axis of the shoulders, and therefore, when the shoulders turn one-eighth of a circle, the head also has to turn one-eighth of a circle in the same direction.

Birth of the shoulders

With a further contraction the anterior shoulder is delivered first. The anterior shoulder slips under the pubic arch while the posterior shoulder sweeps the perineum reducing the size of the presenting diameters. The shoulders are born by a movement of lateral flexion.

Delivery of the rest of the body

Ideally, within the same contraction, and continuing the movement of lateral flexion, the rest of the body is born by lateral flexion. This occurs because the fetal body follows the curve of Carus, which directs it over the symphisis pubis and onto the mother's abdomen. The midwife facilitates delivery of the baby over the mother's abdomen to promote bonding.

Physiology of normal labour

With good antenatal care the woman should go into labour in the best possible physical and psychological condition. The condition of the fetus should also be sound. The process of parturition is aptly named labour, because the woman exerts a considerable amount of energy during this period. Most of the energy is expended by the muscles of the uterus, but the whole body is affected. Normal labour, therefore, has an effect upon the general condition of the mother and the fetus, but if labour is normal, the body compensates for this. Assuming that the care and attention that the woman in labour receives is good, the main factor that will affect the condition of both the woman and the fetus during labour is the length/duration of labour.

General physiological changes to the woman during the first stage of labour

Besides the extensive changes to the urogenital system during labour, the most important changes, which occur mainly as a result of energy expenditure, occur in the following systems:

Changes to the respiratory system. During pregnancy there is the tendency to mild hyperventilation and because more CO_2 is exhaled with each breath, there is a subsequent decrease in carbon dioxide tension ($PaCO_2$). Occasionally there might be hypoventilation. These changes result in changes in the acid-base balance. Hyperventilation tends to increase if the woman is anxious or in pain which may occur during the late first stage of labour and may result in mild respiratory alkalosis. During labour, both the rate and the depth of respiration are increased, causing a further decrease in the $PaCO_2$ levels, particularly towards the end of the first stage of labour. This results in a mild respiratory alkalosis. If hyperventilation is severe the $PaCO_2$ levels can fall too low and will manifest as maternal dizziness, tingling in the fingers, numbness around the mouth, and if extreme, as carpo-pedal spasm. The resulting alkalosis may interfere with the release of oxygen from the maternal blood to the fetus resulting in fetal asphyxia. In order to increase the woman's $PaCO_2$, she should be encouraged to pant and also to frequently take deep breaths. If shallow respiration is overdone, the tidal volume will be low and too little oxygen will be taken in. This can result in fetal hypoxia. It is important to note that the level of oxygen consumption increases as the contractions intensify, which may lead to an increase in labour pain due to myometrial hypoxia and subsequent stimulation of anaerobic metabolism resulting in metabolic acidosis.

Gastro-intestinal changes. Prior to onset of labour there is a certain degree of metabolic acidosis and reduced ability to utilise glucose as the main fuel source for the fetus. The metabolic (energy releasing) processes require glucose as an initial ingredient, and as there is considerable energy expenditure during labour, the glucose requirement is increased. If the woman does not have sufficient glucose intake, other methods to supply energy are utilised by the body, such as the oxidation of accumulated fats. However, fat oxidation results in metabolic acidosis. A mild metabolic acidosis may develop towards the end of the first stage and during the second stage of labour, but it is compensated for, to some extent, by the mild respiratory alkalosis. However, it is essential that the woman receives an adequate intake of glucose and fluids. It is also necessary to undertake urine tests for ketones (ketonuria) at set intervals during labour, in order to diagnose maternal ketoacidosis as soon as it arises or occurs.

If labour is prolonged or if the contractions are very strong and frequent, and if the woman does not receive adequate hydration and sufficient glucose, ketoacidosis can develop very quickly. Although mild maternal ketosis is now thought to be of little importance, severe maternal ketoacidosis is very dangerous and will be followed very shortly by fetal acidosis, which can have very serious consequences for the fetus. (Fetal acidosis, however, can also occur without the initial maternal acidosis.) Severe maternal ketoacidosis is recognised by pyrexia, tachycardia, dehydration and blood and urinary evidence of acidosis. During labour, gastrointestinal motility and absorption are reduced and the contents of the stomach may be retained for up to 48 hours. Factors that exacerbate delayed gastric motility include consumption of food high in carbohydrates and fats, fear and pain as well as use of opioid drugs during labour. Nausea and vomiting may also occur in advanced labour due to maternal acidosis.

Changes in the cardiovascular system. There is increased cardiac activity during labour, and this is especially marked during each uterine contraction. The cardiac output increases by about 20–30% during the first stage of labour but towards the end of the first stage and during the second stage the increase may be even greater. Therefore, labour increases the strain already placed on the heart by pregnancy, but the normal woman has adequate reserves to compensate for this. The increased cardiac output contributes to the rise in the blood pressure and a raised pulse rate. In the first stage of labour, there is little change in the blood pressure between contractions, but there is an average rise of 10 mmHg systolic pressure and 5–10 mmHg diastolic pressure during contractions. There is a slow but progressive rise in the pulse rate during the first stage but the pulse should not exceed 100 bpm, unless keto-acidosis has developed. The pulse rate will be accentuated by prolonged labour, dehydration, haemorrhage, anxiety, unrelieved pain, infection and by certain medications such as those inhibiting labour.

The acid-base balance. As explained in the physiological changes to the respiratory and gastrointestinal systems, the acid-base balance is very delicately poised during labour and conditions such as starvation, lack of adequate glucose and fluids, as well as prolonged, difficult and/or painful labour can result in metabolic acidosis. The pH of the blood just prior to labour is ± 7.42, as it is normally slightly raised towards the end of pregnancy. It usually decreases to ± 7.35 during labour. (The non-pregnant blood pH is ± 7.40.)

Fluids and electrolytes. There is an increased secretion of corticosteroids during labour, and this leads to progressive changes in the serum electrolyte pattern. With the extra energy expenditure, there is increased heat production and subsequent fluid loss from sweating and panting. This is aggravated by reduced gut absorption and also by the tendency to vomit

in advanced labour. As a result, there is a degree of haemoconcentration and a fall in the plasma levels of sodium and chloride.

Temperature. There is often a slight drop (by 0.50 °C) in the woman's body temperature a day or two before the onset of labour. However, during labour there is normally a gradual, slight rise in temperature, but this should not exceed 37.8 °C unless ketosis has developed. Factors that may be attributed to change in the woman's body temperature include the room or atmospheric temperature, as well as prolonged, difficult and/or painful labour.

Factors affecting the fetus during labour

The birth process is not an easy and gentle experience for the mother, but it is an even more traumatic experience for the fetus. However, the physiological reserves with which the fetus normally enters labour enable it to withstand the effects of labour and birth. There are many factors that are involved in this journey from the safety of the uterus, through the birth canal and into the outside world. The fetus also experiences major changes during labour, which may cause stress so it is important to monitor fetal wellbeing. Fetal heart monitoring can be through intermittent auscultation by a fetal stethoscope (fetoscope), by a sonicaid or by continuous fetal heart monitoring using a cardiotocograph (CTG) during normal labour. The factors which may affect fetal wellbeing during labour include the following:

The uterine contractions (powers). During normal uterine contractions, there is compression of the placenta in the upper uterine segment and this can retard the amount of oxygen to the fetus, to a greater or lesser degree, especially during the peak of the contraction. Therefore, even in normal labour, the fetus is subjected to a certain amount of hypoxia. This can be noted when monitoring the fetal heartbeat during contractions. If there is hypertonic or incoordinate uterine action or prolonged labour, fetal anoxia may result.

The passages. The passages refer to the birth canal that the fetus should pass through during the process of childbirth. This includes the smooth dilatation of the cervix, the intact membranes and an average amount of liquor; the adequate size of the pelvis (in relation to the size of the fetus) the normal shape and inclination of the pelvis, the pelvic joints, the softening of the pelvic tissues and the elasticity of the perineum, all of which help to make the path through the birth canal larger and therefore easier. Conversely, if any of these factors are changed, this can lead to a more difficult labour and delivery.

The passenger. The fetus itself dictates to some degree whether the labour is comparatively easy or difficult. Factors that suggest that labour is likely to progress well include a term pregnancy at the onset of labour, a normal sized fetus, adequate pelvic capacity, including the soft tissues and the pelvic floor muscles and normal presentation and position (cephalic presentation) at the onset of labour. An occipitoanterior position coupled with the ability of the fetal skull to mould during passage through the birth canal (but not excessive, rapid or upward moulding) will all contribute to less trauma to both the fetus and the mother. If the fetus is at term, the necessary reserves will have been built up to enable it to withstand a certain amount of hypoxia and trauma. If, however, the fetus is post-term (42 weeks gestational age or more), it will not necessarily be at a greater advantage, moulding is less likely to take place due to ossification of the skull bones and the placenta may have started to degenerate, leading to placental insufficiency and fetal hypoxia (see Chapter 8 on the Ps of labour).

The changes to the fetal systems that are affected by labour are as follows:

Changes to the cardiovascular system. The fetal heart rate (FHR) normally stays within a range of 120–160 beats per minute but in practice 110–160 is accepted as a normal range and this is considered as the baseline FHR. During normal contractions there is only a slight variation in the baseline FHR, with the heart rate remaining within a normal range of plus or minus 20 bpm. An increase in the FHR at the peak of the contraction (beyond the acceptable baseline variability) indicates that there is compensation for mild hypoxia. If the baseline FHR were to increase by more than 20 bpm, to over 160, or to slow down by more than 20 bpm, to less than 110, then this would indicate moderate to severe hypoxia and fetal distress. The rhythm of the fetal heartbeat is fairly constant, with a baseline showing a characteristic fluctuation of about 5–10 bpm over a selected time interval and this is known as the beat-to-beat variation or baseline variability. The loss of this variability may indicate either loss of cardiovascular adaptability to stress or the depression of the cardiac reflex centre in the brain.

Acid-base balance (fetal acidosis). There are normally sufficient glucose reserves to compensate for the effects of fetal acidosis caused by hypoxia during uterine contractions. However, if the placenta has not been functioning efficiently for the last few weeks of pregnancy, or if the labour is preterm, there would be diminished glycogen reserves and the fetus may be unable to compensate for any reduction in the supply

of glucose or oxygen which may occur in a prolonged or difficult labour. Maternal ketoacidosis could also aggravate the degree of fetal acidosis and the use of excessive amounts of analgesia may cause a reduction in the amount of oxygen transferred to the fetus.

24.3 The stages of labour

The length of labour varies in individuals and is affected by both maternal and fetal factors. In general the duration of labour is affected by parity, birth interval, psychological state of the mother, and the type of pelvis, the type of contractions, the presentation and the position of the fetus. A normal labour should not exceed 16 hours in a primigravida and 11 hours in a multipara. Occasionally a woman can have a labour lasting five or six hours and have a subsequent labour of eight to 10 hours for a variety of reasons. In general primigravidae who are undergoing labour have longer first and second stages of labour than women who have already had at least one viable child and a vaginal delivery. This is because the tissue of the cervix, vagina and vulva and all other soft tissues in the pelvis as well as the pelvic muscles have not previously been subjected to the stretching that occurs as a result of the fetus passing through the birth canal.

Physiology of the first stage of labour

The uterus, from the seventh month of pregnancy, undergoes physiological changes in preparation for labour. Once labour has started, further changes occur in response to the action of uterine contractions. True labour begins when strong, regular contractions cause dilatation of the cervix. The first stage of labour ends when the cervix is fully dilated.

Uterine actions

Fundal dominance

Each uterine contraction starts in the pacemakers, which are situated on either side of the uterus near the cornua and spreads across and down the uterus. The contraction is more intense and lasts longer in the fundus but the peak of the contraction is reached simultaneously over the whole uterus. This pattern allows the cervix to dilate and the fundus which is contracting strongly to expel the fetus.

Polarity

Polarity refers to the neuromuscular harmony that occurs between the two poles or segments of the uterus (the upper uterine segment and the lower uterine segments) throughout labour. The upper uterine segment contracts strongly and retracts to expel the fetus while the lower uterine segment contracts slightly and dilates to allow expulsion of the fetus to take place. If polarity is disorganised there is no noticeable progress of labour and the progress of labour may be inhibited.

Contraction and retraction

During labour the uterine muscles do not relax completely following contraction. They retain some form of shortening called retraction; hence do not completely return to their original length after contraction. This assists in expulsion of the fetus because the cavity of the uterus is reduced; as the upper uterine segment becomes shorter and thicker reducing the size of the cavity (see Figure 24.4). Contractions are regular, rhythmic and occur over a specified period of time. Initially they are weak, then become moderate and eventually become strong and expulsive during the second stage of labour.

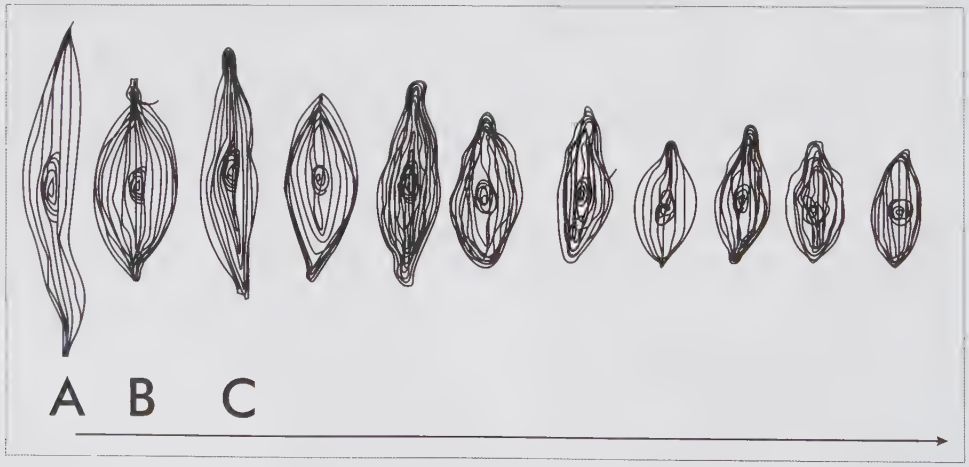


Figure 24.4 Progressive contraction and retraction of the uterine muscle fibres reducing the cavity
A: Relaxed muscle fibres, B: Contracted muscle fibres, C: Retracted muscle fibres

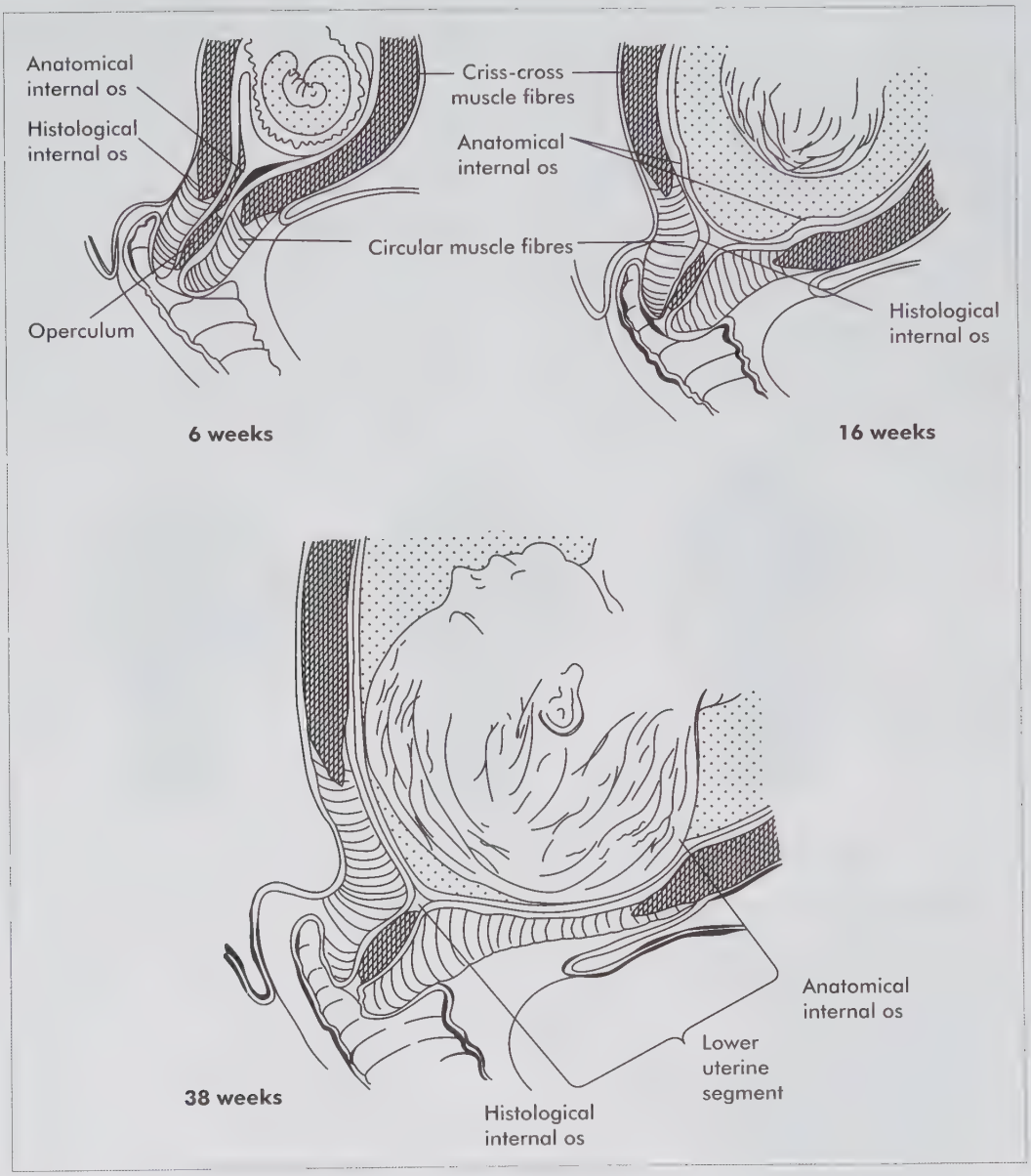


Figure 24.5 Formation of the upper and lower segments of the uterus

In early labour uterine contractions may last about 30 seconds (weak or mild) and occur after every 15–20 minutes. As labour progresses contractions increase in intensity, duration and frequency. Moderate contractions last up to 35 seconds and strong contractions last more than 35 seconds but up to 60 seconds. By the end of the first stage of labour contractions may occur at two to three minute intervals lasting 50–60 seconds.

Formation of the upper and lower uterine segments and development of the physiological retraction ring

By the end of pregnancy the uterus is divided into the upper and lower uterine segments. The lower uterine segment has developed from the isthmus. The upper uterine segment is thick and muscular to enable it to contract and expel the

fetus during labour while the lower uterine segment is thinner to allow for distension and dilatation during labour and childbirth. The longitudinal muscle fibres are responsible for contraction and retraction while the circular muscle fibres are responsible for distension and dilatation.

During labour the upper uterine segment contracts and retracts, pulling on the lower uterine segment and causing it to stretch, and a ridge forms between the upper and lower uterine segments (the retraction ring). This is a physiological ring, which occurs as a result of contraction and retraction of the muscle fibres coupled with distension and dilatation of the lower uterine segment. The retraction ring gradually rises as the upper uterine segment contracts and retracts while the lower uterine segment contracts and dilates. Once the cervix is fully dilated and the fetus is expelled through the birth canal, the retraction ring rises no further. An exaggerated retraction ring is called a Bandl's ring and is found when labour is obstructed (in obstructed labour) (see Figure 24.6).

Cervical effacement

During effacement the muscle fibres around the internal os of the cervix are drawn upwards and merge into the lower uterine segment. The cervical canal widens at the level of the internal os. If the cervix has not been completely taken up during the last days of pregnancy, then this occurs during

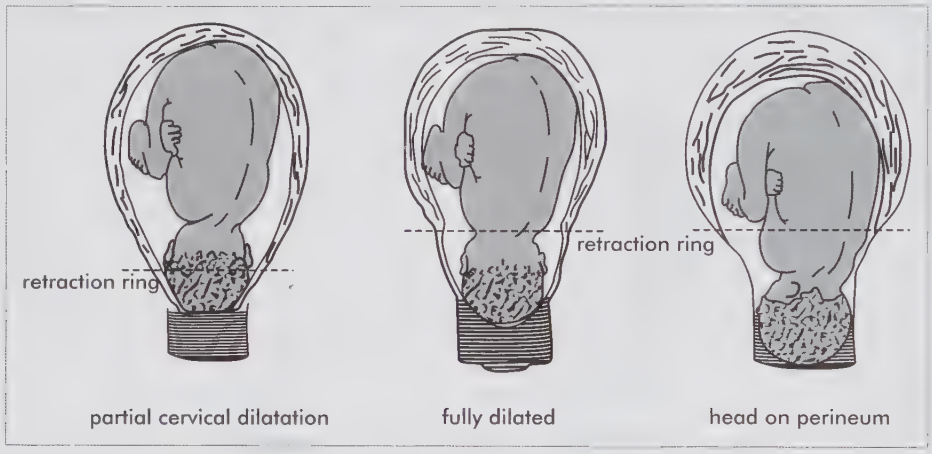


Figure 24.6 Normal or physiological retraction ring of the uterus

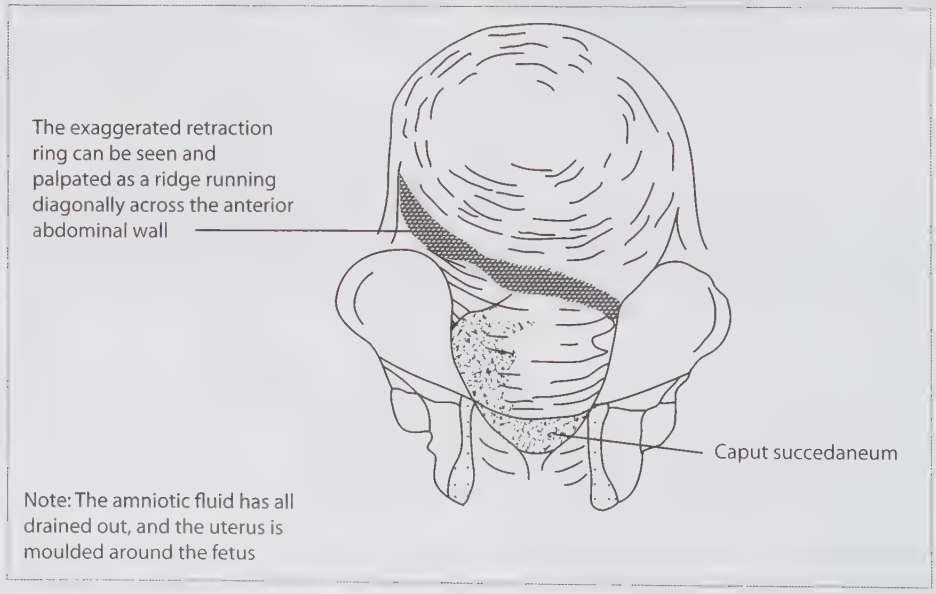


Figure 24.7 Bandl's ring

labour (see Figure 24.7). This commonly occurs in primigravida while in multigravida the external os may begin to dilate before effacement. Effacement and dilatation of the cervix occur simultaneously in multipara.

Dilatation of the cervix

Cervical dilatation is the process whereby the cervix opens (from a small aperture to an opening large enough to allow passage of the fetal head) to allow passage of the fetus during childbirth (see Figure 24.8). Dilatation occurs as a result of uterine action and counterpressure applied by the bag of membranes and the presenting part on the cervix. Pressure applied evenly to the cervix stimulates the uterine fundus to respond by contracting, e.g. a well-flexed head closely applied to the cervix favours efficient cervical dilatation.

Show

When the cervix dilates the operculum which formed the cervical plug during pregnancy falls off and is shed as 'show'. The mucous plug is mixed with blood from ruptured capillaries where the parietal decidua has detached. The woman will give a history of a blood-stained mucoid discharge a few hours before or after labour starts. Frank bleeding may occur and is considered abnormal, while red blood may herald the second stage of labour.

Formation of the forewaters

As the lower uterine segment stretches, the chorion is detached from it and becomes loose. The intrauterine pressure causes the loosened part of the sac to bulge downwards into the internal os. The well-flexed head fits into the cervix

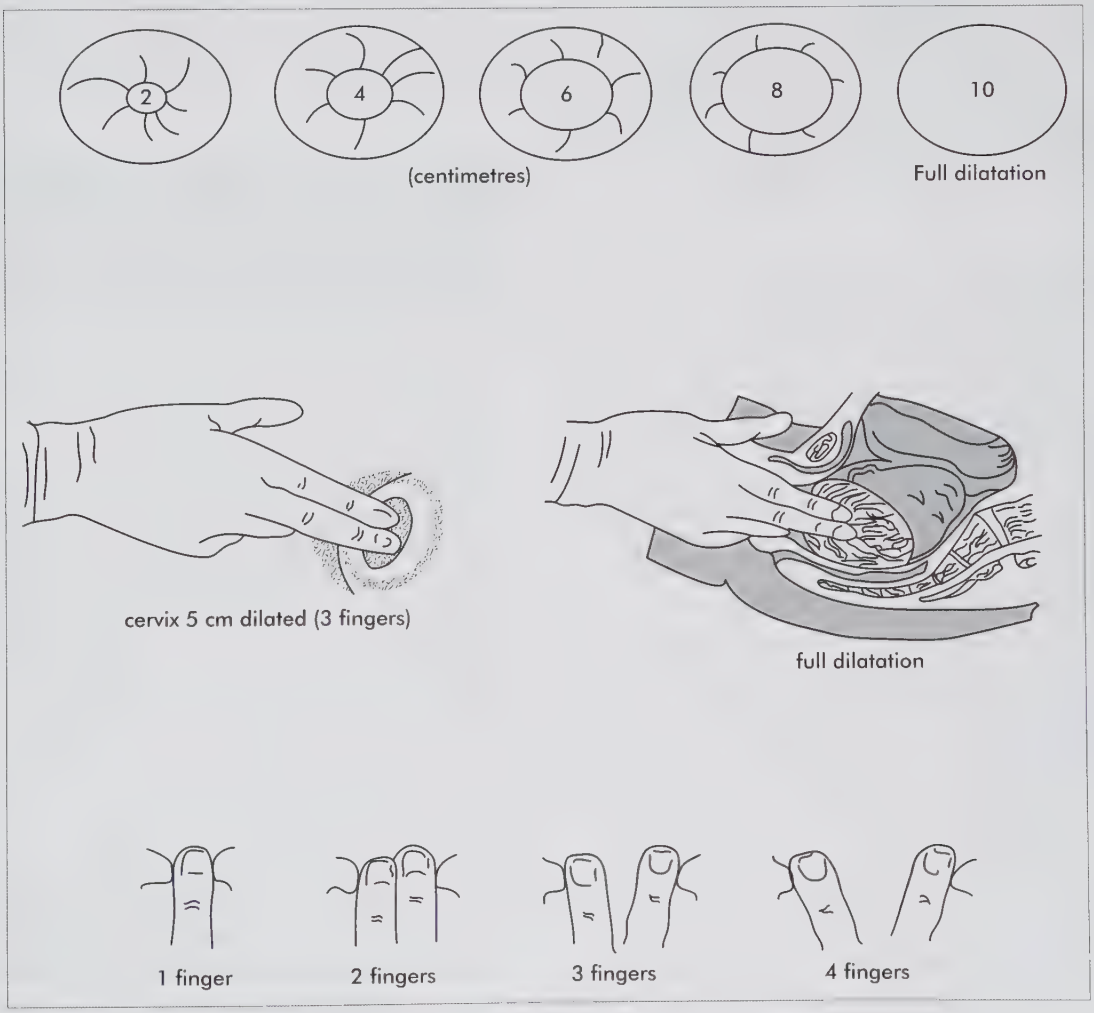


Figure 24.8 Cervical dilatation

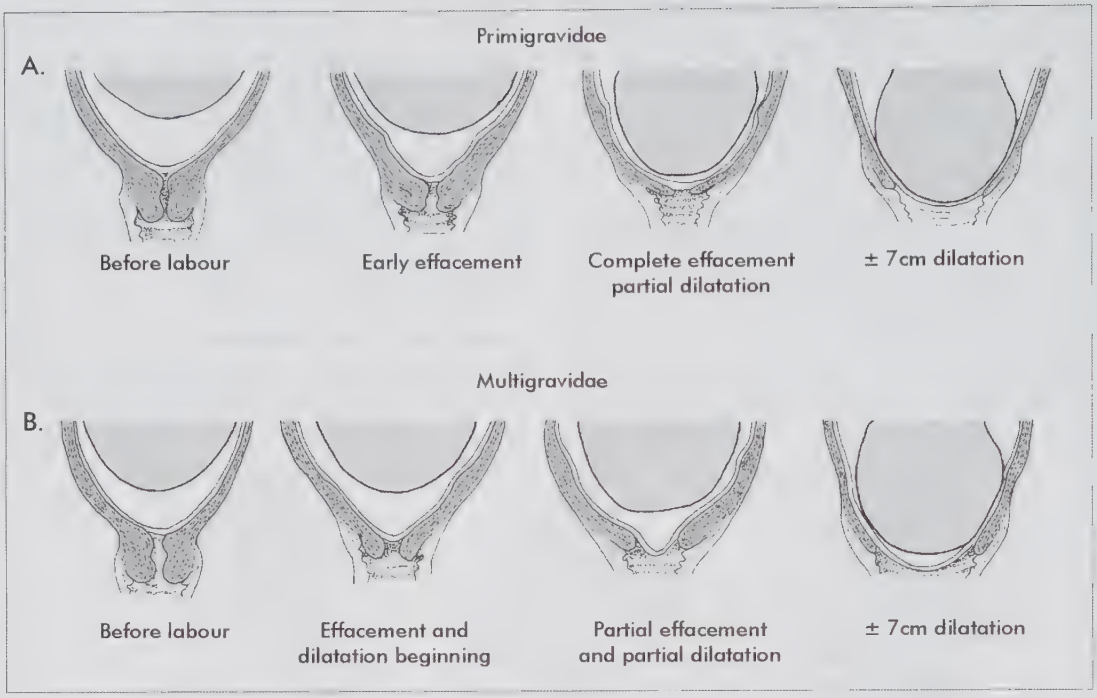


Figure 24.9 Effacement and dilatation of the cervix. A: Primigravidae B: Multigravidae

and cuts off the fluid in front of the head from that which surrounds the body. The fluid in front of the head is known as the forewaters while that which surrounds the rest of the body is known as the hindwaters. The separation of the forewaters is to prevent the pressure applied to hindwaters during contractions from being applied to the forewaters. This scenario assists the membranes to remain intact during the first stage of labour thereby providing a natural defence against ascending infection.

General fluid pressure

General fluid pressure is the term used to describe the pressure that is exerted by the uterine contractions on the amniotic fluid during labour. As the pressure is applied, the fluid cannot be compressed; hence this pressure is equalised throughout the uterus and over the fetal body. When the membranes rupture and a significant amount of fluid is lost during uterine contractions the placenta and umbilical cord are compressed between the uterine wall and fetus, causing diminished oxygen supply to the fetus. If membranes remain intact during labour, this may enhance oxygen supply to the fetus and also assist to prevent intrauterine infection if prolonged labour occurs.

Rupture of membranes

The best time for membranes to rupture is at the end of the first stage of labour when the cervix is fully dilated and delivery of the baby is imminent. This helps to minimise intrauterine and fetal infection especially in HIV and gonococcal infection. During labour, membranes may rupture early if the presenting part is poorly applied to the cervix, resulting in forewaters not being properly cut off from the hindwaters. In certain incidences the membranes do not rupture and appear at the vulva in the second stage of labour as a sac covering the fetal head. Occasionally membranes may rupture days before labour begins and no reason may be attributed to this. This is referred to as early rupture of membranes (EROM). Early rupture of membranes predisposes the fetus to infection and may lead to variable decelerations on cardiotocograph.

Fetal axis pressure

Fetal axis pressure is the force of contraction that is transmitted to the upper pole of the fetus, and down the long axis of the fetus and applied to the cervix by the presenting part. This occurs when the uterus rises forward during each contraction and is more significant after rupture of the membranes and during the second stage of labour.

Physiology of the second stage of labour

The second stage of labour is the period between full dilatation of the cervix and the delivery of the baby. The physiological changes occur as a result of continuation of the activities that occurred during the first stage of labour.

Uterine contractions

The contractions become stronger, longer and expulsive in nature. The combined forces of the secondary powers and uterine contractions force the fetus to descend through the birth canal. The upper uterine segment continues to contract and retract in an effort to expel the fetus from the uterus.

Secondary powers

The descending fetus exerts pressure on the rectum and pelvic floor, giving the woman the urge to bear down. The urge may become controllable for a while then suddenly the woman cannot control it and is overwhelmed, such that the woman begins to bear down. The secondary powers that come into effect are the abdominal muscles and the diaphragm (see Box 24.5).

24.5 Secondary powers during the second stage of labour

Secondary powers during labour include the abdominal muscles and the diaphragm.

Displacement of the pelvic floor

As the fetus advances, the vagina is distended while the pelvic floor is displaced. The rectum is posterior and the bladder is anterior. The bladder is pushed upwards into the abdomen and so is not likely to be damaged during childbirth. The urethra is stretched, and so thins out and the lumen is reduced. The rectum is flattened and faecal matter may be expelled. The perineal body is stretched and thins out while the levator ani muscles become thinned out and are displaced laterally. The head appears at the vulva and is delivered, followed by the anterior shoulder, and the rest of the body is delivered by lateral flexion.

Physiological processes in the third stage of labour

The physiological processes are a continuation from the onset of labour. Separation and expulsion of the placenta occurs due to mechanical and haemostatic factors. The time for the placenta to separate differs. It may separate during the expulsive contractions leading to delivery of the baby or after the delivery of the baby. The third stage usually lasts between 5–15 minutes but in some instances may last up to 45 minutes. Anything beyond 45 minutes is considered to be a prolonged third stage of labour.

Mechanical factors

The retraction process accelerates when the uterine cavity is emptied. The placental site starts to diminish in size by the beginning of the third stage of labour. The placenta is squeezed and blood in the intervillous spaces is forced back into the spongy layer of the decidua. The surface area of the placental attachment reduces and the placenta begins to detach from the shrinking uterine wall.

Separation of the placenta usually begins at the centre resulting in formation of the retroplacental clot. The retroplacental clot causes an increase in weight which will facilitate peeling off of the membranes off the uterine wall. The retroplacental clot is then enclosed in the membranes as the placenta descends with the fetal surface coming first (Schultze method) (see Figure 24.9). Following separation of the placenta, the uterus contracts strongly thereby forcing the placenta and membranes into the lower uterine segment and eventually the vagina for expulsion.

Haemostasis

Haemostasis is brought about by the interplay of three factors:

- The oblique muscle fibres retract and exert pressure on the torn blood vessels acting as clamps thereby securing a ligature action.
- Vigorous uterine contractions exert pressure on the placental site following separation, bringing walls into apposition.
- Clot formation on the placental site on the torn blood vessels is enhanced. When the placenta has separated, the placental site is covered by a fibrin mesh, utilising 5–10% of the circulating fibrinogen, thus securing haemostasis.

Main points

Some of the factors that affect the psychology of labour include culture, previous labour experience, the midwife's response to the woman, pain threshold and the general environmental issues, e.g. light, room temperature, etc.

The factors that trigger onset of labour include hormonal and chemical factors. Prostaglandins play a role in the initiation of labour.

Normal labour is of spontaneous onset, the fetus presenting by the vertex, with no complications to the fetus, the outcome of the baby and the mother.

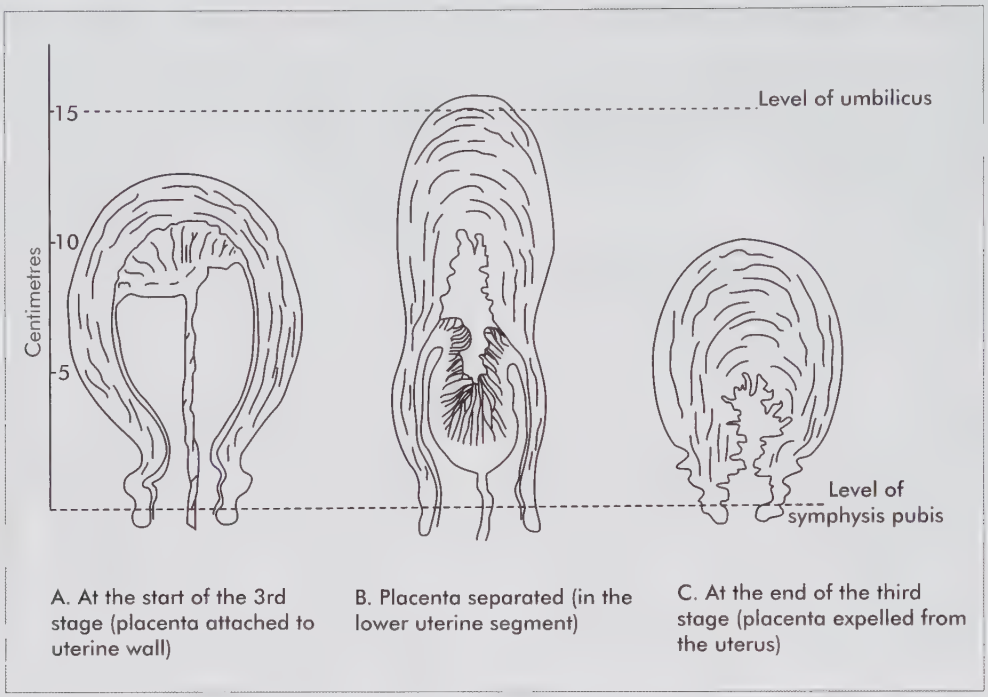


Figure 24.10 Separation of the placenta

Cervical dilatation during labour is partly determined by the type of contractions the woman experiences.

Notable physiological changes occur in the respiratory, gastrointestinal and cardiovascular systems during labour.

The mechanism of labour refers to a series of systematic movements the fetus must make as it passes through the pelvis and birth canal during the process of childbirth.

The duration of labour is determined by the type of powers (contractions), the passage (birth canal and its soft tissues), the passenger (the fetus) and the mother (psyche), e.g. previous labour experience in multipara or anxiety in primigravida.

24.4 Conclusion

Understanding the mechanism and physiology of labour contributes to reduction of complications related to childbirth. Knowledge of the normal mechanism of labour allows midwives and other skilled birth attendants to identify early any deviations from normal and take appropriate action as an abnormal mechanism can result in obstructed/prolonged labour due to large diameters of the presenting part. Knowledge of the physiology of labour also allows for appropriate interventions to be implemented, for instance the contractions have to be regular, rhythmic and increase in intensity as labour progresses to facilitate descent and dilatation of the cervix. In the absence of effective contractions labour can be augmented.

CHAPTER

25 Management and care during the first stage of labour

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- explain the role of the midwife during the first stage of labour
- explain the process of admission of the woman in labour
- explain the general care of the woman during labour
- explain the use of the partogram in the management of labour
- explain the management of the first stage of labour

KNOWLEDGE ASSUMED TO BE IN PLACE:

Physiology of labour
Mechanism of labour
Risk assessment

KEYWORDS

Presentation • Position • Descent • Dilatation • Moulding • Baseline variability • Better Birth Initiative

25.1 Introduction

Childbirth is considered to be a normal physiological process unless complications occur. However, complications can occur in 20% of cases, which may affect the mother, the fetus or both. The most serious complications are haemorrhage, cord prolapse, obstructed labour, fetal distress and prolonged labour. All pregnant women are advised to receive antenatal care during pregnancy and, with the assistance of midwives and other skilled attendants, identify potential problems, develop birth plans, which also indicate where they intend to deliver. Women may choose to give birth at home or in a clinic or hospital.

Women who are at risk should be encouraged to deliver in healthcare facilities that offer emergency obstetric care. These include women who are younger than 16 and older than 35, primigravida, grand multipara, women presenting with certain medical conditions, e.g. diabetes mellitus and cardiac diseases as well as any identified abnormal condition in the fetus such as multiple pregnancy and malpresentations, polyhydromnios or large infant (SPH (>40 cm). The HIV-positive woman's care is given in Chapter 52.

25.2 The role of the midwife during the first stage of labour

The midwife is the preferred skilled caregiver in obstetrics. The midwife gives the appropriate evidence-based technical care and creates a supportive environment for birth by listening to the woman's requests and needs. The midwife's attitude towards the woman is important as it may positively or negatively affect the outcome of labour. The outcomes and level of satisfaction of a natural and uncomplicated delivery will depend upon the care and support that the woman receives from the midwife during labour. Caring communication will give her confidence in herself. In this situation, labour is likely to progress well and last a shorter time. Fear, tension and anxiety are likely if the mother is shown an uncaring, even rude, attitude. Tension and anxiety are associated with prolonged

labour. Humane care creates choice, continuity of care, and autonomy, giving the woman control over the events. This means that a known caregiver listens, acknowledges and is in close proximity, at least 1 metre, from the labouring woman giving evidence-based care and psychological support.

25.3 Diagnosis and assessment of labour

The diagnosis of the first stage of labour is based on the signs and symptoms experienced by the mother and confirmed by findings obtained on vaginal examination. There are certain signs and symptoms, which collectively may suggest onset of labour. Some of the symptoms are presumptive, while the other symptoms are confirmatory. Spontaneous rupture of the membranes at any time during pregnancy is not useful as a diagnostic indicator of the onset of labour unless accompanied by, and considered together with, the presence of regular, rhythmic contractions, presence of show, and effacement and dilatation of the cervix. Contractions that are not regular in rhythm or duration are a presumptive symptom of labour.

Diagnostic (conclusive) signs of the start of the first stage of labour

The following are the diagnostic signs of the start of the first stage of labour:

- *Regular uterine contractions*. These are regular in frequency and duration, 10–12 rhythmic uterine contractions in 20 minutes. The contractions gradually become more frequent, increase in intensity and last longer. Occasionally the woman may complain of lower back pain. These symptoms are experienced by the mother and confirmed on abdominal examination.
- *Dilatation of the cervix*. The regular, rhythmic contractions are accompanied by cervical dilatation. Cervical dilatation is noted on vaginal examination and is measured in centimetres. In a primigravida, cervical effacement occurs first, while in a multipara cervical effacement occurs simultaneously with cervical dilatation.
- *Show present*. This is a thick mucoid, blood-stained vaginal discharge which becomes evident when the cervix starts dilating—the cervical plug, known as the operculum which formed during pregnancy, becomes dislodged. This is the mucus plug that has been protecting the fetus and the genital tract from ascending infection. Birth usually commences within 24 hours after the 'show'.

The midwife confirms the onset of labour by objectively assessing the events communicated by the woman (see Box 25.1). The midwife will examine the abdomen to assess the nature of contractions and perform a vaginal examination to assess the state of the cervix and cervical dilatation.

25.1 Signs of commencement of first stage of labour

- Regular, rhythmic uterine contractions
- Progressive dilatation of the cervix
- Show – a mucous vaginal discharge (not always present).

25.4 The admission of the woman in labour

The following women should be delivered in a facility that offers emergency obstetric care or where there are the means to transfer the woman urgently for emergency obstetric care when the need arises:

- the primigravida
- any woman presenting with risk factors who has not been seen by a medical practitioner prior to onset of labour
- the grand multipara
- any woman who has a bad obstetric history
- any identified risk factor in the woman or any abnormal condition of the fetus
- a woman younger than 16 or older than 35 years of age.

All these categories are considered to have high-risk pregnancies. All women attending an antenatal clinic should be screened for high-risk and risk conditions and relevant action taken.

A care plan for the admission of a woman in labour in hospital would include several factors which are discussed in detail below.

Welcome

The midwife's attitude is very important. The midwife should welcome the mother and give her a brief explanation of the activities which will take place to confirm whether she is in labour or not. The woman's expectations, desires and wishes are discussed and this information will assist with the planning of further management.

Assessments

The general status of the woman can provide information on her wellbeing. It is important that the midwife assesses the psychological, emotional and physical condition of the woman immediately. Listen to the way she answers any questions and

note her attitude. Observe her physical condition, height, gait, and size of feet, hands and any signs of a pendulous abdomen. Emotional instability may predispose the woman to puerperal psychosis while abnormalities of the spine and pelvis may affect the capacity of the pelvis to allow for normal delivery.

Observe for any signs of being undernourished, obese or very thin, including any signs of apparent dehydration. Note if she looks fresh or tired and ask how she has been sleeping lately, and in particular, what sleep she has had over the past 24 hours. Niggling, painful contractions can cause the woman to have disturbed sleep just prior to labour, and she may be very tired. Allow the woman time to talk or ask questions.

History

The woman should be seated in a comfortable chair during the history taking, but if she is experiencing severe labour pains, it may be necessary for her to lie on the admitting couch. She must be made comfortable with pillows and she must lie on her side whenever possible, to avoid the supine hypotensive syndrome. Privacy must be maintained all the time.

The antenatal notes are reviewed. If these are not available then take a full history. Refer to normal pregnancy on the history obtained on the initial antenatal visit (the booking history).

If the woman has the antenatal notes, these must be carefully studied and any abnormalities noted and recorded in the woman's notes, and/or on the partogram. Even if the antenatal notes are available, the past medical history, and the history of the present pregnancy are usually repeated and recorded on the labour notes and any problem or abnormality is highlighted. Note particularly age, parity, type of previous labour and any operative delivery, the outcome of previous pregnancy and any evidence of cephalopelvic disproportion, etc., maternal disease such as cardiac disease, diabetes mellitus, pregnancy-induced hypertension and/or anaemia. Specific attention is given to the last Hb count (after 36 weeks) and HIV status.

Carefully review the section in Chapter 17 on taking a history and follow the procedure outlined.

Obstetrical details of the present pregnancy and labour are very important and they must be carefully noted and recorded:

- *Reason for seeking admission*. Does she think she is in labour, or have her membranes ruptured, or is she not feeling well, etc.
- *Menstrual period*. Confirm the first day of the last menstrual period, in order to work out the estimated date of delivery (EDD).
- *Fetal movements*. Ask about the nature of the fetal movements. Is the amount of fetal movement the same as it has been throughout the pregnancy: are the fetal movements reduced, normal or excessive?
- *Uterine contractions*. At what time did they commence; when did they start to get stronger and more frequent; are they regular now, how often are they coming (frequency) and how long do they last (length); are they much stronger than at first (strength); do they cause discomfort or pain and where is the pain felt?
- *Membranes*. Have the membranes ruptured; what time did they rupture; did a lot of amniotic fluid come out; is there any amniotic fluid draining? If so, check the colour of the liquor.
- *Show*. Has there been a mucus and blood show; when did it start and how much bleeding was noticed?

While taking the history, listen carefully to what the woman has to say. Throughout the admission, the midwife must remember what she has been told and what her findings are and she must see whether they correspond. If they do not correspond, then she must make further investigations and if necessary inform a medical practitioner who may order further investigations to confirm the findings.

Written informed consent

Labour has an unpredictable outcome. In certain circumstances written informed consent should be obtained on admission in case of emergency intervention such as surgery or anaesthesia. Obtaining consent on admission depends on the policy of the institution, the age and the general condition of the patient.

Birth plan

All women are encouraged to have a birth plan, which is developed with the assistance of the midwife during pregnancy. The admission period provides an opportunity to review the birth plan which might be documented in the case notes or separately. The following issues need to be addressed or reviewed if discussed before:

- birth companion if the environment and the facility protocol allows
- ambulation
- position for delivery
- pain relief
- cutting the umbilical cord
- infant feeding after birth
- transfer to postnatal ward.

General examination and baseline observations

Throughout the admission maintain strict sepsis and ensure the privacy of a woman in labour. Cleanliness and strict aseptic and antiseptic measures must be observed. The observations and examination are particularly important for an accurate assessment of the progress of labour.

Carefully review the section on the physical examination in Chapter 17 and follow the procedures outlined.

The woman is asked to empty her bladder and a midstream specimen of urine obtained for urinalysis to exclude proteinuria and ketones. The observations and examinations are similar to those carried out at the first antenatal visit. Temperature, pulse, respirations and blood pressure should be checked and any deviations should be reported immediately or appropriate action taken immediately.

Abdominal examination

The abdominal examination is performed as during pregnancy and is discussed in detail in Chapter 17. In addition the midwife should note:

- engagement
- descent of the presenting part
- uterine contractions
- the fetal heart rate (auscultate for a full minute before, during and after a contraction to note any decelerations)
- response to uterine contractions: is she having discomfort or pain during contractions? Is she calm and relaxed and coping with pain or is she restless and obviously in great pain and distress? Is she in great pain and trying to hide this?

Vaginal examination

See also *Juta's Clinical Guide for Midwives*. Abdominal examination should always be performed prior to vaginal examination and the relevant equipment prepared. Vaginal examinations may be indicated during pregnancy, labour and the puerperium but should be kept to a minimum during labour to prevent ascending infection. Aseptic technique should be maintained when performing a vaginal examination, which should be carried out sensitively and in privacy. Verbal informed consent should always be obtained prior to the procedure.

The vulva and vagina should be inspected for ulceration, warts, varices, any perineal scarring, bleeding or draining liquor, while the cervix should be assessed for effacement (reduction in length) and dilatation. The cervix becomes gradually shorter in early labour; in primigravidae effacement occurs first prior to cervical dilatation whereas in multigravidae effacement occurs simultaneously with cervical dilatation. The cervix may be very thin making it difficult to feel and may be mistaken for full dilatation of the cervix.

The state of the membranes is assessed, whether ruptured or not, if ruptured assess the colour of the liquor. The presenting part is identified and the position determined as well as assessing the degree of moulding if the presentation is cephalic. The station of the presenting part in relation to the ischial spines is assessed. The midwife should assess the size and shape of the pelvic inlet, cavity and outlet noting the important landmarks (the promontory of the sacrum, the sacrospinous ligaments, the retropubic area, the subpubic angle and the intertuberous diameter). A decision should be made whether the pelvis is adequate or not.

25.2 Activity

Outline the activities carried out to assess the adequacy of the pelvis (pelvic assessment) during labour.

Auscultation

The fetal heart should be correctly and accurately auscultated to assess the condition of the fetus and obtain baseline data. The fetal heart should be monitored every 30 minutes (a baseline NST is done to determine the fetal status). If there are irregularities in the fetal heart rate the medical practitioner must be informed and appropriate interventions implemented. Any fetal distress must be noted and interventions to expedite delivery carried out. If the second stage of labour is imminent the baby is delivered. If problems are indentified then medical assistance is employed.

Records

All findings/information should be carefully recorded in the respective records in an accepted manner, and any abnormalities highlighted in red. All the abnormalities should be acted upon or reported to the medical practitioner for further management.

The care provider

If the woman is being attended to by a midwife, or in a satellite clinic, then the midwife may continue with the care of the woman if no abnormalities are found. If there is an abnormality, the midwife must immediately report the abnormality to a medical practitioner/obstetrician, or refer the woman to the nearest hospital. If the woman is being delivered in a hospital under the supervision of the hospital medical practitioner, a general practitioner or an obstetrician, then the medical

practitioner should now be informed that the woman has been admitted and be given a full report on the woman's condition.

When the admission process is complete the woman is shown to her bed or taken to the labour ward. This will depend on the place of delivery and how advanced the labour is on completion of the admission process. If at any time during the admission process delivery appears to be imminent, then the woman is immediately taken to the labour room to allow for a proper delivery.

25.5 Evidence-based, general principles of care during labour

(See BBI in Chapter 4). The admission of a woman in labour should only be undertaken by a qualified experienced midwife who is able to assess whether or not the birth is proceding normally and if not, refer appropriately.

Environment

The physical environment should be clean, warm, safe and supportive. Batho Pele dictates that caregivers' names must be given to patients. The woman must know who is taking responsibility for her care.

Companion in labour

If possible, the woman should have a chosen companion through labour. This may be her husband/partner, mother or other relative, or a friend. The midwife should explain everything to both the woman and her companion throughout the labour. This is not established in the public sector yet.

Privacy

If the environment permits, ideally the woman and her companion should be private. If the environment does not permit, an effort should be made to maintain privacy by not examining the woman in front of other carers and explain the presence of any other people who may be present. Avoid too many people entering and leaving the room as this may cause or increase stress in the woman. These aspects have a negative impact on quality care.

Prevention of infection

During labour, it is essential that every precaution is taken to prevent the occurrence of infection irrespective of the place of birth. In the hospital there is risk of nosocomial infection, while in the woman's own home there is the risk of community-acquired infection. Interventions during labour provide possible vehicles for infection and should be kept to a minimum and performed using full aseptic technique. Vaginal examinations should only be performed when absolutely necessary and with sterile equipment.

If the midwife is suffering from any infection, she must not attend a woman in labour, but must make other arrangements for the woman's confinement. In HIV-positive women vaginal examinations are avoided.

Position and mobility

During the early first stage of labour, the woman may be ambulant if not contraindicated or if membranes are intact to allow for descent of the presenting part and also to relieve the intensity of pain when the woman's focus is diverted. She may even have a shower or bath. She can sit or lie in any comfortable position except supine. The various positions that women can adopt in the different stages of labour will be discussed in a separate section.

Intake of food

The process of labour depletes the individual's energy resources. Hence all low-risk cases of normal labour should not have any restrictions on oral intake and oral fluids and light meals are allowed. Women with high-risk pregnancies should have oral intake restricted in case they require surgical interventions in which case an intravenous infusion may be needed.

25.3 Food intake in labour

Oral fluids and light meals should be allowed in low-risk pregnancies during labour.

Women with high-risk pregnancies should have oral intake restricted in case they require surgical interventions.

In case of mild dehydration, sips of fluids may be permitted.

Care of the bladder

A full bladder impedes the descent of the fetus and contributes to uterine inertia. During the second stage of labour a full bladder may contribute to delayed second stage of labour. The woman should be encouraged to empty her bladder every two to three hours. All urine passed should be measured, tested for glucose, protein and acetone and any abnormalities reported and all findings should be documented. If the woman fails to pass urine but has a full bladder all midwifery measures should be instituted to assist her and if that fails then a catheter should be inserted using aseptic technique.

Care of the bowels

Enemas are no longer used routinely in labour. However, a full rectum can interfere with the descent of the presenting part.

Comfort measures

Pain during labour and birth can be caused by both physical and emotional factors. Various methods can be used to relieve pain, ranging from natural methods to the use of opiates or epidural. Pain relief methods will be discussed in more detail later in this section (see Chapter 26).

Monitoring the progress of labour

The progress of labour is monitored using the partogram (see Figure 25.1). A partogram is a graphical record of the observations made of the progress of labour as well as the condition of the mother and fetus. The record of labour is a legal document and observations must be accurately recorded as soon as any event has occurred. An accurate record of the early stages of labour provides a basis for making objective decisions as labour progresses or fails to progress. Use of the partogram is associated with reduction in frequency of prolonged labour, augmented labour, postpartum haemorrhage, ruptured uterus, puerperal sepsis, perinatal and maternal morbidity and mortality.

25.6 The partogram

(See *Juta's Clinical Guide for Midwives*.) The partogram, also called partograph or cervicograph, has been widely accepted as a tool to monitor progress of labour. In under-resourced settings, the partogram serves as a simple and inexpensive tool to monitor labour in a cost-effective way. The chart is designed for recordings at 30 minute intervals, although the time may vary with institutions or local protocol. There are three main sections: the section for recording fetal condition (fetal heart rate, moulding in cephalic presentation and colour of liquor), the section for recording progress of labour (effacement and dilatation of the cervix, descent, flexion, rotation and presentation) and the section for recording maternal condition (vital signs, urinary output or vomitus, contractions). The advantages of using the partogram include:

- reduces complications from prolonged labour and obstructed labour for the mother (postpartum haemorrhage, sepsis, uterine rupture and its sequelae) and for the newborn (anoxia, infections and death)
- provides information at a glance to assess progress of labour
- reduces maternal mortality and morbidity caused by obstructed labour
- reduces the occurance of prolonged labour, augmentation of labour and caesarean sections
- can help health personnel working in peripheral centres make referral decisions.

The principles for the use of the partogram include:

- The latent phase of labour should not last more than eight hours.
- The active phase of labour starts when the cervix is 4 cm dilated.
- During the active phase of labour the cervix should dilate at least 1 cm per hour.
- The duration between vaginal examinations should be at least four hours. The duration may vary with health facilities, with some facilities allowing four hours during the latent phase and two hours during the active phase.

25.4 Partogram and black women's labour

Phillpot and Castel (1972) found that black women arrive late for admission. On the partogram the time of admission is noted as Zero, because their dilatation rate is twice as long as other women although their second stage is shorter and quicker (Intrapartum care in SA, MRC 2005).

Key legal considerations when using the partogram

All skilled attendants are responsible for their own acts of omission and commission. Obligations include:

- correct and comprehensive recordings
- identifying abnormalities in recordings
- interpreting findings correctly
- identifying warning signs of abnormalities and preventing further development of these abnormalities
- acting on abnormalities in recordings
- timely referral of women in case of abnormalities.

Assessment of the fetal condition

The fetal section is the part used to monitor and assess fetal condition during labour. The fetal heart rate, state of membranes and colour of liquor if membranes have ruptured and moulding of the fetal skull bones are used to assess the condition of the fetus during labour.

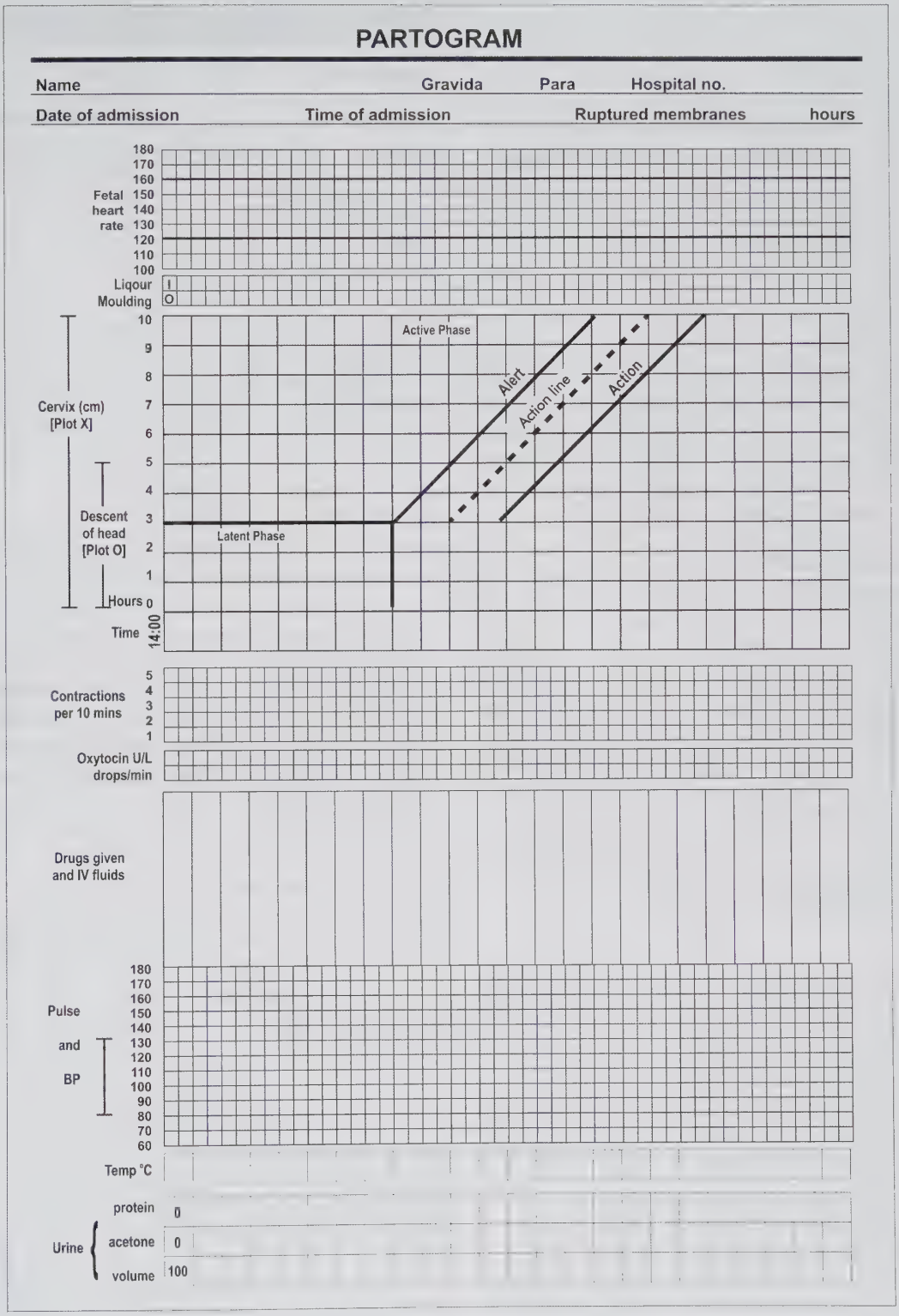


Figure 25.1 A blank partogram

The baseline fetal heart must be recorded including any decelerations which may be present. The decelerations should be indicated whether they are early or late.

The fetal heart should be checked and recorded every 30 minutes. The fetal heart should be checked before, during and after a contraction over a full minute. The fetal heart rate is checked on auscultation and the normal fetal heart rate should range between 110–160 beats per minute (bpm). The rate should not be decelerating with a contraction. If the rate is above 160 bpm it is graded as tachycardia, and less than 110 bpm is graded as bradycardia, and below 100 bpm as severe bradycardia. Continuous fetal heart monitoring can be done using a fetal and maternal cardiotocograph (CTG). In this case the fetal heart is monitored in response to the uterine contractions and provides a graphic record of the response of the fetus to the uterine contractions. Fetal distress can be diagnosed early if a CTG is used to monitor the fetal heart rate. A beat-to-beat on a cardiotocograph tracing of 10 bpm is considered normal (see Figure 17.20).

Monitoring fetal condition

Various methods can be used to assess fetal condition during labour. These include intermittent auscultation using a pinnard (fetoscope) which is a fetal stethoscope or a sonicaid. The fetal heart should be monitored over a full minute. Any abnormal variations should be noted. Continuous fetal heart monitoring can be done using a cardiotocograph apparatus (CTG). This method allows for monitoring the fetal heart in relation to maternal uterine contractions and provides a graphic record (cardiotocography).The response of the fetus to the contractions will be noted. Fetal monitoring will be discussed fully under management of the first stage of labour. (See also *Juta's Clinical Guide for Midwives*.)

Moulding

Moulding is the term used to describe the overriding of the fetal skull bones during labour in a cephalic presentation. The changes take place in the shape of the fetal head as the fetus passes through the birth canal. The change in shape is made possible by the bones of the vault as they override at the sutures thereby reducing the size of the presenting diameters and the diameter at right angles to them lengthens. Moulding (as long as it is not excessive or rapid or in an unfavourable direction) protects the brain from compression. Increasing or excessive moulding with the head high in the pelvis is a warning sign of cephalopelvic disproportion. The bones that overlap are the occipital over parietal and the parietal over parietal (see Table 25.1). The ability to mould is diminished after 40 weeks (see Figure 8.11).

Table 25.1

Assessment of moulding during labour

Description	Degree of moulding
Bones are separated and sutures are felt easily	0 (there is no moulding)
Bones are just touching each other	+
Bones are overlapping but reducible when digital pressure is applied	+ +
Bones are overlapping and non–reducible with digital pressure	+ + +

Membranes and liquor

It is important to record whether the membranes have ruptured or not. Early rupture of membranes exposes both the woman and the fetus to infection, so it is important to indicate the time that the membranes ruptured, particularly in HIV-positive woman. This will help the midwife to decide whether the mother should be put on prophylactic antibiotics or not. If membranes are intact the information is recorded as an 'I' on the partogram and if membranes have ruptured indicate the colour of liquor with the first letter that described that colour, for example 'M' for meconium stained liquor or 'C' for clear liquor.

Progress of labour

The progress of labour is determined by cervical dilatation, the level of descent of the presenting part, the fetal position and uterine contractions.

The cervicograph

The progress of labour is recorded on the middle part of the partogram and this section is referred to as the cervicograph and is defined as a graph of cervical dilatation marked against time. It is divided into the latent phase and active phase of labour (see Chapter 24). The latent phase lasts from 0–8 hours while the active phase starts from eight hours and may last up to 10 hours, depending on parity. The descent of the presenting part is documented on the cervicograph in fifths if the presentation is cephalic. Descent can also be related to cervical dilatation when assessing progress of labour (see Figure 25.2).

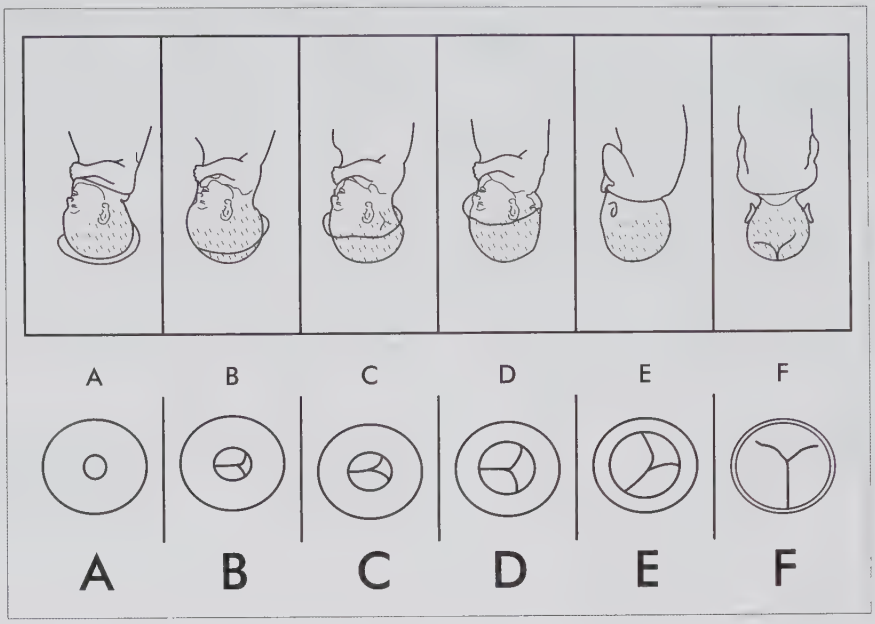


Figure 25.2 Descent of the presenting part showing the suture lines and posterior fontanelle determining the position in an anterior position

Vaginal examination

Cervical dilatation is checked every four hours and the cervix should dilate by between 1–1.5 cm per hour in the active phase depending on parity. The cervix dilates from 0–10 cm and is considered fully dilated at 10 cm. A primigravida dilates 1cm/hr in the active phase. The nature of contractions and the degree of application of the presenting part to the cervix has an effect on the rate at which the cervix dilates (see Chapter 8).

Assessment of maternal condition

Maternal condition is assessed based on the nature of contractions, vital signs, hydration, urinary output, her emotional stamina and response to labour.

Contractions

The contractions are monitored abdominally and classified as mild, moderate and severe. Mild contractions last 20 seconds or less and are plotted with faint dots on the partogram. Moderate contractions last more than 20 seconds up to 35 seconds and strong contractions last more than 35 seconds and not more than 60 seconds. Moderate contractions are plotted as light shaded lines while strong contractions are plotted as dark shaded areas on the partogram (see Figure 25.3). When contractions last more than 60 seconds they are referred to as hypertonic uterine contractions and may cause maternal and fetal distress and sometimes contribute to rupture of the uterus (see Chapter 8). If substances are used to stimulate the uterus they need to be revised immediately.

Administration of drugs

Any drugs administered to the mother during labour should be recorded on the partogram, including any drugs for induction of labour or pain relief.

Vital signs

The temperature is checked every four hours or according to local protocol. The temperature should remain normal. Pyrexia may indicate infection, especially in the presence of premature rupture of membranes or ketosis or maternal dehydration. There may be a slight increase in temperature with an epidural anaesthetic. Pulse is recorded every 30 minutes and is expected to remain normal. Tachycardia may be associated with anxiety, infection, pain, haemorrhage or a reaction to medication. Blood pressure is checked every hour and is expected to remain normal in the absence of essential hypertension or pregnancy-induced hypertension. A supine position may induce hypotension.

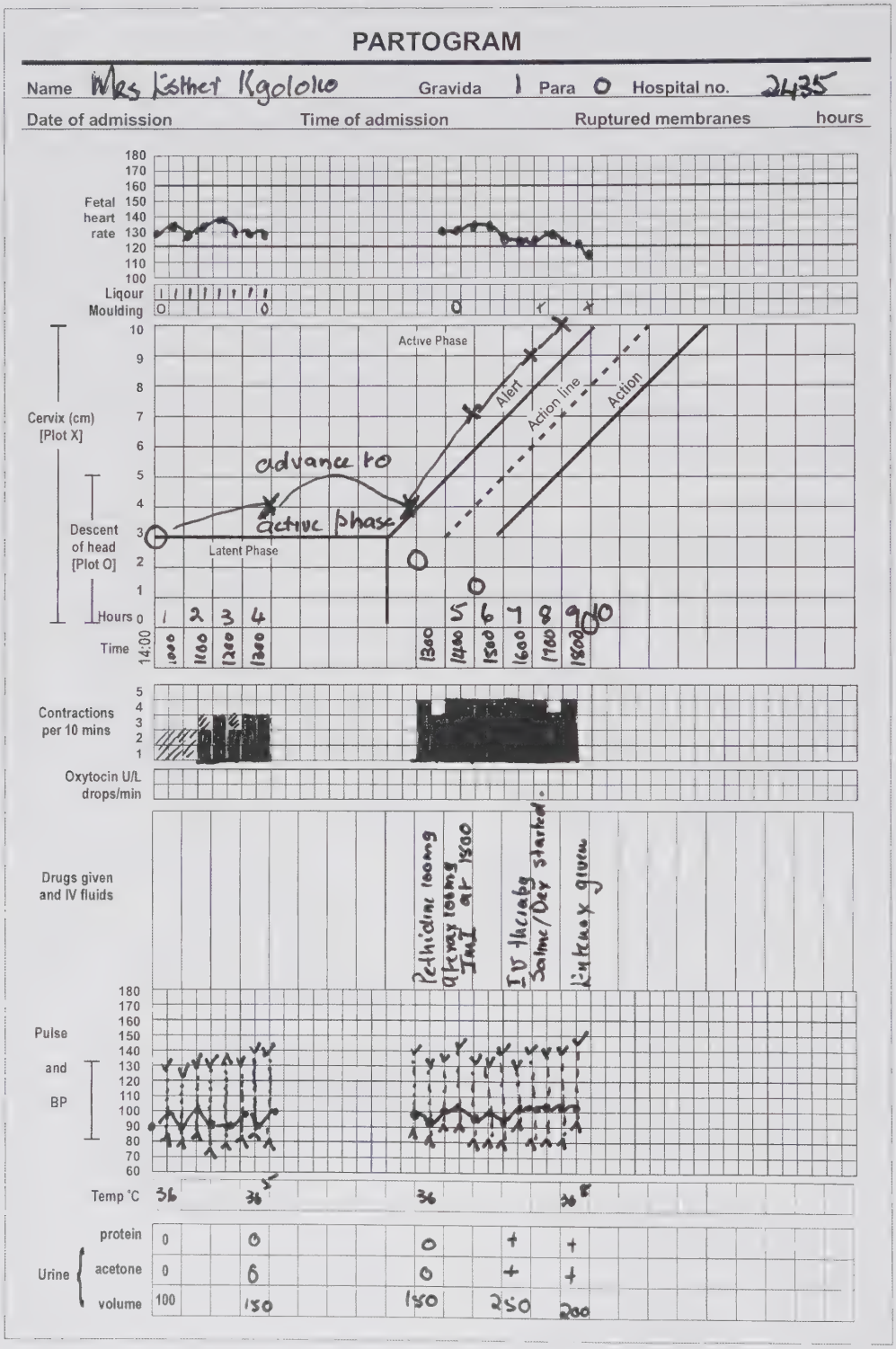


Figure 25.3 Filled in partogram

Urinalysis

The woman should be advised to empty the bladder every hour as a full bladder can interfere with progress of labour (see Box 25.5). If she fails to pass urine and the bladder is full, a once-off catheter should be inserted. All urine passed should be recorded and tested for glucose, proteins and ketones. Ketones may be a sign of maternal distress or starvation if the woman has been in labour for some time without having adequate nutrition. A trace of protein may be a sign of infection or contamination by amniotic fluid if membranes have ruptured. Also exclude pre-eclampsia in the presence of significant proteinuria.

25.5 Points to note

A full bladder is associated with:

- delay in descent of the presenting part during the first stage of labour
- prolonged second stage of labour
- uterine atony after delivery of the baby, causing postpartum haemorrhage.

Main points

If local policy allows and the infrastructure provides for privacy the woman should be allowed to have a companion of her choice during labour.

During the early first stage of labour and in the absence of risk factors or other complications, the woman can be allowed to be ambulant as this facilitates progress of labour and promotes descent.

Contractions start weak (lasting 20 seconds or less), become moderate (lasting more than 20 seconds but less than 35 seconds) and gradually become stronger, lasting more than 35 seconds and up to 60 seconds.

Hypertonic uterine contractions last more than 60 seconds and can cause fetal hypoxia and uterine rupture.

Fundal dominance allows the cervix to dilate progressively as the upper uterine segment contracts and retracts and the fetus is pushed down the birth canal.

Polarity allows for synchrony between the upper and lower uterine segments as the upper uterine segment contracts and retracts while the lower uterine segment contracts and dilates. This results in formation of the physiological retraction ring, i.e. the formation of the thicker upper segment and a thinner lower segment, pulling it over the presenting part.

Increased flexion occurs as a result of fetal axis pressure on the pelvic floor and is more pronounced during the second stage of labour.

An exaggerated retraction ring is found in obstructed labour and is called a Bandl's ring or the pathological retraction ring. If membranes remain intact during the process of labour, there is generalised pressure but when membranes rupture uterine hypoxia may occur when the placenta is compressed between the uterine wall and the fetus.

In the absence of risk factors the woman is allowed to eat during labour because the process of labour utilises a lot of energy. In the absence of sufficient carbohydrates during labour, body fats will be utilised and ketoacidosis may develop. Food intake during labour depends on the policy of the institution.

Monitoring the fetal heart using a CTG allows the midwife to record the response of the fetal heart rate to the uterine activity.

25.7 Conclusion

Having a companion in labour and effective communication with the woman during labour is associated with less anxiety, less labour pain and reduced interventions during childbirth. Labour progresses well in the presence of good uterine contractions, progressive descent of the presenting part as well as progressive dilatation of the cervix. The role of the midwife is to ensure that both maternal and fetal condition remain stable throughout labour (see Chapter 26 for comfort and pain control).

CHAPTER

26 Pain management and comfort in labour

LEARNING OUTCOMES

On completion of this unit the learner must be able to:

- explain the role of the midwife in helping women in labour feel comfortable and reduce and manage pain
- explain the non-pharmacological methods that can be applied to relieve pain in labour
- describe the drugs used to relieve pain in labour.

KNOWLEGE ASSUMED TO BE IN PLACE

Physiology and psychology of pain.
Non-pharmacological and pharmacological pain management

KEY WORDS

Pain perception • Pain pathways • Pharmacological • Non-pharmacological

26.1 Introduction

One of a pregnant women's greatest concerns is the pain that she will experience during labour and whether or not she will be able to cope with it. Expectations of pain in primigravidae depend on reports from others and previous experience in women who have already given birth. Factors that will influence a woman's experience are the intensity of labour pain, the length of time that labour lasts, the environment in which she gives birth, and the support that she receives from her companion and/or caregiver.

Each woman's labour is unique. Some women need little or no pain relief, and others find that pain relief gives them better control over their labour and delivery.

26.2 The psychology and physiology of pain

Psychological factors of pain in labour

The components which determine an individual's reaction to pain are not fully understood. Much seems to depend upon what is known as *the pain threshold*. Each individual has her own pain threshold, and this will also vary according to the individual's psychological and physical state at a given time. A low pain threshold means that pain is experienced when the person is subjected to relatively light and/or small amounts of stimuli, while a high pain threshold indicates that pain is only experienced with relatively stronger and/or greater amounts of stimuli.

Cultural, religious and family backgrounds are also factors in setting the pain threshold in individuals. Factors that may lower the pain threshold include worry, anxiety, insecurity, fear, ignorance, fatigue, intense heat or cold, poor general physical condition, malnutrition and starvation, dehydration, continuous pain, or severe pain experienced over an extended period, either intermittent or continuous, such as in hypertonic uterine action or prolonged labour.

Factors that can raise the pain threshold may be divided into the emotional, psychological and physical factors, which are all aspects of the woman's make-up, and/or the introduction of an outside substance such as an analgesic.

Physiological causes of pain in labour

Pain during labour is related to contraction of the uterus. In normal labour the pain is intermittent. It starts as the uterus contracts, becomes more severe as the contraction reaches its peak and disappears when the uterus relaxes. Pain is usually only experienced by the woman in labour when the intra-amniotic pressure reaches 20–25 mmHg. Pain might

manifest itself as cramping in the abdomen, groin and back. Sometimes women even experience pain in their sides or thighs as well.

Other causes of pain might include pressure on the bladder and bowels by the baby's head, stretching of the lower segment of the uterus and vagina, and pressure on the nerve ganglia in and around the uterus. The nature of labour pain has been described as cramping, burning, sharp, excruciating, throbbing and similar to dysmenorrhea but much worse.

The degree of pain varies in different women, in the same woman during succeeding labours, at different stages in the same labour and in a small proportion of women the contractions are painless. With the increased intensity, duration and frequency of the uterine contractions, the pain experienced during labour is possibly due to:

- the distension of the lower pole of the uterus during contractions, particularly the dilatation of the cervix
- the stretching of the ligaments adjacent to the uterus and other adjacent issue
- pressure on or stretching of the nerve ganglia around the lower part of the uterus and pressure on the bladder and the rectum
- contraction of the muscle while it is in a relatively ischaemic state (similar to angina pectoris). Adequate amounts of blood do not get to the uterine muscles and they become anoxic. This occurs especially when (see Figure 26.1):
  - the uterine tone is too high: either at the peak of contractions or generally
  - the contractions are too frequent
  - the contractions last too long.

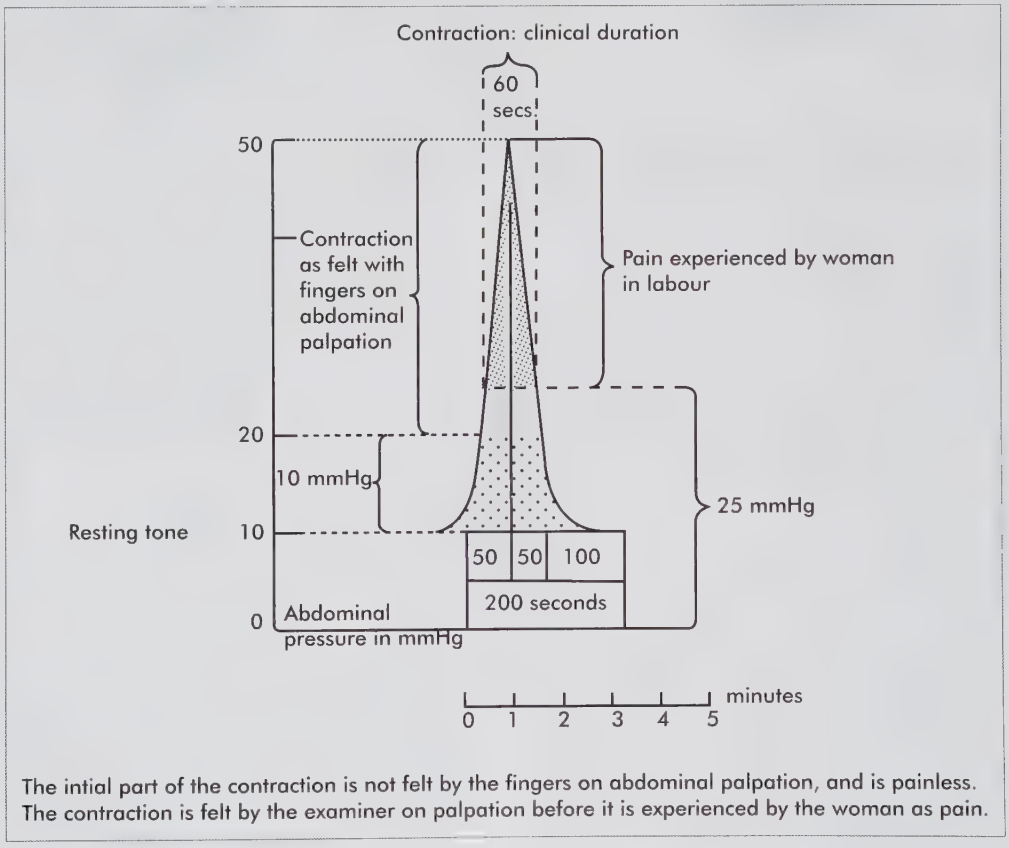


Figure 26.1 Pain as experienced during a uterine contraction in established labour
Redrawn from: Llewellyn-Jones, D. 1982. *Fundamentals of Obstetrics & Gynaecology*. Vol I: *Obstetrics*. London: Faber & Faber

Pain in the lower abdomen

Pain in the lower abdomen seems to be related to the activity in the upper uterine segment and is present when labour is progressing well (see Figure 26.2).

Pain in the back

Pain in the back is related to tension in the lower uterine segment and the cervix (Figure 26.2). In normal labour, slight back pain may be experienced only at the start of a contraction, in the early stages of cervical dilatation. However, backache is common in posterior positions of the vertex, and is severe when there is incoordinate uterine action, particularly when the cervix is abnormally resistant. In general, the less backache, the more efficient the uterus, but primigravidae tend to have more back pain than do multiparae.

Dystocia

Dystocia means difficult and painful labour and can be due to faults in:

- the passenger
- the passages
- the powers.

There may also be a combination of one or more of these factors, including the psychological make-up and outlook of the woman.

The duration of labour

Under normal circumstances, a woman is able to successfully deal with pain for up to six hours. However, after six hours, the pain becomes progressively less bearable. Therefore, in normal circumstances, because the first labour is likely to be almost twice as long as any subsequent labours, with greater discomfort and pain, primigravidae are much more likely to require pain relief using analgesics than are multigravidae.

Analgesia should be given:

- When there is severe unrelieved pain, for whatever reason. It is essential that the pain should be relieved before maternal and/or fetal distress become evident.
- In prolonged labour: usually brought about by abnormal conditions of the powers and/or the passages and/or the passenger (for example, posterior positions of the vertex in primigravidae, especially persistent occipitoposterior positions, incoordinate uterine action, cephalopelvic disproportion, large babies, abnormal lies of the fetus, abnormalities of the fetus).
- If labour has to be induced or augmented, because the contractions brought about by the administration of oxytocics are generally considered to be more painful than the contractions of spontaneous labour.
- In assisted deliveries such as forceps and vacuum deliveries.
- For the incision and suturing of the perineum.
- During manipulative procedures such as internal versions; manual removal of the placenta and so on.

26.3 Theories of pain relief during labour

The endorphin system theory

Endorphins (endogenous opiates) are natural opiate-like substances, similar to morphine and heroin, but not as potent. Endorphins are manufactured by our bodies in the presence of pain and act as a natural analgesic. When we feel a certain level of pain, the brain stem and pituitary gland release endorphins.

The endorphins act by travelling to the opiate receptors, where they fit like a key in a lock and block the transmission of the pain impulse. The levels of endorphin are much higher in women in labour than in women who are not in labour.

This local release of endorphins stops some of the pain messages reaching the brain, decreasing the person's sense of discomfort.

Endorphins are the main reason that women in strong labour look 'sleepy', and often feel relaxed and drowsy. Endorphins can provide internal protection against the intensity of labour and giving birth. Some women even experience an amnaesic affect (forgetting the pain) after birth.

However, when the woman in labour feels that her or the unborn baby's life is in danger, her body releases adrenalin to trigger the 'fight or flight' response, which in turn causes the endorphin levels to decrease.

The gate control theory

The gate control theory was first proposed by Melzack and Wall (1965). The theory has undergone several refinements and it remains one of the best ways of understanding pain perception. The neural fibres that transmit pain are thin in comparison with those that transmit other sensations such as touch, heat and cold. Therefore when the larger A-beta skin nerves (that sense touch, heat, cold and pressure) are stimulated, they are capable of overriding the smaller A-delta and C-fibres that sense sharp, burning or aching pains. The larger nerve fibres carry the sensory message to the spinal cord more rapidly and get priority, shutting 'the gate', to the pain messages being carried by the smaller fibres.

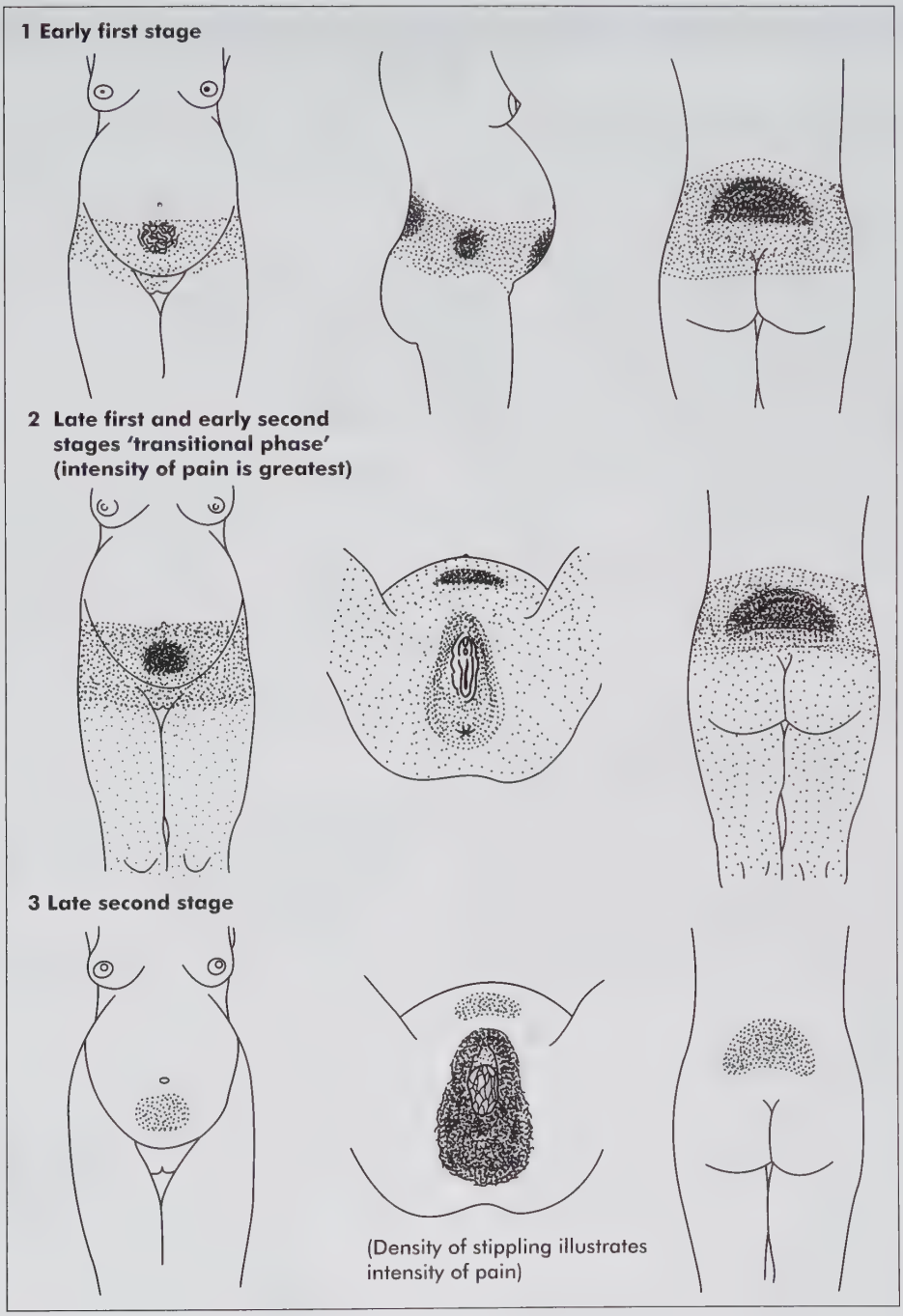


Figure 26.2 The distribution of pain in the various stages of labour
Redrawn from: Beischer, NA. & Mackay, EV. 1981. *Obstetrics and the Newborn*, 2 ed. London: Bailliere Tindall

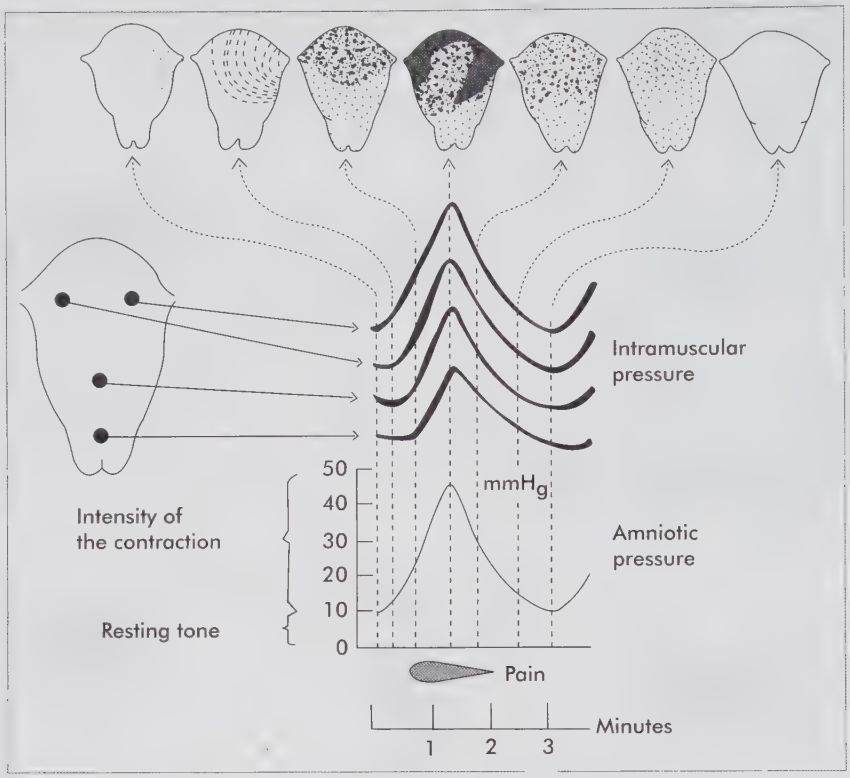


Figure 26.3 Normal labour pain
Source: Sellers, P.M. *Midwifery* 1993. Cape Town: Juta & Co

If the pain intensifies to a higher level the gate is pushed open, increasing the sensation of pain. This usually happens as the woman reaches the transitional phase of the first stage, just before it is time to push.

This is the reasoning behind our natural instinct to rub or massage our bodies when we hurt ourselves. It is also the reason why therapies such as massage, cold or heat packs can change or modify the pain of labour.

Other ways to stimulate the gate control is by changing position, walking, standing, hugging, rolling the hips, pelvic rocks; all these activate receptors in the woman's joints to help reduce the pain.

Cognitive control theory

The descending inhibitory pathways can be enhanced by the following strategies:

- The woman replaces feelings of anxiety and fear of pain with knowledge of childbirth, which includes reading, education, acting out different scenarios of births, looking at informative videos, and building a trusting relationship with her care provider.
- Controlling mind and body activity with relaxation, music, and self-hypnosis.
- Modifying the woman's reaction to pain through techniques such as conscious release, attention focusing, guided imagery, distraction or physical activity.

Factors that influence a woman's perception of pain during labour:

- Labour pain is more than a physiological process.
- Coping with labour pain is emotional and complex and results in feelings of fulfillment and achievement for women.

26.4 Methods used to relieve pain in labour

The three main factors that contribute to pain relief in labour may be taken separately, but should the need arise the greatest effect is obtained when they are combined:

- The personal attention that the woman in labour should receive is undoubtedly the first and most important consideration in the reduction of pain.

Table 26.1

Factors that influence a woman's perception of pain during labour

Factors that would have a positive influence	Factors that would have a negative influence
Education and information during pregnancy reduce anxiety	Physical abuse such as pinching or slapping
Self-help skills to cope better with pain, i.e. position change, relaxation techniques, music, etc	Uncomfortable environment, such as wet or soiled linen on bed, room temperature too hot or too cold
Informed decision making, the woman feels she is in control and she fully understands all the options	Emotional abuse, i.e. ignore the patient when she asks for support, or shouting and blaming the patient
Privacy	Sense of isolation and helplessness
Confidentiality and respect	Feeling unsafe, no reassurance is given
Encouragement from the caregiver, i.e. every pain is nearer to the end, etc.	Anger when her expectations were not met, i.e. poor progress, she failed to cope with pains, etc
Feeling safe and secure, the caregiver displays her skills and knowledge and explains all procedures or interventions as well as the progress in labour with the patient	Being hungry and thirsty, and not allowed to take refreshments
The presence of a professional support person (doula) in labour has been shown to be a significant help to labouring women in managing their pain. Emotional and physical support might also be given by a support person of the patient's choice	Long labour and overwhelming pain, without anyone to help
Administer analgesia on request of the patient before she reaches the stage where she loses control	Factors such as young maternal age, first baby, use of oxytocin to induce or augment labour and a history of dysmenorrhoea are associated with increased labour pain
Factors such as attending childbirth education classes, or reading about pregnancy, and regular aerobic exercise during pregnancy are associated with decreased pain in labour	A key attribute on both the part of the patient and the caregiver and supporters should be flexibility, since the character of labour is an unknown factor, i.e. the woman might initially say she doesn't want any drugs for pain relief but might change her mind in 1–2 hours time. She needs to understand this and shouldn't feel that she failed to cope without pain relief

- A holistic approach to labour by the woman and her family is recognised as one of the best ways to reduce the pain and anxiety around labour.
- Finally, it may be necessary to use medication for the relief of pain in labour, particularly in first labours and for complications in labour.

Pain rating scales are important in clinical practice because:

- They can be used to identify and express levels of pain and responses to prescribed treatments.
- Appropriate assessment and documentation of pain experiences could improve pain control.
- There are different kinds of pain questionnaires that measure the type of pain, the intensity, its duration, and precipitating or relieving factors.
- The scoring method acknowledges sensory, affective and evaluative components of pain.

Four commonly used unidimentional scales are the visual analogue scale, the numerical rating scale, the verbal rating scale and the pain faces rating scale:

- Visual analogue scales are highly sensitive to changes in pain levels experienced by patients, which can make it difficult to use.
- Numerical rating scales are easy to understand and simple to use. It is also not difficult for the midwife to explain to the patient how to use the tool, to score and to document results.
- Verbal rating scales are dependent on a person's interpretation and understanding of the descriptive terms,

and thus lack the sensitivity and perhaps the accuracy of other rating scales.

- The pain faces rating scale was initially designed for use with children, but is well accepted by patients with learning difficulties or language barriers. Six faces are shown, ranging from a happy, smiley face to a sad and crying face.

Good communication skills are essential and can help the patient's confidence and help her to relax. It is important to note that verbal expressions, such as sighing, grimacing and crying, and non-verbal clues such as guarding, may not always be exhibited by a person in pain. Introduce the patient to the assessment tool used and explain the reasons for its use. The assessment tool should not be hurried and the patient should not feel rushed, she should be given time to think and respond to the questions being asked.

Preparation for childbirth

This includes emotional, psychological and physical antenatal preparation (psychoprophylaxis).

Perhaps the most important aspect in dealing with pain in labour is the personal attention that is given to the woman, and every expectant mother should be guaranteed continuous personal attention throughout labour. No woman should ever be left alone at any time during labour.

Antenatal preparation is now offered in many forms and it is essential that neither the midwife nor the medical practitioner do or say anything to destroy the woman's faith in her chosen regime, even if they themselves are not enthusiastic about the method. However, it must be a recognised regime, which in no way compromises the health of the mother or the fetus.

Antenatal preparation includes gaining the woman's attention and her faith in the method. It includes classes on motherhood and fathering, and classes that prepare the woman and her partner for labour, teaching relaxation, breathing, focused concentration, distraction, bearing-down, good posture and other exercises, all of which help to raise the woman's pain threshold.

However, it is also most important to avoid making a promise of painless labour to any pregnant woman, because if she then does experience pain, she will immediately lose faith in the regime. It is far better to tell the woman that the regime is aimed at making pain in labour 'bearable'. In this way, a large proportion of women will receive a most valuable reduction in the amount of pain they experience during labour.

Different ideas and/or methods for the relief of pain, which can be incorporated into antenatal preparation or which can be used during labour, other than the administration of drugs (analgesics and anaesthetics) are considered below.

Natural childbirth or childbirth without fear

Dr Grantly Dick-Read's classical ideas, although considered outdated now, remain the basis for the emotional, psychological and physical antenatal preparation taught today. His concept is that normal labour need not be painful, and that the cause of the pain is the fear-tension-pain syndrome.

Natural childbirth is a fearless, trained, relaxed, easier, satisfying childbirth especially if a mother is helped to give birth to her baby consciously without too much discomfort, instead of 'being delivered' while unconscious.

Natural childbirth is not necessarily painless childbirth or an endurance test. Anaesthesia is used if needed or wanted. Natural childbirth is not a failure if an anaesthetic is used or the birth assisted. Natural childbirth is not a step backward or a denial of the importance of the medical practitioner for physical care during pregnancy and labour, but a belief that psychological care is also important.

Natural childbirth is not hypnosis or connected with 'birth control' or 'planned parenthood'. It is not a cult, nor does it have any religious, political or racial affiliation or bias.

La Leche League of Franklin Park

The principle of natural childbirth is that childbirth is a normal bodily function, and should cause bearable discomfort in a woman in labour (who has the cooperation and encouragement of her husband or significant person). It includes:

- a fearless and loving woman, healthy in mind and body
- birth in a safe environment to welcome a baby for the great event of birth
- understanding what is happening to her and to her baby during the process
- knowing how to relax during labour when this is needed
- knowing how to work with the forces of labour when this is needed
- support and encouragement from those who attend to her in labour.

Psychoprophylaxis — Lamaze

The concept of psychoprophylaxis, developed in France by Lamaze and Vellay, has the conditioned reflex as its basis. These men believed that most women have been conditioned by their social environments to accept that labour is painful.

Psychoprophylaxis focuses on deconditioning women out of the belief that uterine contractions are painful, and this is then followed by reconditioning to the idea that uterine

contractions are a normal process and that the pain can be managed.

In their regime, great emphasis is placed on active participation by the woman and her partner. It is based on the principles of establishing new conditioned reflexes and performing mental and physical activities with the intention of raising the pain threshold.

The specific aims during labour are to achieve the maximum amount of work with the minimum amount of effort, to conserve energy and to raise the pain threshold. To achieve these aims, the conditioned reflex is used for two basic techniques: namely selective relaxation, which is learning to relax each part of the body separately and together, and controlled conscious breathing, which acts mainly as a distraction from pain. (Hyperventilation or over-breathing is not taught and must be guarded against, because this may cause arterial carbon dioxide levels to fall and may result in a reduction in the placental bloodflow, causing fetal hypoxia. Over-breathing may also precipitate maternal tetany.)

Alternative non-invasive methods of relieving pain in labour

Birthing rooms

The concept of birthing rooms has become very popular in some centres. In birthing rooms or birthing centres, the surroundings are adapted to resemble a home, with a normal bed, easychairs and home-type furnishings. The husband/partner and any other chosen attendant may be present and even children/siblings may also be present, depending upon the woman's wishes. The woman is acquainted with the midwife and the medical practitioner who are to attend her during the birth. In the ideal situation, they have attended her throughout her pregnancy, and will attend her in the puerperium.

Aseptic measures must be scrupulously applied. Adjacent to the birthing room, there must be an emergency ward to cope with any complication that could arise during the birth.

After the birth, when both the mother and the baby have been examined and are in a satisfactory condition, the woman may go home. She will be attended daily at home by the midwife until both she and the baby no longer need this supervision (one to two weeks). This type of confinement is very beneficial to the promotion of breastfeeding.

Leboyer milieu

The Leboyer concept of 'birth without violence', is based on an increased awareness and understanding of the wishes and needs of the mother and child. This approach promotes a peaceful and serene atmosphere or milieu for the birth of the baby. Leboyer advocated delivery in a quiet, semi-darkened room on an ordinary bed in surroundings that are familiar to the mother. In other words, the opposite of the typical hospital labour ward with noise and loud talking, bright lights, strong hospital smells, stark white surroundings, high surgical beds, instruments and machines.

Underwater delivery

Leboyer's ideas on non-violent birth have been taken further by the Russian Travkovsky, who advocates that underwater delivery is less damaging to the mother and to the baby's brain. In some birthing centres and hospitals, the woman can sit in a special bath with warm water, and this seems to help relieve the pain of the contractions. However, underwater births are only undertaken in specially screened women, attended by specially trained staff. This is a highly specialised management, which, if undertaken lightly, could be very dangerous to both the mother and the baby.

Hypnosis

Hypnosis may be induced by a hypnotist or the woman may practise self-hypnosis. The woman must be willing to undergo hypnosis and be of reasonable intelligence. She lies down and relaxes in quiet, comfortable surroundings and a state of suggestibility is induced without the use of gimmicks or gadgets. Under hypnosis, the woman can be told that labour pains will be bearable or only slightly painful. The success rate for pain relief is claimed to be as good as that for psychoprophylaxis. This method has similarities to the methods used for relaxation classes. However, unlike relaxation classes, hypnosis may produce disastrous effects in psychiatrically disturbed patients and adverse after-effects have not been ruled out in normal women.

White sound

The use of white sound is a way of distracting the woman's mind from the pain. It is a mixture of many frequencies of sound (just as the colour white is the mixture of all the colours of the rainbow). It is likened to the sound of steam being released under pressure, or of rushing water and is self-manipulated. The woman increases the volume of the sound during contractions. Its use appears to be limited.

Acupuncture

This method of relieving pain has been used in China for over 5 000 years. Needles are placed in points along certain meridians in the body and these needles are then vibrated. Acupuncture is claimed to restore a normal balance of energy flow, which thereby relieves pain. However, in labour, there seems to be very limited pain relief, and acupuncture is

seldom used in China for the relief of pain in labour (see Figure 26.4).

Transcutaneous electrical nerve stimulation

Transcutaneous electrical nerve stimulation (TENS) is administered by an apparatus that delivers both low frequency and high frequency currents.

The low frequency current is used in early labour and probably stimulates the production of endorphins (endogenous opiates) and takes about 40 minutes to become effective. (It is interesting to note that TENS analgesia is partly reversible by naloxone, the narcotic antagonist, which tends to support this theory.)

The high frequency current is believed to close the gate in the spinal cord, so that pain impulses carried by the slower unmyelinated nerve fibres are not transmitted onwards. This is used in advanced labour. The apparatus is self-manipulated and the pain relief is variable, most women obtaining some benefit. The apparatus is relatively inexpensive.

26.5 Analgesics and anaesthetics

The use of analgesic and anaesthetic preparations is absolutely essential in the practice of midwifery and obstetrics. Painful labour increases the output of the catecholamines, adrenaline and noradrenalin, which has an adverse affect on uterine action. Effective analgesia reverses this effect and therefore can shorten the duration of labour by promoting more efficient uterine action. The problem has been and still is to find the ideal preparation and the ideal method of administration.

The ideal medication for normal labour

The properties of the ideal analgesic in labour should include:

- The preparation and/or the method of administration should not be dangerous or potentially dangerous to the mother.
- The preparation and/or administration should not be dangerous or potentially dangerous to either the fetus or the newborn baby.
- Uterine activity should be enhanced and not adversely affected by the administration of the ideal medication.
- With the administration of the ideal medication, sufficient analgesic effect should be obtained to make labour as easy as possible and to reduce the pain to the level at which it is acceptable (bearable) for each individual woman. At the same time, the woman's cooperation, particularly in the second stage, should not be diminished and she should be able to participate in the birth and feel, see and hear her baby at birth.

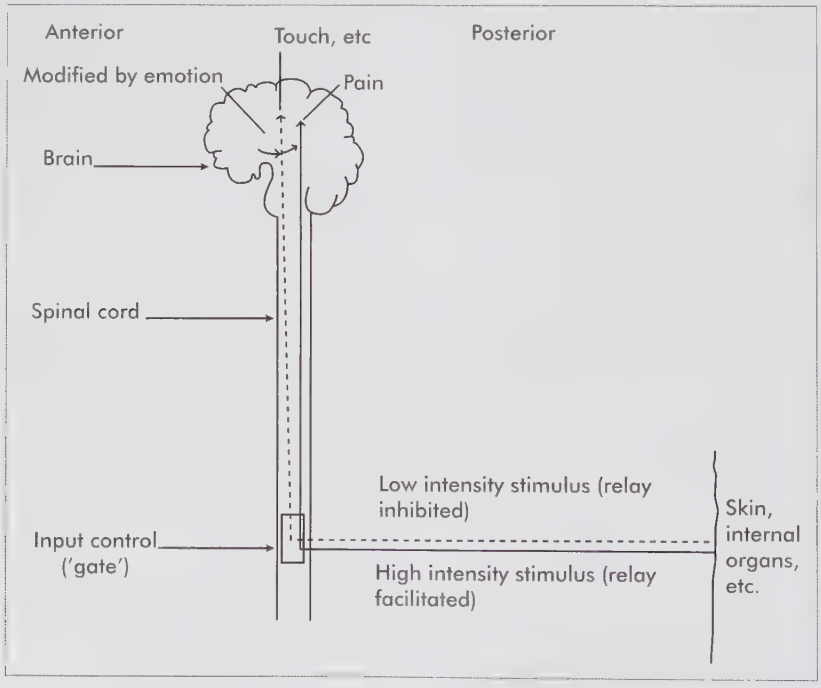


Figure 26.4 Pathways involved in the perception of pain
Adapted from Trounce, JR. 1983. *Clinical Pharmacology for Nurses,* 10 ed. Edinburgh: Churchill Livingstone

- The ideal medication should be available to any woman in need of pain relief in labour and it should be easy to administer.
- With the ideal medication for the relief of pain in labour, there should be no need for medical or midwifery specialists or for specialised and expensive technology or equipment to monitor the progress of labour. (In the total abolition of pain in labour, specialist personnel and technical instrumentation are prerequisites for the care of the woman and the fetus in labour.)
- The ideal analgesic should be relatively quickly and easily excreted by the body of the woman and the newborn baby and its action should be easily reversible should it be necessary to discontinue it.
- The ideal medication and the administration thereof should, financially, be within the means of any woman who requires it.

The ideal medication in *normal labour* and its administration for the relief of pain, has not yet been found, although Entonox® (combined with good antenatal preparation for labour) comes closest at the present time.

The potentially harmful effects of unrelieved pain on mother and fetus

The potentially harmful effects of unrelieved pain in labour, which can be reversed by the timely and effective use of analgesics, are:

- an increased cardiac output of up to 50%, due to a raised blood pressure and an increased heart rate
- maternal and fetal metabolic acidosis
- raised adrenaline and noradrenaline (catecholamines) concentrations which can lead to abnormal uterine action, prolonged labour and this in turn leads to:
  - raised corticosteroid concentrations
  - hyperventilation, if overdone, may reduce intervillous blood flow and result in fetal anoxia
  - increased oxygen consumption
  - nausea and vomiting

Severe unrelieved pain lowers the pain threshold, causing an increase in the intensity of the pain.

Definitions of terms used in pharmacology

These terms are used to classify medications according to the actions which the medications are capable of producing in the recipient.

- *A sedative* is a substance that induces a feeling of calmness and drowsiness, and in this way often relieves anxiety. Given in a large dose, a sedative is capable of inducing sleep (has a hypnotic action).
- *A hypnotic* is capable of inducing sleep, which resembles a natural sleep. A sedative given in a large dose may act as a hypnotic.
- *A tranquilliser* is a substance that is capable of relieving anxiety. There is not a great deal of difference between a sedative and a tranquilliser, although the tranquilliser does not necessarily cause drowsiness.
- *A narcotic is* a substance which, if given in sufficiently large doses, is capable of producing a deep sleep, stupor, unconsciousness or insensibility, and which at the same time may relieve pain.
- *An analgesic* is a substance that is capable of relieving pain without producing unconsciousness. An analgesic may produce total or only partial relief of pain. The relief of pain may be general or regional depending upon the medication used and the manner of administration.
- *An anaesthetic* is an agent that is capable of producing insensibility or the complete loss of feeling. An anaesthetic may produce general anaesthesia and unconsciousness or it may only produce regional or local anaesthesia depending upon the medication used and the method of administration. (In pharmacology the term anaesthesia implies a reversible state of depression of all the senses.)
- *Amnesia* means the loss of memory. With the administration of certain substances, the recipient, while able to feel or experience pain at the time, is unable to remember or recall the suffering later.

Legislation on the administration of analgesics by the midwife

The midwife and nurse midwife cannot prescribe or administer scheduled substances. The professional regulation of midwifery practice does not address pain relief.

Regulations by the Department of Health to guide practice are reflected in Reg. no 24727 10 April 2003. Obtaining of pethidine or preparations or admixtures thereof by registered midwives Reg 47 (Gov Gazette no 7636) (Previous R 777 10 April 1981) exist to support midwives who practice independently.

Midwives do not prescribe but may administer pethidine and other substances when taking a case on as an independent midwife practitioner *if* she has the required permits.

When a midwife works as an employee of an institution the rules of the institution in combination with the scope of

practice apply. As a rule a medical practitioner needs to prescribe pain relief.

Medications used for pain relief in labour

The main types of medication used for pain relief in South Africa and the route of administration, are grouped as follows:

- *Systemic medications:* These may be administered orally, by intramuscular injection or intravenously. They include sedatives, hypnotics and tranquillisers which may be given early in the first stage of labour, and narcotics and analgesics which are given towards the middle of the first stage of labour.
- *Inhalation analgesics:* This is the administration of anesthetics by inhalation, in subanesthetic doses, given in the late first stage and during the second stage of labour, such as nitrous oxide and oxygen (Entonox®).
- *Local and regional analgesia:* These are administered by the injection of a local anaesthetic (excluding epidural and spinal analgesia) and include paracervical block in the late first stage of labour, pudendal nerve block in the second stage of labour, and direct perineal infiltration with a local anaesthetic in the perineal phase of the second stage of labour. Epidural (extradural/peridural) analgesia is administered by injecting a local anaesthetic into the epidural space of the lumbar region of the spine and may only be administered by a medical practitioner. This should afford complete pain relief in the pelvic area and the legs, but also causes some weakness of muscle power of these areas. Epidural anaesthesia can be administered in a single injection, or by inserting a catheter into the epidural space and continually topping up with the local anaesthetic, or, by administering a continuous infusion a continuous epidural block can be attained. Epidural anaesthesia is used to relieve severe pain in labour, for forceps and breech deliveries, for caesarean section, and also in twin deliveries and for patients with cardiac conditions or hypertension.

  Spinal (subarachnoid, intrathecal, intradural) analgesia is administered by the single injection of a local anaesthetic solution into the subarachnoid space. This type of anaesthetic may be used by medical practitioners for breech and forceps deliveries and for caesarean section.
- *General anaesthesia* (intravenous and inhalation anaesthesia): The administration of general anaesthesia is now almost exclusively the task of the specialist anaesthetist and particularly so in obstetrics, because the risks in emergency caesarean sections are relatively high.

The timing of the administration of medications for labour pain

Measures used to relieve pain in labour include antenatal preparations to raise the pain threshold and continuous personal attention to the woman in labour. However, these may not be sufficient to reduce the pain to a bearable level, or, the woman may not have had an antenatal preparation, or, there may be complications in the pregnancy and/or the labour that cause increased pain in labour, or, the situation may arise where it is necessary to obliterate all pain.

Measures are only taken to relieve pain if:

- The woman asks for pain relief.
- The woman is obviously in severe pain, or, with observations made during labour the midwife concludes that the woman is in severe pain, and the midwife suggests that she be given some form of relief.
- The woman agrees to the form of pain relief suggested by the midwife or the medical practitioner.

Pain relief is not to be given against the woman's wishes. However, if the woman refuses pain relief and if the midwife feels that the woman is suffering unduly and unnecessarily, she should inform a medical practitioner.

As yet, there is no ideal type of medication for the relief of pain in labour and therefore it is necessary to use what is available to the very best advantage.

The timing for the administration of any medication for the relief of pain in labour is very important. If medication is prescribed by a medical practitioner it is usually the midwife, being in constant attendance, who judges when the woman needs relief from pain.

The optimal time for administering analgesia is determined by many factors, which are as follows:

- *The careful observation, assessment and evaluation* of the woman in labour, taking into account:
  - the woman's general psychological and physical condition
  - whether the woman is a primigravida, or a multigravida
  - the type of uterine action which the woman is experiencing is normal or abnormal
  - the dilatation of the cervix (the stage of labour)
  - the woman's pain tolerance
  - any conditions which may lead to severe pain (such as occipitoposterior positions, hypertonic or incoordinate uterine action, and cephalopelvic disproportion)
  - comorbidities contraindicated to the experience of severe pain as it would be deleterious to her condition (such as pre-eclampsia, eclampsia, and any cardiac condition)

- *The appropriate time for the administration* of each of the different types and routes of medication. Timing depends upon the type and route of the medication prescription, because:
  - The medication should not be given too early in labour or it may delay the labour.
  - The medication should not be given too late in the first stage as it may not give relief of pain, because it may take some time to take effect. In addition, if it is given too late it may cause respiratory depression in the newborn.
  - There is an appropriate time during labour for the administration of each type of analgesic, depending upon its effectiveness in relieving pain, the route of administration, the time it takes to become effective, the length of time it is effective and the manner and time of its excretion from the body of the mother and of the newborn baby. These facts will be expanded upon when each medication is outlined in the following text.

To obtain adequate pain relief in labour, it may be necessary to use more than one medication during the labour. The use of more than one medication should be extremely carefully assessed. While there is the possibility of a dangerous and even fatal reaction occurring from the administration of a single medication, there is even greater likelihood of a problem occurring due to a medication interacting with one already administered.

Specific considerations in the administration of analgesics by midwives

It is important to note that, not only is there a wide variety of tolerance to pain, but that there is also a wide variety of effects and tolerance to pharmacological preparations such as sedatives, hypnotics, tranquillisers, narcotics, analgesics and anesthetics. Every woman has a different reaction to a given medication and some women may be extremely sensitive or even allergic to a certain preparation, while the same medication may have little effect upon other women. This must be borne in mind whenever any medication is administered to a woman in labour and the effect of the medication administered should be carefully observed and recorded in each instance. Each woman must be considered individually.

The midwife should have a sound knowledge of all pharmacological preparations which she is likely to have to administer. The information she should be familiar with includes:

- the type of medications she may administer
- the routes of administration she is allowed to use
- the specific dose of each medication according to the effect that is required
- the contraindications to the use of these medications
- the side effects of the medications
- the interaction with other medications.

The objective is to administer the minimum amount of any medication prescribed to obtain the maximum amount of pain relief. However, it is useless to administer an insufficient amount, so that the pain remains unbearable. It is also very important that the most suitable medication is given at the correct stage of labour. Continuous personal attention together with the power of suggestion on the part of the midwife helps to increase the effectiveness of the medication. To obtain the best effects from the administration of a medication, certain principles should be followed.

Systemic medications

With the acknowledgement and more widespread use of antenatal psychological and physical preparation for birth, systemic medications such as sedatives, tranquillisers and hypnotics are now less frequently used in labour. In addition, the increased use of epidural analgesia has reduced the need for administering narcotic preparations, such as pethidine. However, in situations where epidural analgesia is either not available or is not acceptable to the woman in labour, systemic medications continue to have a role in obstetrics and midwifery.

Sedatives, tranquillisers and hypnotics

The following sedatives, tranquillisers and hypnotics are used in midwifery and obstetrics.

A sedative or hypnotic is often administered in false labour. This calms the woman and, if it is given in a large enough doses, will induce sleep. Invariably, when the woman wakes up, the painful but irregular contractions will have ceased, or in some instances, true labour will have started.

A sedative or hypnotic may be administered in early labour (in the latent stage of labour) particularly to a primigravida with hypotonic uterine action. A hypnotic given in the evening would induce sleep and rest and very often, when this woman wakes in the early morning, efficient uterine action will have commenced, with strong, regular contractions bringing about effective cervical dilatation.

Hydroxyzine (Aterax®–Schedule 5)

Hydroxyzine is an antihistamine that is often prescribed by the medical practitioner as a preanaesthetic medication. It also acts as a tranquilliser, sedative and antiemetic. It produces minimal circulatory and respiratory depression and does not

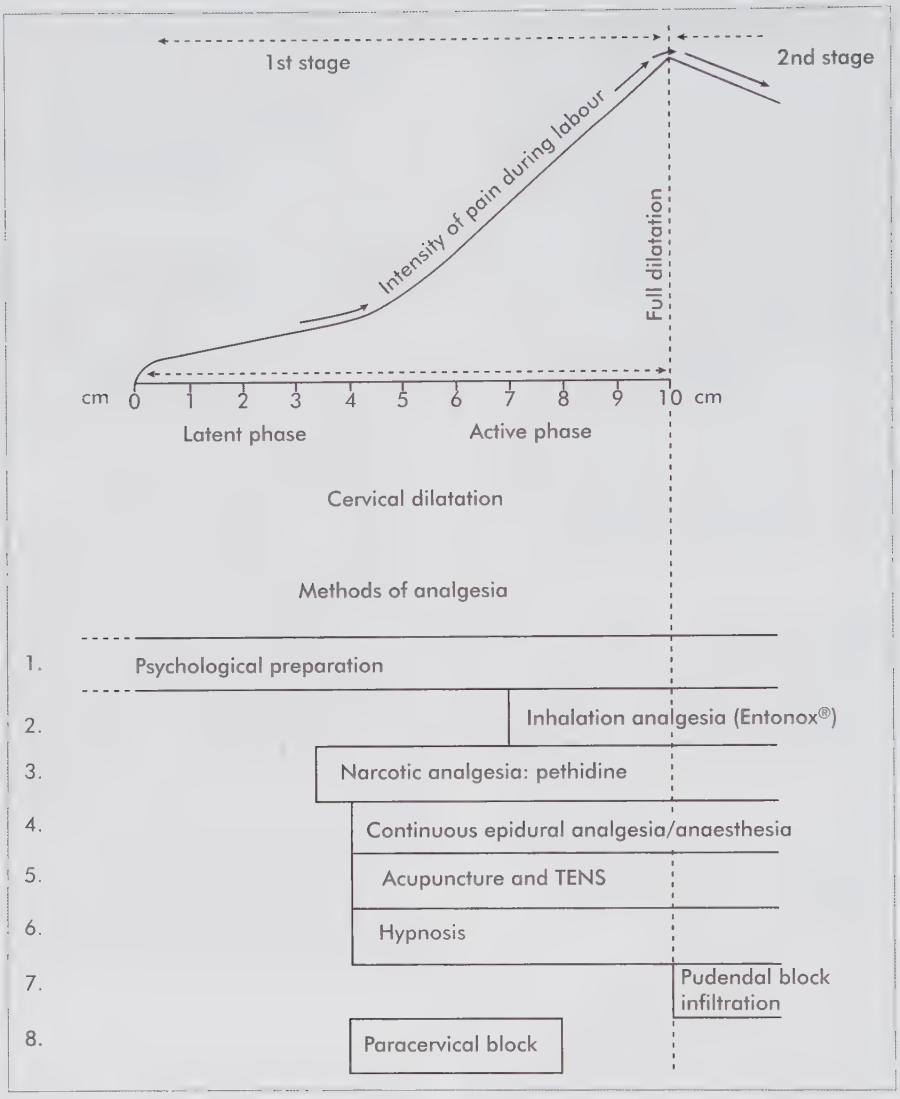


Figure 26.5 A representation of the timing of various methods of analgesia in relation to pain and cervical dilatation
Redrawn from: Moir, DD. 1986. *Pain relief in labour – A handbook for midwives,* 5 ed. Edinburgh: Churchill-Livingstone

prolong anesthaesia. It can also be used in false labour and in early (the latent phase of) labour when the cervix is slow in dilating, to calm an anxious woman.

Hydroxyzine may, on medical practitioner's prescription, be administered in labour in combination with pethidine hydrochloride and this combination is effective for relieving pain and for helping to normalise uterine contractions in women with incoordinate uterine action.

Dosage: Hydroxyzine is given in labour as an intramuscular injection 50–150 mg.

Side effects: It causes drowsiness and it potentiates the effects of narcotics.

Promethazine (Phenergan®)

The phenothiazine derivatives are tranquillisers as well as having antiemetic and antihistamine properties and may be prescribed by the medical practitioner. However, these medications are now prescribed less often in labour, because women complain of loss of self-control and drowsiness. Promethazine is sometimes given with pethidine. The dosage

of pethidine can be reduced. Promethazine has a longer duration of action and so would not be given with a second dose of pethidine.

Dosage: Promethazine and occasionally promazine are the only two phenothiazine derivatives now used during labour. They may be given by intramuscular injection in doses of 25 mg/l ml with a maximum dose of 50 mg. When administered in combination with pethidine, the dose of pethidine is reduced by about a third, or even halved.

Where an antiemetic action is required, promethazine or prochlorperazine (Stemetil®) are used.

Side effects: In some women, these medications have a sedative effect, while in others, euphoria, nervousness, insomnia and tremors may manifest. Other side effects may be tinnitus, dizziness, incoordination, blurred vision, dryness of the mouth and throat, cough, urinary frequency or dysuria, palpitations, hypotension, headache, tightness of the chest, tingling, heaviness and weakness of the hands, epigastric distress with nausea and vomiting, constipation or diarrhoea.

The phenothiazines do not inhibit uterine contractions. They also do not depress respiration in the doses used in labour and are relatively safe medications. However, although they do not depress respiration in the newborn, they may depress reflex responses, such as the sucking reflex.

Narcotic analgesics

Pethidine hydrochloride (Schedule 7)

Pethidine is a synthetic analgesic agent, which, although it exhibits some of the pharmacological effects of morphine, is chemically quite dissimilar. The dose of pethidine that gives approximately the same analgesic effect as morphine has less than half the sedative effect of the dose of morphine. Pethidine is said to be particularly effective against pain originating in the internal organs, such as the uterus.

The analgesic effect of pethidine is experienced 20–30 minutes after an intramuscular injection and lasts approximately four hours. An intravenous injection takes effect about two to three minutes after administration.

Indications:

- Severe pain in labour is the main indication for the administration of pethidine hydrochloride during labour. However, a careful evaluation of the progress of labour must be made and the rate of dilatation of the cervix must be assessed.
- Pethidine does not inhibit the action of well-established labour, and in fact, when pethidine is given at the right time, it often results in a more rapid dilatation of the cervix and the acceleration of labour, even in inco-ordinate uterine action. This is probably due to the reduction of fear and pain rather than directly relaxing the cervix as was previously held.
- Pethidine should not be given at the end of the first stage of labour. Generally, pethidine should not be given after 6 cm dilatation in a primigravida and after 4 cm dilatation in a multigravida. The reasons for this are: first, the danger of depressed respiration in the newborn, and second, the analgesic effect of the pethidine will probably not have had time to reach its maximum before the onset of the second stage and will, therefore, not be of value in the relief of the pain and the woman will be too drowsy to bear down effectively.
- Pethidine should also not be given too early in labour, as it may delay labour. It should only be administered when there is severe, unbearable pain, and therefore pethidine is usually not administered in the latent stage of labour, that is, before 3 cm dilatation. An injection of intramuscular pethidine may be repeated during labour if the need arises, but this would usually only be necessary in the case of a primigravid woman, because in a multipara, the length of the first stage would indicate prolonged labour and further investigations should then be made.

Dosage: Intramuscular injection of 50–150 mg, which may be repeated on medical practitioners prescription only.

Pethidine may be combined with hydroxyzine and this combination is effective for relieving pain and for normalising labour when there is incoordinate uterine action. When these medications are combined, the dose of pethidine can be reduced by half. This is only done with a medical practitioner's prescription.

An intravenous injection of 25 mg of pethidine may be given by the medical practitioner, or in an emergency, by the midwife. This should be given slowly over five to 10 minutes and it should be diluted before injection. This could be used in obstetrical emergencies such as: retained placenta requiring manual removal where no operating theatre facilities are available or in acute inversion of the uterus, etc. The substance is administered slowly over two or three contractions during a contraction.

Side effects: Pethidine is a habit-forming drug but is unlikely to cause addiction in the normal woman when used in labour.

A large percentage of women who are given pethidine during labour complain that it does not remove the pain, but it seems to cause feelings of loss of control. Women may complain of drowsiness and loss of self-control while under

the influence of pethidine, and this may be resented when it interferes with the performance of controlled breathing and selective relaxation. Occasionally, women complain that pethidine causes vivid nightmares or hallucinations.

Other important side effects are:

- *The respiratory system:* Pethidine depresses respiration and the peak respiratory depression is observed within one hour after intramuscular injection. It starts to decrease after two hours, but may last up to four hours. Naloxone, nalorphine and related opiate antagonists can reverse the respiratory depression. However, these substances only reverse the respiratory depressive action of narcotic analgesics (morphine, pethidine, etc.) and have no antagonist effect against barbiturates, benzodiazepines, phenothiazine derivatives or general anaesthetics. In fact, if used with these medications, they could aggravate the respiratory depression. Naloxone is the antagonist of choice because its own action is free from any morphine-like action, while the others can, in certain circumstances, act as narcotics themselves.

  Naloxone 0.4 mg to 0.8 mg can be given intramuscularly or may be given intravenously as a single dose or titrated. Intravenous naloxone takes effect almost immediately after administration.

  Possibly the greatest danger in the use of pethidine during labour is that it freely crosses the placental barrier and therefore it may cause respiratory depression in the newborn baby, preventing the establishment and/or the effective maintenance of respiration at birth. Established respiratory depression in the newborn can be treated with naloxone. Usually, the blood level of pethidine in the newborn baby is approximately 70% of the maternal blood level at delivery. Although the pain caused by labour and birth may stimulate the mother's respirations, this will not occur in the newborn baby, which, if severely depressed, may not make attempts to breathe, and/or may not be able to maintain respiration.

  It is essential that neonatal naloxone (0.01 mg/kg body weight) is only given once perfusion is established.

  If naloxone is administered intravenously to the woman shortly before delivery, it will help prevent narcotic-induced respiratory depression in the newborn, but the preferred method is to administer neonatal naloxone directly to the infant at birth.

  The effects of an intramuscular injection of neonatal naloxone to a newborn baby is delayed when there is respiratory depression and therefore the only really satisfactory method of administration in these circumstances is by the umbilical vein.

- *The cardiovascular system:* When the woman remains in bed after an intramuscular injection of pethidine, her blood pressure is usually normal. However, if she sits or stands, her blood pressure may fall suddenly (orthostatic hypotension). Hypotension may also occur when single intravenous injections are administered, hence the need to give the injection very slowly. Pethidine, administered together with or soon after a phenothiazine derivative or other hypnotics or narcotics, may also result in hypotension. Sudden, severe hypotension may occur when epidural analgesia is used after pethidine has been administered.
- *The gastro-intestinal system:* Nausea and sometimes vomiting occur in about half the women in labour to whom pethidine is administered. Hydroxyzine or certain phenothiazine derivatives with antiemetic properties may be used in the prevention or treatment of nausea and vomiting.

  The main danger of delayed gastric emptying is Mendelson's syndrome, caused by the inhalation of vomited or regurgitated stomach contents while the woman is unconscious under a general anaesthetic. It has been shown that the prolonged gastric emptying time which is sometimes seen in labour is due more to the action of narcotic analgesic drugs than to labour itself. Gastric emptying times are not increased when epidural analgesia is used or if no analgesia is used.
- *The liver:* In severe liver disease, the breakdown of pethidine may be impaired, causing the action of the pethidine to be intensified and prolonged. In the newborn baby, the liver is unable to break down pethidine effectively and pethidine may remain in the body of the newborn for as long as three days. Because pethidine depresses reflex activity, reflexes such as sucking may be delayed for two to three days after birth.
- *Contraindications:* Pethidine should not be administered to any woman who is on monoamine oxidase inhibitors because serious reactions such as coma, profound hypotension and severe respiratory depression may result, with the possible death of the woman and/or baby. Care must be taken when giving pethidine following the previous administration of any sedatives, hypnotics, tranquillisers or other narcotics and analgesics.

Morphine and papavertum (Schedule 7)

These opiates may be used in labour, but have a respiratory depressing effect. However, they are very useful as analgesics

after caesarean section. In case of an intrauterine death or in manual removal after birth, morphine is a useful drug to reduce pain.

Inhalation analgesia

Inhalation analgesia is used in advanced labour (towards the end of the first stage and in the second stage).

Nitrous oxide and oxygen (Entonox®) are administered using a single cylinder of premixed gases with the Entonox® apparatus.

Nitrous oxide and oxygen: the Entonox® apparatus

Nitrous oxide is a weak anaesthetic, but has a relatively strong analgesic action. Stored in cylinders under pressure, nitrous oxide becomes a liquid, but when it is mixed with oxygen, it becomes a stable gaseous mixture – the only exception is if it is subjected to severe cold, when it reverts to the liquid form.

In using nitrous oxide for pain relief in labour, the object is to administer the amount of the inhalation analgesic which affords the maximum relief of pain but at the same time keeps the anaesthetic at a safe level. The 50% nitrous oxide mixed with 50% oxygen which is administered by the Entonox® apparatus provides analgesia which is found to be satisfactory for most women in labour. It is entirely free from harmful effects and can be safely used for up to 12 hours and there are no real contraindications to or side effects from the use of Entonox® and in fact, the administration of nitrous oxide and oxygen by means of the Entonox® apparatus has multiple benefits (see Figure 26.6).

The benefits of using Entonox®

With the use of the Entonox® apparatus, because it is self-administered, the woman cannot be given an overdose, or anaesthetic dose, of nitrous oxide. If the build-up of nitrous oxide becomes too great, she will not be capable of holding the mask over her mouth and nose. Because of this, the midwife should never hold the mask on the woman's face.

Uterine contractions are not inhibited, but the relief from pain and the relaxing effect of the nitrous oxide help to facilitate normal uterine action. This in turn helps to reduce the duration of labour.

Because Entonox® is self-administered, the woman is actively participating in her own pain relief and this in itself helps to distract from the pain of labour.

Entonox® is almost odourless and seldom causes nausea.

The extra oxygen is beneficial to the mother and to the fetus and can be of value if the fetus is in distress, as it can improve fetal oxygenation and reduce metabolic acidosis.

The analgesic effect of nitrous oxide is produced very rapidly, as analgesia is experienced approximately 20 seconds after inhalation commences and reaches its maximum after about 45 seconds. The depth and rate of respiration will influence the amount of nitrous oxide taken up through the lungs and this will, therefore, affect the rate of onset of analgesia.

Nitrous oxide is excreted from the mother's body almost as quickly as it is taken in, and therefore there is very little likelihood of a build-up to a dangerous level with the correct use of the Entonox® apparatus.

However, in spite of the relative safety of Entonox®, the midwife must always observe the correct methods of use.

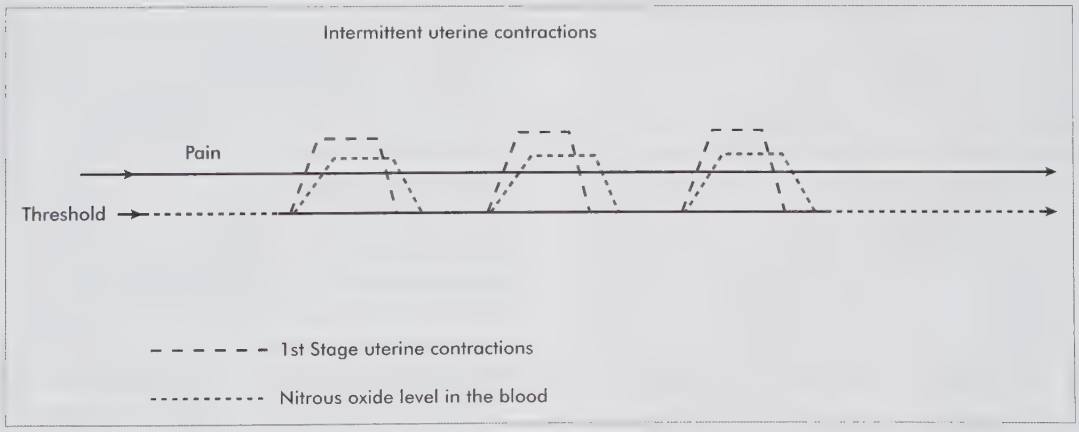


Figure 26.6 The nitrous oxide in the blood when Entonox® is correctly used in labour (50:50 mixture of nitrous oxide and oxygen)
Redrawn from: Moir, DD. 1986. *Pain relief in labour – A handbook for midwives,* 5 ed. 1986. Edinburgh: Churchill Livingstone

Indications for the use of the Entonox® apparatus during labour:

- If the labour is progressing normally and the cervix is 8 cm or more dilated in the primigravida and 6 cm dilated or more in the multigravida, but there is a definite need to relieve pain. In normal labour, without cephalopelvic disproportion, most women who are not coping with the pain towards the end of the first stage of labour should find that Entonox® gives sufficient relief if their emotional, psychological and physical needs have already been met.
- Entonox® is also very useful for relieving pain in the second stage of labour, and also for helping the woman to keep control in the perineal phase, when the head is crowning.
- Entonox® is also a means of providing additional oxygen to the fetus during labour. More than double the amount of oxygen which is present in the air is taken in when the Entonox® machine is used.
- Entonox® is very useful in instances where the woman is unable to prevent herself from bearing down when the cervix is not fully dilated. This may occur in posterior positions of the vertex, particularly in the primigravida. An oedematous lip of cervix can result from this premature bearing down and Entonox® can be very helpful in helping the woman not to bear down.

The midwife would be wise to ask the medical practitioner to give his consent for the woman to have Entonox® at the time of admission in labour.

Contraindications and side effects

There are virtually no contraindications or side effects if the apparatus is correctly used. However:

- The woman's consent and cooperation must be obtained before Entonox® can be used.
- Occasionally, the woman has feelings of suffocation when using the mask for the first time, but this can be avoided if, during antenatal preparation, visits are arranged to the maternity unit and the woman is shown how to use the Entonox® apparatus and encouraged to put the mask on her face, so that she knows how it will feel in labour. If this is not possible, the woman should at least be allowed to use the apparatus for a few breaths, while still in early labour. It is very disconcerting to the woman if, at the end of the first stage when she is in strong labour, the mask is suddenly pushed over her face for the first time.
- Women may feel dizzy and they should then be confined to bed.

Local anaesthesia and nerve blocks (excluding epidural anaesthesia)

The term local anaesthetics is applied to substances which, when injected into the body, bring about analgesia, although the sensations of touch and temperature may not be affected. If most or all sensation is occluded, then this is anaesthesia. Local anaesthetics block the conduction of impulses along the nerves. (See Chapter 32 for epidural anaesthesia.)

The local anaesthetics that are generally used for local infiltration and for regional analgesia are:

- *Lignocaine:* Supplied in strengths of 0.5%, 1%, 1.5% and 2%. However, for local infiltration, for pudendal nerve block and for paracervical block, the concentration should never exceed 1% and the maximum amount is 20 ml.
- *Bupivacaine:* Usually supplied in strengths of 0.25% or 0.5%. This is a powerful substance and gives a longer duration of analgesia than lignocaine and is usually used for epidural analgesia, either by intermittent injection or by continuous infusion.

The use of adrenalin together with a local anaesthetic is to be *avoided* in obstetrics. It is capable of causing severe cardiovascular effects if inadvertently given intravenously and it suppresses uterine contractions in epidural aneasthesia.

Should a local anaesthetic be injected directly into a blood vessel, it is likely to result in a toxic reaction. The danger is greatest if the injection site is close to a major artery such as the pudendal artery in a pudendal block and the uterine artery in a paracervical block. To overcome this danger, the syringe plunger should be withdrawn before the solution is injected, to check for blood. If a dental syringe is used, then the solution should be injected while withdrawing the needle.

Local anaesthetics are transferred fairly freely, via the placenta, to the fetus.

Local anaesthetic is particularly dangerous if the solution enters a blood vessel, and the resulting effects may be:

- suppressed vital centres of the brain stem, resulting in anxiety, shivering, hypotension, inadequate respiration, reduced cardiac output
- cerebral excitation – fine muscular twitchings, especially of the facial muscles, generalised convulsions
- loss of consciousness (with the associated obstruction of the airway and inhalation of vomitus)
- hypoxia or anoxia of the mother and/or the fetus
- death.

Local or regional analgesia (excluding epidural analgesia) is obtained by the following means:

- Pudendal nerve block, which can be used in the second stage for severe pain, or to exclude pain during all complicated deliveries. This may only be performed by a medical practitioner.
- Paracervical block, which can be used in the late first stage and in the second stage of labour, for severe unrelieved pain, or to exclude pain during forceps delivery. This may only be performed by a medical practitioner.
- Direct perineal infiltration with a local anaesthetic can be used in the latter part of the second stage of labour to perform an episiotomy, or in the third stage for suturing the perineum. A midwife is allowed to perform this procedure.

Pudendal nerve block

A pudendal nerve block may only be performed by a medical practitioner, and is an aseptic procedure. It is often used for forceps delivery, together with infiltration of the perineum. If the pudendal nerves on both sides are injected with local anaesthetic, the pain in most of the perineum, vulva and vagina should be abolished. However, the uterus is not affected and the pain of uterine contractions can still be felt.

There are two basic methods of pudendal nerve block:

- *The transperineal method:* The pudendal block needle of about 10 cm is inserted through the skin of the perineum, between the ischial tuberosity and the margin of the external anal sphincter. The needle is directed through the ischiorectal fossa until it lies just behind the ischial spine. After very careful aspiration for any sign of blood (because of the close proximity of the pudendal artery), about 10 ml of local anaesthetic solution is then injected. When this is completed, the procedure is repeated on the other side.
- *The transvaginal method:* This is an effective alternative method of administering a pudendal block. The needle is guarded by two fingers and introduced into the vagina. The tip of the needle is then inserted through the side wall of the vagina, at the level of the ischial spine, so that it comes to lie just behind the ischial spine. The usual precautions are taken before the local anaesthetic solution is injected. The procedure is repeated on the other side.

Infiltration of the perineum is then undertaken. The amount of local anaesthetic solution used in the whole procedure can amount to up to 30 ml. As this is an overdose, toxic reactions should be anticipated.

A wholly successful pudendal nerve block is only likely to occur in 50% of the patients. A useful sign of an effective bilateral pudendal nerve block is the failure of the external anal sphincter to contract when touched.

A pudendal nerve block is relatively effective and safe and is the preferred means of pain relief for forceps delivery where epidural analgesia is unavailable.

Paracervical block

Paracervical block is only performed by a medical practitioner and can only be used in the first stage of labour, in an effort to control severe unrelieved pain. It is sometimes referred to as uterosacral block, because the injections of local anaesthetic are made alongside the cervix near the base of the uterosacral ligaments. The aim is to block the paracervical ganglion (Frankenhauser's plexus) which contains all the uterine nerves. This is an aseptic procedure and is carried out vaginally with a specially guarded paracervical block needle. After very careful aspiration for any sign of blood (because of the close proximity of the uterine artery), 5–10 ml of local anaesthetic solution is then injected into the paracervical tissues on either side of the cervix. Bupivacaine 0.25% is the anaesthetic agent of choice (see Figure 26.7).

There is a high incidence of fetal bradycardia associated with paracervical block and it is now seldom used (see Figure 26.8).

Epidural (and spinal) analgesia has not been included in this chapter as it is not recognised as being part of normal labour. It is not freely available in public hospitals for pain relief in labour but spinal aneasthesia is mainly used for caesarean section. Its uses in obstetrics are:

- for severe unrelieved pain in labour
- to exclude pain during certain procedures, such as forceps delivery, vacuum extraction, etc.

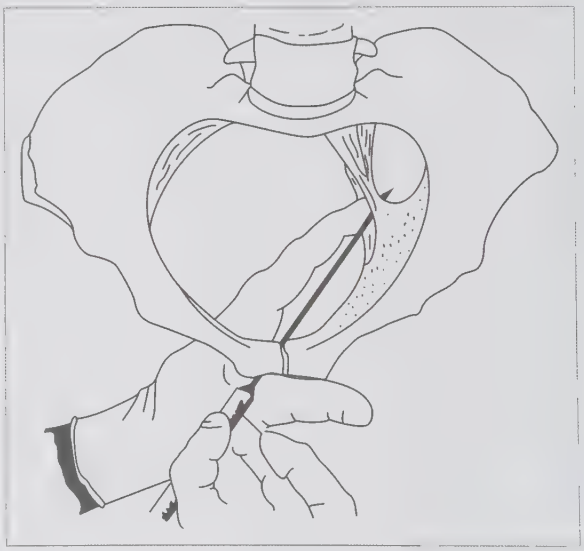


Figure 26.7 Pudendal block in labour

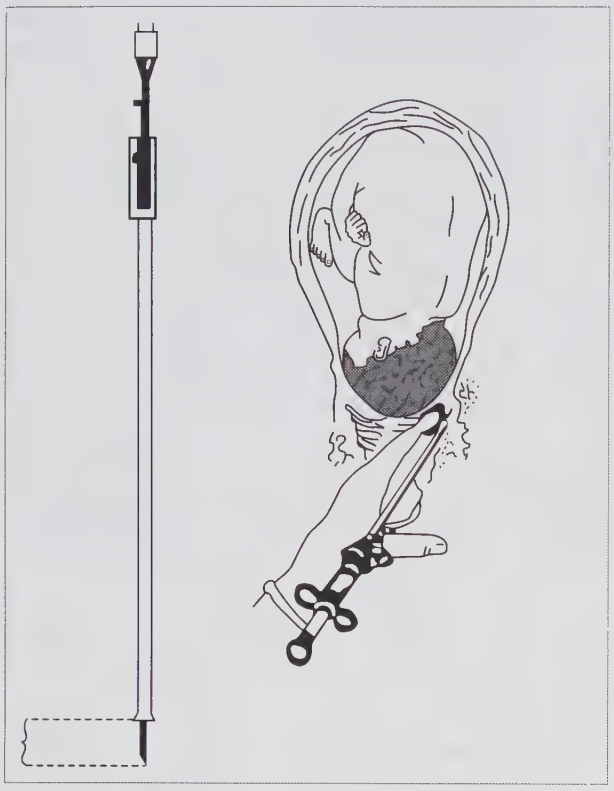


Figure 26.8 Paracervical block in labour

General anesthesia

In modern obstetrics, general anaesthesia is now used only for caesarean section, and even this use has receded with the more frequent use or epidural anaesthesia. Maternal deaths can occur due to the complications which arise with general anaesthesia, such as Mendelson's syndrome. Most of these maternal deaths occur as a result of general anaesthesia used for emergency ceasarean section. (See Chapters 20 and 32.)

26.6 Conclusion

In most languages, the process of giving birth uses words that describe a *process of work* rather than pain. The reference to contractions in labour as labour pains is discouraged. Childbirth is more than a physiological process. Coping with birth is an emotional and complex process that results in feelings of fulfillment and achievement for women.

It is important that midwives are instructed and adopt concepts and practices that steer away from disempowering language and support women referring to birth and contractions rather than 'labour pains'.

CHAPTER

27

Physiology, management and care of the second and third stages of labour

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- explain the second and third stages of normal labour
- explain the positions that are utilised during the second stage of labour
- explain the care during the second and third stages of normal birth
- explain the role of the midwife in normal labour
- describe the role of the midwife in conducting a birth.

KNOWLEDGE ASSUMED TO BE IN PLACE

Knowledge of the anatomical and physiological changes in pregnancy in preparation for birth
Knowledge of the psychosocial preparation for birth
Knowledge of the first stage of labour

KEY WORDS

Eutosia • Normal birth • Pelvic floor stage • Perineal stage • Apgar score

27.1 Introduction

The second stage of labour begins when the cervix is fully dilated (10 cm) and ends with the delivery of the baby.

The second stage can be divided into two phases:

1. *The phase of descent (pelvic floor phase)*, which occurs as the fetal head descends into and through the pelvic canal, and
2. *The perineal phase*, which occurs when the fetal head reaches the pelvic outlet and the fetus is expelled through the vaginal orifice.

Both these phases take longer when it is a first labour as the soft tissues of the birth canal have not previously been stretched.

Transition from the first stage to the second stage of labour is seldom clearly defined. It is only on vaginal examination, when the cervix is found to be fully taken up, that commencement of the second stage is conclusively diagnosed. However, even this does not specify 'the exact moment of commencement of the second stage'.

27.2 The duration, dynamics and challenges of the second stage of labour

The duration of the normal second stage is usually shorter than the normal first stage of labour. As with the first stage, the length of the second stage will depend upon whether it is a first labour or whether the woman has previously given birth to a viable infant. In addition, the length of the second stage will depend on the size and position of the head and the presence of strong uterine contractions. During the second stage, the stronger contractions interfere with the placental circulation, the fetal head is subjected to compression (200 mmHg) as it enters the pelvis and as the head descends in the pelvis. If there should be a loop of cord around the fetal neck, there is the possibility that it will become tightened as the head descends and for these reasons, the second stage of labour is much more hazardous to the fetus than is the first stage of labour. It is, therefore, important that the second stage is recognised as early as possible after commencement, because,

although of a shorter duration, the length of the second stage is much more critical to the well-being of the fetus than is the length of the first stage. The fetal heart rate is observed after each bearing-down effort.

Strong contractions, the effort exerted during bearing down, the weariness caused by anxiety, as well as the length of the first stage and the pain, can all lead to maternal exhaustion and distress if the second stage is prolonged. Maternal distress also leads to fetal distress. A prolonged second stage may also be an indication of some abnormal obstetric condition, such as cephalopelvic disproportion, deep transverse arrest or some other abnormal condition causing delay of the birth of the infant.

The length of the second stage of labour is not so important if the mother is not actively bearing down, for instance, with epidural analgesia.

The average length of the normal second stage of labour:

- in a primigravida/nullipara it is 40 minutes and should not exceed one hour
- in a multigravida/primipara or multipara it is 15–30 minutes and should not exceed half an hour.

These times apply when the woman is actively bearing down, and include the phase of descent and the perineal phase.

The duration of the second stage may depend upon certain criteria:

- the strength and coordination of the uterine contractions (the powers)
- the mother's ability to bear down, depending upon her general condition and the length of the first stage (psychological and physical fortitude)
- the resistance of the soft tissues of the pelvis, depending upon whether it is a first or subsequent delivery (the passages)
- the size and shape of the mother's pelvis (the passages)
- the lie, presentation, position, attitude and the size of the fetus (the passenger).

27.3 Physiological changes that occur in the second stage of labour

The transitional phase or stage extends from just prior to full dilation of the cervix (from 8–9 cm dilatation), when there is only a thin rim of cervix still palpable on vaginal examination and the contractions are very strong and very painful), up to the time the cervix is fully dilated and the contractions have changed in character and the woman feels the urge to bear down. *This is usually the most painful and distressing period of the whole labour and the woman needs the full attention and cooperation of the midwife during this time.*

During pregnancy and in the first stage of labour, the pressure of the contractions is partially absorbed by the amniotic fluid, which more or less equalises the pressure over the whole uterus. The purpose of these contractions is initially to bring about the formation of the upper and lower uterine segments, and subsequently to bring about the effacement of the cervical canal and the dilatation of the cervix. However, in the second stage, the purpose of the contractions is to force the fetus through the birth canal and to expel the infant from the uterus through the vaginal orifice.

The uterine contractions

The involuntary uterine contractions are the primary force to push the baby out. If the membranes have not ruptured previously, they usually rupture at the beginning of the second stage of labour. Much of the liquor amnii drains out, bringing the uterus into closer contact with the fetus. This causes additional stimulation of the uterine muscles, resulting in stronger contractions (Ferguson reflex) which are then further enhanced by reflex stimulation due to the stretching of the pelvic floor and the vagina, as the fetal head descends. This results in:

- uterine contractions becoming stronger in the second stage of labour stimulating an urge to bear down
- the contractions are of an 'expulsive' character and are very painful, but when the woman bears down or 'pushes' during a contraction, this significantly decreases the pain experienced by the woman.

The fetus

During the second stage of labour, the fetal head descends in the pelvis and reaches the pelvic floor. The fetal head makes certain passive movements, known as the mechanism of labour, which allows the fetus to pass down the pelvic canal and through the pelvis and the vagina for birth.

The uterine fundus acts as a piston during contractions, and because the normal placental site is near the fundus, the placental circulation can be interfered with, particularly if the membranes have ruptured. This increases the fetal risk in the second stage of labour.

In addition, the surrounding voluntary skeletal muscles and diaphragm are brought into play when the woman bears down and this increases the pressure of the uterine fundus onto the fetal buttocks, which are normally in the upper pole of the uterus. The expulsion of the fetus is brought about by means of so-called fetal axis pressure, where, although there

is greater flexion of the fetal head, the fetal spine straightens out and the fetus is elongated as it is forced through the pelvis. This elongation of the fetal body results in the fundus remaining above the umbilicus, although the head may have descended well into the pelvis (see Figure 27.1). Flexion and rotation allows the smallest diameters of the fetal head to pass through the pelvis (see Figure 24.1).

The ancillary or auxiliary muscles of the second stage

Certain voluntary skeletal muscles, the abdominal muscles and the diaphragm aid in expelling the fetus from the uterus in the second stage of labour. These are brought into play when the woman 'bears down' or 'pushes' and she can control them.

In normal circumstances, the bearing-down reflex, or the urge to bear down is experienced by almost every woman in the second stage of labour. In fact, a woman may experience this urge even before the cervix is fully dilated, and this should be guarded against, because premature bearing down can result in the cervix becoming nipped between the pelvis and the fetal head, with the danger of causing an oedematous lip of cervix. While bearing down, an increase in the intrauterine pressure can also occur, causing a reduction in oxygen to the fetus. The woman should only be encouraged to bear down when no cervix is felt on vaginal examination; in addition, the woman should only be encouraged to bear down during contractions in the second stage, because bearing down between contractions, as with bearing down before full dilatation, can result in stretching of the uterine supports which could later lead to uterine prolapse.

However, if the muscles from the waist downwards are weakened and the woman is unable to bear down effectively, the *uterine muscles alone are capable of expelling the fetus from the uterus.* This is of particular significance when the woman has been given an epidural analgesia and she is unable to utilise her abdominal muscles properly because they are affected by the local anaesthetic and the bearing down reflex is diminished. This is also of importance in conditions where the woman has some form of permanent paraplegia (paralysis of the lower part of the trunk and limbs) due to poliomyelitis or to accidental trauma to the spinal cord. If the attendants will be patient and not try to hurry things along (as long as the fetal heart rate remains normal), the uterus will expel the fetus unaided, making the use of forceps unnecessary. It will just take longer.

Towards the end of the second stage, when the head is on the perineum, the woman often experiences a feeling which

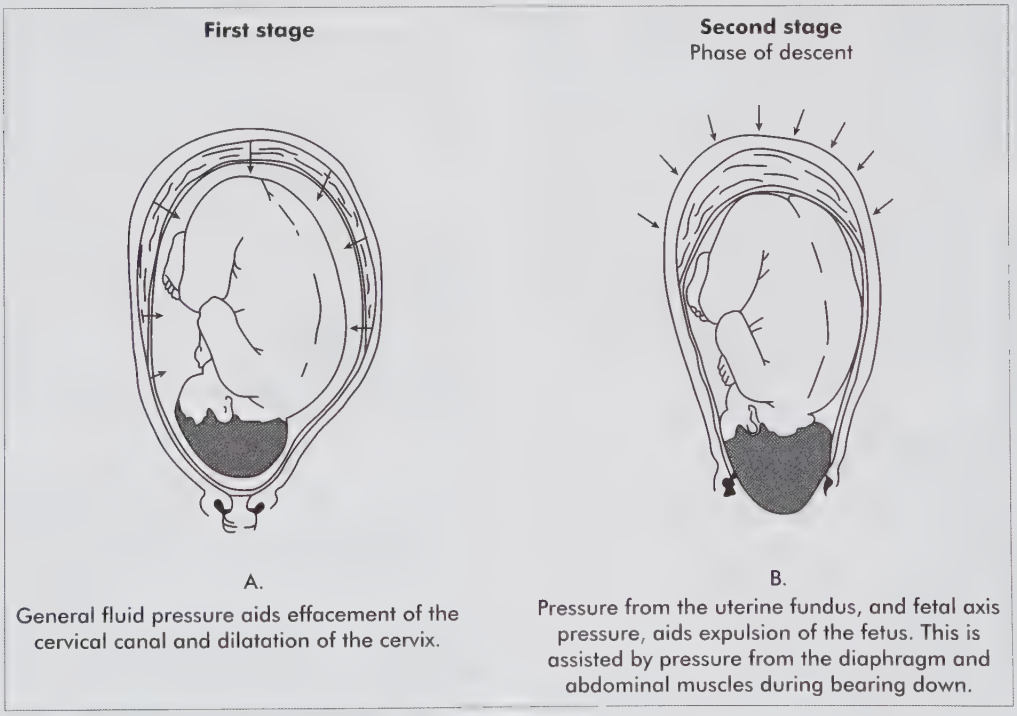


Figure 27.1 Pressure on the fetus during labour

is similar to the reflex to defecate and if the woman requests a bed-pan in the second stage, it may indicate that the fetal head is well down in the pelvis and the woman is about to deliver the baby.

Displacement of and changes to the pelvic floor and pelvic organs

As the fetal head descends, there is pressure on and stretching of the soft tissues and organs of the pelvis.

The bladder is drawn upward and becomes an abdominal organ, making more space in the pelvis for the fetus and lessening the risk of damage to the bladder. However, in the second stage, the urethra is frequently nipped between the bony prominences of the fetal skull and the pelvis.

The descending head stretches the vagina and may cause small lacerations of the vaginal mucosa, which may be seen as a trickle of blood from the vagina.

The posterior part of the pelvic floor is pushed downwards and is elongated and thinned out. The rectum is compressed by the descending head and faecal material may be forced out of the anus. The anus will start to pout and then to gape, revealing the anterior rectal wall.

The vaginal introitus will start to gape and the presenting part will then be seen in the vagina. At first, this may slip back, out of sight, between contractions. The perineal body and perineum are also pushed downward and elongated and as the head is crowning, the vaginal orifice, which is directed upward towards the subpubic arch, is stretched to allow the head to pass out of the vagina. Tearing of the tissues around the orifice may occur, usually in the perineal area, but occasionally laterally or upward into the clitoris.

At this stage it may occasionally be necessary to perform an episiotomy to prevent a third degree tear of the perineum or to aid in the hurried expulsion of the fetus if there is fetal distress. However, an episiotomy should only be performed at the optimum time and only when absolutely necessary, after infiltration with a local anaesthetic.

The birth of the baby

The head is flexed as it passes out from under the pubic arch and as the widest presenting circumference of the fetal head distends the vaginal introitus, the head is said to be *crowned* by the perineum. The head then extends at the neck and the perineum slips over the baby's forehead and the face, mouth and chin emerge from the vagina. The head is then born and there is a pause before the next contraction, when restitution (the undoing of the twist in the baby's neck) takes place. With this next contraction, the shoulders are forced onto the pelvic floor and the anterior shoulder rotates forward, forcing the shoulders into the anteroposterior diameter of the pelvis and at the same time causing the head to rotate externally so that the sagittal suture lies in the transverse diameter of the pelvis (the baby now faces the mother's thigh, either the left or the right depending upon the baby's original position in the uterus).

With the following contraction, the anterior shoulder escapes from under the pubic arch, the posterior shoulder slips out from behind the perineum and the rest of the body follows.

The remainder of the amniotic fluid is also expelled with the fetus. The mother, usually exhausted, relaxes for a few minutes, her attention directed towards the baby, which gasps convulsively once or twice and then cries vigorously.

The second stage ends with the complete birth of the infant and the third stage then commences.

When the head has almost crowned, the woman should stop bearing down and should pant, in small sharp breaths in order to allow the head and then the remainder of the infant to be born slowly and with control. This will help to prevent bad perineal lacerations (see Figure 27.2).

In addition, if the head remains well-flexed during crowning, then the smallest presenting diameter, the suboccipito frontal diameter of 10 cm, will distend the vaginal orifice. This will also lessen the chance of perineal lacerations. Only when this diameter, together with the biparietal diameter has been born, should the head be allowed to extend.

27.4 The diagnosis of the second stage of labour

The diagnosis of the second stage of labour (the phase of descent, followed by the perineal phase) is based on:

- symptoms experienced by the woman
- findings on general examination
- findings on abdominal examination and palpation
- findings on examination of the vulval and anal regions
- findings on vaginal examination.

It is only on *vaginal examination* that the diagnostic or conclusive sign of the start of the second stage of labour can be made. This is full dilatation of the cervix, which means that no cervix at all is felt during vaginal examination.

Anticipatory or warning signs of the start of the second stage of labour

There are both psychological and physical signs and symptoms which are suggestive of the commencement of the second stage

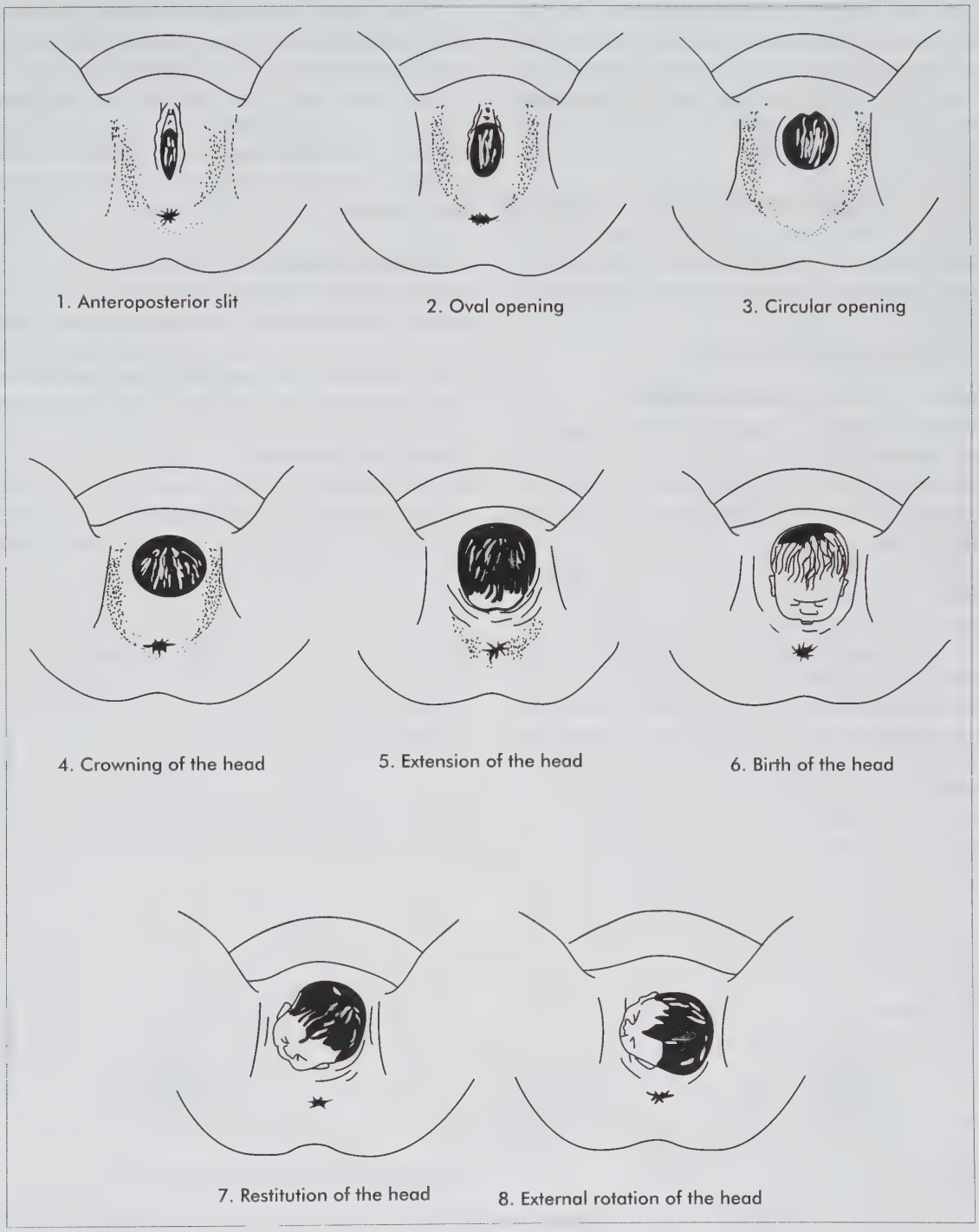


Figure 27.2 Labour: The birth of the head–dorsal position

of labour. As the woman should not be allowed to 'bear-down' before the cervix is fully dilated, these signs should be taken collectively in order to help in the diagnosis of the commencement of the second stage and as an indication of when the vaginal examination should be undertaken, in order to substantiate these findings.

Change in the character of the uterine contraction

At this stage the uterine contractions become very strong and of long duration and are expulsive in character. These contractions are very painful, unless the woman bears down during the contractions. The urge to bear down becomes compulsive and the woman cannot control herself.

Spontaneous rupture of the membranes

If the membranes are intact at the end of the first stage, they very often rupture spontaneously when the woman starts to bear down. This is, however, a very unreliable indication of the commencement of the second stage unless taken together with the other signs.

The fetus

The fetal heart rate patterns often change with the expulsive type of contractions and, if recorded during contractions, the fetal heart may fade altogether and may take longer to return to normal after contractions. The fetal heart rate drops to 80 but recovers immediately after a contraction. It is extremely important that the fetal heart is monitored diligently after each bearing-down effort during the second stage because of the high risk to the fetus.

If the fetal heart rate pattern is causing concern (drops below 80 and recovers slowly) and at the same time, the progress of the fetus becomes delayed, a skilled midwife or a medical practitioner must be notified. Forceps or the ventouse may then be used to hasten delivery.

A trickle of blood

There may be no bleeding at all. However, a trickle of blood may be noticed *at* the vaginal orifice. This could be due to a slight laceration of the cervix *in* the transitional stage, when the fetal head is forced through the external cervical os, and/or it may be due to slight lacerations of the vaginal mucosa as the head descends in the pelvis.

The tension between the coccyx and the anal margin, as the head descends in the pelvis (the phase of descent), is directed backwards at first (the curve of Carus) and compresses the rectum and the region between the coccyx and the posterior margin of the anus, and faeces may be expelled from the anus.

If the midwife gently presses this area with the palmar aspect of her middle finger (postanal palpation), she may notice a tenseness or hardness, which is the hard fetal skull pressing on the soft pelvic tissue. If the hard fetal head is felt, it is a fairly reliable indication that the head is at or below the level of the ischial spines and that the cervix is probably fully dilated. It is important to notice the fontanelles and sagittal suture position.

Pouting and gaping of the anus

Shortly after the tenseness is noticed in the anal region, the anus will start to pout as it is pushed outwards. As the head descends even further, the anus will gape and the shiny anterior rectal wall may be seen through the distended anal aperture, This is also a fairly reliable sign of the second stage.

Gaping of the vulva

When the head reaches the perineum (the perineal phase), it is directed forwards and upwards (following the curve of Carus) and the vulva starts to gape, which usually means that the presenting part is below the ischial spines and the cervix is fully dilated.

The appearance of the presenting part

The presenting part appearing at the vaginal orifice is an almost positive sign that the cervix is fully dilated, and when the presenting part is the fetal head, it is almost conclusive.

If there is excessive caput and moulding, however, this may just be visible in the vagina, although the actual bony skull of the fetus may still be above the ischial spines and the cervix not yet fully dilated. This is unlikely, but it can occur.

Bulging of the perineum

Bulging of the perineum is caused by the hard head compressing the perineum as the woman bears down during contractions. If this is seen and can be felt by pressing on the perineal area, it is almost always an indication that delivery is imminent.

However, even at this stage, an oedematous anterior lip of cervix can precede the fetal head.

Psychological or behavioural signs

Many women have a change of behaviour at the start of the second stage of labour, and the experienced midwife will recognise these signs.

The reason for these changes in character is that the contractions have become very painful and are of an expulsive character. The woman finds that the pain is relieved to a great

extent when she follows her urge to bear down. She is then no longer able to voluntarily control her actions, and with every good intention of breathing during contractions, she finds herself bearing down. She may at this stage make soft grunting noises in an effort not to bear down.

If she has been told not to bear down until the second stage, but the second stage has not yet been identified by the midwife, then the midwife will notice that the woman is surreptitiously bearing down, because she is unable to control this urge. Because she cannot help pushing 'on the quiet', this very often upsets and irritates the woman. She is no longer able to relax and breathe as before, but finds that she is pushing involuntarily and her attitude becomes one of dazed but determined bearing down. She starts to sweat and between contractions she is dazed, but during contractions she gets a slightly 'wild' look in her eyes. She may complain of nausea and she may start vomiting.

Once the midwife tells the woman that it is all right for her to bear down, she becomes 'open' and cooperative again and pushes with purpose.

Very occasionally, the woman may not have an urge to bear down at full dilatation. If this occurs, the midwife need not be concerned because the uterus will expel the fetus eventually, without any bearing-down efforts from the mother. The only time the midwife should be concerned, is if there are abnormal fetal heart rate patterns. If this occurs, a skilled midwife or a medical practitioner must be called; the mother's cooperation will be needed to deliver the baby as soon as possible with the assistance of bearing-down efforts, despite her having no urge to bear down. The skilled midwife or the medical practitioner may decide to apply forceps or the ventouse.

During the transitional stage, the woman may become flushed, and/or sweating or shivering may be noticed.

However, the woman may also perspire with the effort of bearing down, especially in high atmospheric temperatures. On the other hand, she may shiver between contractions if the atmospheric temperature is low.

The woman may become flushed if she is dehydrated and this may be a sign of maternal distress.

Some women vomit at the onset of the second stage. This is probably due to the very painful contractions experienced at this time or the stretching of the ligaments.

27.5 Management of the second stage of labour

It is standard practice to ensure that the bladder is empty before the woman starts bearing down because it will affect descent of the presenting part and also cause uterine inertia predisposing the woman to postpartum haemorrhage (see Figure 27.3). The woman and the accompanying person should be informed about the second stage of labour and what to expect. The necessary equipment is prepared when the woman is in advanced labour but before the cervix is fully dilated. Monitor the maternal pulse every ten minutes. Any signs of maternal distress should be noted and relevant action taken. Auscultation of the fetal heart rate is performed after every contraction if the fetal heart is not being monitored electronically. The woman's comfort is considered throughout the process. Aseptic technique should be observed during delivery. Various positions for delivery can be adopted (see Figure 27.4).

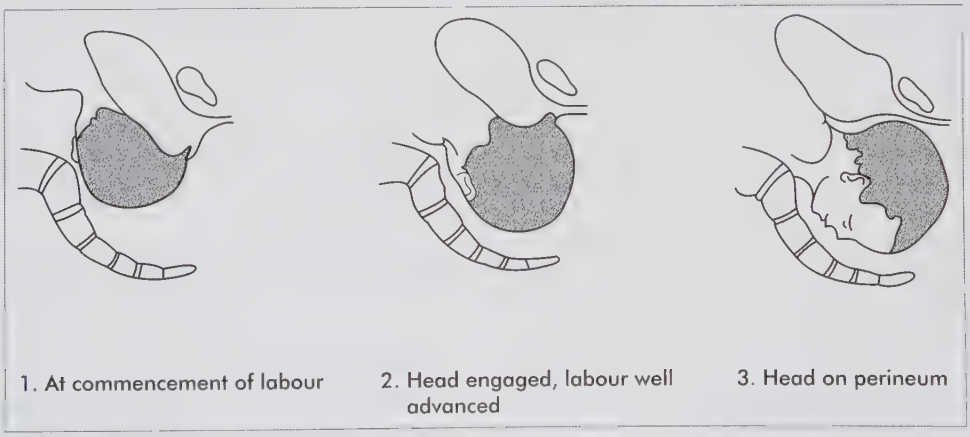


Figure 27.3 The bladder in labour

Positions that can be used during the second stage of labour

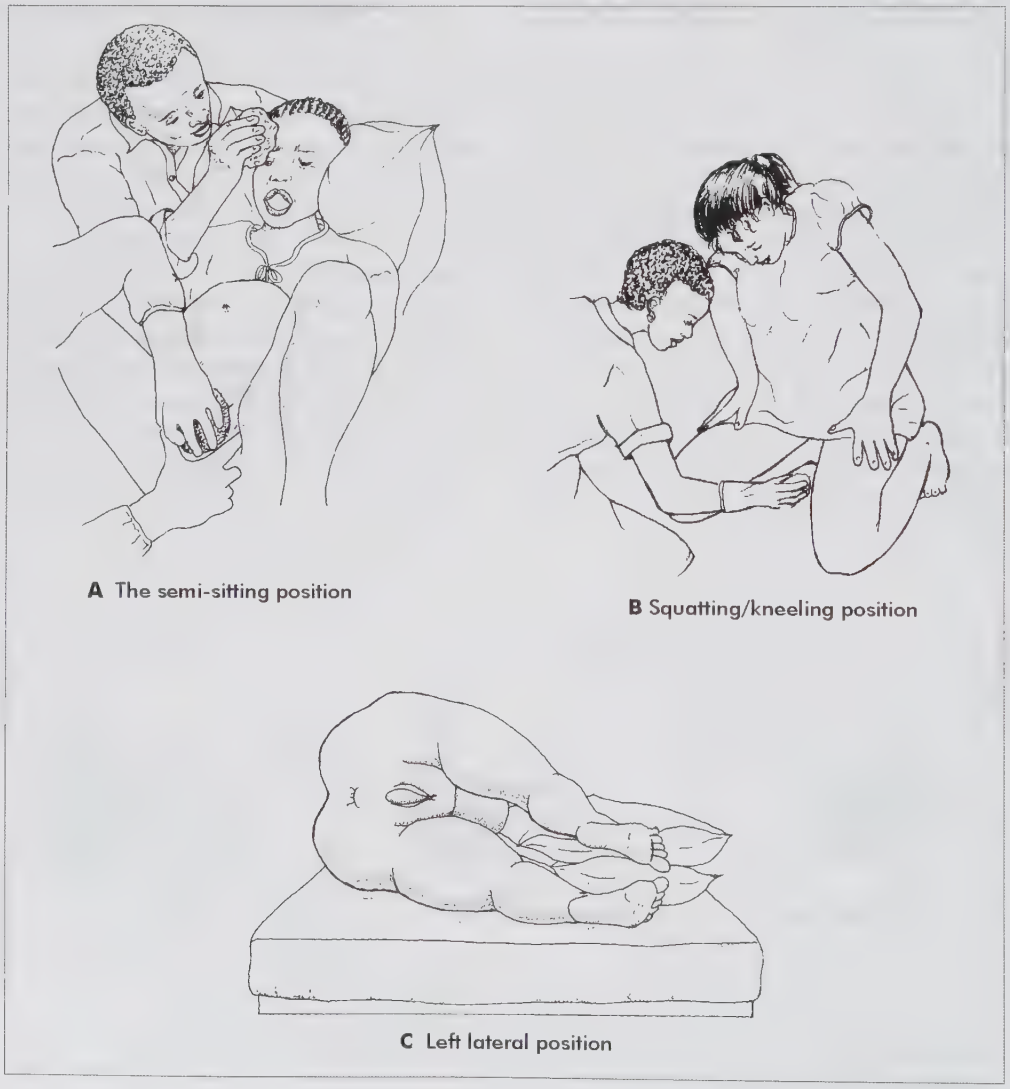
The woman should be encouraged to choose the position that is most pleasing and comfortable to her during labour. The midwife should also consider the circumstances under which the delivery is performed including the relevant skill of the midwife. The following are some of the positions which the woman can be assisted to adopt during delivery of the baby.

The upright and squatting positions

The history of midwifery shows that various cultures have adopted a wide variety of positions for delivery. However, the upright and squatting positions seem to have been most frequently used, therefore reducing the length of labour and possibly decreasing the difficulties/abnormalities.

Up until recently, these positions have not been used in modern obstetrics, but lately there has been a change of attitude and more attention has been given to the position of the woman in labour. The upright and squatting positions are now being more frequently adopted in normal deliveries (see Figure 27.4).

It has been determined that expulsive efforts are more efficient in the squatting position and that the second stage is thereby shortened. It has also been shown that, in the upright position, the pelvic inlet is widened and is more accessible to the descending fetal head. In addition, the force of gravity



27.4 Maternal positions during the second stage of labour

is used, and all these advantages facilitate the descent and engagement of the head. The diameters of the pelvic outlet are also said to be increased in the squatting position, which would inevitably lead to an easier and shorter perineal phase.

The main drawback to these positions is that the woman is upright and mobile and that it is less convenient for monitoring the mother and the fetal heart. In addition, it is difficult for the attendant to see what is happening in the vulval area. Midwives will, therefore, have to learn to adjust to the various 'new' positions of the second stage of labour, with regard to the actual delivery of the baby. In Africa, women naturally deliver in the squatting position. One advantage is the improved oxygenation of the fetus with a low incidence of inferior vena carva occlusion that interferes with placental blood flow.

The dorsal position

The dorsal position is sometimes known as the 'beetle on its back' position. This position that women have been encouraged to adopt for delivery was made popular by the Queen of England. Having the woman in the dorsal position is very convenient for the midwife or the medical practitioner because the vulval area is in full view, the fetal heart is easily accessible, contractions and the tone of the uterus are easily palpated, and good eye contact is possible with the woman in labour. However, *there are very serious drawbacks to the dorsal position.*

The disadvantages of the dorsal position include:

- supine hypotension, which may lead to fetal hypoxia and subsequent fetal distress
- inefficient uterine action, resulting in a prolonged second stage of labour
- the woman's ability to bear down and the effectiveness of her efforts are diminished in the dorsal position as the force of gravity is not used.

It has been suggested that shoulder dystocia (impacted shoulders) is more likely to occur in the dorsal and lithotomy positions than in other positions.

The semi-squatting/semi-sitting/modified Fowler's/ modified dorsal position

For the woman who is confined to bed, this is the ideal position for bearing down. It has all the advantages of the dorsal position, with less of the dangers. The woman's bearing-down abilities are enhanced and are made more effective, as they are directed downwards towards the pelvis and the force of gravity is used. The woman is propped up by pillows, by a backrest or by an adjustable headpiece to the delivery bed. Her legs are abducted and bent at the hips and the knees and the woman grasps her shins or thighs while bearing down (see Figure 27.4).

Lithotomy position

There is absolutely no need to use the lithotomy position in a normal labour. The lithotomy position is embarrassing and demoralising for the woman and is not without its dangers. If the staff are not careful when putting the woman into the lithotomy position, and when taking her legs out of the stirrups, or if she is left in the position for a long period, it can be the cause of serious hip, leg and nerve injuries and/or circulatory problems. The lithotomy position also has all the disadvantages of the dorsal position. Women with cardiac disease should avoid this position.

However, besides having all the advantages of the dorsal position, the lithotomy position also has certain advantages of its own, such as more space to manoeuvre the fetus, particularly during delivery of the shoulders if shoulder dystocia has occurred. It is, therefore, ideal for managing complications of the second stage of labour because of the easy access to the vulval area. The lithotomy position is almost exclusively used by obstetricians and skilled midwives when intervention is necessary. In addition, the lithotomy position is used for the suturing of the perineum.

N.B. Both legs must be elevated and lowered simultaneously before and after delivery. There is a limit to the time that a woman should be in this position.

It is only possible to use the lithotomy position if the necessary equipment is available such as a delivery table or bed with facilities for the insertion of lithotomy poles. The most up-to-date beds also have hand bars on either side for the woman to grasp during contractions and which help her to bear down; otherwise, the woman in the lithotomy position is not able to bear down very effectively (see Figure 27.5).

The (left) lateral position

The (left) lateral position, although a good position in the first stage of labour if the woman has to remain in bed and an excellent position for the actual delivery, is not the best position for bearing down. However, if the woman is unable to bear down, for instance after epidural analgesia, then lying in a propped-up lateral position (see Figure 27.4), leaving the uterus to do all the work, may be better than putting the woman into the lithotomy position too early.

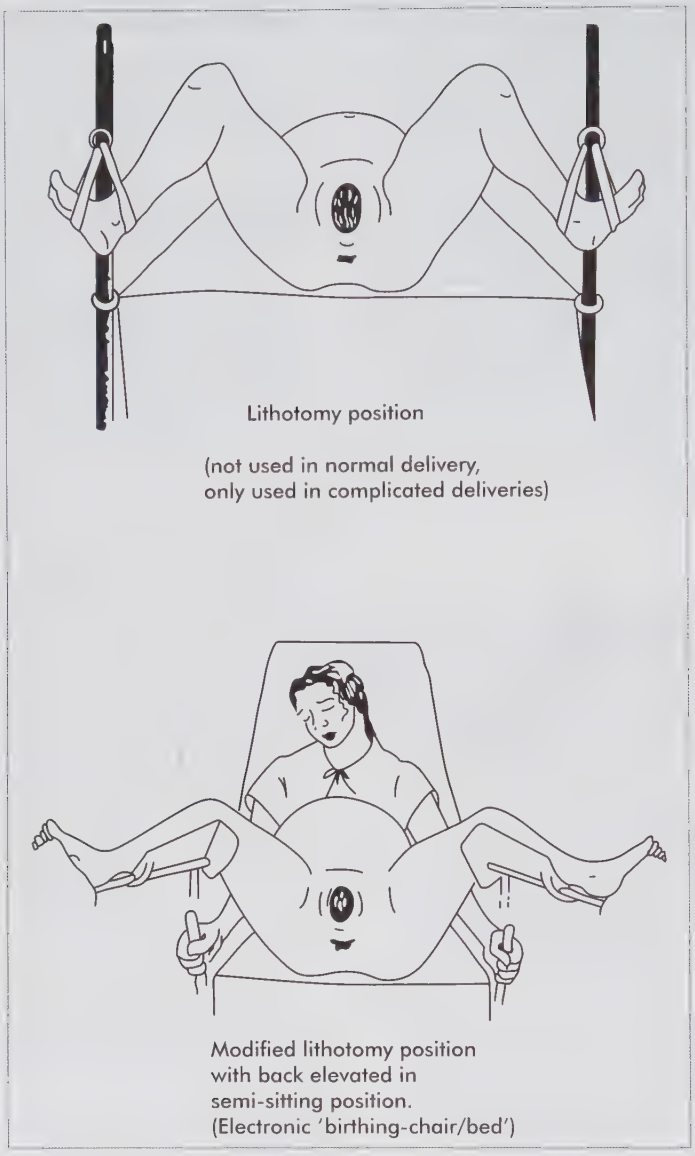


Figure 27.5 Lithotomy positions for delivery

There is less chance of fetal distress in this position and the uterine contractions are more effective.

Maternal observations during the second stage of labour

The second stage of labour is much shorter than the first stage, but, because of possible complications, it is even more imperative that frequent, accurate observations are carried out and that the progress of labour is continually being assessed and evaluated. The maternal pulse should be monitored after every 15 minutes and the fetal heart during every resting stage when the woman is not bearing down in between contractions. An electronic device is useful at this stage.

Descent of the presenting part

Increased descent of the presenting part should occur with every uterine contraction. In a normal cephalic presentation, there should be no receding of the fetal head. Receding of

the fetal head in between contractions may indicate shoulder dystocia. Observing the fontanelles and sutures are useful to confirm the position of the presenting part.

Care of the bladder

The bladder should be empty prior to instructing the woman to bear down. If the bladder is full, the woman should be asked to empty the bladder. If the woman is not able to pass urine the bladder should be emptied using a once-off catheter. In the case of an indwelling catheter *in situ* (epidural), it is removed in the second stage of labour and put back after the delivery.

Fetal observations

The fetal heart should be checked after every contraction, as fetal distress may occur if there is a delay in the second stage of labour or for other reasons.

Maternal wellbeing

During the second stage of labour, the mother's general psychological and physical condition should be monitored continually, particularly if she is a primigravida, as she may be anxious and frightened because she can feel the baby descending and this is a new experience for her and she is afraid of the possible trauma and pain.

In addition, the following observations are made:

- *her colour is noted*: whether she is flushed or pale
- *her skin temperature is noted*: whether she is sweating and how much, or whether her skin is hot to the touch
- *her urine is inspected for the colour/concentration and for the amount passed*: this is recorded on the input and output chart. The urine is tested for ketones.

Asepsis

Delivery of the baby is strictly an aseptic procedure. All instruments and drapes are clean and preferably sterilized before use.

It is absolutely essential that strict asepsis and antisepsis are observed during the second stage of labour. The midwife should take every precaution to ensure that the woman is not exposed to infection or cross-infection during or after labour. It is also very important that the midwife protects herself and any other women in labour from the possible danger of cross-infection. Handwashing, using gloves and eye protection are standard preventative strategies in labour.

Monitoring the fetal heart during the second stage of labour

A prolonged second stage of labour can predispose the fetus to hypoxia, therefore the fetal heart should be checked between contractions immediately after the contraction and compared with the baseline fetal heart rate and any decelerations noted. Any abnormal fetal heart rate patterns should be noted and if any late deceleration is noted and the heart rate takes more than 30 seconds to return to the baseline rate, the fetus needs to be delivered immediately.

Birth

The birth of the baby follows a series of steps known as the *mechanism of labour* (see Chapter 24).

The woman should be allowed to bear down until crowning of the head occurs; then she should be advised to pant the head out to allow for restitution. The head is born by extension in a occiput anterior position. Once the head is delivered the skilled attendant should check for the cord around the neck. If there is no cord around the neck allow delivery to progress. If the cord is loosely around the neck, it should be slipped over the baby's body and if it is too tight, the cord should be clamped and cut before the baby is delivered. This requires swift action as the baby can be asphyxiated.

Restitution and internal rotation of the shoulders should occur before the delivery of the anterior shoulder. Downward traction is applied on the lateral side of the head to deliver the anterior shoulder and lateral flexion of the body to deliver the posterior shoulder and the rest of the body is delivered onto the mother's abdomen to promote bonding (see Chapter 24).

Routine suctioning of the baby is discouraged unless the secretions are unusually thick. If secretions are few a gauze swab is used to wipe the baby's mouth. The cord is clamped and cut (see Figure 27.6). Timing of clamping of the cord varies with local protocols. Active management of the third stage of labour involves administering an uterotonic drug with delivery of the anterior shoulder of the baby or within 30–60 seconds after birth. Delaying clamping the cord for two to three minutes seems not to increase the risk of postpartum haemorrhage and can improve the iron status of the infant where access to good nutrition is poor, although delaying clamping increases the risk of jaundice, requiring phototherapy.

The eyes of the newborn are wiped to prevent ophthalmia neonatarum and an eye ointment is instilled according to local protocol. The Apgar score is assessed at one and five minutes. The baby is dried, wrapped in warm towels and placed on the mother's abdomen or under a radiant heater. The infant is given Konakion® (vitamin K_1) according to the local protocol to prevent haemorrhagic disease of the newborn.

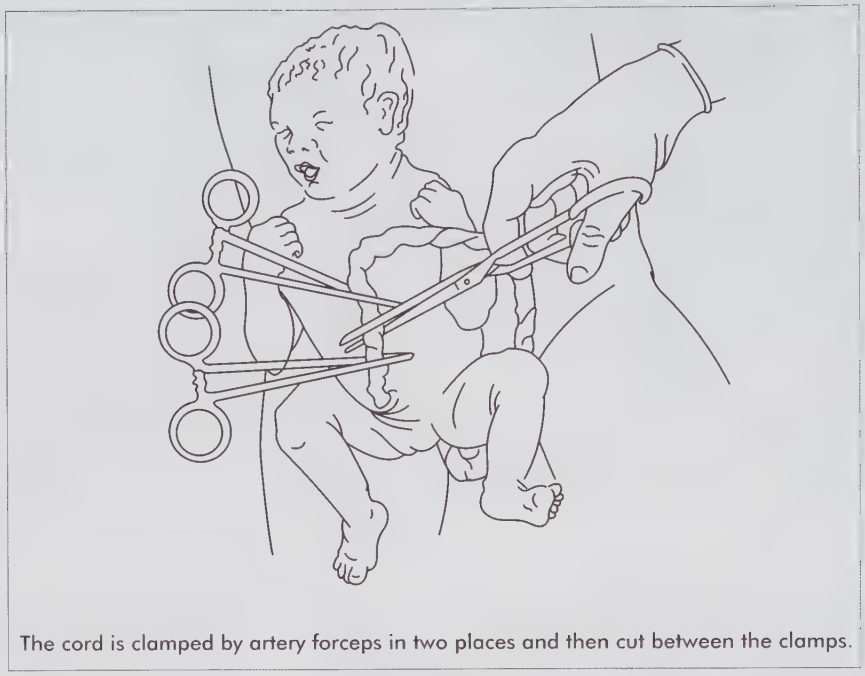


Figure 27.6 Clamping and cutting the umbilical cord at delivery

27.6 The physiology and management of the third stage of labour

The definition of the third stage of labour

The third stage of labour starts with the complete birth of the baby and ends with the delivery of the placenta and membranes.

The delivery of the placenta entails firstly its separation from the uterine wall. This is followed by the descent of the placenta into the lower uterine segment and then its expulsion from the uterus and vagina.

If left to nature, the placenta would in most instances separate with the first few contractions (in the first five minutes) after the birth of the baby and then when separated from the uterine wall, would be expelled by maternal effort. However, because of the danger of postpartum haemorrhage, the preferred practice is the active delivery of the placenta. As a rule 10 IU oxytocin is given intramuscularly with the delivery of the anterior shoulder (in a singleton) or directly after the delivery of the baby. The placenta is then delivered by controlled traction.

The physiology of placental separation

The separation of the placenta is facilitated with the expulsion of the baby from the uterus at birth and the surface area of the inner uterine cavity is greatly decreased when the uterine muscles continue to contract and retract. This has the effect of causing a portion of the placenta, which is unable to contract with the muscle, to become detached from the uterine wall at its implantation site – a shearing-off of the placenta from the uterine wall. (Rather like a piece of inelastic material stuck to the surface of a stretched piece of elastic – when the elastic is allowed to contract, the piece of material becomes detached from the surface of the elastic, because it is not able to contract with the elastic.)

During pregnancy, the endometrium becomes known as the decidua of the uterus and develops into specialised layers. The inner basal layer is separated from the spongy layer by 'the fibrinous layer of Nitabuch', which is also known as the 'postage-stamp layer'. This layer prevents the chorionic villi of the trophoblast from penetrating into the basal layer of the decidua and so into the myometrium. It is also this layer which allows the uniform separation of the placenta from the decidua during the third stage of labour, hence the name 'postage-stamp' layer, because it allows the placenta to shear-off from the uterine wall, like one postage stamp from another.

When a portion of the placenta becomes detached from the uterine wall, blood vessels from the uterus, which carry blood to and from the maternal side of the placenta, are ruptured and there is an outflow of blood between the decidua and the maternal

surface of the placenta. This extravasation of blood causes further detachment of the placenta from the uterine wall.

The uterine muscles, if functioning efficiently, will continue to contract and retract, and will complete the detachment of the placenta from the uterine wall.

The placenta will fall into the collapsed lower segment of the uterus and the contracting and retracting uterus will then push the placenta into the vagina.

The signs and symptoms of placental separation and expulsion are:

- The uterus is tightly contracted and retracted and becomes hard and round (like a cricket ball).
- The uterus can be palpated abdominally through the maternal anterior abdominal wall, between the rectus abdominis muscles. It also rises in the abdomen because it is trying to push the placenta out.
- A fresh trickle of blood is noted vaginally.
- Finally, the placenta is expelled from the birth canal by maternal effort.

The membranes are usually detached from the uterine wall merely by the weight of the placenta descending in the birth canal, causing traction on the membranes and thereby stripping them off the decidua.

The average amount of blood loss in a normal third stage of labour is 150–250 ml.

The two main types of placental separation and expulsion

The placenta separates in one of two ways, and the manner of the separation prescribes the way in which the placenta will emerge from the birth canal. These two types of separation and expulsion of the placenta are recognised and explained below.

The Schultze (shiny) method

This type of separation usually occurs when the placenta is implanted high-up near or in the uterine fundus. Here, the centre of the placenta separates from the uterine wall first, the blood (retroplacental clot) collects in the centre of the placenta and causes the placenta to invert as it descends in the uterus and birth canal. In this way, *the shiny fetal surface emerges from the vaginal orifice first*, with the blood clot contained within the membranes, and very little blood is spilt. The membranes are usually intact except for the hole through which the baby was born.

The Matthews-Duncan (dirty) method

This type of separation may occur where the placenta is implanted in the side of the uterine body. Here, the lower edge of the placenta separates from the uterine wall first, causing bleeding which dislodges the membranes below the bleeding and blood escapes from the uterus, into the vagina and eventually out of the vaginal orifice. The separation continues upwards and when it is complete, *the lower edge of the placenta slips through the cervical os and emerges from the vaginal orifice first*, often together with a gush of blood, to be followed by the maternal surface of the placenta and torn and ragged membranes (see Figure 27.7).

The physiological process of haemorrhage control in the third stage

The control of haemorrhage in the third stage of labour is brought about by two main physiological processes; these are the normal coagulation process of the blood and the constricting effect of the uterine muscles. The coagulation process occurs with any wound, from the release of thromboplastins through to the formation of fibrin (see Figure 27.8). The so-called 'living ligature' effect of the criss-cross muscle fibres of the myometrium (see Figure 27.9) causes the constriction of the contacting and retracting uterine muscles on the blood vessels which controls blood loss.

The failure of either of these physiological processes will result in uncontrolled haemorrhage. If the uterus is able to contract, but there is a failure of the coagulation process, there will be continued bleeding, which in itself will eventually prevent the uterus from contracting efficiently. Conversely, if the coagulation process is normal, but the uterus is atonic, severe haemorrhage can result.

The musculature of the uterus is arranged in such a way that the contracting and retracting of the criss-crossing uterine muscle fibres, after the birth of the baby and the separation of the placenta, controls the bleeding from the exposed blood vessels. (If there is no separation of the placenta, there will be no bleeding from the placental site.)

The smooth muscle fibres of the uterine musculature are arranged in figures of eight around the blood vessels as these vessels pass through the uterine wall. Therefore, contraction of the uterus following delivery of the baby constricts the vessels that had previously supplied blood to the placenta.

As the uterus contracts and retracts, the bleeding from the placental site is controlled. In fact, the efficiency of the uterus is directly proportionate to the efficient separation of the placenta and the efficient control of haemorrhage, if the clotting mechanism is normal (see Figure 27.9).

Disturbances in the normal physiological process of haemorrhage control

Several factors may interfere with normal third stage physiology.

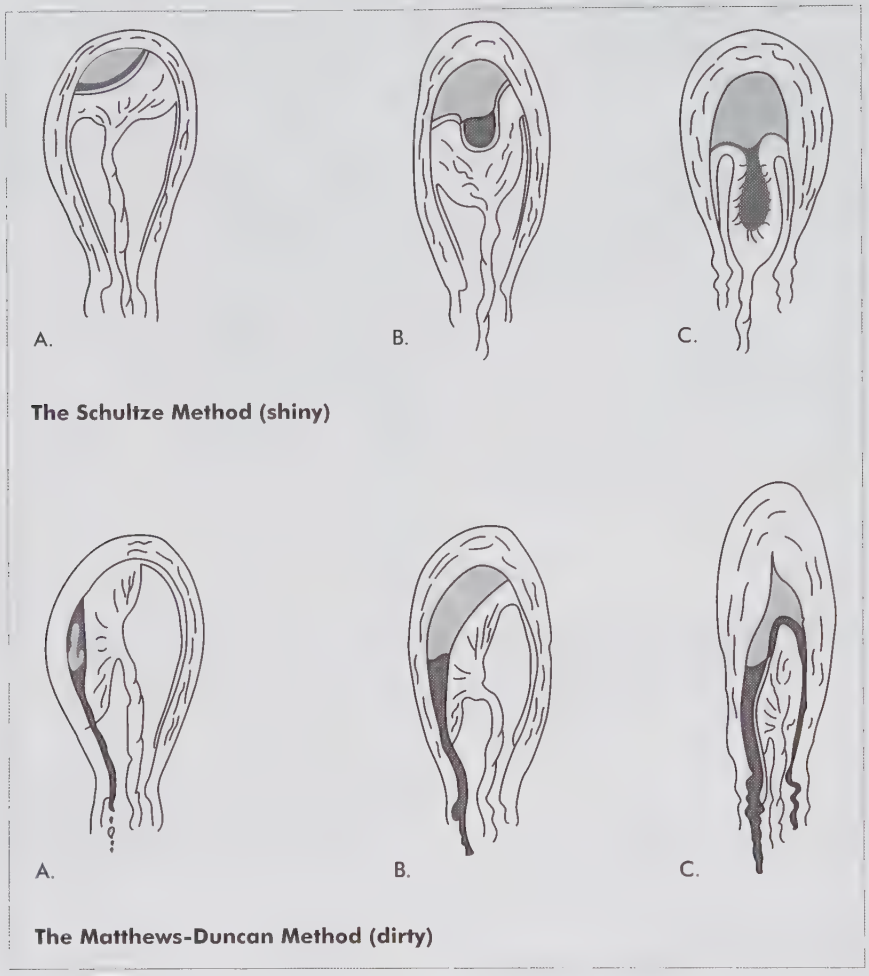


Figure 27.7 Types of placental separation

Coagulation failure

The failure of the blood to clot can be caused by several conditions:

- *Disseminated intravascular coagulation (defibrination).* Due to fibrin degradation products in the blood circulation. The main conditions predisposing to DIC are pre-eclampsia/eclampsia exacerbated by placenta abruption, or a dead fetus remaining *in utero* for longer than four weeks.
- *Blood dyscrasias.* In rare instances, haemorrhage in the third stage can be due to inherited blood disorders, such as Von Willebrand's Disease with a defect in the Factor VIII complex and platelet function, or to other bleeding disorders caused by a deficiency in a blood factor. Platelet disorders such as thrombocytopenia and rarely, leukaemia, may also be the cause of coagulation failure.

Atonic uterus

Factors preventing the efficient contraction and retraction of the myometrium:

- *A full bladder.* This displaces the uterus and prevents efficient contraction and retraction of the muscles.
- *Overstretched uterine muscle fibres.* This can be due to a large baby, polyhydramnios or multiple pregnancy.
- *Tired or debilitated muscle fibres.* These could be the result of prolonged or obstructed labour, anaemia, gross malnutrition, high parity. The administration of anaesthetic agents may result in an inert uterus.
- *Abnormal uterine action.* Bleeding can occur as a result of incoordinate uterine action, or a constriction ring. Both of these could be caused by mismanagement on the part of the attendant (mishandling of the uterus) or by the inappropriate use of uterine-stimulating medications (oxytocics), such as ergometrine, prostaglandins or oxytocin.

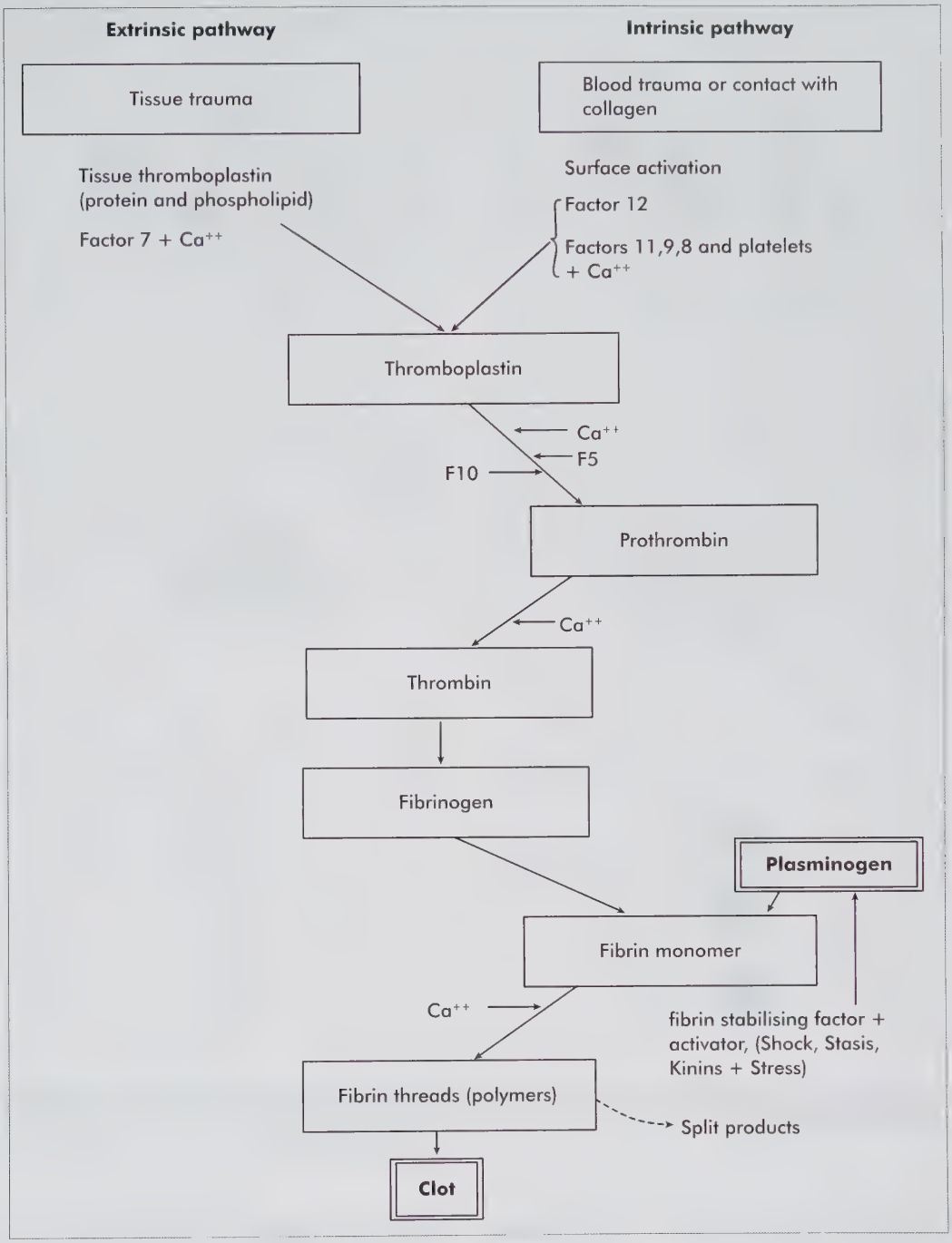


Figure 27.8 The normal coagulation process of the blood (the formation of a blood clot)

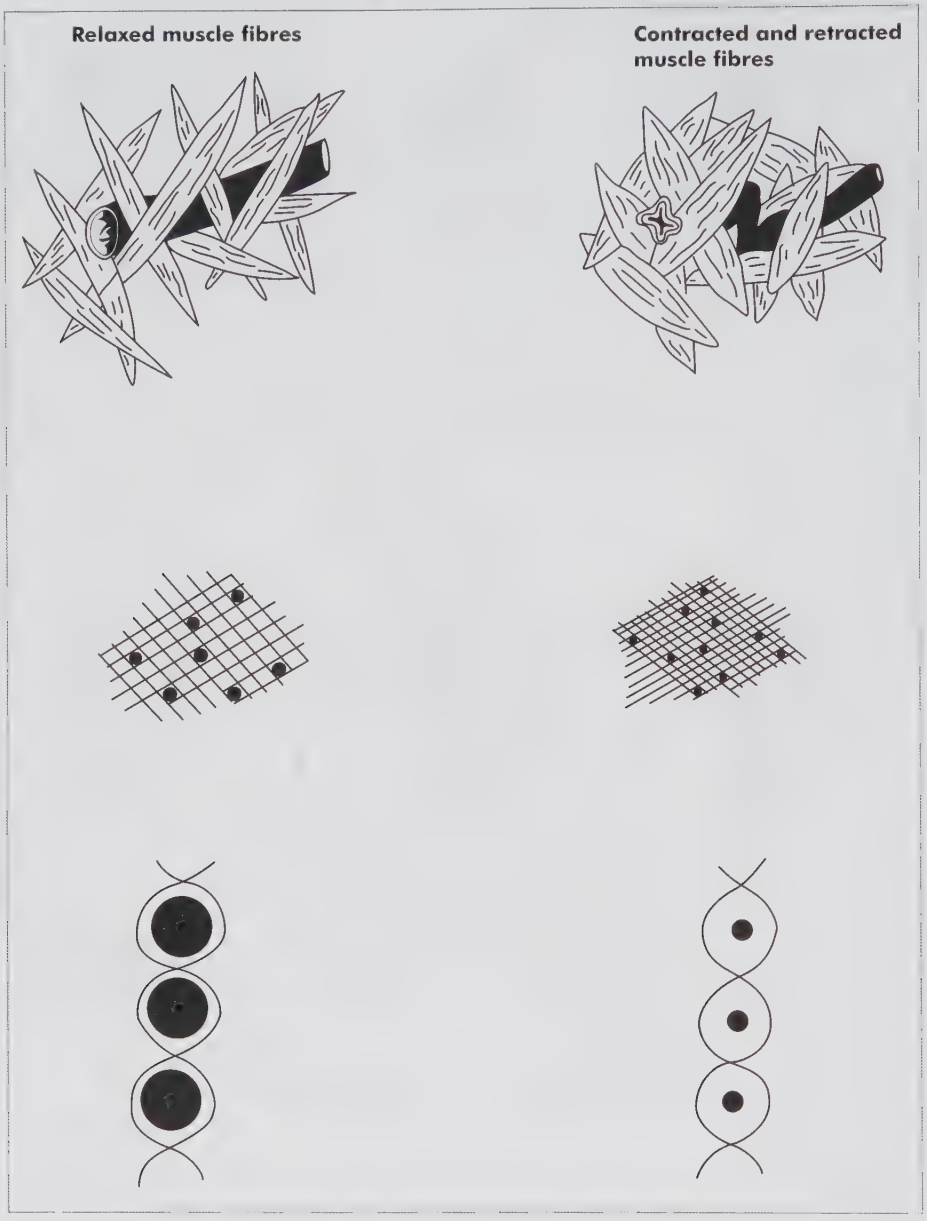


Figure 27.9 The constricting effect of uterine muscles on blood vessels

- *Mismanagement of the third stage.* Partial separation of the placenta could be caused by mismanagement on the part of the attendant.
- *Placental pathology.* Partial separation of the placenta could also be due to a partial placenta accreta.
- *Abnormal presentation.* Partial premature separation could also occur in a breech delivery, or after the delivery of the first baby/babies in a multiple pregnancy.
- *Retained products of conception.* Any piece of placenta or membrane which is retained within the uterus could prevent the efficient contraction and retraction of the uterus and cause haemorrhage from the placental site. It is very important, therefore, for the midwife to examine the placenta and membranes carefully to ascertain if the complete placenta has been expelled.

27.7 Care during the third stage of labour

The third stage of labour involves separation and expulsion of the placenta and membranes as a result of interplay of mechanical and haemostatic factors. Generally the third stage lasts about 5–15 minutes in active management. Two approaches in the management of the third stage of labour are described: the expectant or physiologic management and the active management of the third stage of labour (AMTSL).

The expectant or physiologic management involves waiting for signs of placental separation and allowing for spontaneous delivery of the placenta. NB: The bladder must be empty.

In the natural passive approach, the attendants are passive and they wait for the physiological process to continue unhindered, and intervention is only undertaken if haemorrhage or some other complication occurs. This includes waiting for the signs of separation of the placenta to occur (see Table 27.1). If the woman is not bleeding this period can be prolonged to a few hours. Blood loss is increased.

Active management

The active management of the third stage involves clamping and cutting the umbilical cord immediately after delivery of the infant, administration of 10 IU oxytocin IMI and the delivery of the placenta using controlled cord traction and applying concurrent counter indirect pressure on the uterus (see Figure 27.10). After delivery of the baby, the uterus is immediately palpated to exclude undiagnosed multiple pregnancy. The 10^4 oxytocin is administered intramuscularly within one minute of the delivery of the infant and the placenta delivered by controlled cord traction. A second trained person must care for the baby (immediate care of the newborn). Once the baby is born, the midwife should continue to reassure the woman and her husband/partner on the baby's condition and other care processes.

In the meantime the woman should be in the dorsal position, so that the uterus can be easily observed and the uterus should remain in the midline. (If the woman has delivered in the left lateral position, she should be turned into the dorsal position, keeping her legs together so that air is not sucked into the vagina and possibly the uterus during turning.)

It is essential that the woman's bladder should be empty. The bladder should have been attended to before the end of the second stage of labour, but if the uterus is not in the midline, and is not well contracted, the woman should be catheterised, as a full bladder can lead to postpartum haemorrhage. Figure 27.10 illustrates the active delivery of the placenta.

NB. Indirect traction is used with contractions of the hand behind the symphysis pubis. The traction of the vagina keeps tension on the cord, with the elbow resting on the bed. The hand behind the symphysis pubis pushes the uterus away. The placenta will be released and appears in the vagina.

If direct traction is applied or the uterus is rubbed while the placenta is *in situ*, the cord can snap (separating from the placenta), or the uterus can be pulled out while the placenta is still attached causing the inversion of the uterus.

The rule in third stage labour is 'hands-off' the fundus.

Stimulating uterine contractions

Rubbing-up the fundus of the uterus is only done after the placenta has been delivered. The hand is gently but firmly pressed against the fundus and then rotated in tiny circular movements. This causes the uterine muscles in the fundus to contract and so helps the uterus to expel any blood or clots which may have filled the uterine cavity.

The procedure is undertaken if the fundus has risen in the abdominal cavity after the third stage of labour. However, the

Table 27.1

Normal uterine consistency and the height of the fundus in the third stage

The uterus	At start of third stage (placenta attached)	Placenta in lower segment or in vagina (separated)	At end of third stage (placenta expelled)
Uterine consistency	Feels wide but firm – like a beach ball (*not* soft and flabby).	Feels round, smaller and hard, like a cricket ball: ballotable.	Has no specific from, but is firm and immobile (not soft and flabby).
Fundal height	About 2.5 cm below the umbilicus.	At or just above the level of the umbilicus.	4-5 cm below the umbilicus.

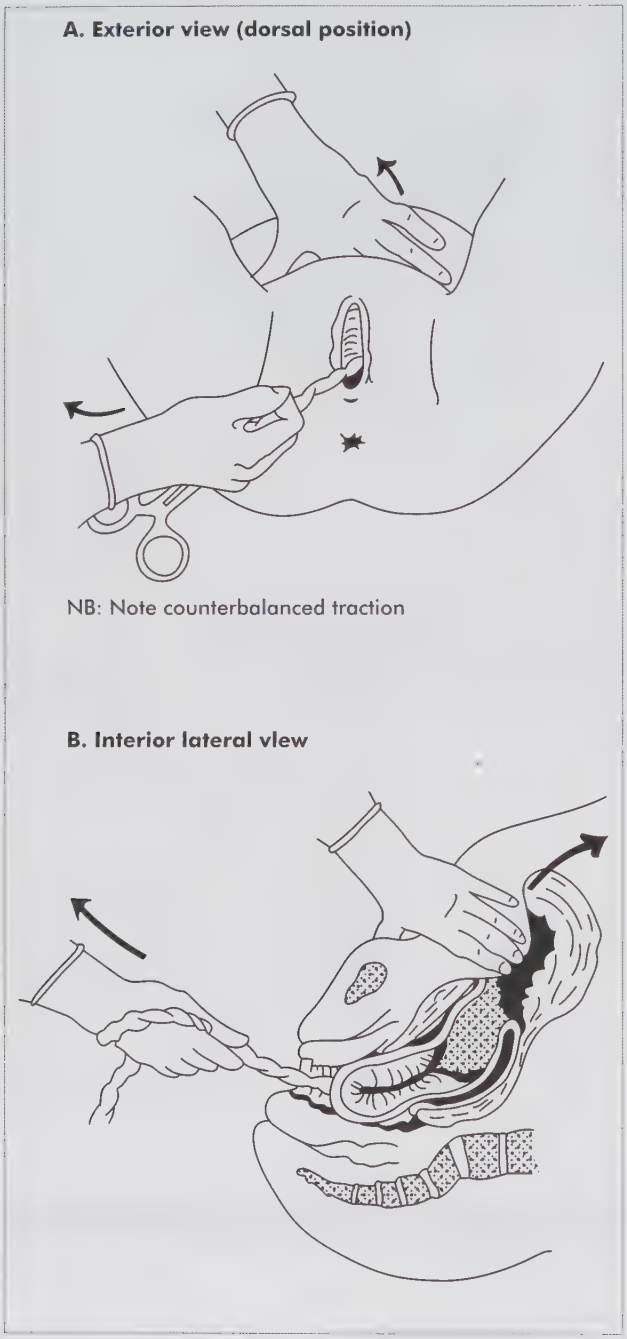


Figure 27.10 Controlled cord traction

fundus must NOT be repeatedly rubbed-up as this would prevent the blood from clotting at the ends of the constricted maternal uterine blood vessels and would therefore increase the danger of postpartum haemorrhage.

Checking the fundus means placing the hand on the fundus in a similar position, in order to establish whether the fundus is well contracted and to determine its position in the abdominal cavity, but does NOT include pressing or rotating the hand.

Guarding the fundus means holding the hand over the fundus in order to prevent the uterus from filling up with blood, but does NOT include rotating the hand.

27.8 Conclusion

- The second stage of labour extends from the time the cervix is fully dilated up to the time of delivery of the baby.
- The baby should be delivered on the mother's abdomen to initiate the bonding process if in a good condition.
- The baby should receive an eye ointment to prevent ophthalmia neonatorum and Vitamin K_1 to prevent haemorrhagic disease of the newborn.
- All babies should have identity bands bearing the mother's name as a form of identification and reduce the chances of mothers and midwives mixing up and eventually swopping the newborn babies.
- The third stage of labour begins immediately after delivery of the baby up to the time the placenta and membranes are delivered including the time when homeostasis is achieved.
- Separation of the placenta begins from the centre of the placenta and blood collects behind the placenta resulting in formation of a retroplacental clot.
- Occasionally the placenta may separate from the edges and blood trickles from the placenta resulting in the retroplacental clot not being formed. The placenta is delivered with the maternal surface coming out first.
- The placenta can be delivered using the physiological process or active management. The physiological process does not include any intervention; it is a 'hands off' approach, while the active management involves administration of a uteronic drug and delivering the placenta by controlled cord traction.

The management of haemorrhage is described in Chapter 21.

CHAPTER

28 Care and management of the fourth stage of labour and newborn care

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- explain the physiology of the fourth stage of labour
- demonstrate knowledge and skill in the management of the fourth stage of birth
- explain all the observations to be carried out during the fourth stage and give a rationale for each observation
- show competency in using standard procedures in the examination of the placenta.

KNOWLEDGE ASSUMED TO BE IN PLACE

Physiology of the third stage of labour, maternal–child bonding

KEYWORDS

Bonding • Infant feeding • Placenta • Ophthalmia neonatorum • Infant mortality

28.1 Introduction

The fourth stage of labour is defined as a period of one hour after birth. Breastfeeding is initiated in this hour. The perineum and cervix are examined for tears or lacerations. Any lacerations, tears or episiotomy should be repaired immediately to reduce the incidence of infection. The amount of blood loss is estimated to exclude postpartum haemorrhage and should not exceed 500 ml or enough to cause a change in maternal condition. The placenta and membranes are examined at birth and under running water to make sure it is complete.

Palpate the uterus to check if it is well contracted and check the perineal pad for blood loss before transfering the mother to the postpartum ward. The maternal condition is observed and vital signs are checked (blood pressure, temperature and pulse). All observations should be recorded and essential records completed. Physiologically the temperature is normal, the pulse is less than 90 bpm and the blood pressure is lower than the values at birth. Any abnormalities must be reported. The woman is usually tired and thirsty. A cup of tea or drink is offered.

Psychology – bonding

Immediately after delivery, the baby is usually wide awake, with open eyes and a strong urge to suckle, while the mother and the father may be full of awe and wonder, often with strong protective maternal and paternal feelings. This is, therefore, a good time for the family, including older siblings if desired, to share in the process of getting acquainted with the new addition to the family (see Chapter 12).

28.2 Basic principles of the management of the newborn

Care before birth

During pregnancy and labour, the mother and the fetus are monitored closely to detect the first signs of any abnormal conditions. Should any abnormality be noted, the woman is immediately referred to a medical practitioner, and the woman and the fetus are treated accordingly. The cardiovascular changes at birth are explained in Chapter 7, also see colour illustrations Figures 7.35 **(C11)** and 7.36 **(C12)**.

Care during and immediately after delivery

Preparation for delivery of the baby should be done towards the end of the first stage of labour when the second stage of labour is approaching. By this time the midwife can anticipate the possible condition of the baby at birth and be able to make the necessary preparations. When labour is progressing well, the condition of both the mother and the fetus is satisfactory, therefore the baby will not need any resuscitation. If the fetus has suffered intrapartum hypoxia, the baby is likely to be asphyxiated at birth and will require active resuscitation (see Chapter 45).

The environment should be warm to prevent hypothermia and the atmosphere in the labour room at the birth of the baby should be quiet and calm.

Careful management during delivery is extremely important in order to ensure a healthy live infant (see Chapter 27).

Immediate care of the neonate

The two most important actions in the immediate care of the neonate are establishing respiration and maintaining the baby's temperature.

The immediate care of the newborn includes the following:

- Deliver the baby on the mother's abdomen to establish bonding. Keep the baby covered.
- Assess the general condition of the baby and note the type of respiration immediately following delivery. This will assist in determining the subsequent care of the baby. Identify whether or not the baby will need active resuscitation. Assess and record the Apgar score one minute and five minutes following birth.
- Clamp and cut the umbilical cord and avoid milking the umbilical cord.
- Show the baby to the mother and ensure that the mother confirms the sex of the baby and put the nameband on the baby's ankles in her presence.
- Quickly dry the baby. If the baby requires resuscitation inform the mother, and the assisting midwife will initiate resuscitation procedures and inform the medical practitioner/paediatrician if necessary. The aim is to initiate, establish and maintain adequate respiration at birth.
- Identify the baby by placing a nameband with the mother's name on the baby according to the local protocol on identification of the newborn.

28.3 Standard midwifery care of the newborn baby

Use universal precautions at all times. In order to give the best possible care to the infant at birth, the following regime should be adhered to immediately after delivery.

If the mother wishes to deliver the baby herself, the midwife should help her to reach down and grasp the baby around the thorax, under the arms, and lift the infant onto her abdomen and continue to give the necessary encouragement, guidance and instruction at this time. If the mother does not wish to deliver her own baby, as the baby is delivered, the midwife holds the baby around the thorax with one hand, at the same time supporting the head. The baby is very slippery at birth and therefore, with the other hand, the midwife must grasp the baby firmly but gently by the ankles, keeping the forefinger between the ankles to protect them. The time of birth should be noted. The baby is safely put on the mother's abdomen and covered.

Clamp and cut the cord

The optimum time for clamping and cutting the umbilical cord remains debatable. In the normal newborn baby, the umbilical arteries go into spasm at delivery, which prevents blood from passing from the placenta to the baby. Whether it is good or bad to delay clamping of the cord until the baby has taken a few breaths in order to encourage transfusion of blood via the umbilical vein into the fetal circulation has not yet been resolved. It has been shown, however, that at three months after delivery there is no difference in the haemoglobin content between babies with early or those with late clamping of the cord. On the other hand, there is a greater incidence of neonatal jaundice where clamping has been delayed, and this is of particular significance in preterm babies and in babies with Rhesus incompatibility.

If the baby is asphyxiated, immediate clamping and cutting of the umbilical cord is necessary, as these infants will require resuscitation. The cord is clamped with artery forceps from the delivery pack, 5–6 cm from the baby's abdomen. The cord is clamped by a second pair of forceps about 2–3 cm above the first clamp, on the placental side (see Figure 27.6). The cord is cut between these forceps with scissors from the delivery pack and protected by a gauze swab, to prevent blood from spurting over the baby, and also to protect the wriggling baby from the blades of the scissors. If the mother is Rhesus negative with antibodies, or has any other haematological condition that requires this, cord blood is taken from the placental side of the cord.

Maintain body heat

The baby should be dried as soon as possible after birth, and wrapped in a warmed towel. Measures should be taken to maintain the baby's body temperature. The baby

is placed over the mother's abdomen to maintain skin-to-skin contact with the mother as this provides better warmth and promotes early bonding. The delivery room and the resucitaire or cot should be warmed and unnecessary exposure of the infant must be avoided. If the mother needs special attention after birth, such as suturing of the perineum, the baby may be placed by the mother's side, kept warm and watched carefully or in a rescucitaire and should not be left alone in cold and draughty places. Cover the baby's head, but make sure that the nose and mouth are open.

Apgar scoring

At precisely one minute after birth, the Apgar Score Rating is done. This is a system used to assess the condition of the baby at birth. This is repeated at five minutes (see Table 28.1).

The infant's physical condition is objectively assessed and documented using this score:

- The score at one minute indicates whether the newborn infant requires immediate resuscitation.
- The score at five minutes gives an indication of the success of the infant's adaptation to extrauterine life.

Apgar scoring rating:

- 7–10 normal
- 4–6 mild birth asphyxia
- 0–3 severe birth asphyxia.

Initiation of respiration

The normal newborn baby should take its first cry within 60 seconds following delivery. No suction is required and if there are any secretions sterile gauze should be used to clear the mouth. The baby should only be suctioned in the following circumstances:

- Baby fails to initiate respiration at birth within 60 seconds.
- Meconium is present in the amniotic fluid or on the baby's skin.
- Excessive secretions are noted at delivery.

Risk factors associated with resuscitation of the newborn

When suctioning of the newborn is indicated, a gentle and brief aspiration first of the mouth and then the nose, should be sufficient to remove any mucus or fluid. The suction catheter should not be pushed to the back of the baby's throat as it may cause damage to the mucous membranes (no suctioning should be carried out on a baby who cries immediately after birth and a baby with no observed secretions). (See Box 28.1.)

28.1 Factors during labour that are associated with neonatal resuscitation

- assisted delivery, e.g. forceps or vacuum extraction
- abnormal presentations, e.g. breech
- premature labour
- prolonged rupture of membranes
- delayed second stage of labour
- antepartum haemorrhage, e.g. placenta praevia or placental abruption
- abnormal fetal heart rate
- cord prolapse
- uterine tetany due to induction of labour.

Table 28.1

Apgar scoring

Sign	Score		
	0	1	2
Heart rate	Absent	Under 100 bpm	Over 100 bpm
Breathing	Absent	Slow and irregular	Breathing actively or crying loudly
Muscle tone	Absent	Some flexion of the extremites	Arms and legs in flexion Active movement at times
Response to stimulation	Absent	Grimace	Cough, sneeze or cry
Colour	Pallor or central cyanosis	Body pink, but extremities are cyanosed	Body and extremities are pink

However, if mucus, amniotic fluid or meconium is present in the upper respiratory passages at birth, this can be inhaled into the bronchi and could result in atelectasis or pneumonia in the neonate. It is, therefore, imperative that the air passages are cleared before the baby tries to breathe. Suctioning should be carried out with a soft catheter, using a low negative pressure, not exceeding -10 cm H_2O, and should be gentle and brief to avoid reflex apnoea and bradycardia.

If the infant does not breathe well soon after birth, the midwife should provide stimulation, by flicking the baby's feet with his/her fingers or by gentle rubbing with a warmed towel. If this does not result in adequate respiration, then 100% oxygen should be administered through a face mask and the feet flicked again. A few gasps of oxygen are, in most instances, all that is required to establish and maintain respiration.

If, however, the baby still does not breathe adequately, then all midwives need to be competent to act in accordance with protocol to resuscitate the newborn. If the mother received pethidine shortly before delivery, then the baby may be given an intramuscular injection of naloxone hydrochloride (neonatal Narcan®) 0.01 mg/kg (see Chapter 45).

Identify the baby

Two identification bands should have been prepared for the baby before delivery. These must bear the mother's name, the sex, the birth date, and time and type of delivery. These details must be verified verbally with the mother before the birth and again when being attached to the baby immediately after birth. One identification band is placed on the baby's wrist and another on the baby's ankle.

In some centres, the baby is identified before the umbilical cord is cut, in order to avoid any chance of mixing-up or interchange of babies. This can easily happen if the baby is not identified immediately at birth, and is a serious legal safety matter. It is, therefore, very important to impress upon everyone concerned the necessity for immediate and correct identification of the baby. It is important that the mother notices a feature to identify her baby. A hand- or footprint of the baby is made in the mother and baby's file.

Remove the baby from the mother's abdomen or bed

The baby is gently removed from the mother's abdomen, while explaining why this is necessary. The baby is laid on a safe, horizontal surface nearby, on either his/her left or right side. The baby's general condition is noted, in particular, whether the breathing is satisfactory (in some centres this is done while the mother is still holding the baby). The baby is weighed and measured.

Care of the eyes

The eyes should be cleaned and an eye ointment applied. Eye care is provided according to local protocol. The baby's eyes are wiped with sterile cottonwool swabs and sterile water and an eye ointment is applied after the delivery of the baby to prevent the risk of ophthalmia neonatorum (gonococcal infection), which might lead to blindness. The common eye ointments used include chloramphenicol, erythromycin or tetracycline. These eye ointments are also active against Chlamydia infection.

Care of the cord

A sterile, disposable plastic umbilical clamp is attached to the cord about 2.5 cm above the umbilicus and the forceps are removed. Ensure that the clasps in the clamp are tightly closed, to prevent any chance of haemorrhage from the cord. (The loss of 30 ml of blood from a newborn baby is comparable to the loss of 600 ml of blood from an adult.) The end stump of the cord is cut just above the clamp, on the placental side (see Figure 28.1). The cord is inspected to ensure that three vessels are present. (Two vessels would indicate a congenital abnormality.)

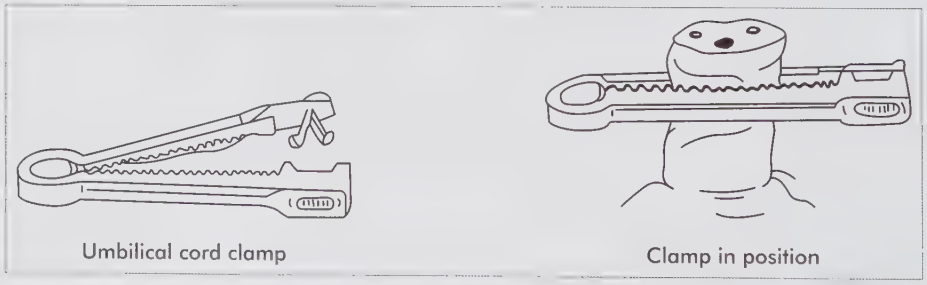


Figure 28.1 An umbilical cord clamp

If this umbilical clamp is not available, the cord can be tied using sterile linen, string, silk or tape ligature, provided it is not too fine. The ligature must be capable of occluding the blood vessels but must not damage the cord at the site of the ligature. The cord is observed for haemorrhage.

28.4 Measurement and immediate examination of the newborn

Weigh the baby

The baby should be weighed without causing undue heat loss and the weight documented. The baby should be weighed without wearing any clothes. The recording forms a baseline for future assessment.

Observations

Several observations are carried out with the least possible exposure: measure the baby's crown–heel length and the baby's head circumference, encompassing the occipitofrontal diameter. While these measurements are being taken, the midwife should observe the baby quickly but carefully for the following:

- *Respiratory distress.* Note breathing pattern and colour for signs of respiratory distress.
- *Hypothermia.* Temperature per axilla should be between 36.5–37 °C.
- *Abnormal neurological features.* Features such as jitteriness, twitching, convulsions, excessive lethargy.
- *Blood sugar.* Blood sugar is observed and feeding established.
- *Anatomical abnormalities.* Abnormalities such as hair lip and cleft palate, meningocele, exomphalos, deformities of hands and feet, etc.
- *Trauma.* Signs of birth trauma.

Chapter 40 provides complete information for a full examination of the neonate.

If the midwife is not satisfied with the baby's condition, a medical practitioner should be notified immediately.

The warmly wrapped baby is then returned to the mother/parents if the condition of both the mother and baby is entirely satisfactory. Following delivery, the baby's eyes are usually open and the baby is very alert. The parents are congratulated on the birth of their infant. Infant feeding is started within the first hour following childbirth and the mother's choice of infant feeding must be respected.

During the first 24 hours after birth, the baby should be observed frequently (every half to one hour). The baby's colour, respiration and temperature should be noted, whether there is any mucus in the baby's mouth or nose, and to check the cord for bleeding. If there are any complications, the baby should be kept under constant observation in high care and the airways aspirated whenever necessary.

Documentation

All the information regarding the baby's condition at and immediately after birth should be fully and accurately recorded as per local protocol.

Report any abnormalities.

If at any time during this period, the midwife is not satisfied with the condition of the newborn infant, a medical practitioner should immediately be notified.

28.5 Examination of the placenta and membranes

Immediately following delivery of the baby the placenta and membranes are examined to make sure that they are complete and to detect any abnormalities that may point to abnormalities or problems in the neonate.

Hold the placenta up by the cord to assess the hole that the baby made during birth. The hole should be round and membranes should not be ragged. Ragged membranes may be a sign of retained pieces of membrane, which may interfere with contraction of the uterus leading to blood loss.

Thereafter the placenta is placed on a flat surface under good light. The insertion of the cord is noted, usually centrally and the length of the cord is about 50 cm. A short cord is associated with premature separation of the placenta while a long cord is associated with the cord around the neck during labour.

The umbilical cord is checked for blood vessels. Three blood vessels should be noted (the umbilical vein and the two umbilical arteries). If one of the umbilical arteries is missing, this may be a sign that the baby has only one kidney (renal agenesis). The baby should be referred to the paediatrician for further management.

The placenta is turned over to check the maternal surface. The blood on the maternal surface is wiped off and clots removed into a jar so that blood loss can be measured. The maternal surface is examined to check if all cotyledons are present and to note any areas of infarct (whitish patches). Any blood vessels running into the membranes are noted to rule out an extra lobe. If there is a hole within the placenta, the placenta is cupped in the hands to establish if there is a retained lobe. If the hole closes on cupping, then no lobe was retained and if the hole does not close on cupping, suspect a retained lobe. The woman should be observed for postpartum haemorrhage due to retained products of conception.

If a blood vessel runs to the membranes and a hole is noted in the membranes then a succenturiate lobe is suspected.

The amnion is stripped from the chorion up to the point of insertion to check whether both membranes are present. In this case the woman should be referred to the medical practitioner/obstetrician.

The placenta should be weighed and the normal weight is one sixth of the baby's weight. All findings should be recorded in the woman's notes and any abnormalities should be reported and acted upon (see Chapter 7 and colour illustration Figure 7.26 (C6)).

A thorough examination of the placenta is done under running water. A report is written up which has legal implications. The midwife reports the membranes and placenta as:

- apparently complete, or
- suspicious with ragged membranes, or
- incomplete.

In the case of the last two bullets, medical advice is sought, the patient remains under observation and it is advisable to have an intravenous line with oxytocin *in situ*.The action taken is indicated in the report.

28.6 Transitional care in the fourth stage

Following delivery of the placenta and membranes, the midwife should palpate the abdomen to ensure that the uterus is well contracted and note any signs of uterine atony.

For women who plan to breastfeed, it should be initiated within one hour of birth. The woman should be supported in her choice of infant feeding.

The woman is encouraged to pass urine as a full bladder may contribute to uterine atony and subsequent postpartum haemorrhage.

Observations should be carried out for both the mother (check for bleeding per vagina, blood pressure, pulse, temperature and respirations) and the baby (colour, respiration, heart rate and temperature).

When transferring the mother and the baby to the postpartum ward in hospital deliveries both the mother and the baby should be kept warm. Ideally the mother should be holding the baby, either sitting in a wheelchair or lying down in bed or trolley, to encourage bonding.

On arrival in the postpartum ward, a comprehensive report should be given to the receiving midwife, which includes history relating to the antenatal period, labour, birth and the immediate puerperium. The woman should be examined to exclude any excessive bleeding per vagina and assess for uterine contraction.

28.7 Conclusion

Observations should be done according to protocol and any abnormalities acted upon immediately as delay may result in maternal or neonatal morbidity and mortality. Fetal distress is likely to occur when the woman is delivered in the supine position, especially when the second stage is prolonged.

Achieving adequate homeostasis allows the midwife to prevent primary postpartum haemorrhage. Hypothermia can be minimised by providing adequate warmth to the baby when transferring both the mother and baby to the postpartum ward in case of hospital deliveries.

CHAPTER

29

Malposition, malpresentation and dysfunctional labour

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- give a classification of complications commonly occurring in birth
- identify and describe the causes of dysfunctional labour
- identify and describe ways to prevent dysfunctional labour
- identify and describe specific interventions for the dysfunctional situations
- develop the basic competencies to assist women during labour.

KNOWLEDGE ASSUMED TO BE IN PLACE

Knowledge, competency and skill in the basic management of normal birth.
Know the Ps of birth

KEYWORDS

Dystocia • Distress • Dysfunction • Disproportion • Obstruction • Prolapse

29.1 Introduction

The most commonly encountered complications directly due to obstetrical causes are presented in this chapter. A midwife should be able to anticipate and identify these conditions and refer them for medical attention. There may be no time to refer, in which case the midwife needs to intervene, particularly in life-threatening conditions. Diagnosis, treatment and care are competencies and skills required for the practice of midwifery that involve the ability to use learned information in a practical way. Midwives need experience to master these skills.

This chapter gives an introduction to the principles of diagnosis with guidelines for intervention. It is essential that the terminology and definitions are understood. Please refer back to normal pregnancy and birth.

29.2 Occipitoposterior position

The occipitoposterior (OP) position is the most common malposition that a midwife will manage. Early recognition and referral can improve the outcomes for mother and fetus. The OP position is associated with prolonged, painful labour, assisted deliveries and an exhausted mother and fetus.

Incidence

The incidence is between 15–20%.

Definition

In an occipitoposterior position of a vertex presentation, the occiput (the denominator) lies in the posterior quadrant of the pelvis. That is, the occiput lies adjacent to either the right sacroiliac joint (ROP), or, in a few instances, the left sacroiliac joint (LOP). (The LOP is unusual because the descending colon lies in the left posterior portion of the pelvis.) A posterior position of the vertex is known as a *malposition*, because of the problems that can arise in posterior positions (see Figure 29.1).

Causes of posterior positions of the vertex presentation

Posterior positions of the vertex appear to be influenced by the following conditions:

- *The shape of the pelvic brim (inlet).* The position in which the occiput enters the pelvis appears to be determined to a large extent by the shape of the pelvic brim, which allows the biparietal diameter (widest transverse diameter)

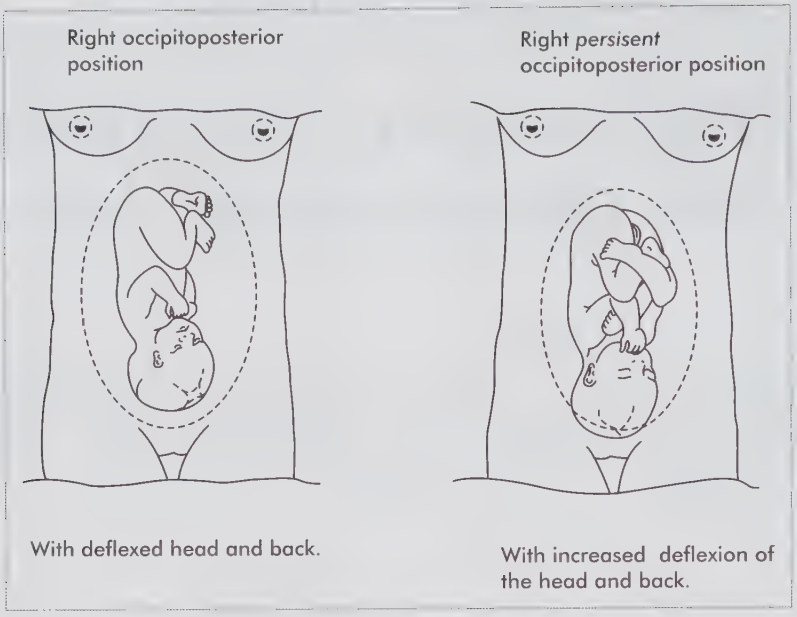


Figure 29.1 Occipitoposterior positions (abdominal view)

of the fetal skull to be most easily accommodated (largest diameter of the pelvis).

For this reason, when the pelvis is an average-sized gynaecoid pelvis and the fetal head is well flexed, the head commonly lies with the sagittal suture in either the transverse diameter with the occiput lying laterally, or in one of the oblique diameters with the occiput lying anteriorly. However, where the transverse diameter of the pelvic brim is narrowed, and/or where the sacrocotyloid space is narrowed, the head is more easily accommodated with the occiput lying posteriorly. The android type of pelvis has a heart-shaped brim with the wider space posteriorly and a narrowed sacrocotyloid space. This allows the broader part (occiput) to be posterior. The anthropoid type of pelvis has a reduced transverse diameter and a wider anteroposterior diameter of the brim, therefore, both these types of pelvis can predispose to occipitoposterior positions. Other types of contracted pelvis, and some spinal deformities, could also be implicated.

- *The shape and size of the fetal head.* The shape and size of the fetal head will also affect the position of the occiput in a vertex presentation. The following conditions could contribute to occipitoposterior positions:
  - increased multiparity as babies tend to get larger with each pregnancy
  - prolonged pregnancy (fetal postmaturity), the fetal skull is large and less moulding is possible because of advanced ossification
  - diabetes mellitus in the mother because babies are larger than average.
- *Maternal causes.* In the primigravida woman with tight abdominal muscles, the fetal attitude is one of less flexion of the back, 'the military attitude', and this could lead to the vertex presenting posteriorly
- *Obstetric causes:* In placenta praevia, the fetal head takes a different position. If the umbilical cord is around the neck, the head may remain high.

Possible outcomes of an OP

There are several possible outcomes of the occipitoposterior position. These are as follows:

- *A long rotation forward ending in a spontaneous normal delivery.* In 90% of all posterior positions of the vertex, the head rotates and the occiput becomes the leading part (see Figures 29.2 and 29.4). This usually happens in second stage labour.
- *A persistent occipitoposterior delivery (POP)(Face-to-pubis) (short rotation).* This delivery occurs because the head remains in the posterior position and meets the pelvic floor first. The baby delivers 'face to pubis'. This occurs in about 10% of all posterior positions.

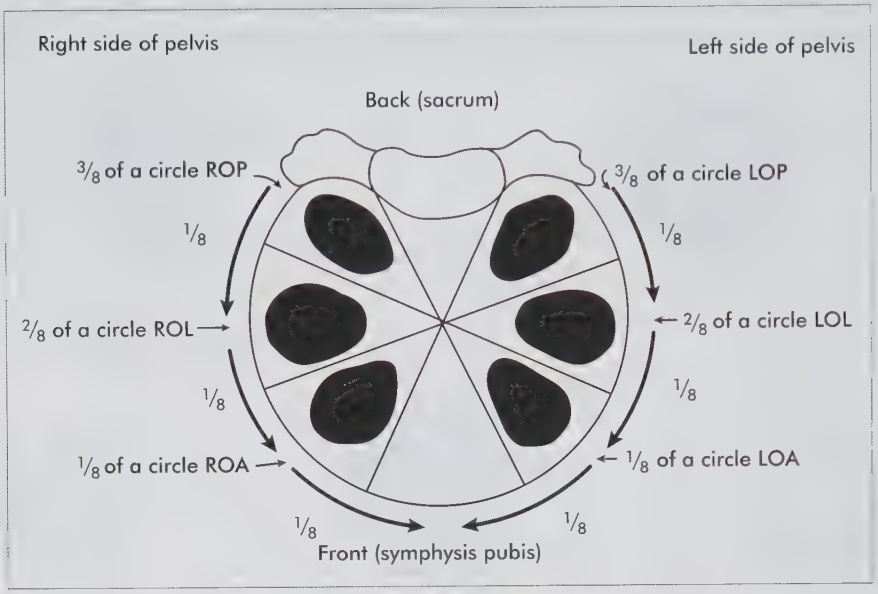


Figure 29.2 Long forward rotation of the fetal head during labour in posterior positions of the occiput

The correct name is a *persistent occipitoposterior* (see Figure 29.3).

Complications of OP

More complications arise in posterior positions of the vertex than in anterior positions, usually due to larger diameters that rests on the posterior sacrum causing a poor 'fit' on the cervix. The presenting diameters are the occiput frontal 11.5 cm and the biparietal 9.5 cm. This is not a round circle and cause poor application and dilatation, The descent of the head is slow with pressure on the sacrum, back ache and prolonged labour, and this in turn causes an increase in dysfunctional labour for the mother and the fetus. If posterior positions are not identified in labour and correctly managed the following complications can develop:

- *Prolonged labour and maternal distress*. Owing to the long rotation forward of the head, the length of the first stage of labour is increased. With the larger diameters of the fetal skull passing through the pelvic cavity, both first and second stages are prolonged.
- *Infection*. A long labour lowers the mother's resistance to infection. Frequent vaginal examinations and catheterisation may be necessary, as well as other operative measures, and these, together with the early rupture of the membranes, predispose to intrauterine infection, infection of the urinary tract and general infection (puerperal infection).
- *Fetal and neonatal infection*. The early rupture of the membranes, the frequent vaginal examinations and other operative procedures may introduce infection into the uterus and so to the fetus. This infection may only manifest in the neonatal period.
- *Haemorrhage*. The incidence of both atonic and traumatic postpartum haemorrhage is increased. Lacerations and damage to soft tissue because of the larger engaging diameters and because of the necessity for intervention, episiotomies, tears of the vagina and perineum, bruising and haematomas are more prevalent.
- *Anoxia and asphyxia neonatorum*. Prolonged labour and excessive compression of the fetal head in labour can lead to fetal anoxia, intracranial injury, haemorrhage and asphyxia at birth. The upward moulding of the deflexed head in posterior positions can lead to intracranial haemorrhage due to tearing of the tentorium cerebellum. In addition, because of the larger engaging diameters of the head, excessive moulding takes place in the birth canal, and this can lead to cerebral oedema and to haemorrhage.
- *Cord prolapse*. The presenting part is uneven (not round) because the head is deflexed, and the deflexed head has difficulty entering the pelvic brim and so remains 'high'. Both these conditions predispose to early rupture of the membranes and to the danger of prolapse of the umbilical cord.

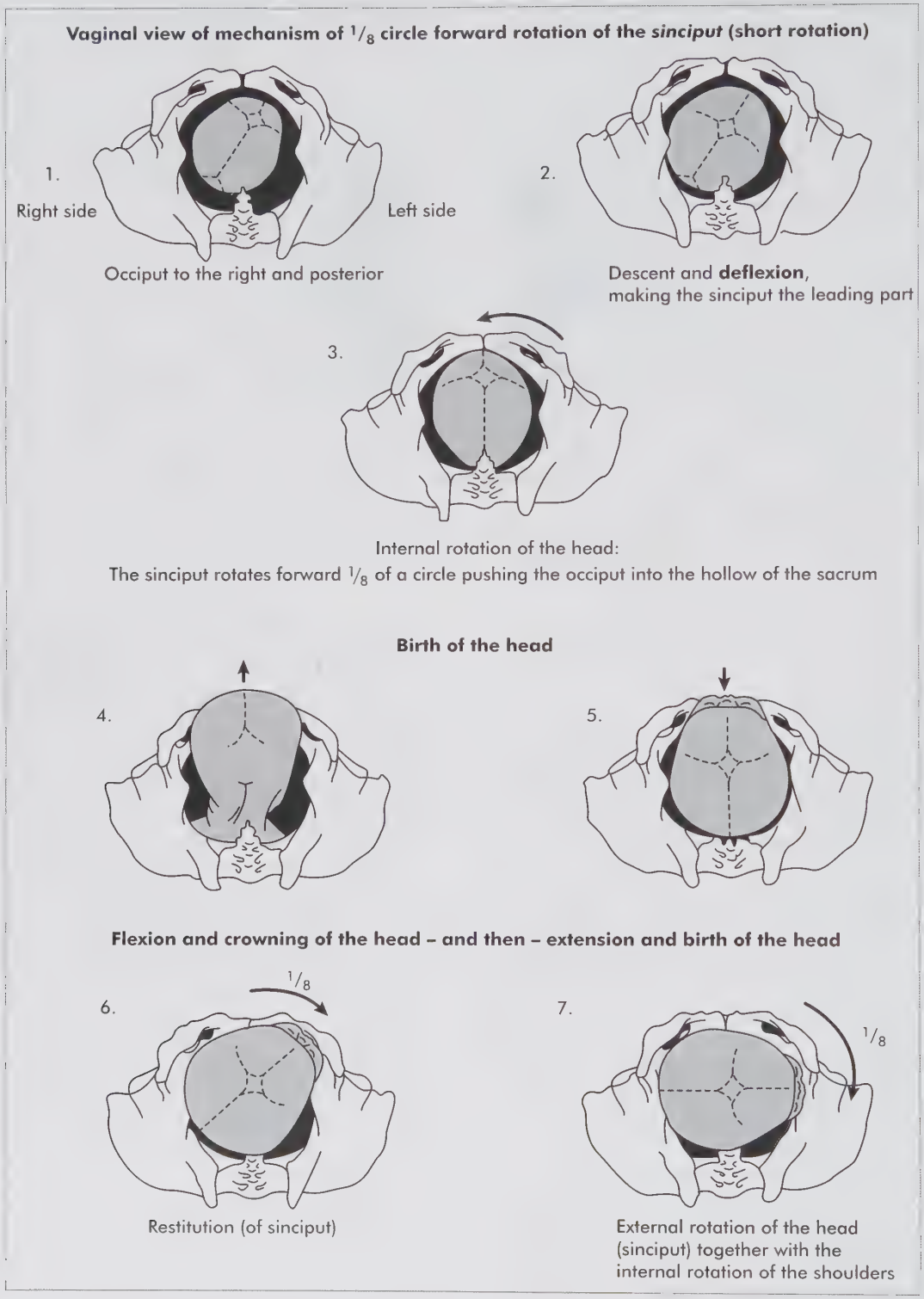


Figure 29.3 Mechanism of persistent occipitoposterior positions – right persistent occipitoposterior (POP)

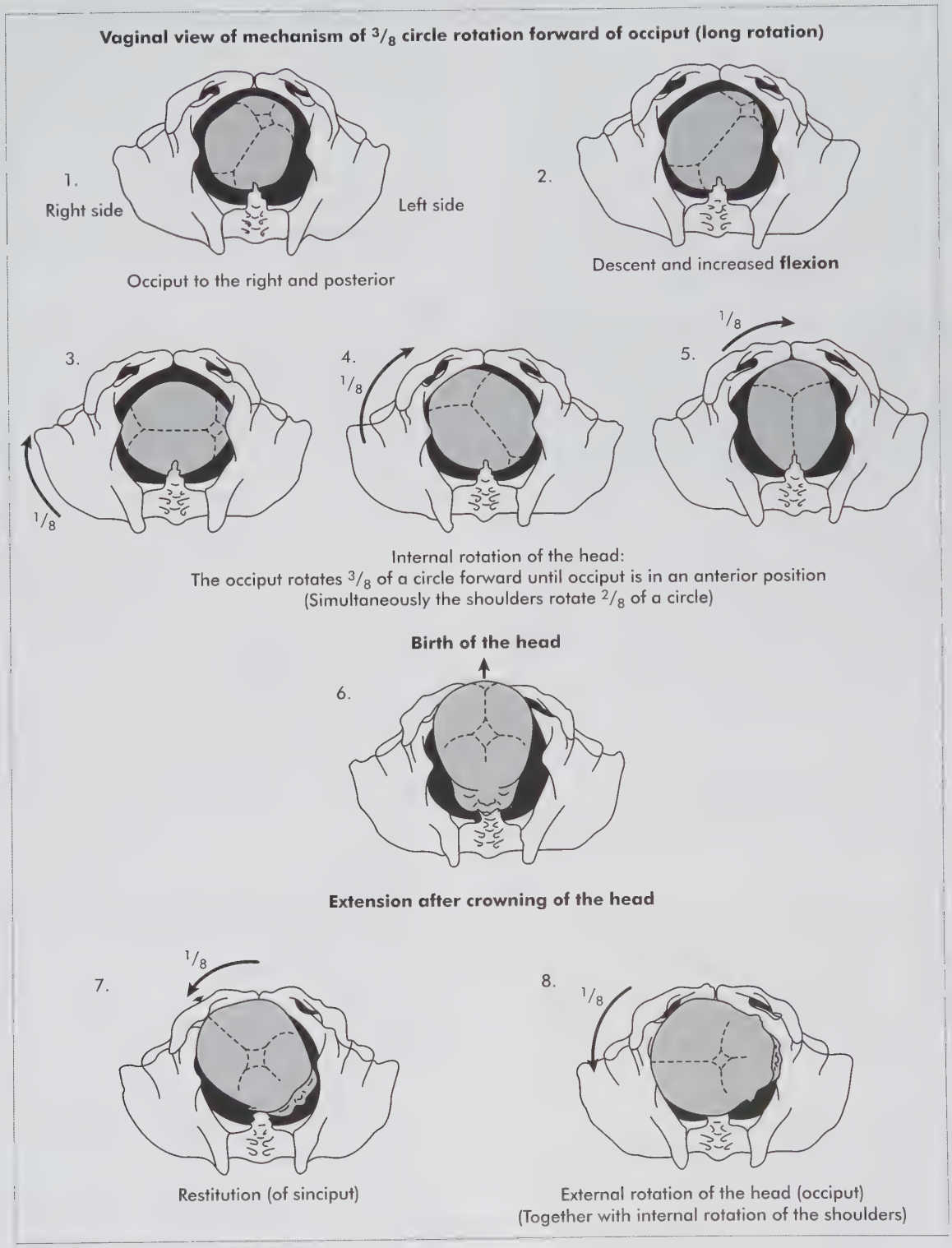


Figure 29.4 Mechanism of occipitoposterior positions — right occipitoposterior (ROP)

- *Deep transverse arrest.* The head flexes sufficiently to allow the occiput to become the leading part and to start the long rotation forward. However, in about 15% of these cases, the occiput becomes stuck at the ischial spines, with the sagittal suture in the transverse diameter of the pelvis, causing a deep transverse arrest. This condition is often associated with the android type of pelvis, which has prominent ischial spines, a long narrow pelvic cavity and a reduced outlet. A deep tranverse arrest cannot be delivered vaginally. Refer to a medical practitioner immediately. Forceps are not used because the sagittal suture should be in the AP position. If the cervix is fully dilated and the fetus is of average size a medical practitioner may attempt to flex the head and rotate it. If this is unsuccessful the baby is delivered by caesarean section.
- *Obstructed labour.* If the fetus is large or moderate CPD exists, obstructed labour can develop (see Chapter 8 and 30). Obstructed labour is a result of the poor quality of care and should be prevented at all costs. Early diagnosis and prompt referral is essential. In the case of obstructed labour, start an intravenous infusion, place the women in the left lateral position, start oxygen and call the medical practitioner immediately. Delivery will be by caesarean section. Potential outcomes are:
  - *Bandl's ring.* In primigravida Bandl's ring or the pathological retraction ring is formed.
  - *Uterine rupture.* In the multigravida the uterus may rupture.

Mechanism of occipitoposterior

This is a typical explanation of an ROP, the reverse is true for a LOP. Short and long rotation of the head can occur. These are explained together.

Abdominal palpation

Abdominal palpation findings are:

- *Lie.* The lie is longitudinal, (vertical) parallel to the long axis of the mother which is the spine of the fetus and the maternal spinal column. The fetal back is in right maternal flank and the small parts anterior left or felt over the abdomen.
- *Fetal heart.* The fetal heart beat is heard in the right maternal flank or over the umbilicus.
- *Attitude.* The attitude is flexion which means that all the parts of the fetus are flexed and the chin is on the chest (in OP there is a degree of deflexion).
- *Position.* The occiput of the fetus points to the right sacroiliac joint and sinciput to the left iliopectineal eminence (ROP).
- *Presentation.* The presentation is the vertex. The left parietal bone is right anterior.
- *The relationship of the denominator to the bony pelvis.* Theortically, the occiput is in the right posterior part of the maternal pelvis, the anterior fontanelle (bregma) is anterior left near the symphysis pubis.
- *Presenting diameters.* Presenting diameters are the occipital frontal 11.5 cm and the biparietal 9.5 cm. This is not a round circle and the larger diameter complicates birth.

Mechanism

The mechanism of the occipitoposterior is complicated and can follow two possible pathways:

- *Descent.* Descent takes place with increased flexion, when the occiput reaches the pelvic floor. There is increased flexion of the head (the chin is on the chest).
- *Internal rotation.* The pelvic floor facilitates internal rotation. One of two pathways can be followed.
  - *Short rotation.* The occiput rotates through 45° to the posterior to face the pubis or persistent occiput posterior in 10% of cases. The occiput is in the hollow of the sacrum. The face is under the symphysis pubis and the sagittal suture line is in the anteroposterior position. The head may still be at spines but is in the right position for birth.
  - *Long rotation.* In 90% of cases, mostly in multigravidae with large pelvises, the fetus may take a long rotation. This occurs mainly in the second stage and the rotation can be seen when the head is crowning. The occiput turns 135° from the occipitoposterior (OP) to the occiput-transverse (OT) to the occipitoanterior (OA) to the anteroposterior (AP) position, ready for delivery. The occiput turns from the posterior right position to the anterior right position and birth is normal. The anterior fontanelle is now posterior in the hollow of the sacrum the posterior fontanel anterior under the symphysis pubis with the sagittal suture line in the anterior posterior position.
- *Descent and internal rotation of the shoulders.*
  - *Short rotation.* The shoulder follows the head. The anterior shoulder enters the pelvis in the oblique and meets the pelvic floor. It rotates and follows the head. The shoulders should be in the AP (anteroposterior position) for delivery.
  - *Long rotation.* This follows the normal mechanism.
- *The position of the fontanelles and suture lines.*
  - *Short rotation.* After the short rotation the anterior fontanelle is anterior under the symphysis pubis

and the face is under the symphysis pubis with the smaller diameter of the sinciput, and the posterior fontanelle is posterior in the hollow of the sacrum with the broader diameter of the occiput. The sagittal suture line is in the anteroposterior position for delivery.
  - *Long rotation*. In the long rotation the anterior fontanelle is posterior in the hollow of the sacrum and the posterior fontanelle is anterior. The sagittal suture line is in the anteroposterior position for labour.
- *Crowning*.
  - *Short rotation*. Crowning occurs when the larger diameter sweeps the pelvic floor and the perineum bulges with the head in flexion. The back is against the sacrum and birth is difficult, painful and slow. There is a high risk for perineal trauma.
  - *Long rotation*. Crowning is normal and the birth is normal.
- *Extension*.
  - *Short rotation*. The head is born with extension with the face under the pubis.
  - *Long rotation*. The head is born with extension with the face posterior.
- *Restitution*. The head turns back on the shoulders to align with the previous position in both positions.
- *Internal rotation of the shoulders and external rotation of the head*. These processes occur simultaneously. The shoulder reaches the pelvic floor and turns into the anteroposterior position with the back to the right.
- *External rotation aligns the head with the body*.
  - *Short rotation*. The posterior fontanel is now right and the anterior fontanel left, with the sagittal suture line in the transverse position.
  - *Long rotation*. The posterior fontanel rotates right and the anterior fontanel is left with the sagittal suture line in the oblique.
- *Birth of the shoulders*. The anterior shoulder is born under the symphysis pubis and the posterior shoulder follows.
- *Birth of the body*. The body is then delivered in lateral flexion over the maternal abdomen.

29.1 Activity

Self-assessment: the mechanism of an occipitoposterior. Use a doll and a pelvis. Work in groups to understand the mechanism of labour.

Treatment and care

Identification of an occipitoposterior position can already be made in the antenatal period. At 36 weeks, when the presenting part engages in a primigravida, sure signs of OP are observable on abdominal palpation. On admission for labour, an abdominal palpation can reveal the position of the fetus. This includes:

- the shape is ovoid
- the saucer-like indent over umbilicus (make sure the bladder is empty)
- a fetal solid part is towards the mother's back

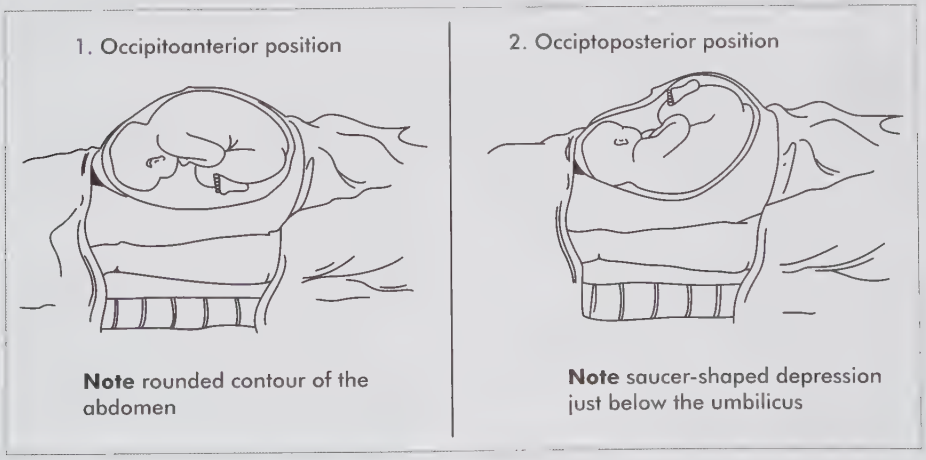


Figure 29.5 The shape of the abdomen contour on inspection

- small parts are on both sides of the abdominal midline
- fetal heart can be heard on the umbilicus
- fetal head may be difficult to palpate because the sinciput is under the symphysis and the broader occiput is in the sacrum.

Effects in labour

Owing to the poor application of the presenting part on the cervix:

- The cervix may be long and posterior (not ripe).
- There are poor contractions and contractions may be irregular.
- Membranes may rupture before the onset of labour.
- The presenting part may be above the spines and poorly applied on the cervix.

Once an occipitoposterior presentation is diagnosed the midwife should arrange medical backup, good pain management, a pediatrician, an anaesthetist and theatre because there is a high risk of assisted delivery or caesarean section. In some cases, the women will need to be transferred for appropriate medical care. Refer early!

The partogram is used to observe the progress of labour, with particular reference to the contractions, descent of the presenting part, application to the cervix, caput and moulding, position of the fontanelles, sagittal suture line and duration of labour (speed of dilatation). Application of the presenting part is usually poor and unequal. An anterior rim or a lateral rim refers to a partial dilatation where the cervix under the broader occiput dilates and the part near the sinciput remains undilated.

The position of the woman is crucial in the rotation of the presenting part (see Figure 29.6). In the exaggerated lateral position the woman lies on the side where the fetal back is, with the lower leg straightened and the upper leg flexed, almost lying on her stomach. This opens the pelvis and pushes the presenting part down facilitating rotation. Alternatively, the cowboy position (over a chair with open legs) can help to promote descent, flexion and rotation.

Medical intervention may include augmentation of labour with oxytocin. The mother requires pain management and should be checked for signs of exhaustion. Women with OP positions have constant pain in the back where the fetal head is resting on the sacrum.

An epidural is the pain management of choice, if available, for long and painful labour (which causes maternal exhaustion). Dehydration is common and once ketones are present in the urine it is difficult to reverse, so should be prevented by starting a prophylactic intravenous infusion using 5% dextrose in saline at 125 ml/hr.

Prolonged labour and maternal exhaustion affect the fetus. Observations of the fetus include continuous fetal heart patterns, caput and moulding and descent of the fetal presenting part. If the fetus show signs of distress in the first stage the second stage will be even more traumatic.

Once membranes are ruptured check for meconium and cord prolapse. In an OP position the membranes are kept intact as long as possible to facilitate the even pressure on the cervix.

The second stage is usually complicated resulting in an assisted delivery and/or a caesarean section. A large episiotomy or pelvic floor trauma is common. Neonatal asphyxia or a low Apgar score are common because of the long second stage.

29.3 Malpresentations and malpositions

Definition

Malpresentations include breech or shoulder presentation. Malpresentations are deviations of the breech or vertex, usually referring to deflexions of parts of the fetal body and/or asynclitism caused by a variety of maternal, fetal and obstetric causes. Abnormalities or malpositions of the lie of the fetus are the transverse and oblique lie.

Normally the long axis of the fetus is parallel with the long axis of the mother. The long axis refers to the spine of the mother and fetus.

Deviations of the presentations deal with deflexion of a part of the fetus. Normally the fetus is in an attitude of full flexion (fetal position) where all the parts are flexed. If any part of the fetus is extended this causes complications. The fetus rotates, flexes and extends to negotiate the pelvis. These movements can be observed using abdominal palpation during pregnancy and include lie, position, engagement and station of the presenting part. The abdominal examination is followed by a vaginal examination to determine what part is presenting and if the presenting part is in flexion and extension, and the station of the presenting part.

In most cases of abnormal presentation or malposition the medical practitioner is called and/or the woman is referred to a higher level of care. These births are known to be complicated with a high incidence of interventions, and maternal and perinatal morbidity and mortality. Women with malpresentation and positions need to deliver in an appropriate level of care with a medical practitioner, access to theatre, an anaesthetist, paediatrician and appropriately trained midwives.

The main task of the midwife is early identification and referral to the appropriate level of care. Abnormalities can



Figure 29.6 Effective maternal positions during the first stage of labour

29.2 Rules for fetal positions in labour

If the fetal head is flexed it needs to extend for birth in the second stage. If it is extended it needs to flex for birth to allow the best diameters to pass through the birth canal.

The best diameter is a flexed occipitoanterior in synclitism (an average-term fetus): biparietal diameter = 9.5 cm x suboccipit bregmatic diameter 9.5 cm. The same diameters are found in the total extended face presentation where the submento bregmatic diameter is 9.5 cm and the biparietal is 9.0 cm. In the occipitoanterior position the head extends when delivered and in the face presentation the head flexes. All other deviations theoretically make birth more difficult (not considering other factors such as the relationship with the pelvis) including asynclitism and partial extension (deflexion) or exaggerated extension or flexion that allows for less favourable diameters.

Table 29.1

Landmarks of the presenting part indicating the positions (see also Figure 29.8)

Position	Part felt on vaginal examination
Vertex	Fontanelles and suture lines
Shoulder	Shoulder/scapula/arm
Breech	Genitalia, knee or foot
Brow	Orbital ridges and anterior fontanelle
Face	Mouth, nose and eyes
Asynclitism	Ear, felt anteriorly or posteriorly

be identified at 36 weeks, or on admission at the start of labour or during labour using a partogram. Table 29.1 gives the landmarks that will indicate abnormal presentations on vaginal examination.

A malpresentation (a transverse and oblique lie) in a fetus identified at 36 weeks cannot deliver vaginally unless corrected and there is a high risk of cord prolapse. External version or an internal podalic version can be performed in labour by a medical practitioner. Table 29.2 is a comparison of normal versus abnormal findings in palpation and vaginal examination. This comparison can be used to decide whether or not a normal birth is possible. If you suspect complications, refer early.

Causes of malpresentations/positions

The causes of malpresentations/positions are overlapping and are related to the Ps of labour in most cases, namely power, passage, passenger.

Maternal causes

The following are maternal causes:

- *Pendulous abdomen*. Uterine muscles may be lax causing a pendulous abdomen.
- *Polyhydramnios*. Polyhydramnios may cause the fetus to take an abnormal position.
- *Contracted pelvis*. Usually where the sacrocotyloid dimension or anteroposterior diameter of the pelvic brim are decreased.
- *Spinal deformities*. Where the fetal head is directed forwards, for example in exaggerated lordosis or in spondylolisthesis.
- *Placenta*. Posterior placenta praevia.
- *Uterus*. Uterine abnormalities.
- *Neoplasm*. Of the lower segment.
- *Iatrogenic*. From an external version.
- *Idiopathic*. Unexplained.

Fetal causes

These are also known as primary causes:

- *Abnormalities*. Abnormalities of the fetus such as anencephaly, tumours of the neck or other tumours.
- *A large head*. Hydrocephaly.
- *Umbilical cord*. Coils of umbilical cord around the neck.

Possible outcomes

This section will consider face and brow presentations, common malpresentations. These conditions are managed by a medical practitioner and are briefly explained in Table 29.3 and Figure 29.10).

Brow presentation

A brow presentation is very difficult to diagnose because the head is high and the cervix not dilated so it is difficult to feel the presenting part. Labour can be prolonged over days. NB: dilatation can never be the only criteria of labour. A brow presentation cannot be delivered vaginally unless the head is totally deflexed to a face presentation.

Table 29.2

Comparison of normal versus abnormal findings in palpation and vaginal examination

	Normal criteria	**Deviations**
Abdominal palpation		
Fundal height	Correlates with the dates and grows and develops normally as plotted on a graph (SF only useful between 20–35 weeks)	Unsure or no correlation
Amniotic fluid	Is adequate (allowing the fetus to be felt and moved, ballot) with ease on abdominal palpation	Too little or too much
Fetal movement	Is present and normal (at least 10 movements a day)	Not felt by practitioner/mother
Fetal heart	Heard and regular and heard through the posterior thorax wall of the fetus. In a vertex presentation the fetal heart is heard under the umbilical line	Fetal heart noticed all over abdomen, or above umbilical line
Fetal parts	From 30 weeks the fetal head can be felt on abdominal palpation	Difficult to feel fetal head
Head	Only two poles felt	Three poles identified
Presenting part	At 36 weeks the presenting part is engaged in the pelvis in a primigravida and the fetus is in position in a multigravida (sometimes only at birth)	Not engaged by 36 weeks in primigravida. Unstable lie in multigravida
Vaginal examination		
Station	The presenting part is at spines or 1 cm above and fixed (not ballotting)	Presenting part above spines
Application	Fair or good application on cervix	Cervix poorly applied, long and posterior
Bishop score	Bishop score > 5	Bishop score < 5
Synclitism	Synclitism (sagittal suture in middle)	Asynclitism (ear felt)
Landmarks	Posterior fontanelle can be felt (well flexed)	Anterior fontanelle felt (deflexed)
Pelvimetry	Clinical pelvimetry diagonal conjugate 12.5 cm, ischial spines not prominent. Ligaments allow two fingers, subpubic arch allows two fingers, intertuberous diameter 10 cm	Any diameter narrowed
Labour		
Membranes	Membranes intact with forewaters	Rupture before labour starts or bulging in vagina
Contractions	Normal contractions and uterine tone	Lower or higher tone, abnormal pattern (coupled, hypo- or hypertonic)

continued

Table 29.2

Comparison of normal versus abnormal findings in palpation and vaginal examination *(continued)*

	Normal criteria	**Deviations**
Cervix changes	Cervical changes correlate with contractions. Normal rate cm/hr	No or slow cervical changes with contractions, less than 1 cm
Cervix position	Cervix anterior, effacing and dilating	Cervix long and posterior/hang like a sleeve (curtaining)/paper thin
Partogram	Follow normal guidelines	Exceed normal criteria

Table 29.3

Differences between brow and face presentation (see Figures 29.7, 29.8 and 29.9)

	Brow	**Face**
Incidence	1:1 400	1:750
Lie	Longitudinal	Longitudinal
Presenting part	Vertex	Vertex
Denominator	Sinciput	Mentum
Presenting diameters	Mentovertical diameter of 13.5 cm Biparietal 9.5 cm	Submentobregmatic 9.5 cm Biparietal 9.5 cm
Flexion/extension	Deflexed head	Total extension of head
Landmarks	Orbital ridges and root of the nose felt	Mouth, nose and eyes (no sutures or fontanelles)
Clinical diagnosis	Difficult to diagnose	Clear landmarks distinguish from breech
Diagnosis	X-rays and ultrasound	Clinical/X-ray/ultrasound
Membranes	Bag of amniotic fluid may hang in the vagina	Intact or ruptured Application good
Fetal heart	Heard through anterior chest pushed out	Heard through anterior chest pushed out
Vaginal examination	High head, poor application, no fontanelles felt	High presenting part
Mechanism	Cannot deliver, need to flex to OA or extend to a face presentation	Can deliver because favourable diameters present (see Figure 29.10) Need to extend to deliver Mentoposterior cannot deliver vaginally (see Figure 29.11)
Effect on birth	Prolonged labour/obstructed labour/ maternal distress	Prolonged labour Difficult second stage
Fetal	Asphyxia and distress	Facial oedema and bruising Breathing difficulty
Outcomes	Caesarean section Vaginal birth if head flexed or extends to face presentation in an average infant	Mentoanterior can deliver because the diameters are favourable (see Figure 29.10) Mentoposterior does not have mechanism (see Figure 29.11)

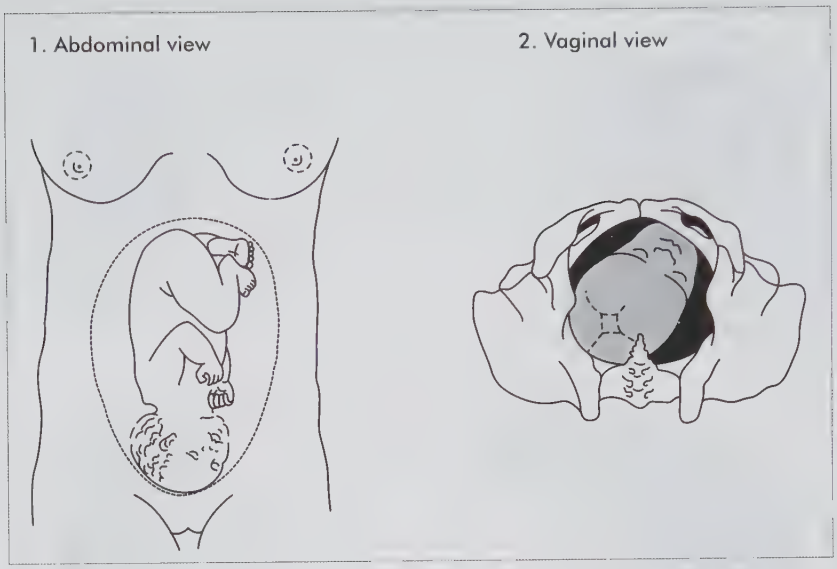


Figure 29.7 Brow presentation

Face presentation

(See Figures 29.9, 29.10 and 29.11.) Face presentation is more common than brow presentations and can deliver vaginally because the diameters that present are the same as the flexed vertex anterior but the head is in total extension. The biparietal diameter is 9.5 cm and the submentobregmatic is 9.5 cm.The mentum is the denominator and vaginal birth is possible, although the second stage is more difficult. If the baby is in a mentoposterior it cannot be delivered vaginally because the head cannot flex sufficiently to be born.

Diagnosis of brow and face presentation is difficult on abdominal and vaginal examination. Any abdominal palpation that is unclear, or a fetal heart that is heard where it is not expected needs to be questioned and confirmed with ultrasound or X-ray if the vaginal examination is inconclusive. A high presenting part with an undilated cervix and unclear information should be a warning sign. Because the presenting part is not well applied, contractions are often poor and dilatation slow.

Complications of malpresentations

Maternal complications

The following are maternal complications:

- prolonged labour and maternal distress
- presentation and prolapse of the umbilical cord
- obstructed labour and all the complications that occur with obstruction
- uterine rupture and trauma to other pelvic organs, such as the bladder
- maternal death
- puerperal infections.

Fetal complications

The following are fetal complications:

(NB: All the complications that affect the fetus in prolonged and obstructed labour also apply here.)

- fetal distress
- intrauterine death
- asphyxia neonatorum
- birth injuries
- neonatal infections
- neonatal death.

29.4 Breech presentation

The breech presentation is a malpresentation that can deliver vaginally. Breech presentation can present unexpectedly and the midwife in attendance should be able to deliver the baby if medical help is not available. Therefore the breech presentation is presented in more detail.

Incidence

At 32 weeks 25% of fetuses are in a breech presentation, which means that the incidence of breech birth is higher in preterm birth. At the start of term labour only 4–7% of fetuses are still in the breech position.

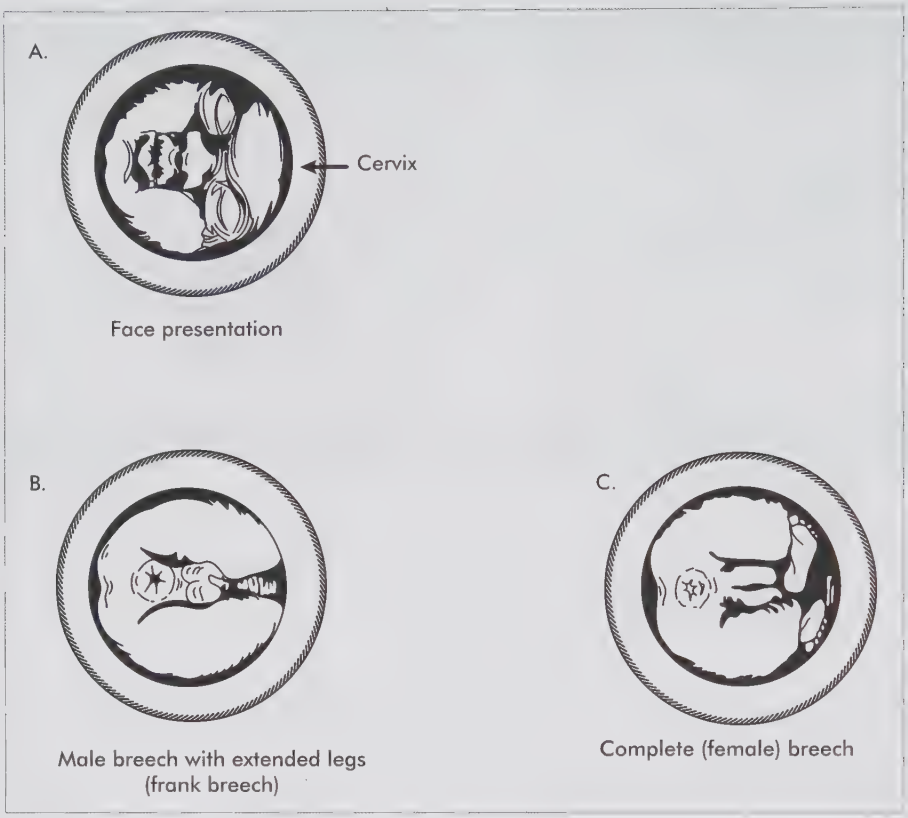


Figure 29.8 Malpresentations

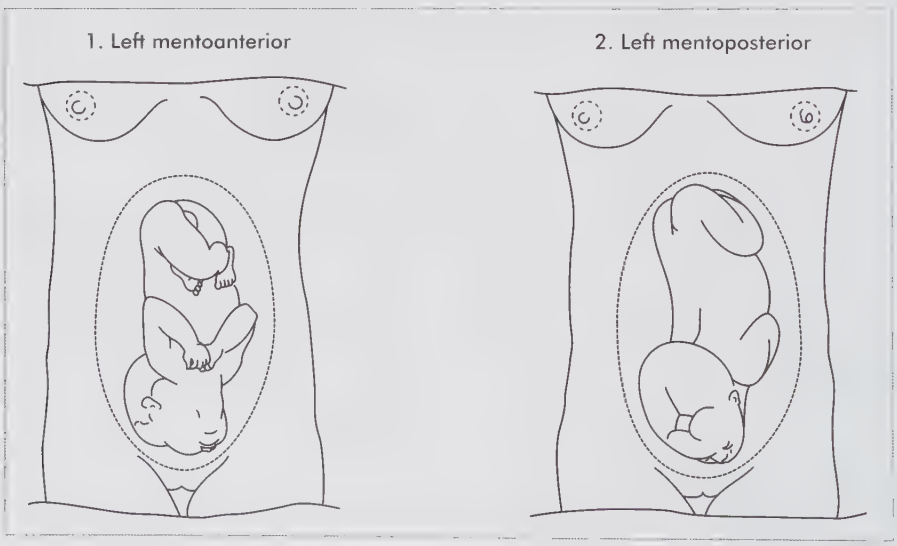


Figure 29.9 Face presentation

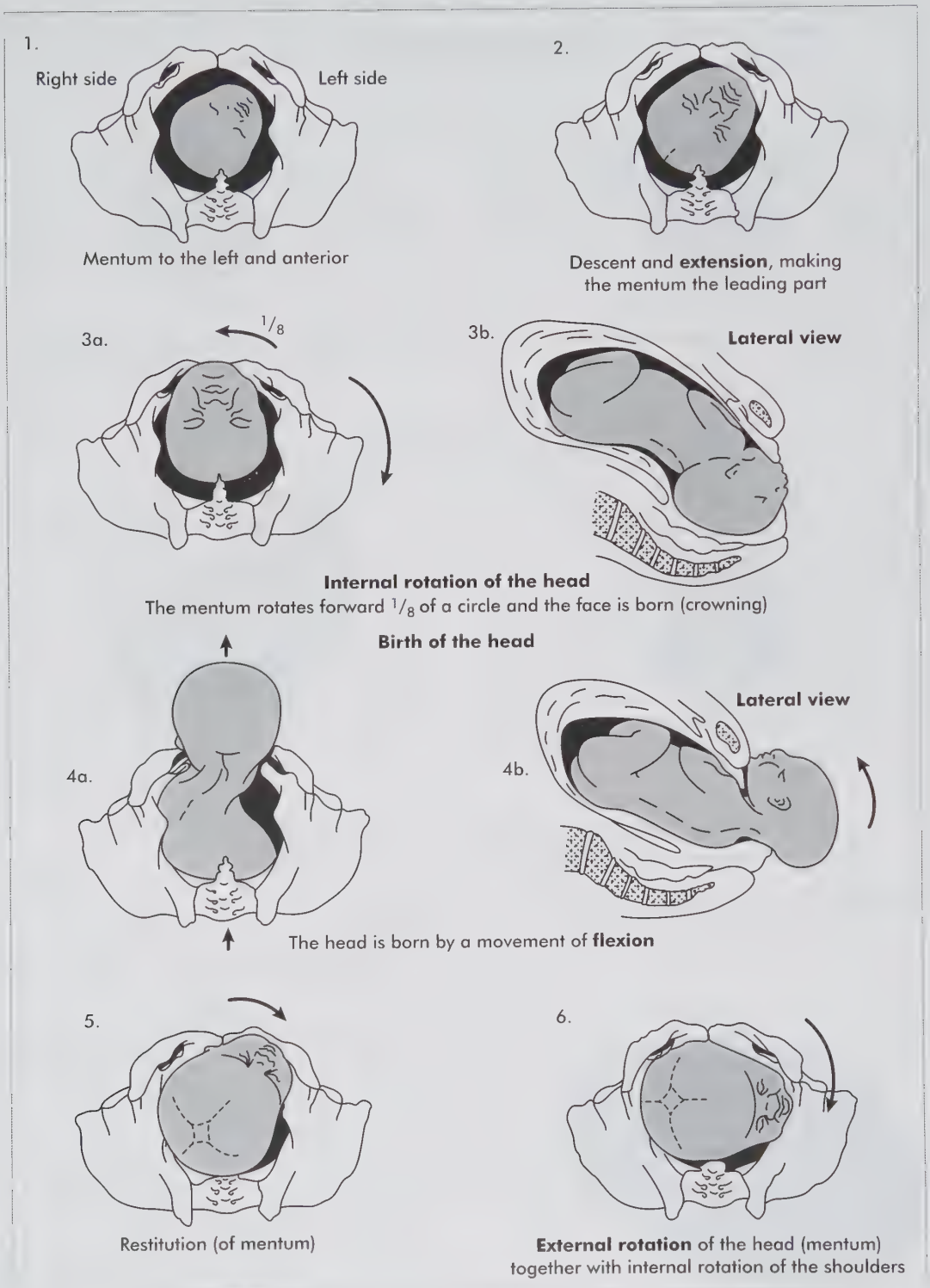


Figure 29.10 Mechanism of a mentoanterior (face presentation)

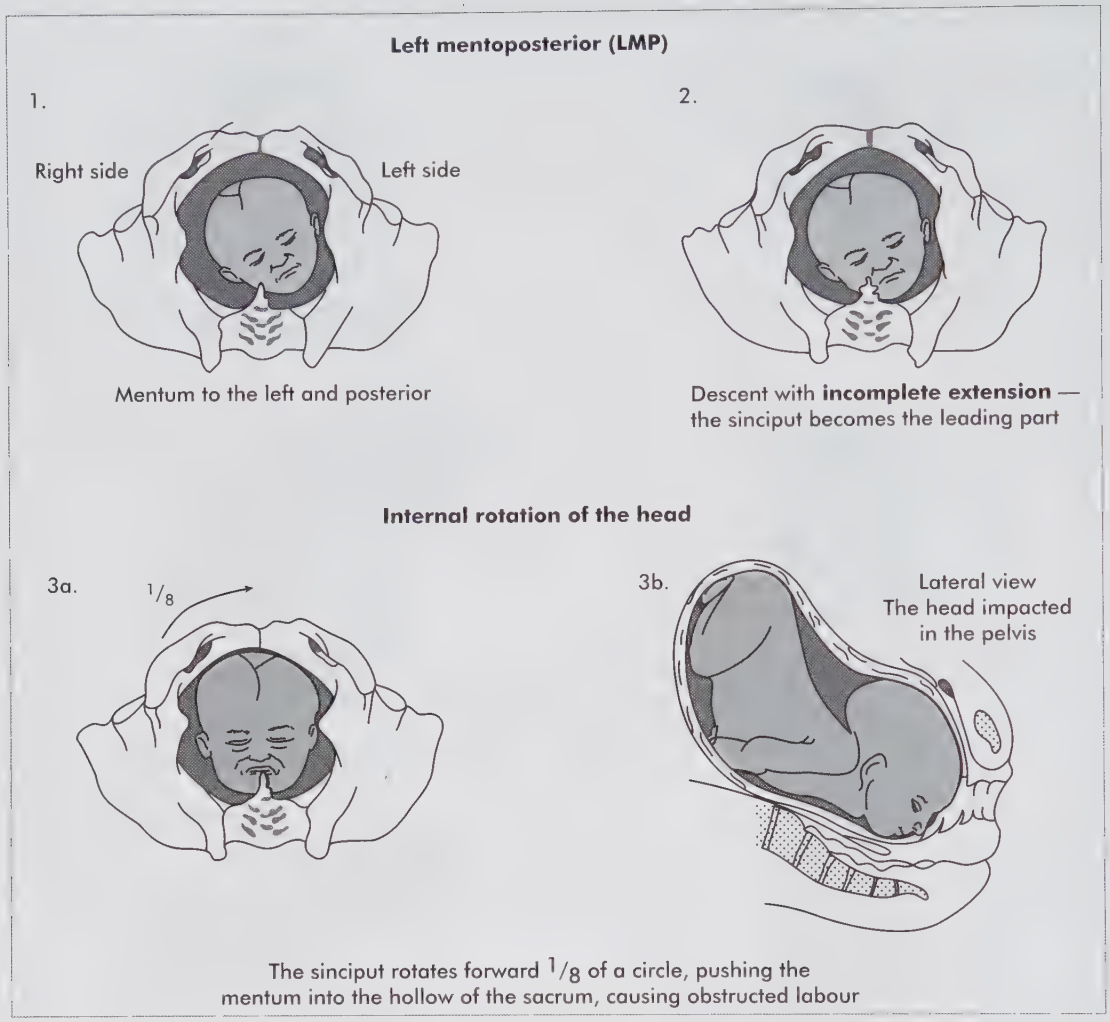


Figure 29.11 Complication of a mentoposterior

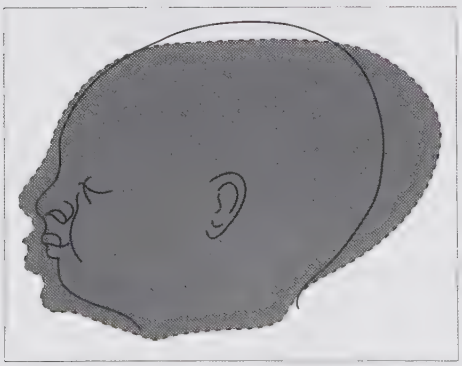


Figure 29.12 Moulding of a face presentation

Definition

In a breech presentation the presenting part in the pelvic brim is the breech.

Classification of breech presentation

The classification of a breech presentation refers to the level of deflexion of the fetal body (see Figure 29.13):

(NB: The more deflexion there is present the more complicated the delivery will be.)

- *A complete breech.* A complete breech is fully flexed and is an uncomplicated breech. A midwife can deliver an uncomplicated breech.
- *A frank breech.* A frank breech has extended legs where the legs are (deflexed) extended at the knees. The legs are like splints and prevent the body from flexing in labour. The person delivering the fetus attempts to flex the legs at the knees during labour (see Figure 29.13).

- *A footling.* In a footling the deflexion is at the hip joint and at the knee of one of the legs while the other is fully flexed (see Figure 29.15).
- *A kneeling.* A kneeling is a breech with both legs flexed at the hip joints.
- *Extended arms and head.* When the arms or head are extended a skilled practitioner is needed for a safe delivery. The extended arms and head are often complications of a podalic version and a breech extraction (see Figure 29.16).

Causes of breech presentation

Prematurity is the main cause.

Other causes include:

- short cord
- cord around the neck
- placenta praevia
- maternal pelvis shape and size
- primigravida with a tight uterus that does not allow the fetus to turn after 35 weeks



Figure 29.13 Types of breech presentation

- oligo- or polyhydramnios
- fetal abnormalities (anecepahaly and hydrocephaly) and others
- multiple pregnancy
- uterine tumour and abnormalities (bicornuate uterus).

Possible outcomes

The outcome in a breech presentation can depend upon one or more of the following factors:

- the attitude of the fetus (type of breech presentation):
  - whether the legs are flexed or extended
  - whether the the arms are flexed or extended
  - whether the head is flexed, deflexed or extended.
- the size and shape of the pelvis
- the size of the fetus, and particularly the size or diameters of the after coming head.

Flexed legs usually deliver spontaneously. Extended legs will usually require expert handling in order to be delivered. Once the body is delivered, however, the greatest problem may arise in the delivery of the head. As the larger diameters of the bony vault will come out last, the head may not be able to negotiate the pelvis and there is less time to allow the moulding process to occur. This may be due either to the large size of the head, or to a deflexed or partly extended head with large diameters trying to pass through the pelvis.

In addition, if an arm or arms is/are extended, this can further decrease the area of the pelvic cavity available for the head.

In some instances, for example in a frank breech or a footling presentation, the body or the leg may slip through a partially dilated cervix, which could prevent larger diameters such as those of the head from being delivered. This will result in an obstructed labour. In a breech delivery, the head has to be delivered within seven minutes of the body, if the fetus is not to become anoxic.

In preterm babies, which are more likely to be breech presentations than term babies, the head is larger in relation to the body than in the term baby and this will increase the danger of obstruction and anoxia, if the body should slip through a partially dilated cervix. In some instances, just before or even during labour, before the membranes rupture, a breech presentation may turn spontaneously and present as a vertex presentation, surprising everyone.

The Zatuchni-Andros index is used to screen woman for suitability for vaginal birth (see Box 29.3).

The mechanism of an uncomplicated breech delivery in a sacrum right anterior position (RSA)

An uncomplicated breech refers to a fetus in full flexion. The opposite will apply to a LSA (left sacroanterior). The standard mechanism is followed (see Figure 29.14). The learner can use a step-by-step guide (see Figure 29.16) to learn the delivery of an uncomplicated breech based on the mechanism of a breech.

Abdominal findings

- *Lie*. The lie is longitudinal podalic. On abdominal palpation the back is on the right side anteriorly and the small parts are on the left posteriorly. The shape of the abdomen is more ovoid and looks full in the fundus (where the head is). Two poles are identified (if the breech is not engaged). The head can be distinguished because it is hard and round and ballotted when moved (without the body moving). The fundus may be fuller and higher than expected for the birth.
- *Fetal heart*. In a right sacroanterior (RSA) presentation the fetal heart is heard right above the umbilical line through the posterior thorax wall of the fetus.
- *Attitude*. The attitude is full flexion.
- *Position*. The position is a right sacral anterior, where the sacrum is turned to the right iliopectineal line of the maternal pelvis.
- *Presentation*. The presentation is a breech and will be the anterior (right) buttock.
- *The relationship of the denominator to the bony pelvis*. The sacrum lies adjacent to the right iliopectineal eminence, thus making it a right sacroanterior position (RSA). The bitrochanteric diameter will lie in the right oblique diameter of the pelvis. The natal cleft will therefore be in the left oblique diameter of the pelvis.
- *Presenting diameters*. The presenting diameters of the breech is the bitrochandric diameter (between the femur joints) 10 cm in the term fetus.

Mechanism

- *Descent*. In a breech presentation, the anterior buttock will reach the pelvic floor first, with the anterior hip near the symphysis pubis and the posterior hip posterior in the sacrum in an oblique position. The anterior buttock becomes the leading part.
- *Internal rotation*. The breech will rotate forward by 45° for the anterior hip to lie under the symphysis pubis, pushing the posterior buttock into the hollow of the sacrum.

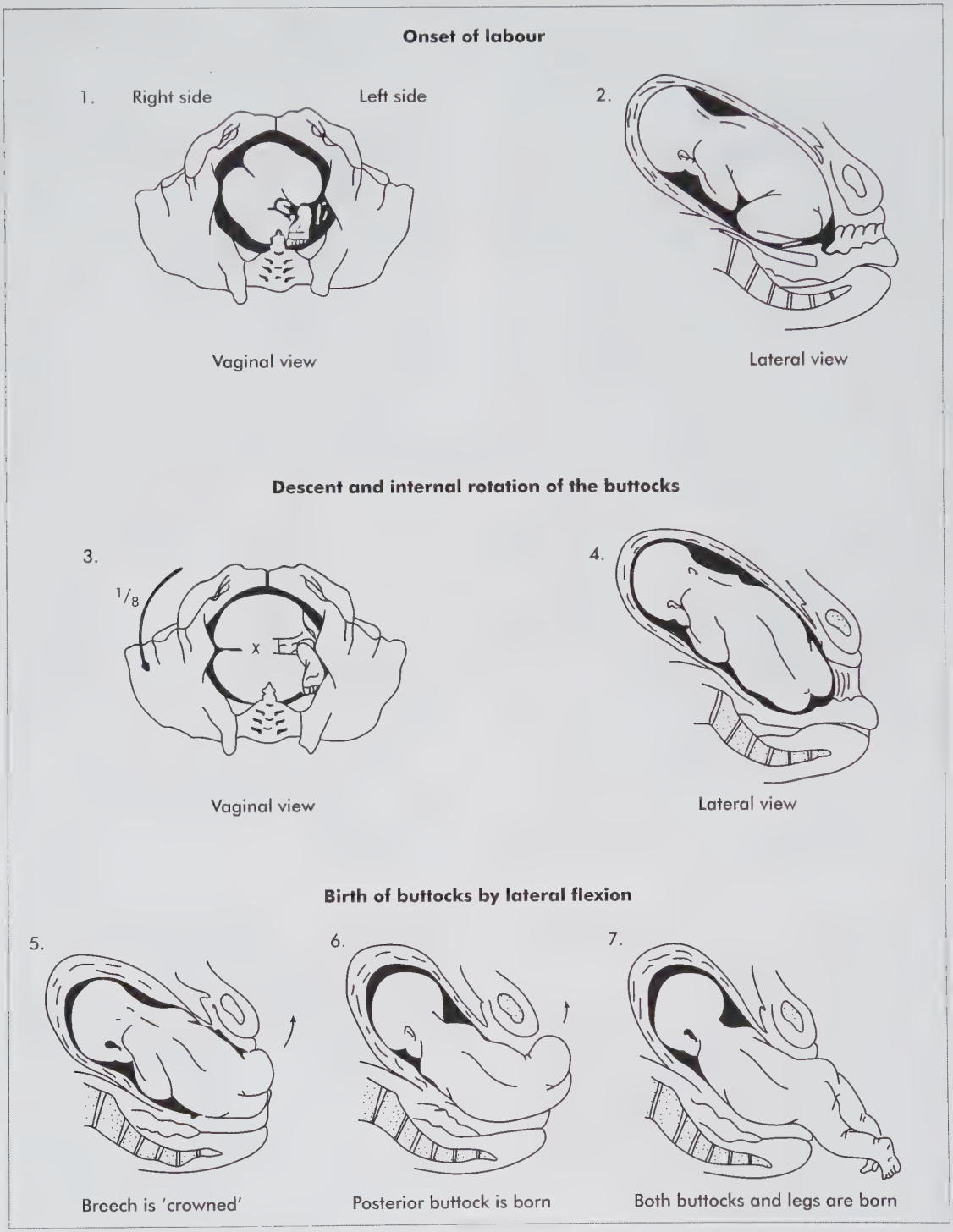


Figure 29.14 Mechanism of an uncomplicated breech

continued

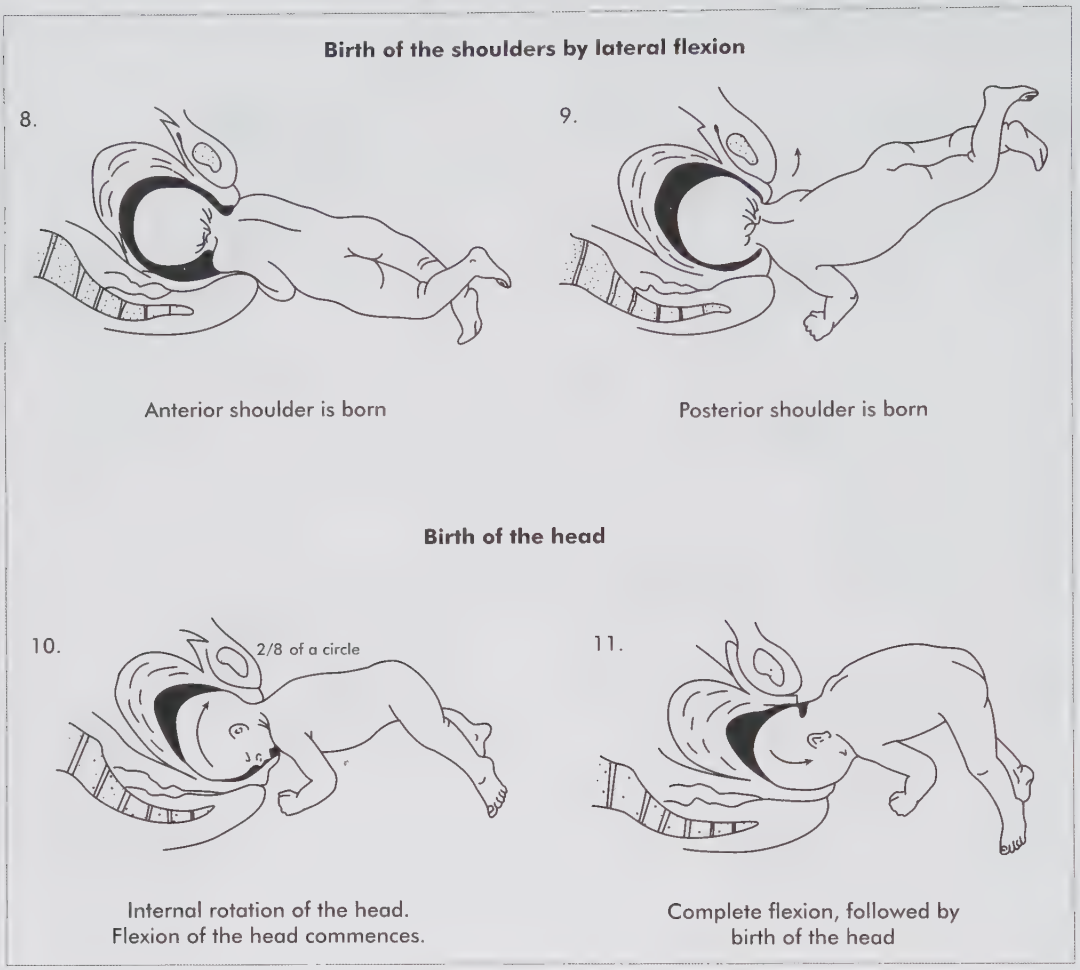


Figure 29.14 Mechanism of an uncomplicated breech (*continued*)

The largest diameter of the breech is the bitrochanteric diameter of 10 cm (between the hip joints).

- *Position*. The bitrochanteric diameter will now lie in the anteroposterior diameter of the pelvic outlet with the anterior hip under the symphysis pubis and the posterior hip in the hollow of the maternal sacrum. The fetal sacrum is on the right side of the mother (in a RSA position) with the flexed legs on the left side. The genitals of a male fetus can guide the midwife or medical practitioner during vaginal examination, on the position of the fetus. In the female infant the genital parts may be confused with a face presentation.
- *Second stage*. When fully dilated the mother can bear down. The breech is easier to deliver than the head and, particularly in a preterm birth, can pass through a poorly dilated cervix. However, the after-coming head may then become stuck. Therefore the mother should not bear down before full dilatation.
- *Birth of the buttocks*. The woman is allowed to bear down. The anterior buttock escapes easily under the pubic arch (in the AP position). The buttock crowns (stretching the perineum). The breech is delivered in lateral flexion. The sacrum is directed towards the mother's right thigh. **The rule of care is 'hands off'**. The body is allowed to be delivered spontaneously and may be supported by the midwife. The legs are free and are allowed to deliver by themselves.
- *Loop of cord*. When the fetal abdomen is revealed at the umbilicus a loop of umbilical cord is pulled down gently with the fingers to allow for the after-coming head.

- *Restitution*. Restitution takes place in order to undo the twist in the body of the fetus. The anterior buttock rotates back 45° to align with the head. The fetal shoulder and head enters the pelvis as the body is born.
- *Internal rotation of the shoulders*. The shoulders (the biacromial diameter) also enter the pelvis in the oblique diameter. The anterior shoulder meets the pelvic floor first and rotates forward 45° and comes to lie under the lower border of the symphysis pubis with the posterior shoulder in the hollow of the sacrum. (The biacromial diameter of the shoulders lies in the anteroposterior position of the pelvis.)
- *Birth of the shoulders*. The anterior shoulder escapes under the pubic arch, and then, with a movement of lateral flexion, the posterior shoulder sweeps past the perineum and the shoulders are born. **Hands still off!**
- *Descent of the head*. The head enters the pelvis in flexion, with the sagittal suture in the transverse or oblique diameter of the pelvis. The occiput is in the right of the pelvis. The posterior fontanel is right anterior, the anterior, left posterior and the sagittal suture line is left oblique.
- *Internal rotation of the head*. As the occiput reaches the pelvic floor it rotates anteriorly forward 90° to lie under the symphysis pubis. The suboccipital area of the head is under the symphysis pubis (anterior) and the face is in the sacrum (posterior). The sagittal suture line in the pelvis is in the anteroposterior position.
- *External rotation of the body*. The external rotation of the body and the internal rotation of the head are simultaneous processes. The external rotation of the body takes place with the back always turning anteriorly to lie under the symphysis pubis. The body is now completely delivered and enough cord should be available.
- *Birth of the head*. The body is delivered and the after coming head must be delivered within 7–10 minutes. Start counting from the time the head is engaged in the pelvis because the cord will be compressed. No more than 7–10 minutes should be allowed between delivery of the body and head. The body is allowed to hang until the posterior hairline is visible. This will improve flexion of the head and allow it to descend. The pulsation of the cord can be monitored.

Methods of delivering the head

There are two methods used to deliver the head:

- *The Burns Marshall manoeuvre*. The baby's body is allowed to hang downward with the head inside the pelvis for one to two minutes. (The person delivering must keep the hands near the baby's pelvis in case the head is delivered).

  When the posterior hair line appears under the pubic arch, the baby's feet are firmly grasped in the right hand, and the midwife exerts firm pressure downward, then outward and finally uses upward traction to keep the spine straight (in order to prevent damage to the spine and cord), and the body is drawn upward over the maternal pubis, in an arc of 180°, using the fetal occiput as a pivot. While this is being done, the left hand is used to guard the perineum and to prevent the head from emerging too quickly. The baby's body is held vertically, while the vault of the head remains in the vagina.

  The mouth and the nose are then free from the perineum, the airways are gently cleaned, suctioned and cleared, and the baby can now breathe. The time is noted in order to ascertain how long the delivery has taken from the delivery of the umbilicus.

  The mother is instructed to continue breathing deeply and the vault of the baby's head is delivered very slowly and carefully over about two to three minutes. The mother pants the head out rather than bearing down. A medical practitioner may apply low forceps at this stage to control delivery of the head.
- *Maurice Smellie-Veit manoeuvre*. The after-coming head can be delivered slowly by the Maurice Smellie-Veit manoeuvre. Lay the body on the forearm. Put the index finger and middle finger on the ridges below the eye. The other hand is placed on the occiput. The head is controlled and is delivered in an 180° circle until the mouth is open. The airways are suctioned and the head slowly delivered as the mother pants the baby out (see Figure 29.15).



29.15 Maurice Smellie-Veit manoeuvre

Principles of treatment and care of a breech presentation

Early diagnosis and referral are vital. External version may be performed by a medical practitioner after 37 weeks or in early labour, where ultrasound, theatre, anaesthetist and paediatrician must be available.

Determine whether the woman can have a vaginal birth using the Zatuchni-Andros score (see Box 29.3).When in labour the membranes are kept intact as long as possible, because the cord can prolapse and this keeps even pressure on the cervix (the breech does not give good even pressure on the cervix). If the membranes rupture a vaginal examination is performed to make sure that the cord has not prolapsed. Avoid premature bearing down before full dilatation.

Analgesia is important and if epidural anaesthesia is available this is of great value. An anaesthetist and paediatrician are alerted and on standby. An intravenous infusion may be needed because labour is slow.

Management during the second stage of labour:

- Extra staff is needed in the labour ward.
- Make sure the cervix is fully dilated.
- Keep the bladder empty.
- Check the fetal heart regularly.
- Do an episiotomy for the after-coming head.

29.3 Zatuchni-Andros score index

Zatuchni-Andros score index 1965

Parameter	Score 0	Score 1	Score 2
Parity	0	1	2>
Gestational age in weeks	39+	38	<37
Previous vaginal birth	0	1	2
Estimated fetal weight	>4	3.5–4	<3.5
Cervical 2 cm	2	3	4>
Station of presenting part	–3	–2	–1
Score 0–4	**Ceasarean section**		
>5	**Allow breech delivery**		

Source: www.caroldenny.com/index.php.options=com

- The hands-off approach is preferred unless there are complications.
- A loop of cord is pulled down when the body is delivered at abdominal level to make sure the cord is long enough.
- The cord is felt for pulsation. If it drops to 100 b/m time is running out.
- You have 7–10 minutes for the delivery of the head.
- The head is delivered slowly and in a controlled way.
- A medical practitioner should do the delivery and a paediatrician needs to be present.

The potential complications of a breech presentation

Increased perinatal mortality in both term and preterm babies. In term babies the mortality rate in breech presentations is three times higher than in cephalic presentations. In the preterm breech presentation, the mortality rate is much higher.

Maternal complications

A midwife needs to be alert to the following during a breech presentation:

- There is a high presenting part and the early rupture of membranes. Because of the high and irregular presenting part, the membranes tend to rupture early in labour and much of the liquor drains away. Because of this there is a greater possibility that the umbilical cord will slip between the legs, resulting in a cord presentation or prolapse. The buttocks, especially in the complete breech, do not usually engage before labour and therefore the presenting part remains high. This is less likely to occur in the frank breech. Prolonged labour and possibly obstructed labour may also occur.
- There may be a prolonged first stage in the complete breech and in the footling or kneeling breech presentation. The frank breech presents a more compact and regular area, which facilitates the dilatation of the cervix. However, although the smaller circumference in the frank breech can pass through a certain cervical diameter, the larger after-coming head may become caught up in the not quite fully dilated cervix and this can obstruct further progress. This condition can also apply in the footling and kneeling breech.
- The second stage in breech presentations can be prolonged due to the complications that can arise with the abnormalities of attitudes (or types) of breech (extended legs see Figure 29.15). Obstruction can also occur with the after-coming head when the engaging diameters are too large to pass through the pelvis at the inlet, at the mid-cavity or at the outlet.

- Extension of the arms can be a complication (see Figure 29.16).
- The mother may become distressed with the prolonged labour, but there may also be emotional distress because she knows that the delivery is complicated. In addition, any manipulations that may be necessary will cause further distress.
- Early bearing down. The woman is inclined to want to bear down before the cervix is fully dilated, particularly if there is a foot or a knee in the vagina.
- There is a high risk of complications and the perineum can be severely lacerated if there is difficulty with the after-coming head. A large episiotomy is, therefore, a necessity. Caesarean section is often performed in preference to vaginal delivery in breech presentation. Destructive operations may be necessary if the fetus has died during delivery, usually when the after-coming head has become caught up in the pelvis.
- There is an increased incidence of both traumatic and atonic postpartum haemorrhage. There is also a possibility of intrapartum haemorrhage with a short cord causing premature placental separation and because a loop of cord has to be pulled down when the buttocks are born, so that there is no tension on the umbilicus while the head is delivering.

Fetal complications

The following complications can arise:

- fetal hypoxia and compromise (distress)
- asphyxia neonatorum, caused by:
  - difficulties with, damage to and delay in delivering the fetal head, including the rapid and upward moulding of the after-corning head, can result in hypoxia and asphyxia
  - premature inspiration, while the head is still in the pelvis. For this reason, the body should not be touched with cold hands while the head is still in the pelvis

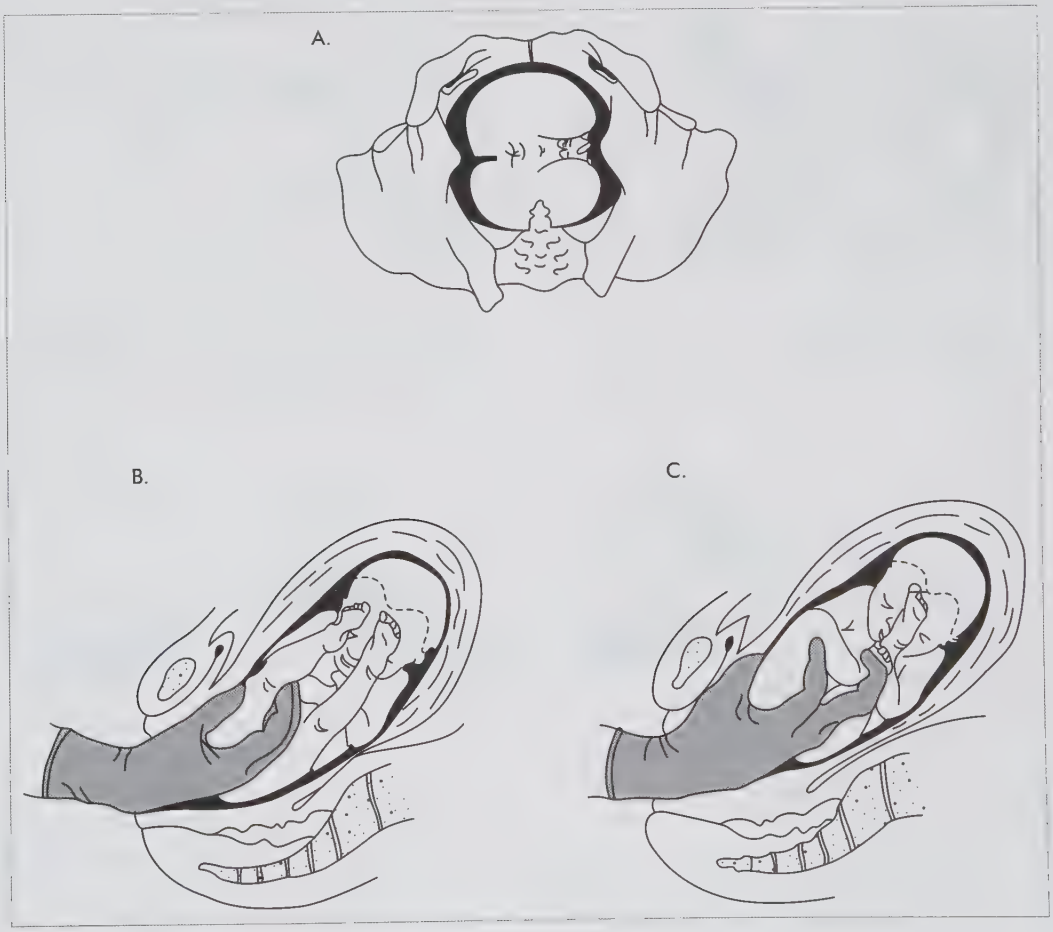


Figure 29.16 Delivery of extended legs

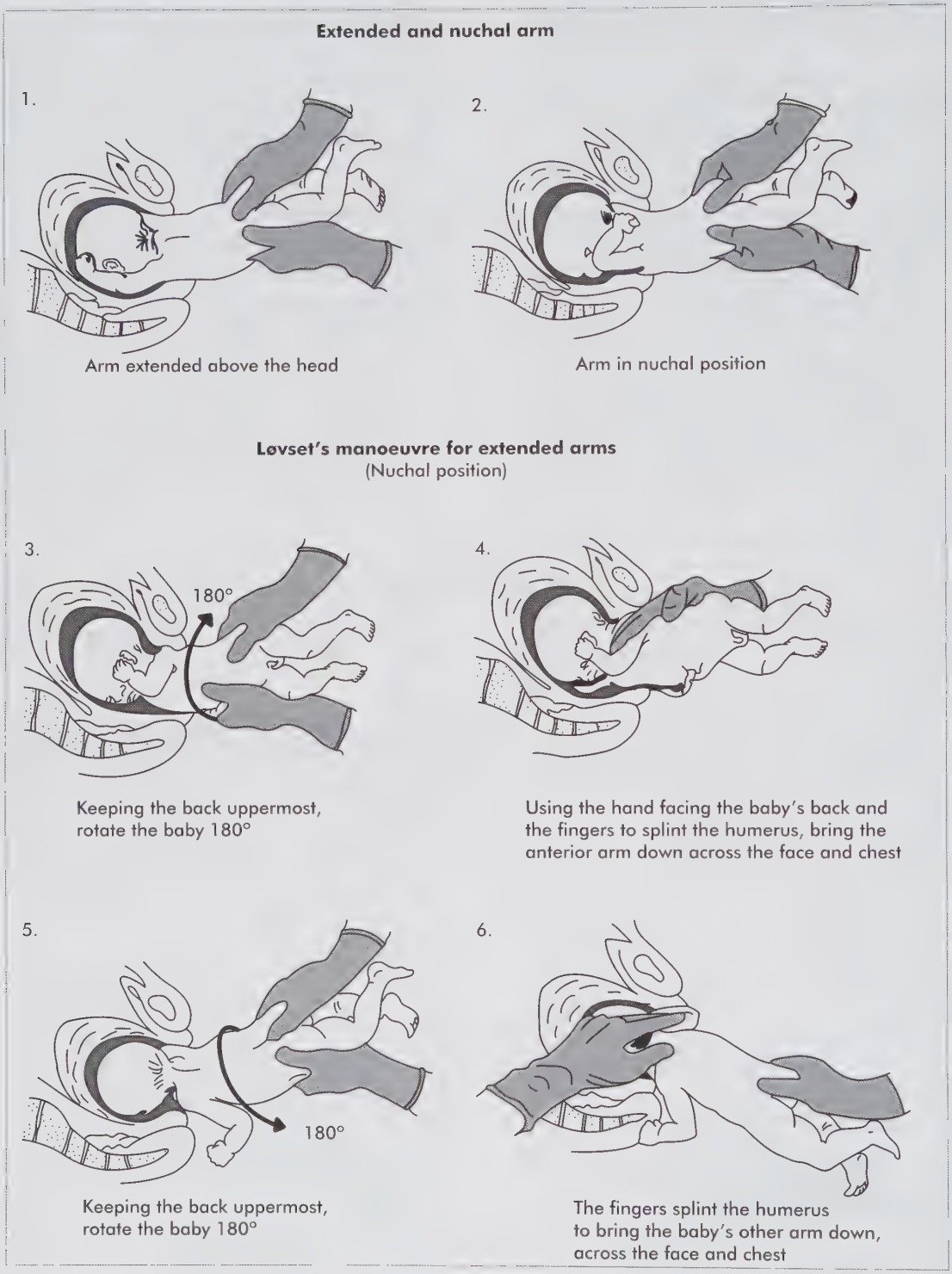


Figure 29.17 Delivery of extended arms (skilled midwife or medcial practitioner)

- breathing difficulties caused by extension of the head
- preterm babies have respiratory problems due to a lack of surfactant, as well as a high incidence of cerebral injury.

- Fetal abnormality may be undiagnosed. Breech presentation could very well reflect some underlying fetal abnormality such as hydrocephaly or anencephaly. For this reason, any woman with a breech presentation that is diagnosed during pregnancy should have thorough investigations to detect any fetal abnormality and to find out the attitude of the fetus.
- Birth injuries.

The following complications can arise:

- fractures of the spine, the legs, the arms and the clavicle due to mismanagement or difficulties during delivery
- damage to the spinal cord, resulting in paralysis below the spinal injury, or the brachial plexus, resulting in the Erb-Duchenne or Klumpke types of paralysis of the arm
- damage to, or rupture of, abdominal viscera (the liver, the spleen, the adrenal glands) by incorrect handling of the baby during delivery. This is even more likely in a preterm baby
- bruising of the buttocks and the external genitalia
- cerebral haemorrhage when the after coming-head in a breech presentation is subjected to both rapid and upward moulding (compression and decompression) which may result in intracranial haemorrhage. There is rapid and excessive compression as the head passes through the pelvis, and then there is rapid decompression if the head is allowed to be delivered quickly. Preterm babies have soft skull bones and the contents of the skull are easily damaged
- neonatal infection from the early rupture of membranes and from the high rate of intervention.

29.5 Cephalopelvic disproportion (CPD)

Incidence

Incidence: 1 in 250 pregnancies may present with mild or severe CPD.

Definition

Cephalopelvic disproportion is a condition in which the engaging diameters of the fetal head (cephal) are too large to pass through the pelvic canal. This means that there is disproportion between the fetal head (the passenger) and the mother's pelvis (the passages), which will affect the course and possibly the eventual outcome of the labour.

Types of disproportion

There are two types of disproportion namely *relative* and *absolute*.

Relative disproportion

Relative disproportion means that the attitude of the fetal head is not favourable causing the largest diameters to present at the pelvic inlet which causes complications, for example, occipitoposterior, brow or face presentations.

Absolute disproportion

Absolute disproportion means that the fetal head (in a normal position and attitude) itself is too large to negotiate the pelvis with ease, or, that the pelvis is too small, or both, for example, occipitoanterior position.

Maternal causes of disproportion

The causes of disproportion can be maternal or fetal. Deviations in the pelvis shape and size are common causes of CPD.

A contracted pelvis is a pelvis in which one or more of the average gynaecoid pelvic measurement is diminished by 1 cm or more.

The degree of disproportion may be:

- mild/minor (where a pelvic diameter is 1 cm less than normal)
- moderate (where a pelvic diameter is 1–2 cm less than normal)
- severe/major (where a pelvic diameter is over 2 cm less than normal).

The amount (degree) of disproportion will depend to a large extent upon the type (shape) and size of the pelvis. However, the degree of disproportion can only be assessed after 36 weeks' gestation, when the size of the fetal head has almost reached its maximum.

The disproportion may occur at the inlet (brim), the midcavity, or at the outlet, or at two or more of these planes. The ischial spines between the midcavity and the outlet may cause problems if they are prominent.

Although in most instances the head is the largest part of the fetus and is usually the presenting part, other parts can be so enlarged as to be bigger than the head, and these can, therefore, cause varying degrees of disproportion. For the sake of convenience, this type of disproportion is also included here.

The disproportion may occur on any level of the pelvis: the inlet, midpelvis or outlet.

Pelvic inlet contracture

This may be caused by or be predisposed to by:

- *Small stature*. CPD is more common in women who are less than 152 cm in height.
- *Type of pelvis (genetic)*. Android, anthropoid, plattypelloid, justo-minor, etc.
- *Abnormalities of the pelvic shape and size*. This may be due to congenital abnormality (deformities or dwarfism); to poor development from malnourishment (rickets); to injury (fractures); to disease (poliomyelitis), etc.
- *Spinal*. Spinal deformities and injuries (scoliosis, kyphosis, spondylolisthesis, etc.).

If the woman has any noticeable type of skeletal deformity, or a limp, then a deformity of the pelvis should be suspected.
The effects on the fetus:

- non-engagement of the head
- an increase in deflexion of the head and malpositions
- an increase in malpresentations
- exaggerated synclitism and asynclitism (see Figure 29.12)
- excessive caput succedaneum and other injuries to the skull and scalp
- an increased incidence of umbilical cord prolapse
- an increase in asphyxia neonatorum
- an increase in birth injuries, both intracranial and others
- an increase in preterm babies
- an increase in the incidence of perinatal death.

The effects on labour:

- prolonged labour, with slow dilatation of the cervix and descent of the presenting part
- disordered uterine action, particularly secondary incoordinate uterine action
- premature rupture of the membranes
- increased malpresentations
- spontaneous symphysiotomy
- obstructed labour
- an increase in operative procedures such as forceps delivery, vacuum extraction, symphysiotomy, caesarean section and destructive operations
- increase in postpartum haemorrhage
- increase in maternal injuries, trauma to the perineum, the vagina and the uterus
- increase in maternal infection
- vesicovaginal fistula.

The causes of midcavity contracture

The android type of pelvis with the long, narrow, less curved pelvic canal is a contracted pelvis. This type of pelvis also predisposes to occipitoposterior positions. Black women are liable to this complication because they carry heavy objects on the head from early childhood, which causes the head of the femur to push the acetabulum inwards, resulting in a narrowing of the side walls of the pelvis.
The effects on the fetus:

- most of the effects of inlet contracture
- moulding
- caput formation.

The effects on labour:

- most of the effects of inlet contracture
- it may prevent or delay anterior rotation of the head in occipitoposterior positions, resulting in persistent occipitoposterior positions and in deep transverse arrest
- labour may be prolonged and become obstructed
- poor application of the cervix on the fetal head.

Pelvic outlet contracture

The following conditions may be causes or predisposing to:

- pelvises in which the distance between the ischial spines is diminished
- pelvises in which the distance between the ischial tuberosities is diminished
- pelvises in which the angle of the subpubic arch is diminished
- an immobile coccyx.

The effects on the fetus:

- excessive and abnormal moulding of the fetal skull
- excessive caput succedaneum and other injuries to the skull and scalp
- an increase in asphyxia neonatorum
- an increase in birth injuries, both intracranial and others
- an increase in the incidence of perinatal death.

The effects on labour:

- may prevent or delay anterior rotation of the head in occipitoposterior positions, resulting in persistent occipitoposterior position or in deep transverse arrest
- prolong the second stage of labour
- increased use of forceps may result in bad perineal tears such as third degree tears, especially if the subpubic arch is narrowed, as the head is then directed backwards into the perineum. To prevent bad tears, large episiotomies are performed.

The soft tissue conditions of the pelvis:
- anterior obliquity of the uterus (pendulous abdomen)
- placenta praevia
- tumours of the pelvic tissue (hard and soft)
- abnormal uteri, congenital causes or fibroids.

Fetal causes of disproportion (the passenger)

There are several fetal causes which predispose towards cephalopelvic disproportion namely abnormalities of growth, congenital abnormalities, abnormal presentations and the inability of the fetal head to mould.

Abnormalities of growth

A fetal weight of 4.5 kg or more, which can result from:
- diet and eating habits in the mother
- familial tendencies (genetic factors)
- multiparity (babies tend to get bigger with each pregnancy)
- maternal obesity
- maternal age (older women tend to have bigger babies)
- maternal diabetes mellitus (macrosomy)
- prolonged pregnancy (postmaturity).

Congenital abnormalities

Parts of the baby may be enlarged as a result of:
- hydrocephaly
- tumours such as encephalocele
- achondroplasia
- conjoined twins
- ascites, exomphalos, atresia of ureters causing retained urine
- maternal diabetes mellitus causing an enlarged shoulder girdle
- hydrops fetalis.

Abnormal presentations

The size of the fetal head is within normal limits, but one or all of the following are abnormal, causing the presenting diameters to be large:
- the presentation
- the attitude (deflexion or extension)
- the lie (transverse or oblique).

Inability of the fetal head to mould

In the following conditions, little or no moulding is able to take place and therefore there is disproportion:
- face presentation
- postmaturity
- hydrocephaly
- craniostenosis.

The effects on labour:

The effects on labour are varied, depending upon the cause/s, but they are generally much the same as for the maternal causes.

Diagnosis, treatment and care of CPD

The main objective in the diagnoses of disproportion is to be able to correctly assess the size of the fetal head in relation to the size of the pelvis through which it will have to pass.

High risk factors for CPD

High risk factors will include:
- patients with a contracted pelvis, but a normal sized baby
- patients with a normal sized pelvis, but an excessively large baby
- patients with both a contracted pelvis and a large baby
- labours where the head may not be able to negotiate the pelvic brim
- labours where the head may negotiate the brim, but will have midpelvic and perhaps outlet difficulties
- labours where the head may negotiate the brim and the midpelvis, but may have difficulties at the outlet.

Borderline conditions for CPD

It is the borderline conditions that give the most trouble, those where the head may or may not negotiate the brim, the midcavity and/or the outlet. Severe cephalopelvic disproportion is usually diagnosed more readily.

Minor degrees of cephalopelvic disproportion may be overcome by maternal and fetal conditions.

Maternal conditions:
- efficient uterine action
- the 'give' of the pelvic joints
- the expandability of the soft tissue of the pelvis.

Fetal conditions:
- a favourable attitude
- a favorable presentation
- a favourable position
- increased flexion of the fetal head during labour in a vertex or in a breech presentation
- the ability of the fetal skull to mould. (Excessive, upward or rapid moulding can result in intracranial injury, and a reduction of 0.5 cm or more in the bi-parietal diameter is considered dangerous to the fetus.)

Clinical assessment

The diagnosis of cephalopelvic disproportion is usually made by the medical practitioner during the later weeks

of pregnancy, and the woman is told to deliver in hospital. However, sometimes there are unknown factors, such as prolonged pregnancy, occipitoposterior positions, malpresentations, disordered uterine action and others, which may only become evident and/or relevant during labour. In addition, there are those women who have not attended an antenatal clinic and have not been examined by a medical practitioner during pregnancy. The midwife will need to look after these women in labour and know when to refer.

The methods for diagnosing cephalopelvic disproportion that are available to the midwife are as follows:

The history. The best indicator of birth is said to be the baby, and if the mother has previously given birth to a baby of a particular size, under normal circumstances she should be able to do so again.

However, there may be other factors, such as malposition or malpresentation, which were not present before.
Any history of:

- skeletal injuries or disorders
- poliomyelitis or rickets
- diabetes mellitus
- grande multiparity
- the elderly primigravida
- previous prolonged labours
- previous operative procedures
- contracted pelvis
- large babies
- birth trauma, or any of the other predisposing causes of cephalopelvic disproportion should be recorded.

The estimated date of delivery is noted.
The stature (size) and posture of the woman are noted.

Abdominal palpation. Palpation is done to assess the following;

- the 'feto-pelvic fit'
- the lie, attitude, presentation and position of the fetus; the bladder must be empty
- the size and weight of the fetus
- the fifths of the fetal head above the pelvic brim
- whether the head is engaged, and if not, whether the head can engage
- if the head cannot engage, pelvic palpation will determine the amount of 'overlap' (the degree of cephalopelvic disproportion).

Methods

It is the medical practitioner's responsibility to gauge the amount of disproportion and to decide on the course of action. However, in situations where a medical practitioner is not available and the patient may need to be transferred from a clinic to a hospital, the midwife must be able to diagnose disproportion and recognise the degree of the disproportion.

The methods described here are only valid if performed after 36 weeks, because the fetal head will not have grown sufficiently to provide evidence of cephalopelvic disproportion prior to this time.

Deep pelvic palpation. (See Chapter 17.) The head is grasped as for deep pelvic palpation. Pressure is exerted on the fetal head in a downward and backward direction, following the plane of the pelvic canal. If the head moves downward through the brim of the pelvic inlet, disproportion can be ruled out. (There is a feeling of 'give' when the head enters the pelvis, but the head does not remain in the pelvis when the grip is released, but returns to the original position.)

Pelvic palpation for cephalopelvic disproportion is the method for determining if the head will engage, and the amount of overlap (or degree of cephalopelvic disproportion) if the head does not engage (see Figure 29.18).

The left hand grip. The fetal head is grasped in the left hand (an inverted Pawlik's grip), with the thumb on the patient's right side. Pressure is exerted on the head (as described above). If 'give' is experienced, the head can engage. If the head does not move downward, the index and middle fingers of the right hand can assess the amount of 'overlap' (see Figure 29.18).

Sitting the patient up (Chassar-Moir method). This is the Chassar-Moir method of determining the overlap using abdominal palpation.

This method is used when the head cannot be engaged in the above methods, and will help to determine the amount of disproportion by indicating the amount of overlap.

Standing on the patient's right side, the midwife faces the patient's feet. She/he places her/his left hand on the mother's abdomen, over the upper border of the fetal head. The ulnar border of the hand, which will extend from the occiput to the sinciput, pushes the head downwards and backwards, towards the pelvic brim. When the head will no longer move, the index and middle fingers of the right hand assess the degree of overlap at the summit of the symphysis pubis.

Vaginal assessment (Munro-Kerr method). This method is usually used by the medical practitioner and must be performed under strict aseptic conditions. If the midwife requires more definite proof of cephalopelvic disproportion, she

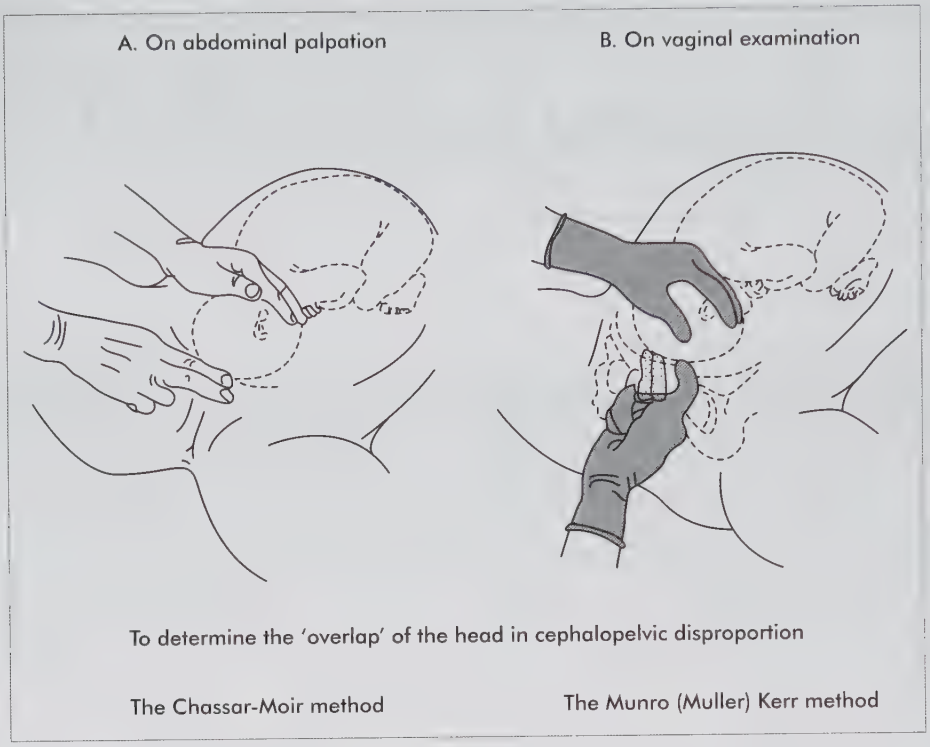


Figure 29.18 Methods used to determine the overlap of the head for CPD

can undertake this method, but must be very careful not to rupture the membranes (see Figure 29.18). The patient should preferably be referred to a skilled midwife or a medical practitioner.

The midwife must bear in mind that this is a painful and very uncomfortable procedure for the patient.

The patient is placed in the modified dorsal or lithotomy position (shoulders and back propped up with pillows). The index and middle fingers are then inserted into the vagina and pelvis, while the thumb is placed on the outside of the pelvis on the upper, anterior border of the symphysis pubis. The left hand is placed on the abdomen over the fetal head, and presses the head downwards and backwards, into the pelvic brim.

The fingers in the pelvic canal assess the amount of descent of the presenting part, while the thumb determines the degree of overlap at the summit of the symphysis pubis.

The 'overlap' is the amount of fetal skull that extends outwards, anteriorly, above the brim of the pelvis, at the summit of the symphysis pubis, when the head is pushed towards the pelvic brim. There are three categories of 'overlap':

- *Mild*. When the anterior parietal bone is level with the anterior border of the symphysis pubis.
- *Moderate*. When the fetal head slightly overlaps the anterior border of the symphysis pubis.
- *Severe*. When there is a pronounced bulge of fetal head over the anterior edge of the symphysis pubis. The circumference of the fetal head (COH) increases by about 2 mm per week from 36–40 weeks. (The biparietal diameter of the fetal skull increases by about 0.15–0.2 cm per week from 30 weeks.)

Interventions

None of the above methods is infallible, and if there is any possibility of cephalopelvic disproportion, the midwife must not hesitate to transfer the patient to the nearest hospital and to call a medical practitioner. CAT scan or ultrasound investigations are more accurate than clinical assessments. After 32 weeks an X-ray pelvimetry is also useful if other diagnostic tests are not available.

A trial of labour

All cases where mild to moderate cephalopelvic disproportion is suspected, *a trial of labour* in hospital can be suggested. (see Chapter 32). The medical practitioner and the woman will make a collaborated decision. A trail of labour requires a

normal birth within limited time with good progress (recorded on a partogram). Medical assistance is available.

Elective caesarean section

The medical practitioner will usually do an elective caesarean section on women with moderate to severe cephalopelvic disproportion, or if there is some other abnormal condition as well as CPD.

Early induction of labour

The medical practitioner may decide to induce labour early (between 36–38 weeks' gestation), in order to allow a smaller baby to pass through the pelvis.

29.6 Conclusion

The midwife's scope of practice is normal birth. However, it is important that a midwife is able to identify abnormal labour and refer a woman for medical care in time. When a midwife works in collaboration with a medical practitioner she needs the knowledge to give effective assistance.

CHAPTER

30 Dysfunctional uterine functions

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- identify and describe causative factors of dysfunctional uterine contractions
- identify and describe preventive measures and interventions of dysfunctional uterine contractions
- develop the basic competencies to assist women with dysfunctional uterine function.

KNOWLEDGE ASSUMED TO BE IN PLACE

Knowledge, competency and skill of the basic management of normal birth

Know the Ps of birth (Study in collaboration with Chapter 8)

KEYWORDS

Dysfunction • Hypotonic • Hypertonic • Colicky • Dystocia

30.1 Introduction

In this chapter abnormal uterine functions will be explained and the fact that they result in dysfunctional labour. The prevention, early identification and management of these conditions are presented. Midwives need to be able to identify abnormal uterine function and take appropriate action. Normal uterine functions (see Figure 30.1) can be felt on palpation of the abdomen.

The midwife may feel the contraction before the woman is aware of it because women feel a contraction when the uterine pressure exceeds 25 mmHg. This difference between being able to manually palpate the contraction and the woman feeling the contraction can be 20 seconds. If a woman feels a contraction before it is palpated by a midwife or the contraction does not show on a cardiotocograph, or the woman complains of pain after the contraction has subsided, abnormal uterine function is suspected. During a normal uterine contraction the intrauterine pressure, which is called *intensity* or *amplitude of the contraction,* increases. The contraction rises sharply and has a slow decline. The frequency of the contraction is the number of contractions in 10 minutes and is scientifically measured in Montevideo units (MVU); (intensity (mmHg) x frequency (per 10 minutes) = uterine activity). The mean force to initiate cervical change is measured in Montevideo units and the intensity times the number of contractions in 10 minutes and should reach 275 MVU.

In clinical practice three to four contractions of 60 seconds are required for labour and are measured by abdominal palpation or external cardiotocograph. The uterine tone needs to go back to the baseline or relax completely between contractions for at least 40 seconds.

30.1 Calculating Montevideo units (MVU)

This is the peak strength of contractions in mmHg measured by an internal monitor multiplied by their frequency per 10 minutes.

Measure the peak amplitude of each contraction = A in mmHg

Count the number of contractions in 10 minutes = N

MVU = A x N

Example: contractions of 60 mmHg with 4 in 10 minutes = MVU of 240. In a retrospective report, 91% of women in spontaneous active labour achieved contractile activity greater than 200 Montevideo units and 40% reached 300 Montevideo units. (See also Figure 8.17)

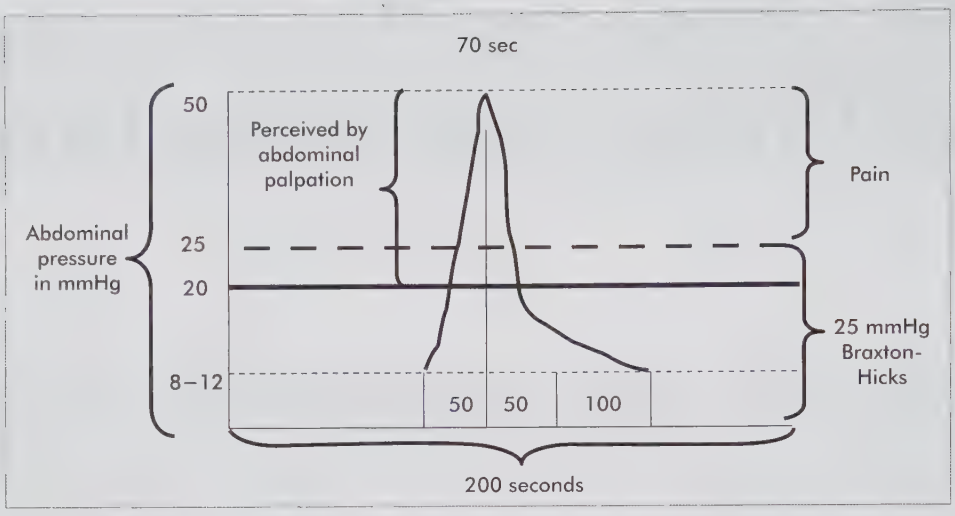


Figure 30.1 Normal uterine contractions

30.2 Dysfunctional uterine function

Abnormal uterine function can manifest as hypotonic uterine function, where labour may require augmentation or as hypertonic uterine function, where contractions are very strong, which may lead to uterine tetany or even uterine rupture.

Augmentation or acceleration of labour is a process that aims to correct the poor progress of labour by increasing the efficiency of poor uterine contractions. Oxytocin or other stimulants can be used to accelerate labour. The condition of the woman and fetus is monitored the same way as during induction using a partogram and electronic monitoring in addition to normal observations. Using the partogram, abnormalities in the duration of labour can be detected (see Table 30.1).

Incidence of dysfunctional uterine function

The incidence is 1–2%.

Definition

Dysfunctional uterine function occurs when the uterine contractile pattern deviates from what is considered normal.

Causes

Eighty-five percent of dysfunctional abnormal uterine functions are found in primigravida. Other causes include:

- mechanical causes:
  - minor disproportion (OP positions)
  - CPD cephalic pelvic disproportion
  - large infant (those that weigh more than 3 400 g are three times more at risk)
  - high head (lack of fundal dominance)
  - overstretched uterus (grand multipara, polihydramnios, and multiple pregnancy)
  - myomata
  - previous surgery to uterus
- prolonged pregnancy
- psychological factors (fear inhibits catecholamine production)
- congenital abnormalities of the uterus (bicornuate uterus).

The partogram is a graphic presentation of labour that is used to detect abnormalities or dysfunctional labour. Six distinct abnormal patterns are detected:

- prolonged latent phase
- protracted active phase (slowed)
- slowed descent
- prolonged deceleration
- secondary arrest
- arrest of descent (obstructed labour).

The uterus, fetus and pelvis work together in labour. Defects of one may affect the others. If the pelvis is abnormal the fetal head may remain high, which may prevent the presenting part applying well to the cervix. The poor application of the presenting part delays the ripening of the cervix and the Ferguson reflex. The uterine contractions are insufficient and irregular, or the uterus may contract violently to try to overcome the obstruction if present.

Table 30.1

Abnormal patterns of labour

First Stage labor	Nullipara	Multipara
Abnormal duration	>24.7 hours	>18.8 hours
Protracted dilation	<1.2 cm/hr	<1.5 cm/hr
Arrest of dilation	>2 hours	>2 hours
Second stage of labour		
Arrest of descent (epidural)	>3 hours	>2 hours
Arrest of descent (no epidural)	>2 hours	>1 hour
Note: Oxytocin has a half-life of 3–5 minutes, and reaches steady state in approximately 40 minutes.		

Types of abnormal uterine function

Hypotonic uterine function

In hypotonic uterine function (see Figure 30.2), there is poor or no dilation of the cervix, the weak (slow) short and infrequent uterine contractions cause slow dilation of the cervix or none. It is common in primigravida and may be due to malposition, or malpresentation or cephalopelvic disproportion.

Incoordinate uterine function (colicky uterus)

Polarity is lost, resulting in reversed polarity (hypertonic lower uterine segment and loss of fundal dominance). This may lead to prolonged labour and maternal distress. The cervix fails to dilate and the woman complains of lower abdominal pain and backache. A colicky uterus can occur as different parts of the uterus contract independently. A raised resting tone above the 8–12 mmHg is present and the woman experiences pain between contractions. The presence of cephalopelvic disproportion or malpresentation needs to be excluded before any intervention is considered (see Figure 30.3).

Primary incoordinate uterine function

Primary incoordinate uterine function (see Figure 30.4) usually affects young, very tense, primigravidae and is primarily of psychological origin. The following clinical features are noted:

- The woman is very tense and anxious.
- There is what is known as a 'colicky uterus': the contractions are uneven, there is a raised resting tone, and there is little cervical dilatation (a rigid cervix).
- The contractions are very painful (more painful than the strength, frequency and duration would suggest).
- There is a prolonged first stage (latent and active phase.)

Management of incoordinate uterine function. Antenatal preparation for labour, including antenatal classes on relaxation techniques and psycho prohylaxis are aimed at preventing this condition.

Analgesia, particularly epidural analgesia, is indicated and usually the labour continues well once the analgesia has taken effect. If an epidural is not possible, the woman may be sedated and given an analgesic. The medical practitioner may prescribe hydroxyzine and/or pethidine. The woman will require expert midwifery care and particular support, encouragement and understanding throughout labour.

Secondary incoordinate uterine function

There are two types of secondary incoordinate uterine function:

Type 1. This type of secondary incoordinate uterine function usually has some underlying physical cause. This may be due to malposition of the presenting part, an ill-fitting presenting part, or some other cause of difficult labour, such as cephalopelvic disproportion. The following clinical features are noted:

- strong, painful uterine hypertonic contractions (see Figure 30.6)
- a raised resting tone
- severe pain with contractions and continued pain between contractions
- constant or severe backache
- slow or no cervical dilatation (a rigid cervix)
- prolonged active phase of the first stage of labour
- deteriorating physical and emotional condition
- decreased urine output with ketones in the urine.

This type of secondary incoordinate uterine function has very similar clinical features to the primary type, and these two types could be combined in a patient. It is, therefore,

important that both the psychological and the physical causes are investigated and managed.

Management of Type 1. Quality midwifery care will reveal the delay in labour (partogram) and the medical practitioner must be notified as soon as possible. The obstetrical management will be analgesia or epidural analgesia and either assisted or caesarean section delivery.

When abnormal uterine function is suspected an intravenous line should be *in situ* to prevent exhaustion of the woman.

Type 2. The other type of secondary incoordinate uterine function may be caused by constriction ring dystocia. A group of circular muscle fibers go into spasm usually due to irritation of abdominal or vaginal manipulation. This can affect the first and second or the third stage of labour as follows:

In the first or second stage there is poor progress or arrest of progress with constant pain in labour that has been in progress for some time. The liquor has usually drained and the uterus is moulded around the fetus, preventing it from descending, due to the spasm of the muscle around the fetus or the fetus maybe totally or partially above the spastic fibers.

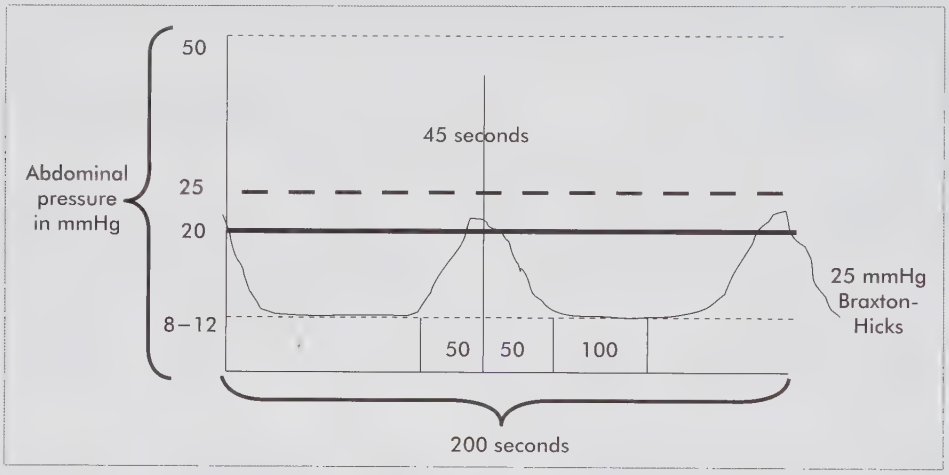


Figure 30.2 Hypotonic contractions

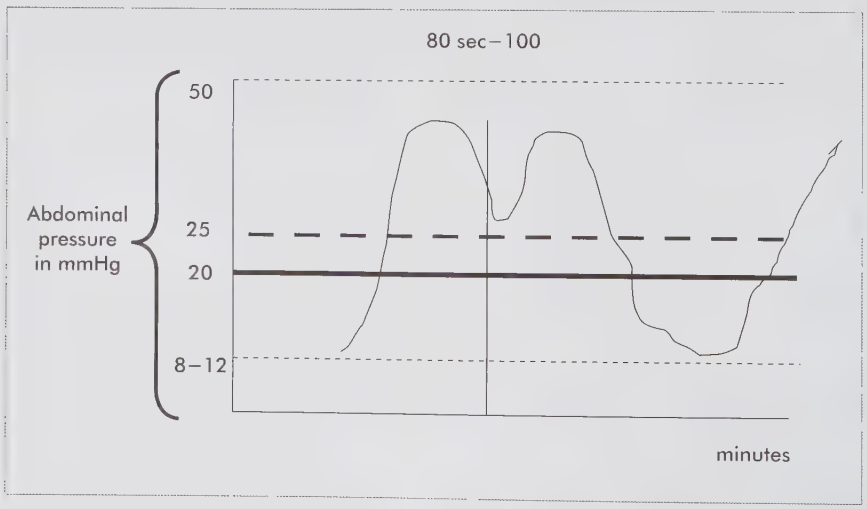


Figure 30.3 Apolarity (coupled contraction)

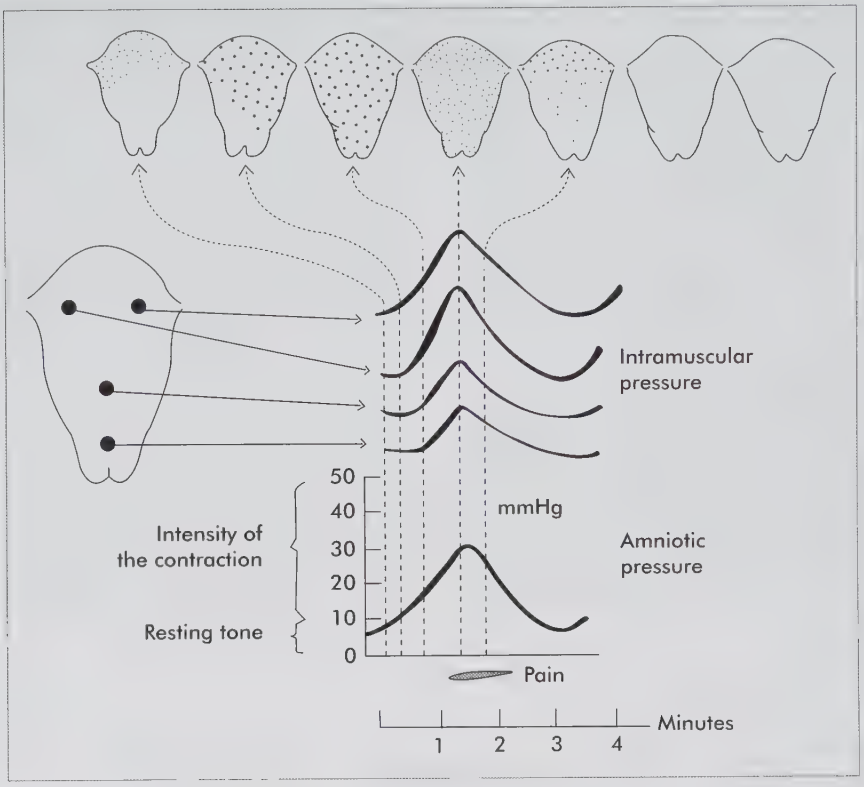


Figure 30.4 Hypotonic uterine function (primary)
Source: Sellers, P.M. *Midwifery.* 1993. Cape Town: Juta & Co

Another instance when this condition may occur could be after some manipulation, such as a version (active retention of the fetus).

Hypertonic colicky uterus may cause a constriction ring in the second stage (the presenting part fails to descend) or if it is during the third stage of labour, an hour glass contraction prevents delivery of the placenta. In both circumstances the aim of the interventions is to effect relaxation of the constriction ring. The medical practitioner/obstetrician must be informed and the necessary interventions employed.

Often there is a raised resting tone, which means that the uterus does not relax well between contractions (see Figure 30.6). Constant pain between contractions requires attention.

In the third stage a constriction ring may occur, usually at the junction of the upper and the lower segment, trapping the placenta in the uterine cavity. This is known as 'an hour-glass constriction ring', and may be caused by the use of oxytocics before the placenta is delivered, or by mismanagement and handling of the uterus before the placenta is delivered.

Management of Type 2. The management of this type can be divided into:

- *The first and second stage of labour.* The medical practitioner must be notified immediately and a caesarean section is performed.
- *The third stage.* A medical practitioner is informed immediately and the patient is taken to the operating theatre and given a general anaesthetic to relax the uterine constriction ring. There could be severe haemorrhage if the placenta has separated.

Hypertonic uterine function

There are two types of hypertonic uterine function:

Type 1. The hypertonic contractions of the uterus in obstructed labour in the multigravida.

In the case of the uterus trying to overcome an obstruction, the uterine contractions increase in intensity and frequency until the maximum retraction is reached and the uterine contraction starts to seemingly disappear. The

presenting part remains high, with or without moulding and the application of the presenting part on the cervix is poor, hanging like a curtain called *curtaining of the cervix*. The uterine contractil pattern is normal with resting in between. The fetal heart is usually normal. The clinical features of obstructed labour will be present, with maternal and fetal distress. A pathological retraction ring is a complication in primigravidae and the risk of uterine rupture is increased in multigravidae (see Figure 24.6).

Management of Type 1. The midwife observes the uterine function, application of the presenting part on the cervix, dilatation rate, descent of the presenting part, caput and moulding and progress of labour. The experience of pain of the laboring women is observed as well as the physical wellbeing of the fetus and mother. When ketones are detected in the urine an intravenous infusion is indicated. It is difficult to reverse ketones and it is an indication that labour is becoming pathological. Good pain relief is required. *The use of uterine stimulants is contraindicated.*

The obstetrical management will be an emergency caesarean section. If a woman is in the primary healthcare setting she should be transferred when labour crosses the alert line. *Obstructed labour develops due to poor quality of care.*

Type 2. The hypertonic contractions are caused by the misuse of oxytocics and other agents.

In this case, the uterus contacts with increased frequency with too short resting periods in between. The mother and fetus can become distressed and the risk of placental abruption is increased. This woman has been given uterine stimulants for induction or augmentation of labour. (In the South African context where women use traditional substances that also stimulate the uterus, adding other uterine stimulants may have a severe effect. In addition black women's labour patterns vary from that of western women, see Chapter 8). Hypertonic contractions may cause precipitate labour and fetal distress. Overstimulation of the uterus leads to severe complications such as placental abruption.

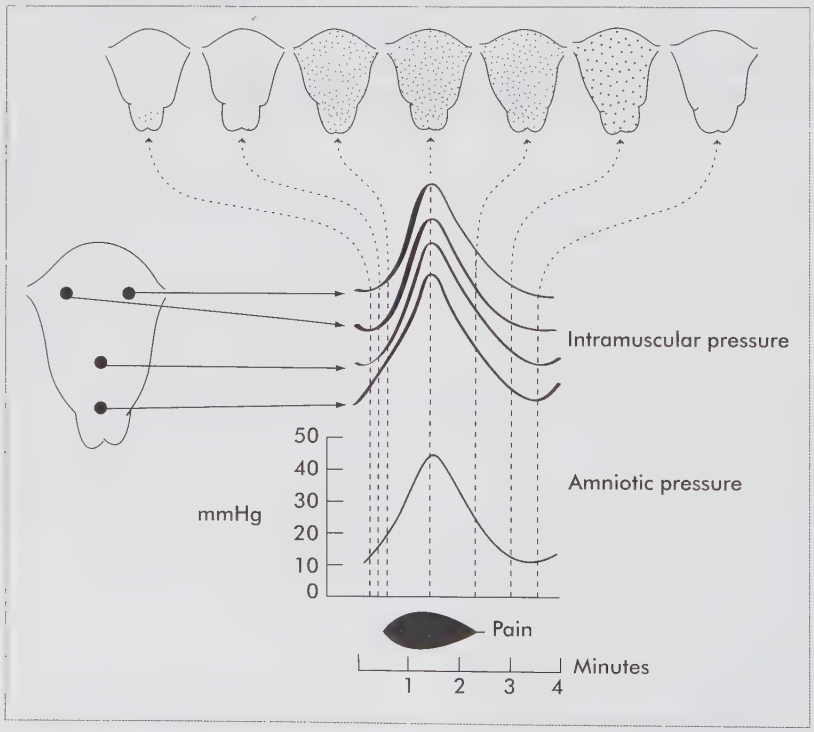


Figure 30.5 Hypertonic uterine function
Source: Sellers, P.M. *Midwifery.* 1993. Cape Town: Juta & Co

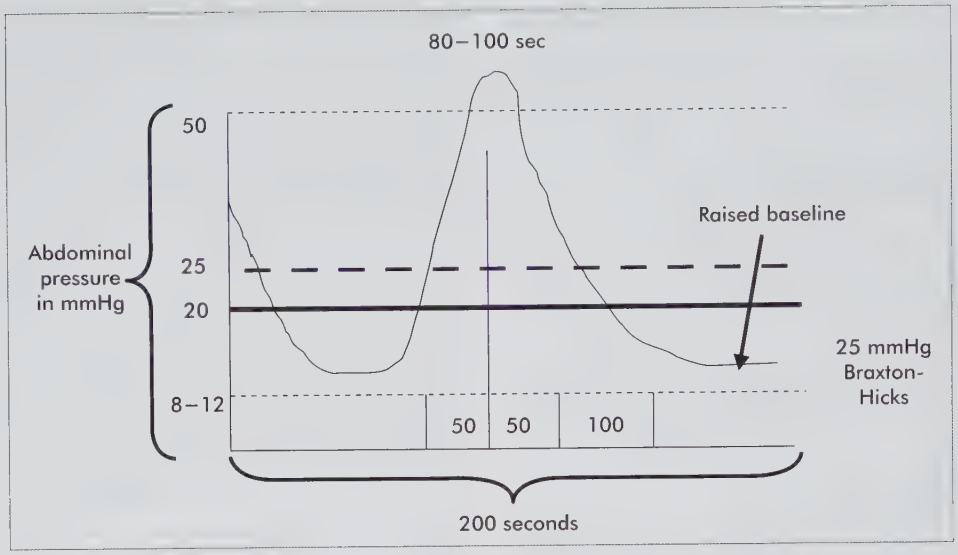


Figure 30.6 Tonic contractions (refer to obstructed labour)

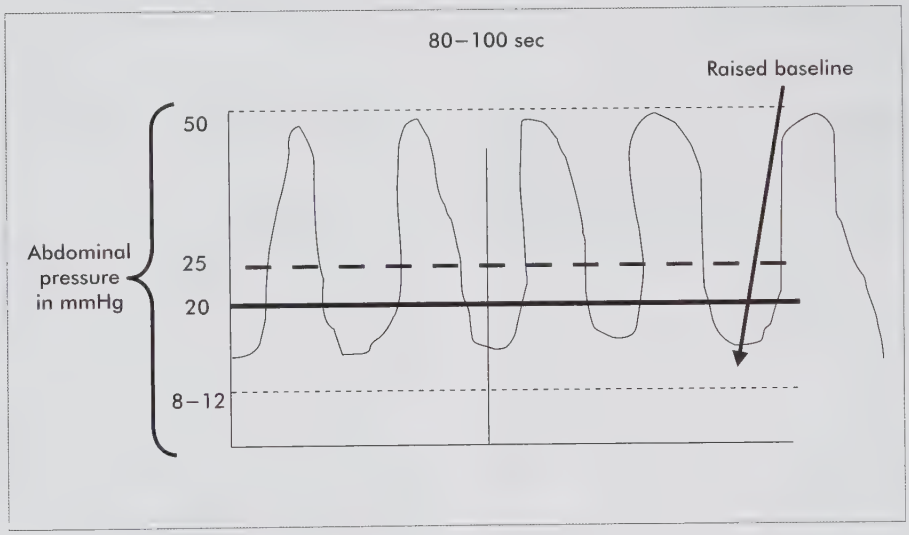


Figure 30.7 Hypertonic contractions (no relaxation)

Management of Type 2. It is important that midwives consider differences in women's patterns of birth (see Chapter 8) and on admission take a history to determine if the woman has taken any natural or traditional remedies that may affect the uterus before starting to stimulate it.

All uterine stimulations are only administered on written prescription of a medical practitioner. Once the midwife accepts the prescription it becomes her independent responsibility to administer the safe dosage and observe for adverse effects. Always start with the lowest dosage for safety and remember that some substances when absorbed cannot be stopped.

If an oxytocin infusion is used, it can be discontinued. If misoprostol or prostaglandin gel or tablets are used further administration is discontinued. This condition could have been prevented by good midwifery care during the administration of the oxytocin and other oxytotics, but, occasionally, a patient may be highly sensitive to the medication and have an exaggerated response. This could also occur if too large a dose of oxytocin is given to the patient in error (see Figure 30.7 and Chapter 32).

The management will be to immediately discontinue the treatment and to call the medical practitioner. The woman is given oxygen and pain relief. The medical practitioner will take further action.

30.3 Cervical dystocia

Definition

Cervical dystocia is a rigid cervix which, despite good uterine contractions, is unable to dilate.

Causes

There may be underlying psychological causes and/or physical causes, such as:

- a tense primigravida
- surgery to the cervix (cone biopsy)
- scars of the cervix due to Shirodkar or McDonald suture
- scars to the uterus due to cervical tears
- congenital abnormalities

Types of cervical dystocia

Cervical dystocia can be primary or secondary.

Primary cervical dystocia

The cause could be either of the following:

Type 1. The rigid cervix is often closed, hard and posterior. Incoordinate uterine function or strong normal contractions may be present, causing difficult prolonged labour, tension and pain.

Management of Type 1. Epidural analgesia is the answer to this condition, although intervention such as caesarean section may be necessary.

Type 2. The congenital absence or reduction of nerve supply to the cervix resulting in failure of the cervix to dilate, causing obstruction in soft tissue dystocia.

Management of Type 2. In most instances, the medical practitioner will do a caesarean section. If this is not possible and the labour is obstructed, the medical practitioner may cut the cervix (cervicotomy), but this could result in an incompetent cervix and the woman will require elective caesarean section for subsequent pregnancies.

Secondary cervical dystocia

There are two types of secondary cervical dystocia:

Type 1. Surgery or repairs to tears of the cervix, which has resulted in permanent scarring of the cervix with the inability to dilate. These include pre-malignancy or malignancy with the resultant cone biopsy, trauma during a previous labour or a Shirodkar's cervical suture for incompetent cervix (McDonald suture).

If these conditions have not been diagnosed before labour, the labour could become temporarily obstructed by the rigid cervix. If the patient is neglected (perhaps is labouring at home and has not presented at a clinic or hospital until the labour has been in progress for a considerable length of time), the whole cervix may eventually slough off. This is called an annular detachment of the cervix and is a very serious condition that could require hysterectomy.

Management of Type 1. The treatment is early diagnosis and transfer. Prepare the patient for an elective caesarean section, if the woman has a Shirodkar suture inserted. This must be documented, and the suture must be removed at the start of labour.

Type 2. Oedema of the cervix can be caused by an anterior or posterior lip of cervix becoming nipped between the hard fetal head and the pelvic girdle. This could occur if the patient begins to bear down before the cervix is fully dilated, particularly in occipitoposterior positions. Early diagnosis of malpresentation and good pain relief is important.

All women diagnosed with a malpresentation at the onset of labour should be referred to a higher level of care in anticipation of potential problems and risk of interventions regardless of the findings of the partogram.

The management of Type 2. Antenatal preparation for labour, with information and relaxation exercises should help to prevent this condition from occurring. However, sometimes the woman cannot restrain herself from bearing down, and in this situation epidural analgesia is ideal.

If the patient already has an oedematous anterior lip and the cervix is almost fully dilated, with the head well down in the pelvis, the midwife will see the thick, swollen, reddish-purple tissue preceding the head. (It almost looks like an edge of a placenta.) In this condition, the midwife must give the woman Entonox® and try to prevent her from bearing down while she attempts to gently slip the oedematous cervix over the top of the fetal head, under the pubic arch. This condition could result in lacerations and tearing of the cervix and permanent scarring could result, as in Type 1 secondary cervical dystocia.

Summary

The identification of abnormal uterine function is a basic skill of the midwife. The differential diagnosis to determine the cause is more difficult. The administration of uterine stimulants should be used with great caution on written

prescription of a medical practitioner, who will consider all the risks, and will prescribe only in a woman with a vertex presentation, and with a presenting part well fitted on the cervix. The physical condition of the mother and the fetus should be normal. Induction of labour should be performed only in settings where a medical practitioner and emergency theatre are available.

All high risk patients should have an intravenous infusion during labour.

Pain relief is essential in abnormal uterine function. Remember a kind word and the presence of a caring midwife is as good as oxytocin. The use of doulas in labour is also helpful (see Chapter 26).

30.4 Prolonged labour

Progress of labour should be documented according to local protocol, so that a skilled midwife will be able to identify early any signs of poor progress and take relevant action (see Table 30.1).

Definition

Poor progress of labour can progress to prolonged labour if appropriate interventions are not implemented. It can occur in both the first and second stages of labour.

Causes

Causes of prolonged labour can be described with the acronym 4Ps, often referred to as the Rule of 4Ps. The deviations from normal can be uterine contractions (powers), the fetus (passenger), the birth canal–bony pelvis and/or the soft tissue structures (passage) or the pregnant woman (patient).

The powers (uterine contractions)

The uterine contractions may be inadequate, lasting 40 seconds or less, i.e. less than three in 10 minutes, or ineffective, or the contractions may be adequate but there is still no progress of labour and no signs indicating disproportion. Apolarity or colicky uterine contractions may be present.

The passenger (the fetus)

The fetus may be adopting an abnormal position, or presentation, or lie. The fetus may also be too big or have congenital malformations, e.g. hydrocephalus or Siamese twins.

The passage (birth canal and the soft tissues)

Placenta previa, myomata and other congenital uterine abnormalities may be present. There may be atresia of the vulva (acquired or congenital), vaginal atresia, cysts or septa, cervical stenosis, other pelvic tumors, conditions or abnormalities.

Maternal causes

Maternal causes may be physiological or psychological:

- A full bladder or rectum may interfere with adequate uterine contractions as well as impede descent of the presenting part.
- Insufficient analgesia or dehydration may also contribute to prolonged labour.
- The position the woman adopts in labour should be comfortable and allow her to feel in control of the situation without affecting the condition of the fetus.
- Previous traumatic labour and childbirth may also contribute to prolonged labour (fear and anxiety inhibit uterine functions).

There are guidelines for the time of each stage of labour and birth, but it is generally accepted that labour should not exceed 24 hours in a primigravida and less in a multigravida. The partogram was designed as a scientific tool to guide the duration of labour. Most women deliver within the normal time period. Prolonged labour negatively affects the birth and outcomes for mother and fetus. Figure 30.8 gives examples of the graphic display of various types of prolonged labour.

Treatment and care of prolonged labour

Identify the cause (any of the 4Ps) early and correct the abnormality if possible. If the patient is at a peripheral health facility or in the community, refer. If the patient is in a health facility where emergency obstetric care is available, the management will depend on the cause. The medical practitioner/obstetrician should be informed and will guide further management.

Prolonged latent phase

Figure 30.8 illustrates the prolonged latent phase. Malpresentations like a face presentation should be considered. There is great variation in the duration of the latent phase of labour. An abdominal palpation excludes malpresentation. A malpresentation and poor application of the presenting part on the cervix, a high presenting part, breech, cord around the neck and pelvic shape may cause the presenting part to fit poorly on the cervix. The result is a poor Ferguson reflex and poor contractions causing slow progress.

The treatment and care depends on the cause. Women are encouraged to move around in the first stage to allow the head to 'come down'. Observation is made of the station of the presenting part, the condition of the cervix, the contraction and the changes of the cervix. Amniotomy is delayed or avoided. Keeping the membranes intact may assist with the rotation of the presenting part and dilatation of the

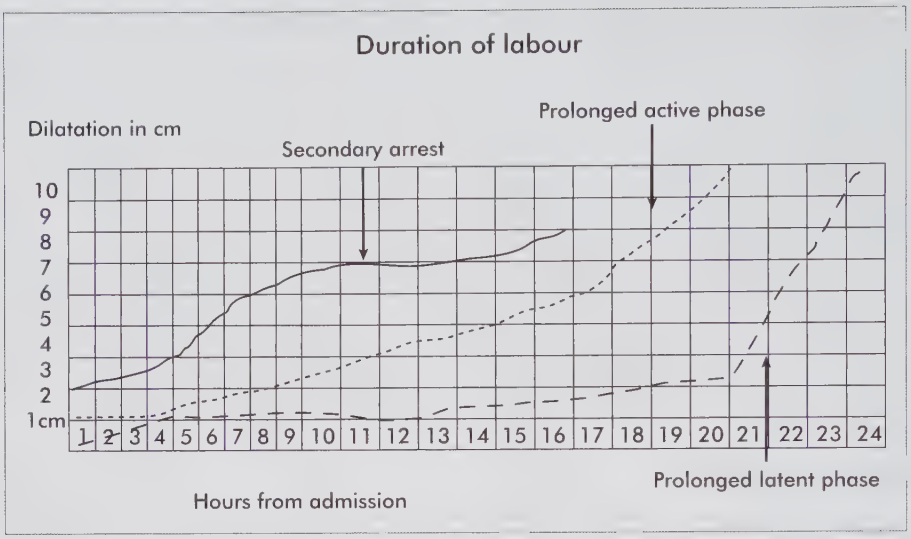


Figure 30.8 Three patterns of abnormal labour

cervix through even pressure on the cervix by the membranes in cases of malpresentation. Pain relief may be useful if the mother is becoming tired. Uterine stimulation is only prescribed by the medical practitioner if malpresentation and CPD are excluded.

Prolonged active phase of labour

In the active phase of labour, cervical dilatation should occur at the rate of 1 cm per hour in nullipara and 1.5 cm in multipara. Dilatation of less than 1 cm per hour is considered as delayed progress.

If the powers (uterine contractions) are inadequate labour can be augmented (if not contraindicated). Prior to administering oxytocin, cephalopelvic disproportion, malpresentation and fetal distress must be excluded. The woman should be advised to empty her bladder to allow for descent and promote effective uterine contractions. Labour should be monitored and adequate pain relief administered (see Figure 30.8). If the alert line is crossed the woman should be re-assessed. The gravity, presentation, level of the presenting part, pattern of contractions, application of the presenting part and cervical dilation are assessed, versus the wellbeing of the mother and fetus. The two hour action line indicates the need for medical attention or referral to a higher level of care.

Crossing the four hour action line indicates the need for delivering the baby. Ignoring these guidelines may lead to obstructed labour.

Prolonged second stage of labour

The second stage of labour is considered to be delayed when maternal bearing-down effort is considered effective but delivery has not occurred within 45 minutes in a primigravida and 30 minutes in a multipara. Causes of prolonged second stage of labour are many and varied (see Box 30.2). The cause should be identified and rectified. If the uterine contractions are poor, administer oxytocin as an intravenous infusion. If there is poor maternal effort in spite of good uterine contractions and no cephalopelvic disproportion, deliver by vacuum extraction. If cephalopelvic disproportion is diagnosed, deliver by caesarean section.

The second stage of labour is a critical period for mother and fetus. A change in the position of the mother may facilitate birth. The woman may be allowed to squat or be upright to improve the process. Using fundal pressure is discouraged as it may cause placental abruption and bruise the uterus, or cause a constriction ring.

It is not possible to transfer a woman in second stage to a higher level of care. It is thus important to identify cases of large infant, malpresentation, abnormal pelvis and anticipate potential problems for early referral. Breech presentations and occipitoposterior positions require referral to a higher level of care where specialist care is available.

Although intervention and termination of labour are the medical practitioner's responsibility, the midwife is responsible for timing the labour, routine observations of mother and fetus and their care. The medical practitioner depends on

30.2 Causes of a prolonged second stage of labour

The following are some of the causes of prolonged second stage of labour:

- Ineffective maternal effort usually resulting from fear of the unknown, exhaustion or lack of sensation especially if an epidural block is in use for pain relief in labour.
- Secondary hypotonic uterine contractions may occur which can be relieved by use of oxytocin.
- A large fetus or malposition resulting in large diameters presenting or a malpresentation. A large fetus or malpresentation may require a caesarean section to be performed.
- Reduced pelvic outlet, mostly in an android pelvis, is likely to cause obstruction at the outlet because of the prominent ischial spines and the narrow subpubic arch. The baby may be delivered by forceps or caesarean section.

the midwife alerting him/her if there are any abnormalities. When a labour has exceeded the average time, the midwife informs the medical practitioner, but if the labour is progressing, albeit slowly, the medical practitioner may decide not to intervene unless some abnormality arises.

Prevention of prolonged labour

Prevention requires good antenatal care and screening of pregnant women, and the immediate referral of all those at risk or with a poor obstetric history. Any abnormal condition should be recognised early by the midwife, and the patient referred, so that early treatment can be provided by specialists. Hospital delivery is arranged for those women who have any abnormality, particularly those who could contribute to prolonged labour and would require specialised care, in an environment where all the necessary expertise and equipment are easily accessible.

Good antenatal education and training are given in order to eliminate fear and tension and to build up the woman's confidence in herself and her confidence in those who will be attending to her during her delivery. Labour is only induced when absolutely necessary and then only when the cervix is or has been ripened.

Any woman admitted in false labour is given special care to increase her confidence and remove fear and tension. The signs and symptoms of true labour are carefully and kindly explained, and the woman and her partner are advised to return home and await the onset of true labour.

Midwifery management. Together with the standard midwifery care of a woman in labour, the following special care is given:

- *In the first stage.* Normal care and management and the observations necessary for all labour must be conscientiously carried out (see Chapter 25).

  Use the partogram to determine normal cervical dilation in the first stage of labour. A midwife also considers other aspects such as the application of the presenting part on the cervix and position of the fontanelles and suture lines to determine the position as well as the station of the fetal head.
- *In the second stage.* Precautions are taken to make sure mother and baby are well before bearing down. In primigravidae, the normal duration of the second stage is one hour and should not exceed two hours. In multigravidae, the normal duration is 15–30 minutes and should not exceed one hour. If problems are anticipated medical assistance is requested or the woman is referred.
- *In the third stage.* The midwife must choose the type of management carefully, according to the situation.

  Risk factors for the third stage include prolonged first and/or second stages of labour. Complications can be unsuspected. The active management of the third stage is best practice in midwifery (see Chapter 27). The normal duration of the third stage of labour is 5–10 minutes. With active management, an oxytocic is administered to the woman with the delivery of the anterior shoulder in a singleton birth and the placenta is removed by controlled cord traction.

In the passive management of the third stage, one hour may be allowed for the delivery of the placenta. If there is no bleeding the placenta may stay in longer.

A manual delivery of the placenta may be indicated if the placenta is not delivered. An intravenous infusion will be commenced and medical assistance requested.

In all stages of labour, the midwife should make sure that the woman is able to pass urine and if she is not able to, then the woman must be catheterised. Quality midwifery care is essential during any labour, but particularly during prolonged labour, where there is a special need for vigilance, extra observations and continual reassessment of the situation. Particular attention is given to the fetal condition, the progress of labour and the maternal condition, to ensure the early recognition of any abnormality. The midwife must be caring and instill confidence in the woman.

Lack of proper attention or relaxation of observations could lead to complications. This could be construed as negligence on the part of the midwife, because the midwife is responsible for letting the medical practitioner know as

soon as possible when some abnormality has arisen, and this includes prolonged labour.

Any maternal distress or fetal distress (compromise) is immediately reported to the medical practitioner and treated by the midwife, pending the arrival of the medical practitioner.

If the membranes have been ruptured for some time (12 hours and more on HIV-negative cases) and there is the danger of infection, a high vaginal swab is taken and sent to the laboratory for culture and sensitivity. Preparations are made for either a caesarean section if the first stage of labour is prolonged or for an instrument delivery or caesarean section in the second stage of labour.

Preparations must be made for resuscitation of the newborn infant and for possible complications in the third stage of labour. After a prolonged labour, the baby is observed in high care until its condition is satisfactory or stable.

Obstetrical management. The obstetrical management depends upon the cause of the prolonged labour, the duration of labour and on which stage of labour is prolonged.

In order to prevent labour from becoming prolonged, active management of labour is advocated, which ensures that no woman will labour for longer than 12 hours in the active phase. Before the start of labour, the woman is given the assurance that, should the labour last as long as 12 hours, a caesarean section will be performed in order to deliver the baby. In addition, any primigravida woman with hypotonic uterine function will have labour augmented by an intravenous infusion of oxytocin. The woman is also allocated a specific midwife or medical student to stay with her throughout the 12 hours of labour.

- *In the first stage.* When the prolonged labour is due to hypotonic uterine function in the primigravida, the medical practitioner may order oxytocin by intravenous infusion (augmentation of labour) if cephalopelvic disproportion (CPD) and pelvic abnormalities have been excluded. The mother and fetus must be well.

  This will strengthen uterine contractions, enhance the polarity of the uterus and so the effectiveness of the uterine contractions.

  Good effective pain relief is a requirement, particularly when oxytocin is administered. An epidural is the method of choice.

  If the membranes have not already ruptured and the fetal condition is satisfactory, and there is little or no cephalopelvic disproportion, and HIV status is negative, the medical practitioner may rupture the membranes if labour is established and there is no malpresentation.

  If there is little or no progress in labour, or if there is obstructed labour and/or if the maternal or fetal conditions are not satisfactory, the medical practitioner will usually do a caesarean section.
- *In the first and/or second stage.* With minor cephalopelvic disproportion, when the cervix is fully dilated, but the head is above the spines and the fetal condition is satisfactory, a symphysiotomy, and/or a vacuum extraction may be performed. When the cervix is fully dilated, and the head is at the spines and the fetal condition is satisfactory, a forceps (instrument) delivery is probable.

  If there is fetal distress, if the head is high and there is more than minor cephalopelvic disproportion, or if the maternal condition is unsatisfactory, or if there is placenta praevia, the medical practitioner will usually perform a caesarean section.

  If the woman has certain abnormal general conditions that contraindicate bearing down, such as cardiac conditions, respiratory conditions or severe pre-eclampsia or eclampsia, the medical practitioner will usually perform a low forceps delivery, once the head is well down in the pelvis. However, if there is maternal and/or fetal distress or if there is CPD, the baby will be delivered by caesarean section.
- *In the third stage.* If the first two stages of labour were prolonged and the woman is very tired, or if she has been heavily sedated or has been given epidural analgesia, the woman may be receiving intravenous oxytocin in labour. However, the medical practitioner may prescribe oxytocin 10 units to be administered with the birth of the anterior shoulder, to prevent postpartum haemorrhage.
  The placenta will be delivered by controlled cord traction. A continuous infusion of 20 IU oxytocin is maintained for 24 hours to keep the uterus contacted to prevent postpartum haemorrhage. A tired uterus in prolonged labour may refuse to contract after birth.

Complications of prolonged labour

Complications are as follows.

Maternal complications

Maternal complications would include the following:

- intrauterine infection because membranes tend to rupture early due to poor application of presenting part to the cervix and repeated vaginal examinations, performed to assess progress of labour and interventions
- maternal distress and exhaustion due to strong uterine contractions and lack of progress

- increased risk of vaginal lacerations due to prolonged pressure of the fetal head (in cephalic presentations) on the pelvic floor and vaginal walls
- postpartum haemorrhage mostly as a result of uterine atony due to prolonged labour
- pain and shock due to higher risk of interventions that may result in psychological trauma, which can affect future pregnancies
- placental abruption
- pelvic floor trauma

Fetal complications

Fetal complications include the following:

- birth asphyxia from prolonged labour leading to cerebral damage/cerebral palsy
- intracranial haemorrhage due to assisted delivery
- intrauterine infection manifesting as meningitis, septicaemia and/or pneumonitis
- admission to neonatal unit and prolonged hospitalisation
- poor maternal–child bonding
- breastfeeding difficulties
- fetal death or stillbirth or early neonatal death.

30.5 Obstructed labour

Obstructed labour occurs when there is failure of the presenting part to descend/advance in spite of good uterine contractions.

Incidence

Obstructed labour ranked forty-first in Britain in 1990, representing 0.5% of the burden of all conditions and 22% of all maternal conditions. The WHO considers it to be the most disabling condition of all. The estimated incidence for Africa is 4:100 births. Obstructed labour is associated with poor quality of care, an inadequate healthcare system, poor transport and an inadequate use of the partogram, no diagnosis of abnormal labour and insufficient diagnosis and recognition, intervention and referral.

Definition

There is no clear definition of obstructed labour and 'dystocia' is a synonymous concept.

Obstructed labour occurs when the fetus cannot be delivered through the birth canal in spite of good contractions.

Causes of obstructed labour

Causes of obstructed labour can be either in the fetus (passenger) or the birth canal (passage). Some of the causes of obstructed labour include the following:

- Cephalopelvic disproportion, e.g. the fetus may be too large as compared to the maternal pelvis or the maternal pelvis may be grossly contracted or a previous fracture to the pelvis may cause pelvic contraction.
- An abnormal pelvis.
- Abnormalities in the fetus, e.g. hydrocephalus.
- Malposition resulting in deep transverse arrest as in occiptoposterior position.
- Pelvic tumours, e.g. cervical fibroids or ovarian tumour, which may prevent engagement of the head.
- Malpresentations that make vaginal delivery impossible, e.g. brow presentation.

Signs and symptoms of obstructed labour

Obstructed labour should be suspected initially if the presenting part does not enter the pelvic brim at the onset of birth or subsequently if there is no descent of the presenting part in the pelvis in the presence of good uterine contractions, accompanied by slow dilatation of the cervix. The poor application of the presenting part to the cervix contributes to early rupture of membranes and the cervix hangs like an empty sleeve (curtaining of the cervix). If there is no intervention, the contractions become hypertonic and more frequent in an attempt to overcome the obstruction. In a primigravida, the contractions may cease only to restart later with more vigour. The woman becomes distressed, anxious and looks ill due to pain. Dehydration may set in and the body temperature will be raised and a rapid pulse will be palpable. Occasionally the woman may vomit and there will be oliguria (diminished urinary output). In the final phase the woman may become ketatonic with no response to her external environment and the contractions seem to disappear due to the state of pathological retraction of the uterus, meaning that the uterus has reached its maximum contractile ability with the upper segment bundled and the lower segment stretched to the maximum.

On abdominal examination, the uterus will be moulded around the fetus due to ruptured membranes (the liquor amnii is drained). The presenting part remains high and the uterus is hard. The difference between the upper and lower segment may be palpated abdominally as a ridge.

If the obstruction is severe a Bandl's retraction ring is noted mainly in primigravida (a sign that the upper uterine segment is bundled and the lower uterine segment has been overstretched due to retraction of the upper uterine segment), and uterine rupture may occur in multigravidae.

The fetal heart may be normal. Often the oxygen supply to the fetus is diminished and the fetus may become distressed or die. Severe caput and moulding may be present. In a cephalic

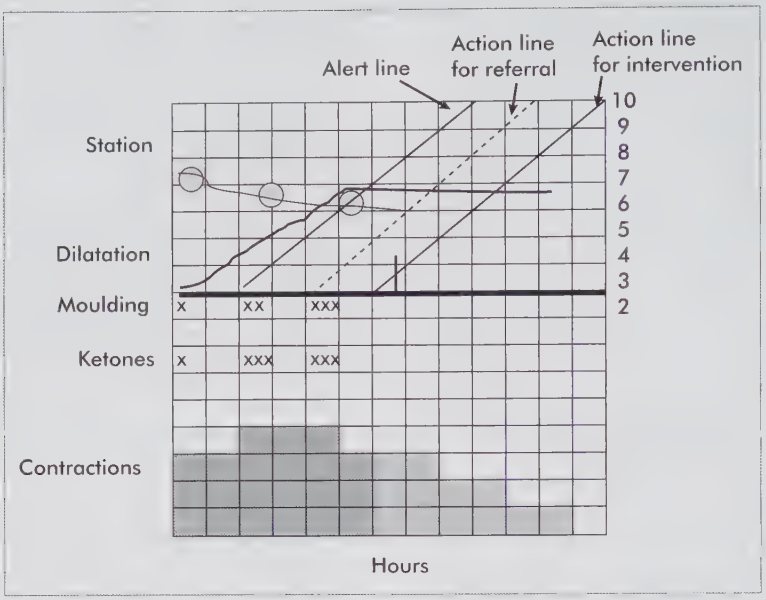


Figure 30.9 Obstructed labour

presentation there is excessive moulding and the presence of a large caput succedaneum which may be mistaken for a head. In some cases where the head is above the brim no caput may be present.

The woman at this stage is overly exhausted and may die as a result of exhaustion, haemorrhage and shock from abruptio placenta or uterine rupture. Gas in the colon may be noticed on the sides of the uterus indicating paralysis of the gastro intestinal system.

The urine is scanty and 3+ ketones are present. The woman is severely dehydrated. Obstructed labour indicates poor quality of care in pregnancy.

Treatment and care

Prevention

Prevention is better than cure and accurate history taking combined with the strict screening of high-risk women should be carefully undertaken in every antenatal clinic or by the midwife in private practice.

- If a woman has any of the predisposing causes of obstructed labour, she should immediately be referred to the nearest hospital.
- All primigravidae should deliver in hospital and the labour should be treated as a trial of labour (see Chapter 32).
- All patients undergoing a trial of labour should have careful observations and attention in hospital.
- All women with a poor obstetric history, previous large infant, previous assisted delivery or malpresentation should be referred for medical attention.
- The use of the partogram is invaluable for diagnosing prolonged labour and early obstructed labour, so that early intervention can be implemented before the later signs of obstruction become evident and grave. The station and descent of the presenting part is crucial and can be assessed by abdominal and vaginal examination.

Midwifery management. This is an obstetrical emergency. The management will depend upon whether the patient is in a clinic or a hospital situation. If in a clinic situation, the woman must be hospitalised/referred as soon as possible and if in a hospital situation, a medical practitioner must be notified immediately (see Chapters 25, 31 & 33).

- An intravenous infusion is started immediately.
- An indwelling Foley catheter is inserted and the urine is tested.
- The woman is reassured.
- The woman is kept on her side and the baby is monitored continuously.
- The woman is given oxygen per mask.
- The woman is prepared for immediate caesarean section.

This patient will require specialised care and attention during the third stage of labour and during the puerperium.

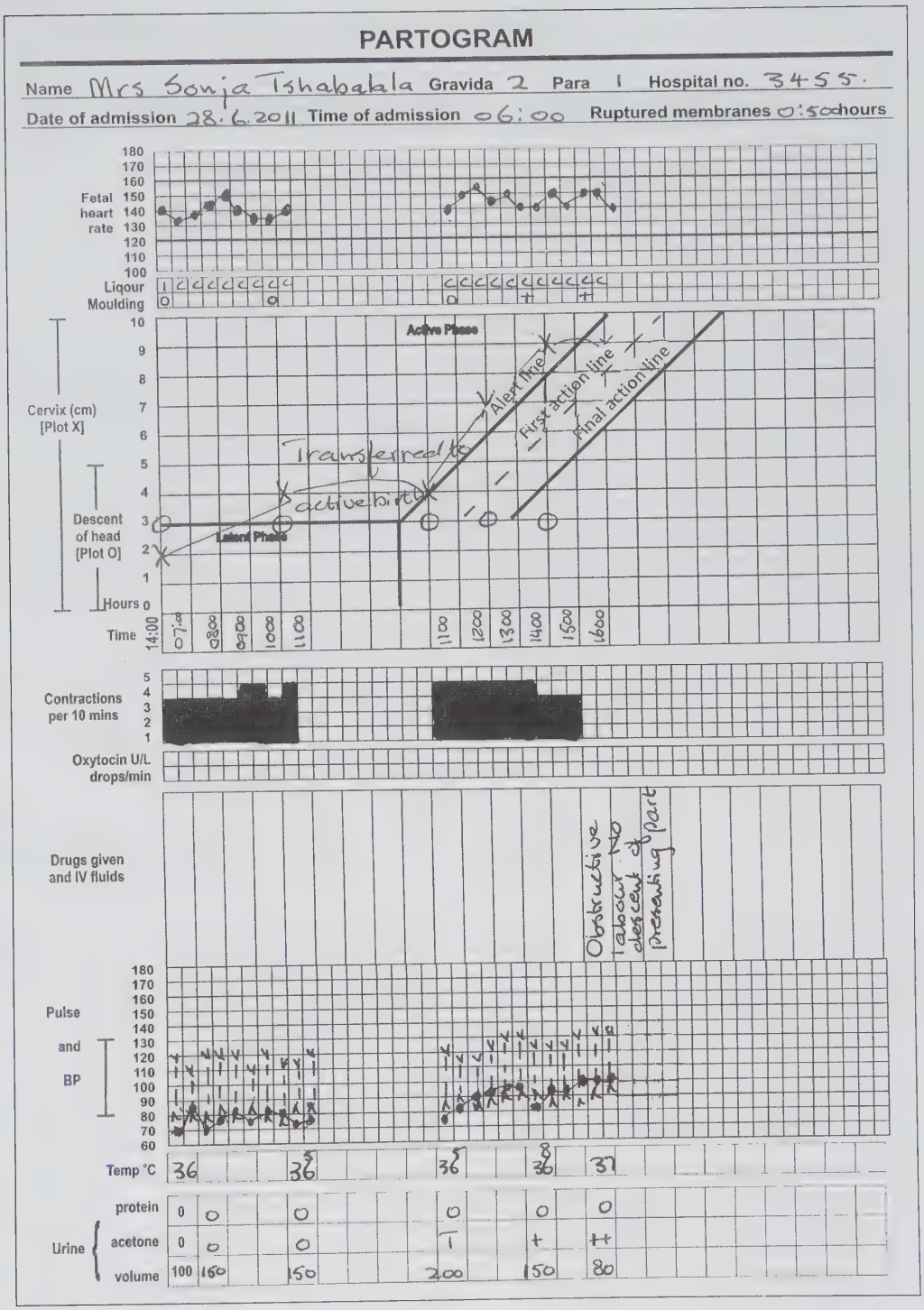


Figure 30.10 Partograph of a multigravida showing cephalopelvic disproportion causing obstructed labour

There is a danger of both atonic and traumatic postpartum haemorrhage. If the baby is alive and is successfully resuscitated, the baby should be admitted to high-care or intensive care.

Obstetric management. Once/if the patient is in hospital, the following steps may be taken:

- Rehydration of the patient by intravenous fluids.
- Maternal acidosis is corrected by giving an intravenous electrolyte solution.
- Operative procedures depend upon the cause of the obstruction, the length of labour, the condition of both the fetus and the mother.
- Emergency caesarean section is performed if the baby is alive, for insurmountable cephalopelvic disproportion, all abnormal lies and pelvic tumours, and for locked twins. Under certain conditions caesarean section may also be performed if the baby is dead, especially when there are late signs of obstruction. The caesarean section should be done by the most experienced person available.
- Every precaution is taken to prevent postpartum haemorrhage in the third stage of labour and the patient is watched carefully for signs of bleeding in the postdelivery period.
- The medical practitioner may prescribe broad-spectrum antibiotics.
- The baby will require expert resuscitation and expert care in the puerperium.
- If the baby has died, the mother and her husband/partner will require a careful explanation and understanding, and the midwife should supply all the support they may require, or she should refer them to a specialist psychologist.
- The mother will require specialised care during and after the puerperium, with follow-ups if any complications were present. The woman may be very upset about not delivering normally, and may require psychological support.
- The patient and her husband are referred to the family planning clinic, and they are warned of all the dangers of her becoming pregnant again before the damaged tissues are healed. The absolute necessity for her to attend antenatal clinic early with any subsequent pregnancy and to deliver in hospital is also carefully explained to her and her husband/partner. She must be told of the reason for the caesarean section so that she can relate this during future pregnancies.
- A symphysiotomy may be performed if the obstruction is within the pelvic cavity, as may occur in the after-coming head of a breech, or in selected cases with obstruction in occipitoposterior positions, when there is only borderline disproportion.
- If the baby is dead and there is no likelihood of rupturing the uterus, instead of performing a caesarean section, a destructive operation may be performed (see Chapter 32), although this is unlikely unless the woman lives in a very remote area (to preserve the integrity of the uterus). A destructive operation is performed in the operating theatre, under general anaesthesia after adequate maternal resuscitation.

Complications of obstructed labour

- Dehydration related to inadequate fluid intake as a result of pain may occur, as well as infection related to prolonged rupture of membranes and repeated vaginal examinations.
- Maternal exhaustion due to hypertonic uterine contractions.
- Bandl's ring in the primigravidae.
- Rupture of the uterus in multigravidae.
- Couvelaire uterus and hysterectomy.
- If there is no intervention and obstruction persists, vesicovaginal fistula related to prolonged pressure on the bladder leading to injury and necrosis of related pelvic tissues may occur as well as maternal death related to uterine rupture.
- In the fetus, intrauterine death may occur due to intrauterine hypoxia. Intracranial haemorrhage may occur due to hypoxia or trauma sustained during a difficult instrumental delivery.

30.6 Conclusion

In this chapter dysfunctional uterine functions are described as well as their management. Correct identification and management of these conditions will reduce maternal and perinatal mortality and morbidity.

CHAPTER

31 Obstetric emergencies

Learning objectives

On completion of this unit the learner must be able to:

- identify obstetric emergencies at all the stages of birth
- identify and describe factors that cause obstetric emergencies
- identify and describe ways to prevent obstetric emergencies
- identify and describe specific interventions for the obstetric emergencies
- describe evidence-based emergency measures and standards for each situation
- develop the basic competencies to assist pregnant and labouring women in an emergency.

Knowledge assumed to be in place

Knowledge, competency and skill in the basic management of normal birth
Know the Ps of birth

Keywords

Uterine rupture • Fetal distress • Amniotic fluid embolism • Inversion • Prolapse • Shoulder dystocia • Eclampsia (see Chapter 20) • Ante- and postpartum haemorrhage (see Chapter 21 and 33) • Infections (see Chapter 50 and 51)

31.1 Introduction

Obstetric emergencies are events that need the knowledge and skill of a competent team to save the life of a mother or baby. Clinical competencies need to be supported by administrative standards, staff ratios, adequate skill-mix, enough equipment, logistic support and a transport system. Skill drills should be done and each midwife should be responsible for developing the required skills to deal effectively with an emergency. Prevention, early diagnosis and intervention are essential. Most conditions described in this section can occur at any stage of pregnancy and birth. However, shoulder dystocia only occurs at birth and the midwife has a limited time to save the baby.

31.2 Uterine rupture

Rupture of the uterus is an obstetric emergency that has a poor outcome for the fetus. This complication can be prevented or its occurrence minimised with effective antenatal and high-quality intrapartum care. It remains a global concern because the prevalence in developing countries remains high.

Causes of uterine rupture

Certain circumstances can precipitate uterine rupture and these include the following:

- A weak uterine scar – this is more common in classical caesarean section but can occur with previous hysterotomy or any other uterine surgery. The complication can be exacerbated by impaired healing, overdistension of the uterus due to multiple pregnancies or polyhydramnios, obstructed labour or trauma following manipulation of the fetus.
- Women with high parity are likely to experience obstructed labour, resulting in uterine rupture.
- Incorrect use of oxytocin – excessive use of oxytocic drugs can cause hypertonic uterine contractions resulting in a uterine rupture.
- A severe cervical laceration sustained as a result of premature bearing down or even a forceps delivery (applied before the cervix is fully dilated). The cervical tear may extend upwards into the lower uterine segment.

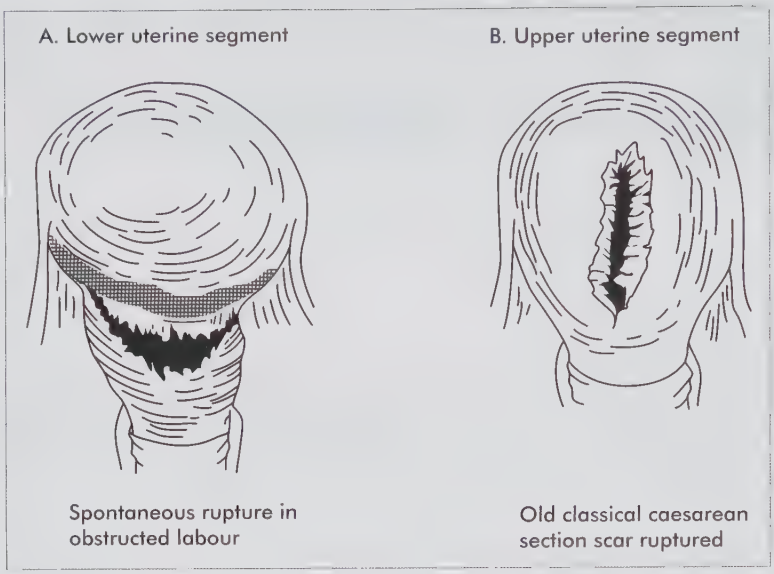


Figure 31.1 Rupture of the uterus

Classification of rupture

The following ruptures of the uterus can be found.

Silent rupture

This is the rupture of the uterus in the antenatal period that may occur in the last four weeks of pregnancy and usually involves a previous classical caesarean scar (hence often referred to as the silent rupture). The rupture can be spontaneous or traumatic.

Complete uterine rupture

The most common type of uterine rupture is the complete rupture. The laceration is in direct contact with the peritoneal cavity, and all the layers of the uterus are involved. This usually involves a previous classical caesarean section scar (see Figure 31.1).

Incomplete rupture

When the rupture is incomplete, the laceration is separated from the peritoneal cavity by the peritoneum, which remains intact. An incomplete uterine rupture involves the endometrium and the myometrium only. This can occur in a spontaneous rupture of the uterus or when cervical tears extend upwards into the lower segment.

Dehiscence

This occurs when a transverse lower-segment caesarean section scar separates, leaving a window in the lower segment. However, the rupture can spread sideways, involving the uterine blood vessels, resulting in extensive haemorrhage.

31.1 Types of uterine rupture

Complete uterine rupture – all the layers of the uterus are involved and it is common in previous classical caesarean section.
Incomplete rupture – the endometrium and myometrium are involved but the peritoneum remains intact.
Dehiscence – occurs when the lower segment caesarean section parts leaving a window. It may involve uterine blood vessels, resulting in extensive haemorrhage.

Rupture before the onset of labour

The rupture is sudden and the woman experiences pain in the right side of the abdomen for several days. The pain is caused by irritation of the peritoneum due to bleeding from the uterine scar. Continued loss of blood will cause severe abdominal tenderness and the woman may be shocked. The fetus experiences severe intrauterine hypoxia resulting in intrauterine death. Diagnosis is clinical. The woman is prepared for a laparotomy where the diagnosis will be confirmed.

Treatment and care

The woman is prepared for an urgent laparotomy. Her general condition is assessed and vital signs checked. Blood will be

collected for a full blood count and cross-matched for possible blood transfusion. Prophylactic antibiotics may be administered as per protocol. The uterine scar will be repaired or a hysterectomy performed, depending on the nature of the uterine rupture. If the scar is repaired the woman is advised to delay pregnancy for at least a year. The subsequent pregnancies should be closely monitored and the woman advised to deliver by caesarean section.

Intrapartum rupture

Intrapartum rupture of the uterus is usually sudden. The characteristic features include sudden onset of severe lower abdominal pain, which is persistent and becomes worse during contractions. There may be suprapubic tenderness and vomiting. Fetal tachycardia or fetal heart decelerations may be noted followed by cessation of the fetal heart once the uterus ruptures. Blood in the urine on a catheter specimen may indicate a pending rupture. There might be fresh blood noted per vagina, which can be mistaken for a heavy show. A rise in maternal pulse rate may indicate danger. The rupture occurs at the peak of a contraction followed by cessation of contractions and rapid shock sets in. If the woman is under epidural the early warning signs may be missed. The diagnosis is usually made on the clinical picture.

Rupture as a result of obstructed labour

Vigilant management of labour through use of the partogram may assist in the management of labour and identify obstructed labour early. The medical practitioner can then implement the relevant interventions to minimise the occurrence of complications in obstructed labour.

Incomplete uterine rupture

This type of rupture usually occurs at the end of the second stage of labour and may be a rupture of the previous caesarean section scar. The endometrium and myometrium are ruptured and the perimetrium is not affected. Continuous vaginal bleeding is present. The baby may be delivered vaginally and may not suffer any intrauterine hypoxia. The shock is not consistent with the amount of blood loss and/or the type of delivery. The woman does not respond to any treatment given. Diagnosis is confirmed in theatre following an exploratory laparotomy.

The management is the same as for complete uterine rupture.

Signs and symptoms of a ruptured uterus

The warning signs are often the same as the signs for obstructed labour. The woman complains of severe and constant abdominal pain with or without accompanying vaginal bleeding. Fetal distress is severe and if no relief is obtained fetal death may follow. In extensive and complete uterine rupture, fetal parts can be palpable through the abdominal wall. Onset of maternal shock may be slow, depending on the extent of rupture and the amount of blood loss. Early warning signs are an increased pulse rate, a drop in blood pressure, and if she has a Foley catheter *in situ*, blood in the urine. If the rupture is extensive with severe blood loss the woman may rapidly progress into severe shock (see Chapter 33).

Interventions

Resuscitation is critical and a blood transfusion may be necessary. Resuscitation is performed based on the degree of shock. An emergency caesarean section is performed in an effort to save the baby and repair the uterus. When the baby and placenta are delivered the extent of the damage to the uterus is assessed and the uterus repaired if possible. If the tear is extensive a hysterectomy is performed. If blood loss is severe, the woman is likely to be in shock. A blood transfusion is administered depending on the amount of blood loss.

Prevention

Antenatal prevention

Preventive health education should be targeted at women, their families and the community at large. Women who have had previous caesarean sections should be educated on the factors that contribute to a ruptured uterus and the possible consequences. Women who have had previous caesarean sections should be advised to deliver in health facilities where emergency obstetric care is available. These women should be advised to present themselves at the health facility as soon as labour starts. Women who stay further away from health facilities should always have emergency transport available when the need arises. Midwives should refer all women with previous caesarean sections to healthcare facilities to be attended to by skilled attendants in pregnancy, labour and childbirth.

Careful screening of pregnant women in the antenatal period can prevent subsequent uterine rupture.

Prevention in labour

All women who have had previous caesarean sections and request a vaginal birth after a caesarean section (VBAC) must be admitted in the labour ward at the nearest hospital that has facilities to perform an emergency caesarean section.

Other preventative measures include:

- assessing the fetal size and position
- using an electronic fetal monitor
- using a partogram to monitor labour

- early recognition of prolonged and possible obstructed labour and immediate reporting and timely intervention by the medical practitioner
- avoiding the use of oxytocin and other uterine stimulants.

Midwifery care

This is an obstetrical emergency so the medical practitioner/obstetrician should be notified immediately.

Together with the standard nursing care of a woman in labour the following specific nursing care is given:

- An intravenous infusion is *in situ*.
- An indwelling Foley catheter is inserted.
- Oxygen is administered; this will help the woman and may help the fetus.
- Informed consent for operation is obtained. This should include consent for hysterectomy, should one be necessary.
- Vital signs should be monitored quarter-hourly.
- The patient is nil per mouth.
- The patient is prepared for the operating theatre.
- The midwife must never leave the patient alone and should explain the problem to the woman and give her support and encouragement, as well as to the partner.

If rupture has taken place at a clinic or is suspected, the patient is stabilised and then transported to a hospital as soon as possible. The hospital is notified by telephone or radio, and the expected time of arrival is given. The midwife must accompany the woman.

Complications

Complications are normally severe and include the following:

- maternal and/or fetal death
- Sheehan syndrome
- Couvelaire uterus
- hypovolaemic shock
- increased fetal hypoxia/asphyxia.

31.3 Fetal distress

Introduction

Fetal distress occurs when the fetus is deprived of oxygen *in utero*. If hypoxia is moderate the baby may experience mild asphyxia. Severe hypoxia may result in severe asphyxia and the fetus may suffer brain damage at birth or be stillborn.

Incidence

In South Africa (2007) neonatal asphyxia rated third as a cause of perinatal deaths, accounting for 17% of neonatal deaths.

Factors that predispose to fetal distress

Maternal factors

Maternal distress and fetal distress are closely connected in labour, and, if untreated, maternal distress will lead to fetal distress, with changes in the fetal body chemistry and acidosis. Factors include:

- Maternal conditions causing placental insufficiency and intrauterine growth retardation, the most common being pre-eclampsia and cigarette smoking.
- Maternal diabetes mellitus is a condition that poses a serious threat to the fetus during labour and consequently caesarean section may be performed at, or slightly before term, in order to avoid the rigours of labour.

Obstetric factors

Antepartum haemorrhage is one of the main causes of fetal distress. During labour, the head of the fetus is subjected to compression by the lower uterine segment and by the bony pelvis, causing moulding of the skull bones. This compression causes a reduction of blood flow to the brain, and if the compression is excessive and/or extended, and/or if there was some previous compromise, the brain and particularly the lower part of the brain stem can be damaged.

Placental and cord factors

The uteroplacental blood flow is interrupted during uterine contractions and therefore the oxygen supply to the fetus is intermittently impaired during labour. If the fetus is in good condition, the reserves built up in the fetus during pregnancy for this purpose will allow the fetus to withstand these periods of hypoxia. However, if there is previous compromise, or if there are other superimposed conditions that will lead to fetal compromise, then the periods of hypoxia will increasingly stress the fetus.

In addition, a low-lying placenta, an umbilical cord that is compressed in any way, oligohydramnios, or any other condition that leads to further oxygen impairment will bring about fetal compromise. Cord prolapse has a catastrophic result and is related to a high head or polyhydramnios.

Fetal factors

Intrauterine growth restriction (IUGR) or preterm birth and congenital abnormalities of the newborn are some of these.

Iatrogenic factors

Induction of labour and the use of uterine stimulants may cause oxygen deprivation. Fetal distress may develop.

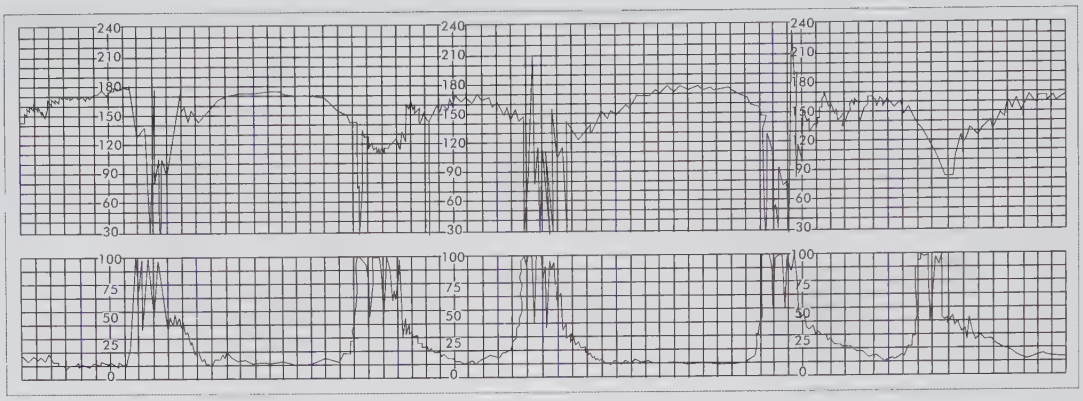


Figure 31.2 Asphyxial patterns: Complicated tachycardia

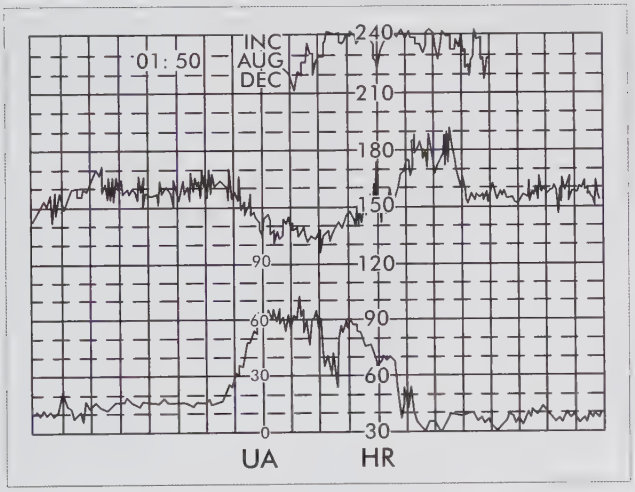


Figure 31.3 Suspicious pattern: Early deceleration (Type 1 dip)

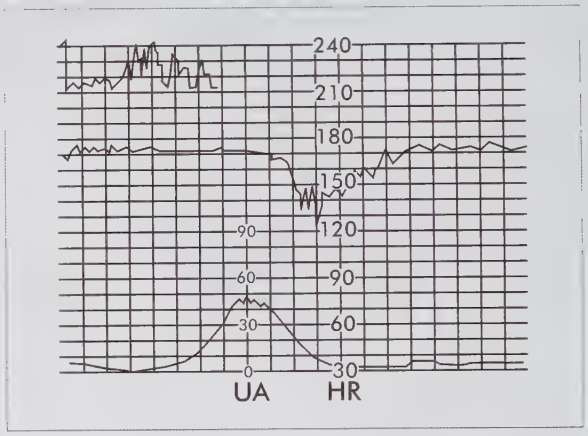


Figure 31.4 Asphyxial patterns: Late deceleration (loss of beat-to-beat variation Type 2 dip)

Signs of fetal distress

Fetal tachycardia is considered an early sign of fetal hypoxia.

Fetal bradycardia is considered a serious sign. Loss of beat-to-beat variability, early and late decelerations, and a shift in the baseline need medical intervention (see *Juta's Clinical Guide for Midwives*). (See also Figures 31.2, 31.3 and 31.4.)

Passage of meconium in a cephalic presentation is a sign of fetal distress. It needs close monitoring as the situation may deteriorate.

Treatment and care

The aim is to relieve the hypoxia by improving placental perfusion. Once fetal distress is diagnosed, inform the woman and explain all the procedures to her as well as the outcome of any interventions. The medical practitioner should be informed immediately for appropriate management. In the meantime intrauterine resuscitation is done. Administer oxygen immediately. Position the woman in the left lateral position to prevent supine hypotension. Adequate maternal hydration should be maintained to increase placental perfusion; give 500 ml Ringer's lactate stat intravenously. If the woman is on an oxytocin infusion, discontinue the infusion to reduce the impact of uterine contractions on the distressed fetus. Maintain continuous fetal heart monitoring.

Occasionally fetal distress may occur as a result of cord prolapse so perform a vaginal examination to exclude cord prolapse, vaginal bleeding or full dilatation of the cervix.

If the cervix is fully dilated, deliver immediately where possible. Assisted delivery will speed up the delivery process. If delivery is not imminent, delivery will be by caesarean section. The woman should be prepared for caesarean section if in a facility that offers theatre facilities. If these are not available

locally the woman should be transferred immediately. A paediatrician should attend the birth (see Chapter 45).

31.4 Cord prolapse

Introduction

A cord is considered prolapsed when the cord lies in the birth canal below the presenting part or the cord becomes visible in the vagina with the ruptured membranes (artificial or spontaneous) (see Figure 31.5). A prolapsed umbilical cord is an obstetrical emergency and the life of the infant depends on the midwife's early recognition of the condition, the immediate and subsequent management and prompt delivery of the patient. Cord prolapse can occur when membranes rupture in the presence of poor application of the presenting part to the cervix whether in labour or not. In a cord presentation, the cord lies alongside the presenting part (not in front of the presenting part) with membranes intact (see Figure 31.5).

Incidence

This occurs in 1–6:1 000 births.

Factors that predispose to cord prolapse

Any condition that causes poor application of the presenting part to the cervix predisposes the woman to cord prolapse, such as the conditions discussed below.

High presenting part

When the presenting part remains high, membranes should not be ruptured. Artificial rupture of membranes should not be performed when the presenting part is high and is not well applied to the presenting part to prevent the cord from prolapsing.

Multiparity

Lax uterine and abdominal muscles increase the risk of malpresentations. The presenting part (head) may not be engaged at the onset of labour.

Prematurity

The available space between the small fetal head and the maternal pelvis in preterm labour allows the loop of the cord to slip through and prolapse.

Malpresentation

Most malpresentations cause poor application of the presenting part to the cervix. Cord prolapse in such circumstances usually occurs when membranes rupture spontaneously. These include breech presentation, shoulder and/face and brow presentations and in multiple pregnancy, which is also associated with malpresentations.

Polyhydramnios

The cord is likely to be swept down by a gush of liquor when membranes rupture spontaneously.

Diagnosis

The first possible indicator is a sudden unexplained abnormal fetal heart rate, particularly bradycardia. On vaginal examination a loop of the cord may be felt lying in the vagina or seen at the vulva.

Treatment and care

This is an emergency and the midwife should call for assistance. The woman and her partner should be informed and an explanation given of the change in how she is going to be managed from now. The assistant should be asked to check the fetal heart with a fetoscope or a sonicaid. The progress of labour should be assessed (the cervical dilatation and level of the presenting part) and care should be exercised not to irritate or apply pressure on the cord as this may cause spasms of the vessels. Pressure on the cord must be relieved as much as possible. If the woman is in early labour and at a facility which offers emergency obstetric care, an emergency caesarean section must be performed. If the woman is in advanced labour, where possible delivery should be expedited either with forceps or vacuum extraction. If the woman is in a peripheral facility, she must be transferred immediately to a facility which offers emergency obstetric care.

Measures to relieve pressure on the cord

Place the woman in the exaggerated Sims' position with two large pillows to elevate the buttocks. This will relieve pressure on the cord (see Figure 31.6).

The woman may be placed in the knee chest position (with the chest on the floor and buttocks up) to allow the fetus to gravitate to the fundus and relieve pressure on the cord. The position is useful for emergency caesarean section within the same facility but not for transfer to the next level of care. Bladder infusion may relieve pressure on the cord (see Box 31.2).

A vaginal examination by the midwife to push the fetal presenting part away from the cervix can be done. The operator does not remove his or her hand and keeps it in the vagina as long as possible.

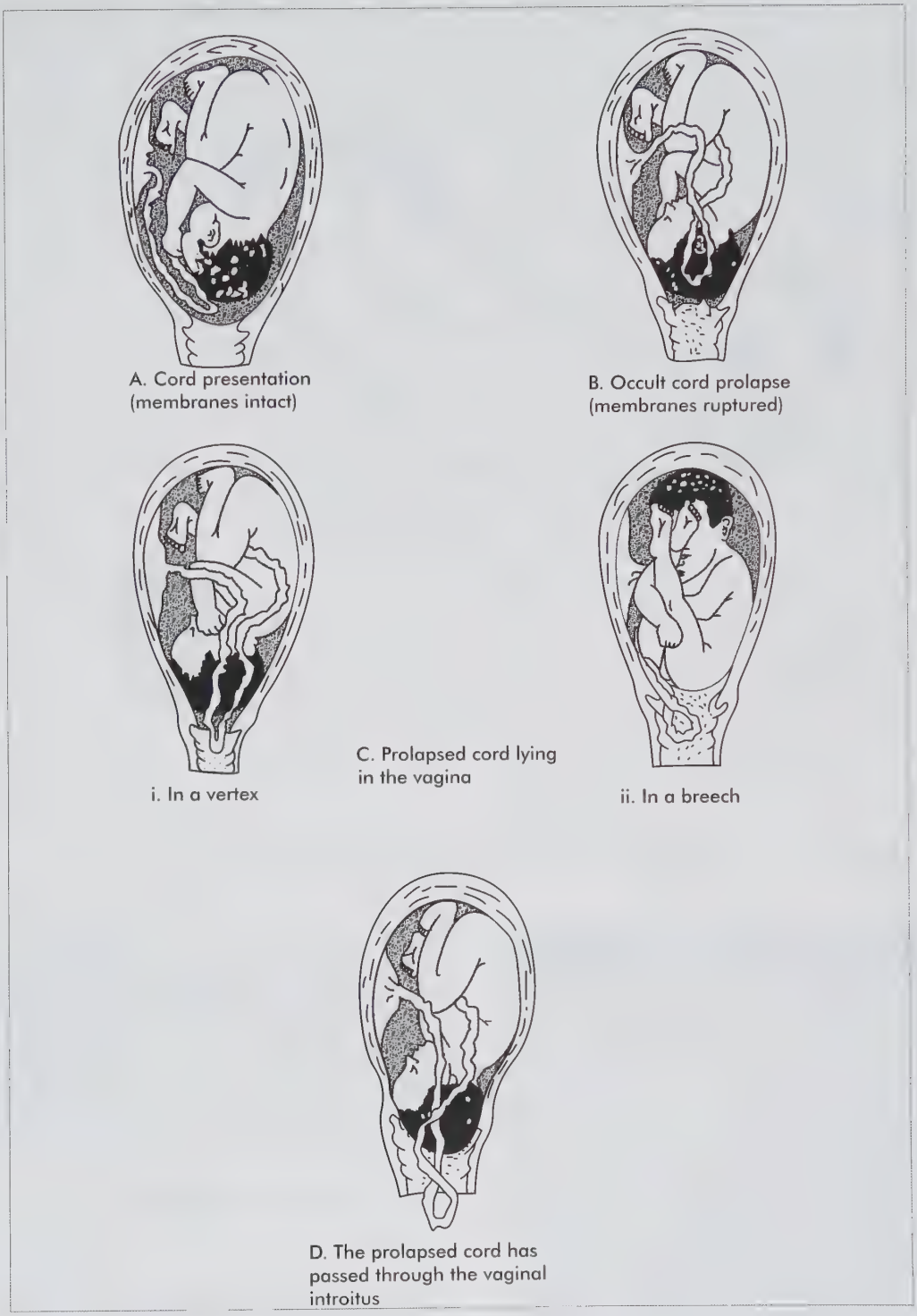


Figure 31.5 Cord presentation and prolapse of the umbilical cord



Figure 31.6 Knee-chest position and exaggerated Sims' position to relieve pressure on the umbilical cord

31.2 Bladder infusion

The following must be ready on the emergency trolley:

- Foley catheter no 16
- 10 ml syringe
- catheter tip syringe 50 ml
- artery forceps/clamp
- plaster.

A catheter can be inserted in the bladder. The bladder can be filled with saline or Ringer's lactate at body temperature (35 °C), using 500–750 ml depending on the woman's body size. Clamp the catheter. The full bladder will lift the presenting part from the cord. This keeps pressure off the cord and the patient can be transferred from a peripheral health facility to a facility where there is emergency obstetric care. Remember that a full bladder is very painful. Note the time that the catheter is inserted and the bladder filled. Release it regularly and before the delivery. Take care of the woman's comfort.

Maintain these measures until the woman is delivered to facilitate delivery of a live baby.

31.5 Shoulder dystocia

Introduction

Shoulder dystocia is an obstetric emergency that occurs when the head is delivered and difficulty is encountered in delivering the shoulders. It is associated with both fetal and maternal mortality and morbidity. Various manoeuvres have to be applied in order to facilitate vaginal delivery. The aim of

continued

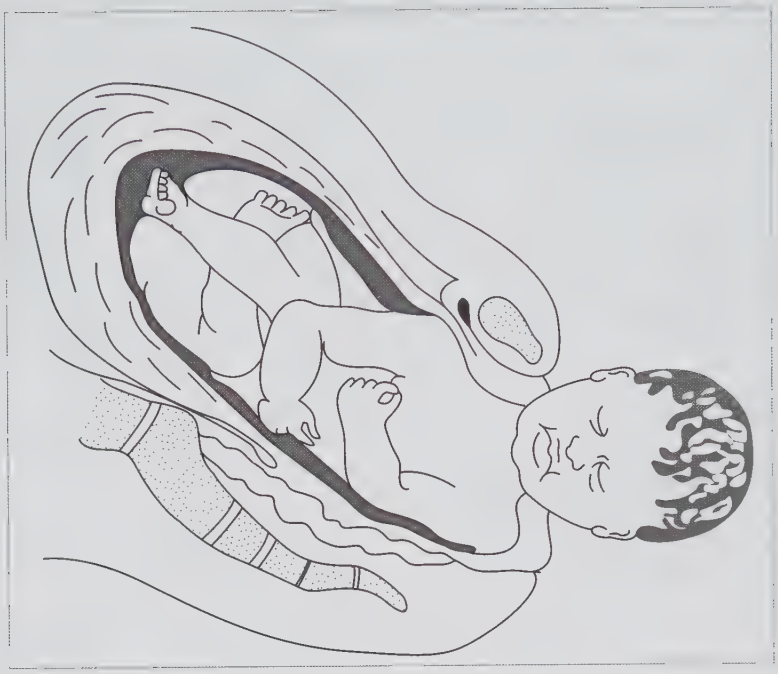


Figure 31.7 The mechanism of shoulder dystocia.

instituting the different manoeuvres is to facilitate delivery of a live baby and reduce maternal mortality and morbidity.

Definition of shoulder dystocia

Shoulder dystocia occurs when the shoulders fail to rotate into the anteroposterior diameter of the pelvic outlet and the anterior shoulder becomes impacted behind the symphysis pubis when the head is delivered (see Figure 31.7). It is an obstetrical emergency and usually occurs during delivery of big babies.

Incidence

The incidence is between 0.5–1%.

Causes

- All conditions that are likely to cause big babies (fetal macrosomia) such as diabetes mellitus, and maternal obesity with a weight over 90 kg and maternal age over 35 years (SF measure of 40 cm after 37 weeks).
- Big babies weighing more than 4 kg.
- Women with an abnormal pelvis, e.g. platypelloid pelvis, which has a reduced anteroposterior diameter resulting in shoulder dystocia in the presence of a normal-sized baby.
- Poor management of the second stage of labour when restitution is not allowed to take place.
- Oxytocin augmentation.
- History of previous big babies.
- A prolonged second stage of labour.
- Assisted deliveries, e.g. vacuum extraction or forceps delivery of a large baby.
- Contracted pelvic outlet.

Signs and symptoms

Besides the factors from the mother's history, the following will present at birth:

- The head will recede between contractions (caused by reverse traction).
- The head fails to advance with crowning and no restitution takes place.
- The chin appears to be buried in the perineum.
- There is difficulty in delivering the face and chin.
- If there is delay in delivering the baby, the head becomes suffused with blood and the face becomes oedematous and turns bluish due to hypoxia. The baby may make unsuccessful attempts to breathe.
- When delivery eventually takes place, the baby with its pale body and livid head, lies limp and unresponsive. The baby has usually passed meconium during the delivery.

Differential diagnosis

Conditions besides shoulder dystocia that may cause difficulty during delivery:

- a very short cord
- a very small head that has slipped through a not fully dilated cervix
- a uterine constriction ring
- a compound presentation (head and hand)
- locked or conjoined twins
- hydrocephaly, neoplasms or other fetal deformities.

Prevention

The incidence of shoulder dystocia may be reduced through:

- antenatal screening of women at risk, through proper history taking to screen women with previous history of shoulder dystocia or diabetes mellitus (SF measure > 40 cm)
- identifying obese women and referring such women timeously for assessment and a recommendation regarding the mode of delivery
- identifying any fetus at high risk through ultrasonography by estimating the head-to-body ratio
- referring women with a fetus that is big for gestational age to an obstetrician for assessment and further management
- identifying women presenting with big babies who should ideally be delivered by caesarean section
- assessing and carefully monitoring women in labour who have predisposing factors and thereby anticipate shoulder dystocia in high risk patients
- identifying those with a history of a previous complicated second stage.

Treatment and care

Shoulder dystocia is an obstetric emergency and the midwife should immediately call for help. Remain calm and reassure the mother and her partner.

When delivering the baby do not twist the head as this may cause damage to the brachial plexus. The type of manoeuvre taken and the outcome of each manoeuvre including the time taken should be recorded. Procedures performed can be invasive or non-invasive. Together with the standard nursing care of a woman in labour the special delivery method discussed below can be used to deliver the shoulders.

McRobert's manoevre

(See Figure 31.8.) The midwife must keep calm and work quickly and efficiently, managing each step confidently and attempting each step for only 4–5 seconds before going on to the next step, if the shoulders have not become dislodged.

- The patient is put into the lithotomy position so that there is a wider field for manoeuvring and for vision.
- If no lithotomy poles are available, the woman is asked to flex her legs and grasp her thighs and to pull her legs as far back towards her shoulders as possible (McRobert's manoeuvre). The weight of the legs will create pressure on the mother's abdomen thereby dislodging the impacted anterior shoulder.
- The buttocks must be at the very edge of the bed.
- A large episiotomy is performed to facilitate access to the fetus and minimise perineal tears, if one has not already been done.
- The infant's nose and mouth are quickly wiped to clear the airway of mucus if mucus is present.

Backward and downward traction of the head. The midwife places her hands on either side of the head and grasps the head over the ears, and applies gentle but firm backward and downward traction of the head towards the perineum in an attempt to dislodge and deliver the anterior shoulder (see Figure 31.9). This must be done without any forced rotation or excessive angulations of the head. All movements must be smooth and continuous. Great care has to be taken to avoid jerky movements, which can cause injuries to the spine. At the same time, the mother is encouraged to bear down and an assistant is asked to apply suprapubic pressure on the side of the fetal back towards the chest to abduct the shoulders (see Figure 31.10).This manoeuvre should dislodge the anterior shoulder.

Rotation of the shoulders into the oblique diameter. The aim of this manoeuvre is to place the shoulders into the larger oblique diameter. Two fingers are placed in front of the posterior shoulder vaginally, and two fingers are placed behind the anterior shoulder abdominally. In this way, an attempt is made to rotate the shoulders into an oblique diameter and then deliver the anterior shoulder as with a normal delivery, followed by the posterior shoulder.

The delivery of the posterior shoulder. The aim is to disimpact the shoulders by elevating the head of the baby towards the symphysis pubis and pushing the shoulders backwards into the pelvis. The midwife delivers the posterior shoulder first. The midwife can insert a hand deeply into the posterior vagina, along the curve of the sacrum and behind the posterior shoulder of the fetus. (If the baby is facing the midwife's right, she/he must use her/his right hand, and if facing the midwife's left side, she/he must use her/his left hand).



Figure 31.8 Technique to relieve shoulder dystocia: McRobert's manoeuvre

An attempt is now made to flex and deliver the posterior arm, by locating the antecubital fossa of the posterior arm and using finger pressure to flex the arm. The forearm is then grasped and swept across the chest and the face, and the wrist is grasped and the arm extracted (see Figure 33.11).

The head is then grasped as previously described (see Figure 33.9) and gentle but firm downward and backward traction of the head toward the perineum is again applied. The mother is asked to bear down and the assistant is asked to apply suprapubic pressure. The midwife again attempts to deliver the anterior shoulder (this time with the posterior arm already delivered).

Care after delivery

Once the baby is delivered, the midwife must be prepared to resuscitate a severely asphyxiated baby. If the baby has suffered hypoxia, the baby's body will be limp and white, while the head will be congested and livid. If the baby is alive, a full examination must be carried out for injuries. The mother must be examined for lacerations and trauma of the genital



Figure 31.9 The management of shoulder dystocia. Backward traction of the head, together with pressure on the abdomen above the symphysis pubis, pushing the anterior shoulder downwards

tract and observed for postpartum haemorrhage. The medical practitioner will explore the uterus and check for any rupture.

It is extremely important that the midwife shows concern and respect for the mother's and the father's feelings and that she spends as much time as is required to explain, clearly and simply, the exact nature of the problem. She should answer truthfully any questions they may ask and explain the exact condition of the baby. She should encourage them to talk about their fears and perhaps express their sorrow to her and to the medical practitioner, if the baby has been injured or has died. The midwife should try to help the woman and her family in every way possible.

The baby is nursed in high care. As soon as the mother's condition is stable, the mother should be allowed to see and hold her baby.

31.6 Acute inversion of the uterus

Definition

Uterine inversion occurs when the uterine fundus collapses into the endometrial cavity. It is a rare complication of vaginal delivery, but when it occurs, it is a life-threatening obstetrical emergency. If not promptly recognised and treated, uterine inversion can lead to severe haemorrhage and shock, depending on the degree of inversion.

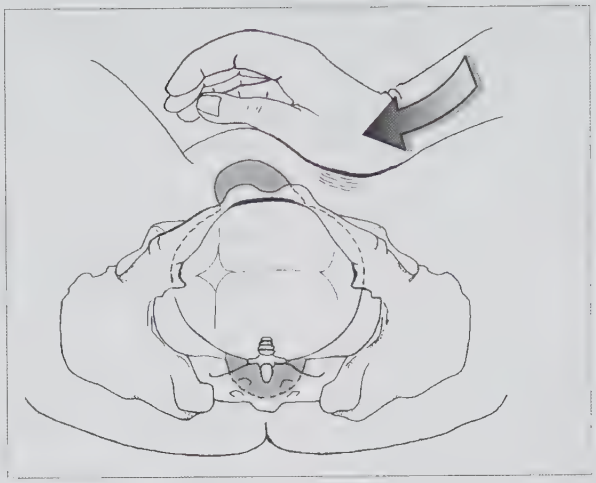


Figure 31.10 Correct application of suprapubic pressure



Figure 31.11 Extraction of the posterior shoulder in shoulder dystocia

Spontaneous inversion of the nonpuerperal uterus is even more rare. It is almost always associated with the presence of a polypoid uterine tumour, usually a leomyoma, but other tumours (teratoma, sarcoma) have also been implicated. The condition is often only diagnosed in the postnatal ward.

Incidence

This ranges from 1:1 500 to 1:20 000.

Classification of inversion

- *Partial inversion*. Where the inverted fundus appears at the cervix.
- *First degree inversion*. Where the fundus of the uterus inverts as far as the body of the uterus.
- *Second degree inversion*. Where the fundus of the uterus reaches the vagina.
- *Third degree inversion*. Where the fundus is turned completely inside out.

Factors that predispose to inversion

- Abnormalities of the uterine contents.
- A short umbilical cord.
- Neoplasm of the uterus.
- Fundal implantation of the placenta.
- Adherent placenta.
- Weakness of the uterine wall at the placental site.
- Congenital anomalies of the uterus: such as bicornuate uterus.
- Disturbance of the contractile mechanism of the uterus.
- Relaxation of the myometrium.
- General anaesthesia, which has the potential for relaxing the uterus as well as the cervix.
- Over-stretched uterus (polyhydramnios and multiple pregnancy).

Causes

The usual cause of inversion of the uterus is mismanagement of the third stage of labour, and is brought about by the following:

- Undue traction on the umbilical cord in a patient with an atonic uterus (that is, instead of using *controlled* cord traction, only cord traction is undertaken).
- Excessive fundal pressure on the uterus to expel the placenta could cause uterine inversion. (Using the fundus of the uterus as a piston is *never* to be undertaken.)
- The use of Credé's manoeuvre (squeezing or kneading the uterus) to deliver the placenta can easily cause uterine inversion and is not used anymore.
- Hasty manual separation and extraction of an adherent placenta can cause acute inversion.
- Uterine inversion could occur when abdominal pressure is increased suddenly in the third stage of labour during coughing, sneezing or vomiting.
- Uterine inversion sometimes occurs spontaneously for unknown reasons.
- Failure to actively deliver the placenta.

The clinical picture and diagnosis

The following clinical picture unfolds as *acute* inversion of the uterus occurs with traction on the cord:

- There is advancement of the cord.
- There is increased abdominal pain.
- The placenta is still attached or partially attached to the inside of the uterus and looks like a greyish-blue mass that protrudes from the vagina.
- This is usually accompanied by profuse vaginal bleeding, particularly if the placenta is partially or completely separated.
- The uterus cannot be palpated in the abdomen. (In a partial inversion of the uterus, a cup-shaped depression is palpated in the upper portion of the uterus.)
- There is excruciating pain, combined with an 'explosive' sensation of fullness in the vagina. (The pain is caused by the stretching of the Fallopian tubes and the broad ligament that leads to tension on the ovaries and stretching of the peritoneal nerves.)
- Profound shock results, and is manifested by sweating, pallor, tachycardia (and later bradycardia) and hypotension.
- Vaginal bleeding may be watery.

If untreated, the following course of events will result:

- With inversion of the uterus, contraction of the lower uterine segment occurs, producing a cervical constriction ring.
- This leads to oedema of the lower inverted portion of the uterus below the constriction ring.
- This results in a reduction of the blood supply to the inverted portion of the uterus.

Complications

This is an extremely dangerous condition and in extreme cases the patient may die from shock due to extreme pain and the damage to tissues and/or from haemorrhage. There is also:

- excruciating pain
- profuse haemorrhage
- profound shock
- oedema of the uterus that can lead to reduced blood supply with gangrene, necrosis and sloughing of the portion of the uterus that is constricted by the cervix

- air embolism
- infection and sepsis
- anuria
- urinary retention.

Partial inversion

Partial inversion of the uterus may not be acute and diagnosed immediately or over a period of hours.

Women complain of pain and continue to bleed vaginally, loosing blood constantly. Shock is associated with the pain and hypovolaemia develops gradually.

Any woman who complains of constant pain with vaginal bleeding (often watery blood) should receive attention.

Treatment and care

It is essential to actively manage the third stage of labour. In addition, prevention includes the following:

- avoiding the use of fundal pressure in the second and third stages of labour
- delivering the placenta with controlled cord traction and counteraction above the symphysis pubis and not fundal pressure
- *never* using Credé's manoeuvre to deliver the placenta
- identifying risk factors.

Immediate interventions

- Send urgently for medical assistance and an anaesthetist.
- Raise the foot of the bed and try to maintain the inverted mass within the vagina (rather than allowing it to hang right out of the vagina).
- Withhold uterotonic agents (mistoprostrol and oxytocin).
- Avoid separating the placenta, if still attached, to decrease bleeding.
- Administer 40% oxygen by face mask.
- Monitor the pulse rate and blood pressure every five minutes and record.
- Start a large-bore needle intravenous infusion using an electrolyte solution.
- Catheterise the patient.

If no medical practitioner is readily available, it is important to treat the profound shock first and then attempt to replace the uterus. These can be done simultaneously if an assistant is available.

Medical interventions

The ideal medical intervention is to immediately replace the uterus into its normal position. If this is not possible, other emergency treatment must be undertaken:

- Provide adequate analgesia, for example, Entonox® can be used, or if this is not available, pethidene or morphine could be given. A general anaesthesia, after written consent has been obtained, is the second choice of management.
- Elevate the foot of the bed and place the patient in the Trendelenberg position.
- Replace the uterus under general anaesthesia by first replacing that part of the uterus that inverted last, that is: that portion of the uterus adjacent to the cervix (the lower segment) is replaced first, and then the upper segment, with the fundus being replaced last. The uterus is replaced using the taxis manoeuvre by an experienced medical practitioner (see Figure 31.12).

Taxis manoeuvre

- The (inverted) fundus of the uterus is grasped in the palm of the hand, and is gently and gradually pressed upward and reintroduced into the vagina.

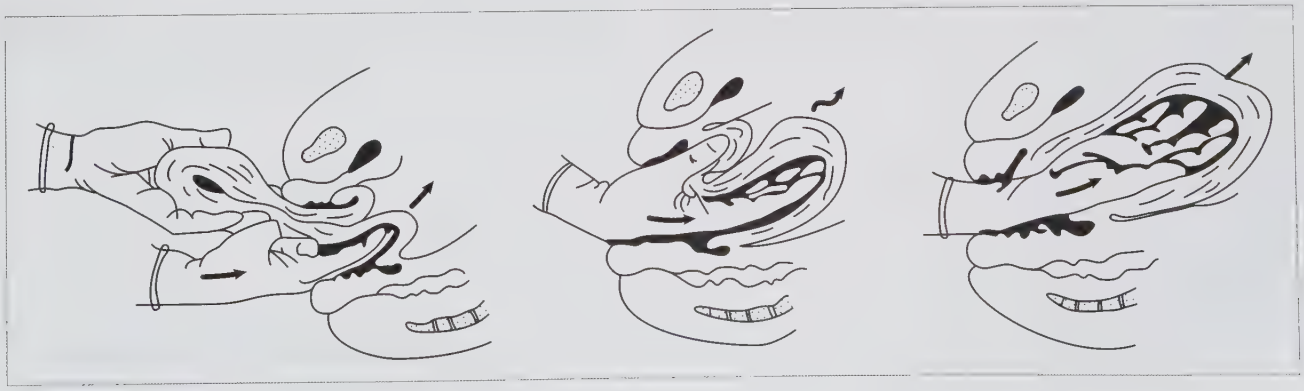


Figure 31.12 Manual replacement of the uterus

- The pressure is maintained until it is possible to lift the uterus out of the pelvis and into the abdominal cavity above the level of the umbilicus, which will stretch and tighten the uterine ligaments.
- This tension is maintained for 3–5 minutes. The tension causes the cervical (constriction) ring to widen and the fundus is drawn through into the uterus.
- After replacement of the uterus, the fist is kept in the uterus until the corpus is well contracted by oxytocics, otherwise it will invert again.
- Once the uterus is well contracted, a manual removal of the placenta is performed.The patient may be taken to theatre and the uterus corrected under general anaesthesia.
- The pain and shock is treated.
- The haemoglobin and heamatocrit are determined before replacement of blood to make sure that the shock is related to blood loss.
- The woman is at risk for infection and is treated with IV antibiotics.
- An intravenous infusion with 30–40 units of oxytocin is administered to maintain the uterine contractions for 24–48 hours.
- The woman is on bed rest.
- In rare cases a hysterectomy may be needed if the placenta is adhered (placenta accrete or percreta).

31.7 Amniotic fluid embolism

Introduction

Amniotic fluid embolism is a syndrome in which there is a sudden development of acute respiratory distress, shock and collapse, caused by an infusion of a large amount of amniotic fluid into the maternal circulation. The onset is very sudden and occurs during labour or soon after delivery. The amniotic fluid enters the maternal circulation through a laceration (which may be very small) in the uterus, usually the lower segment.

Although this is a rare condition, it is very dangerous, because a large percentage (25%) of those women who experience amniotic fluid embolism die within an hour from respiratory distress and shock. Those women who do survive develop disseminated intravascular coagulation (DIC).

Incidence

The incidence is 9–12:100 000 births. The condition is often undiagnosed.

Causes

Any condition in which the uterine muscle is cut or may tear easily, or where strong contractions bring about tearing of the uterine muscle, is a likely cause of amniotic fluid embolism. Most cases occur in women aged more than 30 years. 50% of cases have antenatal complications.

Specific causes are discussed below.

Relaxed and overstretched uterus

This condition could be caused by any of the following:

- Multiple pregnancies.
- Polihydramnios.
- Age > 30 years.
- Large infant.
- Meconium in liquor.
- Strong uterine contractions, prolonged labour.
- Operative interventions.
- Caesarean section.

Manipulation and assisted delivery

Complications may follow where there is an increased incidence of manipulation and assisted delivery such as any of the following:

- manual rotation of the head
- forceps delivery
- vacuum delivery
- uterine rupture
- internal podalic version
- external version
- manual removal of the placenta
- intrauterine catheters and electrodes
- overstimulation of the uterine muscle by the use of oxytocin and prostaglandins, as in induction of labour or augmentation of labour.

Signs and symptoms

The clinical features of amniotic fluid embolism include:

- sudden, profound, unexpected shock during or immediately after labour
- chills, shivering and pallor
- sudden extreme respiratory distress, with severe dyspnoea, cyanosis and restlessness
- sudden, acute drop in blood pressure
- weak, rapid pulse
- vomiting
- the rapid onset of pulmonary oedema and acute respiratory embarrassment but with no cardiac disease.

This condition is usually diagnosed on postmortem examination, when components of the liquor are identified in the maternal lungs and circulation. Histology of the lungs will reveal:

- oedema
- alveolar haemorrhages
- emboli consisting of fetal squamous cells, fat, mucin, bile and lanugo
- dilated pulmonary vessels at the area of embolisation.

Differential diagnosis

Other conditions that could be confused with amniotic fluid embolism are:

- pulmonary embolism from a deep-vein thrombosis
- air or blood embolism
- fat embolism
- Mendelson's syndrome
- eclampsia
- anaphylaxis, which can be caused by hypersensitivity to medication, or mismanagement of the administration of medication
- cerebrovascular accident
- congestive cardiac failure
- acute inversion of the uterus
- ruptured uterus
- haemorrhagic shock.

Interventions

Send for a medical practitioner immediately and treat the patient as for shock. The medical practitioner will administer medications, such as aminophylline, to relax the pulmonary airways and vessels. If the patient should survive, the medical practitioner will treat her for disseminated intravascular coagulation, with the administration of blood, fibrinogen, and in some specific cases, heparin.

Outcomes

The following percentages apply:

- 80% mortality and risk increase with age
- 50% of fetuses die *in utero*
- 25% die within one hour.

31.8 Conclusion

Midwives are the primary caregivers of women in pregnancy and labour. Emergency support may not always be available, so the midwife needs to be able to identify women at risk of emergencies in the antenatal period and early in labour and understand the principles of emergency treatment.

This chapter reviewed emergencies that may occur in pregnancy and in labour. Other conditions that may require emergency interventions such as eclampsia, shock, haemorrhage, infections and anaphalaxis are reviewed in other chapters.

CHAPTER

32 Obstetric interventions

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- identify standard obstetric procedures and interventions associated with birth
- identify obstetric procedures and interventions that are life-saving in all settings
- identify obstetric procedures and interventions performed at specific levels of care
- develop obstetric 'life saving' competencies
- develop competence in obstetric procedures.

KNOWLEDGE ASSUMED TO BE IN PLACE

Basic knowledge, skill and competency in the care of a normal birth

KEYWORDS

Obstetric interventions • assisted delivery • caesarean section • regional anaesthetic

32.1 Introduction

This chapter considers the interventions that are considered important in obstetrics. Obstetric interventions do not fall within the scope of practice of the midwife. The midwife's scope of practice focuses on the normal. Most of the interventions are directly performed by a medical practitioner, preferably an obstetrician, or are prescribed by an obstetrician and the care is instituted and given under his or her direct or indirect supervision.

However, in some cases task shifting may be necessary, for example where there are not enough medical practitioners available. In such cases, skilled midwives may perform certain obstetric interventions.

The role of the midwife may be summarised in the following way:

- The midwife must know the clinical and legal boundaries and scope of practice in South Africa.
- The midwife must have up-to-date knowledge of the clinical principles of obstetric interventions (indications, contraindications, and complications).
- The midwife must be aware of the norms and standards for procedures in the health facility's clinical manual and have regular in-service training or skills drills.
- The midwife must be experienced in the various interventions and must be up-to-date with life-saving skills.
- The midwife must be aware of and use the protocols of the healthcare system and the particular setting wherein midwifery is practiced (basic antenatal care (BANC) programme, referral protocols).
- The midwife must be a codeveloper of norms and standards of clinical care, equipment and staff for quality and effective procedures.
- The midwifery manager and supervisor must take responsibility for evaluation of the outcomes of care.

32.2 Selected common obstetric interventions

Several interventions and skills require advanced specialised training, medical education and experience beyond the general. Midwives may acquire some of the skills through experience and specialist education, training and through specialist programmes and skill drills.

Table 32.1

Competencies, interventions and procedures in obstetrics

Essential (life-saving) obstetric interventions and competencies for skilled attendants	Interventions by independent midwives	Medical procedures	Procedures that midwives perform under supervision/ collaboration
Breech delivery	Artificial rupture of membranes	Infertility investigations	Induction of labour
Premature delivery	Episiotomy (cut and suture)	Induction of labour	Augmentation of labour
Ventouse delivery	Suture of 1st and 2nd degree tears and episiotomy	Anaesthesia/general/epidural and spinal	
Prolapsed cord	Termination of pregnancy (TOP) before 12 weeks	Augmentation of labour	Vaginal birth after caesarian section
Fetal distress/neonatal asphyxia	Insertion of IUD	Forceps delivery	Emergency care in pregnancy-induced hypertension
Uterine rupture	Limited obstetric ultrasound	Suture of cervical tear	Sepsis management
Shoulder dystocia	Administration of pethidine and oxytocin (3rd stage) (independent)	Suture of 3rd degree tear	Administration of Entonox®
Ante- and postpartum haemorrhage/hypovolaemia	Transcutaneous electrical nerve stimulation (TENS)	Termination of pregnancy (TOP) after 12 weeks	
Inversion of the uterus (emergency care)	External version		Pain management
Intubation (mother and newborn)	Administer local anaesthetic	Obstructed labour	
Eclampsia	External version (second twin)	Caesarean section	
	Hydrotherapy	Manual removal of a placenta	
	Ventouse delivery	Surgical evacuation of the products of conception	
	Resusitation	Prescription and administration of medication	
		Suppression of labour	
		Inversion of uterus (curative)	
		Amniocentesis	
		External and internal version	

Table 32.1 lists essential obstetrical competencies, interventions and procedures skilled attendants (the midwife or medical practitioner) may perform. The scope of practice differentiates between procedures restricted to medical practitioners and those that a midwife could perform in collaboration or under medical supervision. Task shifting requires that midwives perform essential emergency procedures.

Midwives in the public sector work in different levels of healthcare. All obstetrical care is under the indirect supervision of an obstetrician. Women with clinical indications of adverse outcomes are referred to a higher level of care where more technological support and medical expertise are available. Level 3 obstetrical care is specialised care and is under the direct supervision of a specialist. MOUs (midwife obstetric units) are

specialised units in the public health sector where midwives give independent care for low-risk cases under the indirect supervision of a medical practitioner. Natural birth units are units where private midwives give independent care for low-risk births.

Women with known problems who are under the supervision of the medical team are often subjected to interventions to both diagnose and treat women who present with a history or signs and symptoms of factors that may adversely affect health outcomes.

These interventions and procedures used in obstetrics are briefly mentioned.

32.3 Induction of labour (IOL)

Definition

Induction of labour is the deliberate initiation of uterine contractions prior to their spontaneous onset. When labour is initiated after the end of the 6th calendar month (26 weeks) of pregnancy, it is known as induction of labour; when initiated before this time, it is known as therapeutic abortion or termination of pregnancy (TOP).

Incidence

This is 184:1 000 in the USA. No statistics from southern Africa are available.

Classification of induction of labour

IOL can be classified according to *its purpose*. An elective induction is a planned induction, which may be with or without medical indication.

IOL can be classified according *to method*.

A *medical induction* refers to the administration of substances to stimulate the uterus.

A *surgical induction* uses the artificial rupture of membranes and the stretching of the cervix to release prostaglandins to start labour in a woman.

Medical and surgical induction of labour are often used in combination.

32.1 Differentiating induction of labour from augmentation of labour

Induction of labour involves initiating labour because the woman is not yet in labour. The cervix may need ripening after assessment (Bishop Score) and oxytocin administered to initiate onset of contractions.

In augmentation of labour, onset of labour is spontaneous but the contractions are not effective and need strengthening to facilitate progress of labour.

Prerequisites for IOL

IOL is only performed on prescription of a medical practitioner in a woman with an obstetric indication, in a setting where there is a theatre available as well as neonatal care. The woman should be under supervision during the induction of labour.

Depending on the medical and obstetrical indication for the induction the following are important prerequisites:

- *The gestational period.* IOL is performed when a pregnancy is term.
- *The presenting part.* The presenting part is engaged.
- *The presentation.* A cephalic presentation is a prerequisite.
- *Fetal wellbeing.* An induction cannot be done on a compromised fetus (reactive NST).
- *The size of the fetus.* No macrosomia.
- *The maternal history.* No previous perinatal loss or obstructed labours.
- *The pelvis.* The pelvis should be adequate.
- *The placenta.* The position of the placenta must be known.
- *The cervix.* The Bishop score must be favourable (see Table 32.2).
- *Consent.* The mother must give consent to both the time and method of the procedure.
- *Skilled attendants.* The staff must be competent.

Bishop score

The Bishop score is a prelabour scoring system used to assist in predicting whether induction of labour will be effective and can be used to assess the odds of spontaneous preterm delivery and labour (see Table 32.2). The criteria are briefly explained below.

Dilatation. Dilatation is a measure of the diameter of the stretched cervix. It complements effacement, and is usually the most important indicator of progression through the first

Table 32.2

Bishop score

7 – 9	SCORE			
FACTOR	0	1	2	3
Dilatation	Nil	1–2	3–4	5+
Effacement	0–30%	40–50%	60–70%	80%
Station	–3	–2	–1	+1
Consistency	Firm	Medium	Soft	
Position	Posterior	Mid	Anterior	

stage of labour. Some dilatation of the cervix is more favourable than no dilatation.

Effacement. Effacement is a measure of stretch already present in the cervix. It is analogous to stretching a rubber band; as the rubber band is stretched further, it becomes thinner. This is affected by individual variation and previous surgery such as loop excision for cervical dysplasia or cancer. Effacement is measured in centimetres. An uneffaced cervix is 2 cm long.

Station. The station of the presenting part is the position of the presenting part in relation to the ischial spines, as determined on vaginal examination. The station above the spines or below the spines is related to the cervical changes.

Consistency. In primigravidae the cervix is typically tougher and resistant to stretching, much like a balloon that has not previously been inflated. Furthermore, in young women the cervix is more resilient than in older women. With subsequent vaginal deliveries the cervix becomes less rigid and allows for easier dilatation at term. A non-pregnant cervix feels like the tip of the nose while a pregnant cervix is as soft as the lips. If a cervix is tight (called cervical dystocia) birth may be difficult.

Position. The position of the cervix varies between individual women. In pregnancy the cervix changes its position, particularly when the lower segment forms and the presenting part moves down. The anterior position is better aligned with the uterus, and therefore there is an increased likelihood of spontaneous delivery. A posterior cervix indicates that the needed changes have not yet taken place.

Interpretation of the Bishop score. Each component is given a score of 0–2 or 0–3. The highest possible score is 13.

- A presenting part at spines, with a soft anterior cervix with 50% effacement, 3–4 cm dilated gives a Bishop score of 10, indicating a ripe cervix and a readiness for birth.
- A high presenting part with a firm posterior cervix with poor effacement and no dilatation gives a Bishop score of 1–2.
- A score of 5 or less suggests that labour is unlikely to start without induction. A score of 10 or more indicates that labour will probably start spontaneously. A low Bishop score often indicates that induction is unlikely to be successful. A score of 8 is considered to be a reliable prediction of a successful induction.
- A poor Bishop score at term with a high head needs further consideration of a large infant or a malpresentation. When the fetal head is well fitted (applied) on the cervix, prostaglandins are released that can cause the cervical changes and the Ferguson reflex kicks in. Poor application of the presenting part is suspicious.

Indications for IOL

The most important indications for induction of labour are called true indications. Induction without any pathological cause presents unnecessary risks to both mother and baby and is, therefore, not a true indication for induction of labour.

Maternal conditions

Conditions of the mother that warrant the delivery of the baby include:

- hypertensive disorders (if fetus is viable and the L/S of the lungs is normal the baby can be delivered to prevent eclampsia)
- malignancies (the mother needs to start chemotherapy or radiation)
- previous precipitate labour (to have a more controlled birth)
- maternal conditions that need surgery, such as cholecystectomy may be a reason for selective induction of labour.

Fetal conditions

The following factors put the wellbeing of the fetus at risk:

- maternal diabetes
- Rhesus (Rh) incompatibility with sensitivity
- intrauterine growth restriction
- antepartum haemorrhage (not life threatening)
- PROM (premature rupture of the membranes)
- previous perinatal loss
- congenital abnormalities.

Obstetric reasons

Obstetric reasons for induction of labour include the following:

- Intrauterine death (the pregnancy is terminated).
- Postmaturity (the pregnancy is not allowed to continue to prevent complications).
- Persistent, acute renal disease.
- CPD - when the woman has a contracted pelvis, or if there is a history of large babies, induction may be undertaken at 37–38 weeks' gestation in order to avoid cephalopelvic disproportion and subsequent caesarean section and so avoid scarring the uterus. This is especially relevant for women living in rural areas or to avoid the necessity of major surgery in patients with serious cardiac or respiratory conditions.

Social reasons (elective induction of labour)

Social induction of labour is a very controversial subject. Induction of labour is requested for social reasons or for the medical practitioner's convenience. Other reasons include:

- The woman may live some distance from the hospital.
- The family may be moving from the district shortly and they wish deliver to avoid not reaching the hospital on time, or to deliver in a new unknown place.
- There may be discomfort.
- There may be severe oedema or pruritis due to the high circulating hormones.

Contraindications for IOL

There are absolute and relative contraindications for IOL.

Absolute contraindications

The following are absolute contraindications:

- If the patient has refused consent for induction of labour, the medical practitioner must be informed immediately.
- Two previous caesarean sections for cephalopelvic disproportion or obstructed labour.
- Surgery of uterus, e.g. myomectomy.
- Fetal distress (compromise) (poor kick chart or Doppler)
- High presenting (unengaged presenting part or cephalopelvic disproportion).
- Malpresentation/positions (transverse lie, brow or face presentation).
- Placenta praevia.
- Grand multiparae.
- Cancer of the cervix.
- Active herpes infection.
- HIV infection.
- Prematurity (if no maternal indication).
- Cord presentation or prolapsed if the fetus is alive.
- Vasa praevia.

Relative contraindications

The following are relative contraindications:

- Previous caesarean section (for reasons other than cephalopelvic disproportion or obstructive labour).
- Grande multipara (risk of uterine rupture).
- Overextended uterus due to hydramnios or multiple pregnancy.
- Placental dysfunction/insufficiency.
- Breech with frank breech (the legs splint the body).
- Large infant (40 cm on the SF measure by 36 weeks – high risk of shoulder dystocia).

Complications

The risks of IOL are associated with the method of induction, the indications and risks. Induction of labour is performed in a unit under the supervision of a medical practitioner with an available theatre, and anaesthetist and neonatal care.

If the Bishop score is unfavourable the induction may fail.

It is impossible to know how a woman's body and uterus will respond to the stimulation of substances in medical IOL. The following are known complications:

- Precipitate delivery with severe pelvic floor and perineal damage (see Chapter 30).
- Hypertonic contractions with cerebral injury in the newborn, asphyxia neonatorum and increased perinatal mortality rate (see Chapter 30).
- Fetal distress with intrapartum death (see Chapter 45).
- Placental abruption with intrapartum death (see Chapter 21).
- Rupture of the uterus (see Chapter 31).
- If malpresentations or a large fetus are present obstructed labour can occur with maternal distress (see Chapter 29).
- Postpartum haemorrhage due to an exhausted uterus (see Chapter 21).
- Malpresentation if mild CPD exists (see Chapter 29).
- Raised incidence of jaundice in the newborn. There is considerable epidemiological evidence of an association between maternal administration of oxytocin and neonatal jaundice (see Chapter 43).
- Allergy or hypersensitive to oxytocics and prostaglandins such as asthmatic women (see Chapter 33).
- Maternal emotional/psychological disturbances such as posttraumatic shock (see Chapter 13).

When surgical induction is used and artificial rupture of membranes (AROM), there is an increased incidence of the following conditions:

- infection of both mother and fetus (see Chapter 50)
- cord prolapse if the presenting part is not engaged and not well fitting on the cervix with fetal distress and death (see Chapter 31)
- there is an increase in the risk of intrauterine infections with rupture of membranes and multiple vaginal examinations for more than 12 hours (see Chapter 50).

AROM may not initiate labour and is usually used in combination with medical induction.

Principles of care in the induction of labour

The patient is admitted to hospital. If sedation is prescribed, it is usually given early in order to prevent any fetal sedation

at birth. A short-acting sedative is preferable. The induction is not usually started at night.

Immediately before the induction of labour is started, the condition of mother and fetus must again be carefully assessed.

Preparation

- The patient signs consent for the procedure.
- The patient's history is reviewed (the EDD, LPM and gestational age and other risk factors).
- The patient's emotional state and her expectations of the procedure are assessed.
- A physical examination is carried out and recorded. In this way, the midwife can assess the contraindications and make baseline observations.
- Urine tests for protein, glucose and ketones are carried out.
- Temperature, pulse, respiration, blood pressure and colour are checked.
- Other tests results are considered, such as maternal blood tests, recent haemoglobin (within seven days).
- Ultrasound scans, non-stress test, amniocentesis (for maternal wellbeing and/or for fetal wellbeing and maturity) are done.
- Any allergies or hypersensitivity to medication (asthma) are noted.

Obstetric examination

An obstetric examination includes:

- The reason for the IOL is recorded and the woman's preference for pain management is recorded. This assessment is similar to that which is carried out on an admission of labour.
- Abdominal palpation is done to determine the size and position of the fetus.
- The engagement of the presenting part is determined.
- Fetal wellbeing is assessed through a cardiotocograph non-stress test.
- An explanation of the procedure and expectations are discussed with the birth companion.

Vaginal examination

It is extremely important that all the results of the examinations are carefully recorded, so that any change will be obvious once the induction has been started.

- A vaginal examination is performed and a clinical pelvic assessment may be done if indicated.
- A Bishop score is done.
- The state of the membranes – if ruptured, the state of the liquor (clear or meconium stained) and the presence of any vaginal discharge is noted.
- The presenting part – the station, moulding, cord presentation/prolapse, vasa praevia are noted.
- The application of the cervix to the presenting part is noted.

Special examination

Further tests may be requested, such as ultrasound scan, X-ray, laboratory tests of urine, blood or liquor, non-stress test. An amniocentesis can be done to determine lung maturity.

32.2 Midwife's liability

The midwife, on accepting the prescription to induce labour, makes sure that there are no contraindications to the procedure and refers it back to the medical practitioner if abnormalities are noted. Once she accepts the prescription she is liable for her own actions.

Methods of induction

The choice of the method of induction is made by the medical practitioner in collaboration with the woman. Certain factors will guide the choice of method, the route of administration and the dosage used.

- *Gravity and parity*. The dosage must be changed for a multigravida. In a grande multigravida a lower dosage of uterine stimulants is used due to the risk of uterine rupture.
- *Risk of infection*. The rupture of membranes is avoided in cases of lowered immunity, vaginal and other infections.
- *Drug sensitivity*. Asthma is a relative contraindication for the use of prostaglandins.
- *Cardiac, lung and kidney problems*. These women are prone to water toxicity associated with the administration of oxytocin.
- *Bishop score and ripe cervix*. These will guide the method of induction.

Cervical ripening

Cervical ripening usually begins prior to the onset of labour and is necessary for cervical dilatation and the passage of the fetus, if the Bishop score is unfavourable (see Table 32.2).

Induction of labour is less likely to succeed if the cervix is not ready (scoring 5 and less on the Bishop Cervical Scoring System). Before the start of either surgical or medical induction, it may be necessary to make the cervix more favourable. The medical practitioner will then prescribe medication for this purpose (see Table 32.4).

Physiology of ripening of the cervix. Various hormones are involved in a complex series of interactions to stimulate the chemical reactions critical for cervical ripening. An increase in the enzyme cyclo-oxygenase-2, leads to a local increase of prostaglandin E2 (PGE_2) in the cervix. The increase in local PGE_2 leads to a series of important changes causing cervical ripening. Prostaglandins are an important substance involved in cervical ripening.

Processes to improve cervical ripening. Prostaglandins are present in the body (cervix) and are also present in semen, which means that cervical ripening can be promoted during sexual intercourse. Therefore sexual intercourse is discouraged in preterm birth and encouraged after 36 weeks. Women often have contractions after sexual intercourse.

Stretching the cervix

The stretching of the cervix releases local prostragladins causing contractions.

Hydroscopic dilators. If the cervix is closed it can be stretched by Lamicel (seaweed). This is a tampon that is placed in the cervix. It swells as it absorbs fluid and pushes the cervix open over a period of 24 hours, releasing prostaglandins. This is useful in cases of IUD where the cervix is closed. However, it is associated with peripartum infections.

Membrane stripping. A very old method used to stimulate labour is the stretch and sweep. This is useful in multigravidae with an open cervix of 2–4 cm. The fingers are placed in the cervix and the membranes are separated from the lower segment through moving the fingers around the cervix between the cervix and the membranes. This will release prostaglandins and may lead to the start of birth.

Balloon catheter. A 30–50 ml Foley catheter filled with saline is placed in the uterus and the balloon is inflated. The catheter is placed extra-amniotically (between the membrane and the uterus) and is pulled down in the lower segment. It places pressure on the lower segment and releases local prostaglandins. There is no increased risk of chorioamnionitis and this is as effective as prostaglandin gel. This method is more useful in primigravidae and used with IUD (intrauterine death).

Medical induction

Medical induction is the use of substances to start or augment labour. These include the following:

Anti-progesterone. Mifepristone (formerly known as RU 486) is a very effective antiprogesterone and antiglucocorticoid that works by binding to progesterone and glucocorticoid receptors. It is used mainly for abortions and inductions of intrauterine death.

Low dosage oxytocin infusion. This method is useful with women whose fetuses are at risk of intolerance in labour, because the infusion can be closed if needed. A low dosage of oxytocin is administered in an intravenous infusion 1–4 mU/min (2 U at 30 drops per minutes – see Table 32.3). It is compared favourably with the effectiveness of misoprostol. Nipple stimulation is a known method of releasing oxytocin in the body: the woman rubs her nipple until it contracts. Women can be encouraged to express colostrum in the bath after 36 weeks of gestation.

Prostaglandin E2 (dinoprostone PGE_2). Two forms of PGE_2 (dinoprostone) are available commercially. The first is Prepidil®, which is formulated as a gel and is placed inside the cervix, but not above the internal os. The application (3 g gel/0.5 mg dinoprostone) can be repeated in six hours, not to exceed three doses in 24 hours.

The second is Cervidil®, which contains 10 mg of dinoprostone embedded in a mesh and is placed in the posterior fornix of the vagina. This allows for controlled release of dinoprostone over 12 hours, after which it is removed.

Prostaglandin E1 analog (misoprostol). This is a synthetic prostaglandin, which is marketed as an antiulcer agent under the trade name Cytotec®. One quarter of a tablet (25 µg), can be crushed and placed on the cervix. This can induce cervical ripening and labour. It can be repeated every four hours. The administration routes are buccal, sublingual, oral, vaginal or rectal, but vaginal administration seems to be best. It should also not be given in combination with oxytocin.

Table 32.3

Guidelines for oxytocin infusion in 1 000 ml solution

Rate drops/ minute	2 units/ℓ mU/min	10 units/ℓ
1	0.13	0–66
15	2	10
30	4	20
60	8	40

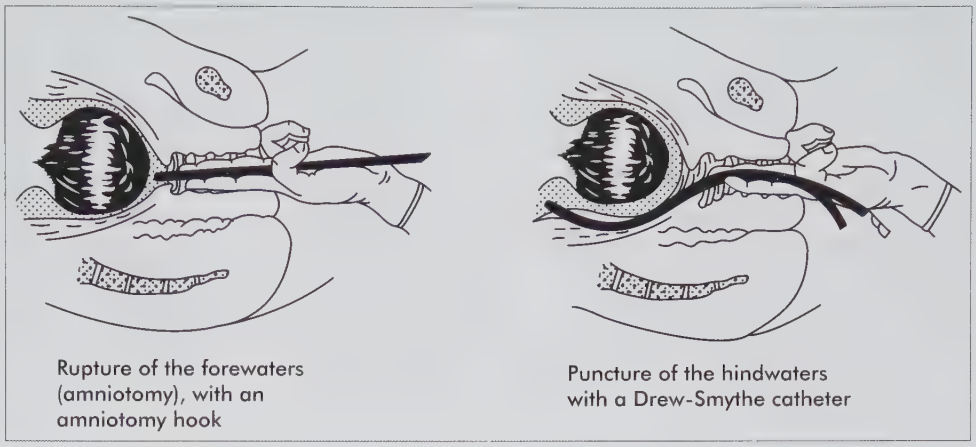


Figure 32.1 Amniotomy

Surgical induction (amniotomy)

This is the safest and most reliable form of induction of labour, especially if the patient is near term. However, the cervical os must be dilated enough to introduce a finger into the cervix to rupture the membranes.

Often surgical induction is combined with a medical induction. Otherwise, if labour is not established within four hours of the membranes being ruptured, a medical induction is started.

Precautions. Amniotomy is contraindicated in cases of:

- high presenting part (due to the risk of cord prolapse)
- HIV-positive status (membranes are kept intact as long as possible)
- malpresentations (occipitoposterior positions). The amniotic fluid is a wedge that equalises the pressure on the cervix. If the membranes rupture the pressure on the cervix is unequal and the presenting part may deflex
- polyhydramnios. Great care needs to be taken if membranes are ruptured with polyhydramnios. The risk of cord prolapse is very high as well as placental abruption with the sudden decompression of the uterus
- active herpes genitalis can infect the fetus when passing through the birth canal.

Artificial rupture of the membranes (AROM). If a woman is not in labour, an amniotomy is performed by a medical practitioner or by a skilled midwife under the medical practitioner's prescription. It is safer to start and establish labour before an amniotomy is performed bearing in mind the contraindications of amniotomy. The procedure and method are explained carefully to the patient and her partner. Written consent is obtained. The following guidelines are observed:

- The patient's bowel and bladder should be empty.
- The patient is bathed or showered.
- The patient is wedged in a dorsal or in semi-Fowler's lithotomy position, and there is a stool and a good light available for the medical practitioner.
- A baseline fetal heart rate is taken and recorded and should be within normal limits (NST)
- An aseptic technique is maintained. Sterile instruments are used.
- If the presenting part is well fitted and a sac of forewaters is formed, the forewaters can be ruptured if the cervix allows a finger to be admitted.
- If the presenting part is not well fitted and the cervix is 4 cm dilated, a high rupture can be performed leaving the forewaters intact. This is done by an obstetrician and is seldom performed now. Great care is taken to avoid a cord prolapse.
- The index and second fingers, liberally smeared with antiseptic obstetric cream, are gently inserted into the vagina.
- One finger is then inserted into the cervix (which must be at least 2 cm dilated) and the membranes are stripped away from the uterine wall around the cervical os.
- The instrument of preference is then carefully inserted into the vagina and cervix, guided by the finger in the os and the membranes are punctured.
- The instrument is then removed, the hole in the membranes is widened by the finger in the cervix. The amniotic fluid is collected in a kidney dish. If the forewaters

are ruptured a small amount of liquor (up to 250 ml) is allowed to drain out of the amniotic sac. If a high rupture is done more amniotic fluid may drain but the forewaters may stay intact. Before the fingers are removed, check for prolapse of the cord.
- The fetal heart is checked before and after the rupture.
- The volume of the amniotic fluid, the colour, consistency and smell are recorded (any meconium staining and abnormalities are reported).
- The patient is cleaned and made comfortable.
- If all observations are normal and contractions have started, the patient should be encouraged to walk around to help the presenting part engage in the pelvis and to help stimulate contractions.
- Should labour not have started, medical induction can be started on prescription.
- If the patient has not delivered within 12–18 hours, a high vaginal swab should be taken for microscopy and culture and the medical practitioner may order an antibiotic that crosses the placental barrier with ease. Should labour not have started after an hour, the medical practitioner will review the situation and if contractions have not started, he/she will usually order a medical induction.
- If the patient has not delivered within 18 hours, the medical practitioner may decide to do a caesarean section.
- Appropriate pain relief is administered according to prescription.

Table 32.4 summarises the medications, contraindications and side effects of the substances used for induction of labour.

The role and function of the midwife in induction of labour

The following are important for a midwife involved in induction of labour:
- Scientific knowledge – the midwife must have a thorough knowledge of the medications used for induction of labour, the drug, the storage of the drug, the preparation of the drug, the routes of administration, the dosages, the indications and contraindications, the side effects and antidotes.
- The midwife follows the protocols for induction of labour in a well-resourced centre with adequate medical backup, theatre and neonatal support.
- The midwife makes sure that the drugs and emergency equipment are in place for emergencies.
- The midwife follows strict protocols on the prescription of the drugs. Drugs are only administered on *written* prescription from a medical practitioner.
- The midwife is careful to identify contraindications and side effects of the drugs.
- The drug is always checked with a second person before administration.
- Thermo-unstable substances are kept in the fridge – 25 °C (oxytocin *and* prostin alpha F_2).
- Always start the treatment with the lowest dosage using the correct route of administration.
- Prostin E_2 and misopostrol cannot be counteracted once absorbed.
- Oxytocin can be discontinued if given intravenously and the effect stopped.
- Give the appropriate dosages for the parity.
- Be very careful when using prostaglandins (misopostrol) with oxytocin (drug interactions).
- Make sure that there are no contraindications before the therapy is started.
- Observe carefully, particularly of the uterine action. Aim for a uterine pattern close to normal labour. Two contractions in 10 minutes with a normal resting tone in between (see Chapters 18 and 30).
- Continuous Electronic observation of the fetal heart is done continuously.
- Do not exceed the maximum dosage.
- Make sure that the woman is receiving sufficient pain relief. The contractions of artificial inductions are more painful than normal birth.
- The midwife keeps clear and accurate notes of the events.
- The midwife monitors the progress of labour and prevents complications such as obstructed labour, uterine rupture and fetal distress.

32.4 Anaesthesia in pregnancy and labour

Several factors put the woman at risk for anaesthesic complications in childbirth including the physiological changes of pregnancy (see Chapters 20 and 26).
Physiological factors include the following:
- *Cardiovascular and haematological changes*. The enlarged uterus presses on the inferior vena cava when the woman is in the supine position after 20 weeks of pregnancy, which interferes with normal cardiovascular function and influences cardiovascular stability. All women are wedged during anaesthesia until the baby is delivered.

Table 32.4

Guidelines for medical induction

Prostaglandins	Dosage and administration	Contraindication	Dangers and side effects
Dinoprostin Prostagladin E_2 tablets Prondin® E_2 gel	A powerful agent Vaginal insertion Maximum dosage 2 mg x 4 hourly which is 1 tab hourly x 10 A safer dosage is 4 tabs of 0.5 mg every 4 hours The preferred method of usage is the gel which is 1 mg/3 g Maximum dosage is 3 mg administered as 1 mg every 6 hours	See general contraindication for IOL A history of asthma Avoid vaginal administration when membranes are ruptured Avoid with previous c/s Not used for grande multiparae	Gastrointestinal: Nausea, vomiting, diarrhoea Tonic uterus: fetal distress, placental abruption and pain Rupture of uterus Hypertension Anaphylaxis
Dinoprost Prostagladin F_2 Alpha® *Injection only administered by a medical practitioner*	Very powerful agent Used for IUD induction of labour or when pregnancy is terminated for an abnormal fetus (intra-amniotic) Can be used in PPH to contract uterus 1–2 mg intramyometrial	Fetal: When baby is alive Maternal: Epilepsy, cardiac, lung, kidney or liver problems, Immune compromised Hypertension Glaucoma	Continuous administration for more than two days is not recommended Gastrointestinal: Nausea, vomiting Tonic contraction of the uterus Hypotension Pulmonary oedema Tachycardia Fever Headache
Misoprostol Prostagladin E_1 Cytotec®	Synthetic prostaglandin E_1 The available data suggest that the *best dose of misoprostol for induction of labour is 25 µg vaginally every 4 to 6 hours* (MAXIMUM 6 dosages) Safe to use if IUD or with PPH Useful if Bishop score is poor Misoprostol versus PE_2 fewer failures to induce labour, fewer epidurals, fewer c/s and more hyperstimulation of uterus	See the general contraindications for IOL A risk of uterine rupture 12% in previous c/s	Hyperstimulation syndrome Uterine rupture Fetal distress and meconium in liquor Amniotic fluid embolism Diarrhoea if taken orally plus gastrointestinal effects Vaginal application may influence immune responses

(continued)

Table 32.4

Guidelines for chemical induction (*continued*)

Prostaglandins	Dosage and administration	Contraindication	Dangers and side effects
Oxytocin	*Synthetic oxytocin* Intravenous administration only Primigravidae: 5–10 units in 1 000 ml Saline/dextrose/Ringer's Multigravidae: 2–5 units in 1 000 ml Grande multiparae: 2 units in1 000 ml Initial dosage 5 drops/min Increase every 30 minutes with 5 drops till uterus contracts 2 contractions in 10 minutes Maximum 30 drops per minute Do not exceed 1 500 ml in 10 hours	Fetal distress Hydramnios Partial placenta previa Prematurity Borderline cephalopelvic disproportion Any condition in which there is a predisposition for uterine rupture, such as previous major surgery on the cervix or uterus including c/s Overdistention of the uterus, Grand multiparity Past history of uterine sepsis or of traumatic delivery The decision can be made only by carefully weighing the potential benefits that oxytocin can provide in a given case against rare but definite potential for the drug to produce oxytocin-induced water intoxication Placental abruption Amniotic embolism	Hyper stimulation of the uterus Maternal: Anaphylactic reaction Postpartum haemorrhage Cardiac arrhythmia Fatal afibrinogenaemia Nausea Vomiting Hypertensive episode Rupture of the uterus Severe water intoxication with convulsions and coma have occurred, associated with a slow oxytocin infusion over a 24-hour period. Maternal death due to oxytocin-induced water intoxication has been reported. Severe hypertension has been reported when oxytocin was given three to four hours following prophylactic administration of a vasoconstrictor in conjunction with caudal block anesthesia. Fetal: Bradycardia Permanent CNS or brain damage Fetal death Neonatal seizures have been reported Low Apgar scores at five minutes Neonatal jaundice Neonatal retinal hemorrhage

A wedge or a pillow is placed under the mother's left side to lift the uterus off the inferior vena cava and the blood pressure and pulse are monitored.

- *The changed haematrocrit, Hb and coagulation profile.* The blood loss in caeserean section is more than a normal birth – estimated at 1 000 ml during the procedure.
- *Gastrointestinal changes.* The enlarged uterus is pushed against the diaphragm and stomach and the risk of aspiration is increased. When this occurs it is usually a fatal condition called Mendelson's syndrome. Cricoid pressure is used to prevent aspiration during intubation from 12 weeks of pregnancy.
- *Hormonal changes.* The effects of progesterone cause relaxation of the cardiac sphincter of the stomach and the acidic contents of the stomach are easily aspirated.
- *Changes in electrolyte balance and intra- and extravascular volume.* These alter drug pharmacokinetics.
- *Respiration.* The respiration rate is increased.

General anaesthesia and childbirth

The anaesthetist needs to consider two patients: a mother and baby. Anaesthetic procedures are adapted and the use of anaesthetic agents altered to accommodate the baby. The baby needs to be delivered quickly. As a rule, the surgical drapes are placed and the surgeon is ready before anaesthesia is induced.

The motto of surgery in obstetrics is to avoid general anaesthesia as far as possible. If general anaesthesia is needed it should be administered by a competent anaesthetist. The risk is failure to intubate.

Factors to consider:

- *Premedication.* The normal premedication is not administered to a woman during childbirth because it can cross the placenta and affect the fetus. Routine premedication may include a mild short-acting sedative the night before, an antiemetic to facilitate gastric emptying and prevent nausea and an antacid to neutralise stomach contents.
- *ECG.* ECG changes are present because of the changed position of the heart in pregnancy.
- *Risks.* Pregnancy-associated anaesthetic risks are aggravated by emergencies in which the mother and fetus are already compromised, for example hypovolaemia, DIC, eclampsia, HELPP syndrome, cardiac problems and obesity.

Regional anaesthesia in childbirth

Regional anaesthesia has become the more popular and safer option of anaesthesia in childbirth.

Epidural and spinal anaesthesia carry risks and should only be administered by a skilled anaesthetist or obstetrician. The midwife needs to be aware of these risks and know the potential complications of the procedure and how to monitor the patient effectively.

Epidural analgesia is the only intervention that can (totally) relieve the pain of uterine contractions. Epidural analgesia has become an extremely popular form of pain relief in labour and therefore it is important that midwives are fully conversant with it.

However, it is a time-consuming procedure in a busy labour ward and if there is insufficient care and preparation by the nursing and medical staff in the delivery unit, a dangerous situation could arise.

Midwives in the labour ward must have a thorough understanding of anaesthetic technique, as well as the dangers and complications that could arise and know how to correct them. They must be competent in resuscitation techniques and, should the need arise, they should be fully conversant with any 'topping up' ordered by the medical practitioner and with continuous epidural infusions.

Early detection of an incipient complication by the midwife will help to contribute to the success of the medical management and will provide patient support.

In the private sector regional anaesthesia is more available than in the public sector where regional anaesthesia may only be available in Level 3 institutions. Spinal anaesthesia is the norm for caesarean sections, even in emergencies, in all levels of care in the public and private sectors.

The management of the complications of epidural and spinal anaesthesia

Epidural and spinal anaesthesia are high-risk interventions requiring advanced skills during which several complications can occur.

The patient is generally given an explanation of epidural anaesthesia during the antenatal period. If a woman has an epidural she needs to give consent for the procedure and the possible side effects should be carefully explained to her and her partner. It is the medical practitioner's responsibility to take consent.

Epidural anaesthesia is only performed in a facility where medical practitioners and theatre facilities are available. It is preferable to have a room or area set aside in the labour ward for the specific purpose of epidural analgesia.

Table 32.5

Comparison of epidural and spinal anaesthesia in obstetrics

Aspect	Epidural	Spinal
Definition	This is a form of regional analgesia in which local anaesthetic is injected into the epidural space of the spinal column. The level at which the local anaesthetic is usually injected is between LI–L4. Continuous analgesia can be obtained by introducing a polythene cannula into the epidural space to infuse a specific volume of the medication into the epidural space	Spinal anaesthesia is insertion of a once-off dosage of local aneasthsia into the dural space between L2–L4
Top-up	◗ Single initial injection (bolus dose) of a specific amount of local anaesthetic ◗ The 'top-up' system where local anaesthetic is injected at regular intervals, via an epidural cannula, into the epidural space ◗ Continuous epidural infusion of a local anaesthetic via an epidural cannula, regulated by an infusion pump, the rate of which is determined by the medical practitioner	No top-ups are given
Indications	Maternal request Obstetrical: ◗ Occipitoposterior positions/malpresentations ◗ Induction of labour ◗ Pre-eclampsia and hypertension ◗ Assisted deliveries ◗ Pain relief for obstetric interventions ◗ Intrauterine death/IOL	The main indication is caesarean section It can be used for any emergency obstetric situation where a patient is not compromised, for example manual removal of the placenta
Contraindications	◗ Woman refuses ◗ Scar/uterine scar ◗ Cardiac/mitral stenosis ◗ Unsafe facilities/inexperienced staff ◗ Local sepsis or septicaemea ◗ Women on coagulation therapy ◗ Spinal deformities kyphoscoliosis ◗ Fetal distress ◗ Drug allergies ◗ Severe anemia	◗ Woman refuses ◗ Neurological disease ◗ Sepsis ◗ Clotting defects ◗ Hypovolaemia ◗ Unsafe circumstances ◗ Inexperienced staff
Prerequisites	◗ The procedure is done in an acute setting with emergency support/theatre (Not PHC) ◗ The emergency trolley and all equipment are prepared ◗ Consent must be signed ◗ Contraindications need to be considered ◗ A patent intravenous line must be in place ◗ A competent anaesthetist must do the procedure ◗ A competent midwife supports the medical practitioner and provides care for the woman ◗ Adequate staffing levels with designated competent practitioners ◗ There is a standard protocol in place ◗ Keep accurate records	◗ Consent is signed ◗ The spinal is done in theatre before the procedure with all practitioners in attendance ◗ Contraindications are identified ◗ Patent intravenous line is in place ◗ Preloading of fluid as for epidural ◗ Procedure is performed by a competent anaesthetist ◗ Follow standard protocol

continued

Precautions	The effects of the epidural requires specific observations and precautions as well as sterile procedure *Hypotension.* One of the effects is a drop in blood pressure due to the vasodilatation of the blood vessels distal to the level of anaesthesia (the sympathetic nerve fibres in the area are blocked) ◗ The blood pressure is observed throughout the procedure every five minutes until stable (1 hour) and with each top up ◗ The women is preloaded with 500 ml Haemacel or 500–1 000 ml saline dextrose or Ringer's lactate before the procedure, to counteract this effect If the blood pressure drops too much, place the woman on her side, give more fluid and give ephidrine IV as prescribed. *Motor weakness.* Motor weakness will develop in the muscles distal to the block, but the severity will depend upon the type, the strength, and the volume of local anaesthetic used. ◗ A walking epidural allows the women to still move around blocking only sensory perceptions ◗ A motor block will also affect the bladder and the woman will not be able to feel the need to pass urine ◗ A Foleys catheter 12 – 14 g is inserted, with 5 – 10 ml of fluid in the balloon to keep the bladder empty and the woman is position on her side or in a Fowlers position, after which the balloon is inflated with a further 10 ml ◗ Because sensation is blocked the woman has no urge to push, so regular vaginal examinations are done to determine the progress of labour *Fetal bradycardia.* Give oxygen and change maternal positions/increase blood pressure if hypotensive ◗ Continuous epidural carries extra risks over and above the single dose and consent is needed	◗ Sterile procedure ◗ The spinal anaesthetic carries major risks because the spinal needle perforates the dura and the drug is administered in the dural space ◗ A 21-22 gauge pencil point spinal needle is used to avoid the headaches ◗ The effects are the same as for epidural for hypotension and respiratory suppression ◗ The position of the women is important and the wedge is used to prevent hypotension with IVC effects (see Figure 32.3) ◗ Total motor paralysis are induced and the woman cannot move her legs. Care is taken to position the legs correctly so as not to cause pressure and injury. ◗ The woman is catheterised using a Foleys 12–14 gauge catheter and the balloon inflated with 5–10 mls until after the birth
Drugs used	◗ Bupivacaine has the following side effects: excitation, nervousness, tingling around the mouth, tinnitus, tremor, dizziness, blurred vision, or seizures, followed by depression: drowsiness, loss of consciousness, respiratory depression and apnoea. ◗ Fentanyl® is a powerful opiate. Sufentanil® is another opiate, five to ten times more potent than Fentanyl®. ◗ Ephidrine (hypotension) (see Table 32.6)	◗ Bupivacaine ◗ Opiods such as Fentanyl® ◗ Ephidrine (hypotension) ◗ Adrenaline ◗ Anti-emetics ◗ Sedatives
Method	◗ Consent is required ◗ Position left lateral or sitting (Curve the spine See Figure 32.3) ◗ Identify region and infiltrate skin with lignocaine ◗ Identify lumbar space L1 – L4 Use a Touhy epidural kit needle 16 g ◗ There is reduced resistance as you pass the needle through the ligamentum flavum (see Figure 32.2)	◗ Consent is required ◗ Position left lateral or sitting (Curve the spine. See Figure 32.3) ◗ Identify region and infiltrate skin with lignocaine ◗ Identify lumbar space L1–L4. Use Touhy spinal needle 12–14 gauge

continued

Table 32.5

Comparison of epidural and spinal anaesthesis in obstetrics (*continued*)

	Epidural	Spinal
	◗ No fluid or blood to be withdrawn ◗ Catheter can be placed according to the specific marks on the catheter (4–6 cm to remain in the space) ◗ The patient may feel a prick in the leg ◗ Needle is removed and catheter secured ◗ Test dosage given (cold feeling in back) ◗ Women placed in semi-Fowler's ◗ Take blood pressure and fetal heart every 5 minutes ◗ Full dosage is given if no adverse reaction ◗ Reaction, level of effectiveness and level of anaesthesia is checked (see Figure 32.5)	◗ There is reduced resistance as you pass the needle through the ligamentum flavum ◗ Move the needle until the dura is perforated and dural fluid appears ◗ A test dosage is given, wait for 3–5 minutes ◗ Then total dosage is given ◗ The needle is removed and the injection point is sealed with a plaster ◗ The woman is placed on her back with a wedge under the left side ◗ The blood pressure is monitored ◗ Wait 10–15 minutes to make sure the woman is stable and the desired level of anaesthesia is reached for the surgery ◗ When the medical practitioner works on the omentum the woman may vomit so anti-emetics are given ◗ Give the baby to the mother after birth ◗ A sedative is given while suturing the abdomen
Specific care	◗ Fluid preload and administration is monitored ◗ Best position maintained, in the first half hour the woman may be changed from side to side to allow the drug to spread evenly (see Figure 32.3) ◗ Check blood pressure every 5 minutes for one hour or till stable ◗ Check effectiveness and level of anaesthesia and respiration ◗ Foley catheter insertion depends on the level and dosage of anaesthesia. Observe 2-hourly emptying of bladder if walking epidural ◗ Check fetal heart ◗ Check uterine contractions, which may subside particularly if adrenaline was used/start oxytocin ◗ Observe dilatation 2-hourly ◗ Keep accurate records ◗ Observe and treat side effects such as itching	◗ Fluid preload and administration are monitored ◗ Best position maintained and the legs are given care during surgery ◗ Check blood pressure throughout the operation ◗ Check effectiveness and level of anaesthesia and respiration before the surgery, ensure that oximeter and ECG leads are in place ◗ Foley catheter is inserted ◗ Keep accurate records ◗ Anaesthetist is in constant attendance
Advantages	◗ Pain free within 2–4 minutes ◗ First stage of labour may be shortened ◗ Women more alert and cooperative ◗ Fetus benefits from shorter birth and less exhaustion ◗ Mother more rested and ready to bond with and feed baby ◗ Manual delivery of the placenta if needed is not traumatic ◗ No urge to 'bear down' beneficial in malpresentation and breech ◗ Manipulations and assisted deliveries less traumatic	◗ It is a safe and quick procedure ◗ Women alert and can see her baby immediately after birth

continued

Disadvantages	◗ Weak uterine contractions may need oxytocin infusion ◗ Woman may be uncomfortable and feel out of control if not feeling her body ◗ Cannot bear down effectively ◗ Requires assisted delivery ◗ Dissatisfaction if only partially effective ◗ Labour intensive, needs more than one person to assist the mother ◗ Cannot get up for at least 12 hours or without assistance ◗ Complications very unpleasant ◗ Risk of bladder infection due to catheterisation	*Requires highly skilled practitioners *A total motor block is present. Woman cannot feel or move her body distal to the anaesthetic level and will need reassurance and assistance
Complications	◗ Hypotension/shivering ◗ Spinal tap ◗ High block with respiratory distress/arrest ◗ Infection ◗ Bloody tap ◗ Incomplete block ◗ Death (1:100 000) ◗ Postepidural headaches ◗ Iatrogenic: using wrong medication ◗ Haematoma ◗ Neurological damage ◗ Women with epidural may develop a fever not related to infection ◗ Fetus may be born with a raised temperature	◗ Headache due to spinal tap ◗ High block with paralysis of the diaphragm ◗ Infection ◗ Segmentation (sensation retained in some areas) ◗ Hypotension ◗ Itching ◗ Death

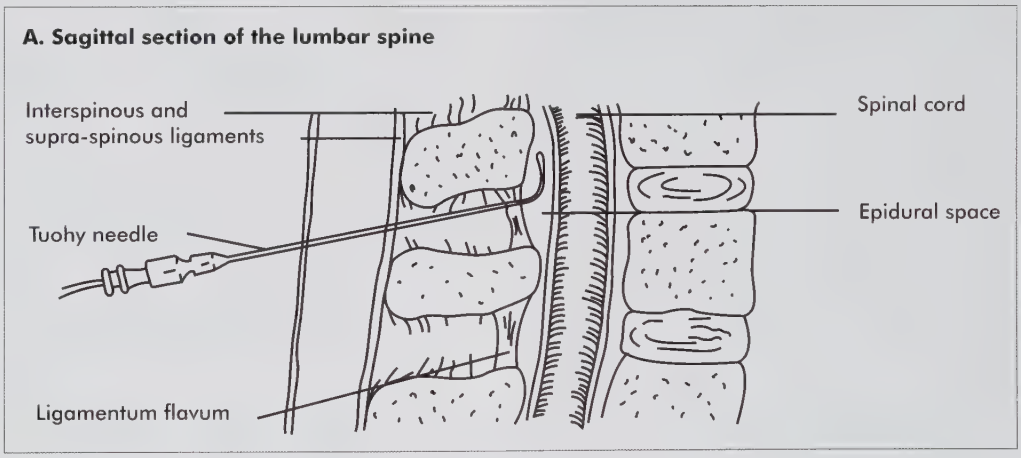


Figure 32.2A Insertion of needle in the epidural space (L1–L4): Sagittal section

Equipment required includes:

- blood pressure monitor
- stethoscope
- administration sets and solutions
- a bucket for the discarded equipment near the bed
- an anaesthetic stool for the medical practitioner
- resuscitation equipment and the emergency trolley
- suction apparatus
- an anaesthetic trolley containing all the medication (drugs) which are likely to be required in an emergency
- a correctly prepared epidural trolley–care must be taken to ensure that there is no contamination of the epidural needles and cannula by cleaning solutions (see Box 32.3)

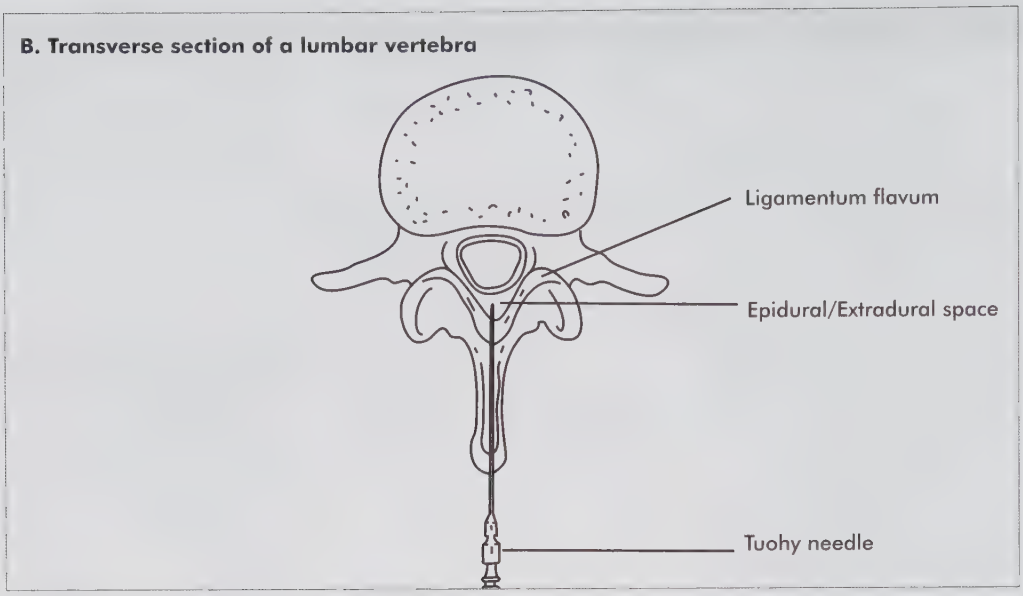


Figure 32.2B Insertion of needle in the epidural space: Transverse section

32.3 Equipment required for epidural/spinal anaesthesia

NB: This is a sterile procedure and full aseptic precautions must also be taken prior to starting the procedure.

- mask for the medical practitioner
- gown and drapes
- bowls, gallipots and receivers
- swabs and a swab holder
- cleaning solution
- dental syringe and needle
- cartridges of local anaesthetic (lignocaine 2%)
- Epidural pack consisting of:
  - 18 or 16 guage Tuohy needle (with stilette)
  - epidural catheter
  - disposable (Millipore) bacterial filter (pore size 0.2 microns)
  - calibrated epidural cannula
  - a selection of injection needles of various sizes
  - a 21–22 gauge pencil-point spinal needle.

Other clean materials include:

- a plastic spray
- plaster
- local anaesthetic for injection into the epidural space
- transparent plastic dressing (if available)
- Foley catheter 14 with urine bag, and catheter pack
- Drugs

Prevention of hypotension

Hypotension is a serious side-effect of epidural and spinal anaesthesia. The effect of the drug is vascodilatation of all the blood vessels distal to the level of anaesthesia resulting in a sudden drop of the blood pressure.

While the procedure is in progress, the midwife becomes the means of communication between the patient and the medical practitioner. She must notify him of any change in the patient's condition. She must also notify him when a contraction begins, as he will then pause and wait for the contraction to pass. This is important, as the epidural space is narrowed during a contraction and it is then difficult to locate.

Once the epidural space has been located and the test dose administered, the blood pressure is taken and recorded every minute for five minutes, and then every five minutes for 20 minutes. The medical practitioner is informed of every reading taken.

The midwife observes abnormalities and reports to the medical practitioner. The patient under epidural analgesia must *never* be left alone at any time. The medical practitioner will check the effectiveness of the procedure.

The woman may be nursed on alternate sides or sitting upright. She must not be allowed to lie flat on her back. If the woman is nursed on her side, two to three pillows can be placed under her head, one must be placed between her legs to prevent pressure areas from developing and one behind her back for support. She must be turned regularly. Ensure that the legs are supported when moving the patient as she cannot control them.

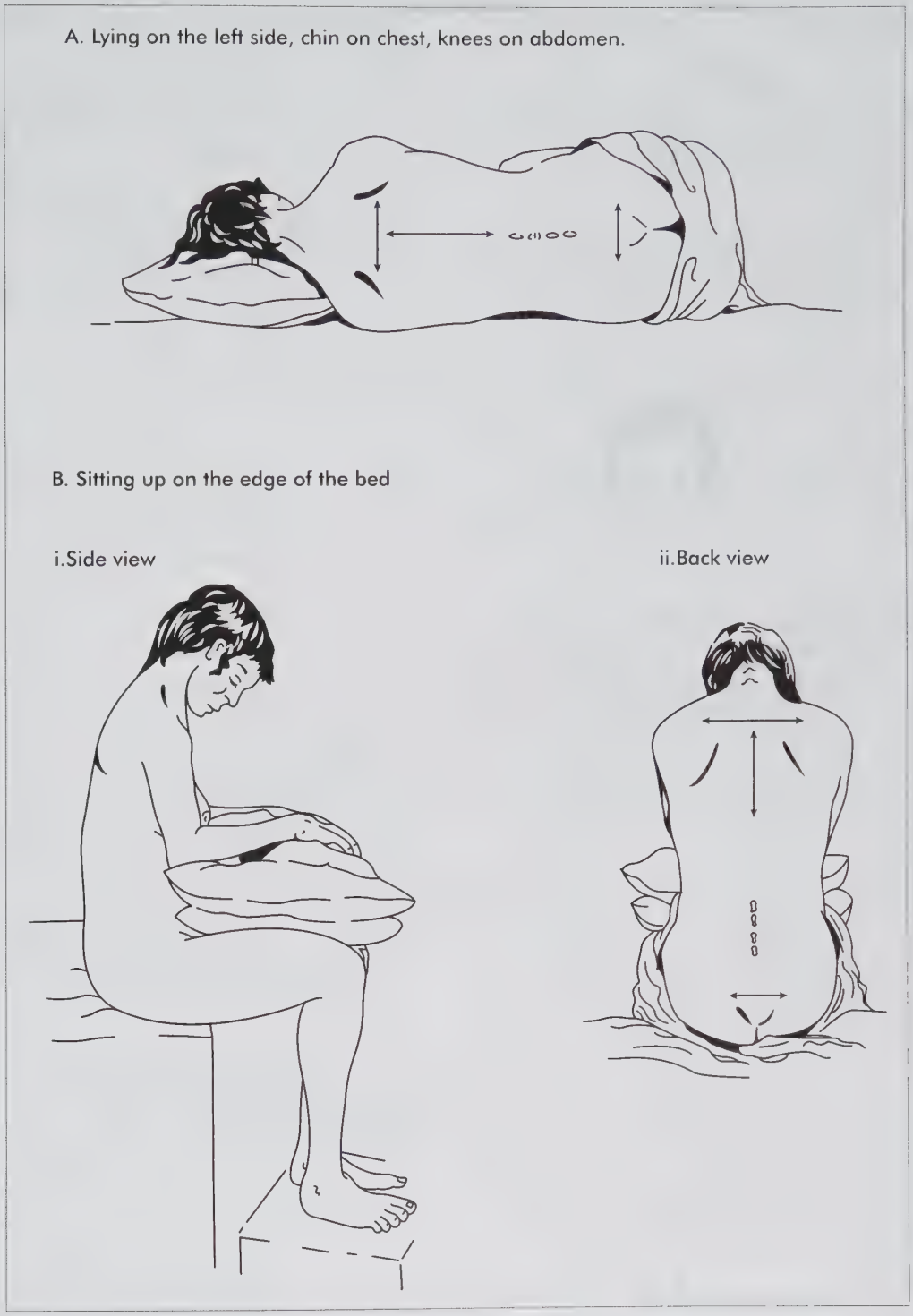


Figure 32.3 Positioning the patient for epidural/spinal anaesthesia

The women must be catheterised and intake and output recorded.

Signs and symptoms. The effective block is indicated by immediate relief from pain and warm skin distal to the block and a sudden drop in blood pressure which may be accompanied by shivering, nausea and dizziness.

Intervention. An intravenous line is in place before the procedure and 500–1 000 ml of Ringer's lactate, Plasmalyte B solution, or Haemacel is given. This will take about 15–20 minutes, and increases the circulating blood volume and helps to prevent hypotension.

Baseline blood pressure is taken and recorded and the medical practitioner is informed before the procedure starts. Adequate explanation of all procedures must be given to the woman and her partner all the time.

The woman must be positioned correctly and the midwife helps the woman to maintain that position during the procedure (see Figure 32.3).

The woman may be placed on her side, with her knees drawn up and her chin resting on her chest and with the flat

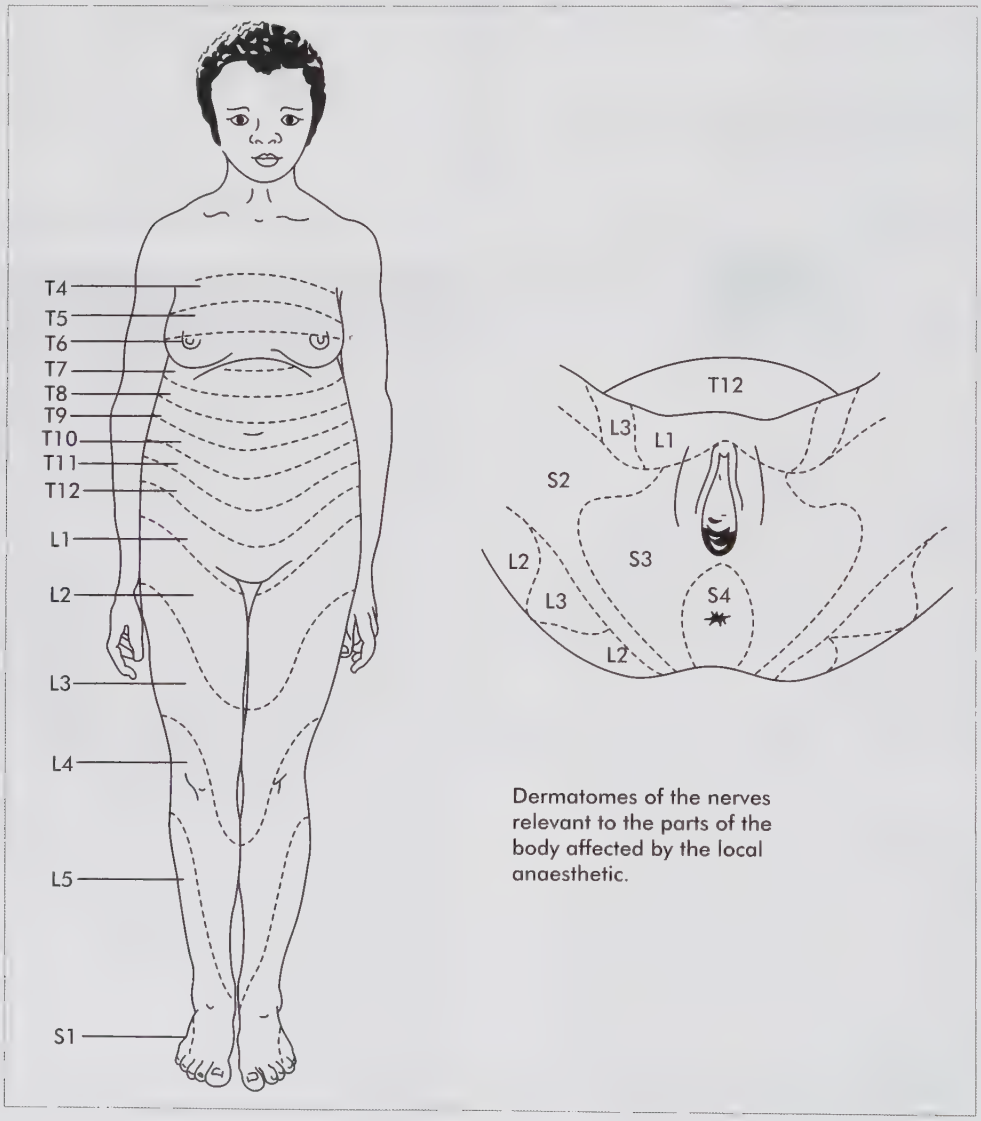


Figure 32.4 Epidural anaesthesia in the dermatone levels

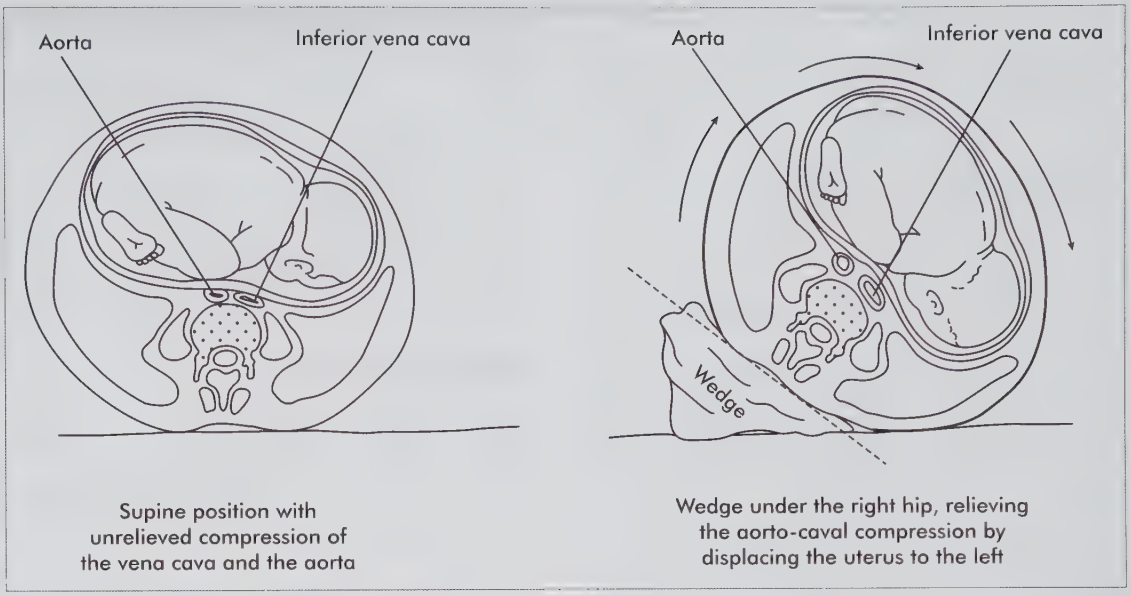


Figure 32.5 Aorta caval compression

plane of her back vertical and at right angles to the horizontal plane of the bed, or she may be sitting upright on the edge of the bed, leaning very slightly forward, with her arms resting on pillows on her lap.

Total spinal block

Total spinal block may arise with frightening speed and occurs when the local anaesthesia that is injected depresses the spinal cord and brainstem.

Signs and symptoms. These include the following:

- Sudden hypotension.
- Bradycardia and difficulty in breathing.
- Cardiac arrest, unconsciousness and death may follow.

Interventions. The rate of the intravenous infusion is increased for cardiovascular support.

Give 100% oxygen immediately. The medical practitioner may give adrenalin 1 ml of 1:10 000. In some instances, intubation and ventilation will be necessary until the effects of the total block wear off. 'Top-ups' may cause this condition, so midwives must be aware of possible complications.

Epidural intravenous injection

Epidural intravenous injection occurs when the needle has punctured a blood vessel (in the epidural space) and the clinical features will arise while the medical practitioner is injecting the local anaesthetic through the cannula. A test dose should always be given before the full bolus of medication is inserted into the epidural space.

Epidural intravenous injection may be caused by:

- failure to perform the aspiration test
- giving an inadequate test dose
- misinterpretation of the test dose
- late intravenous cannula migration into one of the epidural veins.

Signs and symptoms. Effects are dose dependent. The reaction could be mild, moderate or severe as indicted in Table 32.6.

Massive intravascular doses can result in sudden circulatory collapse within one minute. Extradural doses cause reactions within 5–30 minutes, depending upon the site of injection.

Interventions. If a reaction occurs, management is according to the emergency protocols. Give 40% oxygen by mask. The patient is turned onto her side, as this encourages optimal venous return. A vasoconstrictor is given by the medical practitioner at 45 second intervals until the systolic blood pressure is 110 mmHg. It may be necessary to intubate and ventilate the woman.

High block

A high level of block may result in difficulty breathing, along with numbness of the hands and shoulders.

Intervention. Place the women in a high Fowler's position to allow the drug to flow lower. Discontinue the epidural infusion. Give oxygen by mask. Do not leave the woman alone. Increase the intravenous fluids. Ventilation may be required.

Postdural puncture headache (PDPH)

The incidence of PDPH is 1:500. This may occur accidentally during epidural anaesthesia. It typically occurs hours to days after puncture. Headaches are caused when the dura mater is punctured and there is leakage of cerebrospinal fluid.

Interventions. Some women only need analgesia and bed rest. If the headache persists, however, an epidural blood patch may be required, in which 10 ml of the woman's blood is injected into the epidural space near the site of the original puncture, which seals the meningeal leak.

This is a sterile procedure that gives immediate relief.

A bloody tap

A bloody tap occurs if one of the epidural veins is punctured. Blood will track up the cannula and the epidural will have to be redone, using a higher intervertebral space.

Intervention. The procedure is abandoned. A higher level of vertebra may be attempted.

Shivering

The cause of shivering after epidural puncture is not exactly known but may be caused by lowering of the core temperature. The shivering occurs within 10 minutes of the administration of the local anaesthetic.

Intervention. Fentanyl® added to the infusion may prevent shivering.

Haematoma formation

A haematoma may form either in the epidural or in the subdural space. These are more likely to occur if the woman is receiving anticoagulant therapy, or in patients with the HELLP syndrome. Symptoms depend on the site of the haematoma.

Interventions. The medical practitioner must take note of any pain complained of by the patient and, before continuing with the procedure, should closely question the patient as to the nature and extent of the pain. The medical practitioner may then decide not to continue with the epidural, or to move the needle to a higher space or to give more local anaesthetic.

Routine observations and basic nursing care

All routine observations are continued. Temperature is important. The legs are warm after epidural because of vasodilation. If there is a unilateral block there will be a difference in temperature between the legs.

All basic nursing care is continued during the procedure, the labour and the birth.

The midwife must continually give reassurance, encouragement and support to the woman and to her partner if he is present.

Vaginal examinations

Vaginal examinations are performed as required. In many instances, where the patient has been in established labour prior to the epidural, there is rapid dilatation of the cervix once there is no longer any pain. It is very important, therefore, to observe the woman for signs of the second stage of labour.

The midwife must check the progress of labour in the usual way and report any problems to the medical practitioner.

Maintenance of anaesthesia

Anaesthesia is maintained either using the 'top-up' procedure or using a continuous epidural infusion. The midwife is only involved in continuing observations and reporting to the medical practitioner if there are problems. A skilled midwife may be asked to top-up the epidural according to the medical practitioner's prescription.

Possible problems include:

- Inadequate analgesia because the patient is lying only on one side, but this should not occur with good nursing care.
- A misplaced cannula can cause a high segment block (only TIO to T8), or too low a block (only blocking L2 to L3), which would require a higher volume of the medication.
- An overdosed patient is a potential problem. With continuous epidural analgesia, the patient *must* be monitored continually for the level of numbness and for the degree of muscle paralysis. The level of anaesthesia should be checked hourly and recorded (see Figure 32.4). This can be achieved very simply by supplying the patient with a small block of ice and asking her to run the ice slowly down her chest and onto her abdomen. The level at which loss of sensation is experienced is then recorded. If the patient complains of numbness above the level of T6 (the xyphisternum), the medical practitioner must be informed immediately and emergency interventions instituted.

Table 32.6

Degrees of toxicity

Mild	Moderate	Severe
palpatations	nausea	coma
vertigo	vomiting	severe
tinnitus	hypotension	hypotension
apprehension	muscle twitching	bradycardia
confusion	convulsions	respiratory
headache	unconsciousness	depression
metallic taste in the mouth		cardiac arrest

The second stage of labour

Most patients are delivered in the lithotomy position as they have very little control over their lower limbs. The patient's head and shoulders are propped upright against pillows.

Hyperflexed lithotomy position causes postural stress, and therefore the lateral tilt must be used to elevate one hip to prevent fetal hypoxia due to venacaval compression. *Both legs must be elevated and lowered simultaneously, in order to avoid strain on the patient's lower back and hips.* The aim of the epidural is to allow for spontaneous delivery, and as long as no complications arise, this can be achieved. While the patient has no sensation to bear down, and if the fetal condition is satisfactory, the presenting part should be allowed to descend onto the perineum before the patient is prepared for delivery and encouraged to bear down. In most instances, the baby can be delivered by uterine action alone, particularly in the multiparous woman, without any additional bearing-down efforts. This will reduce the incidence of instrumental deliveries associated with epidural analgesia.

If the woman is catheterised, this must be removed in the second stage, before delivery to prevent bruising and trauma to the urethra during the delivery. If the patient requires an assisted delivery, the urethra could be severely damaged.

Women tend to vomit if syntomterine is administered after an epidural, so it is better to use oxytocin after delivery.

The third stage of labour

Take care positioning the patient's limbs until all sensation has returned. Reassure the patient that all sensation will soon return and check for this at regular intervals.

The epidural catheter is removed on the medical practitioner's prescription. It is not usually left in for longer than 72 hours, because a fibrin pocket can develop at the tip of the catheter.

When removing the epidural cannula, the midwife must make sure that the patient is lying on her side, slightly curled up. The cannula is removed in a slow, steady movement and in an outward direction. If the cannula appears to be stuck, ask the patient to curl up a bit more. If the cannula still cannot be removed, stop immediately and notify the medical practitioner. Never use excessive traction on the cannula. After removal, the tip of the cannula is inspected to make sure that it is complete.

Postpartum care

The patient is kept on strict bed rest (12 hours) until all sensation has returned to the lower limbs. She must be instructed not to get out of bed until she is able to do so. When she is allowed up for the first time, she must be accompanied by a member of the staff, who must make sure that she is capable of walking and is not feeling dizzy.

An indwelling catheter is left in place until all sensation has returned, the midwife must make sure that the patient is able to void urine adequately.

It is extremely important that all observations and procedures are accurately recorded in the patient's case notes.

32.5 External and internal versions

Definition

A version involves either changing the presentation or lie of the fetus in a non-labouring women, or in an emergency during labour.

In the developing world where caesarean sections are not readily available and women do not always attend antenatal care, undiagnosed twins may present unexpectedly. Medical practitioners and skilled midwives should be able to perform versions.

External cephalic version is also a common intervention to avoid caesarean section.

According to South African Nursing Council Regulations for Midwifery Practice regarding versions (Directive 4, paragraph 2 (k)(iii),(iv):

'An external version . . . for a transverse lie should be taught in the case of a patient in early labour, and in the transverse lie of the second twin after the first has been delivered. Version in these cases is attempted only where a medical practitioner is not available.'

Incidence

The incidence of breech presentation at 28 weeks is 25% while the incidence at the onset of birth is between 3–7 %. The breech presentation is more common in preterm birth.

The incidence of transverse lie in twin pregnancy is estimated at 3–4% of pregnancies.

Classification of versions

A version can be spontaneous or by manipulation. Manipulation can be external or internal:

- *External cephalic version (ECV)*. This version entails changing the fetal position from a breech or transverse to a vertex, to bring the head into the brim of the pelvis using abdominal palpation.
- *Internal podalic version (IPV)*. This version entails changing the fetal position from a transverse or oblique lie to bring the buttocks over the pelvic brim (also for the second twin), by placing the hand through the vagina into the uterus and using the other hand on the abdomen.

32.4 Protocols for external cephalic version (ECV)

ECV before term is of no value because the fetus may turn back. Evidence exists that mortality of fetuses in preterm birth is increased with ECV. ECV can be achieved after 37 weeks with assistance of tocolysis in more than 50% of cases. Leaving women as long as possible may lead to spontaneous version.

The incidence of noncephalic birth is reduced by 33% and the incidence of caesarean section by 50%. There is a small risk of placental abruption and a very low risk of fetal loss weighed against the risks of cord prolapse, breech presentation, of trauma in breech and precipitate labour.

External cephalic version

Prerequisites. The following are prerequisites for ECV:

- 37 weeks or early labour
- ultrasound normal
- NST reactive
- no specific reason why fetus is breech
- no placenta praevia
- amniotic fluid adequate
- no uterine abnormality.

Contraindications. The following are contraindications to ECV:

- prematurity
- placenta praevia
- cord around the neck
- previous caesarean section
- ruptured membranes
- vaginal birth contraindicated
- abnormal uterus or fibroids.

Procedure. The following is the procedure for ECV (see also Figure 32.6):

- Tilt the woman 45° with two pillows under her left side and two under her head.
- Relax the uterus with 10 μg hyxoprenaline slowly IV.
- Observe the pulse rate (not to exceed 120 bpm).
- Use powder on stomach.
- Talk the patient through the procedure.
- Manipulate the breech rather than the head.
- Lift the breech out of the pelvis abdominally.
- Keep breech in position with one hand and allow the fetus to readjust.
- If this is not successful do a forward somersault in which pressure is placed on the fetal head (always maintaining flexion).
- Listen to the fetal heart every two minutes during the procedure.
- Repeat the NST. Fetal heart rate becomes reactive after 30 minutes.
- In a Rhesus-negative woman give anti-D to prevent transplacental bleeding and the possibility of Rhesus isoimmunisation.
- The woman can only be discharged when there are no contractions and the fetal heart rate is normal.
- If complications arise a caesarean section can be performed because the woman is 37 weeks pregnant.

Potential complications. The following are potential complications of ECV:

- placental abruption
- fetal distress
- cord prolapse
- rupture of membranes.

Principles of treatment and care. The ECV is done in an appropriate level of care (ultrasound, NST and theatre) by skilled healthcare professionals (obstetrician or skilled midwives).

In the case of a transverse position of a second twin, if a medical practitioner is not present a midwife may do an external version if the membranes are intact.

Internal podalic version (IPV)

Internal podalic version (see Figure 32.7) is usually performed in a multiple pregnancy during birth, where the second twin is transverse or in an undiagnosed twin with

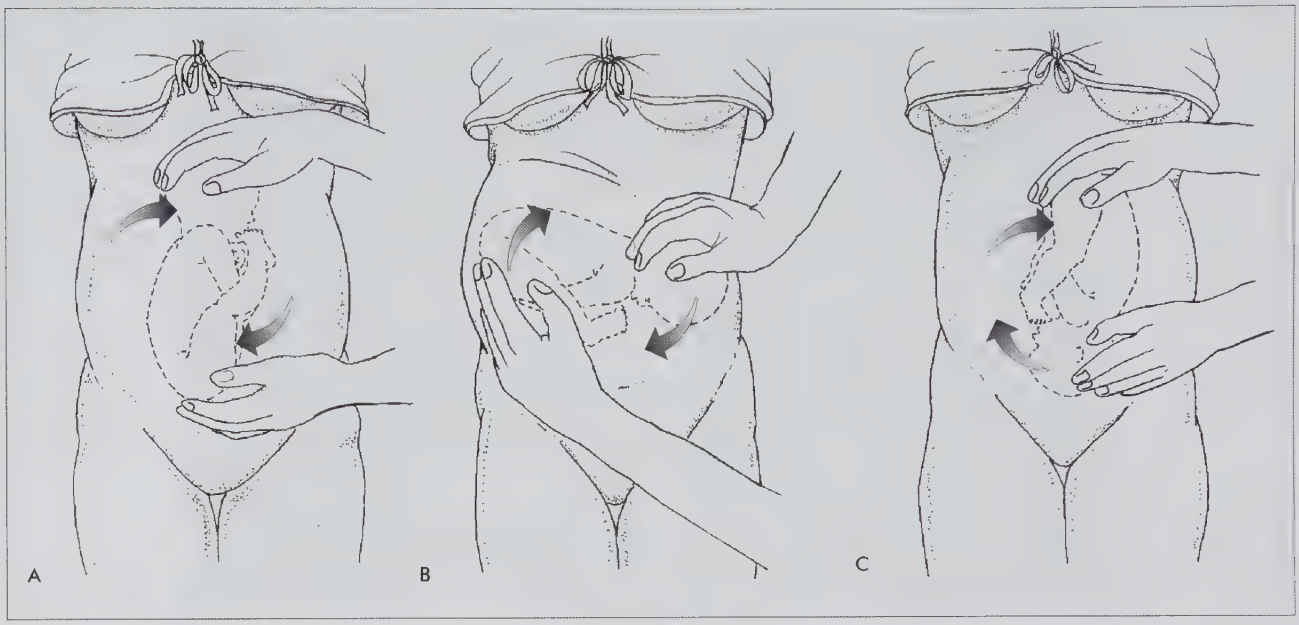


Figure 32.6 External cephalic version

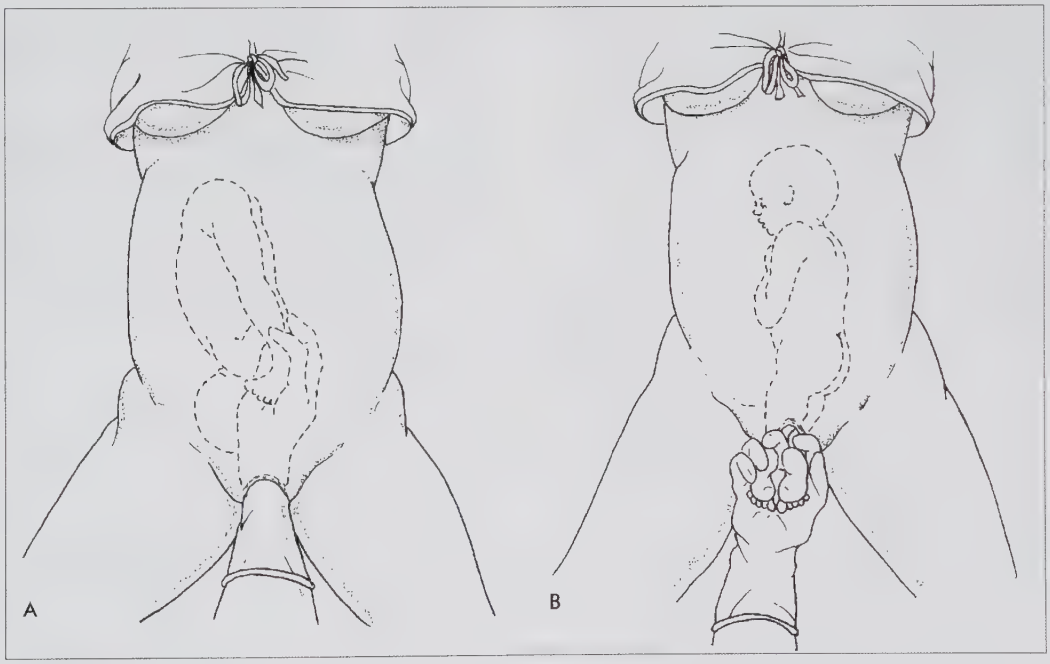


Figure 32.7 Internal podalic version

a transverse lie. A medical practitioner should perform the delivery. There is a higher perinatal mortality rate where IPV is performed. The mortality is associated with gestational age, birth weight and whether singleton or twins. The mortality rate is increased in singleton pregnancies. Currently caesarean section is performed for most cases of transverse lie, even for stillbirths. In settings where caesarean section is not an option, an internal podalic version may be needed.

Maternal complications may include abruption and sepsis. Fetal complications are associated with cord prolapse and the fast delivery in the breech presentation.

32.6 Assisted delivery

Births that are complicated by malpresentations and obstructed labour may require assisted delivery.

Forceps delivery

Incidence

The incidence varies greatly, depending upon the community, medical practice and preference and may range from 5–15% or even higher in some hospitals.

Types of forceps

There are more than 600 varieties of forceps. Forceps are designed to follow the curve of Caris, and have a pelvic curvature and (fitting the pelvis) a cephalic curvature (fitting the fetal head). Forceps are made from good quality stainless steel, are light and polished. Poorly manufactured forceps should not be used as they can damage the mother and child.

The forceps are made in pairs with a left and a right blade and have corresponding numbers inside each blade. It is essential to use the blades made as original pairs. Before use the forceps should be checked to make sure they are a pair. Forceps have two blades, a shank, a lock and a handle. Figure 32.8 illustrates the parts of a pair of forceps.

Forceps commonly used in South Africa are discussed below (see Figure 32.9).

Wrigley's (low forceps or outlet forceps). Low forceps may be applied when the biparietal diameter has passed beyond the ischial spines and the vertex is visible at the vulva, without the labia being separated. The sagittal suture must be in the anteroposterior diameter, and the station +3 cm. These forceps are often used for minor degrees of pelvic outlet contraction.

Wrigley's forceps are used for low forceps delivery. Steady traction is applied in a forward, downward, outward and then upward direction. (Wrigley's forceps are also often used to deliver the after-coming head of a breech presentation.) A Wrigley's forcep with a very short shank is designed to be used for delivery of a fetus with caesarean section.

Anderson's (midcavity forceps). Midcavity forceps are used when the fetal head is level with the ischial spines (at station 0 cm). In these instances, the biparietal diameter has passed through the pelvic brim (the head is engaged), but the presenting part has not advanced beyond the ischial spines.

Examples of midcavity forceps are Anderson's forceps, Simpson's forceps and Neville-Barnes forceps.These forceps have locks that need to be locked before use.

Kielland's (high forceps). In most first world countries with modern obstetrical services, high forceps deliveries are no

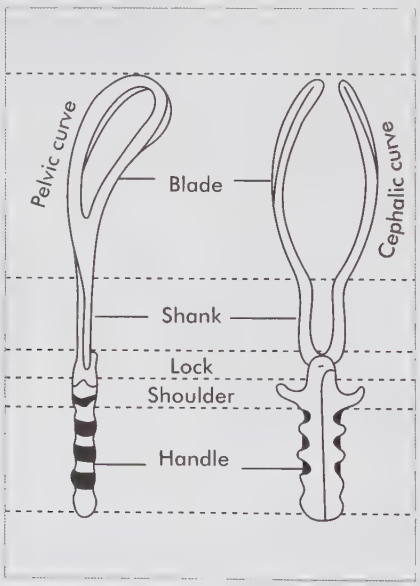


Figure 32.8 Obstetric forceps

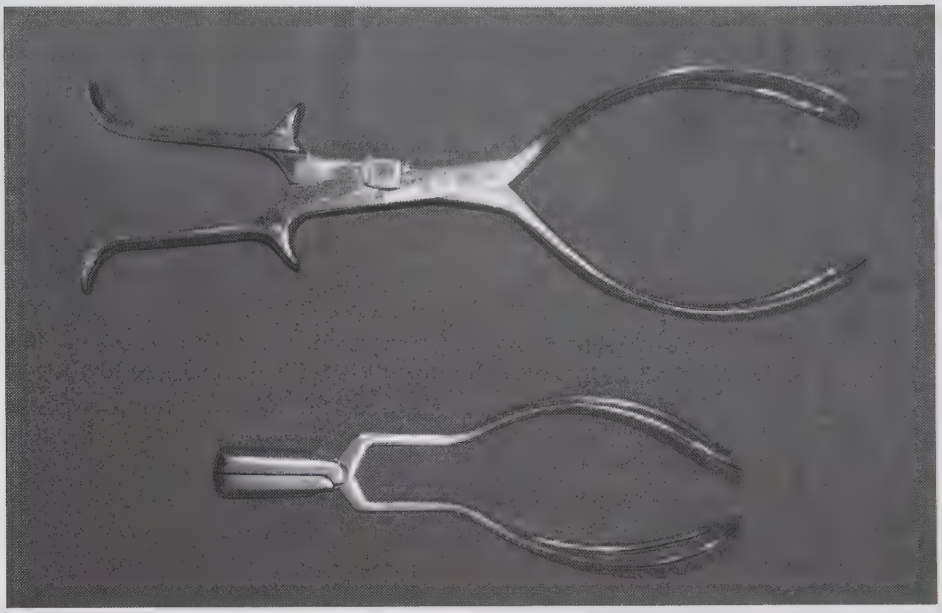


Figure 32.9 Forceps used in South Africa

longer performed. Caesarean section is chosen in preference, causing less trauma and fewer complications (for both mother and child). However, in third world countries, where facilities for caesarean section are not always available, Kielland's forceps may be used in selected cases. Kielland's forceps are usually used for flexing and rotating the fetal head from a posterior or lateral position into an anterior position or with a head above spines. Kielland's forceps have a sliding lock.

The maternal complications associated with high forceps delivery include:

- uterine rupture
- injuries to the bladder
- injuries to the rectum
- injury to the baby.

This procedure requires extra skill and judgement as well as experience. High forceps may occasionally be applied when the head has entered the pelvic brim but due to deflexion of the head, has not yet become engaged (the biparietal diameter has not passed through the pelvic brim).

Prerequisites for forceps use

Advanced skills are required to prevent abuse and complications during assisted delivery.

A full abdominal palpation must be done prior to the forceps being applied, in order to ascertain the following:

- that the presentation is the vertex
- that the head is flexed and the sagittal suture line is in the anterior posterior position
- that the head is engaged in the pelvis (two-fifths above the pelvic brim, or less)
- the position of the baby
- that there are good uterine contractions.

A vaginal examination must also be done prior to forceps delivery, for the following reasons and to confirm the findings made on abdominal palpation:

- to determine the size and shape of the pelvis
- that the vertex is presenting, and the amount of caput and moulding
- that the cervical os is fully dilated
- that the membranes have ruptured
- the position of the fetus is determined by means of locating the fontanelles and sutures. (The sagittal suture must be in the anteroposterior diameter of the pelvis, or the exact position of the fetus must be known.)
- to check the fetal heart

The prerequisites are:

- a skilled operator
- the head must be engaged
- sagittal suture line must be in the AP (anteroposterior for all but Kielland's)
- the cervix must be fully dilated

- good contractions should be present
- membranes must be ruptured
- bladder must be empty
- lithotomy position is preferred
- anaesthesia/pudendal block/epidural is needed.

Indications for the use of forceps

The three classical indications for forceps delivery are maternal distress, delay in the second stage and fetal distress.

Maternal indications. The following are maternal indications to assist a woman in the second stage of labour:

- cardiac conditions
- pulmonary disease, for example, tuberculosis
- pre-eclampsia and eclampsia
- chronic nephritis
- diabetes mellitus
- chronic hypertension
- poliomyelitis, with slight pelvic distortion and paralysis of the abdominal muscles
- after operations, when the patient must not bear down, such as:
  - recent eye operations
  - recent brain operations
  - recent abdominal operations.
- where there is poor maternal effort:
  - maternal exhaustion and distress, mental and/or physical
  - secondary uterine exhaustion, but with only mild cephalopelvic disproportion
  - after an accidental dural tap during epidural analgesia, where it is preferable not to allow the patient to beardown.

Obstetrical indications. The following are obstetric indications to assist a woman in the second stage of labour:

- delay in the second stage of more than 45 minutes in total and 30 minutes on the pelvic floor
- slight outlet disproportion
- a rigid pelvic floor and/or perineum
- the failure of descent of the presenting part
- the failure of internal rotation of the head.

Fetal distress. The following are fetal indications to assist a woman in the second stage of labour:

- fetal distress
- occipitoposterior positions (including persistent occipitoposterior positions and deep oblique arrest)
- deep transverse arrest
- face presentations
- prolapsed umbilical cord in the second stage of labour
- the after-coming head in the breech presentation.

Procedure

Treatment and care. A full explanation is given to the patient, and to her partner if he is available, and written consent is obtained. The woman should have been taught something about forceps delivery at antenatal preparation for labour. It is the midwife's duty to give support and encouragement to the woman throughout the procedure, as the woman may be distressed. A full abdominal palpation and vaginal examination should be done before proceeding with a forceps delivery (see Prerequisites).

The procedure is as follows:

- The patient should be given adequate analgesia, either an epidural analgesia or a pudendal nerve block.
- There should be a good light source.
- The procedure is performed using an aseptic technique at all times.
- The bladder is emptied prior to the application of the forceps. If an indwelling catheter is in place, this must be removed prior to delivery to prevent damage to the urethra from the catheter bulb at delivery.
- The patient is carefully placed in the lithotomy position for better vision and manipulation. However, this position is uncomfortable and undignified and therefore the time the woman has to spend in this position should be as short as possible. (Both legs should be raised simultaneously to avoid sacroiliac joint injury, and the legs should be removed from the lithotomy poles in the same manner.)
- An assistant is necessary for the procedure.
- There must be good facilities for resuscitation of the baby.
- A large episiotomy is performed.
- The medical practitioner, after lubricating the blades of the forceps, selects the left-handed blade first and inserts it into the vagina to fit snugly around the fetal head. The right-handed blade is then inserted and locked over the left one (see Figures 32.10 and 32.11)
- At times, considerable traction is needed in order to deliver the infant, and this can be dangerous in inexperienced hands. The average pull is about 18 kg for a primigravida and 12 kg for a multipara.
- Forceps can be used to rotate the fetal head, and the type of forceps with a sliding lock and without a pelvic curve will permit this manoeuvre, such as the Kielland's forceps.
- The midwife must record the time of application of forceps and the time of delivery.

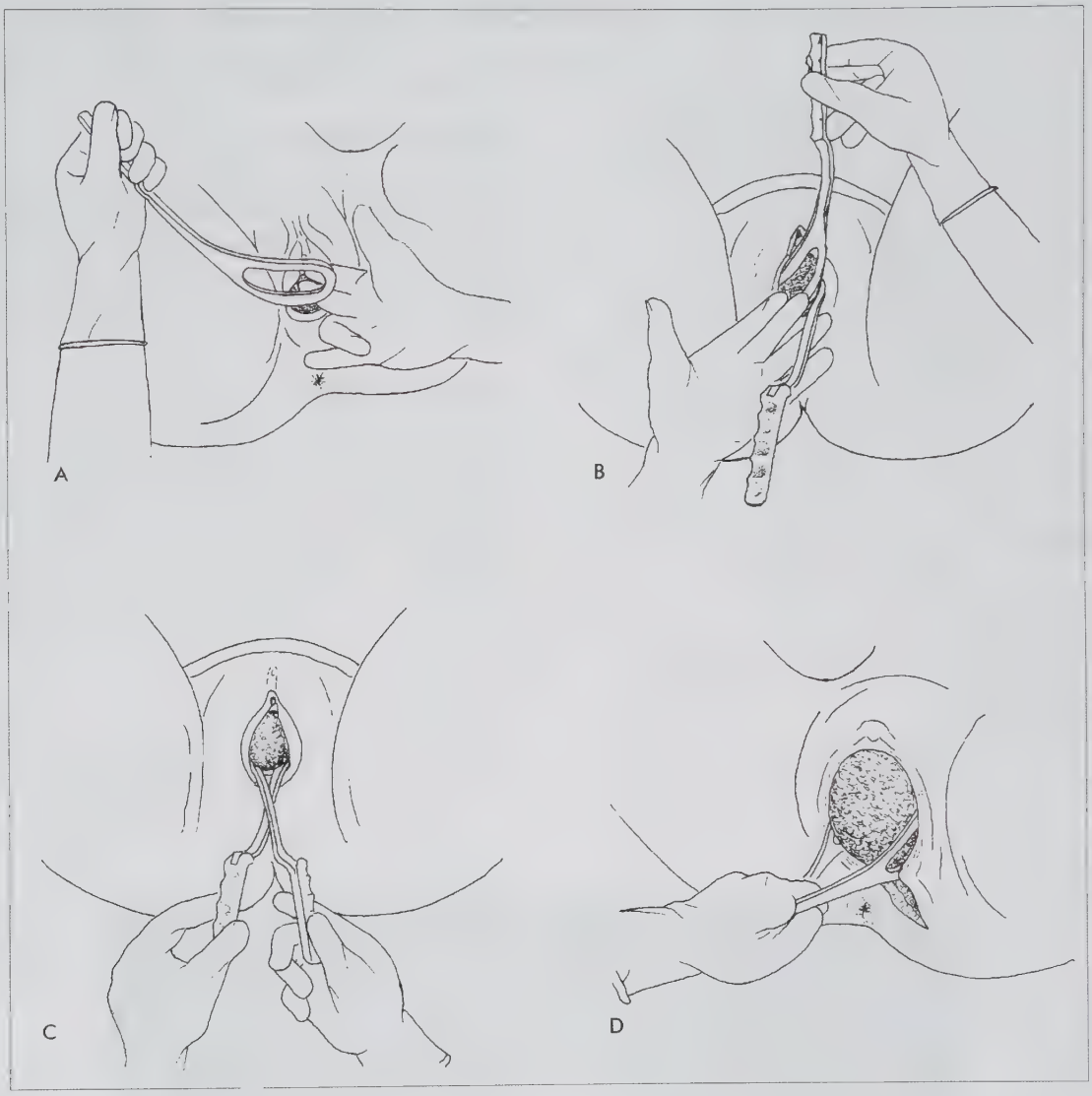


Figure 32.10 Forceps delivery A: Insertion of the left blade, B: Insertion of the right blade, C: Locking of the blades, D: Gentle traction is applied to deliver the head. Episiotomy is cut when the perineum is bulging

- The baby may need to be rescusitated after a forceps delivery and therefore all the necessary equipment must be in good working order.
- The baby may have injuries to the scalp and the face, which may require attention.
- The baby may require highcare nursing after delivery for possible intracranial injuries.

Complications

There are maternal and fetal complications.

Maternal. The following are maternal complications:

- damage to maternal soft tissues, such as uterine rupture, lacerations of the cervix, vagina, perineum and/or the rectum
- post-traumatic stress
- long-term health effects of uterine fistulas and prolapse
- infection of the birth canal
- traumatic postpartum haemorrhage, due to lacerations
- haematomas
- shock



Figure 32.11 The relationship between the pelvis and the forceps

- injury to the bladder and the rectum
- bladder atony causing retention of urine, urinary tract infection, oedema and pain
- fracture of the coccyx
- injuries to nerve endings
- failure of the forceps delivery.

Fetal complications. Poor application and incorrect use of the forceps can cause:

- intracranial damage such as tearing of the falx cerebri and tentoriurn cerebellum
- depressed fractures of the skull, causing brain compression
- asphyxia neonatorum and general respiratory depression
- lacerations due to the use of excessive force and to compression, such as cuts of the scalp, the eyes, the nose, the lips and the ears
- cephalohaematomas and subaponeurotic bleeding
- facial palsy
- brachial nerve injury – Erb-Duchenne palsy
- compression of the umbilical cord
- fetal death
- constriction ring.

Trial of forceps

A trial of forceps is carried out in the operating theatre, which is set up for immediate caesarean section in case the forceps delivery fails.

The medical practitioner applies gentle traction to the fetal head with forceps, and if this results in easy progress down the birth canal, the baby is delivered vaginally. However, if excessive force is needed in order to deliver the baby vaginally, then the forceps are removed, and the baby is delivered by caesarean section instead.

Vacuum or ventouse extraction

The vacuum or ventouse extractor is an instrument used to rotate and/or extract the fetus from the birth canal. These are achieved by means of the suction of a vacuum cup on the fetal head. Ventouse is the French word for a cupping glass, which was applied to the skin in ancient times in order to draw blood to that part of the body.

Types of extractors

The standard models have various sizes of round metal or silicone cups, each with an attached chain and a traction handle. It is connected by rubber tubing to a glass bottle, fitted with a gauge and a hand suction pump. The cups which fit onto the head of the fetus come in various sizes: 30 mm, 40 mm, 50 mm and 60 mm. An instrument powered by electricity is also available. New hand-operated models use silicone cups.

The function of the ventouse

The vacuum extractor is used to:

- *Flex the fetal head.* By the correct placing of the cup over the anterior parietal bone as far back towards the posterior fontanelle as possible, flexion of the fetal head is improved to assist the correct diameters for delivery.
- *Achieve traction on and rotation of the fetal head.* Rotation is also brought about by flexing the head, causing forward rotation of the fetal part on the pelvic floor. Extraction of the fetus from the birth canal is facilitated by pulling the fetus by the scalp.

Prerequisites

An abdominal palpation must be done prior to the vacuum extraction for the following information:

- the lie of the fetus
- the presenting part is cephalic, well flexed and engaged
- good uterine contractions
- no cephalopelvic disproportion.

A vaginal examination must also be done prior to the vacuum extraction, for the following reasons and to verify the abdominal palpation:

- that the vertex is presenting
- to check the dilatation of the cervix
- the membranes are ruptured
- to determine the station of the presenting part. Ensure the moulding score is less than 4+.

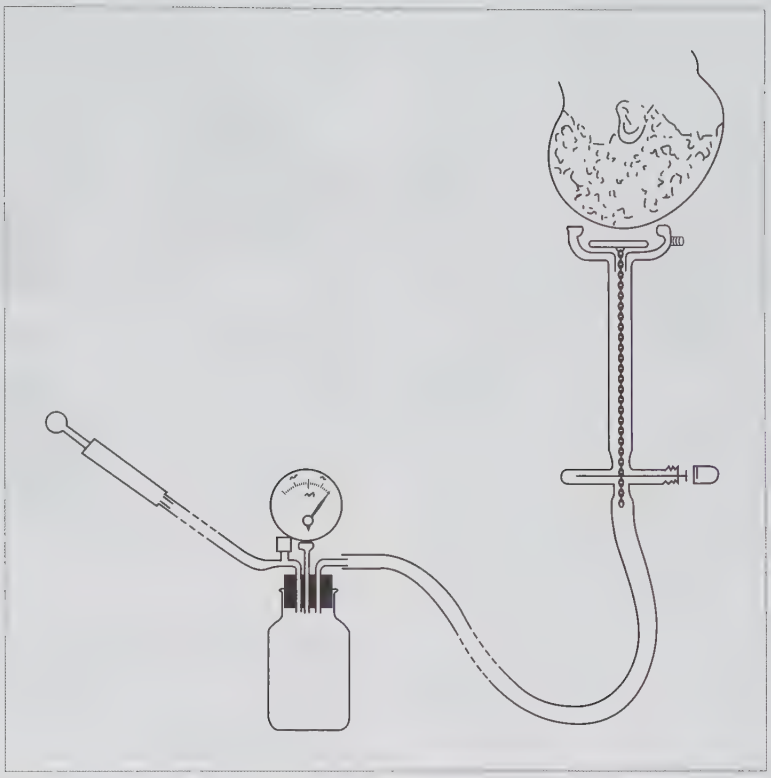


Figure 32.12 Vacuum instrument

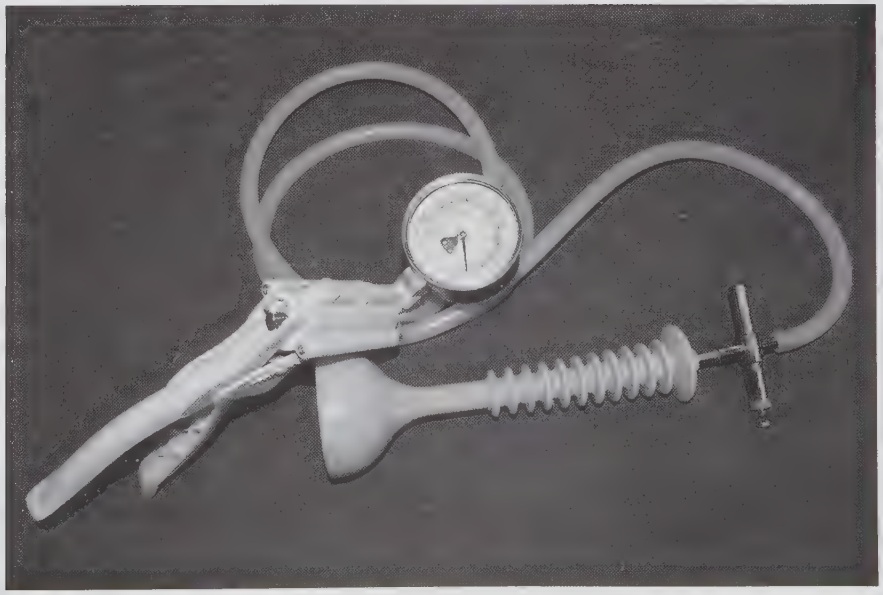


Figure 32.13 Modern vacuum instrument with plastic cups

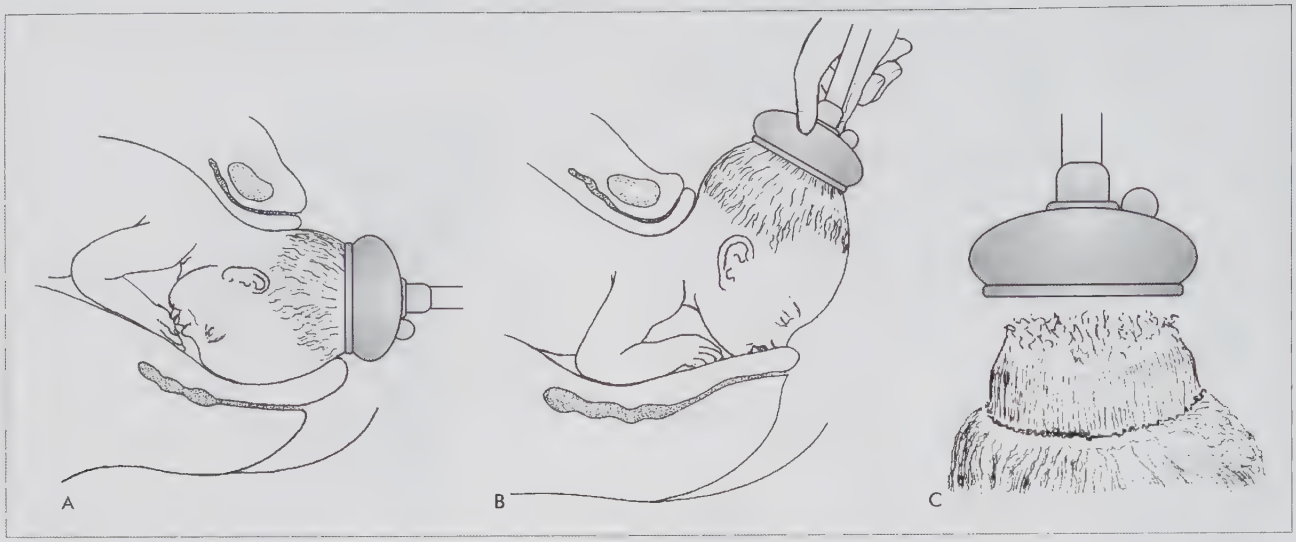


Figure 32.14 The application of the vacuum (metal cup)

The following are prerequisites for using the ventouse:

- An experienced operator.
- Maternal consent after being provided with full information and support.
- Effective analgesia given to the mother.
- A good light source so that the operator can see clearly.
- Empty bladder and rectum.
- A large episiotomy may be needed.
- Patient carefully placed into lithotomy position for better vision and manipulation.
- An assistant to help with the procedure.
- An aseptic technique must be used at all times.
- Adequate facilities ready for resuscitation of the baby.
- Perfect working order of all apparatus and instruments.
- Adherence to the specific instructions of the ventouse model being used.

Contraindications

There are two types of contraindications, namely absolute and relative.

Absolute. The following are absolute contraindications:

- moderate to severe cephalopelvic disproportion
- malpresentations such as breech, face or shoulder presentations
- if the fetus is macerated
- in preterm infants of 35 weeks or less
- an uncooperative patient
- where immediate delivery is imperative
- if the head will not engage on abdominal palpation.

Relative. The following are relative contraindications:

- fetal congenital anomalies, such as anencephaly
- uterine inertia.

Indications for use

There are maternal and fetal indications for the use of the ventouse.

Maternal indications. When there is delay in the second stage of labour due to:

- maternal exhaustion with poor maternal effort after a prolonged first stage and/or for prolonged second stage of labour
- failure of descent and rotation of the fetal head (occipito-posterior position)
- deflexion of the head
- abnormal maternal conditions such as cardiac disease, respiratory disease, gestational proteinuric hypertension, eclampsia and asthma.

Fetal indications. The following are fetal indications:

- abnormal position of the fetus, to flex and rotate the head in occipitolateral or occipitoposterior positions.
- mild fetal distress during the second stage of labour, and the fetus needs to be delivered quickly
- for the delivery of the second twin, when fetal distress occurs in a clinic situation.

Special use. A vacuum extractor is sometimes used when there is a delay in the first stage due to primary uterine inertia (primary hypotonic uterine inertia). The condition for which the extractor is used is relative cephalopelvic disproportion

due to deflexion of the fetal head, causing large cephalic diameters to present at the brim. The vacuum extractor is used together with a symphysiotomy, in order to bring about flexion and rotation of the head.

Advantages of vacuum extraction. The following are the advantages of using vacuum extraction:

- One of the main advantages is that it can be applied before full dilatation and when the head is descending the cervix will open.
- It uses less space in the pelvis as it is attached to the fetal head.
- It is very useful in order to flex the head.
- Rotation of the head will automatically take place at the optimum level in the pelvis.
- A vacuum extraction is relatively easy to perform.
- There is less discomfort to the mother than there would be in a forceps delivery.
- It is safer than the forceps because it will come off if the fetus is stuck.

Disadvantages of vacuum extraction. The following are the disadvantages of using vacuum extraction:

- It cannot be used on malpresentations such as a face or breech presentation.
- It cannot be used for preterm birth.
- It cannot be used for a macerated fetus.
- It cannot be used in severe fetal distress because it takes at least 10–15 minutes versus the 2–3 minutes of a forceps delivery.

Procedure

The following protocol is followed for a vacuum extraction:

- The correct size to be used is selected by the operator (after all the prerequisites for a vacuum extraction have been met).
- The cup is then applied to the fetal head as close to the posterior fontanelle as possible (centred over the posterior fontanelle if possible). The position of the cup will depend on the experience and dexterity of the operator, on the level of the presenting part, and on the position and the attitude of the head.
- The pressure pump is operated by an assistant. The optimal pressure for ordinary traction is slowly built up from 0.1 kg per square cm, to 0.6 kg per square cm by increasing the pressure by 0.1 to 0.2 kg per square cm, every 2–3 minutes (according to the instructions of that particular model of ventouse). 0.8 kg per square cm of pressure is used for rotation and manipulation of the fetal head. The negative pressure of the vacuum must not exceed 0.7–0.8 kg per square cm at any time.

  Before exerting any traction on the fetal scalp, an artificial caput succedaneum is allowed to form on the scalp as the loose skin is drawn up into the cup. This is known as a vacuum chignon. If a pull of more than 50 kg occurs the vacuum will come off (follow the safety regulations).
- Traction on the head must only be exerted during uterine contractions. The cup should not be on longer than 15 minutes and can only come off twice.
- The midwife records the time the cup is attached and the time of delivery of the baby.
- A general rule is not to keep a cup on the head for longer than 10 minutes.
- There may be a need to resuscitate the baby after vacuum extraction and therefore all the necessary equipment must be in good working order.
- The baby may have injuries to the scalp and the face, which may require attention.
- The baby is observed in highcare after delivery for possible intracranial injuries.

Complications

There are three categories of complications, namely maternal, fetal and failure.

Maternal. Maternal complications include:

- Lacerations of the birth canal such as the vagina, cervix, uterus, labia and/or the urethra.
- Third degree tear of the perineum, in addition to or as an extension of the episiotomy.
- Damage to the bladder.
- Traumatic postpartum haemorrhage.
- Infection of the birth canal.

Fetal. Fetal complications include:

- A type of caput known as a 'vacuum chignon' forms where the cup was placed, but this should subside after 12–24 hours. Abrasions, necrosis, or ulceration of the fetal scalp occur if the vacuum was too great or the cup was left on for too long. The portion of the scalp encircled by the cup can even become detached in extreme instances.
- Cephalhaematomas develop on the skulls of 10–15 % of babies on whom a vacuum cup was used.
- Postnatal asphyxia can occur.
- Cerebral irritation can occur.
- Fractures of the skull can occur.
- Perinatal retinal haemorrhage can occur.
- Intracranial haemorrhage from trauma during birth and/or from asphyxia.
- Occasional jaundice will occur when intertissue haemorrhage has occurred, due to absorption of the blood.

Failure rate. The failure rate is 2–20%. The cap can come off only twice and then the procedure is discontinued.

32.7 Caesarean section

Caesarean section is defined as a surgical procedure performed for the purpose of extracting a viable fetus through an incision in the abdominal wall and the uterus. The operation can be performed either under general anaesthesia or under epidural anaesthesia. (In most instances, the purpose of the procedure is to deliver a live baby.) The removal of a fetus and the products of conception through the abdominal wall before viability (26–28 weeks) is called a hysterotomy.

Currently, caesarean section is relatively safe, due to:

- improved surgical methods
- ability to suture the uterus to control haemorrhage
- ability to give a blood transfusion to replace blood loss
- availability of antibiotics to control infection
- improved anaesthetics and anaesthesiology
- improved perinatal care.

Incidence

An acceptable caesarean section rate is 20% in a healthcare system. There is an overuse of the caesarean section in healthcare for no indication, particularly in the private sector (45%).

General reasons for a caesarean section are:

- arrested labour 30%
- repeat caesarean section 20%
- breech 10%
- fetal distress 10%.

In a study in Dublin (1965–1980) the caesarean section rate was reduced to 4–5% with a lower perinatal mortality (4–16%). The protocol included careful control of indications for a caesarean section (repeat caesarean section and arrested labour). The principles for admission to the study were; admission only for true labour, the use of oxytocin for primigravidae and psychological preparation for birth.

These findings were similar to those in other healthcare systems with the same background.

The HIV pandemic may influence the caesarean section rate in a given healthcare system. Caesarean section is considered as the best way to prevent MTCT of HIV. Unfortunately in resource poor settings, with the highest prevalence of HIV, women often do not have access to safe caesarean section.

Classification of caesarean section

Caesarean section is divided into the following:

- *Upper segment.* Also known as classical caesarean section (rarely used)
- *Lower segment.* The lower segment is developed after 28 weeks of pregnancy, is less vascular and has fewer muscle fibres. Lower segment section has improved outcomes for follow-up caesarean sections.
- *Elective.* This refers to a procedure decided on before labour starts.
- *Emergency.* This caesarean section is demanded by a risk factor or a life-threatening situation that develops during labour.

Indications

Indications for caesarean section are listed in Table 32.7.

Advantages of caesarean section

The following are the advantages of using caesarean section:

- It is the safest method of delivery for many of the complications of pregnancy and/or possible complications of labour.
- It is preferable to a long and difficult labour and traumatic vaginal delivery (with possible fetal and/or maternal morbidity or even mortality).
- Surgical sterilisation can be combined with caesarean section.

Disadvantages of caesarean section

The following are the disadvantages of using c/s:

- There is a six-fold increased rate of complications over vaginal delivery.
- The complications of an elective caesarean section are 50% lower than emergency caesarean section.
- Maternal mortality is four times higher.
- Analgesia and anaesthesia become necessities rather than options and are a major cause of morbidity and mortality.
- There is postoperative pain and discomfort from the surgical incision and the general anaesthetic. These can now be controlled with the availability of epidural anaesthesia.
- There is extended hospitalisation, and there can be protracted recovery, but these can also be minimised by epidural analgesia.
- There is an increased financial burden on the family due to the operating theatre and surgeon's fees and the length of hospitalisation necessary.
- There is an abdominal wound.
- There is uterine scarring.
- There may be anxiety about future childbearing.
- It is more difficult to care for the baby after birth due to pain and discomfort.
- The risk for anaesthetic complications in obstetrics is doubled.

Contraindications to caesarean section

Contraindications include the following:

- Caesarean section is major surgery and should only be performed by competent and skilled surgeons in a well-resourced environment that meets the norms and standards of staff and equipment.
- There must be a valid medical or obstetric indication.
- It should be avoided in cases of cardiac disease, diabetes mellitus and intrauterine death or where the fetus has immature lungs or is preterm.

Principles of treatment and care

There should be a competent team of health professionals in a safe environment, with emergency blood and a paediatrician available, along with extra staff to care for the baby(ies) and the woman after the procedure. The woman must sign informed consent, which is an agreement between woman and the surgeon.

Pre-operative preparation

The woman is admitted the night before the operation. A cheerful and sincere welcome and continued caring by understanding midwives helps to instil confidence, trust and reassurance, and will make the woman feel comfortable and well cared-for in a strange and often frightening environment. The patient is orientated to the ward and the nursery, so that her surroundings become more familiar to her.

The pre-operative procedures and preparations are carefully explained to the woman and her fears dispelled. She is encouraged to talk, and communicate her fears and worries. She is reassured and encouraged by the staff members at all times, in a sincere and supportive manner.

Forms for consent of operation and anaesthetic are completed and signed. Any allergies are recorded and highlighted. The fetal heart is monitored four-hourly.

The anaesthetist visits the patient pre-operatively to discuss the type of anaesthesia and to do a general examination. Any questions the patient may have should be discussed with the medical practitioner at this time.

Blood tests are done when necessary, for example blood grouping and haemoglobin.

Urinalysis is carried out prior to surgery.

A sedative is prescribed by the medical practitioner for the night before the operation, to ensure a good night's sleep.

The patient is not given anything to eat or drink for six hours prior to the operation.

A premedication to prevent Mendelson's syndrome is prescribed by the medical practitioner and is given just prior to going to the operating theatre. Some medical practitioners use metoclopramide to empty the stomach.

Prior to leaving the ward, the patient is identified by means of an arm band.

Patients undergoing epidural analgesia will require intravenous therapy for preloading.

It is important to include the woman's partner in this pre-operative preparation. In many centres, he is encouraged to support and encourage the woman and to watch the birth of his baby. The father will also need time to ask questions, and his fears and worries should also be allayed by careful, truthful answers and by encouragement and support.

Table 32.7

Indications for caesarean section

Maternal	Fetal	Obstetrical
HIV-positive status	Fetal abnormalities	Poor obstetrical history
Congenital abnormality of the uterus	Genetic disease	Cephalopelvic disproportion
Soft tissue scaring	Fetal compromise	Obstructed labour
Cone biopsy	Fetal distress	Contracted pelvis
Tumours	IUGR	Malpresentation/breech presentation
Previous uterine surgery	Multiple pregnancy	Uterine dysfunction
Hysterotomy	Erythroblastosis fetalis	Cervical dystocia
Myomectomy		Antepartum haemorrhage
Carcinoma		Failed induction
Previous cervical cerclage		Elderly primip
Eclampsia		Cord proplapse
Active herpes infection		
Failed assisted delivery		

Intra-operative care

In many institutions the caesarean section theatre is part of the labour ward and the midwives are responsible for the theatre. If not, the labour ward staff is responsible for receiving the neonate and for the fourth stage of labour. If the father wants to go to theatre the labour ward staff will also take responsibility for him, to show him what to do, tell him what is happening, keep an eye on him and let him hold the baby. The midwife will also make notes of the events in theatre and the amount of blood lost.

The mother should be assisted to feed her baby within one hour after birth.

The preparation of the postoperative room

While the patient is in the operating theatre, the room is prepared to receive her after the operation. Her bed is prepared with clean linen and extra blankets. Emergency equipment, such as oxygen and a suction apparatus, is made available should it be needed. The charts are prepared and sanitary towels, a drip stand and the emergency trolley are placed nearby.

Postoperative care

The general principles of care for an uncomplicated caesarean section are given in this section. A woman with a complication or specific problem will receive specialised care.

Postoperative care includes the following:

- *Level of consciousness*. After general anaesthesia, the level of consciousness must be assessed and once the patient is fully conscious, she is placed into a semi-Fowler's position.
- *Position*. Unless contraindicated (hypovolaemic) the initial position of a woman is left lateral if still unconscious. Once consciousness is regained the woman is placed in Fowler's position to improve uterine drainage and reduce tension on the abdomen, reducing pain. After epidural Fowler's position is required unless there was a spinal tap.
- *Vital signs*. The vital signs are checked half hourly for six hours or until stable. That is, temperature, pulse, respiration and blood pressure are checked according to the hospital policy.
- *Blood loss*. The intrapartum blood loss is taken into account and added to the blood loss in the first 24 hours postpartum. Changing the sanitary pads every 20 minutes indicates too much blood loss after birth. The report on the examination of the placenta and membranes is checked for completeness. The preoperative haemoglobin is important. Unless there is a postpartum haemorrhage the haemoglobin is checked when the haeomodynamics are stabilised, usually day four postpartum.
- *Lochia*. The lochia is observed for colour, odour, consistency and amount. Any profuse or abnormal lochia is reported to the medical practitioner immediately. The patient is given a vulval toilet four-hourly for 24 hours and she is then encouraged to swab herself under supervision until she is able to do so herself.
- *Oxytocin*. Oxytocin is administered 20 IU in 1 000 ml/8 hourly for at least 24 hours.
- *Wound*. The wound is observed for bleeding. The abdominal wound is checked frequently for bleeding in the first 24 hours, and then daily. The midwife must report on the condition of the wound, including any haemorrhage or infection. If Portovac drainage is used to drain the wound, this must be emptied every four hours and the drain removed on the medical practitioner's prescription. The wound is kept as dry as possible. Some medical practitioners advocate a light abdominal dressing after 24 hours, allowing air to circulate around the wound.
- *Suture/clips*. The sutures/clips are removed on the medical practitioner's prescription, usually day five or six.
- *Intravenous fluids*. These are administered as prescribed. The rate and the infusion site must be checked regularly.
- *Diet*. The patient is not allowed to eat or drink for the first 12–24 hours with general anaesthesia and then graded oral fluids are given until full fluids are tolerated on about the second postoperative day. A regular diet should start on about the third postoperative day, when bowel sounds are heard and flatus is passed. Water and fruit juices are encouraged to prevent constipation. In epidural anaesthesia normal diet is allowed.
- *Urine*. All fluid intake and urine output are measured and charted while the Foley catheter is in place. The amount and colour of the urine are checked and charted. The urinary catheter is usually removed after 24 hours. The patient must be encouraged to void urine every 1–2 hours after the removal of the catheter. The bladder is checked for distension after voiding.
- *Bowels*. The midwife must enquire daily whether there has been a bowel action. An aperient of natural grain only can be given on the third or fourth postoperative day if there has been no bowel action.
- *Ambulation*. Early ambulation encourages the passage of flatus, and a diet high in fibre, fruit and vegetables will help to avoid constipation. The woman is encouraged to be ambulant within 24 hours to prevent thromboembolism. The legs and the groin are examined daily for signs of tenderness and infection. When a patient has undergone epidural anaesthesia, the midwife must observe for the return of all sensation to the lower limbs. The woman

is not allowed out of bed until all sensation has returned and then a member of the staff must accompany the woman on her first walk, until confident that she will not fall or faint.

- *Pain and analgesia*. The midwife must check on the pain which the woman is experiencing: the type, the location and whether the analgesia is having the desired effect. The main types of pain that may be experienced are generalised abdominal pain, pain from the incision, after-pains, pain from flatus, throat pain from intubation, headache, and pain from breast engorgement. If the patient complains of leg pains, the doctor must be notified, as this could be caused by a thrombosis. Analgesia is given on the medical practitioner's prescription following principles of pain assessment and care. If the analgesia is not working well, the medical practitioner must be informed and an alternative analgesic prescribed. If the woman has had an epidural anaesthetic, the anaesthetist will be able to administer a top-up of either pethidine or morphine into the epidural space.
- *Physiotherapy*. Active and passive leg exercises are encouraged, as well as deep breathing and coughing.
- *Baby friendly principles*. The baby is put to the breast as soon as possible after the operation, that is, as soon as both the mother and the baby are ready. Each feed must be supervised until the woman is able to manage on her own. The midwife must remember that the woman has a painful abdominal wound and it is not always easy to handle and manage the baby. The baby is demand fed, and the midwife must examine the breasts for fullness and engorgement. The woman may require further assistance when the milk comes in, as the baby may find it difficult to fix/latch on the breast. The woman is encouraged to wear a well-fitting, good supportive bra, and any difficulty or problem must be attended to. If there are any complications, the medical practitioner is notified.
- *Infant care*. Initially, the baby is nursed by the staff in the ward/nursery, until the patient is up and about and able to care for the baby herself. The baby will usually be rooming-in with the mother, but careful observations must be undertaken for any possible complications.
- *Rest and sleep*. Care must be taken to ensure that the patient gets a good sleep at night. In addition, the woman should be able to rest and sleep undisturbed for a few hours during the day.
- *General hygiene and comfort*. A full wash is given daily until the patient is able to manage on her own. Even then, there are probably some aspects that she will require help with. Pay attention to the patient's mouth and hair. Mouth washes should be given frequently, until she is able to clean her teeth herself.
- *Education*. During her stay in hospital, the patient is taught how to care for herself and for her new baby, so that by the time she is discharged, the woman is confident and happy, and able to go home and care for her baby and family. The postpartum period allows for education. The woman is advised to get as much sleep and rest as possible, and she and/or her partner should arrange for help at home for the first two postoperative weeks if possible.

  The woman is instructed not to lift any heavy objects until the postnatal check-up and she should not drive a car for up to six weeks postoperatively. She should also avoid climbing too many stairs at first.

  The midwife makes sure that the woman knows the reason for the caesarean section, particularly if it was an emergency. She must be told of the importance of delivering in hospital for any subsequent babies.

Complications of caesarean section

These complications can be maternal or fetal.

Maternal complications

The following are maternal complications:

- Haemorrhage (in the postoperative period), due to:
  - haematomas in the broad ligament
  - bleeding from the placental site in uterine atony
  - bleeding from the abdominal or uterine wounds
  - bleeding caused by infection due to a breakdown of sutures or to infection of the placental site.
- Anaesthetic complications.
- Pulmonary collapse caused by:
  - amniotic fluid embolism
  - aspiration pneumonia
  - thromboembolism.
- Infection (puerperal sepsis) of the uterus, the urinary tract, the wound, the lungs, the abdominal wall, generalised septicaemia.
- Dehydration due to loss of fluids.
- Hypovolaemia.
- Bladder and ureter injuries, retention of urine.
- Wound dehiscence.
- Flatulence and vomiting.
- Gut distension causing paralytic ileus (a rare complication).
- Incisional hernia, umbilical hernia, abdominal hernia.
- Fistulas (a rare complication).
- Endometriosis of the scar (rare).
- Abdominal pain, intestinal obstruction probably due to adhesions (both rare).

- Lack of bonding.
- Difficulty breastfeeding.
- Hysterectomy.
- Mendelson's syndrome.
- Increased risk of repeated caesarean section depending on the indication.
- Risk of a ruptured uterus in subsequent pregnancies.

Fetal complications

The following are fetal complications:

- Transient wet lung syndrome as a result of amniotic fluid not being squeezed out of the chest as occurs in a vaginal delivery.
- Respiratory distress syndrome (immature lungs).
- Birth injuries from the scalpel, from forceps, or other instruments used.
- Prematurity due to incorrect dates (the caesarean section being mistakenly performed before term).
- Asphyxia neonatorum caused by delay in the birth during general anaesthetic (this usually only happens with inexperienced medical personnel).

Vaginal birth after caesarean section (VBAC)

VBAC is a natural vaginal birth after a previous caesarean section. This is also called a trial of scar. The success rate of VBAC is 68% and in the USA, the incidence is 26%.

Indications

Women who had a caesarean section for reasons such as placenta praevia, pre-eclampsia and other reasons that may not recur are allowed to have a VBAC.

Contraindications to VBAC

Women with a poor obstetrical history, perinatal deaths, multiple pregnancy, previous postpartum haemorrhage or previous assisted deliveries and obstructed labour, CPD and large infants are not candidates for a VBAC. Other reasons include:

- more than one previous c/s
- medical problems
- older than 30 years
- a previous classical caesarean section.

Prerequisites

The following are prerequisites:

- This is a high-risk procedure and should be under the supervision of an obstetrician.
- It should be in an institution and at a level of care where a theatre is available and an anaesthetist should be on standby.
- Ultrasound should be done to assess the scar.
- Epidural is contraindicated.
- Induction of labour is contraindicated.

Principles of treatment and care

The following are principles of treatment and care of VBAC:

- The woman must make her own decisions.
- An obstetrician is in attendance.
- The woman must go into labour naturally.
- Progress must be normal.
- Prostaglandin administration is totally contraindicated.
- Any vaginal bleeding or continuous pain is attended to.
- Pulse rate is observed as tachycardia may be a sign of impending rupture.
- Blood pressure is strictly monitored.
- Pain relief is as natural as possible (no epidural).
- Blood in a mid-stream urine specimen is suspicious.
- The protocol requires immediate response if complications occur.
- Blood is on standby.
- Trained VBAC midwives to be in attendance.

Complications

The main complication is the risk of rupture of the uterus with fetal or maternal death.

32.8 Symphysiotomy

Symphysiotomy is a surgical incision into the fibrocartilage of the symphysis pubis in order to permanently enlarge the pelvic girdle. The operation is performed in order to allow the fetal head to pass into the pelvis (engage), so that a vaginal delivery may be achieved. It is performed when there is no facility for caesarean section, and where there is mild to moderate cephalopelvic disproportion, and there is an urgent need to deliver the fetus.

A spontaneous symphysiotomy can occur during a difficult vaginal delivery, and some of the lesser complications may also apply here.

Incidence

The incidence varies between 0.2–0.7% with wide differences between countries. It is rarely, if ever, performed in the Western world where caesarean section is preferred. However, in the developing world the procedure has a place. It is usually performed by medical practitioners.

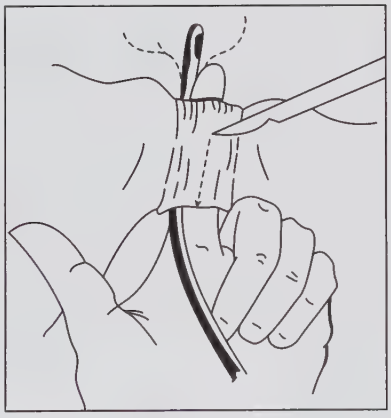
In communities where cephalopelvic disproportion (CPD) is a common complication of childbirth, the procedure is relatively safe, provided that the patient is well-chosen,

1.



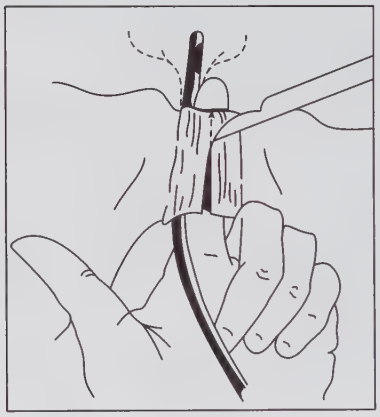
A urinary catheter is inserted to displace the ureter, before the symphysiotomy incision is made

2.



Symphysiotomy incision: incised from upper $\frac{1}{3}$ of symphysis pubis, downwards

3.



Symphysiotomy incision: incised from upper $\frac{1}{3}$ of symphysis pubis, upwards, to complete the incision

Figure 32.15 Symphysiotomy

and careful attention given to the problems which can arise. The operator must be conversant with the indications and the contraindications for symphysiotomy, and must be skilled in the technique.

Indications

The following are indications for a symphysiotomy:

- Overcomes borderline cephalopelvic disproportion. It is preferable to the trauma caused by forceps delivery when used for certain clinical problems, and can be performed at the end of a careful trial of labour.
- Very useful in neglected cases of obstructed labour, where caesarean section would be dangerous to the patient.

  In developing countries, where the patients do not always return after a previous caesarean section for proper antenatal care and subsequent hospital delivery, it is preferable for a symphysiotomy to be performed to correct CPD. This leaves the woman with a permanent cure for the CPD, rather than allowing the woman to run the risk of a scarred uterus from a caesarean section and a future labour with CPD without proper care.
- Useful for women whose beliefs and cultures penalise them for not delivering vaginally.
- Is preferable to caesarean section if more than four children are planned.
- May permit immediate vaginal delivery in obstructed labour, while also sparing the integrity of the uterus.
- Can also save the mother and the fetus considerable trauma, as disimpacting a deeply impacted head at caesarean section is difficult and dangerous.
- Preferable to difficult forceps delivery or to obstructed labour with possible uterine rupture where the fetal mortality rate is high.
- Useful when delivering the after-coming head of the breech presentation, where CPD could be a problem and there may be difficulty delivering the head, and it may prove to be life-saving.
- Could be the procedure of choice where CPD is further complicated by coagulopathy, or by anaesthetic risks or allergies.

Contraindications

The following contraindicate symphysiotomy:

- In gross cephalopelvic disproportion, with more than 80% of the fetal head above the brim of the pelvis.
- In abnormalities of the maternal spine and lower limbs.
- In very obese women.
- Where the baby is estimated to have a mass of more than 4 kg or less than 2.5 kg.
- Where there has been a previous caesarean section.
- Where a symphysiotomy has been previously performed.
- If the baby is dead.
- Where the uterine action is not effective (hypotonic uterine action).
- Where the cervical dilatation is less than 8 cm.
- In a pelvis where the diagonal conjugate is less than 8 cm.
- In malpresentations.
- If there is an unskilled operator or inadequate assistance.
- Where there is no good indication for symphysiotomy.
- Where consent has not been given.

Advantages. The advantages are as follows:

- It is a relatively simple procedure with few risks.
- The procedure only requires five minutes to perform, and the delivery can then be achieved very quickly, which is useful when there is fetal distress.
- It can be performed almost anywhere, and with limited facilities.
- Only local analgesia is required.
- Vaginal delivery is achieved.
- There is only a small risk of infection.
- The operation results in a permanent enlargement of the pelvic girdle, and the healing takes place by laying down fibrous tissue.
- There is an increase in the transverse diameters at each plane of the pelvis, particularly at the outlet, because the lower points of the pubic bones at the symphysis become more widely separated than the upper ends.
- There is a minimal increase in the anteroposterior diameters.
- There is great improvement in the capacity of both android and anthropoid types of pelvises.
- Any following deliveries will be easier, because the fibrous tissue tends to stretch more easily than does cartilage.
- The vaginal delivery rate after previous symphysiotomy is 87% compared to 44% after caesarean section for disproportion.

Prerequisites and preparation

- *Competence.* Symphysiotomy must only be performed by a skilled obstetrician, who must make the decision when to perform the operation. In an emergency, especially in order to extract the after-coming head in a breech, as a last resort, a skilled midwife may perform a symphysiotomy. There must be adequate assistance

because two assistants hold the legs in the lithotomy position.

- *Indications.* There must be proper indications for performing this operation.
- *Informed consent.* The woman must be given a full explanation of the operation. The patient must be cooperative and written consent must be obtained. It is the midwife's duty to give moral support and encouragement to the woman throughout the procedure, as the woman will be very distressed and fearful during this time. The woman is told that she has a tube in her bladder to drain the urine, and that this will ensure that she does not have to sit up or get out of bed to pass urine. The catheter is removed after four days, when she will be able to use a bedpan.
- *Contraindications.* The contraindications must be considered.
- *X-rays.* The operation is only undertaken when the CPD is borderline (mild to moderate), and this must be checked by clinical and radiological estimates.
- *Labour.* There must be effective uterine contractions and dilatation is 8 cm and the head must be 80% engaged.
- *Asepsis.* The procedure is performed using an aseptic technique.
- *Anaesthesia.* Adequate analgesia must be ensured. Local anaesthesia is used.
- *Neonatal care.* Resuscitation facilities must be available for a possibly asphyxiated infant.

Procedure, treatment and care

- *Position.* Two midwives support the woman's legs against their chests, because the legs must not be abducted more than 80° and it is preferable to have the legs at an angle of 45°.
- *Informed consent.* A careful explanation, using terminology that the woman can understand, is given to the patient regarding the incision between the two pubic bones. She should be given reassurance that the wound will soon heal and that she will only suffer minor problems for a while. If any complications arose during the procedure, the woman should be told exactly what to expect. She should be encouraged to comply with the nursing procedures so that optimum healing can take place.
- *Cleaning.* The area to be operated on is swabbed and draped, using an aseptic technique.
- *Anaesthesia.* Local anaesthetic is injected into the soft tissue over the symphysis pubis on either side, and the tissues of the perineum are then also anaesthetised for an episiotomy.
- *Bladder care.* An indwelling Foley catheter is introduced into the bladder and kept in position until four days after the operation (see Figure 32.15).
- *Technique.* Two fingers of the left hand are inserted into the vagina and the urethra and the catheter are displaced laterally. The fingers are kept in position under the symphysis pubis to protect the urethra and the bladder, and to determine the depth of the incision.
- *Symphysiotomy incision.* This is incised from upper third of symphysis pubis, downwards and from the upper third of symphysis pubis, upwards, to complete the incision.
- *Equipment.* A bistoury solid-Waded knife is used. The blade is inserted through a half-inch incision in the skin over the centre of the joint, anteriorly. All the fibres of the cartilage are completely incised from above down. The scalpel is held vertically, like a pencil, the cutting edge pointing downward. The joint is then entered at the junction of the upper and middle third and the lower two-thirds of the joint are incised. The scalpel is removed, rotated 180° and re-inserted to complete the incision of the upper one-third of the joint. The separation must be less than 2.5 cm and the operator must adhere strictly to the midline to avoid osteitis pubis and subsequent difficulty in walking.
- *Control of bleeding.* Haemorrhage is controlled by direct pressure.
- *Leg control.* Once the incision is made, the midwives bring the legs together carefully in adduction.
- *Suturing.* Once delivery is complete, the genital tract is explored for signs of trauma. The symphysiotomy skin incision is sutured.
- *Records.* The midwife records the time of the symphysiotomy and the time of delivery.
- *Delivery.* A large episiotomy is performed when fully dilated so that the head is delivered as far posteriorly as possible, in order to keep the pressure of the head away from the bladder and the urethral walls.
- *Postdelivery care.* The patient is nursed on her sides for 48 hours, and turned two-hourly by two nurses, while her legs are tied together. She must be given help in turning, especially at first. Deep breathing exercises and leg exercises are demonstrated and encouraged. If available, a physiotherapist is called in to help the woman with the exercises. The woman must be given a bed bath daily and oral and other hygiene must be provided. The midwife must ensure that the woman is comfortable and not anxious. Vulval toilette is performed four-hourly, with

the patient lying on her side, until she is able to do this for herself.
- *Diet.* A high protein, high roughage diet, with plenty of fluids is given to the patient and the woman is given assistance with feeding, as she will find it awkward to eat lying on her side.
- *Fluids.* Strict records are kept of fluid intake and output.
- *Medication.* Some obstetricians prescribe an antibiotic cover for five days.
- *Breastfeeding.* The mother is encouraged to breastfeed her baby on demand, and all feeds are closely supervised. She must be reassured that the staff will take care of her baby while she is at bedrest.
- *Analgesia.* This is given for pain, usually in the form of intramuscular injections for 48 hours, and thereafter, oral tablets four to six hourly. The midwife must make sure that the analgesic is effective. The patient is instructed to report any excessive pain experienced and the medical practitioner is immediately informed.
- *Mobility.* On the fifth day, the patient is allowed to sit up, at first only on the edge of the bed for a short while, gradually progressing to standing alongside the bed and finally to walking around the bed and eventually to the toilet with help from the staff and with the aid of rubber-tipped walking sticks, or a walker. This is usually achieved by the sixth to seventh post-operative day. The woman is allowed home on about the tenth postoperative day, provided she is confident and walking normally.

The woman is given the following advice on discharge:
- She is told not to lift or carry any heavy objects for at least three months, and she should have home help.
- She cannot walk long distances.
- She must avoid any undue muscular effort where possible.
- She should abstain from sexual intercourse for about six weeks.
- She is told that she should have a full range of movements by the end of three months.
- She is advised to report any abnormalities, such as difficulty in walking or excessive pain, to the nearest clinic or hospital.

Complications

Any delay in delivery could be due to one or more of the following:
- inefficient uterine action
- the joint insufficiently separated
- an inadequate episiotomy
- greater cephalopelvic disproportion than anticipated
- unanticipated fetal abnormality.

Complications specific to the procedure are usually only found where the patients have not been correctly selected for symphysiotomy, and where the operation has been poorly performed and the after-care and follow-up have not been adequate. These include the following:
- Instability of the pubic joint may occur if the separation is excessive, causing pain and discomfort.
- Tears in the anterior vaginal wall.
- Traumatic haemorrhage at the site of the incision, resulting in:
  - the formation of haematomas
  - pubic pain, at the time and later
  - backache (acute and/or chronic).
- Injury to the bladder and/or the urethra, due to the incision extending through these tissues, later resulting in either a vesicovaginal fistula and/or a urethrovaginal fistula.
- Injury to the sacroiliac joint, causing problems with movement later.
- Stress incontinence may occasionally occur.
- Osteitis of the pubic bones.
- Non-union of the joint, resulting in excessive pain and difficulties in walking.

Pain and difficulty in walking will often be experienced in the first few days after delivery, and the difficulty in walking will be greater when a haematoma occurs.

32.9 Destructive obstetric operations

Destructive operations can be dangerous to the mother, causing trauma to the genital tract, therefore they are very seldom undertaken, and are almost always only performed on a dead fetus and only by a medical practitioner. The purpose of these procedures is to decrease the diameters of the fetus for vaginal delivery because dilatation of the cervix is impaired in the case of a dead fetus due to the poor application of the fetus on the cervix.

The usual support for perinatal loss is given with extra support for a very painful situation (see Chapter 13).

Classification of destructive procedures

Note that major surgical intervention that endangers the mother's life is not desirable. The medical practitioner must be experienced in the procedures discussed.

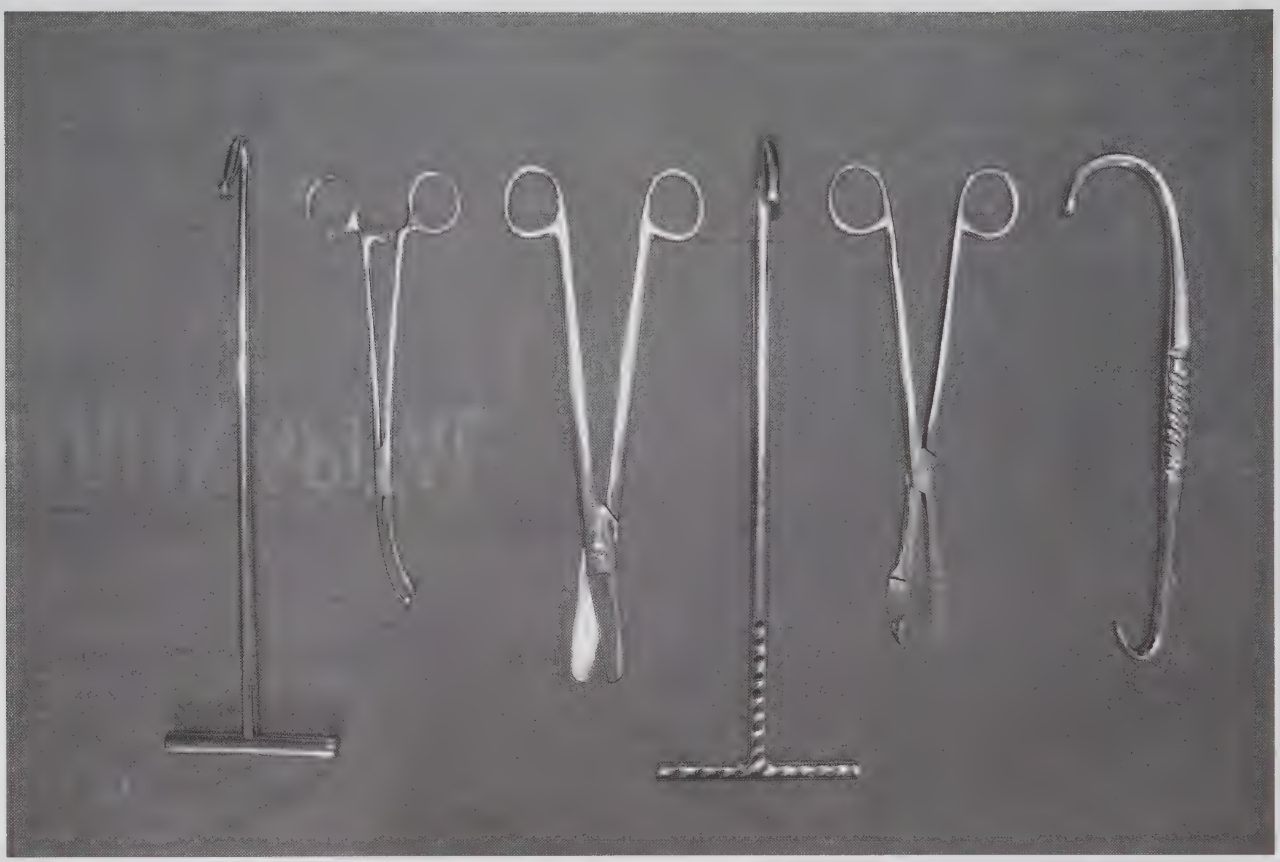


Figure 32.16 Destructive instruments

Craniotomy (opening of the skull)

Craniotomy is used in instances of a dead fetus with:

- hydrocephalus
- impacted brow presentation
- mentoposterior position.

In this procedure, the cranium is perforated in order to crush the head and release the cerebrospinal fluid. A cranioclast or cephalotribe may be required to crush the head. Smellie's scissors could also be used to open the head and evacuate the brain. Traction, using a tenaculum, is used to remove the fetus.

Cranioclasis is the breaking-up of the vault of the skull and cephalotripsy is the crushing of the whole skull.

Decapitation (severing the head from the body)

Decapitation is performed in a shoulder presentation or transverse lie, where there is impaction of the shoulder of a dead fetus, and the cervix is fully dilated. A Blond-Heidler wire saw and thimble is used. The thimble, with an introducer attached, and one end of the wire are passed around the baby's neck. Handles are attached to both ends and by pulling on alternate handles, the neck is severed. The body is delivered by traction on the arm. A Jardene hook could be used instead of the wire saw.

Cleidotomy

Cleidotomy is a procedure which is performed in instances of shoulder girdle dystocia. One or both clavicles are cut with heavy, long, slightly curved scissors in order to reduce the bi-sacromial diameter so that the fetus can be delivered.

Evisceration

This is a procedure in which the organs are removed from the abdomen and the thorax, after a perforator has been used to open the body of the fetus. It is performed in instances of gross fetal abnormality, where delivery is not possible because of the size and the shape of the fetal body, for example, in hydrops with ascites.

Spondylectomy

This is performed for breech presentation and hydrocephaly. The fetal spine is transected after delivery of the thorax, allowing the cerebrospinal fluid to drain out. It is performed in an obstructed after-coming head in a breech delivery.

See Figure 32.16 for the instruments used in these procedures.

Contraindications

The following are contraindications:

- A living, normal fetus.
- Markedly contracted pelvis.
- A cervix less than 7–8 cm dilated.
- When neoplasms obstruct the pelvis.

Complications

The following are possible complications:

- Lacerations of the genital tract.
- Fistulas of the bladder and the rectum.
- Uterine rupture.
- Haemorrhage from lacerations.
- Infections.

32.10 Conclusion

Interventions in childbirth can be very traumatic and yet lifesaving. The abuse of interventions in itself is a subject of debate and a movement against unnecessary interventions exists globally.

CHAPTER

33 Obstetric shock

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- differentiate between the types of shock that will be encountered in midwifery practice
- identify high-risk patients for the different types of shock
- assess for signs and symptoms of shock
- determine the type of shock a patient presents with
- effectively initiate a systematic approach to manage a patient with shock.

KNOWLEDGE ASSUMED TO BE IN PLACE

Normal anatomy and physiology of the cardiovascular system and respiratory system.
Heart failure and pulmonary oedema.
Haemodynamic monitoring

KEYWORDS

Shock syndrome • Haemorrhagic shock • Cardiogenic shock • Sepsis • Anaphylaxis • Atopy • Colloids/crystalloids

33.1 Introduction

Shock is a severe life-threatening emergency since it affects all organs. Shock leads to a decrease in cardiac output, followed by compromised tissue perfusion. The cells are deprived of sufficient oxygen and nutrients, causing cellular hypoxia. If shock is not recognised and managed, cellular death may occur.

The obstetric patient in shock requires immediate attention because of the possible wide-spread effect on one or more body systems. Prompt interventions based on the patient's vital/haemodynamic data are essential. When faced with an emergency involving shock, it is important that the midwife assess the patient quickly and thoroughly, following the ABC approach, while at the same time being alert for subtle changes that may indicate a potential deterioration in the patient's condition. The midwife needs to have a high index of suspicion for the condition to manage and refer as soon as the condition is recognised. Ideally, a shocked woman will be managed by a medical practitioner, but the midwife needs to understand the pathology and be able to manage the woman until a medical practitioner arrives or during transfer to an appropriate facility.

This chapter focuses on the different types of shock that may be encountered in midwifery practice. These include haemorrhagic, cardiogenic, septic and anaphylactic shock. It focuses on general management principles, including the use of a collaborative team approach, using the ABCs to guide assessment and planning and implementing a systematic management approach. This chapter does not focus on the management of the obstetric patient, but rather on basic principles that should be followed when shock occurs in midwifery practice. Table 33.1 summarises the types of shock encountered in obstetrics. The type of shock needs to be identified for the specific treatment required for the effective reversal of the condition.

The clinical picture of shock may include all of the following regardless of the cause:

- low blood pressure
- rapid weak (thready) pulse
- pallor
- cold clammy skin
- cyanosis of the fingers
- air hunger
- dimness of vision

- restlessness
- oliguria or anuria.

Shock may be catastrophic, for example that caused by amniotic fluid embolus.

33.2 Shock syndrome

The shock syndrome is a condition in which the stroke volume of the heart (amount of blood pumped per beat) is affected, which causes a decrease in the cardiac output (amount of blood pumped per minute). This in turn leads to cardiovascular system failure, which leads to total organ failure. Cardiac output needs to be maintained. Cardiac output (between 4–8 ℓ/min) is the amount of blood ejected from the left ventricle in one minute. It is equal to the heart rate multiplied by the stroke volume (the amount of blood ejected with each heart beat).

Stroke volume (approximately 70 ml) is the amount of blood ejected from the left ventricle with each heart beat. Stroke volume depends on three major factors, preload (volume received), contractility (ability of the muscle to contract)

Table 33.1

Classification of shock in obstetrics

Haemorrhagic shock: excessive blood loss may be due to: • bleeding early in pregnancy (abortion and ectopic) • antepartum haemorrhage (placenta praevia and placental abruption) • postpartum haemorrhage (atonic and traumatic).
Neurogenic shock: painful conditions may be due to: • disturbed ectopic pregnancy • concealed accidental haemorrhage • forceps or breech extraction before full cervical dilatation • rough internal version • Crédé's manoeuvre • ruptured uterus • acute inversion of the uterus • rapid evacuation of the uterine contents as in precipitate labour and rupture of membranes in polyhydramnios. This is accompanied by rapid accumulation of blood in the splanchnic area due to sudden relief of pressure (splanchnic shock).
Cardiogenic shock: ineffective contraction of the cardiac muscle due to: • myocardial infarction • heart failure • cardiac arrest.
Endotoxic shock: generalised vascular disturbance due to release of toxins.
Anaphylactic shock: caused by sensitivity to drugs.
Other causes: • embolism: amniotic fluid, air or thrombus • anaesthetic complications, e.g. Mendelson's syndrome • postpartum pre-eclampsia-induced shock.
The shock may be caused by more than one factor such as: • incomplete abortion: leads to haemorrhagic and endotoxic shock • disturbed ectopic and ruptured uterus: leads to haemorrhagic and neurogenic shock.

and afterload (the ability of the left ventricle to create enough pressure to eject blood). These are briefly explained in Figure 33.1.

Preload is the amount of stretch or volume in the ventricle at the end of diastole, just before ventricular contraction takes place. To eject blood, the ventricle must be 'preloaded' with blood to ensure an adequate stroke volume. Preload is determined by:

- the volume of the vascular space
- the amount of venous return
- the amount of blood in the ventricle at the end of diastole.

The type of shock that directly affects the preload in midwifery practice is haemorrhagic shock, which occurs due to an acute loss of blood in the vascular space, decreased venous return and decreased blood in the ventricle at the end of diastole leading to a decrease in stroke volume and cardiac output.

Contractility refers to the inherent ability of the cardiac muscle to contract and eject blood into the pulmonary or systemic vasculature. In midwifery practice cardiogenic shock develops mainly due to stress placed on the heart as a result of myocardial valve dysfunction. Owing to structural and/or functional abnormalities of the valves, the heart muscle will change shape over time and at some point patients will become symptomatic and heart failure is diagnosed. Decreased contractility leads to a decrease in stroke volume, which in turn decreases the cardiac output.

Afterload refers to the pressure that the left ventricle must generate to overcome the higher pressure in the aorta to get the blood out of the heart. The afterload can be increased or decreased. Septic shock directly affects the afterload due to vasodilation, thereby decreasing the afterload. This results in decreased venous return, stroke volume and cardiac output that in turn produces persistent hypotension.

Compensatory mechanisms

During the initial stage of shock syndrome, the cardiac output is decreased and tissue perfusion threatened. Almost immediately, the compensatory mechanism is initiated as the body's homeostatic mechanism attempts to maintain cardiac output, blood pressure and tissue perfusion. The compensatory mechanism is important in protecting the vital organs (brain and heart) and results in a cascade of compensatory events that affect all organ systems.

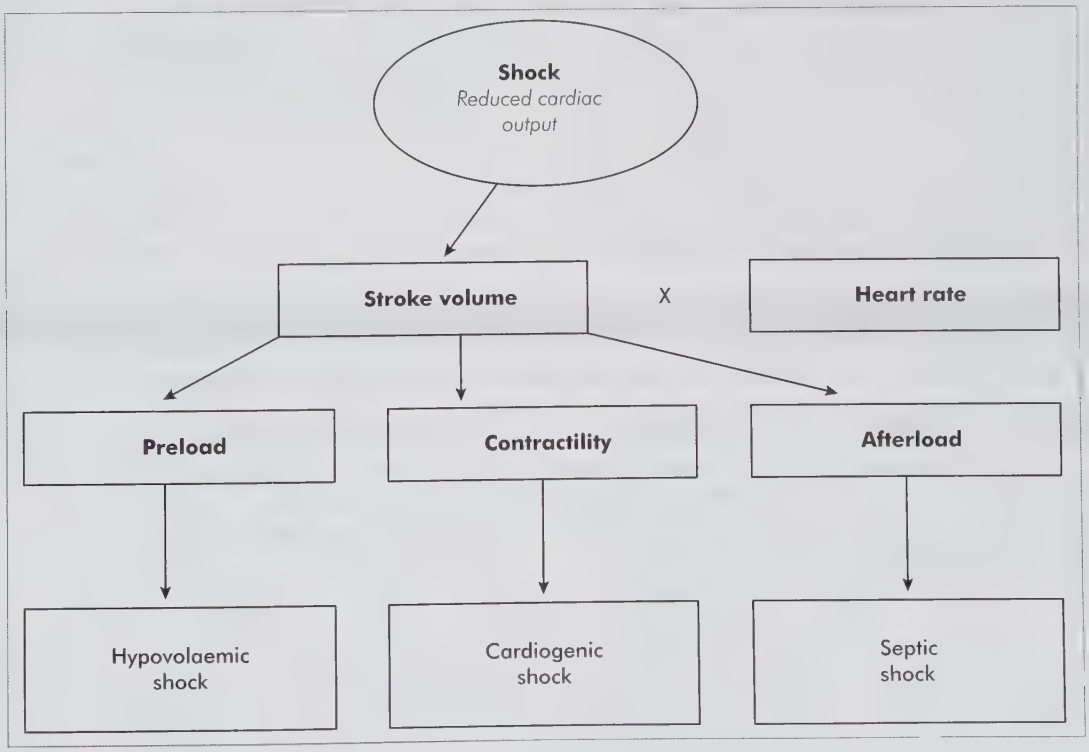


Figure 33.1 Schematic representation of shock

- Initially the body compensates by decreasing the circulation to less vital organs such as the kidneys, gastrointestinal system (GIT) and skin (paleness) in order to preserve the circulation to the vital organs such as the heart and brain.
- This shunting of blood flow to the vital organs is triggered by a decrease in the cardiac output, which is sensed by the baroreceptors within the aortic arch and atrium.
- Neural reflexes then cause a sympathetic outflow to the heart and other organs, which respond by increasing the heart rate and vasoconstriction to the nonvital organs.
- A hormonal response occurs and activation of the renin system leads to further vasoconstriction and the retention of water and sodium (aldosterone and antidiuretic hormone or ADH).
- The anterior pituitary and adrenal medulla are stimulated to increase the glucose and release epinephrine (adrenaline) and norepinephrine (noradrenaline), which further enhances the compensatory mechanism.

As a result of the activation of the compensatory mechanism the obstetric patient will present with tachycardia, tachypnoea, cold clammy skin and an increase in diastolic blood pressure.

Table 33.2 summarises the haemodynamic changes seen in response to the effects of adrenaline and noradrenaline on the different receptors.

In the progressive stage at cellular level, a decrease in perfusion causes the cells to switch from aerobic to anaerobic metabolism as a source of energy. Anaerobic metabolism produces large amounts of lactic acid as an end product, causing metabolic acidosis. A vicious cycle of low cardiac output, sympathetic compensation, myocardial ischaemia and even lower cardiac output develops. While compensatory mechanisms initially stabilise the patient, these begin to fail if progression occurs and the oxygen demands of the already compromised heart and the compensatory mechanism become exhausted. If the cardiac output continues to decrease, damage to the cells and different body systems are inevitable. The patient will present with multi-organ failure, which is:

- *cerebral hypoperfusion* leading to a decreased level of consciousness, which can present as anxiety, irritability, confusion and can even deteriorate to a comatose state
- *myocardial hypoperfusion* leading to decreased contractility and arrhythmias, which decrease the cardiac output
- *respiratory hypoperfusion* leads to hypoxia because there is an increase in pulmonary capillary membrane permeability which in turn decreases the surface area for gaseous exchange, and air hunger develops
- *renal hypoperfusion* develops due to vasoconstriction to this non-vital organ leading to renal ischaemia and ultimately progress to acute tubular necrosis and renal shut down
- *gastrointestinal hypoperfusion* develops due to a decreased blood flow to this non-vital organ, leading to ischaemia and presenting with decreased bowel sounds, impaired absorption and a paralytic ileus
- *Metabolic dysfunction* due to hypoperfusion on cellular level leads to an anaerobic metabolism and the formation of lactate (lactic acid)
- *haematologic dysfunction* affects the clotting cascade and therefore increases the risk for bleeding and DIC (disseminated intravascular coagulopathy).

If the decrease in cardiac output is not identified and managed promptly, cellular damage will be irreversible as the cell membrane loses its integrity. This will lead to irreversible cell damage, multi-organ dysfunction and death.

Table 33.2

Summary of the hormonal compensatory mechanism's effect on the haemodynamic status of the patient

Receptor	Effect	Rationale	Haemodynamic changes
Skin α	Vasoconstriction	↑ systemic vascular resistance to shunt blood to vital organs	↑ diastolic blood pressure Cold clammy skin ↑ capillary refill (> 2 seconds)
Cardiac system β_1	↑ heart rate	↑ heart rate to compensate for ↑ stroke volume in attempt to ↓ cardiac output	Tachycardia
Respiratory system β_2	↑ respiratory rate	↑ oxygen supply Compensatory mechanism for metabolic acidosis	Tachypnoea

Initial management

The first rule in effective patient management is the *5 P rule*, namely **P**re-**P**lanning **P**revents **P**oor **P**erformance.

It is essential that the correct equipment and ward stock are readily available to use once shock has been diagnosed, to provide the best chance for a successful outcome.

Early recognition of shock is essential. Using the ABC approach to assess the patient's airway (patent or compromised), breathing (increase in work of breathing, nasal flaring, use of accessory muscles, crepitations) and circulation (vital signs) and recognising subtle changes are vital.

The ABC approach should be adopted based on the identified type of shock seen in the obstetric patient. Table 33.3 provides the general principles that should be implemented in all types of shock. The differences and specific considerations are delineated in table format following the discussion on each type of shock.

Table 33.3

A structured approach to shock (HABCDEF)

Key principles	Interventions	Clinical notes
History	Obtain history from the woman, relatives or friends and/or ambulance staff SAMPLE history	Maintain high index of suspicion **S**: Signs and symptoms **A**: Allergies **M**: Medications **P**: Past-medical history **L**: Last food/drink **E**: Events History provides valuable information to guide diagnosis of type of shock
Hazards	All team members should wear gloves, aprons/ protective gowns and protective eyewear	Reduce risk of occupational exposure to blood-borne disease such as hepatitis and HIV
Help	Call for help immediately when shock is suspected	Team approach should be followed ▯ Call experienced staff (including obstetrician and anaesthetist) ▯ Designate a midwife to record the vital signs (every 15 minutes), urine output (hourly) and fluid and drugs administrated (continuously) ▯ Place operating theatre on standby (if appropriate)
Airway	Assess airway, using the '3Ps' strategy, namely ensure the airway is ***patent***, ***protected*** and if not ***provide*** it **Airway patent** and **protected:** provide supplemental oxygen via partial re-breathing ***mask*** with a reservoir bag **Airway not protected**: if noisy breathing occurs, the woman is not able to protect her airway, therefore one must perform the ***chin lift manoeuvre*** to open the airway Airway **not patent** or **protected**: initiate ***bag-valve-mask ventilation***	If the woman can speak, it can be assumed that the airway is patent Noisy breathing indicates that the woman cannot protect her airway The tongue falling back in the unconscious woman may obstruct the airway and she is unable to protect it Patients who are unable to protect the airway, consider providing protection by inserting a definitive airway (e.g. endotracheal intubation)
Breathing	**Look**: Observe the respiratory rate, depth and difficulty **Listen**: Briefly auscultate breath sounds bilaterally Initiate pulse oximetry, if available	

continued

Table 33.3

A structured approach to shock (HABCDEF) (*continued*)

Key principles	Interventions	Clinical notes
Circulation	Promptly insert intravenous line Consider the gauge of the intravenous cannula, type of administration set and type and rate of fluid administration Monitor vital signs	Monitor and interpret vital signs vigilantly and frequently *(every 15 minutes until patient is stabilised)* Monitor urinary output using an indwelling urinary catheter (normal = 0.5 to 1 ml/kg/hour) 30ml/hr
Disability	Monitor level of consciousness continuously, using the AVPU scale	**A**: Alert **V**: Responding verbally **P**: Responding to pain **U**: Completely unresponsive
Drugs	Dopamine is the drug of choice in shock	See Table 33.6
Environmental control	Keep woman warm	
Fetus	After the woman has been stabilised, assess the fetus with continuous cardiotocography in the case of a viable fetus	

33.3 Haemorrhagic shock (preload)

Haemorrhagic shock is the most common type of shock encountered in midwifery. It is regarded as a life-threatening emergency and a leading cause of death in obstetric patients. The highest risk of maternal death is related to haemorrhage within 24 hours postdelivery.

Haemorrhage can be managed effectively by recognising the condition, appropriate assessment and initial management. Following the ABCs provides a systematic approach and ensures that priorities are addressed (see Tables 33.2 and 33.3).

History (patients at risk)

Postpartum haemorrhage (PPH) is the leading cause of maternal death.

Women who are anaemic, or pre-eclamptic or have cardiac problems are specifically at risk.

Factors that indicate a risk for haemorrhagic shock include:

- history of uterine atony or overstretched uterus in polyhidramnios, multiple pregnancy or grande multiparae
- postpartum haemorrhage in a previous pregnancy
- previous retained placenta, placenta accreta
- prolonged labour/obstructed labour or failure to progress during the second stage of labour
- trauma and lacerations, associated with instrumental delivery, large for gestational age newborn and surgical interventions such as caeserian section and general anaesthesia.
- hypertensive disorders and HELLP syndrome
- induction of labour and augmentation of labour.

Pathophysiology

Haemorrhagic shock is usually precipitated by an event that results in an acute loss of blood from the intravascular space, causing a decrease in venous return to the heart, which in turn decreases the preload, stroke volume and cardiac output.

The placental site with the placental bed and open arteries in the uterus are not contracted, which can lead to a sudden massive loss of blood volume. A decrease in cardiac output decreases tissue perfusion, leading to a decrease in oxygen supply at a cellular level. The body's metabolic demands cannot be met and the compensatory mechanism is initiated as discussed.

Clinical signs and symptoms

The clinical manifestations of haemorrhagic shock vary depending on the amount of blood loss and the body's ability to compensate for that loss. There are four classes of haemorrhage that are based on the amount of blood lost. Each class has associated clinical manifestations.

The midwife should recognise that in individual patients the distinction between the different classes may not be as straightforward as delineated in the summary provided in Table 33.4. that gives general guidelines for healthy women. The management should rather be guided by the patient's

Table 33.4

Classification of haemorrhagic shock

	Class I Initial stage	Class II Compensatory stage	Class III Progressive stage	Stage IV Refractory stage
Blood loss (ml)	750	750–1 500	1 500–2 000	> 2 000
Blood loss (%)	15%	30%	40%	> 40%
Heart rate	< 100	< 100	> 120	> 140 Only carotid is felt
Capillary refill	Normal (< 2 seconds)	May be delayed (> 2 seconds)	Usually delayed (> 2 seconds)	Always delayed (> 2 seconds)
Skin	Normal	Pale cool skin	Cold and clammy	Cold, pale
Respiration	Normal	Mild increase	Moderate tachypnoea	Marked tachypnoea
Urinary output (ml/hr)	> 30	20–30	5–20	Anuria
Mental status	Normal or agitated	Agitated	Confused	Loss of consciousness
Blood pressure	Normal or increased pulse pressure	Decreased pulse pressure and increase in diastolic blood pressure	Markedly reduced	Precipitous fall Irreversible shock

response to the initial therapy. Consideration must be given to women with cardiac problems, anaemia and pre-eclampsia.

Principles of diagnosis, management, intervention and care

The Advanced Trauma Life Support (ATLS) guidelines published by the American College of Surgeons address the initial management of haemorrhagic shock. A systematic collaborative team approach is essential to optimise patient outcomes. This approach and its principles are also applicable in midwifery practice.

The ATLS guidelines emphasise that diagnosis and management of shock need to occur simultaneously. Once this assessment has been done, immediately initiate appropriate management.

The first step is to stop the haemorrhage, assess blood loss and effectively replace the fluid.

Replacement therapy should be started as soon as possible. The response to fluid should be monitored continuously and subsequent therapy should be based on the findings. Both crystalloids (Ringer's lactate) and colloids should be considered.

The ATLS guidelines recommend that pre-warmed Ringer's lactate be administered intravenously immediately to increase the hydrostatic pressure. An initial dose of 1 to 2 ℓ Ringer's lactate should be given, aiming to replace 3 ml for every 1 ml blood loss. As Ringer's lactate will increase the intravascular volume and therefore the hydrostatic pressure, it will promote the stabilisation of the vascular volume by replacing fluid losses in the interstitial and intracellular spaces.

The principles of assessment and management of haemorrhagic shock include ensuring an adequate airway, oxygenation and ventilation. Thereafter, the focus is on fluid resuscitation, which is regarded as the cornerstone of acute resuscitation. Once haemorrhage has been controlled, administration of warm intravenous fluids is important. All intravenous fluids should be prewarmed to 39 °C before use. An increase in the intravascular volume will predictably increase cardiac output and blood pressure of the woman, which will reverse haemorrhagic shock and restore perfusion to the vital organs. A summary of the key principles to be followed during the assessment and management of haemorrhagic shock are shown in Table 33.5.

Only the specific difference and/or special considerations related to haemorrhage are highlighted in Table 33.5. The principles used during the ABC approach remain the same as in Table 33.3.

The midwife should monitor the woman's response to the fluid bolus including level of consciousness, respiratory rate, heart rate, blood pressure, peripheral perfusion and urinary output.

Blood and blood products can be used during haemorrhagic shock. Blood products are used to restore circulating

Table 33.5

Specific considerations in the structured approach to manage haemorrhagic shock

Key principles	Interventions	Clinical notes
Circulation	Give priority to identifying and stopping the source of bleeding Turn woman on her left side or elevate her right hip to prevent supine hypotension Promptly place two large-bore (14 or 16 gauge) intravenous cannulas and simultaneously draw blood (cross-match, urea and creatine, electrolytes, coagulation screen and full blood count). Use a 10-drops-per-minute administration set. Administer 1–2 ℓ of warm crystalloid solution i.e. Ringer's lactate as a volume expander. This is followed by a colloid solution i.e. Voluven, 3 ml for every 1 ml blood loss. Transfuse blood if appropriate once available	Monitor and interpret vital signs carefully and frequently (every 15 minutes until patient is stabilised) Monitor urinary output using an indwelling urinary catheter (normal = 0.5 to 1 ml/kg/hour)
Environmental control	Keep woman warm (warm fluid replacement and blanket) (39°C)	

Table 33.6

Summary of the dose-dependent actions of dopamine

Dose	Effect
2–5 μg/kg per minute	Stimulate dopaminergic receptors which cause renal, mesenteric, cerebral coronary bed vasodilation, thus increasing blood flow to these tissues
5–10 μg/kg per minute	Stimulate β_1- receptors, which increase myocardial contractility and heart rate that improve cardiac output
>10 μg/kg per minute	Stimulate α-receptors, which results in an increase in the systemic vascular resistance, which may counteract the actions of the dopaminergic and β_1 receptors
Mixing dopamine Dilution: 6 x body weight (kg) equals milligrams to add to sufficient diluent to create a total volume of 100 ml (1 ml/hour delivers 1.0 μg/kg per minute)	

volume, replace coagulation factors and improve the oxygen-carrying capacity (Hb). Replacement of red blood cells is recommended to maintain a haematocrit of more than 30%. Type-specific blood is preferred, but if unavailable, O-negative may be used. There are, however, disadvantages in the use of blood as it must be cross-matched, which requires a specimen from the patient and time for processing by the blood bank. Massive transfusion can produce dilutional coagulopathy, hypocalcaemia and hypomagnesaemia. Blood-borne viral pathogens may be transferred, causing hepatitis and HIV.

Inotropic support can be considered once the fluid status has been optimised. Dopamine, a dose-dependent inotropic drug, is the drug of choice and may be used as a sympathomimetic agent to stimulate the adrenergic receptors and thereby increase the cardiac output and blood pressure in patients with haemorrhagic shock and hypoperfusion (see Table 33.6).

An episode of haemorrhage can have long-term consequences for a woman. Sheehan's syndrome can be caused by an episode of hypovolaemia, when blood pressure drops and there is poor blood flow to the pituitary gland causing lasting hormonal disturbances. The first sign is the failure to lactate after birth with an inability to ovulate later. The prevention of hypovolaemia is essential without risking overloading the patient. Accurate observation of the clinical picture, blood loss and effective replacement need to follow protocols and midwives need to know how to manage blood loss.

33.4 Cardiogenic shock (contractility)

Cardiac shock, also referred to as 'pump failure', is a condition of decreased cardiac output that severely impairs tissue perfusion, resulting in diminished oxygen delivery to the tissues. It leads to severe left-sided heart failure.

History (patients at risk)

A thorough history will help to predict patients at risk for development of cardiogenic shock. The obstetric patient suffering from any myocardial valve dysfunction, e.g. aortic, mitral or tricuspid valve stenosis or incompetence has a high risk of developing cardiogenic shock. Patients who give a medical history of rheumatic fever or congenital cardiac conditions and cardiac dysrhythmias must also be regarded as high-risk patients.

Clinical signs and symptoms

The patient presents with anxiety, tachypnoea, cyanosis and respiratory distress.

Regardless of the underlying cause, left ventricular dysfunction triggers compensatory mechanisms that attempt to increase the cardiac output in an attempt to increase the cardiac output and in turn the tissue perfusion and oxygen supply to vital organs.

The midwife should monitor the patients at risk closely for any of the following signs and symptoms:

- Haemodynamic findings:
  - systolic pressure less than 90 mmHg
  - central venous pressure more than 12 mmHg
  - tachycardia
- Clinical findings:
  - decreased level of consciousness (disorientation, restlessness)
  - distended neck veins
  - dysrhythmias
  - cold and clammy skin
  - decreased urine output (less than 0.5 to 1 ml/kg/hour)
- Pulmonary findings:
  - tachypnoea (more that 15 breaths per minute)
  - dyspnoea
  - abnormal breath sounds (crackles and possible wheezing)
  - arterial blood gas indicates low PO_2
  - use of accessory muscles to breathe.

Principles of diagnosis, management, intervention and care

Acute pulmonary oedema is probably the most important cardiac cause of death in pregnancy, hence the importance of maintaining a high index of suspicion and managing appropriately where it presents.

The major objective in treatment of this type of shock is to assist the contractility of the heart and to alleviate the causative agent.

Patients who have pulmonary congestion should NOT be positioned in a supine position with the legs elevated. The supine position will increase the pulmonary resistance, worsening the pulmonary oedema. The patient should therefore be positioned in a semi-Fowler position during labour.

In high-risk patients respiratory tract infections should be managed promptly.

If anaemia is present, transfusion of packed cells should be given instead of whole blood, as the packed cells will increase the red blood cell concentration without increasing the total circulating blood volume.

Intravenous infusions should be kept to the minimum (0.5 ml/kg/hour), to prevent an increase in the circulating volume. An increased circulating volume may lead to an increased myocardial workload and increased haemodynamic and pulmonary complications. (A microdropper and buretrol or an infusion pump is used to control the volume of fluid administered).

The ability of the patient with heart disease to survive pregnancy labour and the puerperium depends on the:

- capacity of the heart to pump (contract)
- extent of the total demand to work placed on the heart during pregnancy.

(See Chapter 20)

The specific difference and/or special considerations related to cardiogenic shock are highlighted in Table 33.7. The principles used during the ABC approach remain the same those in Table 33.3.

33.5 Septic shock (afterload)

Sepsis is a complex syndrome that occurs as a result of the systemic manifestation of infection. The human response to infection ranges along a severity continuum from systemic inflammation response syndrome (SIRS) to multi-organ dysfunction syndrome (MODS). Figure 33.2 gives an overview of the sepsis syndrome.

Each of the components in Figure 33.2 is briefly discussed.

Classification of shock

Systemic inflammatory response syndrome (SIRS)

Normally, the inflammatory response is an essential, firmly regulated and controlled protective mechanism of local response to invasion by micro-organisms or to local tissue damage. In SIRS the inflammatory response is systemic; it occurs in all

Table 33.7

Specific considerations in the structured approach to manage cardiogenic shock

Key principles	Interventions	Clinical notes
History	Specifically ask during ***past medical history*** whether the patient has underlying: ◗ rheumatic fever ◗ congenital cardiac conditions or ◗ cardiac dysrhythmias, cough of flu-like symptoms in late pregnancy (PPCM)	These patients must be regarded as a high risk and monitored accordingly
Breathing	**Look**: Observe the respiratory rate, depth and difficulty **Listen**: Briefly auscultate breath sounds bilaterally Initiate pulse oximetry, if available	
Circulation	Place woman in a semi-Fowler's position, preferably on the left side during the first stage of labour During the second stage of labour the woman must be positioned in an upright position. Never raise the legs above the level of the heart Insert one 18 or 20-gauge intravenous cannula. Use a 60 drops-per-minute administration set. Use a 200 ml vaculitre of Ringer's lactate or normal saline at a rate of 50 ml/hour	When sitting upright, the pulmonary pressures decrease due to gravitation pressure, decreasing the severity of the pulmonary congestion leading to pulmonary oedema NB: Patient should be fluid restricted as increased circulatory volume will increase the risk of pulmonary congestion and hypoxaemia
Drugs	Administer oxytocin (the drug of choice if needed in labour) **Do not give ergometrine during the second and third stage of labour** Consider furosemide, digoxin and/or aminophylline **postdelivery**	Egometrine works on the smooth muscles of the heart, increasing the flow of blood into the pulmonary circulation, leading to pulmonary oedema Furosemide is used to decrease the circulating volume Digoxin increases the ventricular contractility, increasing the stroke volume and decreasing the pulmonary congestion Aminophylline decreases pulmonary pressures due to pulmonary vasodilation

body systems. The systemic result is an overwhelming and unregulated inflammation process with widespread leakiness of the blood vessels causing the fluid to shift into the interstitial space. This leads to a maldistribution of the circulating volume (relative hypovolaemia). Furthermore there is an imbalance in the oxygen supply and demand on tissue level and uncontrolled coagulation.

Sepsis is the systemic response to infection. Sepsis is diagnosed when two or more of the following systemic responses are manifested:

- temperature > 38 °C
- heart rate > 90 beats p/min
- pyrexia > 15 and above breaths p/min
- white blood cell count > 12 000 or < 4 000.

Severe sepsis is defined as sepsis that is complicated by organ dysfunction. Severe sepsis is associated with organ-dysfunction, sepsis-induced hypotension, and hypoperfusion abnormalities such as lactic acidosis oliguria and acute alteration of the level of consciousness.

Multi-organ dysfunction syndrome (MODS)

MODS is a consequence of the inability of the body to maintain end-organ perfusion and oxygenation, resulting in cellular ischaemia and organ failure. When two or more organs become dysfunctional to the point where maintaining homeostasis requires active intervention MODS is diagnosed.

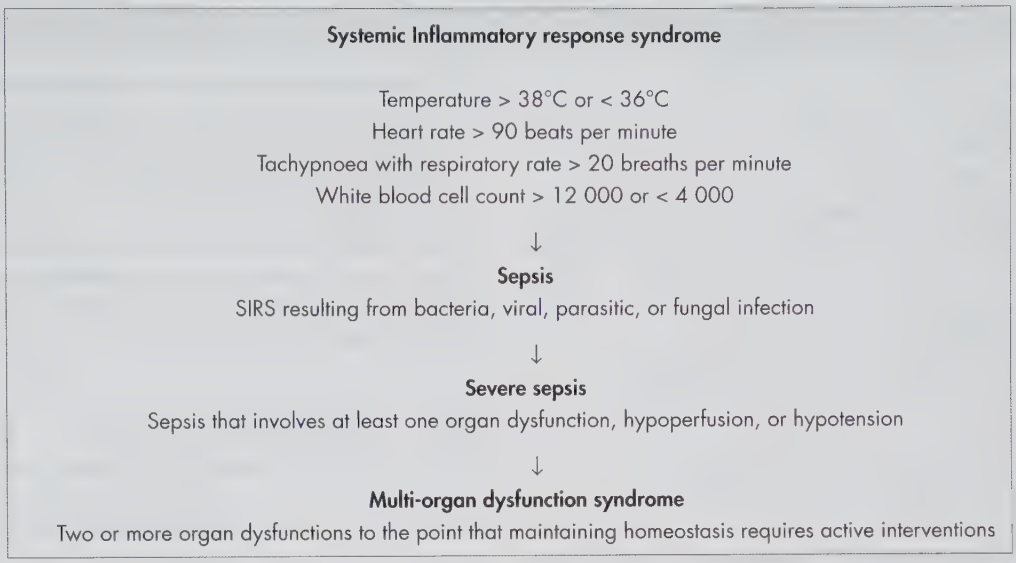


Figure 33.2 Overview of the sepsis syndrome

History of septic shock (patients at risk)

The leading causes of sepsis in midwifery practice include:

- UTI, pyelonephritis and renal calculi
- chorioamnionitis and prolonged rupture of membranes
- endometritis
- necrotising fasciitis
- surgical interventions (caeserian section, amniocentesis and episiotomy)
- septic pelvis trombophlebitis
- anaemia and perinatal infections
- HIV and sexually transmitted infections
- retained products of conception and milk fever (mastitis)
- iatrogenic, such as septic abortion.

Pathophysiology

In childbirth the risk is increased for septic shock because of the direct access of organisims to the system through the placental site via the vagina.

Sepsis begins with the entry of organisms into the bloodstream through the skin, respiratory tract, gastrointestinal tract, breasts and placental site. The organism entering the body may include bacteria, yeast, viruses, and/or parasites. The pathophysiology of sepsis is complex. It involves the activation of the inflammatory response to infection, along with activation of coagulation and impairment of fibrinolysis. An increase in inflammation and coagulation occur as the result of mediator responses, which function as part of the immune system reaction to infection.

Cytokines are released from white bloods cells and other cells in response to the infection in order to protect the cells from the effects of sepsis and to begin the healing process. The cytokines and white blood cells trigger vasodilatation leading to hypotension, increased capillary permeability, neutrophil activation, fever, decreased myocardial contractility and adhesion of platelets to the endothelium.

The compensatory mechanism includes the baroreceptors that are situated in the aortic arch and carotid arteries, which respond to the decrease in the cardiac output. The baroreceptors activate the sympathetic nervous system, which in turn stimulate the release of potent vasoconstrictors, adrenaline, and noradrenaline to maintain blood flow to vital organs: the heart and the brain. Simultaneously, blood is shunted from non-vital organs such as the lungs, kidneys, gastrointestinal tract, and skin. Decreased blood flow to the kidneys activates the rennin system. This process eventually affects the circulatory volume, cardiac output and tissue perfusion. This leads to multi-organ dysfunction syndrome (MODS), and ultimately death.

Clinical signs and symptoms

The midwife should closely monitor the patients at risk for any of the following signs and symptoms.

Haemodynamic findings

- decreased level of consciousness (disorientation, restless)
- tachypnoea (more than 15/breaths per min and above)
- pyrexia (temperature > 38°C)

- systolic pressure less than 90 mmHg
- central venous pressure less than 10 mmHg
- tachycardia.

Clinical findings

- warm and dry skin
- decreased peripheral perfusion
- decreased urine output (less than 0.5 to 1 ml/kg/hour or 30ml/hour).

Additional findings

- serum-CRP > 12 mg/ℓ
- white blood cell count > 12 000 or < 4 000 10^9/ℓ
- lactate >2 mmol/ℓ
- arterial blood gas indicates metabolic acidosis (pH, HCO_3 and BE).

Diagnosis, management, intervention and care

Goal-directed therapy in the management of sepsis is often focused on supporting failing organs with interventions including airway management, fluid replacement, antibiotic therapy and the use of vasopressors. To prevent sepsis progression it is important to identify the infection source and target the specific source, e.g. debridement of an abscess.

With an aim to promote evidence-based sepsis treatment, the Surviving Sepsis Campaign developed specific management guidelines to decrease the mortality of patients with sepsis (see Table 33.9). Initiate these actions and simultaneously call for assistance.

The specific difference and/or special considerations pertaining to septic shock are highlighted in Table 33.8. The principles used during the ABC approach remain the same as shown in Table 33.3.

33.6 Anaphylactic shock

Anaphylaxis is a life-threatening event that can occur any time during pregnancy. It has been reported following administration of various substances with adverse maternal and neonatal consequences. It should be considered in the differential diagnosis of intrapartum collapse. It is important to highlight anaphylaxis as a cause of collapse in pregnancy and birth in relation to a variety of substances that may be given to a woman.

Table 33.8

Specific considerations in the structured approach to manage septic shock

Key principles	Interventions	Clinical notes
History	Focus on past medical history, specifically pertaining to 'infection'	
Breathing	**Look**: Observe the respiratory rate, depth and difficulty **Listen**: Briefly auscultate breath sounds bilaterally Initiate pulse oximetry, if available	
Circulation	Turn woman on her left side or elevate her right hip to prevent supine hypotension Promptly place ***one or two*** large-bore (14 or 16 gauge) intravenous lines and simultaneously draw blood (lactate, FBC, CRP, PCT). Use a 10-drops-per-minute administration set. Administer 20 ml/kg bolus of crystalloid solution, i.e. Ringer's lactate as a volume expander. Repeat bolus if systolic blood pressure remains < 90 mmHg	Monitor and interpret vital signs vigilantly and frequently *(every 15 minutes until patient is stabilised)* Monitor urinary output using an indwelling urinary catheter (normal = 0.5 to 1 ml/kg/hour)
Drugs	Broad-spectrum antibiotic Dopamine is the drug of choice (alternatively use phenylephrine or adrenaline)	The woman must receive the first dose of broad-spectrum antibiotic within 3 hours from diagnosing sepsis. This may decrease mortality by as much as 30–50% Do not give inotropic drugs before fluid boluses. Inotropic drugs are used to increase the afterload (blood pressure)

Table 33.9

Surviving Sepsis Campaign: Resuscitation bundle

Sepsis resuscitation bundle ▸ serum lactate measurement (draw an arterial blood gas) ▸ draw blood cultures prior to antibiotic administration ▸ administer a broad-spectrum antibiotic within three hours after diagnosing sepsis
In the event of hypotension and/or lactate > 4 mmol/ℓ ▸ give bolus of minimum 20 ml/kg of crystalloids (e.g. Ringer's lactate) ▸ administer vasopressors for hypotension not responding to fluid resuscitation to maintain MAP > 65 mmHg (e.g. dopamine)
Refer to the following websites for additional reading: www.alsg.org www.survivingsepsis.org www.resus.org.uk/pages/ALSequiv.htm

It can be severe, can occur within minutes after initial exposure to the offending agent, and can occur with no history of known allergy.

An incidence of 1–17% of the general population of those at risk for anaphylaxis is noted, and of these 0.002% are at risk of fatal reactions. In general in hospital (not obstetrics) 3–5 per 10 000 cases can have anaphylaxis. The estimated intraoperative anaphylaxis incidence is between 1:3 500 and 1:20 000. The same was found in the UK.

The outcomes depend on the age, parity, gestational age, comorbidities, aetiological trigger, coagulopathy, causing agent and clinical picture. Anaphylaxis can result in significant long-term morbidity, mainly related to cerebral hypoxia after an ineffective resuscitation.

History (patient at risk)

Any person may be at risk for anaphylaxis (drug hypersensitivity) by a known or unknown agent. Anaphylactic reaction is usually precipitated by food (nuts, fish), blood products, vaccines, insect bites, latex rubber, plasters, skin antiseptics, and certain drugs such as opioid analgesics, neuromuscular blocking agents as well as oxytocin, antibiotics and ranitidine.

Colloid solution is a commonly used plasma expander in clinical practice and anaphylaxis has been reported in the use of some of the colloids. Colloid solutions are used very frequently for postpartum haemorrhage and sometimes antenatally for severe haemorrhage and can trigger allergic reaction (see Table 33.10).

Women with asthma may have a reaction to prostaglandins.

This type of shock is more likely to occur after parenteral administration in atopic individuals who are particularly susceptible because of their (often unknown) hereditary predisposition to anaphylactic reactions.

Pathophysiology

Anaphylaxis is a rapid systemic hypersensitivity reaction to a substance in a sensitised individual, with potentially life-threatening consequences. IgE antibodies, which can cause histamine and other vasoactive mediators are released from mast cells and basophils. IgE immunoglobulins are found in plasma and are the only antibodies in humans to produce anaphylactic reactions, for example, immediate hypersensitivity. These mast cells are wandering cells that are found in most tissues, but are most abundant in connective tissue. The antibodies are generated on exposure to a specific stimulus. These cells release histamine in the tissues as part of the inflammatory reaction. These histamines produce respiratory, circulatory, cutaneous, and gastrointestinal effects. Increased vascular permeability and peripheral vasodilatation reduce venous return and cardiac output.

Clinical picture

A mild reaction is manifested as flushing, urticaria, itching, redness and localised oedema.

More serious reaction is manifested as shock, bronchospasm, laryngeal oedema, and angio-oedema.

The clinical picture may include various degrees of chest pain, dyspnoea, tachycardia, hypotension, cyanosis and disseminated intravascular coagulopathy (as demonstrated by laboratory findings).

Cardiac or respiratory arrest may result.

Based on the clinical picture and laboratory findings, amniotic fluid embolism or trophoblastic embolism may be

Table 33.10

Comparison of intravenous crystalloids and colloids

Crystalloids	Plasma substitutes and colloids
Substances from crystals (sodium and chloride) that break down in water	Particles do not break down in water
Particles are small and weigh 30 kilodaltons (kDa), can easily pass through compartments	Most of them larger than 30 kDa
Particles are available in three tonicities (osmolarity)	Cannot fit through most capillary pores and stay in capillary bed
Is isotonic (same number of particles as plasma)	Used for volume expansion 250 ml will give the same effect as 4 ℓ of crystalloids
Won't allow shift of fluid in or out of cells. Should not cause oedema	A disadvantage is that the pressure in the capillaries stretches so that the pores and the colloids move through. The oedema that results takes longer to resolve than with crystalloids
Examples Ringer's lactate and normal saline 0.9%	Human albumin, dextran, polygeline (Haemaccel®) tetrastarch (Voluven®), pentastarch (HAES-steril®)
Currently the fluid of choice with resuscitation/electrolyte replacement	Plasma substitutes are widely used for the treatment of hypervolaemia
Current evidence suggests that Ringer's lactate may cause pro-inflammatory responses that may trigger ARDS (acute respiratory distress syndrome)	Problems: Fluid overload, pulmonary oedema and anaphylaxis
5% Dextrose is not used for resuscitation. The glucose is rapidly metabolised and fluid becomes hypotonic. Water swiftly shifts from the vascular bed into the cells through osmosis. This may correct cellular dehydration and hypernatraemia but will worsen hypotension	10–20 ml predosage given and patient's reaction is monitered for analphylactic shock
Hypertonic fluid will pull water from cells and interstitial spaces, shrinking the cells. Hypertonic saline, 0.45% assists with electrolyte imbalances and suppresses inflammatory responses. It is gaining popularity as fluid of choice in resuscitation	

suspected and need to be excluded. History of atopy (genetic tendency to develop allergic reaction) (IgE) is present in fewer than 50% of patients.

Diagnosis, management, intervention and care

There is no valid predictor of drug anaphylaxis. A history of family history, disease profiles, previous allergies, current medication and the use of natural substances is important when a woman is admitted for interventions in pregnancy and birth, particularly for induction of labour or caeserian section and anaesthesia.

Clinical recognition of manifestations is very important. Serial serum tryptase estimations are helpful in diagnosis of anaphylaxis.Tryptase enzyme is released from mast cells and it parallels histamine release. Peak concentrations are well above 20 mg/ml indicate true anaphylaxis/anaphylactic reaction. The peak value of tryptase in the serum occurs between 30 minutes to six hours after an anaphylactic reaction.

There must be a written emergency action plan for the management of anaphylaxis in obstetric care. A list of known allergens/agents triggering anaphylaxis and the conditions attached needs to be visible and available to alert staff of substances in obstetrics with a potential for anaphylactic reactions.

Since anaphylaxis can occur with any drug, all the members of the perinatal team should be familiar with the recognition of symptoms and signs of anaphylactic reaction. It is further highlighted that anaphylactic reactions can be unpredictable and severe reactions manifested in the form

of angio-oedema and cardiovascular collapse need immediate and prompt treatment. Severe anaphylactic reaction can also happen during a surgical procedure. Severe reactions require early recognition and aggressive resuscitation. All obstetricians and midwives should be trained to be able to identify and manage this emergency. Management of anaphylaxis should be included in the emergency drills on a regular basis so that this uncommon life-threatening event is tackled in the most effective way. It is very important that the members of the perinatal team are aware of the symptoms and signs of anaphylactic reaction and are familiar with the management of anaphylactic shock. Treatment includes:

- Immediately discontinue agent causing the reaction.
- First-line treatment: restore blood pressure, let patient lie flat and lift the foot of the bed with a lateral tilt if still pregnant to lift uterus from inferior vena cava.
- Give 100% oxygen.
- Give adrenaline intramascularly 0.5–1.0 mg ℓ in 1 000. Repeat every 10 minutes until improved.
- If haemodynamic instability continues an adrenaline infusion may be required: 1 mg adrenaline diluted in 250 mg normal saline: start at 15 ml per hour and titrate as per clinical symptoms.
- Administer crystalloid for intravascular volume expansion. If colloid was given prior to the reaction, change to crystalloid because the causative agent might have been the colloid substance (500–1 000 ml Ringer's).
- Antihistamines can be administered.
- Corticosteroids (100–500 mg hydrocortisone) are given intravenously in severe cases.
- Bronchodialators may be required.
- Prolonged monitoring in intensive care/intubation.

Adrenaline is the most important drug in anaphylactic reaction, and must be readily available. Intramuscular (IM) is the best route of administration.

33.7 Conclusion

There are different types of shock that a midwife may encounter in obstetric practice. Each of these types of shock may be life-threatening. The ability to differentiate between these types of shock combined with immediate initiation of appropriate and systematic collaborative management, may enhance patient health outcomes. A patient may suffer from several types of shock simultaneously which makes intervention very complex.

Section Six
Postnatal care

34 The psychology of the normal puerperium

35 The physiology of the puerperium

36 Assessment, diagnosis and care in the puerperium

37 Complications of the puerperium

38 Infant feeding

CHAPTER

34 The psychology of the normal puerperium

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- demonstrate competence in assessing the psychological adjustments/adaptations during the puerperium
- provide nursing care to meet the mother's psychological adaptation needs postpartum
- provide support and information to the mother during the postpartum period to promote bonding and transition to motherhood.

KNOWLEDGE ASSUMED TO BE IN PLACE

Preconception care and reproductive health
Normal psychosocial development and challenges in parenthood (Refer to Chapters 10, 11, 12, 13 and 18)

KEYWORDS

Kangaroo-mother-care • Postpartum blues

34.1 Introduction

The first few minutes, hours and days after birth are well researched. This chapter will consider the events and experiences of the mother and newborn and the family that occur shortly after birth.

34.2 The experience of birth

Reactions immediately after birth can vary widely from enthusiastic excitement to dejection, and even rejection of the newborn. While it is easy to participate in the joy and pleasure of a mother or couple whose birth experience has been a good one, it is more difficult to remain encouraging and supportive of the woman who appears not to enjoy the initial moments after delivery. Any inner feelings of irritation, disappointment and anger on the part of the midwife need to be carefully managed while the parents' points of view are considered. Sometimes disappointment or a lack of enthusiasm may be an appropriate response, for example following a long, difficult labour that did not go as hoped. This less than positive experience needs to be accepted by the midwife who should build the woman's self confidence by, for example, praising her for managing a difficult situation well.

Even joyous mothers can respond to their babies in different ways. Some mothers bubble verbally, others are quieter, preferring to touch rather than talk. Both responses are acceptable. Getting to know a baby takes time. For some mothers, their own baby may be the first they have ever held.

If fathers are present, they often hold their babies soon after birth, as many mothers are quite willing to hand over fairly quickly, particularly if the birth was difficult or if they do not feel too sure of themselves.

Research indicates that fathers who were present at the birth and who had the chance to see and hold their babies at this time, become more involved with their babies in the early months than do fathers who were not present at the birth.

However, cultural differences may mean that fathers are rarely, if ever present at the birth. African men are not expected to be present, particularly in rural areas. These cultural differences must be respected.

Experiencing events after birth

The birth plan includes a woman's choice of birth companion and her feeding preferences.

Most maternity units allow parents to spend time together during the first few hours after birth and encourage the father

and the family to be involved. Visiting times may be flexible. This allows couples to relive the birth and to incoporate the transition to parenthood into their self image.

The transition to parenthood, especially for first-time parents, requires adaptation and skills that need to be developed. Talking about the events of the birth together, with the baby present, can assist parents to come to terms with their new experiences.

During this time the midwife should be particularly alert to questions, such as: 'How well did I cope?' This question, which may occur in the hours or days after delivery, may come from a woman's self doubt. It is important that the woman be encouraged to think about her achievements, rather than her disappointments, because a negative self image may predispose to even more difficulties for her in the ensuing weeks and months.

Feelings of failure are common and are aggravated by romanticised images of childbearing, or by nurturing too high expectations of the birth 'performance'. Often the expectation that is created is that birth should be unassisted by medical practitioners or drugs and should be exhilarating, exciting, joyous and perhaps painful, but tolerably so. Births that deviate from this goal are regarded as a failure on their part by many mothers.

Bonding

Bonding should start before conception as the parents plan the pregnancy. If the pregnancy is unplanned, bonding may be delayed but the parents start to become aware of the baby once there are fetal movements, or earlier if there is an ultrasound. This makes the baby real and can enhance bonding. By the end of the third trimester most women have positive feelings towards the baby and accept the pregnancy. A percentage of mothers will say that they only 'fell in love' with the baby after birth, while some women say that they learned to love the baby over time and did not feel a bond with the baby immediately after birth.

Bonding is promoted after birth through early mother to infant skin-to-skin contact (also called kangaroo-mother-care (KMC)), putting the baby on the mother's breast soon after birth, breastfeeding and rooming-in if the baby is not ill and separated from the mother in a neonatal unit (See Chapter 12).

Baby-friendly care promotes parent and infant bonding. Institutions can apply for baby-friendly status, a process that takes about five years to complete, during which time the institute develops an environment that keeps mother and baby together.

A good birth experience (be it a caesarean section or a vaginal delivery without any assistance or intervention) will facilitate the growth of love. Difficult or disappointing deliveries may make this more difficult. Hence the importance of dealing with psychologically difficult birth experiences in the early days after delivery, to release the mother from her emotional constraints.

The birth environment

Family-centred maternity care provides the woman with antenatal care and delivery in a home-like environment in the hospital where she may be accompanied by as many family members as she and the midwives allow. This concept attempts to combine the supportive environment of birth offered by home deliveries, with the security of available hospital facilities should things go wrong. There are private midwifery units in South Africa that allow the family to stay with the mother after birth.

Siblings may wish to be present at the birth and, providing there is someone available to care for them during the process and they have been adequately prepared, some institutions allow this.

Baby care

For the first-time mother in particular, starting to care for her new baby is often a nerve wracking experience. With little prior exposure to babies, as is often the case today, this may be even more difficult. Most pregnant women today will attend antenatal preparation classes or will prepare themselves for parenthood by getting information from their caregivers, midwives or medical practitioners or by reading magazines, books, getting information from the Internet, talking with their mothers, sisters, or friends. A supportive network is valuable during pregnany and after birth.

The midwife should help the woman to gain the knowledge and skills required to confidently care for herself and her baby during and after the pregnancy. If there is to be early discharge, the midwife should ensure that continuing support is available for the new mother at home, either from family members or from a home nursing care service.

Hospitals and clinics provide toll free 24 hours support lines for new mothers to consult after discharge.

Common issues in early parenthood

Most young or first-time mothers encounter certain common problems.

Crying babies

Some babies cry a lot. Mothers often find this disconcerting, and think that 'good' mothers should be able to calm their babies. The concept of a 'good enough mother' should

be separated from parenting skills in the first few days after delivery and parenting over a lifetime.

Explain the different reasons why babies cry and the sleep-wake cycle (See Chapter 10).

Rooming-in and nursing care

Mothers are often concerned about keeping their babies with them all the time after delivery, or about nursery care. This should be flexible. If a mother still cannot look after herself after the birth she may be reluctant to have the baby with her, because she fears she will not be able to care for the child adequately.

If a mother is allowed up and can move around freely she may opt to keep the baby with her. Keeping a baby with her will allow a new mother to become more familiar with her baby's routines, needs, sounds and presence than she could if the child is in a nursery. This will help the new mother to gain confidence and help the midwife, who wants to discharge a confident and capable new mother. Learning to care for the new baby herself, while still having the resources of midwives to call on whenever needed, is the best system to follow if possible.

A nursery care system is best for women who have had complicated births. There must be a written policy on the application of baby-friendly care.

Responsibility

Mothers often only come to realise the full responsibility of parenthood in the days following delivery. Full realisation of these demands may result in what are called 'baby blues' or postnatal blues.

Postnatal blues

Mild emotional disturbances in the days, weeks and months following birth can be classified as baby blues and are transient. This must be distinguished from postnatal depression which is a potentially very serious condition.

The care of a woman experiencing an episode of baby blues includes the following:

- Reassure the woman that the feelings she experiences are normal.
- Explain that hormonal disturbances cause the feelings and that it will pass.
- Ask how it can be made better. Offer to take the baby to the nursery, offer a cup of tea, give a painkiller if needed, give privacy, offer a shower or Sitz bath and make her comfortable or allow her to sleep.
- Give tender loving care and support.
- Try to continue with a normal routine as soon as possible and give support.
- Record the episode and make sure that it is resolved by discharge.
- Observe for signs of psychosis that present within the first week after birth and include symptoms of insomnia, suspicion, abnormal behaviour, neglect or overprotection of the baby and loss of sense of reality.

The baby blues can also present at home. Postnatal depression and psychosis are more serious problems and are discussed in Chapter 13 under mental health.

Care after discharge

Unless the midwife is actively involved in district nursing, she will probably have little contact with the new mother after discharge and during most of the puerperium. It is essential, therefore, that the hospital or clinic-based midwife makes an effort to discharge a confident and capable mother.

Early discharge of women after birth and the lack of supportive postnatal services leave a gap in the care of women postpartum. Support services are needed to help women, particularly very young women, adapt to the demands of motherhood.

A new mother should be provided with a list of resources she can call on, including telephone numbers of support groups or available midwives. Midwives should also provide books and brochures if available.

In addition, if the midwife is concerned about a new mother who is being discharged, she should take particular care to refer her for help or to notify district nursing services to take particular care of her in the ensuing weeks. If necessary, daily home visits could be provided until the district midwife is sure the woman is satisfactorily launched in her new role as a mother.

It is important to consider psychological risk factors during pregnancy that may lead to mental health risks and disorders (See Babytalk://www.babytalk.co.za).

34.3 Conclusion

The transition to motherhood is dependent on psychological and cultural factors.

Pregnancy and birth are considered to be a stress situation that can be normal or put both the woman and her partner's mental health at risk. When the woman and her partner receive appropriate support from the healthcare system and/or their community, the transition to parenthood may be uneventful. Lack of support may lead to complications.

CHAPTER

35 The physiology of the puerperium

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- define the puerperium
- explain normal anatomical and physiological changes characteristic of the puerperium
- explain the normal physiology of lactation.

KNOWLEDGE ASSUMED TO BE IN PLACE

Pre-conception and reproductive health care.
Anatomy and physiology of pregnancy and birth.
Anatomy and physiology of the breasts and synthesis of breast milk

KEYWORDS

Puerperium • After pains • Lochia • Lactation • Involution

35.1 Introduction

After birth the woman's body undergoes physiological changes that include healing of the birth canal, involution of the uterus and breastfeeding. During this time the body gradually returns to a nonpregnant state. The woman is changed by pregnancy anatomically, physiologically, emotionally, socially and economically.

35.2 Definition of the puerperium

The word puerperium comes from the Latin *puer* meaning a child and *perus* meaning to bring forth.

The puerperium is defined as the period from the completion of the delivery (end of the third stage of labour) to the end of the first six weeks postpartum, during which time the woman's body returns to the normal nongravid state.

During pregnancy, many physiological and psychological changes take place in the woman's body and mind, which end in the birth of the baby.

During the puerperium, changes in the anatomy, the physiology and the biochemistry that occurred during pregnancy and labour return to the nongravid state. However, a woman's body never returns to the prepregnancy state. Some of the changes that take place during pregnancy are permanent.

In addition, the woman has to adapt psychologically and socially to motherhood and, together with her husband/partner and other members of the family, faces a time of challenges, happiness and adjustments.

Normal physiological changes in the puerperium

The postnatal period is a time of restoration. The first concern of the midwife is to make sure that the woman goes through the postnatal period without complications.

After the birth, the woman's body begins the process of returning to the nongravid state. However, at the same time she needs to be able to breastfeed.

These changes occur within the first 14 days and the midwife needs to understand these changes and to detect any abnormalities as early as possible. The first 24 hours after birth carries the greatest risk of postpartum haemorrhage.

Endocrine changes

Oestrogen and progesterone

Oestrogen and progesterone levels drop after the delivery of the placenta. By 24 hours after birth, oestradiol has dropped to 2% of the pregnancy level. Progesterone levels do not fall as rapidly as the oestrogen because there is still secretion from the corpus

luteum for the first few days after birth. The level of these hormones remains low for the first few weeks postpartum.

Human chorionic gonadotrophin (HCG), human placental lactogen (HPL), oestrogen and progesterone fall rapidly. Normally, after seven days, HCG is no longer detectable in the woman's urine, and after two days, HPL is no longer detectable in the plasma.

Follicle stimulating hormone (FSH) and luteinising hormone (LH) start to rise slowly over four to six weeks after birth.

Prolactin

Prolactin is decreased when labour starts and increases immediately after birth, with a peak three hours postpartum. The release of prolactin is triggered by the suckling of the baby. Prolactin levels also increase with anaesthesia, surgery, exercise, nipple stimulation, and sexual intercourse. The more the baby suckles, the higher the levels of prolactin. In women who do not breastfeed, the prolactin levels gradually decrease over 14 days.

Oxytocin

Nipple stimulation during suckling also causes the release of oxytocin, which contracts the myoepithelial cells lining the lactiferous ducts and causes the 'let-down' of milk. Oxytocin also causes contraction of the uterine muscle and therefore, at the same time, assists in the involution of the uterus (See Chapter 38).

Restoration of ovulation and menstruation

Ovulation and menstruation are the last major functions to return to normal. In women who breastfeed their babies, ovulation seldom occurs before 20 weeks and may not occur for up to 28 weeks in women who continue breastfeeding for six months. In most instances, the more frequently the baby suckles, the less chance there is of ovulation occurring. However, ovulation may occur earlier than 20 weeks, particularly if the woman is only partially breastfeeding. In nonlactating women, ovulation and menstruation usually start again within seven to 10 weeks.

35.3 Involution

Involution is the return of the reproductive tract to the nongravid state.

The uterus is the main organ involved in involution and almost (but not entirely) returns to a nonpregnant state. The uterine and pelvic ligaments, the vagina, the pelvic floor and the perineum regain much of their prepregnant tone, but some stretching and laxity may remain.

Reproductive organs

The uterus

The uterus is the organ that has to undergo the greatest amount of involution, because it has had to undergo the greatest changes during pregnancy and labour.

The enlarged uterus is no longer needed to carry the fetus therefore tissues developed in pregnancy break down through the following mechanisms:

- *Ischaemia of the myometrium.* This is caused by the continuous contraction and retraction of the uterus after the expulsion of the placenta, making the uterus relatively anaemic and causing atrophy of the muscle fibres. The blood that was contained within the uterine vessels is released into the bloodstream. This greatly increased volume of fluid in the circulation has to be removed by the kidneys, and results in a major diuresis in the early puerperium.
- *Autolysis.* With the withdrawal of the placental oestrogens, protein synthesis is no longer stimulated. Instead, proteolytic enzymes break down proteins, which are finally excreted by the kidneys, increasing the diuresis. Simultaneously, phagocytes invade the collagen fibers between the myometrial cells and fat is removed, while thrombosed blood vessels are also broken down and absorbed.

A cellular barrier forms over the placental site and all tissue superficial to this barrier is shed. A new epithelium develops and covers the area.

By the end of about the first six weeks after delivery:

- The weight of the uterus is diminished from about 1 000 g to about 60 g.
- The size of the uterus is diminished from about 15 × 12 × 8 cm to about 8 × 6 × 4 cm.

The uterus never completely returns to its prepregnant size and weight, but with each pregnancy, the muscle weight and collagen content of the uterus are slightly increased and elastin is deposited around the blood vessels. With each successive pregnancy, therefore, the collagen and elastin content increases, causing the uterine muscles to become less elastic and resulting in the uterus becoming a progressively less efficient organ for pregnancy and labour. After birth the uterus is below the umbilicus. The ligaments are loose and the uterus can move freely in the abdomen. A well-contracted uterus can be palpated and feels like a tennis ball. Within 24 hours the uterus is approximately at the level of the umbilicus because of the increased tone of the pelvic floor. The fundus of the uterus decreases between 1 cm to 1.5 cm or about a finger's breadth per day in a primigravida and 2 cm in a multigravida.

This means that by about 10–12 days after delivery, the fundus can no longer be palpated abdominally, because it has sunk below the level of the symphysis pubis (pelvic brim) and is a pelvic organ again (see Chapter 35).

Involution of the uterine ligaments is gradual, and at first the uterus tends to tilt backwards. However, the uterus has usually returned to its normal anteflexed and anteverted position by the end of six weeks. The uterus will never retain its prepregnant size and the size of the uterus will indicate a previous pregnancy.

After pains

Intermittent uterine contractions continue for the first few days after delivery, but often go unnoticed by the primipara. However, multipara experience uterine cramps and afterpains, probably when the uterus has to expel blood clots and particularly when the baby suckles (the release of oxytocin into the blood circulation causing stronger contraction of the myometrium). The pain is likened to that of dysmenorrhoea and can be so distressing that analgesia is required.

The placental site

Once the placenta is expelled and the uterus contracts and retracts normally, the placental site diminishes rapidly and by the day after delivery has shrunk to a diameter of about 7.5 cm from its pregnant 20 cm diameter. By about the tenth day after delivery the diameter of the placental site is about 2.5 cm. By the end of five to six weeks, the epithelial covering has completely regenerated, leaving only a small depression, but no scar tissue.

The endometrium

The epithelial layer of the endometrium, except for the placental site, has regenerated by the end of two weeks.

Lochia

The living ligatures of uterine muscle and the blood clotting at the placental site prevent excessive bleeding, but a slowly diminishing discharge from the placental site continues to take place for up to six weeks. This discharge is known as the lochia.

The amount of lochia varies in different women, but diminishes from slightly more than the usual menstrual flow, to mere spotting on the perineal pad towards the end of the puerperium. The quantity will also vary from day to day, for instance, when the woman first spends more time walking around, or, after breastfeeding, the amount of lochia may increase for a while. Where the placental site was larger than normal, as in a multiple pregnancy, an increased quantity of lochia will be noted.

Normal lochia has a characteristic strong, but not offensive, smell.

The lochia is differentiated as follows:

- *Lochia rubra*: for the first two to four days after delivery, the lochia consists mainly of blood, dissolved blood clots from the placental site and of trophoblastic debris and is red. From three to seven days after delivery, the lochia becomes reddish-brown as the bleeding is controlled.
- *Lochia serosa*: from five up to 15 days after delivery, the lochia consists mainly of serum, lymph and leucocytes and varies from pinkish to a yellowish-brown.
- *Lochia alba*: from a week up to four to six weeks after delivery, the lochia contains lymph, leucocytes, cervical mucus, organisms and other debris from the healing process and is creamy-yellowish.

A persistent red or heavy lochia for more than 10 days or the continuous passing of clots should receive attention and be reported to the medical practitioner, as this would indicate that the placental site is not involuting as it should and may suggest the presence of retained products, with the danger of a secondary postpartum haemorrhage and infection.

For the first four to five postpartum days, the lochia in the uterine cavity is sterile (if there was no prior chorioamnionitis) but it becomes contaminated by micro-organisms as it passes down the vagina, and this gives the lochia its characteristically strong but not offensive odour. These micro-organisms multiply in the vagina and after four to five days, invade the uterine cavity. The cellular barrier has formed by this time and normally prevents infection of the placental site.

However, if there has been a delay in the healing process, if the woman's resistance is low, if the woman has been subjected to a particularly traumatic delivery, or if the aseptic technique has broken down and virulent organisms have been introduced into the vagina, cervix or uterus, then the barrier can be penetrated and puerperal infection can occur. A lochia with an offensive smell would indicate infection.

The cervix

The cervix is soft and flabby and reddish-blue after delivery and often has small lateral lacerations. The cervix can often be seen at the introitus after birth. As the pelvic floor regains its tone, the cervix is pulled back into the vagina. The involution of the cervix occurs together with that of the uterus and by two to three weeks, the cervical os is a mere slit. (After the first vaginal delivery, the cervical os never returns to the initial nongravid size and shape.)

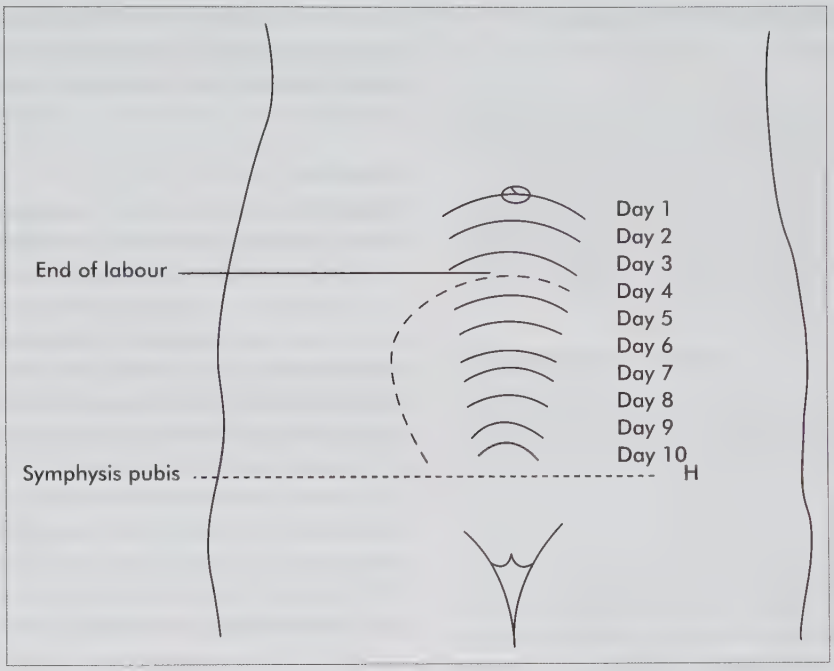


Figure 35.1 Involution of the uterus after delivery

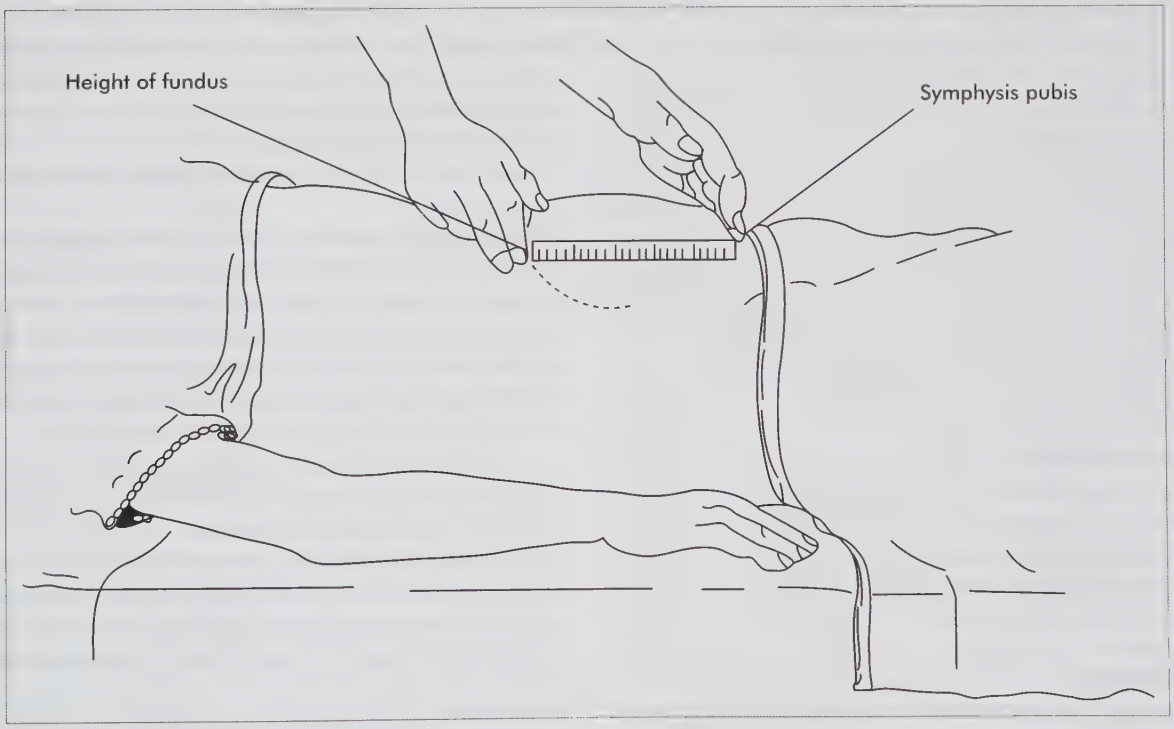


Figure 35.2 Measuring the height of the fundus in the puerperium

The vagina, the vulva and the perineum

The vagina

The vaginal wall has been extensively stretched during the delivery and is, therefore, swollen, reddish-blue and flabby after the delivery. The vagina regains most of its tone by the end of the puerperium. The vaginal epithelium (mucosa) and submucosa may be lacerated or may have been incised with an episiotomy. The mucosa takes two to three weeks to heal, but the submucosa requires suturing and remains delicate for four to six weeks after delivery or even longer.

The vulva

Any superficial lacerations that may have occurred heal relatively quickly. Remnants of the hymen are known as carunculae myrtiformes.

The perineum

Owing to the liberal blood supply to the area, perineal tears and episiotomies, which also require suturing, should be healed after seven days, but severe lacerations may remain sensitive or even painful for weeks. The perineal muscles regain their tone after five to six weeks and this is speeded up and maintained by exercising after the birth of the baby.

The abdomen

The skin of the abdomen, which has been greatly stretched during pregnancy, appears loose and flabby for weeks or even months. The stretch marks gradually fade, but often do not disappear altogether and instead, become silvery-white streaks (stretch marks).

The muscles of the abdominal wall, with the aid of postnatal exercises, should regain their tone within a few weeks. However, the rectus abdominus muscles remain separated in the midline, but also respond to abdominal exercises. In grande multiparae, in older women or when a multiple pregnancy has occurred, skin and muscles take longer to regain their tone, and these women, in particular, should be encouraged to do exercises (see Chapter 18).

The pelvic girdle

During the puerperium, the pelvis gradually regains its former stability as the joint ligaments regain their tone. The process takes several weeks and until it is complete, it is common for the woman to experience backache, particularly related to the region of the sacroiliac joints.

The breasts

During pregnancy, the increased amounts of oestrogen and progesterone in the woman's circulation prepare the breast tissues for lactation, but the high levels of oestrogen inhibit the secretion of prolactin by the anterior pituitary gland. This suppresses the production of milk until the puerperium, when the levels of oestrogen fall dramatically after the expulsion of the placenta.

Lactation

In the first two to three days, colostrum is secreted by the breasts, which is an important component in the nourishment of the newborn baby (see Chapters 9 and 38).

The secretion of milk usually begins on the third day after delivery and the secretion of prolactin is stimulated by the neurohormonal reflex mechanism which is activated when the baby suckles. Therefore, the more the baby suckles, the more milk is produced by the breasts. Rest and sleep are also an important part of this process.

Lactation can reduce the incidence of pregnancy through suppression of ovulation but is not a reliable method of contraception.

If a woman wishes not to breastfeed it is advisable to suppress lactation before the neurohormonal reflex is initiated.

The cardiovascular system

The heart

The cardiac output increases during labour and rises even further after the third stage when the large volume of blood is squeezed into the circulation as the uterus contracts to prevent haemorrhage. The cardiac output gradually decreases during the first few days of the puerperium and has returned to the normal prepregnant output by the end of the third week in women without cardiac disease.

The vital signs of a woman postdelivery are usually physiologically low.

The blood pressure should be normal in relation to the values before or during labour. A diastolic blood pressure of 90 or above is a danger sign for eclampsia. A drop or rise in the blood pressure of 15 mmHg diastolic and 30 mmHg systolic needs to be monitored. Consider a history of infections, surgical interventions, or epidural. Manual removal of the placenta and caesarean section also alter the vital signs.

A woman's temperature is physiologically low after birth. Any raised temperature needs to be noted. (An epidural can cause an increase in the temperature.)

The pulse rate of a woman (without cardiac disease) is physiologically low after birth. Any pulse rate of 90 beats and higher needs to be noted and monitored until stable.

Respiration returns to normal at 16–20 breaths per minute.

The blood

With each 250 ml of blood loss the haemoglobin drops by 1 g/dl, and the haematocrit drops by four points. A woman

who had a haematocrit of 37% and an Hb of 12 g/dl may experience a drop in her haematrocrit to 33% and in her Hb to 11 g/dl. A woman who started labour with a borderline haematrocrit or haemoglobin may become compromised by a moderate blood loss.

Although there is a decrease in the blood flow to the organs after the first few days, the blood flow to the breasts is increased in order to establish lactation. There is a gradual return to normal of the number of red and white cells by the end of the puerperium (see Chapter 20).

During the last few weeks of pregnancy, the levels of fibrinogen, plasminogen and clotting factors increase significantly. In the first few days after delivery, these levels fall fairly rapidly, but the blood is more coagulable, with increased viscosity, and this results in an increased risk of thrombosis.

The clotting factors of the body are activated in the early postpartum period with a particular high level of fibrinogen. This may increase the risk of thrombophlebitis and embolism.

The white blood cell count increases to 30 000, particularly the granulocytes, to protect the body against infections.

The renal tract

There is a major diuresis in the first few days of the puerperium, resulting in a substantial loss of fluid, and the woman is often very thirsty in the first week and after. The midwife needs to be cautioned that diuresis may be inhibited by the use of rectal anti-inflammatory agents. However, at the same time, the neck of the bladder and the urethra may be oedematous and bruised after delivery and this could cause difficulty in passing urine. The result could be extensive bladder distension requiring catheterisation.

The physiological dilatation of the urinary system decreases slowly and only returns to normal by the end of the puerperium. Small amounts of protein may be found in the urine during the first few days after delivery.

The woman is at high risk of urinary tract infection after catheterisation in labour and during procedures such as epidural or caesarean section.

The gastrointestinal tract

Women are naturally hungry and thirsty after natural birth. Women who have interventions such as epidural or caesarean are either nil per mouth or on restricted intake. All other women are offered a high calorie drink or a meal after birth.

There is a very gradual return to normal mobility of the gut, and this may be delayed further by the use of analgesics and possible dehydration after labour and birth and the postpartum diuresis. The woman may not feel like eating (normal appetite) for the first few days and the perineum may be painful, preventing defaecation. All these factors contribute to constipation in the first week of the puerperium. Laxatives, suppositories or even an enema may be required to promote elimination within 3 days.

After the initial birth period women may experience hunger and thirst associated with breastfeeding. Breastfeeding requires energy and the energy requirements in the woman's diet increases. A woman therefore needs to adjust her food intake to meet the needs of lactation.

A decrease in weight

About 5 kg is lost as a result of the delivery of the baby, the amniotic fluid and the placenta. As a result of involution and diuresis, a further 2.5 kg is lost. The changes to the breasts and breastfeeding may add another 2 kg on the weight of the mother. By the end of the puerperium, her weight should have almost returned to the prepregnancy weight, although increased weight may persist for some months after delivery.

General recuperation and the psychological state in the puerperium

Mood swings, blues and depression

Mood swings, or emotional instability, are common in the puerperium, and even the most easy-going women are likely to suffer from some transient mood changes. The great joy, even ecstasy and the sense of achievement and fulfillment, which the woman felt at and immediately after the birth of the baby give way to tiredness, anxiety and a dawning sense of her responsibilities, which, together with the physical changes taking place in her body, often cause an overwhelming sadness or even depression, giving rise to involuntary spells of crying. The woman does not know what she is crying about, she just feels very sad and cannot help crying. These postpartum blues (or third or fourth day blues) as they are commonly called, alternate with feelings of great happiness and pride of motherhood. In the first two to three days, the woman is very occupied with the baby, with visitors and congratulations, but when the milk comes in, the breasts become full and painful and if the baby will not suckle, the woman becomes upset and depressed. This occurs in about 80% of women.

Normally, when the baby is feeding well and the woman is feeling rested and less anxious, her emotions stabilise as her body and mind recover and return to the nongravid state. However, in about 5–20% of women, a deeper depression may occur and continue for some time after the puerperium, and in about 0.3% of postpartum women, a frank psychosis occurs. It is important to be aware of this and to know the danger signs (see Chapter 13).

The need for rest and sleep

Directly after birth woman experience an alertness and cannot sleep even though they are tired, so it is extremely important that the woman has sufficient rest and sleep in the puerperium. This helps to build up her psychological and physical stamina. It also helps to promote lactation and gives the woman time to get to know her baby. If she is under pressure mentally, or physically in pain, she will be unable to cope and the general healing process is slowed down. The return to normal takes longer and complications are more likely to arise.

Sexual function and activity

The postpartum period is characterised by a change in the sexual function of the woman and her partner. Sexual function is modified by:

- trauma to the reproductive organs
- anatomical and physiological problems
- lochia and vaginal discharge
- the presence and stress of the baby
- leaking and engorged breasts
- altered lubrication of the vagina for six months
- fatigue and psychological factors.

Orgasm for women postpartum is shorter and less intense for the first few months due to less vasocongestion of the labia. This, along with painful perineal muscles and any episiotomy, may make it less enjoyable for women for the four to six months it takes for complete healing of a perineal wound. Twenty percent of women report discomfort with sexual intercourse after vaginal birth. No difference was found between women with or without an episiotomy. Many cultures have a taboo on sexual intercourse after birth. The resumption of sexual intercourse depends on the woman's restoration and varies from a few weeks to several months. Counselling may be needed.

35.4 Conclusion

Although the postnatal period is a period of restoration for the woman, modern demands on women and changed lifestyle patterns do not favour rest, sleep and restoration. The lack of a support system, the nuclear family, modern ideas, and a poor healthcare system with early discharge may put a mother and infant at risk after birth. Most women are discharged within 24 hours and are unsupported at home. The midwife needs to identify potential risks upfront and make allowance for these. Woman need to be well informed on discharge of what to expect and what to do if things are not normal.

CHAPTER

36 Assessment, diagnosis and care in the puerperium

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- assess the needs, potential and actual problems in postnatal care
- provide optimum evidence-based immediate, intermediate and follow-up care, comfort and education to woman after birth in all healthcare settings, following all kinds of birth
- educate the parents in the care of the infant and self-care facility
- assess a woman on discharge and design a discharge care plan.

KNOWLEDGE ASSUMED TO BE IN PLACE

Principles of reproductive healthcare and of health education
Anatomy and physiology of the pregnancy, birth and puerperium including lactation
Fundamentals of general midwifery care, paediatrics, gynaecology and surgery
Fundamentals of emergency care

KEYWORDS

Evidence-based postnatal care

36.1 Introduction

It is the responsibility of the professional midwife to assess the needs of each mother and baby in the postdelivery period and plan relevant care. This is the basic routine care that all mothers and babies should receive, and the more individualised 'woman centred' or 'baby-friendly' care.

The period in which the mother and baby remain under direct care and supervision in a hospital, a clinic or in the community is not regulated, and can range from less than 24 hours to a week or more depending on the place of birth (public or private) and the maternal diagnosis, circumstances, comorbidities and the policies of the unit.

In the public sector, mothers and babies are generally discharged as soon as possible and after a normal birth, women may leave the healthcare setting within six to 24 hours. This may place new mothers at a disadvantage because of the lack of support in the community and from healthcare services. In the private sector, mothers and babies are discharged two days after a normal birth and three to four days after a caesarean section. When a woman experiences complications or the baby has problems, mothers may be discharged without the baby. Women in the private sector have usually attended antenatal preparation classes, and have usually arranged a postnatal follow-up. In the public sector women are followed up using the '333 strategy' – on day 3, week 3 and month 3 they return to see a midwife or medical practitioner. They are then referred to a specialist clinic if necessary.

While the midwife has the mother and baby under direct supervision the following must be considered:

- Assess the individual needs of the mother and baby based on the antenatal and birth history and risk factors.
- Compile a care plan and set goals to meet the needs and resolve as many as possible problems while under supervision.
- Include the physical and emotional aspects of care, breast-feeding and child spacing in the assessment.
- Consider the mother's and baby's specific needs and compile an appropriate discharge and referral plan.
- Assess the woman's need for education and support in terms of self-care activities and childcare.

- Consider the effects of early discharge and the adaptations of the mother postdelivery.
- Tailor care to meet the woman's particular needs within the boundaries of the policies on baby-and woman-friendly care.
- Create a positive supportive environment.

The postnatal period is a period of adaptation that has high demands on the mother, psychologically and physiologically. Each woman's unique environment needs to be considered in the following way:

- *Philosophy of care.* Each unit should have a philosophy of care that is in line with principles of 'best practice' following the institutional policies, which should include some form of community involvement.
- *Staff ratios and allocation.* It is important to develop a system where the entire team has the skills necessary to take care of mothers and babies after birth. Women need to see the same staff consistently. New and different people may give conflicting advice and confuse the mother.
- *Policies and procedures.* The policies and procedures in a postnatal unit should be evidence-based. The unit should be working towards obtaining baby-friendly status if it has not already done so.
- *Safety and security.* Most postnatal units have security measures in place to prevent babies being stolen/abducted. Access control places a burden on a unit but safeguards mothers and babies against strangers and puts them at ease.
- *Scientific care.* A scientific method of care allows for the identification of the individual needs of the mother and for quality care.
- *Supportive care.* The midwife should be sensitive to each individual woman's needs during the puerperium. In each situation, the midwife should be kind and understanding and must *not* be critical or judgemental. The midwife should be calm, cheerful, helpful and sensitive to any problems the woman may have. She must listen to what the woman has to say and work out what her problems are. She should help her to become independent. The midwife should ensure that the woman gets plenty of rest and sleep and a good balanced diet.
- *Breastfeeding support.* Midwives should help to establish breastfeeding or, if this is not possible, give advice on artificial feeding. First-time mothers who want to breastfeed need supervised support with each feed until confident. Ideally, a first-time mother should have support until breastfeeding is well established, usually about 10 days. Many maternity units have a lactation consultant or clinic (See Chapter 9).

It is important that a postnatal unit is a place where women feel welcome and supported by a group of midwives that they trust.

36.2 Assessment and diagnosis on admission

On admission to a postnatal unit the midwife plans care and all records and documentation should be available and signed by both parties. Both mother and baby should have identification bands according to unit policy.

Immediate assessment

The immediate assessment should include:

- gravity
- parity
- maternal age
- gestational age and or multiple pregnancy
- problems in this or previous pregnancies, for example polyhydramnios
- specific issues such as a request for rooming-in.

Establish if it was a booked or unbooked case? Was antenatal care received and all prenatal tests done and normal? What is the Hb? What is the HIV status?

Specific information at birth

Specific information on the birth:

- What type of delivery: natural, normal, assisted or caesarean section or induction of labour? If so, what method of induction was used?
- What was the duration of birth (all stages)?
- What was the date and time of birth?
- What mode of pain relief was used? Spinal/epidural?
- Were there any complications of birth, particularly the third stage?
- Were the placenta and membranes complete?
- What is the blood loss? What is the vaginal loss at present?
- What is the condition of the pelvic floor?
- Is the uterus contracted? Has the mother passed urine after birth or is a Foley catheter in place?
- What are the vital signs?
- Is breastfeeding planned?

Information on the baby

Information about the baby/or babies should include:

- The date and time of birth and gender (check name bands and genitalia).
- The Apgar score.

- Did the mother see the baby(ies)?
- Did the mother put the baby(ies) to the breast?
- What is the gestational age and mass of the baby?
- What is the baby's temperature and what is the glucose level?
- Is the baby with the mother or in the neonatal unit and why?
- Has Konakion (vitamin K injection) been given?
- Was eye prophylaxis done?
- Check if the cord clamp is secure and not bleeding.
- Has the baby passed urine or meconium?

History-taking for risk factors

By checking the basic antenatal, birth and neonatal records and history, the midwife can determine which aspects need attention and design a plan of action for the mother and baby. Check for the risk of postpartum haemorrhage by noting the following:

- women with a history of previous postpartum bleeding/ requiring blood or intervention
- women with a low Hb or blood disorders
- women with ante- or postpartum haemorrhage
- women with overstretched or atonic uterus due to multiple births, polyhydramnios and multigravidae
- women who had an assisted vaginal birth or caesarean section or after manual removal of retained products
- women with incomplete placenta or membranes
- women with a full bladder
- women passing clots and who have more than one soaked pad in 20 minutes postdelivery.

Women should be closely monitored for six to 12 hours after birth. This includes checking for full contraction of the uterus (except after caesarean section when the uterus is not handled), vaginal bleeding and vital signs (blood pressure and pulse). Any concerns should be reported to the medical practitioner immediately. See the assessment diagnosis and management of primary postpartum hemorrhage in Chapter 21.

Where the baby is rooming-in, he or she can stay with the mother if her condition is stable. In some institutions the father is encouraged to give the first bath.

36.3 Standard procedures for postnatal care

The *birth plan* (if in use) should include:

- *Rooming-in.* Rooming-in is a baby-friendly principle of care, but not all mothers will want to have the baby with them. If a woman refuses a baby, special intervention is needed. Explain to the mother that midwives care for mother and baby as a unit. Nursery care is preferable if there has been a complicated birth and the mother needs more time to recover.
- *Baby care.* Women may have specific requirements for baby care that need to be discussed with the midwife. Different cultural approaches should be respected as long as they are safe.
- *Baby feeding.* Feeding should have been discussed antenatally and a woman's preferences respected. If the mother wants to breastfeed, but is separated from the baby, breastmilk can be expressed.
- *Visitors.* Units have different policies, but most allow the partner and siblings soon after birth. Bear in mind though that too many visitors can be tiring.
- *Discharge planning.*This depends on the condition of the woman and baby and, in the private sector, on the medical aid scheme. Early discharge is allowed if safe and requested. Different units have different discharge policies. The mother will usually have discussed this before the birth and may even choose a unit based on their discharge policy.

36.4 Routine care on admission

The aim of care directly after birth is to make the woman comfortable, able to rest and establish bonding and breastfeeding. In the first six to 12 hours after birth the woman may find it difficult to sleep, even though tired and she may still be in pain and discomfort.

On admission the woman is introduced to other women in the unit and the staff who will take care of her. She should know her midwife by name.

She is oriented to:

- the call system (in working order)
- the nearest toilet and when she is allowed to be up on her own
- the routine of the care that will follow for the day
- the routine of the care for the rest of the stay
- arrangements about the baby and feeding
- visiting hours
- intake of food and drinks
- made comfortable (clean and dry)
- when she is allowed to be ambulant and under which conditions.
- any specific care aspects, for example the epidural catheter if still *in situ*, the Foley catheter if still *in situ*, and the intravenous infusion if still *in situ*.

Other aspects of care include:

- Specific individualised care may include medical practitioner's orders for postnatal care, removal of drips, urinary catheter and pain relief.
- Individualised care depends on specific medical conditions such as anaemia, infection, high blood pressure or diabetes mellitus.

- The vital signs, temperature, pulse and blood pressure are observed and compared with the predelivery findings.
- The woman (if not catheterised) should pass urine within six hours after birth or after removal of the catheter. Make sure that the bladder is empty. The woman can be helped to the toilet under supervision after a normal delivery.
- The uterus is rubbed and monitored if it is well contracted.
- The vaginal blood loss is assessed. (More than one soaked pad in 20 minutes is considered high blood loss.)
- Women are usually pain free postpartum (if no surgery was performed). Any pain needs to be assessed and monitored.
- A woman is usually nursed in a semi-Fowler's position after birth (at least two pillows) to allow the uterus to drain (unless she is semiconscious after surgery or after a spinal tap when another position may be indicated). Make sure that cot sides are in position for women after surgery or for women who are semiconscious.
- After normal delivery (no epidural) women are allowed to be ambulant as soon as possible. The first time a midwife should be present to make sure that the woman does not faint due to the cardiovascular changes. Women who have had a symphysiotomy are on bed rest as per the medical practitioner's prescription.
- The intravenous infusion and Foley or epidural catheter are removed according to medical prescription or policies of the unit, based on the condition of the woman. Women after caesarean section, or with high-risk factors for haemorrhage will remain on an oxytocin infusion for 24 hours.
- Observations in this period are usually hourly until stable.
- Routine daily assessment includes monitoring vital signs and signs of impending haemorrhage.
- Medication is given as prescribed–anti-D, antibiotics and other.

36.5 Postnatal care

This is based around the:

- physical condition of the mother and baby
- anticipated length of stay related to the presence of risk factors and complications
- availability of a support system (including the father) and their involvement in teaching and care activities.

After the initial period of admission and when the woman is stable, routine standard daily postnatal care follows with individualised care for specific conditions.

36.6 Monitoring physiological status

The midwife actively observes, monitors and assesses the mother's physiological status in the early and intermediate postpartum period. A full physical examination is done daily, including the following.

36.1 Routine nursing interventions for postpartum care

- to monitor and support physiological status
- to assist with the restoration of bodily functions
- to promote rest and comfort
- to facilitate parent caretaking activities
- to promote successful breastfeeding
- to teach effective self-care
- to plan for appropriate discharge.

Vital signs

The temperature is carefully and regularly observed to screen for infection. An epidural and dehydration are possible causes of a mild raised temperature. Cases at risk for infection (postpartum haemorrhage, caesarean section, manual removal of the placenta, amniotic fluid infections, prolonged rupture of membranes and urine infections) usually receive prophylactic antibiotic treatment. In case of a raised temperature, antibiotic treatment is started by the medical practitioner and the source of infection identified through swab and/or blood cultures.

The blood pressure, pulse and respiratory rate are taken four hourly for the first 24–48 hours and then twice daily. Fluctuations in the blood pressure are common. Hypotension may be due to blood loss and lead to weakness and syncope. If a lower than normal blood pressure for a mother is accompanied by a raised pulse (more than 90 bpm) look for uterine bleeding. Hypertension and eclampsia may develop within 72 hours without previous signs and symptoms.

Monitoring optimal uterine tone

The tone of the uterus is observed and palpated abdominally (not in caesarian section) to establish if well contracted. Gentle circular movements will make the uterus contract within a few minutes. If the uterus does not respond to the stimulus the medical practitioner needs to be notified because an oxytocic agent may be needed.

Cases at risk for haemorrhage are caesarean section, incomplete placenta and membranes or other placental pathological conditions, manual removal of products of conception and infections.

Monitoring lochia

Check for offensive clots and the amount of lochia. Obseve the total blood loss, pulse and blood pressure and Hb level. Check the temperature to monitor for infection. The mother should be taught about changes to lochia after birth. She should report foul-smelling lochia, heavy lochia with fragments of placenta, clots, and red lochia after day three, which suggests infection.

Breast care

Check the breasts to detect potential problems such as cracked nipples and engorged breasts in women who want to breastfeed. Interventions include cabbage leaves and breast emptying by regular suckling. Start lactation suppression for women who do not wish to breastfeed. This should be started before the hormonal initiation of lactation. Bromocriptine (2.5 mg twice daily for 14 days) is used to suppress lactation. Side effects include headaches, nausea, dizzyness and hypotension.

Care of the perineum and rectum

Care in the puerperium includes minimising discomfort in the perineum after vaginal birth. Ice packs may be used for the first 12 hours to reduce oedema and discomfort.

Perineal pads should be changed regularly to avoid infection. Vaginal cleansing is done four hourly if the mother is not ambulant. When ambulant, use Sitz baths with coarse salt twice a day or a bidet after each bowel movement. To minimise discomfort the woman can use a ring pillow and is instructed to tighten her buttocks before sitting. Analgesia can be prescribed.

The condition of the perineum is observed daily. Swelling, oedema and bruising of the cervix, labia and perineum are common. Any sign of infection needs to be addressed before discharge home. If there is severe pain after an episiotomy, the stitches may be removed after five days. Check for infection. A third-degree tear requires bed rest fo three to four days and a special diet to soften stools.

Haemorrhoids

Women with a history of haemorrhoids in pregnancy may find that these are worse after a vaginal birth. Some women will develop haemorrhoids for the first time after birth. Treatment is prescribed by the medical practitioner. A ring pillow and laxative may be useful. In extreme cases surgery may be needed.

Monitor extremities

Early ambulation after birth significantly reduces the incidence of thrombosis and is encouraged. Examine the calves daily to check for tenderness.

Thrombophlebitis

Women are prone to blood clotting problems postdelivery specifically if there was trauma to the pelvic floor (forceps and ventouse) and legs (stirrups). The legs are examined daily for tenderness and swelling. The legs can be measured with a tape measure to determine the difference in size of an affected leg. If thrombosis is suspected the medical practitioner is informed.

36.7 Restoring normal body function

The midwife should help the woman with the following after the birth.

Bladder function

The woman is encouraged to void within three to four hours after birth and then regularly. Woman my find it difficult to use a bed pan and are helped to the toilet if possible. Running water may encourage voiding or running warm water over the labia may help the woman relax. Continued difficulty in passing urine is reported to the medical practitioner. Swelling or trauma of the vulva after vaginal birth may cause difficulty passing urine.

After caesarean section, epidural, surgical interventions or complications, a Foley catheter may be in place. Check that the urine is not blood stained and be alert for possible urinary tract infections.

Restoring gastrointestinal function

Immediately after birth a woman may be nauseous and even vomit. Women are thirsty and often hungry after birth. After a caesarean section women are generally kept nil per mouth for a period and then allowed to start with fluids. Once bowel sounds are present solids are added to the diet after general anesthesia. Women after epidural or spinal anaesthesia may be allowed to eat sooner.

Women are often constipated after birth. A laxative or suppository is given on day two or three to stimulate bowel action. A high fibre diet and lots of fluid is given to stimulate peristalsis. If a bowel action is not present by day three or four an enema may be given.

A wholesome, well-balanced diet, rich in protein, with plenty of roughage, is important in the puerperium. Fruit, salads and vegetables provide roughage and vitamins. The woman should have extra fluids. A vitamin and mineral supplement, particularly vitamin B and iron, may be given if the woman's general condition is poor.

Restoring uterine involution

The involution of the uterus is observed daily. Subinvolution of the uterus (in women after vaginal birth) may be caused

by an overstretched uterus (multiple pregnancy, polyhydramnios, or multigravity or abnormal uterus such as bicornuate uterus or myomata, retained products of conception and infections). Subinvolution is detected using serial measurements over a few days. If a woman is discharged within a short period she may be asked to return on day three for assessment. The uterus involutes by 1.5–2.5 cm per day (see Figure 35.2).

Restoring physiological body functions

Anaemia

Check for anaemia by looking at the membranes in the eyes, the tongue and whether or not the woman is pale. Check the Hb immediately after labour, after three days and again at the six week visit. After blood loss of more than 500–2 000 ml check the Hb and haematocrit.

Oedema

Some women may have extensive oedema postdelivery in spite of diuresis. Rest and a normal diet should help this to resolve. Oedema in only one leg should be investigated. Do a Homans' test.

Prevention of complications

Rhesus (Rh) blood factor

Check cord blood and do a Coombs' test within 72 hours in Rh-negative (Rh–) women. Anti-D or Rhogam must be given to the mother within 72 hours if the baby is Rh-positive (Rh+) and the Coombs' test is negative.

Prevention of infection

General hygiene is important to prevent infection in the mother and the baby. Showering is the best way to keep the body clean in the first week of the puerperium. If a shower is not available or is not possible, provide a full body-wash standing in the bath. This is followed by a full bath after the lochia has changed from rubra to serosa or alba.

After caesarean section or when women are on bed rest for other reasons they need a full bed wash daily and a 'top and tail' or half wash in between. Mouth toilette is done twice a day.

Vulva toilette, Sitz baths or bidet

Cleanse the perineum regularly to prevent infection in the vagina, which may track to the uterus. Vulval toilette or swabbing (eight hourly for bedridden women) is carried out in all women who have just delivered and eight hourly for the first 24 hours after a vaginal delivery (then 12 hourly for the first 48 hours after a caesarean section). Saline Sitz baths are very effective in ambulant women, who can kneel in the bath to wash the perineum. When a bidet is available women can be shown how to clean themselves after each bowel action and at least three to four times a day.

HIV status

Woman with unknown HIV status are counselled before discharged for testing and referral (see Chapter 50).

Intravenous and oral antibiotic therapy is given prophylactically for all women who have had surgical interventions, premature and prolonged rupture of membranes and previous infections in pregnancy, or ante- or postpartum haemorrhage. Any raised temperature postdelivery is assessed and antibiotic therapy started if appropriate.

Body image

Women often have body image concerns after birth. They may be disappointed that they cannot fit into their prepregnant clothes. However, breastfeeding women need to eat enough to support lactation and should be discouraged from dieting too stringently. A dietitian should be consulted where necessary.

Postnatal exercises are encouraged. Pelvic floor or Kegel's exercises and Pilates are useful. Exercise helps to tone the body, strengthen the upper body, improve sleep patterns and lift the mood.

36.8 The midwife's role in promoting rest and comfort

Promoting rest

The demands of the postnatal period limit the mother's opportunity for rest. She may not be able to sleep after the stimulation of birth. Baby care, frequent observations and calls from family and friends interfere with rest. Nursing care is planned to allow for unbroken periods of sleep, which can inlcude removing the baby for periods. Analgesia may be helpful but sleeping tablets are discouraged. Help the woman and her family to plan her time at home to allow for rest.

Promoting comfort

Discomfort after birth is associated with uterine contractions, muscle strain, fatigue and pain associated with oedema and trauma to tissue as a result of surgical interventions.

Afterpains

Afterpains occur with uterine contractions after birth, generally only after a woman's second baby. These can be sufficiently painful to require analgesics.

Pain

This is associated with afterpains (multigravidae) thrombosis, inflammation, caesarean section, episiotomy and haematomas after birth. Occasionally women may have a complication of a spinal tap causing severe headache.

Pain may be caused by retention of urine associated with trauma of the bladder or swelling of the labia and meatus and perineal pain and/or bladder infection as a result of catheterisation during labour and birth.

A caesarean section is a major surgical intervention. The associated pain equals any laparotomy pain. Pain relief starts in the theatre with the first dosage administered. Postoperative women are offered pain relief for 48 hours. Analgesia is given regularly, according to a medical practitioner's prescription and the woman's pain level is checked 15 to 20 minutes after the analgesic is given. If pain relief is not effective, assess the reason and call the medical practitioner for a change in the regime.

The mother's position can influence her experience of pain. Prevent stress on the wound by nursing in a Fowler's or semi-Fowler's position, using pillows to support the body, and make sure the woman is warm enough after returning from theatre. Woman with catheters and intravenous lines are assisted with baby care and breastfeeding.

Specific needs

Women with specific needs include adolescents who may need special attention with infant and selfcare. Older first-time mothers may also need support and individual care planning. Women with physical disabilities, sight and hearing impairment, psychiatric conditions, who have adopted, or who have been surrogate mothers have specific needs and require support beyond the routine.

Women who were bedridden for long periods antenatally, with multiple pregnancy, antepartum haemorrhage, cardiac conditions and diabetes mellitus have additional health and emotional needs and may experience pregnancy and birth negatively.

Effective selfcare is a major focus of a midwife after birth. A teaching checklist is commonly used to ensure that a woman (or couple) is aware of all the aspects of selfcare.

36.2 Teaching checklist

- hygiene: perineal care/bathing, douching
- involution: lochia rate, amount, massage of uterus and after pains
- exercise
- contraception
- nutrition
- emotions – baby blues
- siblings
- discharge: sleep, rest, assistance, activity, parent classes
- sexual activity
- bladder and bowel action
- immunisation
- infant feeding
- medication.

36.9 Common problems

Some of the common problems that may arise in the puerperium are discussed below.

The mother

Tiredness

Many women feel tired and listless after returning home with the newborn baby. This is mainly due to the demands of pregnancy and labour and to anxiety and concern for the new baby and for the family as a whole. It is very important that the mother gets sufficient rest and sleep and this is particularly important if she is breastfeeding, otherwise her milk supply may diminish and even dry up. This is where the husband/partner can help the mother to get adequate rest and sleep. In addition, the woman should eat a good balanced diet and she should get plenty of fresh air and take a walk each day (see Chapter 3).

Backache

Backache is usually experienced in the puerperium because the mother's joints, particularly the sacroiliac joints, remain pliant for some weeks after delivery and therefore she should be careful to lift the baby correctly and should be advised not to pick up heavy objects. She should not wear high heels for a few months after delivery or while the backache persists. She should conscientiously carry out her programme of postnatal exercises. If the backache is severe or persists, she should see her medical practitioner or go to the local clinic. The medical practitioner may order a pelvic corset to be worn, in order to give support to the joints.

Dyspareunia

Sexual intercourse in most cases is painful after birth and the body should be given six weeks to recover. If pain persists women are encouraged to discuss it with a medical practitioner.

Visitors

While visitors are usually very welcome and should make the woman feel happy and wanted, they can also be very tiring.

The husband and the other family members must assist the woman by helping to 'control' the visitors, by asking them only to come at certain convenient times and not to stay for too long, nor to expect to be entertained by the woman. They should also be asked to understand if the woman wishes to be excused either to feed the baby or to rest if she feels tired. Visitors should help relieve the burden of the mother and the family rather than add to it, but unfortunately, people can sometimes be thoughtless and selfish.

Back to work

A new mother should ideally not have to go out to work while the child is small, but should be free to stay at home to care for her infant. However, circumstances do not always allow this. If the woman has to return to work, she must have made adequate preparation for the care of the baby. If the mother has not made adequate arrangements, this will adversely affect her psychologically and physically, and this will affect her relationship with the baby and with the rest of the family. The midwife should enquire about this at discharge, and if there are any problems, she should advise the woman on where she should seek help.

If the woman is working and the baby is established on bottle feeds, adequate feeds should be made up and refrigerated for the alternative caretaker to give to the baby. If the mother is breastfeeding, she can express and store enough breast milk for the alternative caretaker to give to the baby in a bottle while she is away.

Breastfeeding problems after discharge

Certain breastfeeding problems may arise later in pregnancy and the midwife should advise the woman and her family about these and tell them how to manage them.

Leaking breasts

Not all breastfeeding women have leaking breasts, but many do, and the amount of milk that leaks from the breasts varies from a few drops to a steady stream, any of which may be normal for a particular woman. The parents must be told of this and reassured that the condition is normal.

It is usually when the breasts are full and the next feed is imminent, or actually during breastfeeding, that the greatest amount of leaking occurs. However, heat, such as on a hot day, or a hot bath or shower, may cause the breasts to leak. Other conditions that are likely to stimulate the milk supply are hearing the baby cry, playing with and loving the baby, watching the baby sleeping or even just thinking of him or her. Love expressed by the husband/partner or by the other children, or any stirring of enjoyable emotions can stimulate the 'let-down' of the milk.

If milk starts to leak, the woman should apply firm pressure to the leaking nipple with the heel of her hand, or if she is in company, she can inconspicuously cross her arms and apply pressure. If during breastfeeding milk leaks from the nipple not being used, the woman can place a thick towelling cloth beneath the nipple. If the milk streams from the other nipple during breastfeeding, the woman can place a container under the nipple, and if the container is sterile, this milk could be retained, refrigerated and used within 24 hours, or frozen. It is important, however, to reassure the woman that leaking breasts are a normal occurrence.

The milk supply

Women should be given written information on how to maintain milk supply and given contact details of a support group in the community to assist when needed.

Breast and nipple care

If the woman is discharged early in the puerperium, before the fifth day, she should be given some advice on full and engorged breasts care and nipple care (see Chapter 38).

The anxious mother

Anxiety and worry about how she is going to cope on her own can cause many problems. The woman who seems anxious and is not managing to cope well with baby care and feeding while under supervision, should preferably not be discharged until she has gained confidence in herself and in her ability to care for her infant or suitable support is secured. Discharging a woman too early in these circumstances could lead to depression, poor interfamily relationships and possibly to child abuse.

Every woman and her husband/partner should be told that if they are worried about how they are managing, or if they have any feelings that upset or frighten them, they should not hesitate to speak to their medical practitioner or to the midwife, or to go to the nearest health clinic, where arrangements will be made for someone with specialised knowledge to see them.

Infection

During labour and the puerperium, the woman is particularly susceptible to infections, because of the trauma that occurs during delivery and because of the open placental site after delivery. Consequently, the woman should be advised to be very careful with her personal hygiene, in order to prevent infection. (See Chapters 6 and 9 for care.)

More serious problems that may be encountered in the puerperium

The parents must be advised to seek help immediately there are any problems that are not resolved easily and quickly. In most instances, the longer a problem is left, the more serious it becomes. The parents must be reassured that having to seek help is no discredit to them or to their ability as parents, as every couple has to seek help at some time or another.

36.3 Guidelines for effective teaching

- Determine individual learning needs.
- Set priorities.
- Provide a comfortable environment.
- Allow mother to absorb, ask questions and review the information.
- Use simple terminology.
- Reinforce with visual aids or let mother carry out care under supervision
- Include the family and/or friends.
- Document teaching.

After delivery, when the woman is discharged, she is informed how essential it is that she has a postnatal check-up and an examination at six weeks after delivery. She should attend a postnatal clinic or see her medical practitioner. Some centres now advise a routine earlier visit as well. However, it is stressed that if any problem should arise, particularly excessive or recurring bleeding, the woman should seek help immediately.

36.10 Discharge of mother and baby

Preparation for discharge

During the postdelivery period the whole family is continuously being prepared for discharge. This includes managing the baby's needs and education on common problems and how to deal with them, including contact details for specific help. This is particularly important for first-time mothers and for women being discharged within 24 hours of birth. Aspects that may concern parents are described below.

The baby

The following aspects of baby care should be included in a discharge plan:

Baby care

The mother, and the father if he wishes, should have been shown how to change a nappy, how to give the baby a bath, and how to care for the umbilical cord. All this should have been practised under supervision, particularly for a first baby.

Feeding the baby

Breastfeeding should either be well established or a suitable replacement/alternative bottle-feeding regime shoud be in place by discharge. The parents should have been instructed on how to prepare the feed, how to store the feed and how to clean the utensils, all of which should be practical and pertinent to their homes and economic situation. It is no good instructing parents on how to care for the baby if, when they return home, they have neither the means nor the facilities to care for the baby in the manner shown to them while in hospital (written information is useful).

Registration of the birth of the baby

The parents should be reminded that it is their responsibility to register the birth of the baby, and that this should be done within 30 days of the birth, with the Registrar of Births, Department of Home Affairs according to Births and Deaths Registration Act No 51 of 1992. Parents are provided with DHA-24 for a live child and BI-1663 for a stillborn, before discharge. Registration of a child within 30 days of birth is free of charge. Early registration of birth helps the parents to access child support grants if the family qualifies. In some hospitals, facilities are provided for the registration of the birth immediately after the delivery.

Nappy rash

Many babies get nappy rash and this can vary from a mild, red, non-raised rash over the nappy area, to a severe rash with bright red papules that erupt and form ulcers, which can become infected. The urine and faeces cause skin irritation and therefore the parents should be instructed to change the baby's nappy as soon as possible after the baby has passed urine or had a stool, and not to leave the baby lying in a wet or soiled napkin. The baby will usually cry when the nappy is wet or soiled. Barrier creams can be used on the buttocks to protect the skin from the urine and to prevent the faeces from sticking to the skin.

The crying baby

The parents should be reassured that it is good for the baby to cry as this helps to expand the lungs and provides exercise for the baby. However, there is normal and abnormal crying and as the parents become used to the baby, they should be able to tell, to some extent, what the baby is trying to convey to them. If they are at all worried about the baby crying or not crying, they should speak to their medical practitioner, to the midwife or to the local health clinic midwives. Studying the

Brazelton's scale will assist midwives to teach women about their baby's behaviour (see Chapter 10).

Constipation and unusual stools

Constipation is seldom seen in the breast fed baby, unless the baby is being underfed. However, in the bottle-fed baby, constipation may be problematic, but can usually be remedied by adjusting the feed. That is, increasing the sugar and water content of the feed, or by giving extra water or pure fruit juice to the baby.

Any very loose, watery or green stools, particularly if they are frequent and/or explosive should be reported to a medical practitioner immediately, as they could be due to alimentary tract infection.

Vomiting

The woman and her husband/partner should be told the differences between milk, which is regurgitated with winds, posseting and abnormal vomiting. Any infant with abnormal vomiting, with or without diarrhoea, should be seen by a medical practitioner immediately. Any vomiting that results in loss of weight should also be referred to a medical practitioner.

Infections

Any infection of the newborn, with or without pyrexia, is serious, because the newborn has little resistance to infection and should be seen by a medical practitioner as soon as possible.

Persistent jaundice

Breast milk jaundice is a rare condition that occasionally affects breastfed babies. Some factor in the mother's milk prevents the baby's liver from functioning fully and this may prolong physiological jaundice in the newborn. No treatment is usually necessary.

If jaundice persists or increases after discharge, the baby should be seen by a medical practitioner. The medical practitioner will screen the baby to ensure that the jaundice is not pathological. Pathological jaundice may be caused by obstruction of the hepatic ducts, or may be caused by infection such as hepatitis or omphalitis.

Maternal help and support

The parents are advised to have some sort of help and support for the mother after discharge. The father/partner can be of great assistance in this early postpartum period and he should be aware of this and should look for ways in which he can help his wife. If the couple do not have domestic help and if the father/partner is unable to be at home to help, then arrangements should be made for either a member of the family or a friend to give the woman support and help in the first few weeks after delivery. This is particularly necessary after the birth of the first baby, or when the woman has a heavy home work load (that is: two or more children at home, in addition to the new baby) or if the woman is physically or mentally debilitated in any way. Refer to community support or electronic support (see Chapter 20).

The baby clinic

Depending on the risks and problems, mothers are asked to bring a baby to the well-baby clinic. The '333 programme' of 3 days, 3 weeks and 3 months is followed when discharge was within 24 hours of birth. Mothers who remained in hospital longer are advised to take the baby to the nearest baby clinic at her earliest convenience (but not later than three weeks postpartum) or if she is at all anxious about the baby's condition.

Immunisation

Children under the age of five must be immunised against common childhood diseases in South Africa. No child should leave the hospital without the immunisation programme being started and explained to the mother. The parents are given an immunisation card and each vaccine is recorded on the card and in the hospital or satellite clinic records. This card is taken to the baby clinic by the mother at each visit and all further immunisation is recorded on the card.

36.11 Conclusion

The postnatal period is an exciting time, but the contact with the mother or couple may be short. The midwife must be skilled to determine the specific needs of the mother and baby to give the best possible care in the time available and refer to a support system.

CHAPTER

37

Complications of the puerperium

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- define secondary postpartum haemorrhage
- demonstrate the knowledge, competency and skill to identify possible complications of the postnatal period
- plan and give appropriate nursing care interventions (preventive, curative and emergency) to meet the needs of women with complications postpartum in all healthcare settings
- evaluate the woman's understanding of complications she should report and her ability to look after the condition herself
- prevent further complications.

KNOWLEDGE ASSUMED TO BE IN PLACE

The anatomical, physiological and psychological adaptations of the normal puerperium (See Chapters 21 and 50)

KEYWORDS

Secondary postpartum haemorrhage • Puerperal infection • Stress urinary incontinence (SUI) • Incontinence severity index (ISI)

37.1 Introduction

Complications of the postnatal period range from mild to moderate to severe. The two most common complications of the postnatal period that are life threatening are haemorrhage and puerperal sepsis.

The risk of maternal death is highest in the first 24 hours postpartum. The main cause is primary postpartum haemorrhage (see Chapters 21, 31 and 33). This chapter will consider the risk of secondary postpartum haemorrhage, infections and other problems such as thrombosis, wound breakdown, breast complications, haematoma and abscess. Psychiatric complications such as puerperal psychosis that present early in the postpartum period are presented in Chapters 9 and 51.

37.2 Secondary postpartum haemorrhage

Definition

Secondary postpartum haemorrhage is bleeding from the genital tract that occurs after the first 24 hours of birth. The bleeding usually occurs between the fifth and the fourteenth day after delivery and is most often caused by retained products of conception resulting in subinvolution of the uterus.

Causes

The cause of secondary postpartum haemorrhage is abnormal involution of the placental site. If the cause of bleeding is due to a retained cotyledon, fragments may become necrotic resulting in formation of a polyp or bleeding from the site.

Predisposing conditions

The following factors contribute to secondary postpartum haemorrhage:

- Antepartum haemorrhage (placenta praevia).
- Primary postpartum haemorrhage.
- Chorioamnionitis.
- Atony of the uterus. Clots may accumulate in the uterus if there is atony of the uterine muscle. The clots formed at the placental site after delivery, which controlled the bleeding from maternal blood vessels and sinuses

(between the living ligatures), may become dislodged or may dissolve.

- Pieces of placenta and/or membrane could prevent the uterine muscles from contracting and retracting fully, causing subinvolution of the uterus. Any of the retained products, especially if there has been interference during labour, could become septic and cause a breakdown in the healing of the placental site and could result in a large haemorrhage and endo- or myometritis.
- The site of any trauma to the genital tract, which the patient may have sustained during delivery, could become septic, break down and bleed.
- Secondary postpartum haemorrhage may be caused by fibroids, carcinoma of the cervix and choriocarcinoma (a rare condition) that may manifest towards the end of the puerperium and which is known as gestational trophoblastic disease.
- Abnormalities of the uterus such as a bicornuate uterus may shed the decidua (endometrium) that was thickened in pregnancy into the uterine sections that were not used during pregnancy. This usually occurs around 14–21 days postpartum.

Incidence

The incidence of secondary postpartum haemorrhage ranges from 0.5 to 1.5% of all vaginal deliveries and will depend on the standard of care given to patients before, during and immediately after delivery and on the length of time these patients spend in hospital after delivery. Where the patients are cared for in hospital for up to five days or more, or where district midwifery postdelivery services are available, patients are observed for signs of subinvolution of the uterus and heavy vaginal loss, especially if the placenta and the membranes were ragged and possibly not complete, or if the patient had any conditions predisposing to postpartum haemorrhage.

If the patient is discharged after 24 hours with no further nursing care, the early warning signs of possible secondary postpartum haemorrhage may be missed. In patients who live long distances from clinics and hospitals the incidence will be higher and the maternal mortality rate due to secondary postpartum haemorrhage will also increase accordingly.

Clinical diagnostic signs and symptoms

History

Early warning of the risk is gathered from a thorough history. Any of the predisposing causes of primary postpartum haemorrhage and a history of primary postpartum haemorrhage need careful assessment before discharge. A history of complications of the second and third stage of labour (manipulations, forceps delivery and other interference in this pregnancy), placental pathology such as placenta accreta, retained placenta or incomplete placenta and/or ragged membranes after the third stage of labour (retained cotyledon, succenturiate lobe or part of the chorionic membrane) should alert the midwife to the risk of secondary postpartum haemorrhage.

Early warning signs and symptoms:

- subinvolution of the uterus
- persistent red vaginal loss, heavy loss, offensive vaginal loss
- passing of clots and/or pieces of placenta and/or membrane with the vaginal loss
- severe uterine contractions and after pains
- uterine tenderness on rubbing-up the fundus
- puerperal pyrexia (infection).

Clinical picture

The vaginal blood loss occurs between the fourth to fifteenth day postdelivery and can, at first, be small amounts on successive days (rather like a menstrual period) or can be a sudden deluge of blood. The haemorrhage can be so severe that the patient may die before treatment is available. Signs of hypovolaemic shock may be present.

Care and management

Prevention. The following can be done to prevent postpartum haemorrhage:

- The placenta and membranes need to be examined after birth under running water even after caesarean section and manual removal of the placenta. Any potential defects are reported as incomplete and inspected by a senior staff member or medical practitioner.
- The uterus must remain well contracted to control haemorrhage. The bladder must be empty at birth and must remain empty for two to six hours after birth and regularly in the postnatal period. The uterus is stimulated to remain contracted by rubbing it abdominally or placing the baby to the breast.
- The uterus is stimulated with an intravenous infusion of 20 IU oxytocin in 1ℓ Ringer's lactate at 120 ml per hour for 24 hours until stable in all woman after caesarean section, after manual removal of the placenta, with atony of the uterus (if the uterus tends to relax), overstretched uterus in case of polyhydramnios, multiple pregnancy and grande multiparae, or after ante- and postpartum haemorrhage. When the oxytocin therapy is discontinued the infusion without oxytocin is continued to make sure that the uterus does not relax again before it is discontinued.
- Women are observed for 12–24 hours postdelivery to make sure that the uterus is well contracted.

The amount, colour and consistency of the vaginal blood loss is assessed two hourly. A soaked pad every 20 minutes is considered heavy blood loss and needs to be followed up. Blood clots in the lochia are abnormal. Painful uterine contractions are also abnormal.

On discharge check the following:
- any history of placental pathology (was it complete?)
- painful uterine contractions
- continuous red lochia.

District midwifery postdelivery services in outlying areas should be set up for early detection of warning signs of secondary postpartum haemorrhage and for admitting patients to a clinic or hospital for immediate treatment.

Specific nursing care and intervention

Secondary postpartum haemorrhage may occur any time after 24 hours to six weeks after birth. If the haemorrhage is earlier the blood loss is still heavy because the uterus and placental site is not yet involuted. Later haemorrhage may appear less but is still dangerous.

Mild to moderate haemorrhage

The midwife must keep calm and start treatment similar to the management of primary atonic postpartum haemorrhage (see Chapter 21):
- Take a brief history of possible causes.
- Call for assistance urgently (if in hospital call for a medical practitioner, if in a clinic stabilise the woman and refer).
- Assess the physical wellbeing and status of the woman (pulse, blood pressure, Hb and haematocrit).
- The main aim of care is to stop haemorrhage by stimulating the uterus to expel clots and induce uterine contractions.
- Insert an intravenous line, giving 20 IU oxytocin into a second line of Ringer's lactate at 125 ml/per hour.
- Give an intramuscular injection of ergometrine 0.5 mg to contract the uterus or alternatively administer misoprostol 600 µg rectally or orally to contract the uterus.
- If the bleeding continues, the midwife must do a bimanual compression of the uterus and continue with this until a medical practitioner is available.
- Pain relief is administered as per medical practitioner's orders.
- If the woman is compromised or hypovolemic, emergency intervention as presented in Chapter 33 becomes applicable.
- If in hypovolemic shock lift the foot of the bed and give oxygen and start fluid resuscitation.
- Insert a urinary catheter.
- The patient must be transferred to a level two or three hospital for further management, accompanied by a midwife or medical practitioner until stabilised.

Obstetrical management

If the bleeding is moderate, or after the woman is stable in more severe bleeding, the medical practitioner will make a diagnosis using ultrasound. The most common cause is retained products of conception and interstitial endometritis. Subinvolution with an open cervix is diagnostic.

Potential further intervention depends on the cause and clinical picture and may include:
- Exploration and possible curettage in theatre if bleeding continues or there are retained products of conception, or if a laceration needs to be debrided and sutured. A specimen of the products of conception is sent to the laboratory to exclude choriocarcinoma. If the bleeding is severe, the medical practitioner may have to do a hysterectomy.
- If the bleeding has been moderate to severe, or if the patient shows signs of shock, the medical practitioner may give the patient a blood transfusion.
- In case of infection, intravenous antibiotic therapy is given and the discharge sent for culture and sensitivity.
- The woman is on bed rest and remains on an intravenous infusion until the results are back from the laboratory.

Specific nursing care in the puerperium

- The baby is admitted as a lodger and can continue to be breastfed.
- The patient is kept in hospital until there is no further bleeding.
- Routine care includes vital signs, four hourly temperature, Hb and bed rest.
- On discharge, the patient is told to see the medical practitioner or attend a clinic in two weeks' time (or immediately if there is any further bleeding).

Complications

The following potential complications can occur:
- Lactation may cease if hypovolaemic shock occurred.
- Hypovolaemia may cause necrosis of the pituitary gland leading to Sheehan's syndrome.
- Diarrhoea may result in the breastfed baby if misoprostol is given.
- Asherman's syndrome (adhesions within the uterus) may be caused by dilatation and curetage if too much endometrium is removed.
- Perforation of the uterus can occur because the gravid uterus is soft and can easily be perforated.
- Puerperal infections or peritonitis or septic shock may occur.
- Hysterectomy if bleeding cannot be controlled.
- Maternal death may occur.

37.3 Infections

Puerperal sepsis

Puerperal sepsis is an infection of the birth canal in the first two to 10 days postpartum (excluding the first 24 hours) indicated by a temperature of 38 °C or more for at least two days of the first 14 days postdelivery (See Chapter 50).

Differential diagnosis:

- If amnionitis was present prior to delivery an infection may occur within 24 hours.
- Endomyometritis may present without a fever.
- Breast infections may present with a fever.
- Other causes such as urinary tract infection.

Causes

This is usually caused by:

- *Streptococcus haemolyticus*, *Streptococcus faecalis*, *Streptococcus pyogenes*, *Staphylococcus aureus:* leading to septicaemia
- Anaerobic Streptococcus species: causing thrombophlebitis
- *Escherichia coli:* leading to local infection of the uterus
- *Clostridium welchii:* occurring after septic abortion, where there is damage to tissues.

Organisms that are rarely involved are Gonococcus, Pneumococcus, Pseudomonas and Proteus.

The organisms gain entry from the placental site due to the loss of the epithelial cover at the placental site, or from retained products of conception, which serve as a site for infection and/or from trauma, for example bruising and/or lacerations of the genital tract.

Mode of spread:

- Exogenous spread occurs through contamination as a result of poor hygiene of attendants, poor ward cleaning and dirty bed linen.
- Endogenous spread occurs from organisms already present in the vagina that gain entry through torn, bruised and necrotic tissue.
- Autogenous spread occurs from the patient via organisms present in the respiratory tract, skin or any other septic focus.

Predisposing conditions

Factors predisposing to infection:

- The woman may have lowered immunity as a result of diabetes mellitus, anaemia, malnutrition, debility from exhaustion, and from haemorrhage. The presence of infections such as HIV will also predispose to infection.
- Bruising, lacerations, vulval oedema, catheterisation and premature rupture of membranes.
- Interference, such as too many vaginal examinations, manual removal of the placenta, internal versions and instrument deliveries.
- Retained products of conception.
- Untreated local infection.

Pathology

Local infection includes the genital tract, but widespread infection leads to:

- cervicitis
- endometritis
- myometritis
- parametritis
- salpingitis
- peritonitis
- septicaemia
- thrombophlebitis
- breast infections.

Infection of the perineum, the vulva and cervix

The causal organism is *Staphylococcus aureus.*

Clinical features

- Tachycardia – on the third day.
- Hyperpyrexia – on the third day.
- Redness.
- Renderness, discomfort and pain.
- Swelling of the vulva and perineum.
- Sloughing of the tissues.

Vaginal loss may initially be normal, but if the infection spreads upwards to the uterus, then the vaginal loss will become brownish and offensive.

Endometritis

Infection of the endometrium

Clinical features

- Hyperpyrexia.
- Tachycardia.
- Profuse offensive vaginal discharge and products of conception may be present.
- The uterus is tender, soft, bulky and sub-involution occurs.
- There are general signs of malaise, headache and anorexia.

Parametritis and pelvic cellulitis

This is infection of the parametrium and the pelvis.

Clinical features

- Hyperpyrexia.
- Tachycardia.
- Vaginal loss is profuse, offensive, and there is sub-involution of the uterus.

As the infection spreads to the surrounding tissues, the patient complains of:

- lower abdominal pain
- vomiting
- general malaise.

Salpingitis

This is infection that involves the Fallopian tubes.

Clinical features

- Low backache.
- Lower abdominal pain.
- Hyperpyrexia.
- Tachycardia.

Peritonitis

The infection has reached the pelvic cavity and it involves the peritoneum.

Clinical features

- Tachycardia of more than 120 beats per minute.
- Rigors.
- Hyperpyrexia (5th–7th day).
- Distended, painful and rigid abdomen causing lower abdominal pain, with rebound tenderness.
- Persistent effortless vomiting, dark in colour.
- Diarrhoea.
- Restlessness, apprehension.
- Paralytic ileus with abdominal distention and lack of bowel sounds.

Septicaemia

This is a generalised bloodstream infection that developed from the lower genital tract. With septicaemia the infection has become puerperal sepsis, discussed in Chapters 33 and 50.

Prevention

The prevention of infections in the postnatal period starts in the antenatal period. Women are educated during antenatal care. Universal infection control must be practised during the intrapartum and postpartum periods.

During pregnancy. Good antenatal care, which involves:

- Health education regarding personal hygiene, sanitation, hygienic conditions in the home.
- Treatment of any infections in pregnancy and any minor disorders of pregnancy.
- Adequate instruction regarding diet and nutrition, ensuring adequate intake of vitamins while pregnant.
- Treating any diseases in pregnancy such as tuberculosis, diabetes, anaemia and so on.
- Prevention and treatment of any complications in pregnancy, especially haemorrhage.
- Advice regarding sleep, exercise, adequate rest, etc.

During labour. The following should be adhered to:

- good personal hygiene
- aseptic technique for all procedures
- reduction in number of unnecessary vaginal examinations
- recognition and treatment of complications
- screening of staff for infection
- limiting traffic through the labour ward
- prevention of prolonged and/or obstructed labour.

During the puerperium. The following criteria should be met:

- Isolation of patients who are contagious.
- Advice on personal hygiene.
- Maintain best practice in a septic vulva toilette, hand washing, and procedures to prevent cross-infection.
- Promote a positive and safe environment that includes clean water, clean bedding, lack of noise to promote sleep and rest, adequate beds that are well spaced, enough baths, showers, toilets and utensils.
- Quality standards of care that allows for adequate staffing, prompt observation, accurate recording of vital signs and treatment of complications.
- Update staff and do skill drills, have poster display of major complications and interventions and keep staff skills updated to manage common and rare complications of the postnatal period.
- Ensure a caring environment.

Medical management

The medical management includes:

- Uterine evacuation where necessary.
- Full blood count and blood transfusion if necessary.
- Septic workup including: a high vaginal swab, a nose/throat swab, blood cultures, midstream urine specimen and a wound swab if needed or milk specimen from the breast. In some cases throat swabs from the nursing staff may be required by infection control.
- Antibiotics: broad spectrum initially and then according to culture and sensitivity results.
- The woman may be nil per mouth if nauseous and intravenous therapy is given for hydration for 24–48 hours.
- Analgesics, iron, multivitamins, laxatives and sedatives are prescribed.
- Special examinations may be requested for typhoid, malaria, viral hepatitis, appendicitis and HIV.

Complications

The following are possible complications:

- infertility
- hysterectomy
- abscesses
- poor wound healing/secondary suturing
- fistulas
- death.

37.4 Thromboembolic disease

Thromboembolic disease can occur in pregnancy, but is more common in the puerperium.

There are two main types of thrombosis:

- *Superficial thrombosis.* This is the most common form of thrombosis in this period and is called thrombophlebitis, a condition in which a thrombus is formed in a varicose vein, with inflammation of the vein wall due to a primary infection.
- *Deep vein thrombosis.* This is less common but is a more serious condition, in which there is an obstruction of a vein by a blood clot without preceding inflammation of its wall. Minor damage of the vessels in labour aggravated by circulatory stasis and sepsis can cause clotting. It can include veins in the pelvis. A pulmonary thrombosis can occur as a result of a whole or a part of a large clot entering the cardiovascular system and obstructing the pulmonary circulation. This will cause chest pain, dyspnoea and shock.

Risk factors for thromboembolism in the puerperium

The physiological risk is increased for a thrombosis after birth due to:

- The effects of high progesterone in pregnancy that causes relaxation of the smooth muscles, resulting in stasis of blood and slow venous return in the lower limbs. If varicose veins are already present, they will predispose to stasis and therefore the likelihood of clot formation is increased.
- Changes in the blood that persists in the puerperium. The increase in the number of platelets that tend to clump together more readily, especially after tissue trauma, as well as an increase in the prothrombin levels, which peaks on 10–12 days postdelivery, increase the risk for thrombosis. Several clotting factors, for example, fibrinogen and factors VII, VIII, IX and X, also increase the clotting tendency after birth.

A history of previous thromboembolism is a risk factor, and re-occurrence is about 12%. If thromboembolism is present in this pregnancy the risk of complications is increased and the woman would be on anticlotting treatment.

Other factors that may contribute include:

- Obesity or forced immobilisation in cases of bedrest over a long period in the antenatal period, epidural in labour and/or following caesarean section. Patients fear movement because of pain, which will in fact be reduced by movement.
- Patients who have been on the combined oral contraceptive pill before becoming pregnant are also more prone to deep vein thrombosis or those on therapy to suppress lactation.
- Heavy smokers are more prone to thromboembolism.
- Patients who are lupus anticoagulant positive.
- Patients who have heredity conditions (e.g. antithrombin III deficiency).
- Thrombophlebitis/embolism is more likely to occur with increasing age; women over 35 years of age are five times more likely to develop thromboembolism than are younger women.
- Any pre-existing inflammatory process predisposes clot formation.
- The condition tends to occur more often in women with group A blood type.

Patients with medical conditions such as cardiac disease and diabetes mellitus, anaemia, in particular sickle-cell anaemia syndromes.

Other obstetric factors which may make a women more prone to thromboembolism are:

- dehydration after prolonged labour
- assisted delivery
- surgical interventions such as ceasarean section
- trauma to the legs as a result of prolonged lithotomy position.

General prevention of thromboembolic disease

During pregnancy

During the antenatal assessment the risk of thrombosis is assessed.

General prevention measures include:

- Anaemia is identified and treated with prophylaxis oral iron, vitamin A and folic acid. If anaemia persists the woman is referred to a medical practitioner.
- Infections are identified and must be prevented or treated immediately.
- A pregnant woman must avoid stasis of blood in the legs as a result of long periods of standing or sitting, for example when working with computers for long periods.

- The woman should avoid sitting on her legs and also crossing one leg over the other while sitting. This will help to prevent pressure on the veins. She should be encouraged to seek additional advice from a physiotherapist or attend antenatal classes and exercises.
- Dieting should be avoided, as weight loss causes ketosis. However, obese women should be helped to control their weight.
- Women with a history of thrombosis or who have had thrombosis in a previous or current pregnancy, may require prophylactic anticoagulant therapy during pregnancy and for six weeks after delivery. This woman will be under medical supervision. Regular clotting profiles must be done if this medication is given. The patient will require health education, supervision in hospital and adequate supervision and control once discharged.
- Women's legs are examined during each antenatal visit. Any complaints of leg pain and tenderness must be treated as very serious and the patient must immediately be referred to the medical practitioner.

During labour

Prevention measures during labour include:

- Exhaustion, dehydration and haemorrhage must be avoided. Intravenous therapy must be given and the hydration of the patient maintained throughout labour, particularly when labour is prolonged or complicated.
- Aortocaval compression (inferior vena cava syndrome which reduces cardiac output) or the supine hypotensive syndrome (preventing venous return to the heart and causing pooling and stasis of blood in the lower limbs) must be avoided.
- Overdistension of the bladder must be avoided, because an enlarged bladder, together with the enlarged uterus, can cause pressure on the iliofemoral venous segments.
- Avoid trauma to the limbs when moving or transporting an unconscious patient, or a patient under epidural analgesia. Avoid prolonging the use of the lithotomy position, which causes pressure and stasis of blood in the legs. The correct use of the lithotomy position requires two people to lift the legs simultaneously and place them correctly inside and not outside the poles.

In the puerperium

General measures include:

- Avoid anaemia and dehydration in the puerperium.
- Early ambulation is encouraged from two to four hours after normal delivery, if possible. If this is not possible, the midwife or physiotherapist teaches and encourages leg movements every two hours. In postepidural and postcaesarean section patients, ambulation starts as soon as possible and within 24 hours.
- Physiotherapy and deep breathing exercises which facilitate venous flow are encouraged.

Women who are at risk for thrombosis or who develop symptoms that present in the puerperium:

- are prescribed antiembolism stockings at all times during the day and night, which will limit the pooling and stasis of blood in the legs
- will receive anticoagulation therapy as prescribed (regular medical supervision is necessary).

Oestrogen-containing lactation suppressants or contraception are avoided postpartum.

Superficial thrombophlebitis

Thrombophlebitis of the superficial veins occurs in about 1% of patients.

Clinical features

The clinical features of this condition include:

- May be asymptomatic with a low grade temperature.
- Redness over the affected area with distended superficial veins (phlebitis).
- Calf and leg vein tenderness.
- Limb may be hot.
- Slight oedema of the leg.
- Mild tachycardia.
- Tingling in the legs.
- Positive Homan's sign: sharp dorsiflexion of the foot by the examiner will cause pain behind the knee or in the calf or affected area.

Medical management

- Diagnosis is confirmed by the clinical picture, sensitivity over the affected area and ultrasound or Doppler studies.
- The foot of the bed is elevated to reduce swelling. The leg circumference may be measured.
- Specific antiembolism stockings for the affected leg are provided.
- Analgesics are prescribed.

Midwifery management

- Initially, the patient is nursed in bed.
- The foot of the bed is elevated, as well as the affected limb.

- Deep breathing exercises are encouraged.
- Encourage full activity as soon as possible, with good leg exercises.
- Analgesics are given as prescribed.
- The patient is given a bed cradle to support the bed clothes and keep the pressure off the affected limb.
- Local anti-inflammatories are sometimes used, such as an anti-inflammatory gel, which can be applied to the affected area.
- Give health education on the use of the medication and the side effects.

Deep vein thrombosis

Deep vein thrombosis is suspected when there is pain on movement of the limb, accompanied by oedema. It occurs seven to 10 days after delivery. The incidence varies greatly from about 0.3–12 women in every 1 000 deliveries. There is a 12% increase in the incidence among women who have had previous deep vein thrombosis postpartum, with an increased risk of pulmonary thrombosis.

A condition known as phlegmasia alba dolens (or milk-white leg) is associated with ileofemoral thrombosis, and clots may occur in the pelvis, the thigh and the calf.

Woman at risk for DVT will be on Clexane® injections prophylatic.

Clinical features

- Pain and discomfort of the leg that restricts movement. Inability to walk due to spasms and pain.
- Positive Homan's sign with severe pain is present.
- Increased pulse and raised temperature.
- Exaggerated oedema may occur and this is a late sign. The leg girth measurement can be increased by as much as 2.5–5 cm.
- Tenderness may be felt in the groin.
- The leg feels heavy and painful.

Diagnosis

It is important to correctly diagnose this condition.The clinical signs are not a good guide to the diagnosis and do not give any indication as to whether the clot is stationary, lysing (dissolving), or progressing (enlarging). It must be remembered that it is possible for the clinical signs to be absent, therefore investigations must be carried out routinely.

Investigations

- *Doppler ultrasound.* This is used to detect the blood flow through the underlying vein. It is a primary means of differentiating leg thrombosis from normal blood flow. Normal blood flow is characterised by a low-pitched surging sound in the vein.
- *Ultrasound.* This will show the clot and the lack of venous expansion of the affected vein.
- *A lung scan (scintigram).* This may be required if there is a suspicion of pulmonary embolism.
- *Impedance plethysmography.* With this technique, blood volume changes in the lower calf can be measured. The changes are produced by inflation and deflation of a pneumatic thigh cuff. Blood flow changes decrease in patients with thrombi.
- *Venogram.* This is still used in some centres where no other diagnostic means are available.

Medical management

The aim of treatment is to relieve pain and to prevent both extensive thrombi and pulmonary embolism.
The following are curative treatments:

- Anticoagulant therapy.
- Heparin
- Warfarin (not used in pregnancy).
- Analgesia for pain.
- Intravenous fluid therapy.
- Pulmonary embolectomy may be required.
- In severe cases, surgery (thrombectomy) may be necessary.

Heparin. Heparin is given initially in the first 48 hours. It is given intravenously in a saline drip and thereafter, subcutaneously. This is followed by oral warfarin for three to six months after birth. The anti-coagulant medication is given according to the daily blood prothrombin index.

The advantages of heparin in pregnancy:

- It does not cross the placenta during pregnancy.
- It can be continued at home.
- It has a short life span and disappears from the circulation in six hours.
- It gives pain relief.
- It is rapidly reversed with protamine sulphate.

The disadvantages of heparin:

- It is not easy to control the degree of coagulability and it is very expensive.

The side effects of heparin:

- may cause pre-term labour and fetal loss
- bleeding tendencies
- long-term use may cause osteoporosis
- thrombocytopaenia.

Warfarin. Warfarin is not used during pregnancy because it causes congenital defects in the fetus, such as:
- optic atrophy
- chondrodystrophy
- mental retardation
- neonatal haemorrhage
- nasal septal defects.

Advice to the patients on anticoagulant therapy:
- Report any bleeding immediately.
- Avoid trauma while on treatment.
- Wear a 'Medic Alert' bracelet at all times.
- Avoid salicylates as they potentiate the effect of the anticoagulants.
- Warn the medical practitioner and nursing staff if you are on anticoagulant treatment.
- Avoid aminocentesis and epidural analgesia.
- Report regularly for prothrombin index or INR.
- Avoid fish oil supplements.

Midwifery care
- Bed rest with the foot of the bed elevated.
- Support for the affected limb.
- Bed cradle to support the bedclothes.
- Analgesia for pain, as prescribed.
- Psychological support, reassurance and encouragement.
- Physiotherapy and exercises when the patient is able to do them, according to medical practitioner's orders.
- Antiembolism stockings and medication.

The use of oestrogen for contraception is contraindicated. If the family is completed, a vasectomy or a tubal ligation is a possibility or an intrauterine contraceptive device. Depo-provera, or nuristerate are suitable contraceptives.

Complications of deep vein thrombosis
Pulmonary embolism is the most common acute complication and may result in death.

Pulmonary embolism associated with deep vein thrombosis. This is a condition that can have a silent onset, with catastrophic consequences. It is a common cause of maternal death.
Warning signs:
- unexplained pyrexia
- syncope
- haemoptysis
- tachycardia
- cough
- painful and difficult breathing.

Major pulmonary embolism results in:
- collapse
- cyanosis
- acute pleural chest pain
- dyspnoea
- anxiety and restlessness
- hypotension
- death.

Diagnosis:
- pulmonary angiogram to identify the clot
- lung scan: (scintigram) both ventilation and perfusion scan to show ischaemia
- chest X-ray (not much use)
- electrocardiogram: specific changes associated with pulmonary embolism.

Immediate intervention:
- This is a medical emergency: call for help.
- Give the patient oxygen and start an intravenous therapy line.
- Nurse the patient in semi-Fowler's position.
- Reassurance, support and encouragement are essential.
- The woman will be transferred to the intensive care unit for further treatment.
  (See the Chapter 33 on obstetric shock.)

37.5 Urinary tract complications in the puerperium

Trauma to the urinary tract is common in prolonged labour due to big babies, assisted deliveries and caesarean sections. Blood in the urine on a catheter specimen after caesarean section indicates bladder trauma (nick). Other problems of the urinary tract are detailed below.

Acute retention of urine

Predisposing conditions
Predisposing factors to acute retention of urine:
- *Reduced tone in the bladder occurs with prolonged labour and obstructed labour.* This is aggravated by the dominant effect of progesterone, particularly after the decrease in oestrogen, when the placenta is expelled. Lack of tone allows the bladder to become over-distended, and this may occur during or after labour.
- *Trauma.* Oedema of the bladder occurs with an over distended bladder during labour. The tissue at the base of the bladder becomes oedematous due to pressure of the fetal head. Bruising of the bladder neck and the urethra occurs, especially if the second stage is prolonged. Postpartum vulval haematoma is also responsible for acute retention.

- *Pain.* Pain and discomfort in the vulva are caused by lacerations, oedema and suturing of the perineum, inhibiting relaxation of the urethral sphincter.
- *Spasm.* Spasm of the urethra following catheterisation causes acute retention of urine.
- *Urinary tract infection.* Due to catheterisation.

Psychological factors that influence micturition are:
- fear of pain and using a bedpan
- position in bed while using a bedpan
- lack of privacy
- reduction in intra-abdominal pressure
- weak abdominal muscles
- loss of sensation usually occurs after epidural anaesthesia.

Medical management

A woman should pass urine within two hours postdelivery. If a woman cannot or has not passed urine after six hours, consult a medical practitioner. The following interventions are helpful in encouraging micturition:
- Encourage the woman to void frequently to avoid bladder distention.
- Use a natural position.
- A warm bedpan or a bidet if available may be helpful.
- A dripping tap or running water within hearing may stimulate micturition.
- Pour warm water over the vulva.
- Give extra fluids. Drinking a glass of water may evoke a reflex contraction.
- Give analgesia on medical prescription for the pain.
- Use heat or ice packs on the vulval area and the perineum.
- If all the above fail, catheterisation may have to be carried out as requested by a medical practitioner.

Retention with overflow

Acute or chronic overdistension leads to a rise in pressure in the bladder. This forces the internal sphincter to open so that small quantities of urine escape repeatedly, without relieving the bladder of the large amount it contains. The rise in pressure is due to the excretory force of the kidneys. The urinary overflow to the exterior takes place quite involuntarily.

Bruising of the urethra, pain and temporary paralysis from an epidural analgesia will also cause retention with overflow.

Medical management

Consult the medical practitioner. On prescription the following may be done:
- Self-retaining catheter for 48 hours. Clamping and opening to develop bladder tone.
- On the second day, a midstream specimen of urine is sent to the laboratory. The patient is given encouragement, support and reassurance.

Complications

Dangers of prolonged urine retention:
- Atony of the bladder develops, which results in retention with overflow and residual urine.
- Hypertrophy of the bladder with the formation of diverticula.
- Urethral reflux as a result of atonicity of the bladder musculature. The valve at the urethrovesical junction becomes incompetent, allowing the reflux of urine into the ureters. This in turn may cause pyelonephritis, hydronephritis, renal atrophy and renal failure.

37.6 Pelvic floor complications

Trauma to the pelvic floor occurs in pregnancy and birth. If the pelvic floor is damaged in pregnancy and birth it may lead to morbidity and severe loss of quality of life in both the short and long term. Prolapse of the uterus and abdominal organs can occur. Other complications, such as vesicovaginal fistula, also arise.

Vesicovaginal fistula

This is the presence of an unnatural opening between the bladder or the urethra and the vagina. It is a common condition in developing countries. Necrosis occurs about five to seven days postdelivery, and is due to the prolonged pressure of the presenting part on the soft tissues of the bladder/urethra and vagina during prolonged or obstructed labour. This pressure causes the tissues to become necrotised and to slough off, thereby causing an artificial opening between the bladder and the vagina. Mechanical trauma from difficult instrumental deliveries can also cause this condition, which results in incontinence of urine.

Predisposing conditions

The following factors contribute to vesicovaginal fistula:
- neglected, prolonged and/or obstructed labour
- inadequate or unavailable transport, thereby delaying arrival at hospital
- lack of skilled attendance (failure of women to come to a hospital or, refusal of permission for hospital treatment from husband)
- female genital mutilation.

Prevention

The following are preventative measures:
- basic education

- provision of maternal clinics
- provision of midwifery services
- referral centres readily available
- community education programmes
- skilled attendance.

Medical management

The medical management includes:

- The woman is hospitalised.
- A urologist is consulted.
- The patient is given extra fluids and kept on a strict intake and output chart.
- A self-retaining catheter is kept in place for two to three weeks to encourage the fistula to close spontaneously. It may be necessary to wait two to three months to repair the fistula, to allow infection to clear and to allow healthy tissue to form.
- The patient's nutritional status must be improved with added vitamins and minerals.
- Surgical repair is undertaken if no spontaneous healing occurs in eight to 10 weeks. The repair is performed, using a support graft, and the vaginal wall is closed. An indwelling catheter is inserted for 14 days.
- Coitus is avoided for three months.

Complications of vesicovaginal fistula

Vesicovaginal fistula causes severe scarring of vaginal and bladder walls. The patient must be counselled regarding future pregnancies. Future deliveries should be by caesarean section if the patient has had a successful vesicovaginal repair.

The cure rate is 80% with a 10% failure rate and a 10% stress incontinence rate.

Rectovaginal fistula

Cystocele

A cystocele is the prolapse of the anterior vaginal wall beneath the bladder due to damage to the pelvic floor. This may be present after birth but usually develops later in life.

(Involus: this is the prolapse of the upper part of the anterior vaginal wall and the bladder muscular wall, leading to herniation of the bladder.)

Cystocele is a common condition, which can be symptomless, but often presents with:

- urinary stress incontinence
- bearing-down sensation
- vaginal protrusion
- if the cystocele is present for a long period, it will result in urethral angulation and hypertrophy of the muscular walls of the bladder
- bladder irritation
- frequency of micturition
- dysuria
- later, pyelonephritis and recurrent episodes of urinary tract infections.

Rectocele

A rectocele is the prolapse or herniation of the middle portion of the posterior vaginal wall over the perineal body. The supports are weakened or torn by childbirth.

Occasionally there are no symptoms, but if sacculation of the vaginal wall occurs, defaecation is only accomplished by digital pressure vaginally.

Predisposing conditions for rectovaginal fistula

The following factors contribute to rectocele:

- trauma to pelvic floor in labour
- assisted labour
- large babies.

Prevention of rectovaginal fistula

The following are preventative measures:

- Prevent trauma to the pelvic floor in the second stage of labour.
- Prevent prolonged labour.
- Forceps to be used by skilled practitioners only.
- Ceasarean sections for large babies.

Medical management of rectovaginal fistula

Both conditions can only be rectified through surgery although this is often not successful.

37.7 Conclusion

For every woman who dies in childbirth five will have a problem that results in long-term health consequences that affect their quality of life. It is important that the midwife is able to identify potential problems, advise and refer women appropriately and is skilled in emergency care to prevent morbidity and mortality (see Chapter 2).

CHAPTER

38 Infant feeding

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- complete 18 hours of training on breastfeeding that includes the following:
  - the development of competencies to facilitate effective positions to feed a baby on the breast
  - the provision of guidance and support to mothers to establish breastfeeding following baby-friendly principles
  - demonstrating knowledge, skill and competencies in educating and assisting families on infant feeding
  - the use of a scientific approach to identify and manage breastfeeding problems in the early puerperium.

KNOWLEDGE ASSUMED TO BE IN PLACE

Anatomy and physiology of the breasts
The physiology of lactation

KEYWORDS

Baby-friendly healthcare initiative • Formula/replacement feeding • Donor milk • Supplementary and complementary feeds

38.1 Introduction

This chapter is studied in conjunction with Chapter 9 on the anatomy of the breast, the physiology and synthesis of breast milk, the value of mother's milk and the advantages of breastfeeding for the newborn. This chapter provides the best practice standards developed and proposed by UNICEF (see www.babyfriendly.org.uk). Midwives need 18 hours of training to become competent in supporting breastfeeding.

The global initiative to promote breastfeeding is hampered by the pandemic of HIV that has a particularly high incidence in sub-Saharan Africa. Newborn care for HIV-positive mothers is given in Chapter 51, including flash pasteurisation of mother's milk.

Baby-friendly healthcare (BFHI)

This global initiative is aimed at the protection, promotion and support of breastfeeding. BFHI's main focus is to encourage and facilitate the transformation of birthing centres in accordance with ten steps for successful breastfeeding to improve the quality of life for both mothers and babies. In South Africa, the BFHI was officially launched in 1994 and by 2005, 176 facilities were declared baby friendly and are assessed annually for compliance. Only two of these are private clinics.

Although breastfeeding is a natural process, it is also learned behaviour and is influenced by the social environment and practices. Breastfeeding needs to be actively supported and promoted.

See Box 38.1 for the criteria for baby-friendly accreditation.

Rooming-in and demand feeding

The concept of the 'rooming-in' of the infant (the infant remaining in the room with the mother) is important in the development of relationships between the new mother and her baby and is one of the requirements of BFHI.

Rooming-in is also important in the development of the relationship between the new father and the newborn baby and is thus beneficial to family relationships as a whole. Women are told about rooming-in during antenatal care and some chose to have their babies where this is not a policy.

38.1 Ten steps to BFHI

1 Have a written policy that is routinely communicated to all healthcare staff. It must be visible at all points and displayed in all languages. It should be audited annually, with the view to improve care.

2 Train all healthcare staff in skills necessary to implement this policy.

All staff that have contact with mothers and babies should be orientated and trained on baby-friendly policy and principles of care and be able to describe these. A copy of the curriculum must be available. Include at least 18 hours training covering all ten steps. A random sample of 80% of staff must have received training within six months after appointment and answer four out of five questions on BFHI correctly.

3 Give information to all pregnant women about the benefits of breastfeeding. This should cover information about exclusive breastfeeding (particularly for HIV-positive women), the benefits of and the basic management of lactation.

Eighty percent of a random sample of women of 32 weeks gestation or more must confirm that these benefits were discussed with them and they must be able to list at least two of the benefits, such as nutritional value, bonding, protection and health benefits for the mother. Eighty percent must confirm that they had no demonstration of formula feeding and must be able to name two management strategies for breastfeeding, such as rooming-in, avoid teats, feeding on demand, position and skin contact.

4 Initiation of breastfeeding. Help mothers initiate breastfeeding within half an hour after birth. An unhurried supportive environment needs to be created. Eighty percent of mothers must indicate that they were given the opportunity to breastfeed within 30 minutes after birth (including caeserean section) and were encouraged to breastfeed.

5 Support. Eighty percent of mothers must indicate that they were helped to breastfeed and shown how to breastfeed and maintain lactation, even if they should be separated from their infants within six hours after birth, including positioning of the infant, how to express milk manually and given written information on expression.

continued

6 Exclusive breastfeeding. A senior member of staff must give reasons why infants are given other food. There is no display of other food or feeds. Give newborn infants no food or drink other than breast milk, not even sips of water, unless medically indicated. Women who are fully educated on the benefits of breastfeeding may still chose to formula-feed.

7 Minimal separation of mother and baby. Practice rooming-in: allow mothers and infants to remain together 24 hours a day. Eighty percent of mothers must indicate that the baby stayed with them day and night.

8 Avoid schedules. Encourage breastfeeding on demand. Eighty percent of a random sample of women must indicate no restriction on feeding schedule and time of feeding and indicate that they were instructed to feed the baby when hungry. This must be confirmed by the head of the unit.

9 Give no artificial teats or pacifiers (also dummies or soothers) to breastfeeding infants. A random sample of eighty percent of mothers must confirm that the baby was not given a teat or dummy. No breastfed baby must be observed to use such. Mothers have the right to use dummies if fully informed not to and wish to do so.

10 Community support. Eighty percent of mothers must indicate that they plan to continue breastfeeding after discharge and have been given the information of a support group or person in the community. The unit must be aware of such groups and refer women to them. There should also be a follow-up system.

Women who are sick or who have had a traumatic delivery may not be well enough to keep the baby with them all the time. This includes conditions such as hypovolaemic shock, caeserian section with hysterectomy, TB, eclampsia or cardiac conditions and infections where the needs of the mother are assessed before she is allowed to have the baby for periods of time.

Sick newborns are admitted to a neonatal unit and may only be allowed to be with the mother when out of danger or when kangaroo-mother-care is instituted.

A healthy woman who refuses to keep her baby in her room or at her bed needs to be assessed for psychological problems. If needed, counselling by a psychologist or social worker can be suggested. No woman can be or should be forced to keep her baby with her.

Healthy babies that receive phototherapy are kept at the mother's bedside in most institutions if the policy and procedures allow such a practice. The benefit of this includes the reduction of the mother's anxiety by involving her in the care of the baby.

Where rooming-in is practised, the midwife cares for the mother and baby as a unit, has the opportunity to teach the mother and family about baby care and can observe for gaps in mother–child bonding and care, which allows early intervention. When a mother rooms-in the baby cannot be left alone on a bed or in the room. When the woman leaves the ward for any reason the baby is placed under supervision of the staff in the nursery and not with the other women in the ward. The principles of rooming-in should be clearly stipulated in a policy and need to be explained to mothers before and on admission. The care of the mother and baby as a unit remains the responsibility of the staff.

The supervision of infant care and feeding

The midwife should give the support and attention that is needed during the first two weeks after delivery and she should understand the needs of the woman, her partner and of the baby. This includes understanding their own attitude towards breastfeeding, emotions and relationships.

Currently the midwife may have limited time available because most mothers and babies are discharged within 24 hours. A structured plan is needed to give support in this time as well as a follow-up plan.

38.2 Infant care and feeding

Breastfeeding and general infant care should be demonstrated and explained in depth to make sure that the mother is fully competent and comfortable with both.

Breastfeeding

During the antenatal period the midwife prepares the expectant couples for successful breastfeeding and lactation. Early maternal-infant skin-to-skin contact has been shown to promote breastfeeding.

The establishment and maintenance of lactation after delivery depends on early suckling by the baby, the physiological neurohormonal processes that are started and the support provided by the maternity unit. The physiological processes of lactation are discussed in Chapter 9 including colostrum, milk production and the let-down reflex.

This *neurohormonal reflex* causing the flow of milk is known by various names:

- the milk draught
- the let-down reflex
- the milk-flow reflex
- the milk-ejection reflex.

The let-down reflex can be inhibited by a stressed mother. This let-down reflex may occur as a result of the baby suckling, but later, hearing the baby cry, or even thinking of feeding the baby, may bring about the let-down. If the mother is hot, leaking may occur from the nipples.

Each mother will experience different sensations when let-down of milk occurs, such as a prickling sensation in the periphery of the breasts, an increased feeling of warmth in the breasts, a feeling of filling and fullness in the breasts, etc (see Figure 38.1).

The sympathetic inhibition of the let-down reflex

The sympathetic inhibition of the let-down reflex seems to be both a direct effect of inhibiting the contraction of the M-E cells and an indirect effect of vasoconstriction of the mammary blood vessels, causing reduced blood flow and therefore reducing the amount of oxytocin to the breast tissue. This inhibition can be a problem, especially in the early or learning period of breastfeeding and may be brought about by stress, pain, fear, anxiety and worry, embarrassment and even distaste at the thought of breastfeeding.

Midwifery actions

It is important to help a mother to be calm and pain free when lactation is initiated. The positioning of the mother is a critical factor (See Figure 38.2).

The mother and the baby must be ready for feeding. A baby may be affected if the mother is not willing or ready and often refuses to take the nipple. A mother is given the opportunity to be with her baby, and talk to the baby. When she relaxes or when the baby starts to suckle the let-down reflex may kick in.

Correct technique for suckling

This includes:

- The whole nipple and the primary areola are drawn into the baby's mouth.
- The baby closes his/her jaws onto areola tissue situated over the lactiferous sinuses (the ampullae).
- This expresses the milk from the sinuses into the baby's mouth and the milk is then swallowed.
- A vacuum is created in the baby's mouth, which helps to draw more milk from the lactiferous ducts into the lactiferous sinuses.

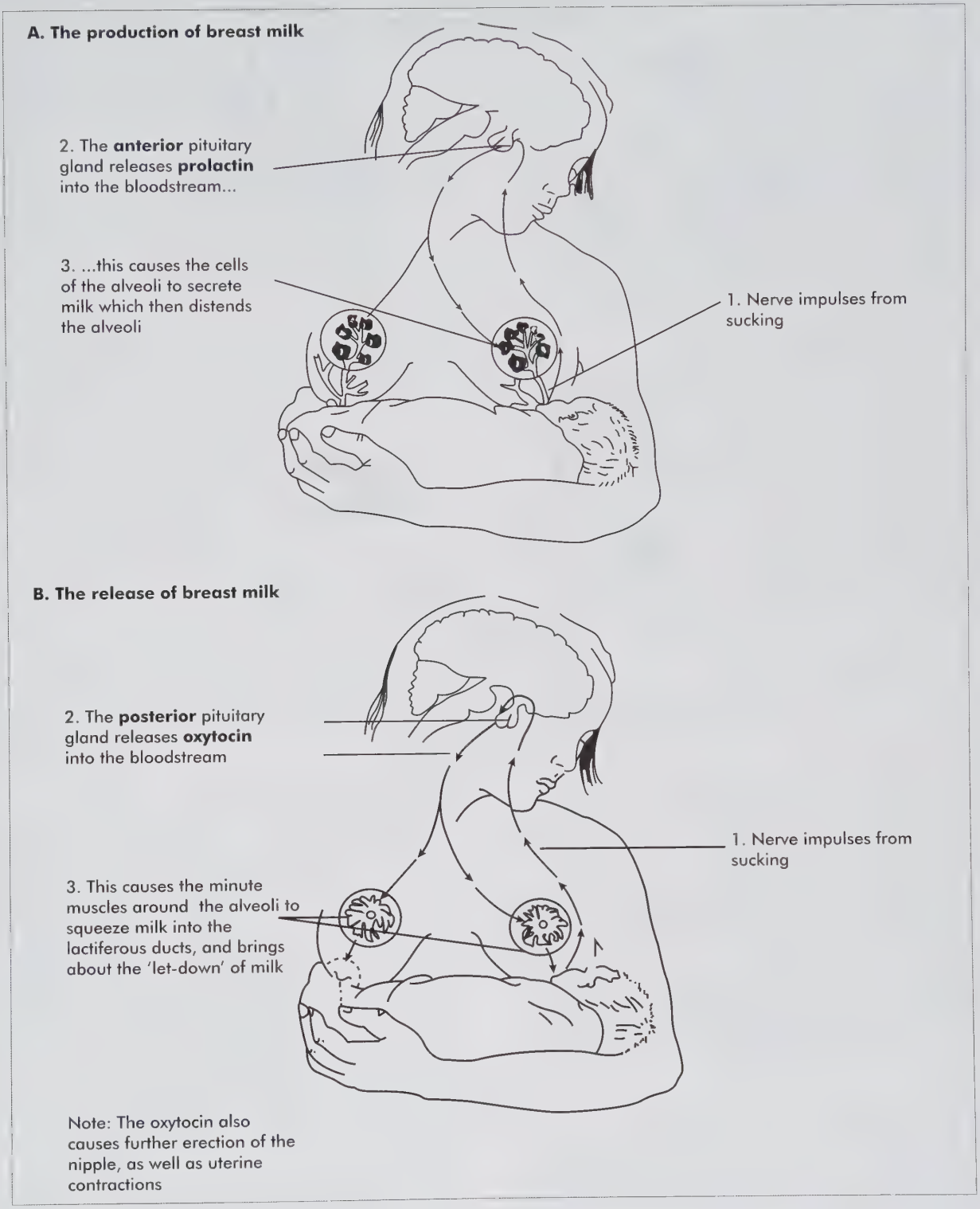


Figure 38.1 The effect of suckling on the production and release of breastmilk via the pituitary gland



Figure 38.2 Positions used in breastfeeding. 1: Cradle hold, 2: Modified football hold, 3: Lying down to breastfeed, 4: Football hold lying down

- As the milk is drawn off from the lactiferous sinuses and lower ducts, more milk flows down from the upper lactiferous ducts, tubules and alveoli, to take its place. This continues until the breast is emptied (see Figure 38.3).
- There is always milk in the breasts but 80% of the milk is produced when the baby sucks. The milk in the breasts is foremilk and the milk that is produced during a feed is hindmilk. The hindmilk contains more fat and protein.
- While breastfeeding, the baby closes his/her jaws onto the areola over the lactiferous sinuses, with the nipple right at the back of the mouth, and presses the milk into the mouth.

When bottle feeding, the baby sucks the teat by pushing it against the palate with the tongue. The milk flows more easily from the bottle and the baby does not learn how to breastfeed, which takes more effort. A baby sucks 60 times harder on the breast than on the bottle, which incidentally also helps to develop the jaw muscles.

The maintenance of lactation

Several interdependent factors are responsible for the maintenance of lactation:

- *Suckling and nipple stimulation.* Without suckling and emptying the breasts, there will be no stimulus for the breasts to produce more milk, hence the importance of continued suckling (and/or expression of milk) particularly when there is an apparently insufficient milk supply. Therefore, the baby's inability to suckle or to suckle properly, which could be caused by a problem with the nipples or due to some adverse condition of the baby or the mother, will lead to a decreased production of milk.
- *The mother's emotional state.* The mother must *want* to breastfeed her baby for breastfeeding to be successful. Milk secretion is influenced, via the hypothalamus, by the mother's emotional state, which affects the release of oxytocin and the let-down of the milk. An upset or tense mother will have difficulties with the release of milk.

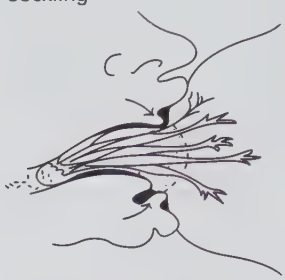
Breastfed baby suckling **correctly**

1a. Commencing suckling



Tongue below the nipple but back behind the gums

1b. Suckling



Gums pressing behind the nipple, with the nipple well back into the baby's mouth

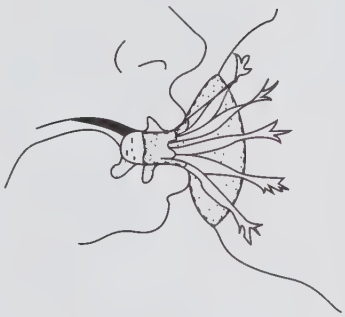
2. Bottle feeding



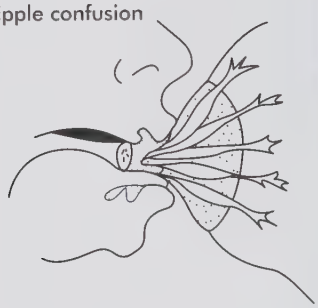
Tongue forward and wrapped around teat–sucking action

Breastfed baby sucking **Incorrectly**

3. Chewing the nipple



4. Nipple confusion



Tongue forward as in bottle feeding

Figure 38.3 Correct and incorrect latching

- *Adequate rest for the mother.* Prolactin secretion and milk production take place during rest and sleep, and therefore if the mother is tense, anxious and not sleeping well, or rushing around and becoming overtired, less milk will be produced.
- *An adequate and balanced maternal diet.* The mother's milk reflects her diet. When a woman is malnourished her milk may be nutritionally lacking and in some cases it may dry up. Mother's milk is unique for each baby and no mother's milk is the same as another mother's. The most important assessment of the quality of a mother's milk is if the baby gains enough weight.

Suppressing lactation

When there is a medical reason not to breastfeed or a mother is unable or unwilling to breastfeed, then lactation will have to be suppressed. If the decision is made before birth then it is better not to let the baby suck at all.

Lactation suppression includes the following:

- Do not stimulate the nipple.
- Do not express milk (unless milk is suppressed after lactation was established).
- Limit the fluid intake.
- Contain the breasts in a firm brassiere or binding.
- Medication may be necessary if a mother's milk has been established and milk is then suppressed, for example if a baby dies after feeding for a period, the process is more difficult.
- Medication will be needed to suppress the lactation. A prolactin inhibitor either (bromocripton orally 2.5 mg twice a day for two weeks or cabertonale, 1 mg single dose IM one day after birth.
- It may be necessary to express the breast milk once or twice for comfort.
- It will take a few days before the milk is suppressed.

Psychological aspects of breastfeeding

Breastfeeding is not always an easy process, particularly at first. Latching onto the mother's breast is frequently not adequately achieved, and babies sometimes need to have their heads guided and their mouths opened in order to feed properly.

Sometimes mothers have to be given extensive training on how to feed their babies. Acute embarrassment may be caused by this and the midwive needs to be sensitive. Mothers may initially feel shy when midwives touch their breasts. Others may feel incompetent and doubt their mothering ability because they cannot seem to do what is supposed to be natural, maternal and instinctive in good mothers. Yet others may be reluctant to bother the busy midwives every three hours for help when feeding their babies. Mothers need to remember that they are in a maternity unit partly in order to get help from midwives and medical practitioners when learning to cope with their babies. Mothers have a right to ask for help whenever necessary. Most midwives are, in fact, very willing to help. Some are particularly good at helping new mothers to overcome the initial difficulties that can occur. Ideally a maternity unit will use such skilled staff as breastfeeding consultants, focusing on the needs of women.

Ideally, one person should be guiding and supporting a mother to avoid confusing advice. Mothers repeatedly faced with unsuccessful breastfeeding attempts may soon despair and give up breastfeeding, sometimes with deep-seated regret or even feelings of guilt.

The baby may also refuse to take the breast. Some babies do not want to latch at all. Such a mother could express the milk and give it to the baby if all else fails.

Common problems in breastfeeding

A common feeling in most mothers who experience problems with breastfeeding is guilt. While feelings of disappointment in those mothers who want to breastfeed but find they cannot is only human, feelings of guilt are frequently unjustified and may be caused by the expectations of the health professionals and community.

In general, there is no question that breastfeeding is, and should be, the feeding method of choice for new mothers. However, in some communities breastfeeding is less common.

Factors that contribute to discontinuing breastfeeding include:

- life-style demands, views of society and lack of support systems
- a birth experience that reduces the woman's self-esteem and confidence rather than enhancing it, changing ideas about breastfeeding, unwilling to 'go to all that trouble'
- the demands of having a family and a career, the need to return to work shortly after delivery, tiredness, an apparently decreasing milk supply, inadequate support in the early weeks when trying to establish a breastfeeding regime, and generally all the stresses, strains and pressures of the modern world
- physiological reasons such as maternal illness, or physiological problems related to abnormal breast development where breasts do not make milk, for example women with thyroid problems

In addition, the following problems may be encountered:

- *Inverted nipples.* Depending upon the severity of the inversion and also on the amount of retraction when the

back of the nipple is pressed between the baby's jaws, this condition can, but need not necessarily, be a cause of unsuccessful breastfeeding. For inverted or retracted nipples, the mother should wear shields in her bra cups from the beginning of the pregnancy if possible. If this has not been done, then she should insert them into her bra cups as soon as possible. They are worn for a few hours each day at first, until the woman becomes accustomed to them and then they are worn during the day and removed at night only. The mother should roll and pull her nipples as often as possible. The midwife should supervise all feeds until the mother is able to fix the baby properly herself. In order to help the baby to suckle, the baby should be fixed to the bottom of the breast and nipple first and then get the upper jaw and lip over the nipple and areola tissue.

- *Painful or cracked nipples.* The length of time that the baby feeds has no bearing upon tender or cracked nipples. The cause of cracked nipples is incorrect positioning and faulty fixing of the baby. The baby should be correctly positioned. The baby should not suckle on the breast using a nipple-and-shield, as this can cause trauma to and bruising of the nipple. See if the baby is properly fixed to the nipple. If the breasts are very full, gentle expressing around the nipples should facilitate easier fixing. Let the baby carry on feeding, as the length of time of feeding is *not* a cause of cracked nipples. A cracked nipple will heal within one hour if the baby is subsequently feeding correctly. Encourage frequent feeding. See that the mother does not pull the baby off the nipple, but show her how to insert her finger into the baby's mouth alongside the nipple, turn the finger and break the suction. The baby will then open his/her mouth and let go of the nipple (see Figure 38.3).
- *Engorged breasts.* Breast fullness is physiological, while breast engorgement is pathological. Engorgement can occur at any time after birth if the breasts are not emptied and the tissue becomes oedematous.

Prevention of breast engorgement

Feed the newborn frequent small feeds from the time of birth. Supervise and support the mother in order to ensure that the baby is fixing properly and suckling correctly.

Care of engorged breasts:

- The mother should take hot showers and gently massage her breasts.
- Cold cabbage leaves and ice packs can be applied to the breasts between feeds for 24 to 48 hours.
- Pain relief, such as paracetamol, should be given when necessary.
- Gentle expression of milk before feeds from the lactiferous sinuses, that is, around the nipple, so that the baby can fix or latch more easily.
- The mother should exercise her arms, apply gentle pressure and massage the breasts gently between her hands, both horizontally and vertically. The midwife can also help the woman to do this if the woman becomes tired.
- The baby should be put to the breast frequently, as frequent suckling is the best treatment for engorged breasts.
- Breast pumps should not be used for engorgement, as these bruise the tissue of the engorged breasts. However, if the baby is not suckling well (for example: a preterm baby), then a manually operated (not an electrical) breast pump of a recommended design may be carefully used.
- The position of the baby is very important. The baby's body should be kept straight and held across the mother's chest at nipple level. The baby's head should be held against the mother's breast to avoid pulling on the breast, with the nipple and most of the areola in the baby's mouth. The mother can then make a small dent in the breast with one finger, beside the baby's nostril, to facilitate easier breathing for the baby.
- Sooner or later treatment by a physiotherapist is useful.

(See Figures 38.2 and 38.3).

Overfeeding

Overfeeding seldom occurs in breastfed babies; the baby usually takes only what he/she requires. The normal feeding time is about 10 minutes on each breast. Occasionally, when the milk supply is over-abundant, or when the baby's requirements are not large, vomiting may occur, especially if the infant is not demand fed. This may occur towards the end of the first or second week after birth. With overfeeding, the baby may also have large, loose, greenish stools.

Because the infant is vomiting and also losing fluids with the stools, he/she may be both hungry and thirsty and may cry and suck his/her fists. The infant who started by gaining well may have a static weight or may even start to lose weight.

Intervention and care:

- Demand feeding is started if this is not already carried out.
- The amount of time on each breast is reduced slightly.
- The mother is encouraged to express a little milk before the feed, to reduce the first rush of milk at the let-down.

- The baby can be fed from one breast only, offering alternate breasts at each feed, and expressing some milk from the breast that is not taken. However, the mother should be careful that the milk supply does not decrease too much if only one breast is offered at each feed.
- The baby usually settles down and takes the required amount if demand feeding is carried out.

Underfeeding

Underfeeding can be due to either maternal or newborn causes or both.

- *Maternal.* An inadequate milk supply, inverted or retracted nipples, inadequate maternal nutrition.
- *Newborn.* The inability of the infant to take sufficient milk for normal growth and development. This could be caused by a number of factors: weakness, vomiting, diarrhoea, immaturity, congenital abnormalities, digestion and absorption problems, infections and other disorders (most high-risk babies).

Signs of underfeeding include:

- weight loss
- often a hungry, crying baby that cannot be pacified, with winds and colic
- a very lethargic baby
- small, greenish-brown stools, which are more formed than the usual stool of the breastfed baby and may contain mucus
- the urinary output may be reduced, and the urine concentrated
- hypoglycaemia.

If not noticed and/or not treated, underfeeding could lead to dehydration and to starvation, with marasmus, and to deficiency disorders such as kwashiorkor, scurvy, pellagra, beri-beri, rickets, etc. However, these conditions are more often found in infants who are artificially fed, or during the transition from breastfeeding to solids (weaning) and in late infancy.

Intervention and care

The mother's breasts should be inspected and all feeds carefully supervised.

If the milk supply is insufficient, the breasts should be stimulated by applying a little heat to the breasts before feeds, for example by a hot shower, warm clothes or the infrared lamp, followed by breast massage.

The baby is encouraged to suckle on the breast.

If the baby is not suckling well, the mother is encouraged to express milk after each feed.

The mother's nutritional state, her haemoglobin level and her diet should be checked.

The midwife should carefully observe the baby in the following manner:

- Assess the gestational age of the baby, because a low birth weight baby may have suckling problems.
- Inspect the baby's mouth for thrush or any abnormality of the tongue or palate.
- Note any vomiting.
- Check the stools.
- Check the urine.
- Look for excessive crying or lethargy.
- Check the temperature – raised or subnormal.
- Look for any other abnormality.

Any serious problem should be reported to a medical practitioner immediately and the condition treated.

If the baby still does not manage to take in enough after all possible problems have been excluded, alternative feeding should be started. This could take the form of an alternative method of feeding, such as bottle feeding, intragastric feeding or intravenous feeding. The feed given could be expressed breast milk, a formula feed of modified cow's milk, a soya formula, or a special intravenous fluid. The feeding could take the form of complementary feeds (giving the baby extra milk in a bottle after a breastfeed), supplementary feeds (giving the baby a bottle feed between breastfeeds) or full artificial feeding.

38.3 Promoting breastfeeding

The WHO promotes exclusive breastfeeding for the first six months of life for all babies with the exception of those women with a few medical conditions.

Preparation for breastfeeding, using printed and electronic information, attending antenatal preparation classes and having a positive attitude, all need to be reinforced by adequate support for breastfeeding. Having *skilled* assistance at the first feed and in the days afterwards can make all the difference in the initial adjustment to breastfeeding. There are postnatal support groups that assist with breastfeeding in many communities. Finally, some valuable assistance can come from friends. Some research, in fact, has suggested that a concerned lay person may be just as good a source of support for breastfeeding as some professional advisers.

38.2 Promoting breastfeeding

1 Refer to breastfeeding as normal rather than best.
2 Refer to the 'risks of not breastfeeding' rather than the 'advantages of breastfeeding'.
3 Make the neurological development benefits of breastmilk known.
4 Infant formula was developed as an emergency feed and needs to be viewed as such.
5 Infant formula is a poor alternative to human milk and should be viewed as such.
6 Adverse health outcomes related to infant formula feeding need to be pointed out.
7 The economic implications of infant feeding methods should be discussed.
8 Human milk banks need to become a routine component of healthcare.
9 Clarify the cost savings of breastfeeding.

Factors that may affect initial breastfeeding:

- *Psychological factors.* The mother may feel embarrassed and shy about exposing her breasts, especially in a general ward and therefore there must be adequate screening to give her privacy. A depressed mother may have a negative attitude to breastfeeding.
- *The husband and/or other members of the family.* There may be relationship problems with the partner, the mother or the mother-in-law, and any of these people may be trying to discourage her from breastfeeding. The new mother may be worried about other children at home and wondering if she will cope once she gets home.
- *Other patients in the ward.* The atmosphere in the ward and the attitude towards breastfeeding of other mothers/patients in the ward can affect the progress of breastfeeding. In addition, a very ill patient in the ward, or a woman who has lost her baby, etc., can cause anxiety and distress.

Physical conditions – maternal and infant

Nipple and breast problems

The nipples and breasts should have been inspected during pregnancy and the woman advised to roll the nipples between her forefinger and thumb and to pull the nipple outwards. This helps to make the nipple stand out and not retract when the baby's jaw presses on the ampullae.

In addition, if the nipples were flat or inverted, the woman should have been instructed on how to wear nipple shields in the cups of her brassiere.

The midwife needs to provide good supervision, advice and support and should not make the mother feel anxious and underconfident.

The attitude of the staff in the hospital

The attitudes of the midwife, the nursing staff and the medical practitioner can have a profound influence on whether breastfeeding will be successful or not. If a policy of baby-friendly care is not in place, women may not receive the needed support to breastfeed.

Requirements for success inlcude:

- The institution of a policy of baby-friendly care is essential to successful and continued breastfeeding.
- One of the most important factors in successful breastfeeding is the mother's ability to relax and enjoy breastfeeding her baby.
- Once successful breastfeeding has been established and maintained, the mother may well find that feeding times can be periods of quiet relaxation for her and the baby.
- The midwife/nursing staff must be able to provide information on available community support for the breastfeeding mother.
- The public attitude towards breastfeeding as a whole and mother's feeding in public also needs to change. This includes aspects of paternity leave and the creation of facilities for breastfeeding mothers in public and at work.

Expressing milk

(See Figure 38.4.) Women should be taught how to express milk. Manual expression is the preferred method. It is important that an aseptic technique is used when expressing milk to prevent contamination.

Milk banks

Donor human milk banking is a service that screens, collects, processes and dispenses human milk donated by volunteer nursing mothers who are not related to the recipient infant. This milk is only used when the mother's own milk is not available for her infant.

Donor milk banking (DMB) plays an important role in reducing mortality and morbidity in a small population of critically ill or premature infants.

South Africa started human milk banks in 2007-8.

Donor milk is almost exclusively for units where babies are ill. Some indications for donor milk are:

- prematurity
- malabsorption syndrome
- renal failure
- inborn errors of metabolism

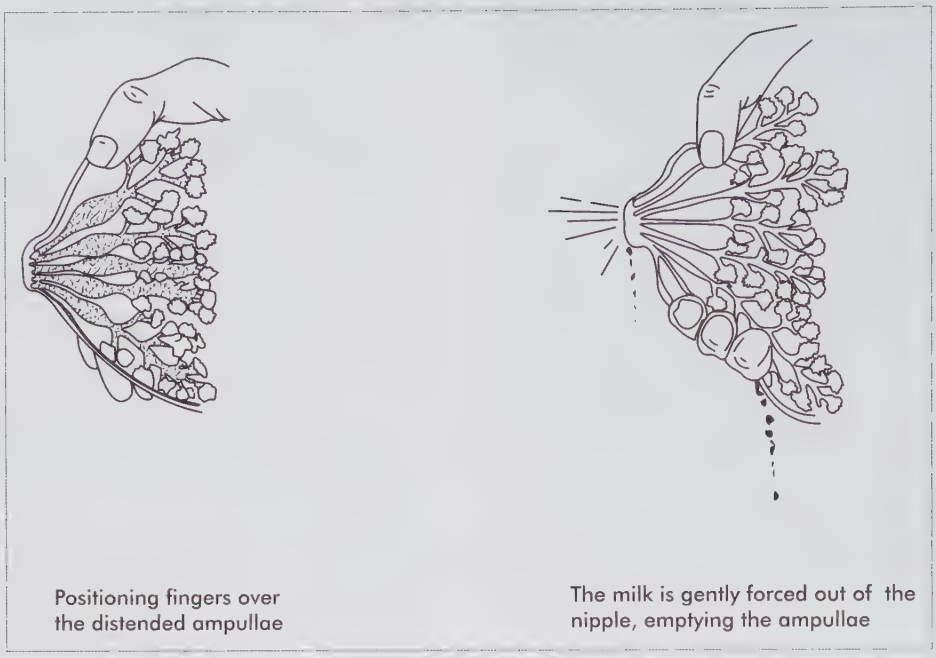


Figure 38.4 Guidelines for expressing milk

- cardiac problems
- paediatric burns cases
- failure to thrive
- short gut syndrome
- feeding intolerance
- postsurgical nutrition
- bronchopulmonary dysplasia.

Human milk can prevent the following conditions in premature babies:

- necrotising enterocolitis
- allergies to bovine and soymilks/feeding intolerance
- sequelae from immune suppression therapy.

Benefits of use in prematurity are:

- faster establishment of full enteral feeding
- better digestibility and bioavailability of nutrients and immune properties
- establishment of optimal acid gut pH
- immunological protection
- shorter stay in hospital.

Supplementary and complementary feeds

When a baby needs complementary (baby may receive breast milk with additional milk) or supplementary feeds (give extra feeding directly after breastfeeding) it is prescribed by a medical practitioner or an experienced midwife for reasons that may include:

- prematurity
- low blood sugar
- congenital abnormalities
- severely growth-restricted babies
- a mother who is unconscious, in intensive care, or dead
- a mother who chooses not to breastfeed because of her HIV-positive status.

38.3 Guidelines for expressing breast milk

- Maintain hygienic principles by always washing hands thoroughly and using a sterile container to receive the milk.
- Create a safe and comfortable environment.
- Apply heat before starting and drink a cup of tea to relax.
- Masssage the breast with gentle strokes from the axilla to the nipple.
- When the milk flows express the milk with gentle rhythmic movements that mimic the baby's sucking.

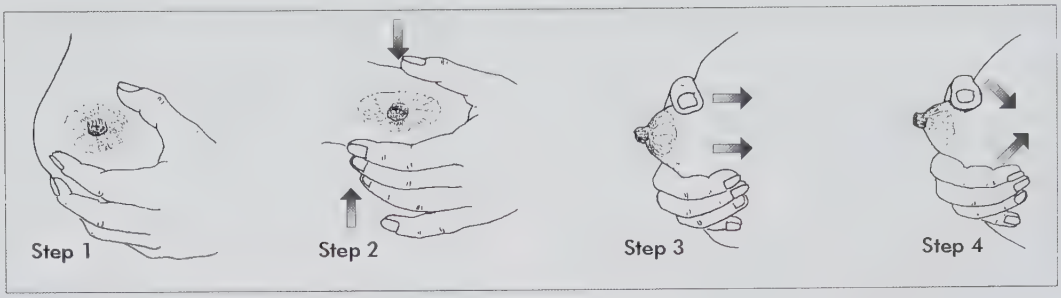


Figure 38.5 Stages in manually expressing milk

Supplementary feeds are given using a cup in prescribed amounts so that the baby will still take breastfeeds. If a baby is not well and the medical practitioner prescribes supplementary feeds, mother's milk is considered as additional to the treatment of this baby until the baby has recovered and can be put on the breast again. In this case the mother must express milk to maintain the volume of milk.

Complementary feeds may be given when there is a delay in the mother's milk production and in large babies who become very hungry and dissatisfied. Complementary feeding may be given by cup or syringe, in babies that will later be breastfed.

38.4 Replacement feeding (formula)

Replacement feeding or formula (bottle) feeding is the use of other feeds instead of breastfeeding. In some communities in the developed world the main mode of infant feeding is replacement feeding. There are many products available to feed infants. None of these are comparable with breast milk.

Formula milk is a poor substitute for mother's milk because the exact chemical properties of mother's milk are poorly understood and seem to be specific for a baby. Mother's milk changes over time according to the needs of the baby and its growth and development. The milk of a preterm baby is, for example, higher in protein than for a term baby and breast milk provides passive immunological protection. Efforts over the years to improve on the quality of breast milk substitutes led in 2001 to the Codex Alimentarius standards to safeguard the nutritional adequacy and safety of breast milk substitutes.

Infant formula is inferior to mother's milk but superior to cow's milk.

Humanised/modified milk

Humanised milk is a modified formulation of cow's milk, (40% casein, 60% whey or lactalbumin) with a fat ratio that closely mimics human milk. The high casein content of cow's milk makes it unsuitable for human babies.

Babies' bodies and intestinal systems do not have the enzymes to digest cow's or goat's milk. The kidneys of a newborn are also too immature to excrete the high sodium and minerals contained in cow's milk. Cow's milk is low in vitamin D and iron.

To make cow's milk more suitable for babies it undergoes several processes:

- *Protein.* The protein is altered to make the protein more digestible and the casein-whey (lactalbumin) ratio is 40% casein, 60% whey. The protein content is too high and is diluted. This results in a drop in the energy value of the modified cow's milk.
- *Vitamins.* The addition of several essential ingredients called *fortification* adds vitamins and minerals to the milk, particularly vitamin D and iron.
- *Fats.* Babies are never given fat-free milk. But in formula the fat may be replaced partially or totally by vegetable fats. Fat particles are decreased by homogenisation and the ratio of saturated to unsaturated fat is adjusted by adding coconut oil and maize.
- *Carbohydrates.* Carbohydrates are an important source of energy and up to 42% of the energy requirements of a newborn are from carbohydrates. Lactose is the main source of carbohydrates. It is a good source of energy and assists with the absorption of vitamins and minerals. Sucrose and glucose are used in soya preparations and lactose-free cow's milk products for babies that are lactose intolerant.
- *Nucleotides.* Nucleotides are compounds found naturally in human breast milk. Some companies add nucleotides to their formula, but they are not found in all formula feeds.

Examples of modified milk are:

- Nan
- S26
- Similac.

Acidified milk

Babies generally have a low stomach pH. Acidified milk may help with digestion and reduce the incidence of gastrointestinal infections. An example is Pelargon.

Milk substitutes

Babies that are lactose intolerant or allergic to cow milk protein can use hypoallergenic feeds such as goat's milk and soya products. These products need to be prescribed by a paediatrician because of the risk of hypoglycaemia.

Examples of hypoallergenic infant feeding are:

- Isomil
- Infrasoy.

Special feeds

The nutritional requirements of preterm babies differ from a normal term baby.

The kidneys cannot excrete sodium and higher protein is needed for growth. Infant feeding for premature babies is thus modified for this purpose.

The choice of milk

There is a variety of baby formulae available to choose from and women may have trouble deciding which formula to use. Mothers may choose a formula based on information from family and friends, clinic's preference and milk available, milk provided by the postnatal unit, and/or formula prescribed and preferred by a medical practitioner or paediatrician. People may have preferences for particular formula feeds, based on their experience.

The International Code of Marketing of milk substitutes requires that:

- No face and baby pictures are used when milk is advertised.
- Advertisements can only be in medical journals and not to the public.

Midwives need to know about formula feeds. It remains the mother's choice how and what she wants to feed her baby. It is the midwives' task to help her to make the best possible decision in the interest of the baby's wellbeing and growth and development. It is recommended that babies receive mother's milk for as long as possible and that mothers exclusively breastfeed for four to six months. Replacement feeding can start after breastfeeding is discontinued.

It is advisable that the milk most suited for a baby is given. In cases of feeding problems a paediatrician is consulted for prescribing a formula.

Factors that influence the choice of milk are:

- type of milk available
- socioeconomic conditions
- literacy level
- prevalence of breastfeeding in a community
- gestational age of the baby
- health condition of the baby (IUGR or galactocaemia)
- allergies
- availability of clean running water and hygienic conditions.

Complications associated with replacement or formula feeding are:

- lack of running water increases the risk of infections and increased perinatal and neonatal death is associated with replacement feeding
- allergies and eczema
- *Candida albicans* infections from poorly cleaned teats
- malnutrition because of incorrect mixing of the milk to stretch it to last longer (kwashiorkor, marasmus and vitamin deficiency)
- cramps because of mixing milk incorrectly
- colic
- lactase deficiency
- constipation or diarrhoea because the feed is not well suited for the baby
- over- or under-feeding
- more posseting and sour smell, rumination and habitual vomiting and regurgitation
- higher incidence of grommets due to ear infections related to feeding positions
- change of types of milk at will causing an upset of the baby's gastrointestinal system. Mothers often change from one milk to another on advice of friends.

If a baby is not coping well on a replacement feed a skilled midwife at the clinic who knows about replacement/formula feeding is consulted or a medical practitioner or paediatrician is asked to suggest another baby formula.

Principles of bottle feeding

The following is important when bottle feeding:

- Maintain asepsis. All bottles and utensils are kept clean to prevent infections.
- Babies are not propped up and left on their own when drinking. The baby is held in the arms when fed.
- The preparation of the milk must be as instructed on the formula tin.

- Cooled boiled water is used. This prevents the destruction of vitamins. The scoop provided is used and it is level and not heaped. One scoop per 25 ml of water is used. A 100 ml feed will then use four scoops.
- Use only bottles approved as safe for babies.
- The amount of food is determined by the age and weight of the baby. Preterm babies require more per kilogram weight than term babies (see Chapter 22).

38.4 Bottle safety

BPA (Bishenol-A) is a chemical used in the manufacture of baby bottles that has been found to be unsafe for babies. These bottles are banned in Canada and the Cancer Association in South Africa has warned against their use.

A term baby will be offered:

- day 1–60 ml/kg/24 hrs
- day 2–90 ml/kg/24 hrs
- day 3–120 ml/kg/24 hrs
- day 4–150 ml/kg/24 hrs.

This can be divided in five to six feeds in 24 hours. Premature babies and babies that are small-for-gestationalage age use different formulas because they need more energy for growth.

After this a baby will be offered 150 ml/kg/24 hrs. A baby needs 600 ml of milk a day until the age of nine months. Milk remains the main source of nutrition up to the age of three.

Growth and development

The full term baby is getting enough food if it gains 25–30g per day in the first weeks after birth. This is about 170–200 g per week. Babies that are small-for-gestational age are expected to gain more weight, normally 50–60g per day. (See Chapter 41 for food requirements for low birth weight babies.)

In addition a baby with eight wet nappies a day is well fed. When a baby is on formula feeds the baby must have a bowel movement every day.

The new Department of Health growth developement chart is an essential tool to assess the baby's growth. Note that there are different charts for boys and girls.

Introduction of solids

Babies should not take solids until five or six months. They do not have the necessary enzymes in their saliva and cannot roll food in the mouth. It is thus advisable not to start with solids before five months.

38.5 Conclusion

The midwife plays an essential role in helping the mother with infant feeding, helping with problems and referring the mother and baby to a paediatrician where necessary. All midwives need at least 18 hours of training in breastfeeding management.

Section Seven
Newborn care

39 The physiology, abilities, characteristics and needs of the newborn

40 Assessment and care of the newborn

41 Disorders of maturation, growth and development

42 Common disorders and abnormalities of the newborn

43 Jaundice and infections in the newborn

44 Congenital abnormalities

45 Respiratory disorders

46 Birth trauma

47 Metabolic and endocrine disorders

48 Transporting the mother and/or newborn

CHAPTER

39

The physiology, abilities, characteristics and needs of the newborn

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- explain terminology related to the newborn
- explain the physiological changes that occur in the respiratory and cardiovascular systems during the transformation from fetal to neonatal life
- explain the anatomical, physiological and psychological adaptation of a newborn after birth
- explain normal characteristics of a newborn
- explain thermogenesis
- differentiate between physiological vital findings and blood and other values of newborns and children.

KNOWLEDGE ASSUMED TO BE IN PLACE

Fetal development *in utero* and physiological changes at birth (See Chapters 7 and 10)

KEYWORDS

Brown fat • Meconium • Passive immunity • Thermogenesis • Surfactant

39.1 Introduction

Under normal circumstances, all the needs of the fetus are perfectly catered for *in utero*. The placenta supplies nutrition and oxygen, and waste products are removed from the fetus via the placenta. The environment is safe and insulated from shock, trauma, infection and from changes in temperature by the placenta, membranes and amniotic fluid.

At birth, the baby is projected out of the warmth and security of the mother's body, into a new, challenging environment.

The baby needs to make major physiological adaptations in the new environment to become independent. The main adjustments are:

- The initiation and maintenance of pulmonary respiration.
- The initiation of circulatory changes, in order to ensure adequate oxygenation of the whole body.
- The ability to regulate body temperature.
- The ability to ingest, retain, digest and absorb nourishment via the alimentary tract.
- The ability to eliminate all waste products.
- The ability to maintain the full functioning of all the body systems.
- The ability to protect the body against infection.

39.2 The respiratory system

Initiation and maintenance of respiration

The initiation of respiration at birth is the most important physiological adjustment to occur. In the uterus the respiratory tract produces fetal fluid that enlarges the alveoli. Near term the production of these fluids decreases. There is approximately 40 ml of fluid in the uninflated lungs at birth.

During labour some of the fluid is lost through the nose and mouth and the rest moves into the interstitial spaces, where it is absorbed and removed by lymphatic channels to allow for air to replace the fluid in the respiratory tract.

With the first breath, considerable negative intrathoracic pressure develops and about half of the air that is drawn in

will remain as residual pulmonary air with negative pressure to keep the lungs open. Although considerable transthoracic pressure is needed to expand the alveoli, which still contain fluid, this expansion is normally achieved with only a few initial breaths. The negative pressure is brought about by the elastic recoil of the compressed chest wall at birth, the downward movement of the diaphragm and the contraction of the intercostal muscles. With the onset of respiration, there is a reduced pulmonary vascular resistance. Once the alveoli have expanded, breathing requires less pressure because surfactant then lines the alveoli, reducing the surface tension, and a functional residual capacity (FRC) is maintained. Respiration at birth can be divided into two stages:

- The initiation of respiration which is characterised by the sharp intake of air and loud crying, which normally should occur within 60 seconds. The newborn experiences mild asphyxia *in utero* as a result of interruption in placental blood flow during uterine contractions. This sets the responses in motion for extrauterine life. Chemoreceptors in the carotid artery and aorta are stimulated by the lowered arterial oxygen tension (PaO_2) and decrease in arterial pH and rise in CO_2 as a result of the cold air and harder surfaces outside the uterus.

  The negative pressure created in the thorax, required to take the first breaths to expand and fill the alveoli, is greater than the pressure needed for normal respiration. This pressure is usually between 20 and 30 cmH_2O, but sometimes this pressure can be as high as 60 cmH_2O. Phospholipid substances (surfactant) lining the alveoli reduce this tension and prevent the alveoli from collapsing between each expansion. The negative pressure which is required for breathing after the first few minutes is smaller – in the region of 5 cmH_2O.
- The initiation of respiration is followed by the maintenance of respiration, which is quiet, shallow, more rhythmical breathing, but which is often irregular with short periods of apnoea and ranges from 30–60 breaths per minute. This normally occurs within the first 90 seconds after birth. Premature infants may adapt well at the initiation of respiration but will fail to maintain respiration and the negative pressure in the lungs is not enough (due to a lack of surfactant) to prevent the alveoli from collapsing. Babies born by caesarean section may have retention of fluid in the lungs, causing transient respiratory problems. Babies with meconium aspiration will have great difficulty in establishing and maintaining breathing until the meconium is removed. A respiration rate of 80 and above indicates respiratory distress. Grunting (audible sounds) and use of intercostal muscles are signs of breathing difficulties.

39.3 The cardiovascular system

Circulatory changes

In the uterus, oxygen exchange takes place from the mother's blood, via the placenta, to the fetal blood (see colour illustration, Figure 7.35, **C11**). The umbilical vein transports this oxygenated blood to the inferior vena cava and to the right atrium of the heart, where the pressure is greater than in the left atrium. The heart contracts and acts as a pump to distribute the blood, with its oxygen and nutrients, to all the fetal tissues.

At birth, with the maternal link severed, the heart continues to beat, but the pulsations will gradually decrease and cease if oxygen does not continue to reach the brain and the heart muscles. The following essential changes take place during and immediately after birth in the cardiovascular system (see colour illustation, Figure 7.36, **C12**).

With the first breath at birth and the subsequent inflation of the lungs, the pulmonary vascular resistance is markedly reduced. The fluid that is forced through the alveolar walls into the circulation increases the volume of fluid in the pulmonary circulation and this in turn helps to increase the pressure in the left atrium, making it greater than the pressure in the right atrium and so forcing the valve of the foramen ovale to close by pressing it against the atrial septum.

With the initiation and maintenance of respiration, the oxygen tension in the blood rises, causing the release of prostaglandins, which, in turn, causes contraction of the smooth muscle in the wall of the ductus arteriosus. There is a gradual closure of this temporary blood vessel which, after about two months, becomes the ligamentum arteriosum.

When the umbilical cord ceases to pulsate or when the cord is clamped and severed, no blood enters the ductus venosus and this further reduces the pressure on the right side of the heart. The ductus venosus constricts several hours after birth and after about a week, becomes permanently closed and forms the ligamentum venosum and the ligamentum teres which is attached to the liver. The hypogastric or umbilical arteries (which convey blood from the fetal internal iliac arteries to the placenta) also constrict and become the umbilical ligaments.

Normal blood pressure of term newborn is 60/30–80/40 mmHg.

The normal pulse of a newborn varies between 110–140 beats per minute.

Haematopoietic system

Normally, the average haemoglobin (18–22 g/dl) and red blood cell values of a newborn are high at birth but fall to normal levels by the end of the first month of life. The body breaks down the extra red blood cells and in the normal breakdown of

these red blood cells, there is often an accumulation of (unconjugated) bilirubin in the neonatal blood stream, resulting in what is known as physiological jaundice.

39.4 Thermogenesis

Temperature regulation and requirements

At birth the temperature of the newborn is more or less the same as that of the mother at 37.2 °C. Within seconds, however, there is a sharp drop in body temperature which is brought about by convection, evaporation, conduction and radiation. Although, as in the adult, heat is constantly being produced as a result of metabolic reactions in the newborn, there is greater heat loss from the skin to the environment, because the baby is naked, wet, and has a larger body surface area in relation to body weight and because blood vessels are closer to the surface of the skin. A newborn does not have mechanisms to shiver and heat up. However, a full-term baby under normal circumstances can usually maintain a normal core body temperature by producing sufficient heat to balance the amount of heat lost, but there is always the danger of hypothermia at birth and this a very serious condition in the newborn baby.

The heat produced is mainly by non-shivering thermogenesis. Instead, thermogenesis is mainly accomplished by increased metabolic activity in the brain, heart and liver from brown fat around these organs that is very vascular and is present only in a newborn baby. This unique source of heat, reserves of brown fat, is laid down in the body during the last few weeks *in utero*. These reserves can be used for several weeks after birth. (Premature infants have fewer reserves of brown fat than term babies, and are prone to neonatal hypothermia and cold stress/injury by the rapid metabolisation of these reserves.)

The increased metabolic activity necessary to use brown fat increases heat production by as much as 100%, but at the same time also uses up large quantities of oxygen and glucose. Therefore, hypothermia can lead to cyanosis and hypoglycaemia. If the baby is already compromised, then the use of large quantities of oxygen and glucose will cause further compromise. In addition, oxygen and energy are diverted from the normal functions such as brain cell activity, heart function and growth, towards trying to maintain the body temperature (thermogenesis). If neonatal hypothermia is allowed to continue for any length of time, depleting the oxygen in the blood, anaerobic glycosis occurs and this leads to metabolic acidosis.

The baby's temperature can drop to 36.5 °C and the baby is not bathed until the temperature is stabilised at 36.5 °C, taken per os. A temperature of less than 35 °C needs immediate intervention.

39.5 The digestive system

Starting oral feeding

The newborn baby needs to suck and swallow in order to obtain food, which has to be retained, digested and absorbed in order to supply the nourishment required for growth and development. The normal baby swallows a variable quantity of air during feeds, most of which is expelled afterwards through burping. Air that is stuck in the stomach and digestive system can cause discomfort and cramps.

In the uterus, the fetus begins to swallow liquor from about 17 weeks' gestation. At term the baby swallows the same amount of fluid that it will drink after birth 360–400 ml per day in a term infant. If there is an obstruction in the upper digestive tract, there is often an excessive amount of liquor present in the mother (polyhydramnios). The liquor plays a part in the formation of the meconium. Meconium is made up of mucosal epithelial cells and embryonic secretions, enzymes, bile pigments, urea, mucopolysaccharides and hair. The baby swallows these and the cells accumulate in the digestive system. At birth, the bowel contains about 200 ml of meconium, a black sticky substance. Although peristaltic bowel movements are present in the fetus from about 16 weeks, meconium is usually only passed *in utero* if the fetus is subjected to hypoxia.

The first stool (meconium) of the neonate is a greenish black, viscid, semi-solid substance which is odourless and sterile at birth.

Normally, meconium is first passed within 24 hours after birth. Once feeding has started, defecation often takes place during or soon after feeds. Feeding stimulates the production of hormones and enzymes in the gut, which are necessary for the digestion of food, and also promotes bacterial colonisation. The normal intestinal flora is essential for digestion and for the synthesis of vitamin K.

In the breastfed baby, the gut is colonised by lactobacillus, which protects the gut by preventing the growth of pathogenic organisms. This colonisation is dependent on the first feed being *human colostrum*. The breathing, suckling and swallowing mechanism necessary for oral feeding in the newborn is a specially coordinated movement. The suckling reflex is present *in utero* from 36 weeks. Babies born before 36 weeks often have poor sucking abilities. The newborn baby is unable to move food from the lips to the pharynx (if these passages developed normally) and therefore it is essential for the nipple to be placed well back inside the infant's mouth. Sucking takes place in small bursts of three or four sucks at a time, between breaths. Swallowing and peristaltic activity in the oesophagus moves the food down the oesophagus and into the stomach through the cardio-oesophageal sphincter. This whole mechanism, although not fully coordinated at birth,

soon becomes efficient in the normal newborn. Persistent lack of coordination of sucking and swallowing could indicate brain damage or some anomaly of the upper digestive tract.

Babies have limited enzymes for digestion. The food is partly digested in the stomach and digestion is completed in the small intestine, followed by absorption. These processes are made possible by secretions, hormones and enzymes from the stomach, the pancreas, the liver and the duodenum. The emptying time of the stomach varies greatly in the newborn (from one to 24 hours) and depends upon the time, spacing and volume of the feeds, the type and temperature of the food, as well as other factors such as the size and weight of the infant, the gestational age, the physical wellbeing and the amount of stress incurred before, during and after labour. Simple carbohydrates and proteins are more easily digested and assimilated than are fats.

Mother's milk has food in the correct quantities for digestion in the gastrointestinal system of the newborn (see Chapters 9 and 38). If a baby is breastfed, milk is often completely absorbed with little residue. Some babies may not have a stool for 10 days when on exclusive breastfeeding.

39.6 The renal system

During intrauterine life, the fetal renal system assists in regulating the volume of amniotic fluid. The products of metabolism are transferred from the fetal circulation to the maternal circulation via the umbilical arteries and the placenta.

At birth, the kidneys have to become functional in order to cope with the products of metabolism, but they do not usually reach the adult level of maturity and function before one year of age. Therefore, if the kidneys are subjected to any extra load, as may occur with infection, incorrect feeding, vomiting and diarrhoea, this can rapidly lead to acidosis and fluid imbalance, with dehydration or oedema.

A small amount of urine is often voided at birth, but it is quite normal for the neonate not to pass urine in the first 12–24 hours after birth. A newborn should pass urine within 24 hours. After this, with correct feeding, the infant should pass urine frequently and should wet six to 10 napkins with dilute urine every 24 hours. This will indicate an adequate fluid intake.

39.7 The reproductive system

In the normal full-term female newborn, the ovaries contain thousands of primitive germ cells at birth. The labia majora are well developed and cover the labia minora. The uterus is proportionally the largest organ in the body in a newborn because of the high levels of oestrogen in the mother. The uterus involutes and becomes more proportional at puberty.

The high levels of oestrogens present during pregnancy often also cause a swelling of breast tissue in both males and females and a drop or two of a whitish liquid may even be seen exuding from the nipples. The condition (called witch milk) will subside as the oestrogen is eliminated from the infant's body, and requires no treatment and is best left completely alone. The drop in the levels of oestrogen in the infant's body after delivery may cause a thick, white mucoid vaginal discharge in baby girls and a slight blood-spotting may also occur. Vaginal tags are often noted and these gradually shrink and disappear.

In male infants, the testes have usually descended into the scrotum by the end of 36 weeks. The foreskin of the penis adheres to the glans penis and cannot be fully retracted for the first few weeks of life. Undescended testes need to be reported.

39.8 The hepatic system

In the newborn baby, the liver is large and occupies about 40% of the abdominal cavity. Some of the functions performed by the placenta in fetal life, such as the excretion of bilirubin, must now be undertaken by the liver.

In the full-term infant, the hepatic system has normally attained the state of physiological maturity that is necessary for normal body function, but any immaturity of the liver could have a number of consequences. The liver may not produce sufficient amounts of the enzyme glucuronyl transferase and the unconjugated bilirubin produced by the breakdown of fetal red blood cells will not be conjugated by the liver. The build-up of unconjugated bilirubin in the bloodstream will cause physiological jaundice and may reach levels that could cause kernicterus (yellow staining of the basal ganglia of the brain) resulting in athetoid paralysis. However, this is more usual in the preterm (immature) infant.

Any obstruction in the hepatic duct system will result in the accumulation of (conjugated) bilirubin, which also causes jaundice referred to as pathological jaundice.

During fetal life, the liver plays an important part in blood coagulation and this is continued after birth for the first few months of life. In the presence of vitamin K, certain substances necessary for blood coagulation are synthesised in the liver. If the normal gut flora is absent, vitamin K is not synthesised in the gut and is therefore lacking in the liver. This can result in a transient blood coagulation deficiency during the first week of life. To compensate for this, an injection of vitamin K is given to the newborn infant soon after birth.

The liver of the newborn also stores iron for the production of haemoglobin. If the mother has had a diet containing adequate iron, the stores should last for the first five months of life. After this, an iron supplement should be given to the infant if the diet does not contain enough iron for the daily needs.

39.9 Immunity

The normal newborn is protected against infection through passive immunity, but is nevertheless highly susceptible to invading organisms, and septicaemia is more common in the neonate than at any other age. It is, therefore, extremely important that the management and nursing care of the neonate at delivery and after birth are aimed at the prevention of infection. There is always the danger of cross-infection in the midwifery unit and neonatal nursery. Therefore, the staff must adopt strict anti-infection practices, such as frequent handwashing, cleanliness of cots, linen, feeding equipment, drains, etc., the isolation of infants (and mothers) with suspected or proven infections, and no overcrowding in nurseries.

Immunoglobulins enhance the immunity of the fetus and the neonate. These immunoglobulins are a type of antibody which are secreted by the lymphocytes and by the plasma cells and are found in the body fluids. The immunoglobulins found in the infant are the antibody fractions IgG, IgM and IgA acquired from the mother.

Immunoglobulin G (IgG)

The fetus receives immunoglobulin IgG *in utero* as the small molecules of IgG are able to pass through the placenta from the mother's system to the fetus. The type and amount of IgG that the fetus receives depends upon which infections the mother has built up immunity against, the quantity in the mother's system and the gestational age of the fetus. A preterm baby has less protection than a full-term baby. The length of the acquired immunity is variable and can last from one to four months depending upon the quantity of IgG received. This antibody fraction is present in all body fluids, both intravascular and extravascular. This type of immunity is called *acquired passive immunity*. Soon after birth, however, the infant's own immunological system begins to manufacture IgG. However, the active antibody synthesis which should take place after immunisation procedures in the first few months of life may be interfered with by these passively acquired IgG antibodies.

Those IgG antibody fractions which have a good transplacental transfer:

- *Viruses:* of rubella, measles, mumps, variola and poliomyelitis.
- *Bacteria:* of diphtheria and tetanus, and the antistaphylococcal antibody. The antibody fraction of *Escherichia coli* appears to have no passive transfer.

Those IgG antibody fractions that have a poor transplacental transfer:

- Viruses, bacteria, and other organisms: *Haemophilus influenzae*, *Bordetella pertussis* (whooping cough), Streptococci, and the causal organisms of dysentery.

Immunoglobulin M (IgM)

The antibodies of immunoglobulin M have a larger molecular weight and are, therefore, unable to cross from the mother to the fetus, via the placenta. The infant normally manufactures IgM after birth. However, IgM may be found in the cord blood if the mother was subjected to an infection during pregnancy, and the fetus also contracts the condition. IgM antibodies are then manufactured by the fetal immunological system. This is a very useful test, because cord blood which contains IgM to a specific organism indicates that the fetus has acquired that infection *in utero* and must, therefore, be treated accordingly.

Some conditions which the fetus can contract in utero and which cause the fetus to produce IgM are:

- The TORCH diseases: toxoplasmosis, others such as syphilis, rubella, cytomegalovirus, herpes.
- Conditions such as maternal measles, chickenpox and hepatitis affect the newborn. The baby may be born with the conditions.

This type of antibody is confined mainly to the bloodstream and the type of immunity is called active immunity.

Immunoglobulin A (IgA)

Immunoglobulin A is unable to pass through the placenta, and is only produced by the infant after the first few weeks of life. The antibody is found in the bloodstream, and also in the secretions of the intestines and respiratory tract. This secretory function is active against some viruses, such as poliomyelitis, and also against some strains of *E. coli*. This type of immunity is known as naturally acquired active immunity.

Immunity through breast milk

All three types of immunoglobulins are found in breast milk. Breast milk also contains lactoferrin and transferrin that promote the growth of the bowel flora, lactobacillus.

Cell-mediated immunity

Other means of immunity in the newborn are the T- and B-lymphocytes, which are derived from the thymus gland and which protect against many viral, fungal and bacillus infections. These T- and B-lymphocytes do not become fully functional until two weeks after delivery.

Inflammatory response

The inflammatory response is not well developed in the newborn infant and is poor in the preterm infant.

General genetic make-up

Immunoglobulin synthesis is related to the gene locus on the X chromosome. This, therefore, favours the female with two

X chromosomes, one from each parent, rather than the male with only the one X chromosome from the mother.

The skin

The skin offers a barrier to micro-organisms and toxins and protects against infection and plays a vital role in fluid and electrolyte homeostasis. It also helps with thermoregulation. Movement of the limbs and body will be accommodated by the elasticity of the skin. The subcutaneous fatty layers serve as an energy store.

The umbilical cord

At birth the umbilicus is an open wound and is, therefore, a very significant place of entry for infection in the newborn baby.

In the first 24 hours, the Wharton's jelly (the gelatinous substance within the umbilical cord) starts to dry up and this causes cord shrinkage, which is greater in a thick cord and should be carefully checked as the ligature may become loose, allowing bleeding to take place.

The cord usually sloughs off between the sixth and the tenth days. A delay in cord separation could be due to a low-grade infection. A thick cord takes longer to separate and may be moist, predisposing the development of omphalitis.

The hepatic system and immunology

In the full-term infant, the hepatic system has normally attained the state of physiological maturity which is necessary for normal body function, but any immaturity of the liver could have a number of consequences. In cases of intrauterine infections the baby may be born with hepatosplenomegaly which is an enlargement of the liver and spleen due to systemic infections. Infections in the newborn can also present with jaundice.

The normal newborn baby is protected to some extent against infection, but is nevertheless highly susceptible to invading organisms, and septicaemia is more common in the neonate than at any other age. It is, therefore, extremely important that the management and nursing care of the neonate at delivery and after birth are aimed at the prevention of infection.

39.10 The neurological system

Neuromuscular development

The nervous system in the newborn is very immature anatomically and differs from the adult nervous system both chemically and physiologically. Newborn babies have poorly myelinated nerves (white matter) and 80% of myelination occurs within the first nine months after birth. In the average, normal infant, the postdelivery growth of the brain follows a set pattern. The brain grows very rapidly during infancy and early childhood and then the growth rate begins to slow down. Because of this pattern of brain growth, the newborn interacts with the environment in a fairly predictable way. However, only a trained and experienced person can readily interpret deviations from the normal pattern. The development of a baby is used to determine normal growth and development after birth.

Deviations in an infant's reactions may result from a variety of conditions, both normal and abnormal:

- *Intrauterine causes* such as intrauterine growth restriction which may be due to placental insufficiency, maternal nutritional deprivation, intrauterine hypoxia, intrauterine infections, or congenital disorders, etc.
- *Intrapartum causes* such as hypoxia or anoxia during labour or delivery, birth injuries such as intracranial haemorrhage or oedema, or muscular-skeletal injury, etc.
- *Postpartum causes* such as congenital metabolic disorders, for example phenylketonuria, cretinism, chromosomal disorders, for example Down's syndrome, etc., neonatal infections, for example meningitis, etc., poor nutrition leading to retarded brain growth, or many other causes such as the gestational age, the state of arousal, the surrounding temperature, direct medication or medication via the breast milk, etc.

Brain growth affects not only the child's physical growth and sensory capabilities, but also the child's motor function, the reflexes and behaviour. Therefore, various authorities have been able to draw up assessment charts to assess an infant's neurological and neuromuscular states at birth in order to arrive at the infant's gestational age, and also to assess progress in infancy and childhood by assessing the milestones of the child.

Enzymes

In the neonate, enzymatic activity is not fully operational as this has been performed to a large extent by the placenta during intrauterine life. Some enzymes are activated before and at birth, but others are only gradually activated as the infant matures. More research needs to be done in this area.

39.11 Conclusion

This chapter focused on the physiological changes from fetal to neonatal life and the adaptations the neonate has to make. The midwife needs to know the normal to identify the abnormal.

CHAPTER

40 Assessment and care of the newborn

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- demonstrate competency in the physical examination and assessment of the newborn
- demonstrate competency in collecting a history and interpret it after birth
- differentiate between normal and abnormal characteristics of a newborn (physical appearance and physiological function)
- demonstrate competency in the immediate, transitional and intermediate care of the newborn, based on clinical assessment.

KNOWLEDGE ASSUMED TO BE IN PLACE

Fetal development and growth *in utero*
Anatomical, physiological, psychological characteristics and abilities of the newborn
Adaptations of the newborn after birth

KEYWORDS

Brown fat • Caput succedaneum • Cephalohaematoma • Meconium • Thermogenesis

40.1 Introduction

Immediately after delivery, while the newborn is wiped dry and suctioned, a brief general examination is made to detect any gross defect or injury. According to the Baby Friendly Hospital Initiative (BFHI), newborns that are healthy should remain with the mother while being assessed. Many of the serious correctable congenital malformations can be detected at birth or within a few days, and may be obvious. Early diagnosis of certain of these abnormalities, e.g. oesophageal atresia, greatly increases the chances of successful surgery and frequently makes the difference between survival and death. In other cases, e.g. congenital dislocation of the hips, early detection and treatment prevents or greatly reduces permanent disability.

40.2 High-risk newborns

The routine care of a newborn is standardised. In some cases, if there was a maternal or fetal condition present during pregnancy that suggests that the baby's health may be compromised *in utero* or after birth, the newborn is considered as a high-risk baby. These may also develop during labour, such as injury to the neonate before or during birth. When a risk factor is detected or a complicated birth is foreseen, the birth is scheduled for a level of care where a theatre is available as well as a paediatrician and a neonatal care unit.

Maturity

The last few weeks of pregnancy (up to 38 weeks) are a period of maturing, with physiological processes such as addition of subcutaneous fat, maturity of the liver, lungs and gastrointestinal system and increased production of glycogen in the liver. Most babies are born between 38–42 weeks.

Babies born before 37 weeks of gestation are considered premature, with immature organs and after 42 weeks babies are postmature with reduced body fat that was used to sustain them *in utero* because placental function is reduced after 36 weeks. Mortality and morbidity are increased in babies born under 37 weeks or after 42 weeks.

Risk factors

Conditions that warrant special care include intrauterine growth restriction, premature newborns, multiple pregnancy or congenital

abnormalities. Maternal health conditions may include diabetes mellitus, pre-eclampsia, perinatal infections, HIV and other medical conditions. Obstetric causes may include prolonged labour, obstructed labour, large infants, caesarean section, assisted deliveries and placental pathology such as antepartum haemorrhage. The newborn is usually kept under observation in a transitional unit or high-care. An initial full examination and assessment are done by a midwife at birth. If high-care is necessary, the parents should be very sensitively advised of this and reassured that it is a precautionary measure for the newborn's wellbeing.

Assessment at birth

A full assessment of the newborn is essential for effective care. A midwife performs a routine first examination on all newborns and records the findings. In a normal neonate this is usually done as soon as the baby's temperature is normal. This assessment consists of:

- interpretation of information from the mother and the neonate (antenatal and birth history)
- the Apgar score/Silverman-Anderson score
- a complete physical examination of the newborn as soon as possible.

The purpose of the assessment is:

- to determine gestational age
- to determine physical aspects for identification, e.g. gender, mass, length and head circumference
- to identify any physical or neurological abnormalities present
- to determine physiological status.

Assessment of gestational age

The weight, length and head circumference are used to determine the quality of intrauterine growth and development. These are plotted on a percentile chart to give the range of gestational age.

The Dubowits and Ballard scores can be used to assess gestational age more accurately and assess physical and neurological characteristics after birth.

Examination of the newborn should be systematic. Start with the history of the pregnancy and birth, follow with a top-to-toe physical examination and then order any special investigations that may be necessary based on this assessment.

History

The history of the newborn is attached to the history of the parents and pregnancy.

The history of the pregnancy and birth includes all the aspects observed during pregnancy.

Factors to note are:

- gestational age
- gravity and parity
- any abortions or perinatal or neonatal deaths
- maternal age
- duration of the pregnancy
- the time of the first visit at the clinic
- was an ultrasound done in early pregnancy?
- what is the HIV status?
- what is the haemoglobin and when was this done?
- any tests for abnormalities like triple test, Fish test or amniocentesis?
- was lung maturity tested?
- presence and treatment of any infection in pregnancy?
- what are the parent's blood groups and Rhesus (Rh) status?
- growth and development of the baby *in utero* (antenatal card)
- complications with previous births?
- duration of birth?
- induction of labour and why?
- time when membranes ruptured, quantity and colour? Any meconium or abnormality?
- type of delivery and reason for interventions?
- any test done in pregnancy and birth? Non-stress test, biophysical profile, ultrasound or Doppler studies.

Apgar and Silverman-Anderson score

The Apgar score is taken at birth and repeated within five and 10 minutes after birth. This gives a good indication of the baby's ability to adapt to extrauterine life. A baby with a low Apgar, 6/10 or less, needs to be monitored. A baby should breathe independently after 60 seconds and maintain respiration at 60 bpm.

A score of 4 indicates asphyxia.

Premature babies may have a normal Apgar score at birth (8/10) and deteriorate over the next few hours. The Silverman-Anderson score is used to indicate respiratory distress in the neonate (see Box 40.1).

A complete physical examination of the newborn

The physical examination should be carried out in all newborns as soon as possible after birth, and again just before discharge. The midwife makes sure that the baby's temperature is 36.5 °C and above. The examination is done in a warm environment with a naked baby or the baby is covered with a warm towel and only the part being examined is exposed to prevent heat loss. Examine the baby in the presence of the mother or father and explain the findings. The examination includes weight,

40.1 The Silverman-Anderson score

Score	0	1	2
Upper Chest Retractions	synchronised	lag on inspiration	see-saw movement
Lower Chest Retractions	none	just visible	marked
Xiphoid Retractions	none	just visible	marked
Nasal Flaring	none	minimal	marked
Expiratory Grunting	none	stethoscope only	naked eye and ear

length and head circumference. This information is part of the identification of the baby and is carefully and accurately recorded and is plotted on the baby's growth chart.

Normal measurements

Normal weight. Normal weight is between 2 500–3 500 g. The normal weight of newborns falls between the tenth and ninetieth percentile on a growth chart. Normal variations are related to: gender; females tend to be smaller, parity; first born babies are smaller than babies that follow (of the same father), maternal weight; obese mothers have large babies, genetic disposition; small parents have small babies, social groups; babies from certain groups (Indians and black Africans) are smaller due to lifestyle patterns and poverty, height above sea level; babies at high altitudes weigh less than at sea level; multiple pregnancy; babies from multiple pregnancies on average are smaller than singletons.

Normal length. Male infants tend to be taller than females. Normal length at birth is between 49–52 cm in a term baby. Abnormalities may include dwarfism (short) and fetal thyroid problems (long).

Normal head circumference. A baby's head circumference at term is between 34–36 cm. It reflects brain growth and is important. Abnormally large heads may be due to hydrocephaly. Abnormally small heads may show microcephaly.

Normal temperature. The axillary temperature of the baby is taken with an oral low reading thermometer for two minutes and should be 36.5–37 °C.

Normal blood sugar. The blood sugar is tested using heel prick blood. Normal blood sugar is 2.5 mmol/l and more.

General information

The following should be carried out in addition to the measurements described above:

- Carry out an inspection.
- What is the general appearance of the baby, ill or well?
- Normal activity? Is the cry normal?
- Are there any obvious malformations? (e.g. Down's syndrome?)
- What is his colour? Pallor? Pallid cyanosis of shock? Cyanosis? Plethora? Jaundice? If pallor of skin, what colour are the mucous membranes and nail beds? Is the cyanosis generalised or localised? Does the upper surface of the tongue look blue? What is the response of the cyanosis to oxygen and on crying?
- Is the cord yellow?
- What is the respiratory rate? Chest movements? Is there a grunt? Is there dyspnoea?
- The apex beat of the heart is frequently visible on inspection.
- What of the shape of the head? Do the bones move freely against each other along the suture lines?
- If the newborn is small-for-dates or unusually skinny, suspect fetal malnutrition. Check on weight for length and look for other evidence of fetal malnutrition, such as dry scaly skin on abdomen and extremities and/or abdominal skin creases and lack of normal subcutaneous fat. (These babies need to be watched for hypoglycaemia and fed early.)

The physical examination is fully illustrated in Table 40.1 and Figures 40.1–40.8. The assessment of gestational age is found in *Juta's Clinical Guide for Midwives*.

Care of the newborn

The care of the normal newborn can be divided into:

- immediate and transitional care (24 hours)
- routine daily care.

Immediate and transitional care

Immediately after birth, the neonate is dried with a warm towel after the nose and mouth are suctioned to remove fluids, and to make sure breathing is well-established. The neonate can be put on the mother's breast. Check if the newborn needs any assistance.

Table 40.1

Full neurological examination and assessment at birth: reflexes, motor function and behaviour

Reflex/other : Procedure ◙	Normal characteristics of the term infant	Abnormality
Moro reflex:		
The supine position:		
◙ 1. Grasp the infant's hands, extend the arms, and release suddenly.	Gives a startled response. Arms fling out in embracing movement, fingers fan out, symmetrically.	Abnormal if absent, asymmetric, weak or incomplete, or exaggerated.
◙ 2. Lift the infant's head off lying surface in to the palm of the hand, then allow head to fall back about 2cm (see Figure 40.1).	Legs may extend and eyes may open wide. Slow return to normal flexed position. Full reflex present from birth, to about 8 weeks.	
Grasp reflex:		
◙ 1.Palmar: place finger in the palm of the infant's hand.	Finger is firmly grasped by infant's fingers.	Abnormal if absent, asymmetric, weak or incomplete, or exaggerated.
◙ 2. Plantar: place finger at base of toes (see Figure 40.2).	Toes curl downward. Present from birth, to 2–3 months.	
Walking reflex:		
◙ 1.Hold baby around upper thorax, under arms, in a standing position with feet on a flat surface (see Figure 40.3).	When head and shoulders lean forward, infant simulates walking, by lifting and placing one foot in front of the other (very unsteadily). Present from birth, to 3–6 week. Term infants walk on soles of feet.	Preterm infants walk on toes.
Rooting and sucking reflex:		
◙ 1. Touch infant's cheek, corner of mouth or lip, with nipple or finger. Must be done before feeds (see Figures 40.4 and 40.5).	Infant turns head toward stimulus, seeking nipple. Opens mouth, accepts nipple and sucks strongly. Both present from birth, rooting goes after + 6 months.	Weak suck at birth (preterm, sedation, jaundice, infection, breathing problems, cerebral injury, mental retardation, cleft lip/palate).
Swallowing:		
◙ 1. Offer nipple or bottle.	Sucking coordinated with swallowing without gagging, coughing or vomiting.	Weak, absent or not coordinated (brain injury or preterm).
Posture and movement:		
◙ Lying in supine or prone position. a. Supine position b. Prone position (See Figures 40.6, 40.7 and 40.8).	Limbs semiflexed, head to one side. Can yawn, sneeze, cough, burp, hiccup. Active. 1. Stretches limbs and curves back. Intermittent clenching of fists and thumb abduction, also of toes. 2. Head turned to one side and lifted momentarily. Hips flexed and tucked under pelvis, which is held up. (Voluntary movements start at about 3 months, when flex or tone recedes.)	Abnormal posture. Weak (floppy), asymmetric or absent movement, twitches, fits or convulsions, coma, (preterm, fractures, sedation, brain or nerve injury, congenital and other disorders).

continued

Muscle tone:		
◙ 1. Prone-suspended with palm of hand/s under mid-trunk.	1. Spine and limbs keep the semi-flexed position. The neck may extend briefly.	Hypotonia, hypertonia, or asymmetric tone. (See disorders of **Posture and movement.**)
◙ 2. Supine, lying.	2. Arms and legs spring back to flexion, when extended and suddenly released.	
◙ 3. Pull-up to sitting position with gentle traction, holding wrists.	3. Head lags at first, then is briefly held upright before rolling forward for the chin to meet the chest.	
◙ 4. Supported sitting position.	4. Back curved, head forward with chin on chest.	
Behaviour: sleeping and wakefulness:		
Deep sleep: intermittent sleep, interspersed with waking and feeding. Sleeps for ± 20 hours out of every 24 hours.	Closed eyes, shallow breathing, abdomen rises and falls with breathing, very little limb movement. During dreaming periods: eyelids flicker, face moves, limbs jerk and breathing changes.	Lethargic or over active. Not waking to take sufficient food or not getting sufficient sleep. (See disorders of **Posture and movement.**)
Awake:	Eyes open, alert and responsive. Limbs, head and trunk move. May cry. Many infants can smile in first 24 hours.	
Cry:		
When awake:	Lusty, sustained cry. Eyes close tightly during crying.	Weak cry. High-pitched or hoarse cry. Grunting when asleep. (See **Behaviour**).
Vision:		
◙ Supine, lying or sitting.	Limited vision. Can follow bright light or object ie face or hand or red object, up to ± 20 cm away.	Absent or poor following. (Blindness, dim vision, cataract.)
Hearing:		
◙ Voice, shout, bang, music. (Clap hands at side of cot and baby turns head toward sound.)	Move eyes in direction of sound. Startled by loud noise, may cry. Soon able to distinguish mother's voice.	No response to noise. Deafness.
Touch, taste and smell:		
Touch:	Soothed by gentle massage, warmth and cuddling. May be lessened to sensitivity to pain in first few days.	Will not be comforted. (Drug-dependency withdrawal.)
Taste:	Can soon tell difference between sucrose and glucose.	
Smell:	Will try to avoid unpleasant smells. Can soon distinguish 'mother's smell' (breasts).	

A full assessment of the physical and neurological examinations is made and all deviations from normal are highlighted and listed. Any abnormality must be reported to a medical practitioner as soon as possible and management implemented.



Figure 40.1 Moro reflex



Figure 40.2 Grasp reflex



Figure 40.3 Walking reflex



Figure 40.4 Rooting reflex



Figure 40.5 Sucking reflex



Figure 40.6 Intermittent clenching of fists



Figure 40.7 Intermittent clenching of toes



Figure 40.8 Supported sitting position

- *Apgar scores*. Record the Apgar score by checking the heart rate, respiratory effort (is he breathing slowly and irregularly, or breathing well and crying lustily), muscle tone, reflexes and skin colour (recorded as 1–5). An Apgar score of eight to 10 requires no intervention. An Apgar score of five to seven may need suctioning and the administration of oxygen. An Apgar score of four and less needs active resuscitation and intubation. When a low Apgar is present the baby may become hypoglycaemic and hypothermic. Special care is given and the baby is kept under observation.
- *Assessment*. Briefly assess size, gross congenital abnormalities or other problems. Then carry out a thorough examination within the first 24 hours.
- *Cutting the cord*. Shortly after birth, the umbilical cord is clamped and cut. Observe the cord for bleeding for the next 12 hours. If the mother is Rh negative, cord blood is collected for testing.
- *Identification*. The neonate should be identified by the mother and staff, and identity bands with mother's name and registration number, together with sex of neonate, date and time of birth.
- *Eye care*. Within one hour after birth, the eyes are treated with chloromycetin ointment, to prevent infection and possible blindness if the neonate is exposed to infections during birth.
- *Vitamin K*. Vitamin K is routinely administered to all newborns directly after birth to prevent vitamin K deficiency, which causes bleeding. The dose is 1 mg given by intramuscular injection into the anteriolateral aspect of the mid-thigh.
- *Immediate care*. The immediate care of the baby can performed by asking the following questions (including the gestational age):
  - Is the baby large-for-gestational age, small-for-gestational age or appropriate-for-gestational age?
  - Is the baby physiologically stable?
  - Can the baby maintain a temperature?
  - Is breathing normal?
  - Has the baby passed urine or meconium?
  - Did the baby suck from the breast?
  - Is the blood sugar normal?
  - Are there any risk factors or infections indicated from the history?
- *First bath*.The baby's first bath is done when the temperature is stable at 36.5 °C and the colour and respiration are normal. Preterm babies and sick babies are not bathed and only 'topped and bottomed' with cottonwool.
- A baby' s temperature drops after a bath. The temperature of the water should be tested before the baby is bathed. The temperature should be 39–40 °C. Take care not to burn the baby with very hot water.
- *First feeding*. All babies should receive colostrum as the first feed. Breastfed babies should drink from the mother within one hour after birth and then regularly. The baby's blood sugar is observed if the baby does not want to drink. Often babies have swallowed blood *in utero* and may be nauseous. The medical practitioner is contacted if a baby refuses to drink or the blood sugar drops.

  The best way to raise the blood sugar is by giving milk feeds, either breast or expressed. If a baby is stable and feeding well rooming-in can be instituted after the first bath or after a transitional period of 6–2 hours.

Babies that have risk factors may be kept under observation and transitional care until stable. This may include the administration of oxygen, and milk feeds to stabilise the blood sugar.

If problems persist medical attention is needed.

A baby born by caesarean section is often admitted for transitional care until stable.

The medical practitioner will discharge the baby from transitional care when satisfied with the baby's condition.

Routine daily care

Basic principles in the daily care of the newborn include:

- *A clear airway and maintenance of respiration*. Babies may vomit or develop fetal distress. In cardiac abnormalities babies may develop symptoms of respiratory distress in the first two weeks after birth. One of the first signs is a baby that becomes blue when feeding or is too tired to drink.
- *Monitoring for complications*.The prevention of, or the early detection and treatment of any possible complication, that is, cyanosis, choking, haemorrhage, hypothermia, hypoglycaemia, infection, jaundice, etc.
- *Warmth and cleanliness*. Maintenance of temperature.
- *Fluid and nourishment*. Maintenance of fluid balance.
- *Establishment of normal bodily function*. Passing of stools and urine. A newborn needs to pass urine and meconium within 24 hours after birth.
- *Development of a sleep–wake cycle*. Babies may be very sleepy at first or very alert and crying.
- *Psychological needs*. Needs such as security, love and affection, gentleness but firmness, bonding.
- *Safety and environment*. Protection and safety measures and a safe environment are important. Discuss the following:
  - Proper identification includes the accurate recording of the baby's weight, gender, length and specific features

unique to the baby. A print of the hand and or foot gives specific identification of the baby. A photo taken with a cell phone can be very useful.

- Most maternity units have access control to prevent the abduction of babies. Mothers are warned not to leave their babies unattended.
- Midwives need to educate parents on baby care, such as the type of bed the baby may sleep in and how to carry the baby safely. Babies are at risk of being dropped.
- Babies can be burned with hot water and hot water bottles.
- Babies can be put to the breast of another mother. This often happens at night when mothers are sleepy. In the current environment with a high prevalence of HIV this is a serious problem with serious consequences.
- Risk of infection is controlled by encouraging everyone, staff and mother, to wash their hands often. The baby is nursed and cared for in its own microenvironment.
- Babies must have two identification bands on at all times to reduce the risk of administrating the wrong feeds or medication. Each baby is identified before administrating any feeds or medication, to avoid mistakes.

The daily assessment, examination and care of the newborn

Every newborn should be assessed and examined daily. The daily examination and cord care can be carried out with the daily bath, and the vital signs and general condition can also be noted at the same time. Any abnormality is noted and referred for early intervention.

The following are noted:

- *Feeding pattern.* Does the baby suck well? How often? Is the baby satisfied? Are there feeding blisters on the lips?
- *Excretion.* How many stools? What is the colour and consistency of stools? What do the buttocks look like? Any nappy rash?
- *Urine.* How many wet nappies in 24 hours? Any abnormality?
- *Temperature.* Is the temperature normal?
- *Behaviour.* Alertness? Sleep and wake cycle?
- *Skin colour.* Any jaundice present?
- *Eyes.* Any discharge?
- *Cord.* Is it drying and clean?

The midwife should teach the mother to examine her newborn as well as how to recognise specific problems and how to treat or refer them to a medical practitioner.

The neonate is weighed before bathing. Condition and care of the neonate are reassessed if any of the following is noted:

- If the neonate should lose more than 3–5% of the birthweight during the first three days.
- If the neonate should continue to lose weight after the third postdelivery day.
- If the neonate does not gain weight daily or within at least every two days after the third postdelivery day.
- If the neonate develops problems on the skin, particularly in the creases and in the buttock area, any rashes, pustules, peeling and/or scratches.
- The neonate's head should be gently examined, feeling the sutures and fontanels. Any swellings are noted, such as cephalohaematoma, and any bruising, forcep marks or lacerations. These are recorded and reported to the medical practitioner.
- The eyes are examined for any discharge. If a discharge is noted, the mother is advised how to clean the eyes with normal saline before bathing and before each feed and the medical practitioner is informed. If the discharge is persistent or purulent, a swab should be taken and sent to the laboratory for microscopy, culture and sensitivity. If eye medication has been ordered by the medical practitioner, this is instilled after the eyes have been swabbed, before bathing and before each feed.
- If the neonate has a snuffly nose. As the neonate is an obligate nose breather, a blocked nose will interfere with feeding. Sodium bicarbonate nose drops may be useful in clearing the nose. If this persists, the medical practitioner is informed. (A snuffy nose may be an indication of congenital syphilis.) The neonate's mouth is inspected for any sign of candida infection.
- The midwife should check that the neonate's identification is intact, or, if the identification tags are loose, they should be replaced, after careful checking with the mother.
- The cord is observed and the condition recorded. Is there bleeding? Is it separating?

Any abnormalities should be carefully explained to the mother and should be recorded and reported to the medical practitioner.

On discharge, the newborn is given a further examination and the mother is advised on care of the newborn.

40.3 Conclusion

The assessment of the newborn starts before birth in the antenatal period, during labour, immediately at birth, in the transitional period, and continues daily. The skilled midwife will identify problems early and intervene appropriately and on time to prevent morbidity and mortality. Education of the parents is a very important aspect of care.

CHAPTER

41 Disorders of maturation, growth and development

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- demonstrate competency in the care of specific categories of newborns
- demonstrate competency in kangaroo-mother-care
- demonstrate competency in incubator care.

KNOWLEDGE ASSUMED TO BE IN PLACE

Fetal development *in utero*.

The anatomical, physiological and psychological adaptation of a neonate after birth (see Chapter 22).

KEYWORDS

Low birth weight neonate • Preterm neonate • Small-for-gestational dates • Post-term neonate • Large-for-gestational date

41.1 Introduction

Any newborn that appears smaller or larger than expected is assessed with the percentile chart for weight, length and head circumference for maturation and gestational age. The scores obtained are assessed according to a score sheet and the gestational age is plotted on a given percentile chart and categorised.

41.2 Assessment of gestational age and maturity

According to Figure 41.1, babies can be categorised based on birth weight:

SGA: Small-for-gestational age is under 10th percentile.

AGA: Appropriate-for-gestational age (between 10-90th percentile)

LGA: Large-for-gestational age is above 90th percentile.

Although this is a useful guide, it is not an accurate reflection of gestational age or maturity. After birth gestational age and maturity can be accurately gauged by using the Dubowitz or Ballard scores (see Figure 41.2) or the simpler SPLEN method (see Figure 41.3). The SPLEN method is very useful for the initial assessment of *all* babies born at outlying clinics. In this way, any *high-risk* baby can be quickly identified and transferred to hospital. Scoring should be done within the first 72 hours of birth for accurate results.

Six physical maturity characteristics of the newborn are assessed as well as six neuromuscular characteristics. These are plotted on a scale that will indicate the gestational age.

In order to ascertain whether the neonate is within the average age standards for weight, as well as for overall length and head circumference, the score obtained by using the methods above should be plotted on a graph that has been specifically devised for this purpose.

In this way, the examiner can work out whether the neonate falls within the average standards for its gestational age. For example, if the weight of a neonate of a certain gestational age falls below the tenth percentile, the neonate is below weight for its gestational age and this shows that the neonate is small for gestational age and has, therefore, intrauterine growth retardation. The same applies to the length and the head circumference.

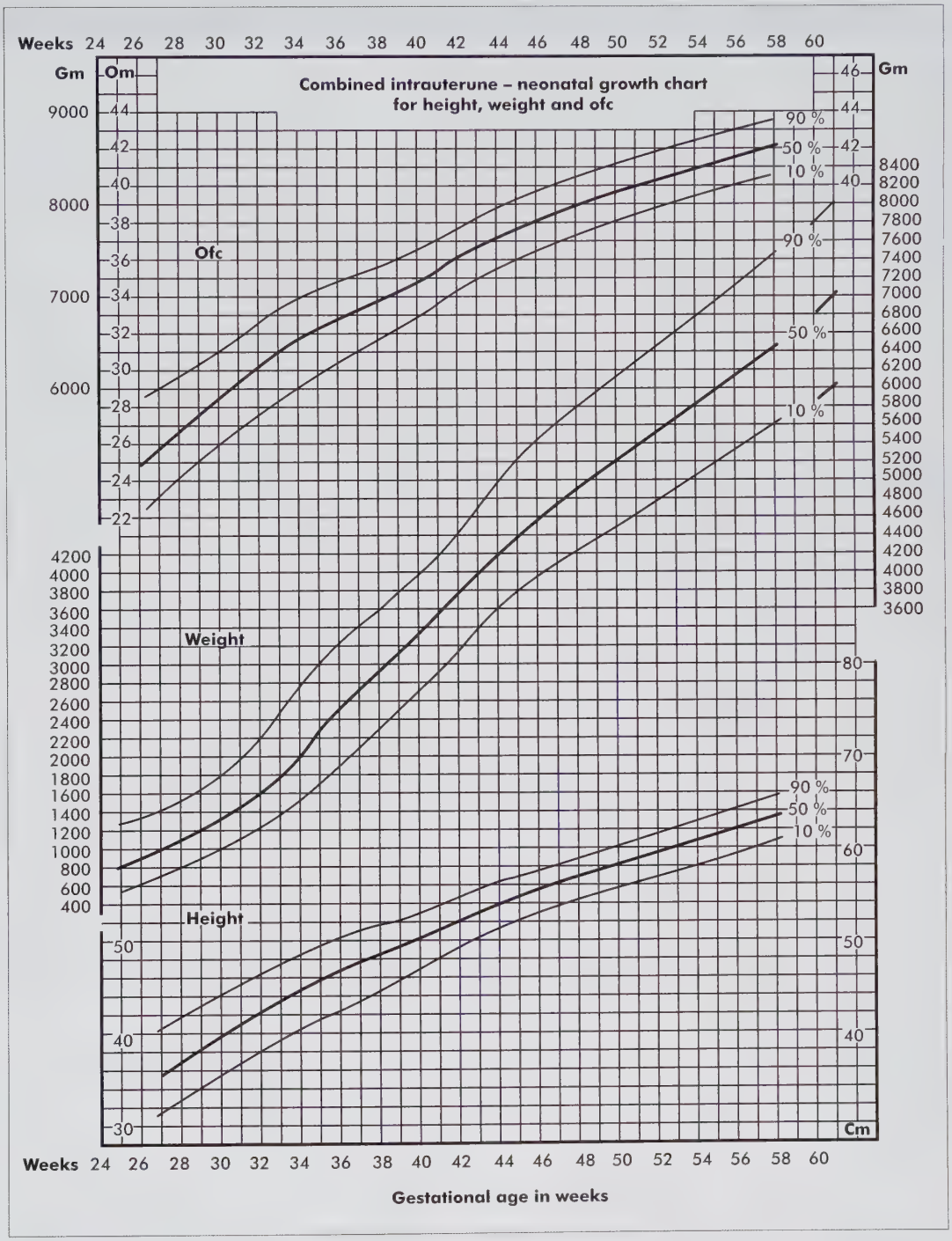


Figure 41.1 The standards of weight, length and head circumference for assessing gestational age, according to percentiles

Adapted from: Luchenco et al. 1966. *Journal of Pediatrics*, vol. 37, no. 3, p. 403 and Anthropometric chart. Boston: Children's medical centre

Table 41.1

Categories of gestational age

Low birth weight – small-for-gestational age (SGA)	Below 10th percentile	Premature or IUGR Less than 2.5 kg at birth
Appropriate-for-gestational age (AGA)	Between 10th and 90th percentile	Normal mass for gestational age between 2.5 and 3.5 kg
Large-for-gestational age (LGA)	Above 90th percentile for growth	More than 3.5 kg

On the other hand, if the weight of a neonate is above the ninetieth percentile for its gestational age, then this neonate is large for its gestational age, and is probably the neonate of a mother with either latent or clinical diabetes mellitus.

41.3 Classification of maturity

Preterm neonate

Characteristics of a preterm baby

- *Weight.* Depends on the gestational age, but less than 2 500 g is considered preterm.
- *Length.* The length is 49 cm or less.
- *Head circumference.* The head circumference is less than 34 cm with soft skull bones and sutures and fontanelles that are relatively wide for the small head. The ears are small and the cartilage soft and pliable.
- *Skin and subcutaneous tissue.* The skin is thin, red and smooth and is easily broken. There is little subcutaneous fat, and the bony structure is easily seen. The blood vessels are clearly visible under the thin skin and are fragile. The skin creases are poorly developed. Lanugo is plentiful and vernix caseosa is sparse. The nails are short and soft.
- *General appearance.*
  - Female genitalia: the clitoris and labia minora are prominent while the labia majora are underdeveloped.
  - Male genitalia: the testes may not have descended into the scrotum before the 36th week.
  - The hair is soft and silky.
  - The breast nodules are small or absent.
  - The hands and feet are often oedematous.
  - The abdomen is relatively large and easily distended.
  - The posture of the baby after birth is a very good indicator of gestational age: the legs and arms are extended before 32 weeks, the legs flexed by about 32 weeks and the arms by 34 weeks. A term baby lying supine will take a normal position with the head turned to one side, lying slightly on one side with the arms and the legs flexed.
  - The baby sleeps most of the day, but often stretches and yawns from 32 weeks' gestation.
- *Respiratory system.* Respiration is abdominal and the soft rib cage may indent between the ribs and at the sternum called rib retraction and sternal retraction. If there is a lack of surfactant the lungs collapse and the baby makes a noise on exhaling called expiratory grunting. The respiration is faster than 60 breaths per minute. The Silverman-Anderson score can be used to identify the presence of respiratory distress and/or the development of hyaline membrane disease (see Chapter 40).
- *The reflexes.* The sucking reflex is present at 34 weeks but week. The sucking reflex is strong after 36 weeks.

Immature or small-for-gestational age infants (SGA):

- *Weight.* The weight is low-for-gestational age and below the tenth percentile.
- *Length.* The length is below the tenth percentile.
- *Head circumference.* In asymmetric growth restriction the head is larger than the body (out of proportion) because the brain was given preference in development. In symmetric growth restriction the head and the body are smaller than usual. The ear cartilage is well developed, indicating advanced gestational growth. The skull bones are firm and the head circumference is below the tenth percentile. The hair is sparse, coarse and straight.
- *Skin and subcutaneous tissue.* Loose, peeling, meconium-stained skin is present with creases on the soles of the feet, indicating the gestational period. The skin may be dry and scaly. There is a lack of subcutaneous tissue. Meconium staining is present on the skin, nails and umbilical cord.
- *General appearance.* The baby has a wasted, dehydrated look. The infant appears to be thin, long, wasted, and wizened. Some babies appear to be dwarfed, with a reduced weight (below the tenth percentile). The baby is active and hungry at birth. The infant has a scaphoid (boat-shaped) abdomen.

Name: ---------- Date of scoring: ----------

Hospital: ---------- Age (in hours) at scoring: ----------

Folder no: ---------- Weight at scoring: ----------

Date of birth: ---------- Length (height) at birth/scoring: ----------

Birth mass: ---------- Head circumference (OF) at birth/scoring: ----------

Neuromuscular maturity

	0	1	2	3	4	5
Posture						
Square window (wrist)	 90°	 60°	 45°	 35°	 0°	
Arm recoil	 180°		 100-180°	 90-100°	 <90°	
Popliteal angle	 180°	 160°	 130°	 110°	 90°	 <90°
Scarf sign						
Heel to ear						

Physical Maturity

Skin	gelatinous red, transparent	smooth pink, visible veins	superficial peeling, and/or rash; few veins	cracking pale area, rare veins	parchment, deep cracking; no vessels	leathery, cracked, wrinkled
Lanugo	none	abundant	thinning	bald areas	mostly bald	
Plantar creases	no crease	faint red marks	anterior transverse crease only	creases anterior two thirds	creases cover entire sole	
Breast	barely perceptible	flat areola, no bud	stippled areola 1–2 mm bud	raised areola 3–4 mm bud	full areola 5–10 mm bud	
Ear	pinna flat, stays folded	slightly curved pinna; soft and slow recoil	well-curved pinna: soft but ready recoil	formed and firm; instant recoil	thick cartilage; ear stiff	
Genitals: male ♂	scrotum empty, no rugae		testes descending, few rugae	testes down; good rugae	testes pendulous; deep rugae	
Genitals: female ♀	prominent clitoris & labia minora		majora & minora equally prominent	majora large; minora small	clitoris and minora completely covered	

Score	Weeks
8	27,2
10	28,0
12	28,8
13	29,2
15	30,0
17	30,8
18	31,2
20	32,0
22	32,8
23	33,2
25	34,0
27	34,8
28	35,2
30	36,0
32	36,8
33	37,2
35	38,0
37	38,8
38	39,2
40	40,0
42	40,8
43	41,2
45	42,0

Assessment

Weeks

Figure 41.2 Scoring system for simplified clinical assessment of maturation in newborn infants
Adapted from: Ballard et al.1979. *Journal of Pediatrics*, vol. 95, no. 5, p. 769

Signs of physical maturity	Score			
	0	1	2	3
Skin	Smooth, pink, visible veins.	Superficial peeling or rash. Few veins.	Cracking, pale areas of skin.	Leathery, deep cracking, and wrinkled.
Plantar Creases	Anterior transverse crease only.	Creases on anterior two-thirds of sole.	Creases over whole sole.	Creases over whole sole.
Labia Or Male Genitals	Clitoris and labia minor are prominent. No testes in scrotum.	Labia majora and minora equally prominent. Testes high in scrotum.	Labia majora cover minora. Testes low in scrotum. Rugae seen.	Labia majora deeply pigmented. Deep rugae.
Ear	Slightly curved pinna. Slow recoil.	Well - curved pinna. Soft with ready recoil.	Ear formed and firm with instant recoil	→
Nipples	Flat areola. No bud.	Raised areola. Bud larger than 5 mm.	→	→
1. The score obtained from examining the infant as above is added to 30 in order to arrive at the number of weeks gestation.				
2. The infant's birth weight (and head circumference and length) is compared to the **Number Of Weeks Gestation** on the **'Percentile Chart'** (Figure 41.1) and the examiner is then able to assess whether the infant is small, average or large for the gestational age. (Average for gestaional age: between 10th and 90th percentiles.) (SGA = Small-for-gestational Age; LGA = Large-for-gestational age.)				

Figure 41.3 The SPLEN method of rapid gestational aging

- *Respiratory system*. The thoracic cage is relatively small with the rib cage easily seen. Breathing is usually irregular in rate and depth and there may be periods of apnoea. The breathing is abdominal. The nostrils are small and easily blocked. The crying is often weak and may be high-pitched. The cough reflex is weak or absent.

Low birth weight or small-for-gestational age babies can be preterm, term or post-term. It is thus important to plot the findings on the percentile chart to make the right decision. A preterm or post-term infant that is also growth restricted has a higher risk of morbidity. Often babies that were growth restricted *in utero* have more mature organs and are more able to adapt after birth.

Large-for-gestational age or post-term infants

- *Weight*. A large-for-gestational age baby is above 3 500–4 000 g at term or on the ninetieth percentile for gestational age, regardless of weight.
- *Length*. Above 52–58 cm.
- *Head circumference*. 35 cm and more. The skull is hard, with narrow sutures and small fontanelles.
- *Skin and subcutaneous tissue*. Toe and finger-nails are well developed. The ear cartilage and the nipples are well developed. The skin is often loose, and may be dry and peeling. The skin may be meconium stained. If postmature the subcutaneous fat may be diminished, giving the baby an 'old man's' appearance.
- *General*. The genitalia are well developed.
- *Respiratory system*. Respiratory distress may be present if there was meconium in the amniotic liquor.

LGA babies may be due to the overproduction of insulin *in utero* in diabetic mothers. These babies may be completely normal, or may be macrosomic and are at risk. They may present as follows:

- flabby and plethoric
- lethargic
- neuromuscular excitability
- difficulty in feeding
- immaturity
- an enlarged liver and adrenals.

41.4 The low birth weight infant

The care of a low or small-for-gestational age infant, whether premature of growth restricted, is aimed at the provision of an optimal environment and support for the immature organs for survival.



Figure 41.4 Differences between a term and a preterm baby

Common problems

Common problems of the low birth weight infant:

- Immature respiratory system that may lead to hyaline membrane disease or respiratory distress and/or apnoeic attacks (see Chapter 45).
- Immature gastrointestinal system, with poor sucking and digestive problems, low capacity for food, and the risk of necrotising enterocolitis (NEC) associated with shock and tissue necrosis of the gut (see Chapter 42).
- Immature liver that may predispose the premature to blood clotting problems (intraventricular haemorrhage due to vitamin K deficiency) hypoglycaemia and jaundice (see Chapter 43).
- Lack of subcutaneous fat that may cause hypothermia and hypoglycaemia (see Chapter 47).
- Immature immune system and responses predisposing the newborn to infections (see Chapter 43).
- Impaired bonding caused by separation from the mother for long periods.
- Iatrogenic problems - pneumonthorax can occur due to high pressures of oxygen as well as chronic lung disease (bronchopulmonary dysplasia) due to high levels of oxygen (toxicity) and pressures of ventilators (barotraumas).
- Retrolental fibroplasias (associated with high levels of oxygen during ventilation) is the damage to the retina that leads to blindness (see Box 41.1).

41.1 Retinopathy in newborns

The blood vessels in the inner retina begin to grow halfway through pregnancy and are only fully developed by term. They are thus incompletely developed in the preterm infant. The more immature the infant, the less the vascular development. Out of babies of less than 1 kg at birth, about 80% develop retrolental fibroplasias (ROP). The continuous administration of high dosage of oxygen after birth increases the risk of ROP.

High-quality care is the key to the survival and positive outcome for premature and low birth weight babies. Babies above 1 500 g are less at risk of ROP. Intervention starts with the prevention of low birth weight infants.

- Other complications may include tissue damage due to intubation and pressure of tubes, and thrombosis due to arterial lines that may cause a loss of a limb.

Prevention of low birth weight infants

The high incidence of low birth weight infants necessitates early intervention and prevention (see Chapter 22). The following principles must be observed:

- Identify high-risk mothers at the early antenatal visits.
- Refer those mothers to a higher level of care: Level 2 or 3.
- Suppress preterm labour for long enough to transfer the patient to a level 2 or 3 hospital or until corticosteroids have been administered (see Box 41.2).
- Prepare for transportation to a higher level of care (see Chapter 48).
- Prepare for complications before the baby is born.

41.2 Prophylaxis against hyaline membrane disease

The intramascular administration of corticosteroids to the mother in two dosages 12 hours apart between 32 and 34 weeks of gestation greatly reduces the incidence of hyaline membrane disease.

Immediate care of the low birth weight neonate

Ideally the womb is the best incubator. Where possible, the mother is transferred to the best level of care before the baby is born. If the baby is born before referral takes place, the following steps should be taken:

- Resuscitate the neonate that is born alive immediately after birth. After stabilising, the newborn should be taken to the nursery for observation and care.
- Provide medical care as soon as possible for low birth weight infants.
- Conduct a full physical and neurological assessment (see Chapter 45).

The standard care for low birth weight infants

The physical immaturity of the baby is the basis of the care and includes all of the following:

- *Keep the airways clear*. Suction secretions regularly.
- *Maintain respiration*. Oxygen is administered by funnel or head box and if needed by intubation. Oxygen saturation should be measured through a pulse oximeter and should be maintained between 89 and 92%. Oxygen is humidified and warmed.
- *Maintain oxygenation*. In the low birth weight baby oxygenation is achieved by CPAP (continuous positive airway pressure). A nosepiece that fits into the nostrils is effective (nCPAP) and increases the residual capacity and reduces respiratory effort significantly. All babies at risk of developing hyaline membrane disease should be started on CPAP. The ventilation of babies through intermittent positive pressure ventilation (IPPV) takes place under the supervision of a paediatric specialist.
- *Prevent hyaline membrane disease*. The paediatrician may prescribe surfactant for babies over 750 g. It is injected into the trachea in divided doses (100–200 mg/kg). It is given soon after birth and reduces the mortality and morbidity in 70% of cases. A second dose may be needed for 30% of cases.
- *Maintain the baby's temperature at 36.5 °C*. The room temperature in a neonatal unit is 22–26 °C. The infant is not bathed but dried and all precautions taken to maintain the temperature at 36.5 °C. The baby is nursed in an incubator or open crib. The baby's temperature is recorded by continuous monitoring or hourly observation. The temperature of the incubator is set according to the baby's weight. The normal temperature of an incubator is 32 °C. Extra interventions to prevent heat loss include:
  - covering the baby's head (most heat is lost form the head)
  - covering the baby with a perspex shield
  - dressing the baby
  - kangaroo-mother-care (if the baby's condition is stable).
- *Maintain fluid balance*. Ensure that the neonate is getting enough energy and fluid and keep a record of intake and output. A neonate with weight of less than 1 500 g should be given intravenous neonatalyte (without potassium) or 10% dextrose water.
- *Maintain the blood sugar*. The blood sugar is observed four hourly and maintained through intravenous fluid and milk feeds if allowed. A blood sugar of less than 2.5 mmol/ is treated as an emergency.
- *Maintain energy*. If a baby is in respiratory distress or very small they may not digest and absorb milk well. A nasogastric tube is inserted (size 6–8) to drain the stomach contents and feeds may be started within three days for a premature baby. A low birth weight baby without respiratory problems will receive feeds as soon as possible after birth and/or three hourly. Expressed breast milk is the milk of choice for a premature baby. There is a reduced incidence of necrotising enterocolitis when mother's milk is given to a small or sick baby.

A low birth weight infant needs more energy and calories than a term baby. The formula for milk is:

- Day 1: 90 ml/kg /24 hrs
- Day 2: 120 ml/kg /24 hrs
- Day 3: 150 ml/kg /24 hrs.
- If the baby is sick (infection) or receiving phototherapy the fluid intake is increased by 10–20%.

- *Feed.* Low birth weight infants may start with small amounts of mother's milk three-hourly per nasogastric feed and if they tolerate the feeds, this will be slowly increased. The rest of the fluid is administered intravenously. Newborns of less than 1 000 g that are not allowed or cannot tolerate oral food may be fed with total parenteral infusion intravenously for weeks. If mother's milk is not available, special formula for low birth weight babies is used, adapted for the needs of these infants. Newborns of less than 35 weeks are not allowed to take food by sucking. A special dummy is available to help the baby to develop the sucking reflex.
- *Prevent and treat infections.* Do this by washing hands before and after handling the newborn and treat where infection is suspected. Antibiotic treatment is given as per prescription. An antiseptic hand spray is used in between to keep the hands clean. Parents are encouraged to wash their hands when entering the unit and before touching the baby. A newborn is cared for in its own micro-environment and the use of communal surfaces is avoided. The incubator is cleaned daily. Only sterile utensils are used and each baby has its own thermometer and utensils. Drip packs and tubes are changed daily. The eyes are cleaned with normal saline and the cord is treated daily with alcohol.
- *Encourage bonding.* Keep the parents and the newborn together if possible to encourage bonding. If the baby is out of danger kangaroo-mother-care can be instituted (see Chapter 12).
- *Observe.* Half hourly observation is essential when caring for sick or small-for-gestational age babies. The following is strictly recorded:
  - body temperature
  - heart rate, respiration and colour
  - incubator temperature
  - oxygen concentration and saturation
  - blood glucose – 3–4 hourly
  - intake and output –continuously
  - serum bilirubin – daily
  - intravenous drips and other device sites on the baby
  - routine care of lips, buttocks, eyes and cord
  - stool, urine, vomit and aspiration
  - feeding instruction and daily intake
  - medical prescription(s) including feeds
  - education and support of parents
  - vitamins
  - immunisation
  - buttocks
  - skin integrity
  - change of position.

41.5 Quality improvement in care of LBW infants

High-quality nursing care of a premature infant is recognised as the most important aspect in the survival of small babies. Staff caring for low birth weight babies need to be specially skilled. The ratio of staff is 1:1 in intensive care and 1:2 in high care. There are certain types of care that are particularly effective, such as kangaroo-mother-care, developmental supportive-care and baby-friendly care principles.

Kangaroo-mother-care (KMC)

Kangaroo-mother-care is a skin-to-skin care between mother and baby. This is used in infants over 2 500 g. The midwife needs to understand KMC and help the new mother understand the concept.

KMC can be started immediately after birth. Infants that are sick will start KMC as soon as they are stable.

Intermittent KMC is done only for periods when the mother visits the baby. The father can also do kangaroo care.

Continuous KMC is care given 24 hours by the mother, day and night.

Aspects of KMC

The following aspects are considered important for successful KMC:

- *Position.* The baby is placed on the mother's chest between the mother's breast wearing only a woolen cap, nappy and socks. This is called skin-to-skin contact (see Figure 41.5).
- *Nutrition.* Two hourly breastfeeding, or giving breast milk by cup or by nasogastric tube for these small babies. If a mother cannot breastfeed, expressed breast milk from the milk bank is given by cup.
- *Support.* Support of the family and community is needed for successful KMC. The family is then included from the beginning.
- *Discharge.* On discharge the mother continues to practise KMC and has been prepared for this.



Figure 41.5 Kangaroo-mother-care

Benefits of KMC

The following benefits for the mother and baby have been documented:

- The mother is more confident.
- Bonding is improved.
- The whole family is involved.
- The father and family play a more active role in care.
- Baby's temperature is stabilised and he/she grows faster. (A mother's skin temperature may rise by 2 °C to keep a baby warm.)
- There is a lower incidence of infections.
- There is less apnoea in babies. Babies sleep better with less bradycardia and improved oxygen saturation and consumption.
- KMC is a safe and effective way to transport babies.
- KMC increases the volume of breast milk in the mother. All babies as small as 30 weeks can be breastfed.
- Earlier discharge is possible if a baby is stable on KMC.
- Fewer staff and less equipment are required.
- It is cheaper than incubators.

KMC can be as safe as incubator care if used correctly. The infant is warmer in KMC than in incubator care.

41.3 Guidelines for instituting KMC

- There must be a unit policy on KMC.
- Written guidelines must be available.
- All staff should receive training on KMC.
- KMC must be taught to pregnant women.
- Women should be supported to continue KMC after birth.
- A space is made available for KMC.

Developmental supportive care (DSC)

DSC seeks to manipulate the environment to reduce complications for the newborn. DSC was started in 1980 and is defined by the National Association of Neonatal Nurses as *care of the neonate to support positive growth and development.* Infant's responses are monitored and the care is modified to the needs of the infant.

When the newborn is not ready for KMC, care is modified for stress reduction. This care is referred to as *developmental supportive care.*

As indicated in the KMC paradigm, the ideal care for the baby is to remain with the mother. When separated the baby becomes stressed. It is the task of the midwife to protect the baby as far as possible and minimise the effects of unfamiliar extrauterine environment. The DSC principles must be applied to all neonates. Short- and long-term effects of incubator care or separation from the mother in the care of the low birth weight infant have been described and are both physical and psychological.

Iatrogenic stressors and the care environment can affect the infant and cause stress. These include:

- bright lights and sleep interruptions
- position, routine and excessive handling
- loud sounds
- unattended crying
- reduced suckling
- social isolation and separation from the mother
- medical interactions and painful procedures.

These have the following effects on small babies:

- disorientation of the sensory system
- increased cortisol and sensory overload
- increased morbidity
- hypoglycaemia
- anaemia
- hypothermia
- hypoxia
- pain and discomfort.

Neonatal stress cues

The infant communicates positive/negative observable behaviour and responses through autonomic, motor and state organisation as summarised in Table 41.2.

The short- and long-term outcomes of stress on the infant include physiological instability, cognitive impairment, attention deficit disorders, visuomotor and spatial orientation impairment, language comprehension and speech difficulties, posture pathology (supine positions) and impeded developmental milestones.

Principles of DSC

Developmental supportive care includes the following principles in line with baby-friendly care principles:

- Individualised infant care that determines the individual needs of the baby based on the cues and physiological and behavioural responses.
- A family-centred approach that involves the family in all decision-making processes.
- External environmental manipulation that includes adaptation of noise, light and odour in the environment, for example no radios are allowed; midwives and parents do not use strong perfume that can irritate the infant.
- Minimal handling and touching is allowed, rather the flat palmer surfaces of the hand is used to calm the infant

Table 41.2

Neonatal stress cues

Autonomic	Motor	Behaviour
◗ Colour change ◗ Hiccup and sneezing ◗ Gagging and spitting up ◗ Increased or decreased heart rate ◗ Blood pressure fluctuations ◗ Changes in respiration rate ◗ Unstable temperature ◗ Apnoea ◗ Pallor and vasoconstriction ◗ Decreased gastric mobility ◗ Increased secretion of cortisol adrenaline and catacholamines (inhibit the repair of tissue)	◗ Generalised hypotonia ◗ Floppiness ◗ Hyperextension of extremities ◗ Splaying of fingers and toes ◗ Facial expression, grim and frowning	◗ Irritable behaviour ◗ Sleep disturbances ◗ Inappropriate behaviour

Hard touching and tickling is prohibited. Pain management procedures need to be stipulated for a unit. Skin-to-skin contact and KMC are encouraged. Swaddle bathing and weighing are used to minimise shock of cold surfaces.

- Non-nutritive sucking is allowed using a pacifier. This calms the infant down.
- Developmental supportive positioning (flexion, three dimensional containment, midline orientation), that is aimed at the simulation of the position *in utero*. The infant is positioned to be oriented in the mid-line (hand to mouth) or contained fetal position. Self-regulation and soothing behaviour are promoted and linen and soft toys are used to position the infant in a position where the hands are in front, knees are flexed and the head is in neutral position supine or lateral.
- Cluster care is used, which is the arrangement of activities based on the cues of the infant with longer periods of rest and fewer interruptions.

41.4 Outcomes of DSC

These include:

- improved respiration
- earlier transition from nasogastric feeding
- increase in self-regulatory abilities and physiological stability
- reduced morbidity
- improved neurological organisation
- improved growth and mass gain
- decreased length of stay in hospital
- decreased costs
- improved neurological development at 24 months
- improved mother-child bonding.

41.6 The large-for-gestational age infant (LGA)

A large-for-gestational age infant is a baby that falls above the ninetieth percentile for length and weight for gestational age.

Causes

The most common cause of LGA is macrosomia associated with diabetes in the mother. Other causes may include obesity in the mother, erythroblastosis fetalis and family trends.

Common problems with LGA infants

There is a fivefold increase risk of mortality for LGA infants. The large size and head often results in these infants having traumatic births and they are exposed to birth injury. If the infant is born to a diabetic mother the risk of hypoglycaemia is increased because the fetal pancreas hypertrophies and continues to secrete insulin. Seventy percent of the infants are polycythemic with a risk of jaundice. Infants of diabetic mothers are also immature and are at risk for hyaline membrane disease and infections. Large infants are hungry and tend to require larger feeds than normal. There is an increased risk

of congenital abnormalities associated with diabetes in the mother.

Care of the LGA infant

The large-for-gestational age infant is identified in pregnancy or during labour. If the mother is prediabetic or diabetic on treatment the midwife should anticipate the potential problems of the newborn.

In these cases:

- the resuscitation of the newborn is done by skilled staff
- a full examination is done to exclude birth injuries and congenital abnormalities
- the baby is kept under observation for hypoglycaemia and hypothermia for 24 hours
- if the blood sugar drops to 2.5 mmol/l a 10% or 5% dextrose/water infusion may be used to maintain the blood sugar (not higher than 7 mm/l) . Early feeding (breast or expressed breast milk) is essential for maintenance of the blood sugar
- to prevent hypothermia the baby is nursed in an incubator for 24 hours and kangaroo-mother-care is instituted thereafter if the baby drinks well and is stable
- the mother is taught how to ensure that the baby's feeding requirements are met
- the standard care and observation routine for a neonate is given.

41.7 The postmature infant

A postmature infant is any infant born after 42 weeks of gestation. This baby may be large-for-gestational age, but can also be small-for-gestational age.

Causes

The cause of postmaturity is unknown. Abnormalities of the fetus (pituitary-adrenal axis in neural tube abnormalities such as anencephaly may play a role). Maternal causes are unknown. The mother, placenta and baby play a role in the onset of labour and the mechanism is not well understood.

Diagnosis of postmaturity

- The accurate determination of the duration of pregnancy.
- The history of the pregnancy, if accurate (early assessment before 20 weeks, including an ultrasound before or at 20–22 weeks), will indicate a postmature pregnancy. The function of the placenta decreases after 36 weeks and the fetus will start to metabolise subcutaneous fat for energy.
- The amniotic fluid will decrease and the fetal skull ossifies loosing the ability to mould.
- An ultrasound after 36 weeks will indicate the maturity and function of the placenta.
- Placental function tests may be performed.

Care of the post-term baby

Before birth

The growth and development of the fetus is monitored by the mother's mass gain, measuring the mid upper arm circumference (MUAC), SFH measurement between 20–35 weeks, the amount of amniotic liquor observed on palpation and measured by ultrasound, the fetal movement determined by a kick chart and the assessment of the fetus by a nonstress test, biophysical profile and Doppler studies.

If a baby is already compromised *in utero*, prolonged pregnancy will pose a risk for the fetus.

During labour

The pregnancy is not allowed to continue after term in case of a compromised fetus. Labour is induced by the medical practitioner or if the baby is severely compromised a caesarean section may be performed. Woman in labour are monitored for duration of labour and fetal distress. Meconium-stained liquor in a vertex presentation and abnormal fetal heart rate patterns in labour indicate fetal distress.

The physical appearance of the baby at birth is diagnostic. The post-term infant is alert and mature. A decrease in subcutaneous fat and soft tissue mass is observed. The skin may hang loose and is dry and peeling. The finger and toe nails are long. The skin and cord may be meconium stained. The head is hard and mature and the fontanelles may be smaller and closed.

The baby has an 'old man's' appearance.

After birth

There is an increased morbidity and mortality associated with post-term infants. The main problem of postmature infants is intrauterine growth impairment due to the placental insufficiency syndrome (caused by infarcts and villous degeneration). Asphyxia *in utero* and after birth is common in post-term infants. The meconium aspiration syndrome is anticipated and prevented by suctioning the airways before the first breath and under direct supervision with a laryngoscope by a skilled medical practitioner or midwife. If respiratory distress is present a medical practitioner is consulted and the baby is admitted in a neonatal care unit.

The risk of hypoglycaemia and hypothermia is increased in post-term babies.

Care includes the following points:

- The temperature of the baby is carefully observed and maintained.
- The blood sugar is checked after birth. Early feeding is started to maintain the blood sugar if the baby is not distressed. A regular breastfeeding regime with complementary feeding is followed to meet the energy needs of the baby.
- A full examination is done to exclude congenital abnormalities.

41.8 Conclusion

Midwives should be skilled in the assessment and care of preterm, immature and postmature infants. It is important that the midwife knows how to assess intrauterine status, as well as neonatal status to ensure adequate, appropriate and effective interventions.

CHAPTER

42 Common disorders and abnormalities of the newborn

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- identify abnormal stools and vomiting in the newborn
- demonstrate competency in the care of a newborn with gastrointestinal problems.

KNOWLEDGE ASSUMED TO BE IN PLACE

Normal anatomy and physiology of newborns
Normal stool patterns in newborns

KEYWORDS

Gastroenteritis • Necrotising enterocolitis • Hernia • Hypothermia • Neonatal cold injury

42.1 Introduction

The common disorders of the newborn, both minor and serious, are briefly presented in this chapter.

Some common disorders, such as neonatal jaundice, respiratory and metabolic conditions are presented in separate chapters that follow. In order to get a full understanding of these disorders and the care required, the midwife needs to regularly update her knowledge. Basic principles are presented in this chapter.

42.2 Complications of the alimentary tract

Stools in the neonate

It is important to know the difference between normal and abnormal stools in the newborn infant. Any abnormality in the stools can be very significant in the early diagnosis and treatment of an abnormal condition.

The first stool – meconium

Meconium is the first stool passed within a few hours of birth and then during the first two days after birth. A newborn will usually pass meconium within 24 hours after birth. Colostrum acts as a laxative and facilitates the passing of meconium. Meconium is not passed *in utero* unless the infant is stressed or compromised by a lack of oxygen. Maternal disease (pregnancy-induced hypertension, diabetes and other) and perinatal infections may affect the infant. Placental pathology such as insufficiency, retroplacental bleeding, detachment/abruption, infarct and aging are responsible for fetal death. Conditions of the cord include cord prolapse, short cord or velamentous inplantation, or vasa previa. Abnormalities of the fetus may include intrauterine growth impairment, twin pregnancy with twin-transfusion syndrome and congenital abnormalities. During a breech delivery, the infant may pass meconium as the body is squeezed through the birth canal.

The colour of meconium is dark greenish-black. Meconium has a smooth and tenacious consistency. The odour is characteristic but not offensive.

Meconium is made up of mucosal epithelial cells, embryonic secretions, enzymes, bile pigments, urea, mucopolysaccharides and hair.

The changing stool

As the gut is colonised and the infant starts to feed on milk, the stools passed from about the third to the fifth day after birth

change. The type of milk given to the infant will determine the change in the stools. This occurs when the last amounts of meconium are passed and when the bowel becomes colonised by bacteria. The colour changes to a greenish-brown at first and then a yellowish-brown. Within 4–5 days the stool is much softer and looser than that of meconium.

The normal stool of the breastfed newborn

The breastfed newborn has a typical stool from the fourth or fifth day onward. The colour is a rich yellow to orange, but may even be bright green in the transition period. The consistency is soft and possibly semifluid. The number of stools passed varies from three to five in 24 hours, to one in three to five days, whatever is consistent in that particular infant. The stool has a non-offensive odour and the pH of the stool is acidic. As the infant is established on breast milk the pattern of stools will change. Some babies can go 10 days without a stool (provided they are on breast milk only). Some babies will have 20 stools a day. Both are considered as normal for exclusively breastfed infants.

The normal stool of the formula-fed or bottle-fed newborn

The stool of newborns on formula feeds is also passed from the fourth or fifth day onward. The colour is a pale yellow, which may acquire a greenish tinge when exposed to air. The consistency is semiformed to formed. The number of stools is one to two per day but constipation may be a problem. The stool has a rather strong and offensive odour and the pH of the stool is more alkaline. Small amounts of mucus may be present in any normal stool. When an infant is formula fed they must have at least one stool a day. A common problem of formula-fed babies is constipation and sore buttocks due to the stools.

Constipation

Under normal conditions, the fully breastfed infant is never constipated if the volume of feed is sufficient. The vast difference in the number of stools a breastfed infant may have often causes unnecessary concern.

On the other hand, the formula-fed infants have much firmer stools than the breastfed infant and the mother may worry that the infant is constipated. The formula-fed infant should have one or two stools per day and may have to strain more than the breastfed infant in order to pass the stool.

Babies on iron supplements will present with black, sticky stools often causing constipation which may require management.

If the infant is constipated, it is usually due to underfeeding, but it may indicate that the infant requires more fluid or that the feed is too rich. In true constipation, the anal region may be red and abraded from passing the hard faeces. The feed is reassessed and if the feed that the newborn has been getting is of the correct proportions, the mother may be instructed to give water after feeds, or to give fruit juices or pureed fruits as the infant grows.

Constipation may be a sign of an abnormal condition such as cretinism (congenital hypothyroidism) or Down's syndrome (Trisomy 21).

Types of abnormal stools

Abnormal stools in the newborn are indicative of some abnormal condition, which may only be due to incorrect feeding, but which could also be extremely serious. Abnormal stools are frequently associated with abdominal distension, and vomiting may also be a clinical feature. The midwife should investigate every abnormal stool and immediately report any stool that is not caused by incorrect feeding because the sooner an abnormality is treated, the greater are the chances of a full recovery.

In order to be able to differentiate between these abnormal stools, the midwife must be familiar with all the abnormal stools which can occur in the neonatal period. Table 42.1 summarises types of abnormal stools.

42.1 Electrolyte solution for the treatment of diarrhoea (intestinal hurry) at home

One litre of *clean* water, in a *clean* utensil. Add to this: 8 level teaspoons of sugar, and half a level teaspoon of salt. Stir well and pour into a *clean* mug and give plenty of the mixture to the child by spoon, while the diarrhoea lasts, and continue breastfeeding. Take the infant for medical attention.

Failure to pass meconium within 24 hours

This condition is usually accompanied by abdominal distension, and later by the vomiting of foul-smelling, bile-stained vomitus if the condition has not been diagnosed and treated. The causes are atresia of the lower bowel, or other causes of obstruction to the bowel such as meconium ileus, or an imperforate anus.

A midwife must make sure that the anus is perforated at the first physical examination.

In preterm babies with respiratory distress syndrome there may be a delayed passage of meconium, with no bowel sounds. Other clinical features will be present.

The medical practitioner is notified if the newborn has not passed meconium in the first 24 hours and if the abdomen is distended. Investigation is required and surgical intervention is usually indicated in obstruction of the bowel.

Table 42.1

Stools of newborns

Types of abnormality	Clinical picture and possible causes	Intervention
Large loose, greenish-yellow stools	The cause of large loose yellow or greenish stools is usually overfeeding in the infant particularly on breast milk. If the infant is also vomiting and/or losing weight, the length of time of feeding should be reduced slightly, until the stool is normal.	Test weighing for 24 hours may be indicated to determine the baby's intake. Observe the growth card to determine the pattern of weight gain.
Small, loose, green mucous stools	Small, fairly frequent, loose, green-brown stools containing an amount of mucus denotes underfeeding and starvation in breastfed newborns. These stools are often semi-transparent and have a faint musty, but not offensive odour. (This stool must not be confused with infective diarrhoea, as this infant requires extra milk feeds and should not to be taken off milk.) The newborn is losing weight, crying a lot, is lethargic, and has a reduced urinary output.	Plotting information on the growth card will indicate if the baby is growing. The midwife should show how the mother's milk supply can be increased and the infant should suckle more frequently. If, despite all efforts, the infant still does not receive sufficient nutrition, alternative feeding will have to be started.
Small, hard, pasty, infrequent stools	These stools would indicate that the formula-fed infant is not obtaining sufficient nutrition, and the infant will be underweight and will appear undernourished. No formula-fed infant should be underfed, because the correct volume and strength are easy to calculate.	In cases of formula-fed infants that are underfed, the midwife should investigate the socioeconomic background and the mental ability of the parents, as they may need help to provide the infant with sufficient nutrition and care. The feed should be reassessed and strength and quantity increased gradually, until the correct nutrition is achieved. The condition and progress of this infant should be carefully followed up.
Frothy, loose greenish-yellow stools with a sour odour	May indicate lactose intolerance.	These stools may occur in the abnormal condition of lactose intolerance, and special feeds may be necessary. Refer to medical practitioner.
Pale, greasy, bulky, very offensive smelling stools (steatorrhoea)	May be accompanied by vomiting and are caused by undigested fat in cow's milk feeds. The fat curds are either not being digested or there is too much fat in the feed. The cause may be cystic fibrosis but this is not usually seen in the newborn because these newborns will present instead with a meconium ileus.	Refer to medical practitioner.

continued

Table 42.1

Stools of newborns (*continued*)

Types of abnormality	Clinical picture and possible causes	Intervention
Large, pasty, smelly, infrequent stools with curds	The newborn with this type of stool usually has an accompanying colic with constipation. It may indicate that casein in the milk is not being digested. Only infant feeds that are approved need to be given for babies' mineral content and therefore could also result in hypernatraemia. This type of feed predisposes to necrotising enterocolitis and could also lead to intestinal obstruction from the inspissated milk syndrome (lactobezoar).	Reassessment of the feed is necessary, with boiling and dilution of liquid cow's milk, or the correct proportions used for making up powdered milk. The parents should be given careful explanations about how to make up feeds and the progress of the infant should be carefully followed up.
Loose, frequent greenish-yellow stools (diarrhoea)	This stool usually indicates the onset of an infection, but must not be confused with the normal stool or the underfeeding or overfeeding stool of the breastfed infant. Diarrhoea is rare in the breastfed newborn, but is a frequent and dangerous occurrence in the formula-fed newborn, particularly in low socioeconomic communities. All mothers in rural areas should be given the instruction (see Box 42.1) for an electrolyte solution which can be given to a child with diarrhoea (intestinal hurry) until medical help can be obtained. Diarrhoea is also a feature of middle-ear infection, necrotising enterocolitis, congenital adrenal hypoplasia and a sensitivity to cow's milk protein.	Refer to medical practitioner.
Frequent, watery, green, offensive smelling and possibly explosive stools (advanced infective diarrhoea)	Advanced diarrhoea caused by an infection of the gastrointestinal tract is an extremely serious condition in the newborn. The main organisms causing diarrhoea are *E. coli,* Salmonellae, Shigella and Staphylococcus, *Candida albicans,* Coxsackie virus, Rotavirus, *Vibrio cholerae.*	Refer to a medical practitioner. The newborn is usually admitted to a clinic or a hospital and isolated from other newborns. Intravenous fluids are commenced immediately and the infant is given no oral feeding. Stool and blood specimens are taken and sent to a laboratory immediately, in an attempt to isolate the infecting organism. Broad-spectrum antibiotics or specific medication are commenced as soon as possible. When the stools begin to normalise, gradual oral feeding is introduced, starting with an electrolyte solution and gradually progressing to a normal milk feed.

Malaena or black, tarry stools, which stain the napkin pink Contains blood	This blood could be maternal blood swallowed during delivery or from cracked and bleeding nipples in breastfed newborns, or it could be the newborn's blood caused by trauma to some part of the alimentary tract, or due to bleeding into the alimentary tract in haemorrhagic disease of the newborn (hypoprothrombinaemia). In the latter condition, the melaena stool often also contains fresh blood from the lower intestinal tract (colon and rectum). On careful inspection, the white napkin assumes a pinkish tinge at the edges of the stool, due to the blood (haemoglobin) in the stool.	Refer to a medical practitioner and an injection of vitamin K1 should be given if not already given at birth. The medical practitioner may order further vitamin K1 and vitamin C to be given and, if the haemorrhage is severe, a blood transfusion may be necessary. The newborn is nursed in high-care. This stool must not be confused with the black stool which results from the administration of iron to the newborn.
Pale putty-coloured stools	Jaundice, liver conditions or an obstruction that prevents bile from entering the alimentary canal. Congenital atresia or obliteration of the bile ducts (intra- or extra-hepatic), or inspissated bile syndrome in cystic fibrosis infections or metabolic conditions that affect the liver.	The medical practitioner is informed immediately and the appropriate management is started.

No further stools after the passage of meconium

This condition is usually accompanied by vomiting. There may be distension of the upper abdomen but not the lower abdomen, or distension of the whole abdomen. The cause is suggestive of either a high obstruction of the bowel, or a partial obstruction of the bowel, such as in Hirschsprung's disease.

The medical practitioner is informed if no further stools or very infrequent stools are passed and immediate investigations are started.

42.3 Gastrointestinal abnormalities

Abdominal distension in the newborn

A slight amount of abdominal distension is normal in the newborn after feeds, and this is especially noticeable in low birth weight babies.

Abnormal abdominal distension is usually accompanied by some vomiting, and may also be associated with either the delay in passing (absence of) stools or with diarrhoea.

The abdomen should not be distended or hard before feeds in normal circumstances. Any excessive distension and/or hardness of the abdominal wall may be abnormal. Abdominal distension in the upper abdomen accompanied by an absence of distension of the lower abdomen, particularly with marked peristalsis, could indicate a pyloric stenosis or an obstruction in the duodenum.

Gross abdominal distension without peristalsis could indicate lower intestinal obstruction.

Causes of abdominal distension

There are many causes of abdominal distension and if this condition is present, the midwife should note any other clinical signs which may assist in a diagnosis, such as size and gestational age of the infant, vomiting, delay in passing stools, diarrhoea, pyrexia, weight loss, dehydration and/or malnutrition, bleeding, etc.

Poor feeding techniques

Abdominal distention and possibly vomiting can be caused by the swallowing of air during feeding, and can be due to the infant feeding too rapidly from an over-abundant milk supply and an excessive 'let-down' when breastfeeding, or can be due to an excessively large hole in the teat when bottle feeding.

Difficulty with or neglecting to wind/burp the infant after feeds, may result in abdominal distension and may lead to vomiting.

Infection

Gastroenteritis, peritonitis and generalised infections such as septicaemia can cause abdominal distension.

Intestinal obstruction or partial obstruction

High obstruction

In conditions such as pyloric stenosis, duodenal atresia or stenosis, abdominal distension may not be noticed at first, as only the stomach and the duodenum will distend.

Low obstruction

In conditions such as intestinal atresia, malrotation of the gut with volvulus and periduodenal bands (Meckel's diverticulum), incarcerated inguinal hernia, rectal agenesis and imperforate anus, and Hirschsprung's disease, the abdominal distension is prominent. The abdominal wall becomes stretched and veins may be seen beneath the skin.

Perforation of the bowel

Perforation of the bowel will lead to abdominal distension and may be due to conditions such as peptic ulcer, sepsis, Meckel's diverticulum, spontaneous perforation, which may occur after an exchange blood transfusion, or necrotising enterocolitis.

Herniation or enlargement of an intra-abdominal organ

Localised distension can occur in umbilical hernia, enlarged kidneys, hepatosplenomegaly, and bladder neck obstruction.

Ascites

Gross abdominal distension (ascites), may be found in haemolytic disease due to Rh incompatability, in nephrotic syndrome, in cardiac failure, and in other unknown conditions.

Necrotising enterocolitis

Necrotising enterocolitis occurs most commonly in low birth weight babies who are not breastfed or given breast milk. The cause is not known, but predisposing factors appear to be birth asphyxia and shock, umbilical catheterisation, cow's milk feeds and certain antibiotics, any of which result in ischaemic necrosis of portions of the gut, mainly the terminal part of the ileum and the colon.

Clinical signs

The clinical signs are abdominal distension three to five days after oral feeding has started, with the outline of distended loops of bowel seen beneath the abdominal wall, diminished bowel sounds, vomiting (bile-stained); gastrointestinal bleeding (blood in the stools), irregular temperature (hypothermia), lethargy, possibly peritonitis and shock.

42.4 Vomiting in the newborn

Types of vomiting

Any fluid coming from the mouth of the infant constitutes vomiting and this fluid may ooze gently from the mouth, spill out of the mouth in small or large amounts, or may spurt out of the mouth (precipitate vomiting). The quantity of fluid may vary from small amounts to the regurgitation of a whole feed. The vomitus may consist of watery mucus, frothy mucus, plain or curdled milk, or milk or mucus containing blood or bile.

Mucus

Vomited mucus is usually caused by liquor or blood, which has been swallowed during birth. This irritates the gastric mucosa, resulting in expulsion of mucus and liquor soon after birth, possibly with some stomach juices. Swallowed liquor may also contain swallowed blood and/or meconium.

If the infant appears to have swallowed much liquor, a stomach wash-out is indicated.

Frothy mucus

Frothy mucus may be present soon after birth and could be a sign of the very serious conditions of tracheo-oesophageal fistula or oesophageal atresia, where the saliva is not being swallowed, but is being directed into the trachea or pharynx and mixed with expired gases. If the mother had polyhydramnios in pregnancy, care is taken to make sure the gastrointestinal tract is intact. The midwife can pass a no 6 feeding tube and test that it is in the stomach with litmus paper, which turns pink in the presence of acid.

This condition should be reported immediately and NO feed should be given to the newborn until further examination and tests have been carried out.

Milk

The vomiting of milk, with or without mucus, is the most frequent type of vomitus seen in the newborn and could be due to a large variety of causes, as indicated below:

- *Posseting and ruminating.* Overfeeding, especially in low birth weight babies, who have very small stomachs and a low stomach emptying time due to immaturity and difficulty in digesting feeds, can lead to vomiting.
- *Incorrect techniques.* Incorrect strength of feed (the mixture is too rich for the newborn). Rough handling of an infant after a feed or not burping an infant can lead to vomiting.
- *Congenital abnormilities.* Chalasia or lax cardiac sphincter of the oesophagus cause feeds to regurgitate. The infant needs to be propped up on pillows, especially after feeds, to prevent the feed from flowing back out of the stomach.

Causes

There are many causes of vomiting in the newborn and certain types of vomiting may be normal in some babies. However, most types of vomiting are abnormal and may be extremely serious and any persistent or unusual vomiting should be reported and investigated immediately, because the sooner after birth a newborn is treated for an abnormality, the greater are the chances of complete recovery.

Bile stained vomitus

Bile-stained vomitus can be caused by any low intestinal obstruction, which is caused by:

- atresia of the bowel
- imperforated anus
- meconium ileus
- volvulus
- Meckel's diverticulum
- strangulated hernia
- Hirschsprung's disease.

In addition, a high intestinal obstruction, such as a duodenal atresia below the entry of the bile duct will cause bile-stained vomiting within the first 24 hours of birth.

Obstruction

High alimentary obstruction or partial obstruction that will cause vomiting includes:

- *Achalasia or cardiaspasm.* This is spasm of the cardia or cardiac sphincter of the oesophagus.
- *Pylorospasm.* Spasm of the pyloric sphincter of the stomach.
- *Pyloric stenosis.* Congenital hypertrophic closure of the pyloric sphincter of the stomach.
- *Hiatus hernia.*
- *Oesophageal atresia or fistula.* This causes drooling and frothy mucus.

Medical conditions

Metabolic, biochemical, endocrine and other disorders that may cause vomiting are:

- galactosaemia
- glycogen storage disease
- congenital adrenal hypoplasia.

Other causes

Further causes of vomiting in the newborn:

- *Infective gastritis.* Non-infective gastritis is caused by the swallowing of liquor and possibly blood and/or mecomium. Infective gastritis is caused by *E. coli* or *Candida albicans* (thrush) or the coxsackie virus.

- *Urinary tract infection.* General infections: urinary tract infections, neonatal hepatitis, septicaemia or meningitis.
- *Raised intracranial pressure.* Conditions such as cerebral trauma: oedema and bleeding meningitis and hydrocephaly can cause vomiting.

Blood-stained vomitus

This may be caused by:

- swallowed maternal blood at birth
- cracked nipples and swallowed maternal blood
- trauma to the pharynx or to any other part of the upper respiratory or alimentary tract
- haemorrhagic disease of the newborn (hypoprothrombinaemia) or any other haemorrhagic condition.

Diagnosing vomiting

The midwife looks at the history of the pregnancy and birth, amniotic fluid and placental pathology, and does a full examination to exclude congenital abnormalities.

Any vomiting is a cause for concern, because the infant is losing fluids and nourishment, which could be extremely serious in a newborn. The midwife should observe the infant very carefully in order to be able to assess whether the vomiting is caused by faulty feeding techniques, which merely require adjusting, or whether the vomiting is due to an abnormality, which requires immediate attention.

There are specific points relating to vomiting which the midwife should observe and report, in order to assist the medical practitioner in making a diagnosis:

- the time of vomiting in relation to feeds
- whether the vomiting has any relation to feeding
- the amount of fluid vomited. The actual amount cannot be measured, but the midwife should be able to gauge whether the whole or half or only a small portion of the feed is returned.

Further points to note:

- Most vomiting occurs during or soon after feeds.
- If the vomiting is delayed after feeds, it is important to note the time lapse between the end of the feed and the vomiting.
- A large vomit before a feed is suggestive of delayed emptying of the stomach.
- The vomiting may have no relation to feeding.
- If the vomiting is related to feeds, the midwife should note whether it occurs at or after every feed or only occasionally.
- The force of the vomiting is important to consider as it gives clues to the cause: It may be a welling-up of feed in the mouth and spilling over, which could indicate overfeeding or too rich a feed. There may be gagging and a large outflow of milk, with or without noise (belching). The infant may be taking the feed too quickly and swallowing air, causing the belching, or there may be some spasm of the pyloris causing the feed to be regurgitated without belching. There may be projectile vomiting, which is found in pyloric stenosis a few days after birth, when gastritis has developed. The vomitus may be projected over a metre from the infant, and is very startling to the mother or the attendant.
- The appearance of the vomitus, is it blood-stained, yellow or frothy?
- The odour of the vomitus should be noted. The vomiting of any feed results in an unpleasant sour odour, and if the feed has been retained for any length of time, has an unpleasant stale smell. Vomitus with a foul-smelling odour is found in obstruction of the lower intestine and has an unmistakable faecal odour.

Other abnormalities associated with vomiting

Abdominal distension

The midwife should note if there is a relationship between the baby's physical condition and the vomiting. The midwife should note whether the infant has abdominal distension before the feed, or after the feed, and whether the distension is relieved after vomiting. The abdomen is examined in order to note the extent of the distension and whether peristalsis is absent, present or exaggerated. Any soft and large, or small and hard lumps are noted, as these may denote a hernia, or hypertrophy of the pyloris respectively.

Stools

It is important to note the stools of any infant that is vomiting as there may well be a relationship between the vomiting and the stools. In intestinal obstruction, no stools will be passed, and in gastroenteritis, diarrhoea and vomiting may be present. Blood-stained stools would indicate necrotising enterocolitis.

General condition and appearance of the infant

If any vomiting occurs, the infant should be very carefully monitored and the temperature, respiration and pulse taken and recorded at least four hourly. Any abnormalities should be reported immediately.

The general appearance of the infant should also be noted, and whether the infant is losing or gaining mass (weight). The undernourished infant will appear pale, listless and thin with little subcutaneous fat, and the dehydrated infant presents with sunken fontanelles, sunken eyes and loose skin. Any excessive dryness of the skin or sweating is noted. The infant's cry is also noted.

42.5 Hypothermia and neonatal cold injury

Hypothermia is a condition where the axilary temperature is less than 36 °C.

Hypothermia

All newborns have a tendency to hypothermia for the following reasons:

- The temperature regulating mechanism is not as efficient as that of an older child.
- Body heat is very easily lost because the newborn has a large body surface area in relation to the body mass, and often less subcutaneous fat.
- The infant is naked and wet at birth.
- The blood vessels are closer to the skin surface.

Newborns prone to hypothermia

These newborns are more likely to develop hypothermia:

- newborns born outside the facilities (BBA) and those who needed to be transferred to a higher level hospital
- wet newborn not dried immediately after birth
- low birth weight newborns
- sick newborn, especially those with infections
- newborn born in a cold environment and undergoing medical procedures such as resuscitation
- newborns who are not fed in time and who have a low blood glucose level.

It is very important, therefore, that great care is taken at birth to prevent heat loss and to maintain the body temperature, because hypothermia is easier to prevent than to cure and serious side effects may arise. Hypothermia leads to hypoglycaemia and to respiratory distress causing metabolic derangement and tissue damage.

Predisposing factors

Predisposing causes of hypothermia are conditions where the infant requires resuscitation at birth such as asphyxia, preterm babies, small-for-gestational age babies, babies of mothers with diabetes mellitus or any other serious condition of the mother or of the infant such as cerebral injury and haemorrhage. The attendants may be concentrating on establishing and maintaining respiration during resuscitation and may fail to keep the infant warm. Heat (energy) and glucose are needed for respiration and therefore respiratory distress which leads to hypothermia and hypoglycaemia will in turn lead to further respiratory distress.

The normal skin temperature of an newborn should be between 36.2 °C and 36.8 °C.

Management and care

Prevention of hypothermia:

- Dry the infant as soon after delivery as possible to prevent loss of heat by evaporation.
- Wrap in warm blankets immediately after drying and keep out of draughts, and for the normal newborn, the room temperature should be above 22 °C, in order to prevent heat loss by convection.
- Frequent observations, particularly if the infant is at risk. Those babies should be placed in a warmed incubator as soon as respiration has been established.

Care of a hypothermic infant:

- Early recognition is very important, observe the temperture.
- Environmental control. The infant is placed in a pre-warmed incubator. The temperature of the incubator may range between 32 °C for a near-term newborn, and 36 °C for an ultra-low birth-weight newborn.
- Protect from heat loss. If the infant is already in an incubator, the temperature can be increased, a perspex heat shield can be placed over the infant and the infant can be dressed in woollen cap, gloves and socks.
- Kangaroo-mother-care. If no incubator is available, the infant can be placed on the mother's chest and an aluminium/silver swaddler placed over them both and covered with blankets. This is very useful for transporting the newborn.
- Treat the cause.
- Prevent hypoglycaemia with early and regular feeding.

Observations for colour, respiration and pulse are done frequently or continuously. Check blood sugar levels.

Neonatal cold injury

Neonatal cold injury, or severe hypothermia, mainly affects low birth weight babies and everything possible should be done to prevent this condition. The brown fat that is metabolised for heat production becomes hard and the condition can be fatal. Neonatal cold injury has a mortality rate of about 25% and many of the newborns that do survive suffer brain damage due to hypoxaemia, hypoglycaemia, or hyperbilirubinaemia.

Clinical features

The baby presents the following:

- cold skin, the temperature may be below 32 °C
- very lethargic infant that does not feed well

- feeble cry
- bradycardia (below 100 beats per minute)
- oliguria
- depressed or absent reflexes
- oedema, which may lead to sclerema (a non-pitting swelling of the skin and subcutaneous tissues which, if it develops around the thorax, can cause splinting of the thorax and further respiratory impairment)
- the face and extremities may be ruddy (due to oxygenated red blood cells being trapped in skin capillaries). This is called pink hypoxia.

Management and Care

Complications:

- Hypoxaemia may occur due to bronchopneumonia and result in cyanosis.
- Metabolic acidosis/acidaemia may occur as a result of hypoxaemia.
- Gangrene of fingers and toes may occur.
- Hyperbilirubinaemia leading to kernicterus may occur in very small babies.
- Intrapulmonary haemorrhage usually results in death.

Care for cold injury:

- The medical practitioner is notified.
- The infant is warmed in an incubator.
- Hourly temperature is done until stable.
- On medical practitioner's prescription, an intravenous infusion of 10% dextrose water is given to prevent hypoglycaemia.
- Antibiotics may be prescribed.
- Oxygen is given by a headbox.

42.6 Conclusion

The midwife must have the knowledge and skill to identify abnormalities in the physical and metabolic function of the newborn and refer the infant for medical attention. In some cases the mother needs to be educated to change the way she cares for the baby.

CHAPTER

43 Jaundice and infections in the newborn

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- explain the physiological basis of neonatal jaundice
- demonstrate competence in the care of a newborn with jaundice
- define 'a safe environment'
- demonstrate competence in phototherapy
- demonstrate competence in education of parents on jaundice and phototherapy.

KNOWLEDGE ASSUMED TO BE IN PLACE

The physiological abilities and adaptation of the newborn (See Chapters 19 and 50)

KEYWORDS

Physiological jaundice • Hyperbilirubinaemia • Phototherapy • Rhesus incompatibility • ABO incompatibility • Kernicterus • Omphalitis • Conjunctivitus

43.1 Introduction

This chapter will cover neonatal jaundice and common infections in newborns.

43.2 Physiological jaundice in the newborn

Neonatal physiological jaundice is one of the most common conditions that need medical attention. More than 60% of newborns develop what is called *physiological jaundice of the newborn*. A small percentage develop *pathological jaundice*, which is more serious.

Types of hyperbilirubinaemia

The differentiation between physiological and pathological jaundice is given in Table 43.1.

Pathophysiology of neonatal jaundice

Unconjugated bilirubin is toxic to the infant brain. After birth, red cells are removed from the circulation in large numbers. There is degradation of the haem component of haemoglobin to form bilirubin, so that even normal newborns may develop marked hyperbilirubinaemia. The production of bilirubin in the newborn is more than twice that in the adult. After birth, conjugation of the bilirubin takes place when enzymes change bilirubin into a water soluble state in the liver and spleen. It is bound to a protein. In the liver the enzyme beta diglucuronide converts bilirubin into conjugated bilirubin. Conjugated bilirubin is carried in the bile to the small intestine, and is excreted in the stool.

The enzyme system that conjugates bilirubin in the liver depends on glucose availability and is dysfunctional in the first week of life, so the amount of bilirubin increases in the serum and the newborn may become jaundiced.

Jaundice in the newborn appears first in the face and upper body and progresses downward toward the toes. Pre-term newborns are more likely to develop jaundice than full-term newborns. The brain barrier that protects the brain from high bilirubin levels is not developed and when the blood values of unconjugated bilirubin reach a level of 250 µmol/ℓ (15 mg%) in a preterm infant and 350 µmol/ℓ (20 mg%) in a term infant the brain can be effected.

Causes of jaundice

About 50% of normal newborns may develop a degree of physiological jaundice, which appears on about the third day after birth. About 5–10% of newborns may develop bilirubin levels of more than 165 µmol (10 mg%). Newborn of 37 weeks of gestation and lower are *four times* more likely than a term newborns to have a serum bilirubin over 220 µmol/ℓ (13 mg%).

Table 43.1

Differences between physiological and pathological jaundice

	Physiological	Pathological
Onset	Seldom present before third day after birth Clears within a week	Can be present from birth or within 24 hours Continues for long periods
Cause	Breakdown of red blood cells and liver too immature to metabolise breakdown of products	Infant: metabolic congenital abnormalities (e.g. cystic fibrosis) Obstructive: liver conditions and bile obstruction Birth trauma: (e.g. cephalohaematoma) Infections: result in jaundice hepatitis Maternal: Rh and ABO incompatibility Breast milk jaundice
Blood levels	Seldom exceed safe levels	High bilirubin levels
Treatment	Phototherapy	Phototherapy and other medical interventions such as antenatal intrauterine exchange infusion and postpartum exchange transfusion
Outcomes	Clear and baby is normal	Prolonged jaundice > 10 days and neurotoxicity (kernicterus)

Raised *Conjugated* hyperbilirubinaemia in the newborn of about 38 µmol (2 mg%) is rare and abnormal. In this situation obstruction to biliary outflow may be a possibility, for example biliary atresia. Uncommon enzyme deficiencies (e.g. alpha-1 antitrypsin deficiency) and other metabolic abnormalities, sepsis, and parenteral nutrition may also cause high levels of conjugated bilirubin in the newborn.

Signs and symptoms

The early feeding of a newborn with colostrum can stimulate peristalsis and meconium stools. There seems to be a lower risk of neonatal jaundice with early feeding. Mothers are thus encouraged to start breastfeeding soon after birth. In babies who nurse poorly, the likelihood of becoming jaundiced is even greater. It must also be remembered that babies of 36 to 37 weeks' gestation (or less) do not nurse as well as more mature babies. One study has shown that infants at 37 weeks were four times more likely to have a serum bilirubin > 230 µmol/ℓ (13.5 mg%) than those of 40 weeks' gestation.

The yellow colour of the skin and other tissues of the newborn are caused by accumulation of indirect unconjugated bilirubin due to an overall increase in the total bilirubin in the blood.

Jaundice starts with yellow discolouration of the sclera of the eyes and then spreads progressively over the body. When the trunk of the baby is affected the bilirubin level will be higher. Jaundice of the palms of the hands and feet indicates extreme levels in the blood.

In some newborns the serum bilirubin level may rise above acceptable levels. Unconjugated bilirubin is neurotoxic and can cause death in the newborn or kernicterus.

Hyperbilirubinaemia in this case is as a result of physiological causes (e.g. immature liver) and not pathological causes such as infections, obstruction or isoimmunisation.

Presentation and duration of neonatal jaundice:

- Physiological jaundice presents normally on the second or third day of life.
- If jaundice is visible during the first 24 hours of life, further evaluation is suggested.
- When severe jaundice continues after the first two weeks of life, the newborn should be observed for galactosaemia and congenital hypothyroidism and other conditions associated with pathological jaundice.

Diagnosis of jaundice

History includes:

- siblings with jaundice
- known family history of Gilbert's syndrome or other family members with jaundice
- known heritable haemolytic disorders
- liver disease
- babies of Asian mothers
- history of pregnancy and delivery
- maternal illness such as diabetis mellitus or infections
- Rh and ABO incompatibility
- maternal drug intake (oxytocin)
- delay in clamping the umbilical cord
- any birth trauma (e.g. bruising or haematoma).

Postnatal history includes:

- stool colour dark yellow or green
- more weight loss than normal

- signs and symptoms of hypothyroidism
- signs and symptoms of metabolic disease
- exposure to total parenteral nutrition.

The diagnosis is made on the history and clinical picture. Risk factors are considered. The condition is confirmed by the blood values of bilirubin in the baby.

The blood values are expressed in µmol/ℓ or mg%. Only total bilirubin is reported.

Three criteria are important in the diagnosis:

1 *Gestational age and birth mass.* The levels of jaundice are considered against the infant's weight. A preterm infant is treated earlier than a term infant.
2 *Days after birth.* If the jaundice starts before day three the cause is considered and treatment begins.
3 *Level of unconjugated bilirubin.* The levels for treatment and other interventions depend on the blood levels of the unconjugated bilirubin against the age and mass of the infant.

Care of a newborn with jaundice

Jaundice in the newborn, whether physiological or pathological, is always referred for medical care. The medical practitioner will choose the intervention required based on existing guidelines and clinical judgement. The first line of treatment is phototherapy.

When the newborn is exposed to fluorescent light of 400–500 nm unconjugated bilirubin becomes water soluble, and is excreted in the urine and stools.

The aim of phototherapy is to change the bilirubin that is bound to the fat in the skin to a water soluable state and excrete it via the urine and bowel.

43.1 Indications for phototherapy

These are the serum bilirubin level and individual condition of the newborn. (Values of µmol/ℓ are divided by 17 to get mg%):

- Preterm newborn <1 500 g – between 85 and 140 µmol/ℓ (5–8 mg%)
- Preterm newborn >1 500 g, sick infants and those with haemolysis – between 140–165 µmol/ℓ (8–10 mg%)
- For healthy term newborns jaundiced after 48 hours – between 280 and 365 µmol/ℓ (17–22 mg%)

Care of a newborn receiving phototherapy

A newborn can be cared for at home, next to a mother in a maternity ward, in a nursery or neonatal unit. The choice of care depends on the condition of the infant and the type of jaundice. The newborn can be in a crib or in an incubator.

Different devices exist for phototherapy. These include phototherapy fluorescent lights, the Bilibed and the Wallaby (a fibre optic band placed around the infant's chest). It is important to use the device according to its specifications. The following general principles apply:

- Phototherapy is prescribed by a medical practitioner based on blood values.
- Total serum bilirubin (TSB) levels are measured daily.
- Careful monitoring of the newborn is essential. This includes the baby's temperature, fluid intake and general wellbeing.
- The baby is nursed naked under the lights, with the eyes covered for protection when using fluorescent lights.
- The lights are 30–50 cm above the infants regardless of the bed used.
- If fluorescent lights are used they need to be replaced every 1 000 hours.
- Continuing with breastfeeding.
- The baby must be removed from under the lights for feeds, but should remain under the lights for most of the time.
- Observe the eyes, cord and buttocks.

Potential complications of phototherapy include:

- dehydration – babies don't drink and are lethargic
- interruption of feeds with slower weight gain
- trauma to eyes from eye pads (infection)
- mother–infant separation and emotional upset
- lack of temperature control causing overheating
- bronze discolouration of the skin in babies under the lights for long periods
- skin rashes are common due to the heat
- diarrhoea – babies tend to have loose stools when excreting the biliribin.

If the jaundice is severe and is left untreated, a neurotoxic condition called kernicterus can develop. Kernicterus is the staining of the basal ganglia of the brain with unconjugated bilirubin, causing irreversible brain damage.

Finally, most authorities agree that if a newborn is discharged early from hospital, he/she must be checked for jaundice by a competent practitioner on day two or three postpartum.

Early discharge has resulted in fewer opportunities to teach new mothers how to breastfeed or to detect medical conditions that don't become evident until 24 to 72 hours after birth. This has resulted in a doubling of readmission to hospital within one to two weeks of birth, mainly due to jaundice and dehydration.

Maternal milk jaundice

There is a low incidence of breast milk jaundice. If a baby presents with prolonged jaundice and all other pathological causes are excluded, breast milk jaundice is considered.

When breast milk jaundice is suspected a baby may be taken off the breast for 24 hours. If the bilirubin falls then it is likely to be caused by breast milk.

The mother and medical practitioner decide the risk if the baby remains on the breast and make a decision accordingly. It is not always necessary to stop the breast milk.

43.3 Pathological jaundice in the newborn

Pathological jaundice in the newborn generally appears within 24 hours after birth, reaches levels of 275 μmol/ℓ and persists beyond 10 days.

Causes

Rh incompatibility

Before the problem of Rhesus (Rh) incompatibility was recognised and addressed, this was a relatively common cause of major fetal morbidity and mortality. Mothers who are Rh negative become sensitised to the Rh antigen when small amounts of fetal (Rh positive) blood leak into the Rh negative maternal circulation, and with the next pregnancy, the mother produces immunoglobulin G (Ig G), which crosses the placenta to cause massive haemolysis in the fetus. The newborn is often severely anaemic, grossly jaundiced, and critically ill, with serious neurological consequences. When a mother is Rh negative, routine administration of anti-D means that Rh incompatibility disease *should be* rare. (The anti-D destroys the Rh-positive cells before maternal sensitisation takes place.)

ABO incompatibility

Some Group O mothers will produce IgG antibodies to the A or B blood group antigens (commonly A), and these may cause a picture similar to Rh incompatiblity, but often milder.

Other causes

- *Glucose 6-phosphate dehydrogenase deficiency (G6PD).* This condition and other uncommon hereditary enzyme deficiencies, such as red cell abnormalities, hereditary spherocytosis, polycythaemia, bleeding into tissues, including cephalohaematomas related to application of a ventouse (vacuum extraction) can cause jandice.
- *Inborn errors of metabolism.* Such as galactosaemia, tyrosinosis, hypermethionaemia, alpha-1-antitrypsin deficiency.
- *Obstructive jaundice.* Atresia of bile ducts, inspissated bile syndrome and choledocal cyst.
- *Infection.* Syphillis, toxoplasmosis, cytomegalovirus, rubella.
- *Congenital abnormalities.* Cystic fibrosis.

Clinical signs and symptoms

Clinical signs and symptoms of this condition are lethargy, hypotonia and poor sucking. The second phase includes hypertonia, opisthotonos and fever. The third phase after about a week includes hypertonia, abnormal Moro reflex (exaggerated or reduced), cerebral irritation, convulsions and seizures. The long-term sequelae are devastating – delayed motor skills, abnormalities of tone and reflexes, athetoid cerebral palsy and deafness.

With severe haemolysis, there is kernicterus. In severe cases of jaundice, it may be necessary to perform one or more exchange transfusions on the infant to prevent kernicterus from occurring.

Depending of the age and mass of the infant an exchange transfusion is done when the total bilirubin is 20 mg/dl (340 μmol/ℓ) in a term infant and 15 mg/dl (255 μmol/ℓ) in a preterm infant.

Care of pathological jaundice

The cause of the condition should be determined. This is done using a thorough history from the mother and examination of the infant. The newborn's blood group can be determined when ABO incompatibility is suspected. Make sure that a sample of cord blood is available after birth for a Coombs' test.

Besides levels of conjugated and unconjugated bilirubin, it may be appropriate to do a full blood count (FBC) with a blood smear for red cell morphology, and other tests, depending on ethnicity and clinical suspicion of red cell haemolytic disorders. Remember that with ABO incompatibility, a negative Coombs' test does not exclude haemolysis, as this test is infrequently positive, although a positive result may suggest more severe haemolysis.

Clinical assessment of the degree of jaundice is often poorly correlated with serum levels, however, it is well recognised that as the severity increases, so yellow pigmentation spreads from the face to the trunk and eventually the extremities. If there is staining of the feet, a serum bilirubin is *most* advisable.

The effects of rhesus haemolytic disease on the fetus and newborn

If Rhesus haemolytic disease is not prevented, it results in serious consequences:

- intrauterine death
- hydrops fetalis (oedema of the fetus)

- icterus gravis neonatorum (grave jaundice of the newborn) which manifests within 24 hours of birth and can result in kernicterus and death if untreated
- haemolytic anaemia.

43.4 Infections

Newborns are more at risk of certain infections, because their immune systems have limited ability to prevent and fight infectious diseases. Special care may be needed for the newborn who develops an infection before, during or after birth, sometimes in the neonatal intensive care unit (see Chapter 50).

Causes of infection

Most infections in newborns are caused by bacteria, but some are caused by viruses. The newborn can be infected by the mother during pregnancy where the causal organism passes through the placenta to the fetus. Examples of those infections include rubella, syphilis, toxoplasmosis, cytomegalovirus and HIV.

The newborn can also catch infections, particularly respiratory conditions and septicaemia, via infected amniotic fluid if the membranes have ruptured early. This condition is known as amniotic fluid infection syndrome (AFIS), but it is very difficult to distinguish between intrauterine or intrapartum infection and an infection acquired after birth.

Herpes infection can be acquired by the newborn from a labial lesion during vaginal delivery and therefore these newborns are ideally delivered by caesarean section.

Hepatitis B is acquired at or shortly after birth. The exact mode of transmission is not known. A high percentage of newborns born to mothers who are Hepatitis B 'e' antigen (HBeAg) positive become infected with the virus and become carriers.

General infections that the newborn may acquire and which could have serious consequences are septicaemia, meningitis, pneumonia, tuberculosis and tetanus. Immunisation of the mother against tetanus in the last trimester produces antibodies in her blood, which reach the fetus in sufficient quantities to protect the infant from neonatal tetanus.

Signs and symptoms of infections

Look for the following signs and symptoms:

- decreased or elevated temperature below 36.6 °C (newborns tend to have a subnormal temperature with infections)
- poor feeding and difficulty waking to feed
- breathing difficulties
- listlessness
- unusual skin rash or change in skin colour
- persistent crying
- unusual irritability
- excessive sleepiness
- change in behaviour
- hepatosplenomegaly (enlarged liver and spleen).

Infections can be systemic or local.

Omphalitis

Omphalitis is an infection of the umbilical cord. This can lead to septicaemia. The usual causal organisms are Staphylococci but *Clostridium tetani* is often the infecting organism when cow-dung or other foreign matter is applied to the cord.

Signs and symptoms. Look for the following:

- moist cord
- redness and swelling of skin
- offensive smell
- bleeding
- purulent discharge.

Management and care. A swab is taken for Gram stain and culture, the cord is cleaned with surgical spirits every three hours and the appropriate antibiotic prescribed in mild infections. In severe infections, an intramuscular antibiotic is given as prescribed by the medical practitioner and the infant is refered to the medical practitioner.

Preventive measures are taken by keeping the cord clean and dry by using full strength alcohol or surgical spirits after bathing, and at each nappy change.

Conjunctivitis

Conjunctivitis is an inflammation of the conjunctiva within the first month of life, often caused by *Staphylococcus aureus, Neisseria gonorrhoeae, Streptococcus pneumoniae, Haemophilus influenzae, E. coli, Klebsiella,* Pseudomonas and *Chlamydia trachomatis.*

Ophthalmia neonatorum, which is caused by the gonococcus bacteria, is a very serious notifiable condition that can lead to scarring and blindness, septicaemia, meningitis and endocarditis.

Signs and symptoms. Look for the following:

- Between the second to third day of life, there is a purulent discharge from the eyes.
- The eyes become red and puffy, with a purulent green discharge.
- The progress of the infection is rapid and severe conjunctivitis results.

Management and care. It is best to take routine preventive precautions by instilling Chloromycetin® or Erythromycin® eye ointment into each eye at birth.

- The baby's eyes should be cleaned with sterile swabs and normal saline at bath time and before each feed for 24 hours.
- The medical practitioner must be informed immediately.
- Take a pus swab.
- Apply antibiotic eye ointment.
- Carefully wash the hands before and after handling the baby.
- The baby should lie on the affected side for drainage, unless both eyes are affected.
- Adequate follow-up of the infant. Health education is given to the mother with regard to the future care of the infant.

Skin infections

Skin infections may vary from a contact dermatitis on the buttocks, to an infected pustule, and from infected vesicles, to abscesses, and from impetigo to cellulitis.

A serious skin infection can be caused by *Staphylococcus aureus*, which presents with pus in blisters on the skin. The blisters rupture to reveal dry reddish skin. In severe cases the skin looks burnt. Medical care is instituted.

Treatment for newborns with limited pustules is cleaning of the area with an antiseptic lotion and prescribing of the appropriate antibiotic such as fluclozacillin 10–25 mg/kg twice a day or cloxacillin 25–50 mg/kg twice daily. For serious infections ceftriaxone is given intramuscularly and the newborn is transferred to a level 2 hospital.

43.5 Conclusion

Prevention of complications of newborns starts in the antenatal period, during labour and in the postnatal period. Many of the complications identified in the postnatal period started in the antenatal period. Quality antenatal care can prevent many of the problems. Severe systemic infections such as septicaemia, HIV, pneumonia and meningitis are encountered in a neonatal intensive care unit and are not presented in this chapter.

CHAPTER

44 Congenital abnormalities

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- define a congenital abnormality, birth defect and inborn error
- give the prevalence of priority problems
- explain the causes of birth defects
- differentiate between genetic and congenital disorders
- institute measures to prevent congenital abnormalities and related complications in pregnancy, birth and newborn related to the specific abnormality
- identify the most common types of congenital abnormalities of newborns
- demonstrate the skills required to care for mothers and newborns with a specific congenital abnormality.

KNOWLEDGE ASSUMED TO BE IN PLACE

Basic knowledge of genetics, diagnosis of genetic diseases and their prevention (see Chapter 7)

KEYWORDS

Congenital • Genetic

44.1 Introduction

One of the most stressful situations in the midwifery practice is the birth of a newborn with a birth defect. The condition may be undiagnosed and unexpected, even with the use of ultrasound during pregnancy and other diagnostic tests.

When a newborn is born with a defect, the health team responds and adapts their behaviour and communication therapeutically and supportively. The birth attendant informs the parents immediately that there is a problem in an appropriate and sensitive manner. In case of immediate emergency treatment a member of the health team should be available to support the parents.

A number of defects may occur in the newborn and this chapter will discuss the most common conditions that are prioritised by the Department of Health.

This chapter needs to be studied in collaboration with Chapter 7.

44.2 Birth defects

Table 44.1 gives a short list of common defects.

Definitions

A birth defect is an abnormality of structure or function in a newborn that is present at birth. The abnormality may be diagnosed at birth, or later in life. Birth defects can occur as an abnormal appearance or as failure to grow and develop normally.

An anomaly may or may not be perceived as a problem condition. Many, if not most, people have one or more minor physical anomalies if examined carefully. Examples of minor anomalies can include curvature of the fifth finger (clinodactyly), a third nipple, tiny indentations of the skin near the ears (preauricular pits), shortness of the fourth metacarpal or metatarsal bones, or dimples over the lower spine (sacral dimples). Some minor anomalies may be clues to more significant internal abnormalities.

Congenital abnormalities are abormalities that are present at birth.

Inborn errors are genetic defects that may be inherited, chromosomal or multifactorial.

Incidence

Every time a couple becomes pregnant, there is a chance that their baby will have a birth defect. One in every 20 newborns

Table 44.1

Common birth defects in newborns

Mouth	cleft lip and palate, ankyloglossia, Pierre Robin syndrome
Eyes	anophthalmia, microphthalmia, cataracts, glaucoma, ptosis, strabismus
Ears	microtia, auricular tags
Face	microguatia
CNS	anencephaly (3x > girls than boys), spina bifida (occult or aperta) hydrochephaly, microcephaly, cranial meningocele, encephalocele
Respiratory	diaphragmatic hernia, choanal atresia
Gastrointestinal	gastrointestinal: cystic fibrosis, oesophageal atresia, deodenal atresia, pyloric stenosis, Hirschsprung's disease, meconium ileus, exomphalos, gastrochisis, umbilical hernia, imperforated anus, prune belly syndrome, malrotation of the gut, volvulus
Genitor-renal system	extrophy of the bladder, ectopic kidney, hydronephrosis, hypospadia, hypoplasis (double), horseshoe kidney, hermaphrodite, polycystic kidneys, cryptorchidism (undecended testes), renal agenesis, hydrocele, torsion of testes, fused labia, hymenal tag
Cardiovascular	dextrocardia, univentricular heart Acyanotic conditions: coarctation of the aorta, atrial/ventricular septal defects, patent ductus arteriosis Cyanotic conditions: total anomalous pulmonal veins, transposition of the great vessels, under-perfussed lungs, tricuspid atresia, tetralogy of Fallot, pulmonary atresia
Skin	aplasia cutis, cutis lax, Ehlers-Danlos, incontinentia pigmenti, bullous impetigo Lesions: vascular naevi, haemangiomata, simple naevi, portwine stains, spider naevi, strawberry spots, pigmented naevi, Mongolian spots, hairy mole, non-vascular naevi
Musculoskeletal	Osteogenis imperfecta, dislocation of the hip (dysplasia), acondroplasia, limb reduction anomalies, amniotic bands, talipes equinovarus (club foot), syndactyly, webbing; polidactyly, microdactyly, arachnodactyly, macrodactyly, gragnodactyly, amelia; hammer toe, hemimelia, phocomelia, mecromelia, craniotabes, cleidocranial dystosis, mermaid infant, Vater syndrome, craniostenosis

has some type of defect. There is a 3–4:100, or 3–4% chance that a baby will inherit a defect from an affected parent. This means that there is a 96–97% chance in each pregnancy that a baby will be normal and healthy. Three to four percent is sometimes called the *background rate* of congenital abnormalities or the *population risk* for congenital abnormality.

There are 3 000 abnormal conditions described. The biochemistry of 200 metabolic conditions is known, with treatment available for only a few conditions. About 3% of newborns have a major physical anomaly, meaning a physical anomaly that has cosmetic or functional significance.

Congenital anomalies with brain abnormalities are the largest group at 10:1 000 live births, followed by heart problems at 8:1 000, renal at 4:1 000, and limbs at 1:1 000. All other physical anomalies have a combined incidence of 6:1 000 live births.

Congenital anomalies of the heart have the highest risk of death in infancy, accounting for 28% of newborn deaths due to congenital anomaly, while chromosomal anomalies and respiratory anomalies each account for 15%, and brain anomalies about 12%.

In South Africa 150 000 babies are born with defects annually. The cost of treatment and care amounts to billions of rands. The mortality is 25% in the first five years of life. It is estimated that at least 7.3 million (93%) of the 7.8 million children born each year with a serious birth defect are born in developing countries.

Classification

Malformations develop during the first trimester and are caused by failure of the embryo to develop normally, and are the commonest form of birth defect. An individual with an abnormal appearance is referred to as 'dysmorphic'. It is important to differentiate dysmorphic features from the normal range of features found in a family or community. Infections can play a role in malformations.

Birth defects can cause physical disability, intellectual disability, blindness, deafness and epilepsy depending on the seriousness of the defect. A mild defect may cause no disability, but a person with a serious birth defect may die soon after birth, or survive with a disability due to the direct effect of the birth defect (e.g. neural tube defect) or due to a secondary effect (e.g. joint damage resulting from bleeding in haemophilia). Some serious birth defects can be treated and this may be life-saving or prevent serious disability.

When medical services are inadequate newborns and children with serious birth defects may die when they are young. Many birth defects are not recognised and diagnosed in time because it is often not realised that those conditions which are seen in clinics and hospitals have a congenital origin, e.g. many forms of intellectual disability, cerebral palsy, deafness and blindness.

Causes of birth defects

The cause of 40–60% of congenital anomalies is unknown. These are referred to as sporadic, a term that implies an unknown cause, random occurrence regardless of maternal living conditions, and a low recurrence risk for future children. Congenital abnormality may be the result of a physical, metabolic or anatomic deviation from the normal development of the fetus, which in the most cases appears at birth or in the first year of life. For 20–25% of anomalies there seems to be a 'multifactorial' cause, meaning a complex interaction of multiple minor genetic anomalies with environmental risk factors. Another 10–13% of anomalies have a purely environmental cause (e.g. infections, illness, or drug abuse in the mother). Only 12–25% of anomalies have a purely genetic cause. Of these, the majority are chromosomal anomalies.

The causes may be the result of genetic abnormalities, intrauterine environment, or a chromosomal abnormality. Drugs, infections, radiation and heat are contributing factors in congenital conditions and genetic mutations. It is important to determine the predisposing condition that was the cause of the abnormality. Knowledge of this can help in the care and management of the newborn, as well as in prevention of future cases.

It is now known that many metabolic conditions may have subtle structural expression, and structural conditions often have genetic links. Still, congenital conditions are often classified in a structural basis, by the primary organ system affected. Disorders can be genetic or congenital.

Table 44.2 gives a summary of common genetic and chromosomal disorders.

Congenital defects may be due to environmental factors, drugs (teratogenic), infections, radiation and exposure to heat. In about 50% of birth defects the cause is not known.

Genetic and chromosomal defects

Many chromosomal disorders are caused when the structure is altered, resulting in trisomy or monosomy of different chromosomes. Most fetuses with trisomy and monosomy are not capable of living and result in early spontaneous abortion.

Chromosomal defects include trisomy 13, 18, 21, X and Y.

Turner's syndrome (i.e. 45 XO) is a monosomy. For every extra X present the individual will be more retarded, for example XXY. For every extra Y the individual will be more aggressive, for example YYX. A mutation of YO is not viable. Many defects are not detectable.

Down's syndrome, with trisomy of chromosome 21, is the commonest form of chromosomal birth defect.

Table 44.2

Common genetic and chromosomal disorders

Autosomal	Trisomy 21 (Down's syndrome) Trisomy 8 (Warkany syndrome) Trisomy 18 (Edwards syndrome) Trisomy 13 (Patau syndrome) Potter Syndrome Cri-du-chat (short arm of chromosome 5)
Sex chromosomes	Klinefelter's syndrome Turner's syndrome
Endocrine	Congenital hypo/hyperthyroidism Congenital adrenal hyperplasia Hypoglycaemia Hypocalcaemia Hypomagnesaemia
Single gene (autosomal dominant)	Arachnodactyly (Marfan's syndrome)
Autosomal resessive	Albinism Ichthyosis (scaling) Osteogenesis imperfecta
Metabolic	Phenylketonuria Galactosaemia Glucose-6-phosphatase deficiency (G6PD) Cystic fibrosis

The most common autosomal recessive conditions are found, or come from, tropical countries. Some single gene disorders are often more common in particular populations or regions, They include:

- sickle cell disease in West Africa
- thalassaemia in Mediterranean countries
- oculocutaneous albinism
- polydactyly in black South Africans
- cystic fibrosis (the one autosomal recessive disorder that is common in people of European descent).

The most common X-linked recessive conditions are:

- red-green colour blindness
- haemophilia
- glucose-6-phosphate dehydrogenase deficiency (G6PD).

Some conditions, such as polycystic kidneys, osteogenesis imperfecta, retinitis pigmentosa and mental retardation, may be inherited by more than one mode of inheritance, e.g. in some families as a dominant trait while in other families as a recessive trait.

Drugs that cause fetal abnormalities

Some antibiotics (e.g. tetracycline, streptomycin); anticancer drugs (e.g. methotrexate); warfarin (an anticoagulant); some anticonvulsants (e.g. phenytoin, valproic acid); lithium (an antidepressant) and environmental pollutants such as methyl mercury may cause fetal abnormalities. There are probably many more which have not yet been identified.

Multifactorial birth defects

These are birth defects that have a combined genetic and environmental cause. The environmental factor is often not known. The person affected with a multifactorial birth defect inherits a combination of genes from their parents that places them at an increased risk for a birth defect. If that individual then experiences certain environmental factors, the result will be a multifactorial birth defect. Multifactorial birth defects, therefore, require both genetic and environmental factors before they present. Neither the genetic factor nor the environmental factor alone will cause the birth defect. This is different from teratogens, which cause birth defects without an obvious genetic factor. The risk that another child of the same parents will be affected by a multifactorial birth defect is small (about 5%).

Multifactorial birth defects are the commonest form of birth defect and usually affect a single structure, organ or system. They often present in infancy or childhood as malformations such as:

- neural tube defects and isolated hydrocephalus
- clubfoot
- cleft lip and/or palate
- congenital heart defects
- the risk of recurrence increases if more than one family member is affected.

44.3 Priority genetic conditions in South Africa

These are the conditions that are prioritised in South Africa for screening, prevention and treatment.

Down's syndrome (Trisomy 21)

This abnormality occurs in 1:600 births. It is associated with increased maternal age, but can occur at any age (1:60 mothers over 35 years). A pair of the 21 chromosome fails to separate during meiosis. Diagnosis is possible through blood tests at 16–20 weeks or through amniocentesis.

Clinical features

The clinical picture can be detected after birth.

- Hypotonia is the most common feature (a floppy baby). Smooth skin and hair are present.
- The head may be small and under the third percentile.
- Epicantic folds are prominent and the eyes slant upwards. The iris can be speckled (Brushfields spots).
- Face: The tongue looks big and protrudes and the nose may be flat. The ears may be malformed and placed low.
- The neck is short with a thick ridge posteriorly.
- The hands and feet are broad with short digits. A wide gap may be present between the first and second digit and one palmer crease is present stretching over the hand.
- In the male the testes are not descended.
- Associated abnormalities: cardiac defects are common, as well as gastrointestinal defects such as duodenal atresia.

Diagnosis, treatment and care

The diagnosis is made on the clinical picture and confirmed by chromosomal tests.

If associated defects are present the child mortality is higher. Most of the children survive and are happy children. The prognosis depends on the level of retardation and care they receive. Their milestones are delayed. They will only walk at 25 months. Normal schooling is unlikely and repetitive work is more suitable. Some well-trained children are able to function in the open market. Males cannot reproduce and females have lower rates of conception than normal. Common problems are respiratory infections and an increased risk of leukaemia.

Neural tube defects

These abnormalities occur during the second and fourth weeks of gestation. Vitamin deficiency and nutritional factors play a role in the aetiology, particularly folic acid insufficiency. The family tendency is 3%. Alpha feto protein accumulates in the amniotic fluid and is diagnostic for a variety of defects. A blood test at 14 weeks or an amniocentesis is offered for women with diabetes mellitus or when a previous abnormal baby was born and for woman on medications that are folic acid antagonists.

Types of defects are: encephalocele, hydrocephaly and anencephaly, spina bifida, meningomyocele.

Encephalocele

Anterior neural tube closure defects are seen in 1:1 000 newborns. Encephaloceles, in which part of the brain is outside the skull in a skin-covered sac, are less common than anencephaly. Occipital encephaloceles are much more common than parietal or frontal ones. The disorganised brain in the sac is usually attached to the remainder of the brain and may contain cerebral spinal fluid.

Clinical features. If the encephalocele is large and there is a large volume of abnormal brain in the sac, then the baby may be profoundly mentally retarded. If it is very small, then the child may be normal mentally. In either case the sac must be excised so that the skin does not erode and cause meningitis.

Hydrocephalus

This is the excessive accumulation of fluid in the ventricles due to an obstruction in or outside the ventricular draining system.

The enlarged lateral ventricles are noted, along with thinning of the white matter. This is characteristic of hydrocephalus due to obstruction of cerebrospinal fluid (CSF) pathways. The increase in cerebral spinal fluid pressure in the ventricles causes distension of the ventricles and pressure atrophy of the brain.

There are two types of hydrocephalus – communicating and non-communicating. In communicating hydrocephalus, CSF can expand into the subarachnoid space but fibrosis of the meninges or arachnoid granulations prevents it from draining into the superior sagittal sinus. In non-communicating hydrocephalus, CSF cannot get to the subarachnoid space because its flow is blocked by gliosis of the aqueduct, fibrosis of the foramina of Luschka and Megendie or a colloid cyst of the third ventricle.

In spite of the fact that CSF pathways are blocked, CSF is formed at a normal rate so the ventricles have to dilate, particularly at the expense of the white matter.

Hydrocephalus is often an accompaniment of a meningomyelocele or Arnold-Chiari malformation. It can also be caused by isolated stenosis of the Aqueduct of Sylvius due to *in utero* viral infection. Meningitis can cause communicating hydrocephalus.

Clinical picture.

- In hydrocephalus, there is blockage of flow of the cerebrospinal fluid (CSF) with enlargement of ventricles at the expense of the white matter and grey matter.
- The head is enlarged above the 97th percentile.
- The sutures are wide open.
- The newborn may present with poor sucking, vomiting, irritability, eyes that appear to gaze downwards and failure to thrive.

Diagnosis, treatment and care. The condition is detected in pregnancy and ultrasound is useful. After birth an ultrasound confirms the enlargement of the ventricles.

If diagnosed in pregnancy, intrauterine surgery may be possible in specialised units. The alleviation of the pressure on the brain is essential to prevent mental retardation. A shunt is placed in position to drain fluid.

Spina bifida

This is a defect of the vertebral column with or without protrusion of spinal cord content.

Spina bifida occulta refers to a condition where a birth mark in the lower back may be the only sign of the malformation and an X-ray is needed to make a diagnosis. Treatment may not be needed.

Spina bifidia cystic is the protrusion of meninges or spinal content through the laminar arches of the spinal column that did not close. A *meningocele* is a protrusion of meninges and cerebrospinal fluid, often covered with skin. It occurs in the lower back and motor function may be normal, Surgical correction is done soon after birth with a good prognosis. The *meningomyocele* is a serious malformation that occurs ten times more commonly and includes a spinal cord that may or may not be in a sac. Motor and sensory loss of the lower limbs and bladder is present in varying degrees depending on the level of the lesion. Mental retardation, hydrocephalus and fecal and urinary incontinence are common problems associated with the condition.

A full neurological examination is needed for every neural tube defect that presents at birth. Care of these children is long term, and although they may be of normal intelligence, they are often paralysed in the lower body and need a wheelchair and long-term care.

Anencephaly

This is characterised by the absence of the vault of the cranium with a partial or total absence of the cerebrum and cerebellum. Most infants are stillborn or die within hours. It is three times more common in girls than boys.

Fetal alcohol syndrome

(See Chapter 10.)

Albinism

Albinism is a hypopigmentation of the skin, hair and eyes. This occurs in a partial or complete form. The features are photophobia, nystagmus and impaired vision. There is no prenatal test available.

The children experience a great deal of social discomfort. Mothers need to be supported and educated about the risk of sunburn and the need to protect the eyes from radiation and the sun. The children need to wear sunscreen and block due to the risk of skin cancer later in life.

Cleft lip and palate

The face, lip, tongue, jaws and palate develop during the fourth and sixth weeks *in utero* and end at the twelth week.

Genetic factors can play a role in the development of cleft lip and palate. It may be hereditary, but may also be a spontaneous defect. There is a 17% chance of a sibling having cleft lip if one parent is affected, versus 4% in an unaffected parent. In a cleft palate there is a 15% chance with an affected parent versus 2% in an unaffected parent.

Cleft lip

The incidence of cleft lip is 1:1 000. A cleft lip is more left sided and more common in boys than girls. The severity can vary from a small notch in the upper lip to a complete split. Although the cleft lip is disfiguring it can be corrected by plastic surgery with minimal effects. The parent needs reassurance and referral to a specialist. A cleft lip is corrected at three months of age.

Cleft palate

Cleft palate is more common in girls than boys with an incidence of 1:2 500. This condition is more serious and has implications for eating and speech development. The child will need orthodontic consultation and intervention. The baby will be able to breastfeed. Pictures of before and after the procedures can help to educate parents about care. An orthodontic device soon after birth can assist the mother with feeding difficulties. The device remains in the mouth and is only removed to be cleaned after feeds. Corrective surgery is done before 12 months, but more operations may follow depending on the extent of the condition. Speech therapy is required and teeth may need to be aligned.

Both defects can be diagnosed on ultrasound.

Club feet (talipes equinovaris)

This condition occurs in 1:1 000 births and is twice as common in boys than girls. It can be isolated or associated with other congenital abnormalities such as spina bifida, hydrocephaly and other conditions. It can affect only one foot or both feet. The foot is plantar flexed (equines) (sole of the foot turned in and upwards) and medially deviated (varus) (turned inwards at ankle). Wasting of the calf muscle may be present, with a small heel.

Immediate orthopaedic intervention is required. Mild cases can be treated with extension strapping that need to stay on day and night. In severe cases surgery is needed. In most cases the condition can be corrected.

44.4 Cardiac disorders of the newborn

The heart is the first organ that is formed and functions in the fetus as soon as the third week *in utero*.

Three in every 1 000 babies will have some form of cardiac defect.

Cardiac abnormalities are associated with Down's and Turner's syndromes, arachnodactyly and rubella syndrome.

Congenital cardiac defects are divided in to cyanotic and acyanotic conditions.

Cyanotic cardiac conditions

Transposition of the vessels

This occurs twice as commonly in boys than girls and should be suspected in babies that are cyanotic. The great vessels open incorrectly into the wrong atrium and normal circulation cannot be maintained (see Figure 44.1). Oxygen rich blood will go to the lungs and oxygen poor blood to the body. Heart murmurs may not be audible. If the ductus arteriosis and foramen ovale close severe cyanosis occurs. A shunt is created between the atria and the condition is corrected later in infancy.

Tetralogy of Fallot

This is a fairly common abnormality with pulmonary stenosis, overriding aorta and right ventricular hypertrophy (see Figure 44.2).

Cyanosis develops over months. It is more difficult to diagnose. A murmur may be present. The condition can be corrected with surgery by four years of age.

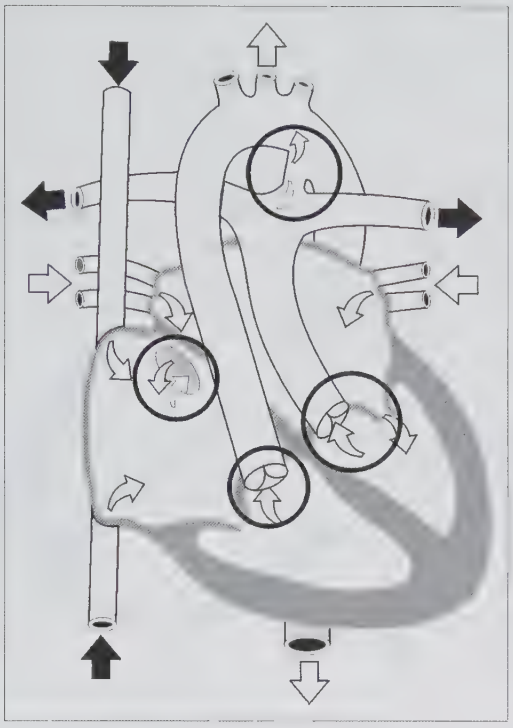


Figure 44.1 Transposition of the vessels

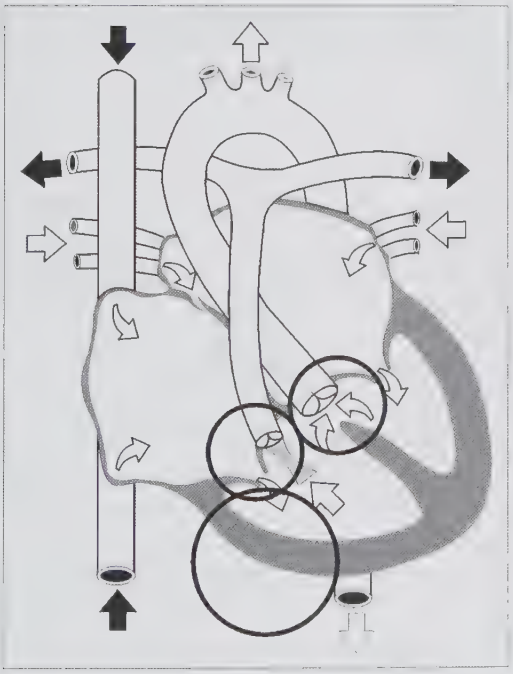


Figure 44.2 Tetralogy of Fallot

Pulmonary atresla

This is a rare abnormality. If the pulmonary valve cannot function blood can only reach the lungs through the ductus arteriosis. If the ductus arteriosis closes, severe cyanosis occurs. This presents soon after birth with signs of cardiac failure and death will occur if the obstruction is not reversed.

Acyanotic cardiac conditions

Hypoplastic left heart is a common disorder causing cardiac failure due to an underdeveloped left ventricle. The blood pressure is low and the blood is shunted to the right atrium and ventricle through the atrial defect. If the ductus arteriosis closes prematurely shock and death may occur.

Ventricular septal defects (VSD)

These are the most common cardiac defects, varying in size and position. There is left to right shunting of blood. A harsh murmur is present down the left sternal border. Larger defects may cause cardiac failure within weeks. Small defects may close spontaneously in 75% of cases by the age of 10 years. Surgery is needed for larger defects (see Figure 44.3).

Coarctation of the aorta

The narrowing of the aorta at any point will impair the flow of oxygenated blood to the body. Blood will bypass the obstruction through other vessels. A patent ductus arteriosis is maintained. Cardiac failure may present within days or weeks after birth. Murmurs are present. Weak femoral pulses are diagnostic with the blood pressure in the upper body higher than the lower extremities. Surgery is recommended later in life (see Figure 44.4).

Patent ductus arteriosis (PDA)

The ductus arteriosis is between the aortic arch and the left pulmonary artery, and is vital *in utero* to direct blood away from the lungs before birth. The mechanism that causes the ductus to close is unsure but seems to be related to oxygen.

The ductus fails to close in premature babies and in some children born at term. It should be suspected when the oxygen requirements in the baby increase or respiratory support is needed for more than 24 hours.

The ductus can be closed with the administration of indomethacin (an inhibitor of prostaglandins) in 66% of cases or it can be corrected surgically.

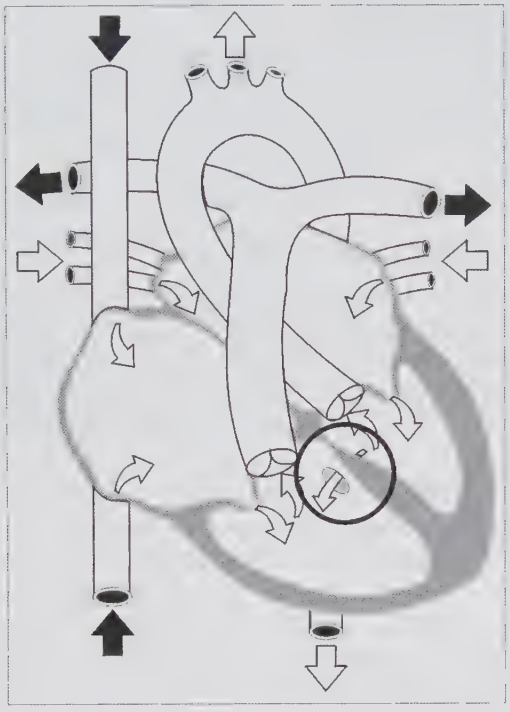


Figure 44.3 Ventricular septal defects

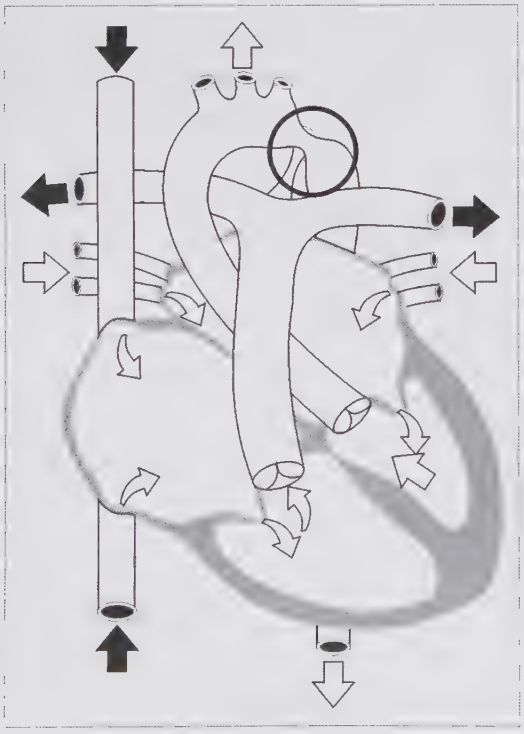


Figure 44.4 Coarctation of the aorta

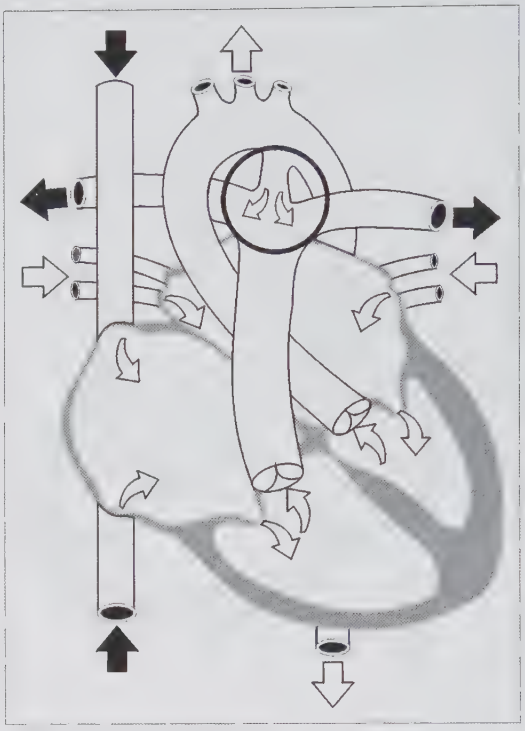


Figure 44.5 Patent ductus arteriosis (PDA)

A newborn with two of the following signs should be referred for immediate care:

- cyanosis
- cardiac failure
- hypotension.

A midwife may be the first to notice an episode of cyanosis and hypotonia. These newborns may appear normal but are often poor feeders, may vomit and have episodes of cyanosis (see Figure 44.5).

Gastrointestinal abnormalities

Tongue

A tongue tie is a common disorder where the cells are grown into the underlying mesenchyme of the mouth. Treatment is seldom required as the tongue will grow forward in infancy.

If it effects breastfeeding (latching) then surgical intervention may be needed.

Teeth

Natal teeth may be present at birth. These may be covered by gums. If loose they may be removed to prevent inhalation.

Epigathus

Various tumours may be present on the jaw and are usually benign. They may be removed if they interfere with respiration.

Oesophageal atresia

(See Figure 44.6.) The changes of the oesophagus occur from three to six week *in utero*. Five varieties of defects occur in 1:3 000 births. Polyhydramnios is usually present in the pregnancy because the baby cannot swallow the fluid. At birth the baby has excessive fluid draining from the mouth and chokes when fed. The diagnosis can be made by passing a nasogastric tube. The tube will not advance or come out through the mouth. The litmus test remains alkaline. Aspiration of milk may cause pneumonia. This is a surgical emergency. The baby is kept nil per mouth. An intravenous infusion of 10% dextrose is given and the baby is suctioned to remove the fluid. The overall survival rate is 60%.

Pyloric stenosis

This occurs in 1:1 500 babies and is more common in boys than girls. First born babies are more likely to be affected. Babies present with vomiting, visible peristalsis, constipation and weight loss. Vomiting may be projectile. The baby is referred to a surgeon.

Hirschsprung's disease

This is a condition where the rectum and lower bowel are affected by the absence of ganglion cells. There are no nerve cells in the affected areas and obstruction results. The passing of meconium may be delayed. A colostomy is required.

Meconium ileus

This is the first sign of cystic fibrosis. Sticky meconium blocks the bowel and abdominal distension occurs. An enema may unblock the meconium, but enterostomy may be needed.

Imperforated anus

Malformation of the anus can be divided in low and high defects. Rectal agenesis is the absence of the rectum. Imperforated anus is when the anal opening is obstructed by skin in 3% of cases. The defects can be corrected surgically.

Exomphalos

This defect occurs in 1:5 000 babies. In 30% of cases there are associated abnormalities. The abdominal contents protrude through herniation in the abdominal wall, surrounded by a sac. Small hernias can be repaired surgically. Conservative treatment of larger defects is given because the bowel cannot be accommodated in the cavity. The sac is treated to prevent it from becoming fibrotic. The contents should be retracted into the abdomen by five to eight weeks. There is a 40% mortality due to associated abnormalities.

Gastroschisis

In gastroschisis the intestines are not covered in a sac. Immediately after birth the intestines are covered with a warm sterile saline dressing. A silastic bag is placed over the intestines and stitched to the abdomen. It is gradually reduced until the intestines are in the abdomen.

Renal abnormalities

Renal agenesis occurs in 1:4 000 babies and is mainly present in males. Many are stillborn but 60% die after birth because of associated pulmonary hypoplasia. In these cases there is a history of oligohydramnios in pregnancy. The newborn has wide-set eyes, epicanthic folds, low-set ears or other abnormalities of the ears.

Other abnormalities of the renal system include hypoplastic or underdeveloped kidneys, and polycystic kidneys. (The kidney is filled with cysts). Many are stillborn, and survivors have continuous health problems in life.

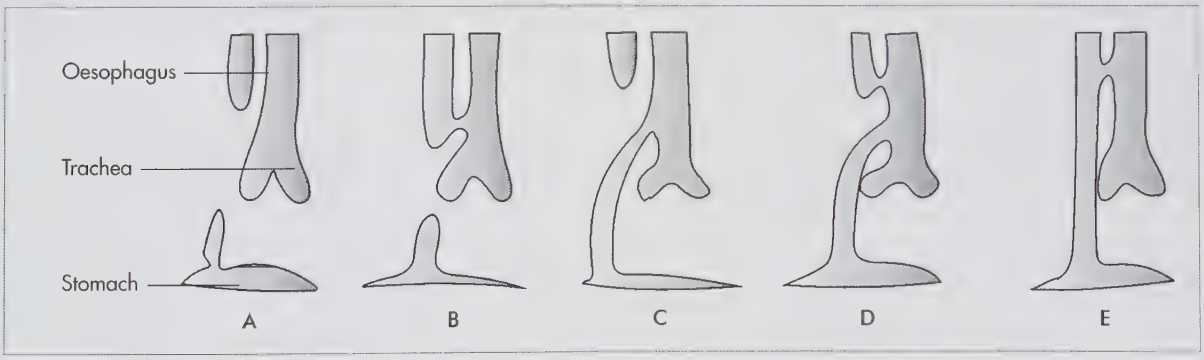


Figure 44.6 Different types of tracheo-oesophageal fistula and tracheo-oesophageal atresia.
A: Oesophageal atresia, B: Oesophageal atresia and upper tracheo-oesophageal fistula,
C: Proximal oesophageal atresia and tracheo-oesophageal fistula to the distal pouch,
D and E: Examples of tracheo-oesophageal fistula without atresia

Genitalia

Undescended testes

The testes are present in the inguinal channel by 28 weeks and descend into the scrotum by 36 weeks. The scrotal temperature is 4 °C lower than the body temperature. The testes may descend spontaneously after birth. If this has not occurred by six weeks the undescended testes may atrophy or become malignant. In uncomplicated cases the testes may be relocated at two years of age.

Hydrocele

The scrotum contains a soft cystic swelling. In most cases it will disappear spontaneously.

Hermaphrodite

A true hermaphrodite has testes and ovarian tissue in the gonads. The external organs show a phallus and fused labia. Diagnosis requires a laparotomy and biopsy. Virilised females are reared as girls and need lifelong therapy.

Musculoskeletal

Various limb malformations may occur in newborns.

Syndactyly

This is the fusion of two digits, which is the most common form of this congenital anomaly.

Polydactyly

Extra digits are present. The extra digit may be tied off in infancy.

Osteogenesis imperfecta

Brittle bone disease is a mutation of the genes for collagen. Four varieties I, II, III and IV are found. Type II is incompatible with life, fractures occur *in utero* and the baby is stillborn. Babies with other forms will develop bone deformities. There is no treatment for this condition.

Hip dysplasia

The condition is not known in the black populations. In other populations the incidence is 1–5:1 000 babies. It is more common in girls. One or both hips may be affected. The diagnosis may be made using Ortolani's test where a hip click is present after birth. Asymmetric creases and limited abduction can be diagnostic. A truly dislocated hip needs immediate orthopaedic intervention. A splint maintains adduction and is applied for several months until the acetabellum has developed normally.

44.5 Conclusion

There are hundreds of abnormalities that can present at birth or early in childhood. The first examination by the midwife should identify the most obvious abnormalities visible. Midwives need to continue to make observations to identify abnormalities that are not as obvious.

CHAPTER

45 Respiratory disorders

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- demonstrate the ability to maintain a newborn's temperature
- compare methods of maintaining an adequate oxygen supply
- outline in detail the emergency procedure for cardiopulmonary resuscitation and relieving airway obstruction
- review anticipatory guidance for parents.

KNOWLEDGE ASSUMED TO BE IN PLACE

Anatomy and physiological changes after birth of the neonate

KEYWORDS

Respiratory distress • Respiratory distress syndrome • Meconium aspiration syndrome • Resuscitation of the neonate

45.1 Introduction

Respiratory distress remains one of the major causes of neonatal morbidity and mortality. Successful management of the newborn who has respiratory distress is based on obtaining a complete maternal and neonatal history, performing a thorough physical examination, recognising the common respiratory disorders, differentiating among various diagnostic entities, identifying those that are life-threatening and implementing the appropriate treatment.

45.2 Definition and classification of respiratory distress

Respiratory distress is an emergency condition when a newborn has difficulty in breathing. It develops due to:

- Immature lung development (hyaline membrane disease in premature babies)
- Risk factors *in utero* (intrauterine growth restriction (IUGR), antepartum haemorrhage (APH), multiple pregnancy, maternal disease) (see Chapter 20)
- Risk factors in labour (fetal distress, meconium, cord prolapse and obstetric emergencies such as assisted deliveries)

Midwives should be competent in the management of respiratory conditions and resuscitation of the newborn.

45.3 Neonatal respiratory distress syndrome (hyaline membrane disease)

Neonatal respiratory distress syndrome (RDS) or hyaline membrane disease is one of the most common complications seen only in premature newborns of less than 38 weeks gestation. The respiratory distress is due to insufficient surfactant in the immature lungs at birth. The surfactant is necessary in order to lower the surface tension of the alveoli and when surfactant is deficient, the alveoli collapse during expiration.

The condition is characterised by nasal flaring, chest retractions, tachypnoea and grunting. As a result of the immature lungs of those newborns, they cannot maintain air, the lung's air spaces empty completely and collapse after exhalation.

The Silverman-Anderson score is used to classify the level of respiratory distress (see Chapter 40).

Predisposing conditions

Preterm (immature) babies are mostly affected and the condition is aggravated by asphyxia of the newborn.

The greater the asphyxiation and shock are, the more severe the respiratory distress.

The synthesis of surfactant is inhibited by hypoxia, acidosis, hypothermia and hypoglycaemia.

Large-for-gestational age (LGA) but also preterm babies (as are often the babies born to mothers with diabetes mellitus) are also prone to RDS.

Causes

The cause of respiratory distress syndrome is pulmonary surfactant deficiency in the lungs of newborns, most commonly in those born before 37 weeks gestation. The risk of this condition increases with the degree of prematurity and is higher in babies born before 28 weeks, because the lungs are less developed. This condition is very uncommon in full-term newborns except for newborns of diabetic mothers.

The disease is mainly caused by a lack of a surfactant, which helps the lungs inflate with air and keeps the air sacs from collapsing. This substance normally appears in mature lungs. The cause can also be the result of genetic problems with lung development.

The risk of respiratory distress syndrome also increases in the following situations: where a brother or sister had respiratory distress syndrome, diabetes in the mother, with a caesarean delivery or delivery complications that lead to acidosis in the newborn at birth, multiple pregnancy (twins or more), and precipitate labour.

The risk decreases in fetal growth restriction, pre-eclampsia or eclampsia, maternal hypertension, prolonged rupture of membranes, and maternal corticosteroid use. The reason for this is that the stress of these situations causes the newborn's lungs to mature sooner.

Pathophysiology

Pulmonary surfactant diminishes the surface tension of the water film that lines the alveoli, thereby decreasing the tendency of alveoli to collapse and the work required to inflate them.

With surfactant deficiency, the lungs become diffusely atelectatic, triggering inflammation which results in pulmonary oedema. Because blood passing through the atelectatic portions of lung is not oxygenated, the infant becomes hypoxaemic. Lung compliance is decreased, and breathing effort is increasing. In severe cases, the diaphragm and intercostal muscles fatigue, and CO_2 retention and respiratory acidosis develop.

Symptoms and signs

Symptoms and signs include rapid, laboured, grunting respiration appearing immediately or within a few hours after delivery, with suprasternal and substernal retractions and flaring of the nasal alae, cyanosis of the skin and mucous membranes, decreased urine output, decreased peripheral pulses and there may be oedema of the peripheries. As atelectasis and respiratory failure progress, the symptoms worsen, with cyanosis, lethargy, irregular breathing and apnoea.

Newborns who weigh less than 1 000 g may have lungs so stiff that they are unable to initiate or sustain respirations after birth.

Many of these babies are asphyxiated at birth and require resuscitation. The lungs offer resistance to inflation due to the raised surface tension of the alveoli and the condition is progressive with the development of:

- tachypnoea
- sternal and rib recession
- expiratory grunting
- cyanosis
- the infant is lethargic and usually lies in the 'frog' position
- air entry is diminished and crepitations may be noted
- an under-expanded chest and a fine reticulo-granular (rice grain) appearance over both lung fields (on X-ray)
- very preterm babies have irregular slow breathing and apnoeic spells, bowel sounds may be absent and the passage of meconium delayed for a few days
- generalised oedema is usually present within 24 hours.

Diagnosis

Diagnosis is made by clinical presentation, including recognition of risk factors such as hypoxaemia and hypercapnia, and chest X-ray. Chest X-ray shows diffuse atelectasis classically described as having a ground-glass appearance, with visible air bronchograms. The appearance correlates loosely with clinical severity.

Differential diagnosis includes group B streptococcal pneumonia and sepsis, transient tachypnoea of the newborn, persistent pulmonary hypertension, aspiration, pulmonary oedema, and congenital cardiopulmonary anomalies. Clinical diagnosis of group B streptococcal pneumonia is extremely difficult; thus, antibiotics usually are started pending culture results.

Fetal lung maturity can be determined in the antenatal period through an amniocentesis. The L.S. ratio (lecithin sphingomyelin ratio) indicates the lung maturity (see Chapter 20). This can help determine the optimal timing of delivery

in elective cases where gestational age cannot be confirmed. Risk of respiratory distress syndrome is low when the lecithin/sphingomyelin ratio is 2:1, but this ratio is different in diabetic women.

Management and care

Best practice is prevention of hyaline membrane disease. With preterm labour between 24 and 34 weeks, a laboratory test to determine the lung maturity of the fetus is essential. When possible, corticosteroids to the mother 24 hours before delivery may be given to help speed up lung maturity in the fetus.

Lung maturity is greatly advanced after birth if the baby receives immediate endotrachael administration of surfacant (see Chapter 54 and Table 54.6).

Premature newborns require prompt attention by a neonatal resuscitation team. Newborns will be given warm, moist oxygen. Although this is very important, take care to reduce the side effects associated with too much oxygen.

Most of these newborns are nursed on a ventilator, which can be lifesaving, especially for babies with the following:

- high levels of carbon dioxide in the arteries
- low blood oxygen in the arteries
- low blood pH (acidity).

This treatment can also be lifesaving for newborns with apnea.

Continuous positive airway pressure (CPAP) that delivers slightly pressurised air through the nose can help keep the airways open and may prevent the need for a ventilator for many newborns. Even with CPAP, oxygen and pressure will be reduced as soon as possible to prevent side effects associated with excessive oxygen or pressure.

Newborns with respiratory distress syndrome should receive developmental-supportive care, which includes little disturbance, gentle handling, maintaining optimum body temperature, careful fluid management and close attention to other situations, such as infections, if they develop (see Chapter 41).

The medical practitioner must be informed immediately. Acidosis must be prevented or treated immediately. Hypoglycaemia is prevented or treated immediately. The infant is usually fed parenterally at first, because of the danger of vomiting and the inability to digest feeds and by umbilical catheter or via a peripheral vein. Later nasogastric tube feeds of expressed breast milk are given.

In very severe respiratory distress and cyanosis, artificial ventilation is necessary. The baby may need intubation and intensive care.

Preventing prematurity is the most important way to prevent neonatal respiratory distress syndrome. Good prenatal care results in larger, healthier babies and fewer preterm births.

Avoiding unnecessary or poorly timed caesarean sections can also reduce the risk of respiratory distress syndrome. If the test liquor does not contain sufficient surfactant, caesarean section or induction of labour can be delayed, or the newborn can be managed for respiratory distress syndrome immediately after birth.

Prognosis with treatment is excellent; mortality is < 10%. With adequate ventilator support alone, surfactant production eventually begins, and once production begins, respiratory distress syndrome can resolve within four or five days. In most cases the condition worsens for two to four days after birth and thereafter slow improvement occurs. Some newborns with severe respiratory distress syndrome will die, although this is rare on the first day of life. If it occurs, it usually happens between days two and seven. However, severe hypoxaemia can result in multiple organ failure and death.

Surfactant hastens recovery and decreases risk of pneumothorax, interstitial emphysema, intraventricular haemorrhage, bronchopulmonary dysplasia, and neonatal mortality in the hospital and at one year.

Complications

Complications of respiratory distress syndrome include intraventricular haemorrhage, tension pneumothorax, bronchopulmonary dysplasia, sepsis and neonatal death.

Intracranial complications have been linked to hypoxaemia, hypercarbia, hypotension, swings in arterial BP, and low cerebral perfusion, blood clots due to an umbilical arterial catheter, delayed mental development and mental retardation associated with brain damage or bleeding, retinopathy of prematurity and blindness.

Long-term complications may develop as a result of oxygen toxicity, high pressures delivered to the lungs, the severity of the condition itself, or periods when the brain or other organs did not receive enough oxygen.

45.4 Transient tachypnoea (wet lung syndrome)

Predisposing conditions

The clinical picture of this condition is very similar to respiratory distress syndrome in the early stage but affects full-term or near-term newborns who are born by caesarean section,

particularly those of mothers with diabetes mellitus. Newborns subjected to hypoxia immediately prior to, or at birth (for example: in placenta praevia, prolapse of the cord and intrauterine or intrapartum asphyxia or depression) can also be affected. The condition is also associated with heavy maternal sedation and/or general anaesthesia.

All newborns who are at risk of this condition, but who do not show immediate signs, should be observed in the high-care or intensive care nursery.

Causes

The condition is probably due to retention of lung fluid or delay of absorption of lung fluid causing a temporary decrease in lung compliance due to hyperinflation of the lungs.

Signs and symptoms

There may be respiratory distress at birth, or the newborn may appear normal at birth and the condition only develops a few hours after birth. However, the signs are usually present within the first two to four hours after birth:

- The signs of oversedation may appear: when the baby is left unstimulated, lethargy and hypoventilation, and depression of the cough, gag and swallowing reflexes, with the danger of aspiration.
- Tachypnoea is always one of the first signs.
- Abnormal respiratory patterns develop with grunting on expiration.
- Sternal recession occurs, depending upon the gestational age.
- Flaring of the nostrils occurs.
- Cyanosis develops in room air.
- The development of tachypnoea which may reach extreme rates of 100–140 breaths per minute.

Management and care

The care is aimed at supplying the newborn with sufficient oxygen, preventing hypothermia, acidosis and hypoglycaemia. The newborn rarely requires ventilation and when the lung fluid clears, the clinical signs disappear and the respiration becomes normal. This condition usually resolves within 24 hours and the prognosis is excellent if the condition is treated immediately.

The avoidance of excessive maternal sedation and anaesthesia, especially in high-risk conditions, is essential.

45.5 Meconium aspiration syndrome

This is the passage of meconium *in utero* into the amniotic fluid. This can vary in quantity, appearance and viscosity from small to copious amounts, from a thin green fluid to a pea-soup consistency and colour. The greater the amount of meconium passed, the greater the respiratory distress. This causes airway obstruction if large amounts of meconium are aspirated due to deep gasping movements, and this causes partial or total airway obstruction. The glottis and/or the trachea and the smaller airways can become physically obstructed in this way. A ball-valve effect occurs.

Air enters the lungs and is trapped in the lungs by the meconium. This then causes hyper-expansion of the lung, resulting in an increase in the anteroposterior diameter of the chest as the air is trapped, and overdistension of the alveoli occurs. The alveoli then rupture, and a pneumothorax and a pneumomediastinum develops as the air leak increases.

In addition, a chemical pneumonitis develops.

Intrapartum meconium aspiration can cause inflammatory pneumonitis and mechanical bronchial obstruction, causing a syndrome of respiratory distress.

Cause

Physiologic stress at the time of labour and delivery (e.g. due to hypoxia caused by umbilical cord compression or placental insufficiency or infection) may cause the fetus to pass meconium into the amniotic fluid before delivery; meconium passage is noted in about 10–15% of births. During delivery, perhaps 5% of newborns with meconium passage aspirate the meconium, triggering lung injury and respiratory distress, termed meconium aspiration syndrome. Post-term newborns delivered through reduced amniotic fluid volume are at risk of more severe disease because the less diluted meconium is more likely to cause airway obstruction.

Pathophysiology

The mechanisms by which aspiration induces the clinical syndrome probably include:

- nonspecific cytokine release
- airway obstruction
- surfactant inactivation
- chemical pneumonitis.

Underlying physiologic stressors also may contribute. If complete bronchial obstruction occurs, atelectasis results; partial blockage leads to air trapping on expiration, resulting in hyperexpansion of the lungs and possibly pulmonary air leak with pneumomediastinum or pneumothorax. Persistent pulmonary hypertension can be associated with meconium aspiration as a comorbid condition or because of continuing hypoxia.

Newborns also may aspirate vernix caseosa, amniotic fluid, or blood of maternal or fetal origin during delivery and

can develop respiratory distress and signs of aspiration pneumonia on chest X-ray. Treatment is supportive. If bacterial infection is suspected, cultures are taken and antibiotics are started.

Signs and symptoms

Some, most, or all of the following clinical features may be present at birth:

- *The skin.* The skin is covered in a yellow-green pigment, from the meconium. The fingernails and umbilical cord are stained with meconium. The skin is cracked and peeling.
- *General.* There is decreased muscle tone. Decreased respiration at birth, with poor respiratory effort and asphyxia are common. There is marked tachypnoea and cyanosis and grunting. Chest wall retraction: intercostal and/or sternal. Hypotonia. Squinting as a result of cerebral hypoxia and/or oedema. Nasal flaring. Hyper-inflation of the chest, with anterior bowing of the sternum. Extreme pallor. Irregular gasping attempts. Apnoea. Bradycardia. Low Apgar rating. In many instances, the child is small for the gestational age (growth retarded) due to fetal hypoxia.
- *The chest.* There are rales and wheezing. Possible rhonchi (a musical noise produced by air passing through narrowed bronchi during respiration). There may be no signs of respiratory distress for several hours, and then sudden, severe respiratory distress occurs, with tachypnoea, cyanosis, hyperexpanded chest, congestive cardiac failure, and an irregular gasping respiration. Findings include tachypnoea, rales and rhonchi, and cyanosis or desaturation. Meconium staining may be visible in the oropharynx and (on intubation) in the larynx and trachea. Newborns with air trapping may have a barrel-shaped chest and also symptoms and signs of pneumothorax, pulmonary interstitial emphysema, and pneumomediastinum.

Diagnosis

Diagnosis is suspected when a newborn shows respiratory distress in the setting of meconium-tinged amniotic fluid and is confirmed by chest X-ray showing hyperinflation with variable areas of atelectasis and flattening of the diaphragm. Initial X-ray findings can be confused with the findings of transient tachypnoea of the newborn. Fluid may be seen in the lung fissures or pleural spaces, and air may be seen in the soft tissues or mediastinum. Because meconium may enhance bacterial growth and meconium aspiration syndrome is difficult to distinguish from bacterial pneumonia, cultures of blood and tracheal aspirate should also be taken.

Management and care

Meconium aspiration is an extremely dangerous condition for the baby, and therefore everything possible must be done to avoid the passing of meconium by the fetus *in utero*. The following management in the antenatal period and during labour is recommended:

- Encourage all women to attend antenatal clinic early in pregnancy.
- All pregnant women at the antenatal clinic must be screened for risk factors.
- The referral of all high-risk women to a tertiary hospital, so that any problem can be dealt with when it arises.
- The transfer to hospital of any woman found to have meconium staining during labour, or any woman with pre-eclampsia, hypertension, prolonged pregnancy (post-maturity), diabetes mellitus, or when there are decreased fetal movements, or any fetus with intrauterine growth retardation.

During labour

Careful observations should be done throughout labour.

The first stage. Observations and preparations in this stage:

- The early recognition of fetal compromise.
- Any fetal compromise should be referred to a medical practitioner immediately.
- Appropriate intervention should be undertaken immediately.
- The nursery staff should be informed beforehand of the possible transfer of an infant suffering from meconium aspiration and asphyxia.
- A paediatrician should be notified of the impending delivery.
- Resuscitation equipment must be available and in perfect working order.
- A large suction catheter, the larger the better, should be available.

The second and third stage. Observations and preparations in this stage:

- The paediatrician is notified.
- After the delivery of the head, an assistant to the person delivering holds back the newborn's shoulders, to prevent immediate delivery.
- The newborn's mouth and then the nose are thoroughly aspirated, using a large suction catheter.
- The newborn is then delivered, and the cord clamped and cut as quickly as possible.

- The newborn is removed to the resuscitative area and dried quickly. It is essential that the newborn is kept warm.
- A laryngoscope is passed by a medical practitioner under direct vision, and the pharnyx, larynx and trachea are cleared of meconium. Once the vocal cords are visualised and meconium is seen beyond the cords, an endotracheal tube is passed. The tube is then cleared of meconium and left in situ for the time being. The midwife may intubate the baby if she is proficient and no medical practitioner is present.

After intubation. Observations and preparations in this stage:

- As much of the meconium as possible is cleaned off the skin of the newborn and the newborn is kept dry.
- The newborn is transported to the nursery as soon as possible (when in a stable condition) and ventilated if necessary. The newborn should be placed in a pre-warmed incubator if available.

Prognosis is generally good, although it varies with the underlying physiologic stressors.

Complications

Meconium is toxic in the lungs, and it sets up an intense inflammatory reaction, which causes severe respiratory distress, resulting in intestitial chemical pneumonitis. This leads to bronchiolar oedema and narrowing of the small airways.

There is uneven ventilation, due to areas of partial obstruction and superimposed pneumonitis, causing severe carbon dioxide retention and hypoxaemia.

There may be rupture of the alveoli, with air entry into the mediastinum and/or into the pleural cavity.

Pulmonary vascular resistance is increased as a result of hypoxia, acidosis and hyperinflation of the lungs. This leads to atrial or digital right to left shunting through the foramen ovale and the ductus arteriosus, due to persistently high pulmonary arterial hypertension.

The newborn, therefore, suffers from extreme metabolic acidosis as a result of cardiopulmonary shunting and hypo perfusion, and also from extreme respiratory acidosis due to shunting and alveolar hypoventilation.

Meconium-stained liquor in pregnancy and labour are graded in the following way:

- *Grade 1.* A good volume of liquor lightly stained with meconium.
- *Grade 2.* A reasonable volume of liquor with a heavy suspension of meconium.
- *Grade 3.* Thick meconium which is undiluted and resembles spinach. Overall mortality is slightly increased.

45.6 Asphyxia neonatorum

Asphyxia means ' pulseless'. It is diagnosed in a newborn who fails to breath within 60 seconds of birth.

Causes

- Prematurity.
- Birth trauma.
- Fetal distress.
- Meconium.
- APH/abruption.
- Congenital abnormalities
- Intrauterine growth restriction (IUGR).
- Postmaturity.
- Maternal disease such as pregnancy induced hypertension (PIH).
- Difficult deliveries, prolonged second stage, caesarean section, general anaesthesia.

Signs and symptoms

The risk of asphyxia is anticipated from the antenatal and birth history.

Rarely, an asphyxiated infant presents unexpectedly. The most common tool of evaluation is the Apgar score. The fetus may already have experienced primary apnoea *in utero* (see Figure 45.1).

Table 45.1 gives a comparison between moderate and severe asphyxia.

Table 45.1

A comparison between moderate and severe asphyxia

	Moderate asphyxia 4–6/10	**Severe asphyxia < 0–3/10**
Muscle Tone	poor	placid
Colour cyanotic / pale	central cyanosis	pale
Respiratory rate	poor efforts	no efforts
Heart rate	100 bpm	<100 bpm
Reflex irritability	grimace	no response

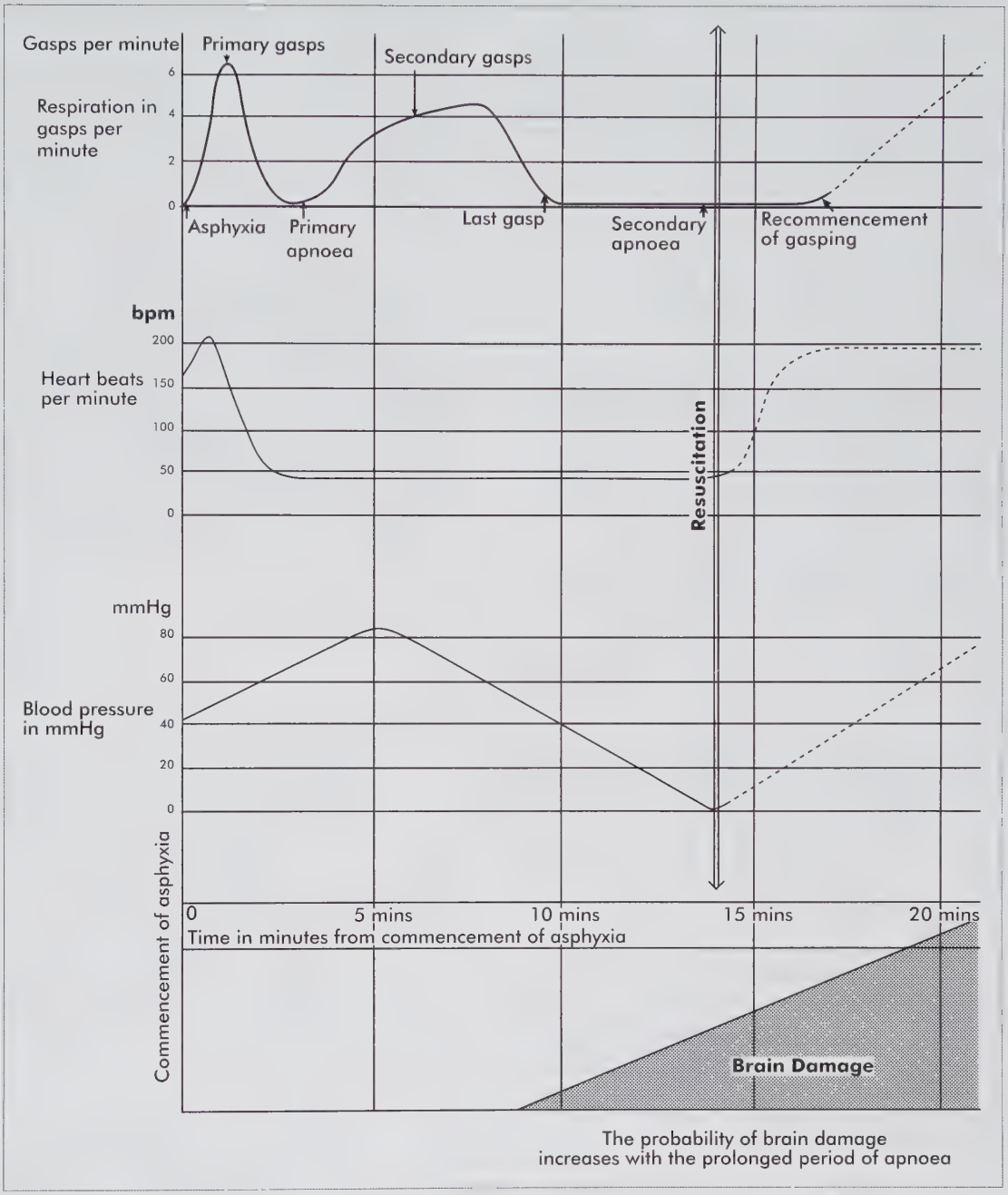


Figure 45.1 Primary and secondary apnoea. Changes which have been noted in the Rhesus monkey during asphyxia

Redrawn from: Harrison, Keet, Shore. 1978. *The Newborn Baby*. Cape Town: Juta & Co

When a baby is born with a low Apgar score it is not possible to know if the baby has primary or secondary apnoea. The following criteria are important. If a heartbeat is less than 100 bpm, there is no response on stimuli, the baby is pale (central cyanosis is better than pale of grey colour indicating the baby is in shock with a low blood pressure and vasoconstriction) with poor muscle tone, no response and not breathing, the baby needs to be intubated.

Consequences of asphyxia:

- Hypoxaemia damages the neurological system (brain). This can lead to brain damage, deafness and eye movement problems.
- Hypercapnoea can cause vasodilatation of the cerebral vessels leading to brain oedema and increased intracranial pressure and haemorrhage.
- Ischaemia due to poor blood supply when the blood pressure drops, is more devastating than hypoxia, because the baby becomes acidotic.
- Respiratory acidosis causes a rise in CO_2 and a fall in O_2 with an effect on the Ph balance of the CSF.
- Metabolic acidosis is the accumulation of lactic acid and pyruvic acid.

Blood pressure may fall, causing multiple organ damage. Deep vein thrombosis, renal shut down, congestive heart failure and lack of blood to the gut can cause necrosis of tissue. Clotting defects can occur.

Management and care

Neonatal resuscitation constitutes a series of actions that are taken in order to revive a newborn infant so that normal respiration may be initiated and maintained. The objective is to obtain a normal respiratory rate and pattern, a normal heart rate, blood pressure, colour and a normal general activity level, if these objectives can be achieved within seven minutes of birth, cerebral damage, leading to cerebral palsy, long-term handicap and even death can be avoided.

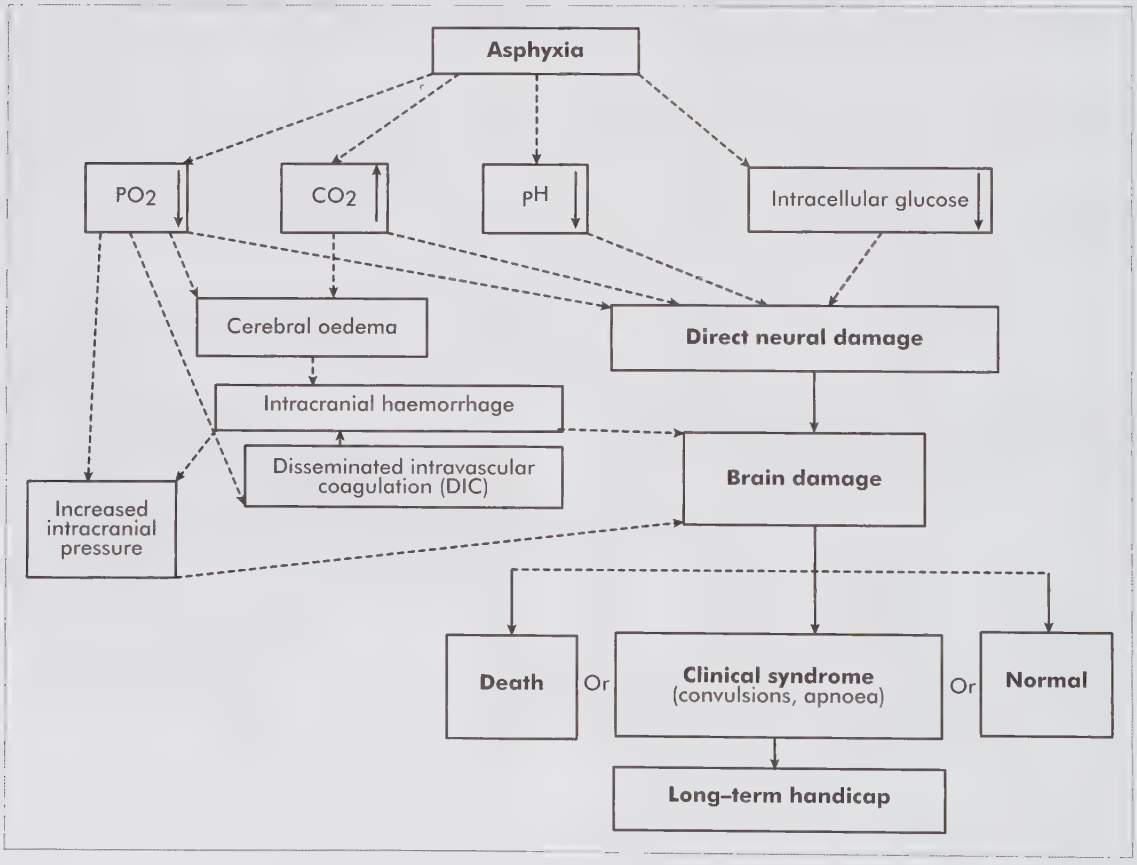


Figure 45.2 Sequela of asphyxia

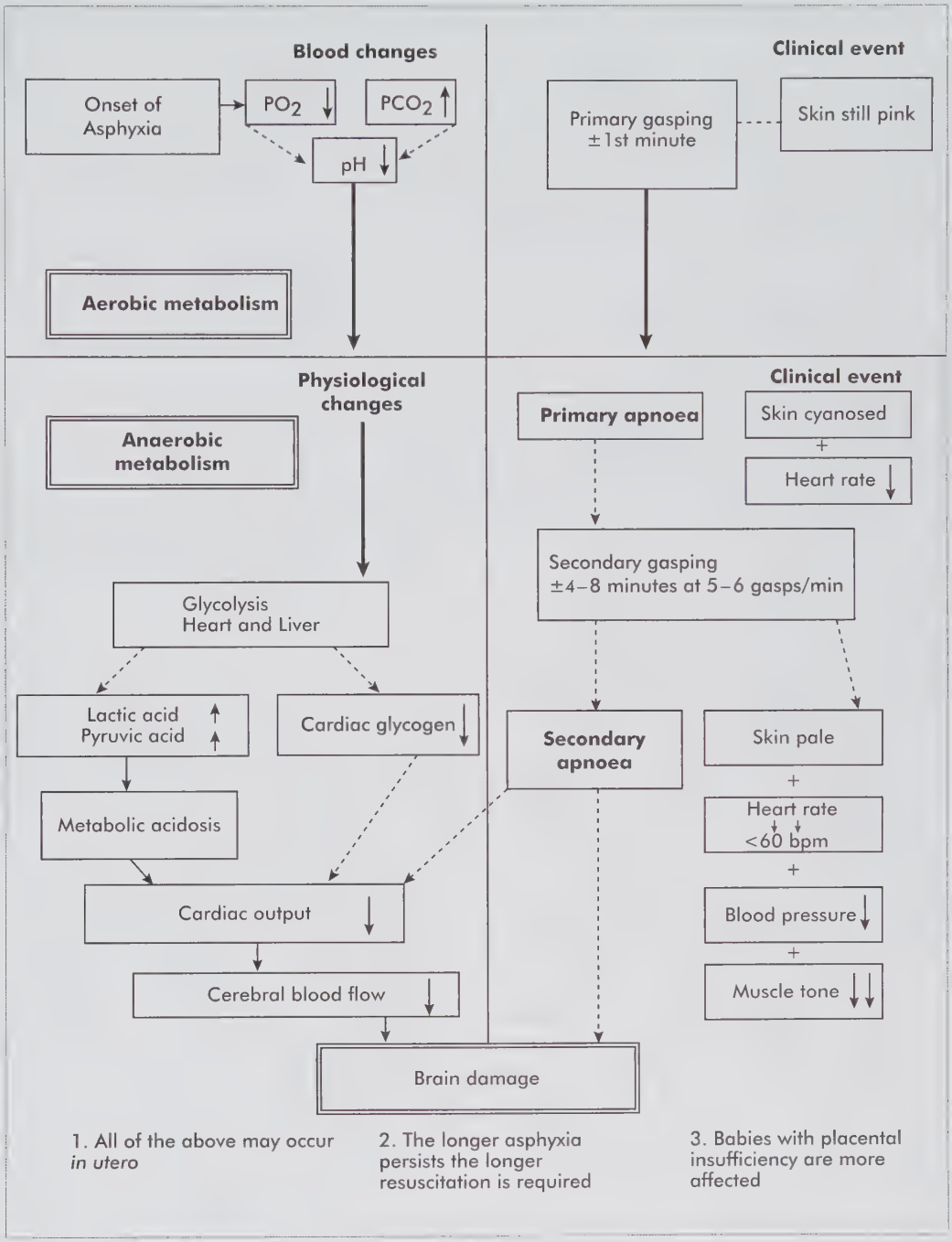


Figure 45.3 Important changes associated with asphyxia

The Apgar score is used to determine if the infant needs resuscitation.
The interpretation of the Apgar score, in asphyxia neonatorum:

- 8–10: no respiratory depression and the infant is in good condition
- 5–7: the infant has mild asphyxia (primary apnoea)
- 3–4: the infant has moderate asphyxia (secondary apnoea)
- 0–2: the infant has severe asphyxia (secondary apnoea)

The Apgar score at one minute after birth shows *the immediate* situation and is an index of asphyxia and the need for intervention and resuscitation.

The Apgar score obtained at five minutes after birth gives a good indication of the infant's response to resuscitative measures and of the infant's ability to withstand hypoxaemia, and correlates best with the long-term prognosis for mental development and/or neonatal death.

Resuscitation management

It is mandatory that all staff working in the labour ward must be able to anticipate and recognise the need for resuscitation in the newborn. Two or three competent professionals are involved in the resuscitation of a newborn.
The aims of resuscitation are:

- to establish respiration and ventilation
- to establish cerebral circulation and so prevent cerebral and other organ cell damage
- to avoid acidosis, hypothermia, hypoglycaemia and to maintain blood pressure
- to prevent further damage to an infant who may have sustained some injury or damage before or during delivery.

Preparation. The preparation includes equipment, medicines, related substances and staff. The equipment includes:

- a warm resuscitation area
- oxygen from a controlled supply
- a neonatal ambubag
- size 3.5, 3, and 2.5 endotracheal tubes
- size 6 and 8 suction catheters
- feeding tube
- laryngoscope with straight blades 0 and 00, with extra light bulbs
- gloves
- KY jelly
- meconium aspirator (with endotracheal tubes and inducer)
- umbilical catheters
- oxygen
- scissors
- tape
- Magill forceps (paediatric).

The medication includes:

- neonatal Narcan® 0.02 mg/ml ampules
- adrenaline ampules 1:10 000
- vacolitre of 10% dextrose water (200 ml)
- sodium bicarbonate ampules 4%
- 50% dextrose water 20 ml ampules.

All staff must be adequately trained in resuscitative techniques and must be fully conversant with the equipment, protocols and policy manuals within that particular unit. However, it is important to remember that in South Africa not all midwives work in tertiary centres with highly sophisticated equipment and with medical practitioners available at all times. Many midwives are situated in rural clinics many kilometres from the base or tertiary hospital. When no medical practitioner is available, the midwives have to manage emergency situations. The basic principles regarding resuscitation should be adhered to and available equipment must ALWAYS be in good working order.

The resuscitation procedure

Once the Apgar score is obtained and it is apparent that the newborn requires resuscitation, the newborn is removed to the resuscitation area for further management.

The prevention of hypothermia, which is important, will depend upon the facilities available, but the basic principles of resuscitation will still apply. See Steps 1, 2, 3 and 4. It is vital to remember that during the resuscitative procedure, the newborn must be kept warm and dry at all times.

The newborn is removed to the resuscitation area and is placed on a flat surface with the head extended into a 'sniffing' position. Remember that hyperextension of the newborn's head and neck can cause soft tissue obstruction of the airway. Further management will now depend upon the condition of the newborn.

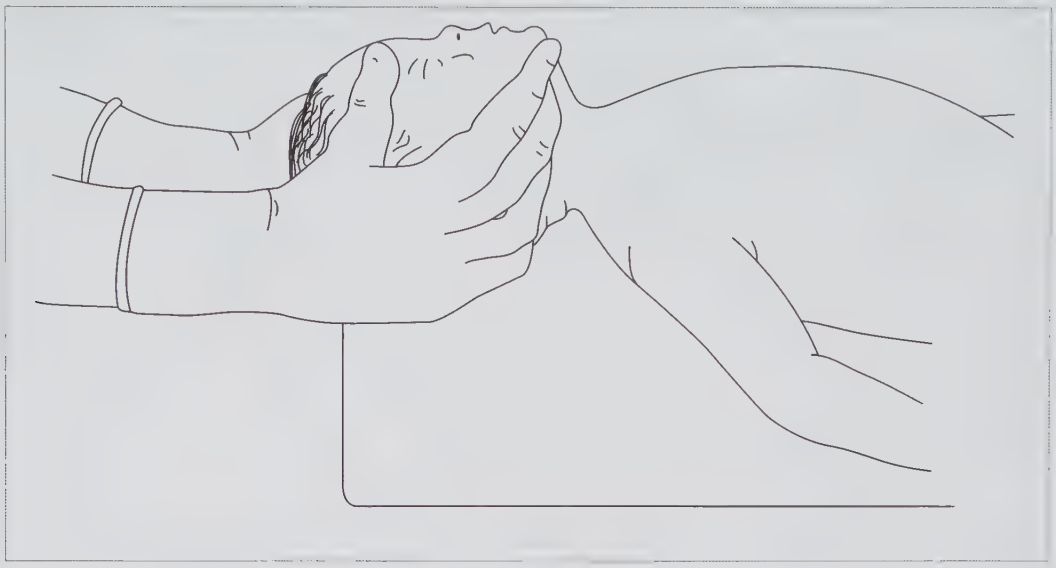


Figure 45.4 The 'sniffing' position

The plan of action comprises of the four steps (A, B, C and D) below, which should be carried out in sequence:

Step 1: Clear the Airways (A). Make sure that the airways are clear of mucus and amniotic fluid.

If aspiration is required, suction *gently* into first the mouth and then along the floor of each nostril.

If meconium is present, suction under direct vision with the laryngoscope to remove meconium before breathing.

Step 2: Establish and maintain respiration (Breathing) (B). Establish whether the infant is breathing or not.

If there is shallow or irregular breathing administer oxygen via a mask held over the infant's face. At the same time, the infant's feet can be flicked as a means of stimulating regular breathing. The oxygen administered in this way may improve the breathing by increasing the PO_2 level, and causing the pale or cyanosed infant to become pink.

If after 30 seconds of oxygen administered by face mask, the breathing and colour are still unsatisfactory or the infant remains apnoetic, then ambubag if necessary.

The condition of the infant must now be reassessed to ascertain if regular respiration has been established.

If normal respiration has not been initiated and maintained, or if the infant's respiration and circulation continue to deteriorate, start intubation and artificial ventilation (see Figure 45.7).

Step 3: Circulatory stimulation (C). The heart rate is the most important sign of the condition of the baby. A heartbeat of less than 100 bpm requires intubation and ventilation.

If a newborn receives 100% O_2 with the ambubag and the heart rate does not improve the newborn must be intubated. Any newborn with a heart rate of 60 bpm must be intubated.

The heart beat is counted at the cord or with a stethoscope by the second operator.

External cardiac massage is needed if the heart rate drops below 60 bpm (see Figure 45.6).

Step 4: Definitive medication (D). The first step is to determine the cause of the lack of spontaneous respiration and then to assess whether biochemical correction will be required.

In delivery units where resuscitation measures are performed without medical assistance, a protocol and policy manual must be devised for the administration of medications.

There are two methods by which drugs can be administered to the infant, either intravenous (through the umbilicus) or endotracheal. The method used will depend upon the neonatologist in charge of the department.

All medicines/drugs must be given very SLOWLY.

- *Respiratory anti-depressant.*
  - Naloxone® 0.01 mg/kg (0.25 ml/kg) of adult ampule (0.4mg) IM or IV.

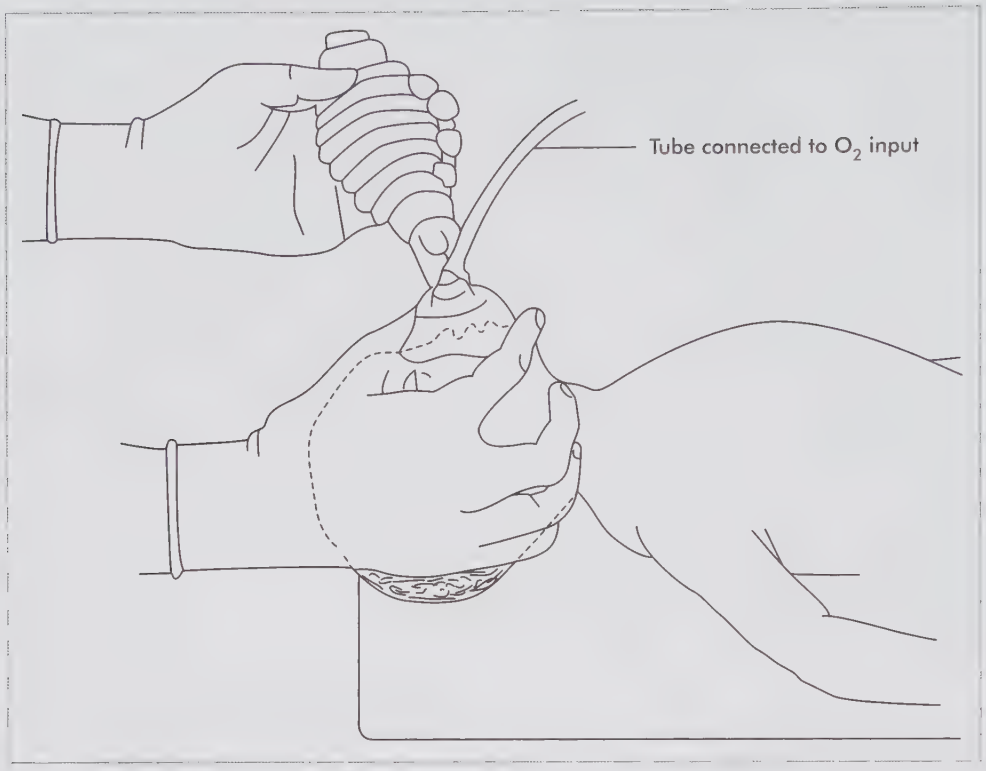


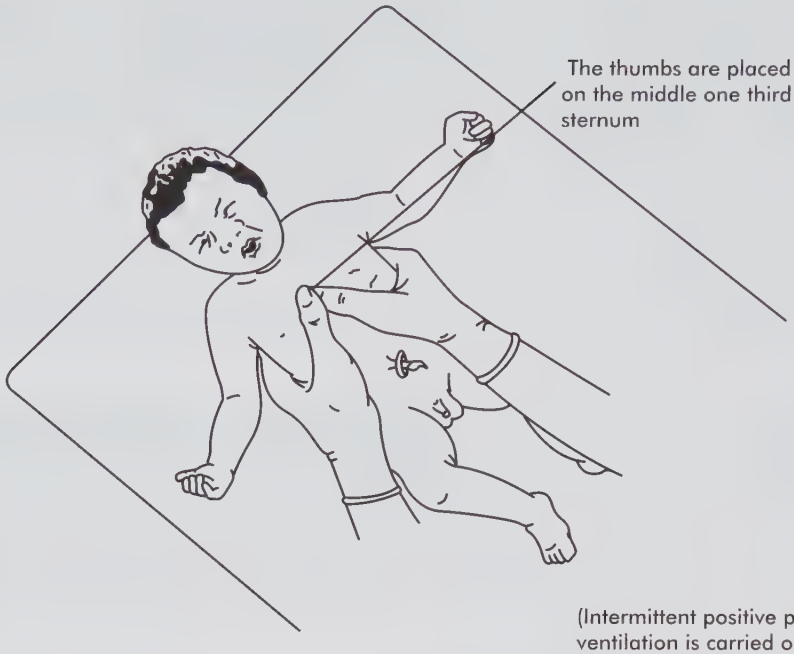
Figure 45.5 Bag and mask ventilation

- This medication may be administered if the mother has been given pethidine or morphine within two hours of delivery.

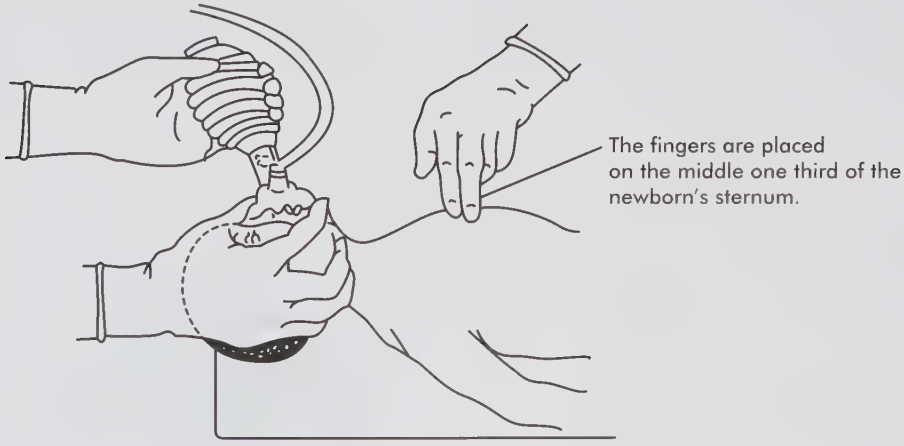
  NB: Naloxone® must never be given to an infant that is not breathing, as it does not stimulate the baby to breathe. Respiration must be controlled BEFORE giving naloxone and it is most efficient when given intravenously (via an umbilical catheter). Naloxone has a half-life of about 50–60 minutes, so it may need to be repeated if a long-acting opioid has been given to the mother during labour.

- *Correction of acidosis by medical practitioner*
  - Sodium bicarbonate 4% or dilute 8.5% with equal amount of sterile water. Do not give in ET. 2 ml/kg of 25% solution slowly over 2–5 minutes.
  - This is administered if the newborn is acidotic.
  - It must also only be given when respiration is controlled, as it can cause narcosis, vasodilatation with hypotension and bounding pulse, which could result in cerebral ischaemia.
  - It should not be given as a bolus dose to preterm infants as it can cause an infraventricular haemorrhage and thrombosis in the major arteries.
- *To correct hypoglycaemia.*
  - Dextrose administration if the blood sugar is less than 25 mg% (1.1 mmol/ℓ).
  - Dextrose 2 ml/kg of 10% solution IV or oral. (Dilute 50% Dextrose 1:2 with sterile water for 10% solution.
- The hazards of intravenous dextrose are:
  - Irritation of the vessel occurs, causing spasm.
  - If the solution should leak into the tissues it could cause sloughing of the tissues.
  - A rapid hyperglycaemia with a rebound hypoglycaemia may occur.
  - Intracellular dehydration and circulatory overload may occur.
- *Other medications in ICU*
  - Normal saline. 10 ml/kg IV for volume expansion. Normal saline may be administered when the infant has failed to respond to any of the above procedures or medications. The failure to respond may be due to hypovolaemia, and the albumin may rectify this condition.
  - Adrenaline 1:1 000. Dilute with 9 ml saline to get a 1:10 000 solution (equal to epidrine 1:10 000) IV administration preferred 0.01 to 0.03 mg/kg. Endotracheal 1 mg/kg.

Method 1 Hand encircling technique



Method 2 Two-finger technique



Rate 3:1 Compressions to one breath. 90 bpm.

Figure 45.6 External cardiac massage

The intubation

Indications. The following are indications for intubation:

- Severe asphyxia and a low Apgar rating: below 4.
- A heart rate below 100 bpm.
- No response to the routine care at delivery.
- Once the newborn has been successfully intubated, intermittent positive pressure ventilation (IPPV) may have to be started.

Complications. The following are possible complications of intubation:

- Pneumothorax can occur if the endotracheal tube is inserted too far into the right bronchus, and if inflation pressures are too high.
- Tracheal perforation can also occur, but this is rare.
- Oesophageal perforation may occur when force is used to insert the tube.
- Laryngeal oedema may occur after extubation and this can cause respiratory distress.

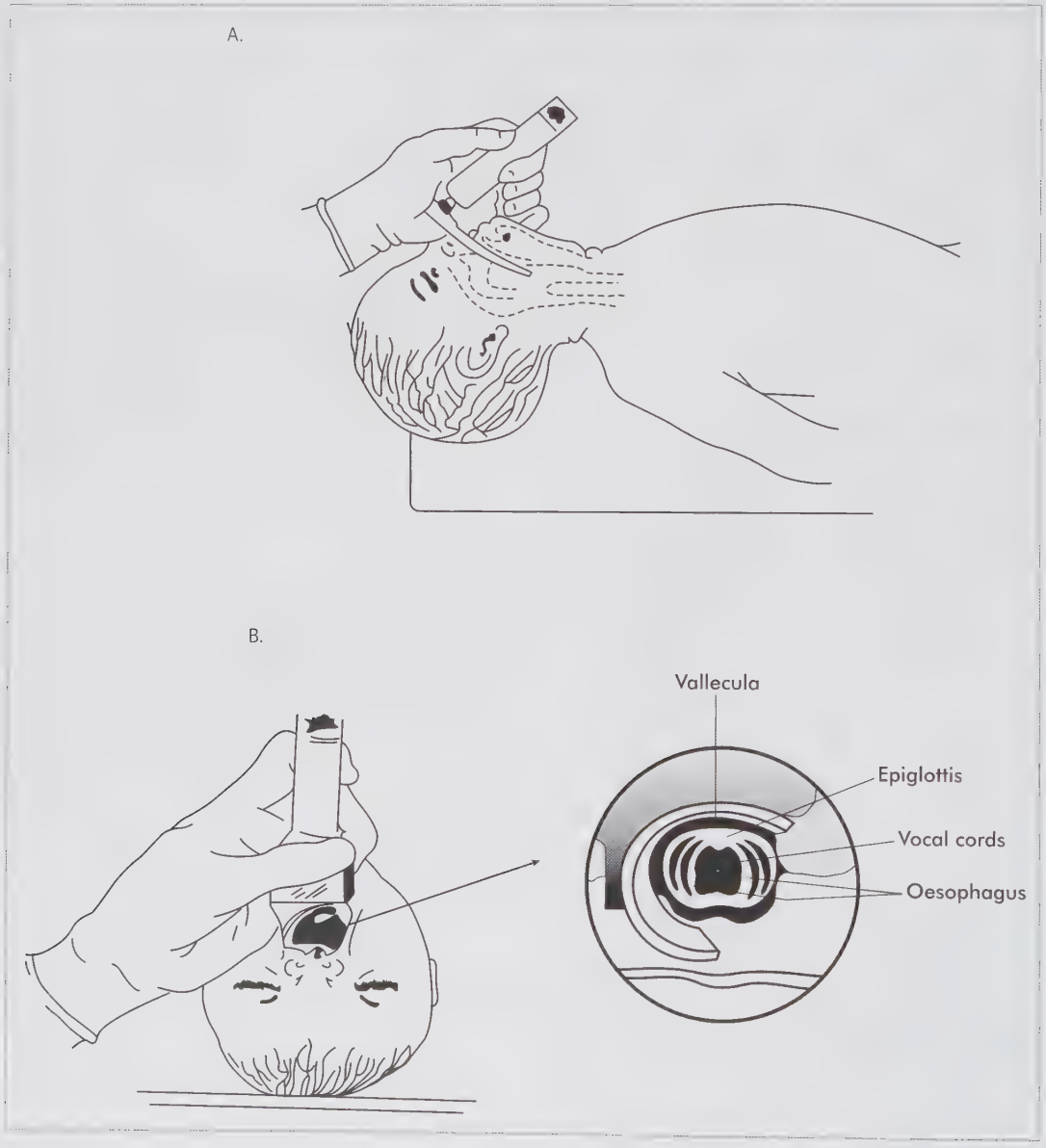


Figure 45.7 Inserting the laryngoscope

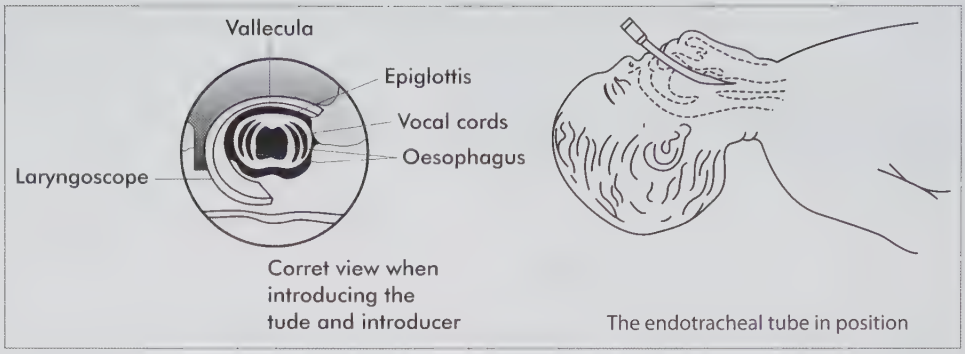


Figure 45.8 Inserting an endotracheal tube

45.1 Resuscitation skills

All healthcare staff working with newborns are advised to obtain a certificate in newborn resuscitation and update their skills regularly. Contact the South African Paediatric Associations (SAPA)

General care of the newborn

The subsequent care of the newborn will depend upon the response to resuscitation.

If the newborn responds promptly to treatment, and very soon maintains its respiration and circulation, the routine care may be completed. Explain the outcome and reunite the newborn with the mother/parents as soon as possible so that the parents' concern is allayed. Remember to give the mother an explanation as to the treatment given and to support, encourage and reassure her/them.

If the newborn's condition is such that it requires further management, possibly in the intensive care nursery, the newborn's condition is stabilised as far as possible and is then transferred to the intensive care nursery in a prewarmed, pre-oxygenated incubator where possible. The nursery staff must be warned of the newborn's impending arrival so that adequate preparations can be made.

Care of the parents

This is extremely important and yet is so often neglected while attending to the immediate needs of the asphyxiated newborn and its subsequent transfer to the nursery for further management. Once the newborn is stable, explain the whole procedure to the parents, or if there are enough staff, ask another midwife to do so while the resucitation is taking place.

The attending medical practitioner takes ultimate responsibility for explaining the situation to the parents.

Let the mother see her baby as soon as possible and be prepared to answer her questions.

45.7 Conclusion

All midwives need to develop a safe level of competency in the resuscitation of a newborn at birth. Besides the ability to intubate the newborn, this includes the ability to recognise dangerous conditions and to perform resuscitation correctly.

CHAPTER

46 Birth trauma

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- identify possible factors that can cause birth trauma
- demonstrate competence to implement measurements to prevent birth trauma
- demonstrate skill in early assessment and diagnosis of birth trauma
- demonstrate skill and competency in the facilitation of care of the neonate and the family.

KNOWLEDGE ASSUMED TO BE IN PLACE

Standard care during birth

KEYWORDS

Caput succedaneum • Cephalohaematoma • Intracranial Subaponeurotic haemorrhage • Vacuum haematoma • Subcutaneous fat necrosis • Cranial nerve injury • Brachial palsy • Erb's palsy • Spinal cord injury

46.1 Introduction

There are many conditions that cause birth trauma to the neonate that can be either minor or serious. This chapter presents the most important aspects that a midwife should be able to prevent, identify and treat.

The forces of labour and delivery occasionally cause physical injury to the newborn. Those injuries are categorised as birth trauma. The incidence of neonatal injury from difficult or traumatic deliveries is decreasing due to increasing use of caesarean section in place of difficult versions, vacuum extractions, or mid- or high-forceps deliveries, but it still occurs occasionally and unavoidably, with an average of 6–8 injuries per 1 000 live births in the USA. In general, larger infants are more at risk from birth trauma. Higher rates are reported for infants who weigh more than 4 500 g.

A traumatic delivery is anticipated when the mother has small pelvic capacity, in cases where the infant seems large for gestational age (often the case with diabetic mothers), or with a breech or other abnormal presentation, especially in a primigravida. In those cases, labour and the fetal condition should be monitored closely. If fetal distress is detected, the mother should be positioned on her side and given oxygen. If fetal distress persists, an immediate caesarean section should be done.

46.2 Mortality, morbidity and causes of birth injury

The birth injuries rate fell from 64.2 to 7.5 deaths per 100 000 live births, from 1970–1985, a remarkable decline of 88%. The reason for this may be the technological advances that allow today's obstetrician to recognise birth trauma risk factors earlier by using ultrasound and fetal monitoring prior to attempting vaginal delivery. A caesarean delivery is also done more readily.

Causes of birth injury

During labour, compression, contractions, torque and traction takes place. When complications such as abnormal fetal size, presentation, or neurologic immaturity occurs, the intrapartum forces may lead to tissue damage, oedema, haemorrhage or fracture in the neonate. The use of obstetric instrumentation

may further increase the risk of birth injuries. Factors predisposing to injury include the following:

- primigravidae
- cephalopelvic disproportion, small maternal stature, maternal pelvic anomalies
- prolonged or rapid labour
- deep transverse arrest of descent of presenting part
- oligohydramnios
- abnormal presentation (breech)
- use of midcavity forceps or vacuum extraction
- versions and extractions
- very low birth weight infant or extreme prematurity
- fetal macrosomia
- large fetal head
- fetal anomalies.

46.3 Head injuries

Head molding is common in vaginal delivery due to the high pressure exerted by uterine contractions on the neonate's malleable cranium as it passes through the birth canal. This rarely causes problems or requires treatment.

Caput succedaneum

The caput succedaneum is a collection of serous fluid between the aponeurosis (muscle sheath) of the fetal scalp and the periosteum (outer covering) of the fetal skull bones.

The fetal scalp is pressed against the relatively taut cervical ring during each uterine contraction, after the rupture of the membranes. This pressure impedes the venous and lymphatic drainage of the fetal scalp, within the area of this ring, and causes an effusion of serous fluid into the subaponeurotic space. The position of the scalp over the cervical ring changes as the head negotiates the pelvic canal, and therefore the site of this swelling is extended accordingly.

A caput succedaneum is present at birth. It usually enlarges and can cross a suture line, starts to reduce in size soon after birth and has disappeared within 24 to 36 hours. If, however, the labour has been prolonged and difficult, the caput will be excessive and may persist for up to 36 hours.

Cephalohaematoma

A cephalohaematoma is an effusion of blood under the periosteum, the periosteum is torn off the cranial bone and there is a slow oozing of blood under the periosteum, eventually causing a large swelling. The swelling develops between 12 to 24 hours after birth and does not cross a suture.

Cephalohaematoma occurs in prolonged second stage of labour as result of some cephalopelvic disproportion, usually affecting the presenting parietal bone. Cephalohaematoma can be differentiated from subgaleal haemorrhage because it is sharply limited to the area overlying a single bone, the periosteum being adherent at the sutures. Cephalohaematomas are commonly unilateral and parietal. In a small percentage, there is a linear fracture of the underlying bone.

Signs and symptoms

Usually the haematoma is gradually re-absorbed into the circulation over six to eight weeks. The neonate may develop hyperbilirubinaemia, jaundice, anaemia or hypotension in severe cases. Occasionally, the haematoma persists as a hard lump on the head as calcium is laid down. In some cases it may be an indication of a linear skull fracture or be at risk of an infection leading to osteomyelitis or meningitis.

No active treatment is necessary, but extra observation and care must be taken with the infant. Vitamin C has been reported to hurry the absorption of the haematoma.

Intracranial haemorrhage

Haemorrhage in or around the brain can occur in any neonate but is particularly common in those born prematurely; about 20% of premature infants < 1 500 g have intracranial haemorrhage.

Subarachnoid haemorrhage probably is the most common type of intracranial haemorrhage. Neonates may present with apnoea, seizures, lethargy, or an abnormal neurologic examination. With large haemorrhages, the associated meningeal inflammation may lead to a communicating hydrocephalus as the infant grows.

Subdural haemorrhage results from tears in the falx, tentorium, or bridging veins. Such tears are more often present in neonates of primiparas, in large neonates, or after difficult deliveries. The signs and symptoms may be seizures; a rapidly enlarging head; or an abnormal neurologic examination with hypotonia, a poor Moro reflex, or extensive retinal haemorrhages.

Intraventricular and/or intraparenchymal haemorrhage is usually present during the first three days of life and is the most serious type of intracranial bleeding, most often in premature neonates, often bilateral, and usually arising in the germinal matrix. Most are small amounts of subependymal or intraventricular blood. In severe haemorrhage, there may be bleeding into the parenchyma or a cast of the ventricular system with large amounts of blood in the cisterna magna and basal cisterns. Most intraventricular haemorrhages are asymptomatic, but larger haemorrhages may cause apnoea, cyanosis, or sudden collapse.

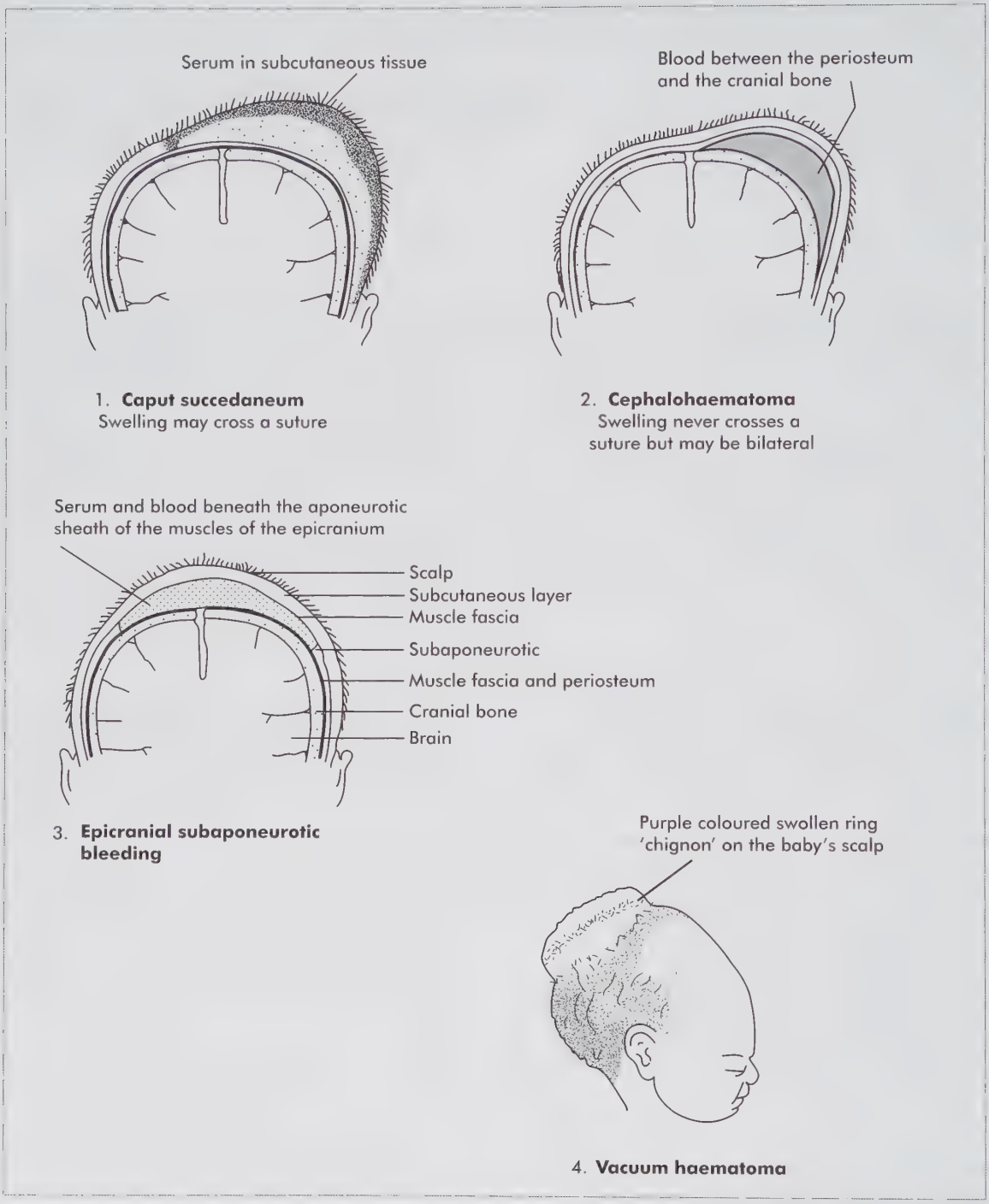


Figure 46.1 Injuries to the scalp and skull

Diagnosis

Intracranial haemorrhage should be suspected in any neonate with signs of apnoea, seizures, lethargy, or an abnormal neurologic examination. Either cranial ultrasound or CT scan is done. For screening of very premature infants (e.g. < 30 weeks gestation) ultrasound is used. If the diagnosis is in doubt, the cerebrospinal fluid can be examined for red blood cells: it usually contains gross blood. However, some red blood cells are often present in the cerebrospinal fluid of term neonates. In subdural haemorrhage, transillumination of the skull may reveal the diagnosis after the blood has lysed.

Complications

The prognosis for subarachnoid haemorrhage is usually good. The prognosis for subdural haemorrhage is guarded, but some infants do well. Most neonates who present with small intraventricular haemorrhages survive the acute bleeding episode and do well. Neonates who present with large intraventricular haemorrhages have a poor prognosis, especially if the haemorrhage extends into the parenchyma. Careful monitoring of preterm neonates with a history of severe intraventricular haemorrhage must be done because they are at risk of developing posthaemorrhagic hydrocephalus. This must be done with serial cranial ultrasound examinations and frequent serial head circumference measurements. Neonates with progressive hydrocephalus require neurosurgical evaluation. Because many neonates will be left with neurologic deficits, careful follow-up and referral for early intervention services are important.

Management and care

Treatment is mostly support unless a haematologic abnormality contributed to the bleeding. Vitamin K should be given if not previously done. If deficient, platelets or clotting factors should be given. Subdural haematomas should be managed by a neurosurgeon; evacuation of the haemorrhage may be needed.

Epicranial subaponeurotic haemorrhage

Epicranial subaponeurotic haemorrhage is bleeding beneath the aponeurotic sheath of the muscles of the epicranium. Trauma from using excessive force or from bad management in an assisted delivery (forceps or vacuum extraction) can cause extensive bleeding. Swelling is present at birth. The oedematous and blood-filled swelling may increase the circumference of the head considerably. The swelling may cross the sutures and may extend to bruising of the eyelids and behind the ears. The neonate may experience pain when moving the head or when the swelling is handled. Shock can present with tachycardia or a low blood pressure.

Management and care

Management includes medical referral, replacing of the blood lost and transferring the neonate to a Level 2 or 3 hospital. The haemorrhage may need to be drained. Bruising may take weeks to be reabsorbed and hyperbilirubinaemia may be a complication. Subaponeurotic haemorrhage is associated with perinatal mortality of 22%. If lacerations complicate the condition, great care must be taken to prevent infection. (see Figure 46.1).

Vacuum haematoma

Vacuum haematoma is the bleeding of the soft tissues in the area where the vacuum was attached. The suction of the vacuum extractor can cause a purple-coloured swollen ring 'chignon' on the baby's scalp. The edge of the swelling may be excoriated and the scalp torn, which may cause the tissues to slough. When excessive suction is produced in the vacuum, a part or even the whole circle of scalp can be torn off the head.

Management and care

The lesion normally heels within a few days, but there is always the danger of infection where there is a laceration and an antiseptic agent must be applied (see Figure 46.1).

Other injuries to the scalp and skull

Abrasions and lacerations sometimes may occur from scalpel cuts during caesarean delivery or during instrumental delivery (e.g. vacuum, forceps). Infection remains a risk, but most heal uneventfully. Any laceration is dangerous because if the mother is HIV positive, her blood may enter the abrasion at birth, transferring the virus to the infant. Because of this danger, scalp electrodes for cardiotocograph tracings are no longer used in high-risk conditions.

Management and care

With any scalp injury there may also be an underlying injury to the skull and brain, and therefore the neonate will require frequent observations and specialised nursing care. Management consists of careful cleaning, application of antibiotic ointment, and observation. Bring edges together using Steri-Strips. Lacerations occasionally require suturing.

46.4 Cranial nerve and spinal cord injury

Cranial nerve and spinal cord injuries result from hyperextension, traction, and overstretching with simultaneous rotation; they may range from localised neurapraxia to complete nerve or cord transection.

Cranial nerve injury

The facial palsy is a muscle limitation of one side of the face due to injury of the facial nerve which results in temporary or permanent paralysis. This may occur as result of forceps pressure on the facial nerve in front of the ear. Most injuries probably result from pressure on the nerve *in utero*, which may be due to fetal positioning (e.g. from the head lying against the shoulder, the sacral promontory, or a uterine fibroid). The compression appears to occur as the head passes by the sacrum.

Signs and symptoms

Signs and symptoms for cranial nerve injuries is an asymmetric face during crying. The mouth is drawn towards the normal side, wrinkles are deeper on the normal side, and movement of the forehead and eyelid is unaffected. The paralysed side is smooth with a swollen appearance, the nasolabial fold is absent, and the corner of the mouth droops. No evidence of trauma is present on the face.

Evidence of forceps marks may be present. With peripheral nerve branch injury, the paralysis is limited to the forehead, eye or mouth.

The condition starts to recover within the first week, but full resolution may take several months. Palsy caused by trauma usually resolves or improves, whereas palsy that persists is often due to absence of the nerve.

Management and care

Management consists of careful surveillance of respiratory status, and intervention, when appropriate, is critical. Protect the open eye with patches and synthetic tears (methylcellulose drops) every four hours. If there is no improvement in seven to 10 days, consult a neurologist and a surgeon.

Most patients recover in the first 6–12 months. The outcome for bilateral lesions is poorer.

Brachial plexus injuries (brachial palsy)

Brachial plexus injuries follow stretching caused by excessive traction on the head and neck during a difficult cephalic delivery, e.g. shoulder dystocia, breech extraction, or hyperadduction of the neck in cephalic presentations. Injuries can be due to simple stretching, haemorrhage within a nerve, tearing of the nerve or root, or avulsion of the roots with accompanying cervical cord injury. The prognosis depends on the site and type of nerve root injury.

Erb's palsy is an upper brachial plexus injury causing adduction and internal rotation of the shoulder with pronation of the forearm The arm is fully extended, with rotation inwards. The movement of the fingers and hand is normal but the Moro reflex is asymmetrical. There is no tenderness, pain or swelling of the arm when there is no fracture.

Management and care

Protect the shoulder from excessive motion by immobilising the arm across the upper abdomen and preventing contractures by passive range-of-motion exercises to involved joints. This must be done gently every day starting at 1 week of age. Put the arm through a range of movements to prevent the development of contractures. If there is no improvement after six weeks, the baby must be referred to a Level 3 hospital for evaluation and possible surgery.

Klumpke's palsy is a lower plexus injury resulting in paralysis of the hand and wrist, often with ipsilateral Horner's syndrome (miosis, ptosis, facial anhidrosis). Passive range-of-motion exercises are the only treatment needed.

Spinal cord injury

Spinal cord injury is rare and involves variable degrees of cord disruption, often with haemorrhage. Complete disruption of the cord is very rare. Spinal cord injury incurred during delivery results from excessive traction or rotation. Traction is more important in breech deliveries (minority of cases), and torsion is more significant in vertex deliveries. True incidence is difficult to determine. The lower cervical and upper thoracic region for breech delivery and the upper and mid-cervical region for vertex delivery are the major sites of injury. When the injury is higher, lesions are usually fatal because respiration is completely compromised. Sometimes a click or snap is heard at delivery.

Major neuropathologic changes which consist of acute lesions, e.g. haemorrhages, especially epidural, intraspinal, and oedema. Haemorrhagic lesions are associated with varying degrees of stretching, laceration, and disruption or total transaction. Occasionally, the dura may be torn, and rarely, vertebral fractures or dislocations may be observed.

Signs and symptoms

Initially spinal shock with flaccidity below the level of injury occurs with irregular retention of sensation or movement below

the lesion. Spasticity develops within days or weeks. Diaphragmatic breathing occurs because the phrenic nerve remains intact as its origin is higher (at C3 to C5) than the typical cord lesion. The intercostal and abdominal muscles become paralysed and rectal and bladder sphincters cannot develop voluntary control when the spinal cord lesion is complete. Sensation and sweating are lost below the involved level, which can cause fluctuations of body temperature with environmental changes.

Prevention is the most important aspect of medical care. Obstetric management of breech deliveries, instrumental deliveries, and pharmacologic augmentation of labour must be appropriate. Occasionally, injury may be sustained *in utero*.

The diagnosis is made using MRI or CT myelography.

With appropriate care, most infants survive for many years. The usual causes of death are recurring pneumonia and progressive loss of renal function. Treatment includes nursing care to prevent skin ulcerations, prompt treatment of urinary and respiratory infections, and regular evaluations to identify obstructive uropathy early.

46.5 Fractures

Clavicular fracture

One of the most common fractures during birth, midclavicular fracture, may occur with shoulder dystocia and with normal, nontraumatic deliveries. Initially, the neonate is irritable and does not move the arm on the involved side either spontaneously or when the Moro reflex is elicited. Healing is most of the time rapid and uneventful because most clavicular fractures are greenstick, but occurs usually in 7–10 days. A large lump forms at the fracture site within a week, and remodeling is completed within a month. The condition is treated by making a sling by pinning the shirt sleeve of the involved side to the opposite side of the newborn's shirt.

Long bone fracture

Loss of spontaneous arm or leg movement is an early sign of long bone fracture, followed by swelling and pain on passive movement. The obstetrician may feel or hear a snap at the time of delivery. Radiographic studies of the limb confirm the diagnosis.

Femoral and humeral shaft fractures are treated with splinting. Closed reduction and casting are necessary only when displaced. Watch for evidence of radial nerve injury with humeral fracture. Callus formation occurs, and complete recovery is expected in two to four weeks. In eight to 10 days, the callus formation is sufficient to discontinue immobilisation. Orthopaedic consultation is recommended.

Radiographic studies distinguish this condition from septic arthritis.

46.6 Intra-abdominal injury

Intra-abdominal injury is relatively uncommon and can sometimes be overlooked as a cause of death in the newborn. Haemorrhage is the most serious acute complication, and the liver is the most commonly damaged internal organ.

Intraperitoneal bleed

Signs and symptoms

Bleeding may be fulminant or insidious, but infants ultimately present with circulatory collapse. Intra-abdominal bleeding should be considered for every infant who presents with shock, pallor, unexplained anaemia, and abdominal distension. Overlying abdominal skin may have bluish discolouration. Radiographic findings are not diagnostic but may suggest free peritoneal fluid. Paracentesis is the procedure of choice.

Hepatic rupture

The most common lesion is subcapsular haematoma, which increases to 4–5 cm before rupturing. Symptoms of shock may be delayed. Lacerations are less common, often caused by abnormal pull on peritoneal support ligaments or the effect of excessive pressure by the costal margin. Infants with hepatomegaly may be at higher risk. Other predisposing factors include prematurity, postmaturity, coagulation disorders, and asphyxia. In cases associated with asphyxia, vigorous resuscitative effort (often by unusual methods) is the culprit. Splenic rupture is at least a fifth as common as liver laceration. Predisposing factors and mechanisms of injury are similar.

Rapid identification and stabilisation of the infant are the keys to management, along with assessment of coagulation defect. Blood transfusion is the most urgent initial step. Persistent coagulopathy may be treated with fresh frozen plasma, transfusion of platelets, and other measures.

Hepatic rupture has no specific racial predilection and has equal sex distribution. Patients usually present immediately following birth, or rupture becomes obvious within the first few hours or days.

46.7 Conclusion

Recognition of trauma necessitates a careful physical and neurologic evaluation of the infant to establish whether additional injuries are present. Occasionally, injury may result from resuscitation. Symmetry of structure and function should be assessed as well as specifics such as cranial nerve examination, individual joint range of motion, and scalp/skull integrity.

CHAPTER

47

Metabolic and endocrine disorders

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- identify metabolic and endocrine disorders in the newborn
- show competency in the care of newborns with these disorders
- provide skilled care and treatment of the newborn and the family.

KNOWLEDGE ASSUMED TO BE IN PLACE

Normal physiology and anatomy of the newborn

KEYWORDS

Hypoglycaemia • Congenital hypothyroidism • Galactosaemia

47.1 Introduction

This chapter discusses common metabolic disorders in the newborn.

47.2 Hypoglycaemia

An adequate supply of glucose is essential for normal body function and an insufficiency can lead to severe brain damage.

Hypoglycaemia may be due to inadequate or depleted glycogen stores in the placenta before delivery, or in the liver after delivery (preterm, low birth weight, late feeding), or due to an increased demand for glucose (respiratory distress, hypothermia, infection), or due to hyperinsulinism (diabetic mother, Rh disease) or due to liver damage. Therefore, the predisposing causes of hypoglycaemia are very similar to those of hypothermia.

Clinical features and diagnosis

Normal blood glucose in a neonate is 2.5 mmol/l. Hypoglycaemia occurs if this drops to < 1.1 mmol/l. Brain damage occurs at this level.

Non-specific signs and symptoms include tremors, seizures or hypotonia, apnoea and cyanosis, lethargy and poor feeding, and tachycardia.

Causes

- Common causes are: IUGR, small-for-gestational age, prematurity, asphyxia and fetal distress, postmaturity and infant of a diabetic mother.
- Less common causes are postexchange transfusion, Rh disease and galactosaemia.

Management and care

- All infants are routinely observed for hypoglycaemia.
- Prevention by early feeding is the best course. If the baby is very small or very ill and unable to suck, tube feeds (and if necessary intravenous feeding) are commenced as soon as possible after birth.
- The baby must be kept warm.
- Blood glucose levels in high-risk infants (preterm infants, large-for-gestational age babies, especially those whose mothers are diabetics, growth-restricted babies, as well as babies with prolonged asphyxia, intracranial injury, hypothermia, haemolytic disease, and with infections) are tested by means of test strips (Dextrostix) every one to four hours for 24–48 hours until the condition is stable.
- Maintain blood sugar levels through regular milk feeds.

- Energy needs must be reduced by correcting acidosis, by preventing hypothermia and infection, and by the early treatment of sepsis.

Specific care

- If the blood sugar drops to < 1.1 mmol/l urgent intervention is needed.
- The baby is immediately given a 50 ml milk feed and 1–2 ml 50% dextrose water, added to the feed. Check glucose one hour after the feed.
- If the Dextrostix test does not show improvement after three hours, the medical practitioner may need to start a 10% dextrose intravenous infusion. This should be continuous and steady and is kept up until it is replaced by milk feeds. This may take from 48–72 hours after birth.
- The Dextrostix levels are monitored at least every hour until the infant's condition is stable. It is advisable to maintain the Dextrostix readings at or above 2.2 mmol/l.
- Hydrocortisone 5 mg/kg is given 12 hourly, and should be started if the blood glucose is not normal after six to 12 hours of treatment.
- Glucogon, in a dose of 0.3 mg/kg intramuscularly, is effective in an emergency for the treatment of hyperinsulinaemia (those infants who have no glycogen stores with which to respond). This must be followed by an intravenous infusion.
- Babies of diabetic mothers are routinely on a dextrose intravenous infusion after birth for a 24 hour period or until stable.

Complications

Brain damage of varying severity may result from hypoglycaemia, ranging from learning problems to severe intellectual retardation. Whatever the cause, the first step in the treatment of hypoglycaemia is to recognise its presence as early as possible. Permanent neurological effects of hypoglycaemia correlate with the duration of time the cerebral tissues are deprived of glucose.

47.3 Congenital hypothyroidism

This is a disorder that is easy to be identified by routine screening. Affected newborns do not have enough thyroid hormone and so have retarded growth and brain development.

Early detection of this disease can be treated with oral doses of thyroid hormone to permit normal development. The incidence: 1:4 000.

47.4 Galactosaemia

The incidence is 1:60 000–80 000. There are several less severe forms of galactosaemia that may be detected by newborn screening, which may not require any intervention.

These babies are normal until milk feeds are introduced.

Within weeks they start vomiting, become jaundiced and listless. They fail to gain weight.

Urine screening will show reduced sugar and albumin.

Newborns with galactosaemia have a lack of the enzyme that converts galactose (one of two sugars found in lactose) into glucose, a sugar the body is able to use.

The result of this is that milk (including breast milk) and other dairy products must be eliminated from the diet. Otherwise, galactose can build up in the system and damage the body's cells and organs, leading to blindness, severe mental retardation, growth deficiency, and even death.

The baby will be on a life-long galactose-free diet.

The prognosis is good if the diet is maintained.

47.5 Sickle cell disease

Sickle cell disease is an inherited blood disease, where red blood cells have an abnormal 'sickle' shape and can cause episodes of pain, damage to vital organs such as the lungs and kidneys, and even death. Young children with sickle cell disease are especially prone to certain dangerous bacterial infections, such as pneumonia and meningitis.

With early screening of the newborn a diagnosis can be made and antibiotic treatment can be started before infections occur. The screening test can also detect other disorders affecting haemoglobin.

The incidence is about 1:500 in African-American births and 1:1 000 to 1 400 Hispanic-American births. The incidence in sub-Saharan Africa is up to 2% of all childern born, but in South Africa it is less than 10% of births.

47.6 Cystic fibrosis

Cystic fibrosis (CF) is a genetic disorder that particularly affects the lungs and digestive system. The newborn will be exposed to repeated lung infections. There is no known cure. The condition can be treated by trying to prevent serious lung infections and providing adequate nutrition. Early detection helps medical practitioners reduce the problems associated with CF, but the real impact of newborn screening has yet to be determined. The incidence is 1:2 000 white newborns; less common in African-Americans, Hispanics, and Asians.

47.7 Phenylketonuria

Phenylalanine is an essential amino acid present in food. Normally it is changed by the enzyme phenylalanine hydroxylase to tyrosine. When it is absent phenylalanine accumulates in the body. It can poison the brain and cause mental retardation.

This occurs 1:10 000–20 000 births.

Infants may present with vomiting, eczema and 'mouse'-like smell to their urine. Convulsions may occur. Most children are blond with blue eyes due to lack of melanin.

Varied degrees of retardation are present and children may be hyperactive, have microcephaly and show growth retardation.

Care is mostly preventive:

- Children are screened for phenyalalanine with the Guthrie test on a drop of heel blood.
- The optimal time is five to seven days after birth.
- A phenylalanine-free diet is prescribed.
- Breastfeeding continues in the early months.
- The blood levels of phenylalanine should be kept between 0.24 and 0.48 mmol/*l*.
- Mental retardation can be avoided.

47.8 Lactose intolerance

Disaccharides in the diet are changed into monosaccharides by the enzymes in the gut before absorption.

Congenital lactose intolerance is caused by the lack of the enzyme lactase. The presence of lactose in the gut causes fermentation of sugar by intestinal bacteria with the release of carbon dioxide and lactic acid. The result is frothy and sour-smelling stools with a low pH, which test positive for reducing substances.

The infant develops diarrhoea in the first week of life and fails to gain weight.

Withdrawal of lactose in the diet will stop the condition within 24 hours.

A lactose-free diet is prescribed for the first two years.

47.9 Conclusion

This chapter presented some of the more common metabolic disorders that may be seen in the newborn.

CHAPTER

48 Transporting the mother and/or newborn

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- identify emergency situations for the mother and the newborn
- demonstrate skill and competency in the management and care for women and newborns during transfer and transport
- explain the role and function of a midwife in transporting a mother and baby.

KNOWLEDGE ASSUMED TO BE IN PLACE

Basic knowledge of resuscitation and nursing care of the mother and the newborn.

48.1 Introduction

In current healthcare settings and practices an increasing number of mothers and newborns need to be transported from clinics and district hospitals to regional and tertiary hospitals for specialised care. Owing to advances in adult and neonatal intensive care, it is now possible to safely transport the adult mother as well as very small and very ill newborns over short or long distances.In South Africa dedicated ambulances are assigned to maternity services. In addition Netcare 911 and ESR are private services that use helicopters to airlift a baby if necessary. These services are expensive and usually need approval, but are well equipped and have an excellent team of highly skilled paramedics and medical practitioners for safe transport.

Midwives may find they often need to transport mothers and babies. However, it is still better to prevent the complications that require such transport or identify high-risk cases early so that the mother can deliver in a specialised unit.

Three factors contribute to the successful transport of an ill mother or newborn:

- Adequate communication between all members of the teams, both at the clinic and at the tertiary hospital.
- Stabilisation of mother and/or the newborn before transfer.
- Skilled care during transportation.

48.2 Indications for the transportation of a pregnant woman with health risks

The indications for transportation of a woman to an adult intensive care unit fall mainly under the following headings.

Antenatal period:

- Women with serious medical conditions.
- Women with eclampsia.
- Women with antepartum haemorrhage.

Intrapartum:

- Eclampsia.
- Serious medical conditions.
- Prolonged labour with complications.
- Obstructive labour with complications.
- Disseminated intravascular coagulation (DIC).
- Postpartum haemorrhage/retained placenta.

Postpartum:

- Eclampsia.
- Postpartum haemorrhage.
- DIC.
- Complications of serious medical conditions.
- Any other emergency situation.

48.3 Indications for the transportation of a sick newborn

The general indications for transportation of an infant to a neonatal intensive care unit are newborns with:

- Respiratory problems:
  - a respiration rate of more than 60 bpm for more than three hours
  - that require more than 40% oxygen
  - respiratory distress syndrome and recurrent apnoeic attacks
  - with aspiration of meconium needing ventilation
  - recurrent apnoeic attacks
  - severe asphyxia resulting in respiratory depression.
- Low birth weight:
  - infants of less than 2 000 gm (2 kg), where adequate facilities for nursing these infants are not available
  - having convulsions.
- Jaundiced and needing exchange transfusions.
- Haemorrhaging from any site.
- Suspected heart disease.
- Conditions requiring diagnostic or therapeutic investigations which are not provided for at the place of delivery.
- Diabetic mother, requiring stabilisation or investigation.
- Conditions requiring surgery.
- Congenital abnormalities requiring medical care.
- Conditions needing special care for any reason.

48.4 Prerequisites for the transportation of mothers and newborns

Safety is of utmost importance when a mother and or newborn are transported. The following guidelines and principles need to be observed:

- Full resuscitation or stabilisation must be complete before transportation.
- It is important that midwives know and understand the principles involved in the transportation of sick mothers and/or newborns, as this will vastly improve the woman's and/or newborn's chances of survival, and will ensure that they arrive at the destination in a stable condition.
- There should be a close association between the mother and neonatal transfer, because mother and the newborn need to be transported together.
- The method of transportation will depend upon the circumstances such as availability of transport, the staff, the distance to be travelled, the condition of the patient, the reason for the transportation and how easy it is to arrange transport.
- Adequate communication between the referral hospital and the tertiary centre is essential and must be kept easy, direct and efficient. The staff should know how to arrange transport and who to contact. Full details must accompany the sick person and the receiving hospital must be warned of the impending arrival.
- Either a medical practitioner and/or an adequately trained midwife should accompany the mother or newborn. An inexperienced midwife is inappropriate.
- A referral letter should accompany the patient. The letter should contain all the relevant information concerning mother and newborn, and should be attached to the hospital records containing medical and nursing care already given, including detailed information of what treatment the patient received, especially medication etc.
- All equipment and drugs that may be required must be available for use, and must be checked.
- A duplicate of the mother's and the newborn's charts, containing all medication and treatment given should accompany the patient.
- X-rays and any test results available on the patient's condition must accompany the patient.
- Written consent is needed from the parents for any procedures that may need to be carried out, either in transit or at the tertiary hospital.
- The mother should accompany the newborn where possible, but ill health or other domestic problems may prevent this and in these circumstances there will have to be written consent from the parents for the transfer.
- The positioning of the patient in the aircraft is also important.
- If the mother is not well and the newborn is well, the newborn is also taken with the mother to the tertiary hospital. The goal is not to separate a mother and newborn.

The equipment needed for transporting a sick patient

Equipment is needed to keep the patient warm, provide oxygen and intravenous fluids, to monitor the patient and resuscitate if necessary and to provide emergency treatment if necessary. This includes:

- A portable incubator if at all possible.
- Adequate thermal protection during transportation of the newborn must be assured. The newborn is kept as dry as possible.
- There must be adequate visibility of the newborn with adequate illumination, particularly of the face and chest, during the period of transit in case of the newborn.

- Adequate oxygenation must be maintained during transportation. Therefore, an adequate oxygen supply must be available to cover the time and distance of the journey and to allow for any possible delays.
- A suction machine or mucus extractor with catheters must be available in the event of vomiting or excessive mucus.
- A thermometer is required.
- A stethoscope should be available, although this may not be of much use in a helicopter because of noise levels.
- There should be space blankets in the event of incubator failure. (Kangaroo-mother-care can keep a baby warm.)
- A cardiac monitor may be required depending upon the illness of the newborn.
- Spare nappies to keep the newborn dry and to prevent hypothermia.
- Newborn airways sizes 0, 00, 000.
- Adult airways should be available in sizes 3 and 4.
- An effective functional Ambu bag should be available if ventilation is required.
- There should be a selection of syringes and needles.
- An adult and newborn laryngoscope, with blades, (straight blade 0/00 for a newborn), batteries and globes and endotracheal tubes (sizes, 2/2, 5 and 3 for a newborn) should be available.

Before transportation

Together with the routine daily examination and care of a newborn, the following specific care is given when transporting a sick newborn:

- The temperature must be 36.5 °C before the newborn is transported to prevent hypothermia and hyperthermia because these can cause permanent damage or death. Hypothermia can lead to acidosis, to hypoglycaemia and to the death of the newborn.
- The blood glucose level must be between 2.0–4.0 mmol/*l* before the newborn is transported. If the blood glucose is below 1.7 mmol/*l* an intravenous line is started with 10% neonatalyte solution.
- The newborn should be appropriately rehydrated. The urinary output should be 1 ml per kilogram per hour.
- Oxygen must always be available and administered to keep the mucous membranes pink.
- Vital signs should be monitored, specifically pulse, blood pressure and peripheral circulation before transfer, in order to assess whether the newborn might be either in cardiac failure or in shock. Both these conditions will have to be corrected before transportation.
- Intubation and ventilation should be started before the newborn is transported if there is a reasonable chance that they may be required in transit.

During transportation

- All nursing care during the journey must be maintained at the same level as was given at the transferring hospital or clinic.
- Once the newborn's condition has been stabilised, the referral hospital must be notified of the newborn's time of departure and the approximate expected time of arrival.
- During the transportation, the staff must keep the newborn's temperature above 36 °C.
- The newborn must have a properly functioning intravenous line, which will require close monitoring and supervision.
- If the journey is longer than one hour, the blood glucose should be tested in transit.
- A clear airway must always be maintained and the suction apparatus used when necessary.
- Oxygen is administered when necessary.
- The accompanying staff should be aware of and treat any deterioration in the newborn's condition during transit (within the scope of the equipment available and the ability of the staff), and any emergency must be immediately and efficiently managed.
- Accurate records must be kept throughout the journey or if this is not possible and they are not complete, they must be written out at the earliest opportunity or immediately on arrival.

On arrival

On arrival at the tertiary hospital, the escort must hand over to the staff in the neonatal intensive or maternity care unit at the hospital. A report must be given on any change in the mother and or newborn's condition during transportation and any further treatment that has been given during the journey.

There must be good communication between the referring medical practitioner and clinic staff, and the obstetrician and/or neonatologist and staff at the tertiary centre.

Care of the parents

The ideal would be to transfer the newborn with the mother. However, this is not always possible.

It is very important to ensure that the mother/parents know to which hospital the newborn is being transferred. They should be given the opportunity to see and touch their newborn before the transfer. The staff should make sure that the parents have the telephone number of the hospital to which the newborn is taken and if possible, the name or number of the ward.

These parents are understandably very worried and upset and must, therefore, be treated with great empathy.

48.5 Conclusion

Transport of a mother and/or newborn is a daily occurrence in midwifery practice. It is essential that there is a written policy to guide the standard of practice with regard to transport. The maximum time that an ambulance should take to transport a patient is two hours. Maintaining high standards of transport is essential in the improvement of the quality of care, public perception and ultimately reductions in perinatal and maternal mortality.

Section Eight
Family planning

49 Childbirth and family planning

CHAPTER

49 Childbirth and family planning

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- develop competencies in counselling and healthcare screening in reproductive healthcare
- assess women and select the appropriate method of contraception
- demonstrate knowledge of the appropriate use of all available contraceptive methods used after child birth
- show knowledge and skill with regard to the management and care of termination of pregnancy.

KNOWLEDGE ASSUMED TO BE IN PLACE

Basic anatomy and physiology of human reproduction

KEYWORDS

Contraception • Termination of pregnancy (TOP)

49.1 Introduction

This chapter focuses on the role of the midwife in reproductive healthcare that includes contraception and child spacing. Many young women will only come in contact with healthcare and healthcare workers during pregnancy and birth. This is an ideal time to assist women to make appropriate choices to space pregnancies and plan their children.

These choices are known as 'family planning' or 'pregnancy spacing' and it can ensure holistic mental, physical, spiritual and social wellbeing of the parents who can then provide the best care and education for their children.

49.2 Family planning

Reproductive healthcare is the process of helping women and couples to make choices about reproduction and includes methods of contraception. Planned Parenthood and Positive Parenthood are movements developed to assist parents in planning families and learn behaviour patterns that benefit the child. There is an increase in single-parent families and teenage pregnancies and many women opt for termination of pregnancy because they have not sought contraceptive advice.

49.1 The South African population

South Africa (2007) had a population of 47 850 million, with a birth rate of 17.94:1 000 and a death rate of 22.4:1 000. The birth rate is dropping slowly and the death rate has increased sixfold in the last two years. The life expectancy of a man has dropped to 49 years and a woman to 52 years. The fertility rate is 2.43 children per woman.

On a global level, the world's population has become potentially unsustainable. However, in the developed world, the number of children born has declined to levels where some countries are facing declining population growth, which has implications in terms of their welfare status.

In the developing world, however, this is not the case and many countries still see rising populations. Educating women is known to be the single most important way of ensuring that pregnancies are planned and children do not grow up in poverty.

It is estimated that 34% of the world's population growth over the next 50 years will be in Africa, where the average fertility rate is 2.43 per woman. The ideal fertility rate is 2.2 per woman for a positive population growth.

Healthy population growth begins with families and communities that plan the number of pregnancies and children that they will be able to take safely through life and educate as responsible citizens.

During consultations, reproductive healthcare professionals also have the opportunity to educate women about breast and cervical cancer, other aspects of reproductive health and HIV and other sexually transmitted infections (STIs).

49.2 National guidelines for the cervical cancer screening programme

One in 41 women in South Africa will get cervical cancer, the second most common female cancer in South Africa. Papanicolaou smears (Pap smear) are the screening method of choice. The main cause of cervical cancer is certain strains of a sexually transmitted virus, the human papillomavirus (HPV). The screening programme aims at an adequate coverage of 70% in 10 years. The target group is women 30 years and older. Women aged 30 years or older will be screened three times, at least three years apart. The aim is three Pap smears per woman in a lifetime.

The Pap smear needs to be done before 28 weeks of pregnancy due to hormonal changes of the cervix or during the six weeks examination. All women attending family planning who are 30 or over should have a Pap smear. http://www.doh.gov.za/docs/factsheets/guidelines/cancer.pdf.

The midwife needs to have the knowledge and skill to help women to make appropriate choices in the long term, but also in crisis situations where necessary. Termination of pregnancy is a potential outcome of unwanted or unplanned pregnancies or when family planning has failed.

49.3 Termination of pregnancy (TOP)

There are two kinds of terminations:

- termination of pregnancy for medical reasons where the mother's life or mental state is at risk or a fetus is malformed or genetically affected
- termination of pregnancy by choice, where the fetus is normal, but unwanted.

The Choice on Termination of Pregnancy Act (Act 92 of 1996) came into effect from 1 February 1997 in South Africa. It gives the conditions under which a pregnancy can be terminated and allows for termination by choice (see Box 49.3).

49.3 TOP guidelines (Choice on Termination of Pregnancy Act, Act 92 of 1996)

- Until 12 weeks of gestation (this is roughly 10 weeks of pregnancy) a medical practitioner or registered midwife, trained in the procedure, can end a pregnancy at the request of the woman.
- Between 13 weeks and 20 weeks of gestation (11–18 weeks of pregnancy) only a medical practitioner, after consultation with the woman, can perform the procedure. A pregnancy can only be terminated during this period if the medical practitioner is of the opinion that:
  - there is a risk to the woman's mental or physical health
  - there is a substantial risk that the fetus would have a severe physical or mental abnormalities
  - the pregnancy resulted from rape or incest
  - the pregnancy would severely affect the social and economic status of the woman.

After 20 weeks of gestation, termination is allowed only if the woman's life is in danger or in case of severe malformation of the fetus.

The state promotes the provision of non-mandatory and non-directive counselling before and after termination. Spousal consent is not required. Minors will not be forced to get consent from their parents, but should be advised by a medical practitioner or midwife to consult with their next of kin before the pregnancy is terminated.

All terminations must be recorded by the medical practitioner or registered midwife who performed the procedure. Information must remain confidential. The Director General must be notified of all terminations performed at health facilities within one month of the termination.

Any person guilty of the following acts will be fined or sentenced for a period not exceeding 10 years:

- termination of pregnancy contrary to the rules set out by the Bill
- preventing termination or obstructing access to services for termination
- failing to notify the Director General of terminations performed at health facilities.

Termination of pregnancy by choice is not considered as a family planning method, but rather as crisis intervention. Midwives carrying out TOPs are trained in the technique and may carry out TOP up to 12 weeks only. However, all

midwives should be able to counsel a patient on TOP where requested.

Health workers are under no obligation to perform or take an active part in the termination of a pregnancy if they do not wish to. However if the termination becomes life-threatening then healthcare workers are obliged by law to assist. In a non-emergency situation, healthcare workers who do not wish to be involved in TOP are obliged by law to refer a woman to another practitioner and facility that will help her. The woman should have pre- and post-TOP counselling. This counselling is and should be available at all facilities that offer TOP.

TOP is free of charge at state hospitals or clinics.

TOP is carried out either surgically or by using drugs. The most appropriate method is chosen according to the woman's reproductive and medical history (see Box 49.4).

49.4 Emergency contraception

Take note that emergency contraception is not the same as termination. Forms of emergency contraception include the following:

- *Emergency contraceptive pills (ECP) or emergency contraceptives (ECs) - the morning after pill.* These drugs contain hormones that prevent ovulation or fertilisation and possibly implantation of a fertilised ovum. ECPs are distinct from medical abortion methods that act after implantation.
- *Intrauterine devices (IUDs).* IUDs are usually used as a primary contraception method, but sometimes used as emergency contraception.

Emergency contraceptive pills (or emergency hormonal contraception) may contain higher doses of the same hormones (oestrogens, progestins, or both) found in regular combined oral contraceptive pills. ECPs are effective when used shortly before intercourse, and are licensed for use up to 72 hours after sexual intercourse and can be used for up to five days after unprotected intercourse.

The progestin-only method uses the progestin in a single dose or as two doses 12 hours apart. The progestin-only regimen is 89% effective when used correctly.

The most common side effects reported by users of emergency contraceptive pills are nausea and vomiting. If a woman vomits within two hours of taking an ECP, she should take a further dose as soon as possible.

Less common side effects may be abdominal pain, fatigue, headache, dizziness, and breast tenderness. The side effects usually do not last for more than a few days after treatment, and they generally resolve within 24 hours.

49.4 Methods used to terminate pregnancy

Medical: Mifepristone and misoprostol

During the first seven weeks of pregnancy a combination of two drugs, mifepristone (RU486) and misoprostol are used for termination. Patients first take RU486 to reduce the body's level of progesterone, which sustains an early pregnancy, and later take misoprostol, which make the uterus contract and expel its contents.

Uterotonic drugs

During the second trimester, medical practitioners may use drugs or an instrument called a dilapan to dilate the woman's cervix. Then, they administer a prostaglandin drug to cause the uterus to contract, such as intravenous or oral misoprostol, or vaginal dinoprostone.

Surgical

Vacuum aspiration uses a syringe or pump, which removes the contents of the uterus during the first trimester of pregnancy. Once this is complete, the medical practitioner performs curettage, or scraping, of the uterine wall.

Dilatation and curettage (D and C)

During the second trimester, medical practitioners utilise dilatation and curretage. The medical practitioner uses drugs or a dilapan to dilate the cervix, and a vacuum pump is used to remove the contents of the uterus.

From 1997 to 2009 between 26 000 and 89 000 terminations were reported annually in South Africa. The legalisation of termination has resulted in a fall in morbidity and mortality caused by illegal abortions, although women do sometimes still resort to these through ignorance of their legal rights or because they have not been correctly counselled by healthcare workers.

ECPs are generally recommended for backup or emergency use, rather than as the primary means of contraception. They are intended for use when other means of contraception have failed, for example, if a woman has forgotten to take a birth control pill or when a condom has torn during sex.

Intrauterine device (IUD)

(See Figure 49.1.) An alternative to emergency contraceptive pills is the copper-T intrauterine device (IUD) which can be used up to five days after unprotected intercourse to prevent pregnancy. Insertion of an IUD is more effective than use of

hormonal methods – pregnancy rates when used as emergency contraception are the same as with normal IUD use. IUDs may be left in place following the subsequent menstruation to provide ongoing contraception (3–10 years depending upon the type of device).

49.5 The benefits of fertility control

The basic rights of people to control their fertility are contained in many major international human rights treaties, as well as patients' and providers' rights. These indicate that everyone has the right to decide freely and responsibly the number and spacing of their children and to have the information, education and means to exercise this right. The Constitution of the Republic of South Africa, 1996 (Act 108 of 1996) enshrines reproductive health rights through access to reproductive health services.

There is evidence that the health and survival of children can be improved by:

- ensuring an adequate interpregnancy interval
- ensuring childbearing within certain age limits
- limiting the number of children in the family.

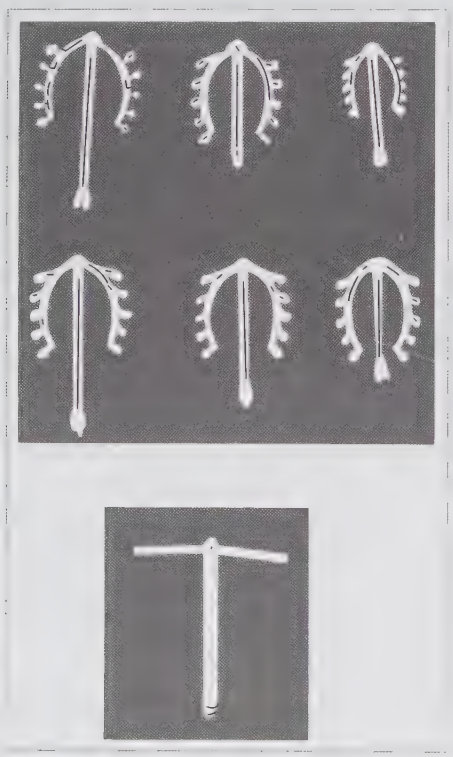


Figure 49.1 Intrauterine contraceptive devices (IUDs)

Fewer children means that the mother can care for each baby adequately because she has the time and the energy to do so and this prevents poor child care and the high morbidity and mortality associated with repeated pregnancies.

The health and life expectancy of the mother is improved through the following:

- Ensuring that the mother has the time to recover completely after delivery before falling pregnant again.
- The mother is able to continue breastfeeding as long as she wishes with benefits for both herself and her baby.
- Maternal mortality rates are reduced.
- Terminations will be avoided.
- Teenage pregnancy rates drop.
- Health-screening tests can be provided during family planning consultation.

Benefits to the family:

- Promotes a stable and harmonious relationship within the family, as couples can enjoy their sexual relationship free from the anxiety of an unwanted pregnancy.
- Families will plan childbirth and childrearing for the time when they have the resources to cope with the increased responsibility.
- They can limit the number of children to the number that they are able to care for adequately, including proper education, food, clothing, shelter and medical care.
- Children are brought up in a stable family, where mother and father can devote more time to each child.

Benefits to the community:

- Stable families form a strong foundation for stable communities with less family disorganisation, socially deviant behaviour such as crime, substance abuse and so on.
- Prevents the population rising above the carrying capacity of the environment, thus improving food security; preventing shortages of water, housing, and healthcare services and improving job security.
- Environmental problems such as air pollution and illnesses caused by overcrowding are prevented.

49.6 Counselling and screening

Counselling

Reproductive healthcare counsellors should be comfortable with their own sexuality and be able to give advice to clients who have problems in their sexual relationships. While complex problems will require referral, information or simple advice may solve many difficulties.

All women requesting contraceptive methods should be given adequate counselling to help them to make informed and voluntary choices about contraceptive methods and the correct way to use them. Counselling should be provided in a comfortable, private room with confidentiality ensured throughout. Counselling starts with the first contact in pregnancy and is followed up throughout pregnancy and birth. In the postnatal period, before discharge, women are helped to make appropriate choices about breastfeeding and child spacing or if the women is HIV-positive, about antiretroviral treatment. Follow-up is arranged, generally six-weeks postnatally.

Women generally fall into the following groups:

1. Those who know exactly what they want.
2. Those who have little idea about what is available or have problems in explaining their wishes.
3. Those who, because of previous experience or advice from friends, know the method(s) they do not want.
4. Those with special needs due to breastfeeding, social pressure or medical conditions, such as STIs, HIV or AIDS, heart disease and hypertension.

Group 1 can usually be quickly organised as long as the method they request is appropriate and available. Group 2 will need time, so that the available methods are carefully explained and the women can make an informed choice. Do not attempt to persuade women in group 3 to accept methods they do not wish to use, even if it appears to be the most suitable choice. They are very likely to return with side effects. Group 4 are limited in their choice because they need to use a method that is most suitable for their medical problem. Women with treatable STIs should be treated at this stage. An HIV-positive woman who has not yet been offered treatment should be appropriately referred. Sterilisation may be an option for women with a medical condition that may complicate another pregnancy (and is life threatening).

Screening

All women who visit the family planning clinic for care and who present during pregnancy and birth should be screened to help them choose the most appropriate contraceptive method. This can be done by:

- Establishing a rapport with the woman by ensuring privacy and making the woman feel comfortable.
- Using language that is understood by both healthcare provider and woman.
- Creating an interactive communication and a trusting, caring relationship.

The woman's needs are assessed using the nursing process.

History

The history should include the following:

- *Personal history*. Name, address, occupation and marital status.
- *Social history*. Habits such as smoking and alcohol intake.
- *Contraceptive history*. Includes present and previous methods, complications, reasons for discontinuation of the method.
- *Menstrual history*. Age of menarche, regularity of cycle, amount and length of bleeding.
- *Obstetric history*. Number of pregnancies.
- *Birth intervals*. Number, ages and health of children.
- *Problems*. Any problems experienced during pregnancy, labour or after childbirth.
- *Any miscarriages or abortions*.
- *Gynaecological history*. Any sexually transmitted infections (STIs), pelvic inflammatory diseases (PID), vaginal discharge, ectopic pregnancies, pain during sexual intercourse (dyspareunia).
- *Medical history*. History of any serious illnesses or operations, any chronic illnesses such as diabetes mellitus, hypertension, etc.
- *Family history*: History of anyone in the family suffering from any of the chronic conditions (diabetes mellitus, hypertension, asthma, etc).
- *Risk assessment*. For exposure to STIs/HIV: assess a woman's risk of these by asking questions about sexual relationships in a positive, confidential and supportive manner.
- *Drug history*. Always take a drug history as an essential part of prescribing oral contraceptives due to possible interactions with other substances.

Physical examination

A full physical examination should be done on all women requesting contraceptive methods and this should include:

- *General attitude*. Observe how she walks into the consulting room
- *General physical state*. Observe her general physical state: does the woman look sick, emotional, what is her weight, blood pressure, pallor, pulse?
- *Pallor*. Check for signs of illness such as jaundice.
- *ACCOL*. Using the acronym ACCOL look for:
  - A-anaemia
  - C-cyanosis
  - C-clubbing
  - O-oedema
  - L-lymphadenopathy

- *Chest examination.*
  - Heart: check for abnormal heart sounds.
  - Lungs: check for abnormal sounds.
- *Abdominal examination.* Check for masses, distension or tenderness.
- *Breast examination.* Palpate for masses and nipple discharge, discolouration, axillae for lumps, enlarged lymph nodes.
- *Pelvic examination.* Check for signs of infection in the external and internal genitalia.

Special examination

Do a cervical smear.

Choice of method

Provide information about the available contraceptive methods and dual protection. Briefly discuss each available method, the effectiveness and benefits of the method, common side effects and how to deal with them and recommend protection against STIs and HIV. Help the woman make an informed choice.

The final choice of the method must always be made by the woman based on the following:

- *Suitability.* The method must be medically appropriate and suitable for the woman's social habits and in accordance with the standardised clinical practice guidelines for contraceptive method provision.
- *Effectiveness.* Efficacy of contraceptive methods depends on a number of factors that have to be considered and thoroughly explained when giving advice.
- *Access to services.* Contraceptive service delivery must be accessible geographically (within reasonable distance), financially (what the woman can afford) and functionally (service to be available for the community to meet their needs).
- *Acceptability.* Privacy and confidentiality must always be ensured during consultation and the method must be acceptable to the client.
- *Cultural and religious factors.* The method must be acceptable for the woman and her family in terms of religious or cultural norms.
- *Previous contraceptive use/current fertility.* The woman who has previously used a method successfully will generally want to continue this method, unless she is breastfeeding or has developed contraindications to the method.
- *Breastfeeding.* Women who wish to breastfeed have a limited number of methods available that are compatible with breastfeeding. Progesterone-only oral contraception is the method of choice if a hormonal method is preferred.
- *Protocols.* Follow the standard protocols for the provision of contraception methods.
- *Drug interactions.* Drug interactions may reduce the effectiveness of the oral contraceptives and lead to an unwanted pregnancy, or the oral contraceptives may interfere with other medication.

Interaction of oral contraceptives with other drugs

The interaction of oral contraceptives with other drugs includes the possibility of drugs interfering with the contraceptive's metabolism in the liver, and/or the oral contraceptive interfering with the drug's metabolism.

A wide range of drugs increases the rate of metabolism of contraceptive steroids in the liver thereby reducing the effectiveness of the contraceptive. The effect may take several weeks to develop and to wear off. These drugs include:

- anti-tuberculous drugs: rifampicin
- anti-convulsants: phenytoin, phenobarbitone, primidone, carbamazepine
- hypnotics, sedatives or other CNS depressants
- some antibiotics: tetracyclines
- some diuretics: spironolactone
- some anti-inflammatory analgesic agents: phenylbutazone
- some antiretroviral drugs (there is limited evidence that antiretroviral drugs may raise or lower hormonal drug activity).

Always ask women whether or not they are taking oral contraceptives before prescribing therapy likely to interfere with drug action. Rifampicin is a very potent enzyme inducer and women who are using oral contraceptives need to be offered an alternative method when on this drug.

Depo-provera may be used in women who are on anti-convulsant therapy. Anti-convulsant therapy is one of the few indications for using an oral contraceptive containing 50 mcg or 80 mcg ethinyl oestradiol. Any patient taking a drug acting as an enzyme-inducing agent should be advised to use additional contraception during cycles in which these drugs are used.

Some antibiotics and fungal drugs may reduce the efficacy of the oral contraceptive – for example ampicillin, tetracyclines and cotrimoxazole. Women taking these drugs should be advised to use additional contraception while on the antibiotic and for seven days after stopping it.

Some conditions such as gastrointestinal disorders, diarrhoea and vomiting may decrease the efficacy of oral contraceptives, so women should be advised to use additional contraception during such an illness and for two weeks after the illness is finished. If the problem arises late in the cycle,

the pill-free week should be omitted and the next pack started immediately.

Oral contraceptives may alter the metabolism of drugs such as anti-coagulants, beta-blockers, benzodiazepines, corticosteroids, or tricyclic antidepressants. The clinical significance of this is as follows:

- Women requiring anti-coagulants or beta-blockers should not be on the oral contraceptive pill.
- Women using corticosteroids who are also on the oral contraceptive pill need to be carefully monitored.
- Women taking antidepressants (e.g. imipramine) and benzodiazepines (e.g. diazepam) should be given lower doses of the oral contraceptive pill.

49.7 Types of contraceptives

The different types of contraceptives are the following:

- Hormonal (combined oral contraceptives and progesterone-only pills):
  - oral
  - injectable
  - intravaginal
  - subdermal.
- IUD.
- Natural.
- Surgical.
- Barrier methods.

Table 49.1 includes details of all contraceptives, including methods, side-effects, contraindications and use. Due to the higher risk involved with the combined contraceptives pills (with oestrogen) they are explained in detail in the following text.

Check with your local clinic for the types of oral contraceptives prescribed in the public health service. These will differ in women who receive prescriptions from private medical practitioners.

The combined oral contraceptive pill (COC)

In both developed and developing communities the risks associated with pregnancy and childbirth are much higher than the risks of complications associated with taking oral contraceptives. However, there are certain women for whom the pill is generally regarded as being inappropriate because of an unacceptably high risk of serious complications. Some conditions contraindicate the use of oestrogen-containing oral contraceptives. Termed as combined oral contraceptive (COC) pills these carry a risk for some women's health. Early warning signs of complication of oestrogen-containing contraceptives are summarised in Box 49.5.

49.5 Warning signs of complications of oral contraceptives

- Severe leg pains – severe in calf or thighs
- Eye problems – involving blurring or loss of vision
- Abdominal pain
- Chest pain or breathlessness.

Guide to the use of combined oral contraceptives (COC)

If after the first three packs the woman continues to have problems when on a COC it may be necessary to change the type of oral contraceptive being used. If the problem is BTB (breakthrough bleeding), heavy periods, breast tenderness or headaches while on the active pill, switch to a more progestagenic variety. If the problem is oligomenorrhoea, overeating, oily skin and acne or dyspareunia due to a dry vagina, change to a more oestrogenic preparation.

Advice to patients on oral contraceptives

Since at least 50% of women starting on the COC discontinue its use in the first year, it is vitally important to try to establish a trusting relationship with the woman so that she will follow your advice and not discontinue unnecessarily. Tell the woman to take the pill regularly, at approximately the same time each day as instructed and at a time of day when it is easy to remember (e.g. when cleaning her teeth). Women who become nauseous should take the COC just before going to bed. Irregular pill taking results in irregular bleeding and a risk of pregnancy. The commonest reason for unwanted pregnancies in association with COC use is irregular pill taking. This may be due to forgetfulness or it may be deliberate, when the woman stops the COC because of discontinuation of a relationship, or because she becomes apprehensive about side effects or supposed risks. These issues need to be discussed with each woman, so that she gains an understanding of the absolute necessity of regular pill taking as long as she is sexually active and relying on the COC for protection against pregnancy.

It is important for the prescriber to know the content and specific combination of the COC being used. Most manufacturers' package inserts advise taking the first pill on the first day of the cycle beginning on either the named day (for example if bleeding begins on a Monday, the client will take the tablet labelled 'Mon') or beginning with the pill marked '1' or '0'. Some recommend starting pill taking on the first Sunday after the period begins. In some preparations, the result of following the manufacturers' instructions is that pill taking usually begins with a placebo.

Immediate contraceptive protection is provided when a hormone-containing pill is started on the first day of the menstrual cycle. Starting the pill later in the cycle risks the possibility of ovulation occurring, so that in these circumstances extra precautions are advisable for the first two weeks (e.g. condoms). Breakthrough bleeding is common in the first cycle and the cycle is short if hormone taking begins on the first day of the cycle. In consultation with the woman, a choice has to be made between:

1. Starting on the first day.
2. Starting on the fifth day.
3. Starting on the first Sunday after the period begins.

Extra precautions are advisable for two weeks if either options 2 or 3 are taken. The woman must follow the arrows on the pack to ensure that the pills are taken in the correct order.

Starting after delivery. During lactation, the progestogen-only pill is advised and replaced by the COC when the child is weaned. If the patient is not breastfeeding, combined oral contraceptives can be started about four weeks after delivery if not contraindicated.

Starting after termination of pregnancy or miscarriage. The pill should be started immediately.

Manipulation of the menstrual cycle. To postpone a period using monophasic preparation, the woman can take two packets consecutively with no break.

To postpone a period using phasic preparations, she should omit the placebo and continue to use tablets from the final phase of a new pack of the same brand of phase preparations or change to a monophasic pack. In the latter case, the woman should begin active pills from the monophasic pack the day after the last active pill of the triphasic pack has been taken. She will resume the triphasic pack one week after the last dose of active pills in the monophasic pack.

Changing preparations. The first active pill of the new pack should be taken on the first day after the last active pill of the old pack is finished. A similar regime is followed when changing from the progestogen-only preparation. When changing from a stronger to a weaker preparation, a seven day hormone-free interval can be allowed between finishing the old pack and commencing the new one. The woman should not be advised to wait for the withdrawal bleed. It may not occur. It is important to know where the placebo tablets are in both the old and new packs, otherwise there is a danger of the client moving from one course of placebo tablets to another and falling pregnant.

Continuous use of active pills. Some women are attracted to the idea of less frequent vaginal bleeding or are troubled by headaches during pill-free days. In such cases, they can take three or four packets of monophasic pills consecutively followed by a seven day break. The disadvantage of such a regime is that it increases the total amount of hormone intake and the woman does not get the reassurance of a monthly bleed.

Omitted pills. The most dangerous time to miss a pill is immediately before or after the hormone-free interval.

In a delay of less than 12 hours, take the forgotten pill at once, then take the next pill at the correct time. There will be no loss of protection.

In a delay of more than 12 hours, there is a risk of loss of protection. The woman should return to her regular routine immediately and use a back-up method for the next seven days or avoid sex. If these seven days include the hormone-free interval, when extra protection is advised, the client should start the active pills in the next pack immediately the present one is finished (i.e. the placebo is omitted). If some bleeding occurs while taking the pills, ignore it. If a second pack is begun without any intervening placebo, the client may not bleed. This is not a cause for anxiety. She will bleed at the end of the second pack. If she continued with coitus while forgetting the pill, postcoital contraception should be considered.

Reasons to discontinue COC

These include:

- Contraception is no longer needed because the woman desires to fall pregnant. The patient should use an alternative method of contraception for the first three months to allow the establishment of a normal cycle and hence the opportunity to establish the gestational age of a subsequent pregnancy. Such precautions may not be necessary where ultrasound is readily available for assessment of gestational age.
- An unreliable pill taker.
- When any life-threatening complications present, for example a sustained diastolic blood pressure of more than 95 mmHg.
- The development of a new risk factor, such as increasing age, starting smoking, onset of jaundice, or the planning of major elective surgery in older women (stop four weeks before surgery and resume two weeks after surgery).
- Neurological problems (weakness, vision, speech).
- Long-term immobilisation. There is an increased risk of thromboembolism associated with COC. When a woman is immobile the risk increases.

Table 49.1

Contraceptive methods

Hormonal contraceptives

Hormonal contraceptives consist of manufactured (synthetic) steroids, which are very similar to the hormones women produce in their bodies that control the menstrual cycle. These steroids are very effective when taken regularly every day and most can be prepared cheaply and very easily. The following methods are available: oral, injectable, intravaginal, subdermal and transdermal.

Oral contraceptives

Method	Mode of action	Disadvantages/side effects	Contraindications	Use after birth
Combined oral contraceptives (COCs) Low dose combined oral contraceptives contain oestrogen and one of the progesterones. The only oestrogen now in common use is ethinyl oestradiol. They are very effective in preventing pregnancy when taken regularly every day and are safe for most women Monophasic Biphasic Triphasic (See Appendix B)	Inhibition of ovulation. The endometrium becomes unsuitable for implantation. The cervical mucus resists sperm penetration. Capacity of the sperm is impaired. Production of pituitary hormone is affected preventing follicle maturity	*Life-threatening.* Alters clotting factors, raises blood pressure *Related to menstrual cycle.* Interferes with menstrual cycle/amenorrhea *Other side effects.* Depression, reduces libido in some women, headache, may worsen migraine, nausea and vomiting, weight gain, causes skin changes, breast tenderness, reduces the quantity of breast milk and may shorten the duration of lactation. No protection against STIs/HIV	Undiagnosed vaginal bleeding Pregnancy/lactation Migraine Liver, renal and thyroid disease Malignancies Diabetes mellitus Smoking Age > 45 yrs Porphyria Surgery 4 weeks before and after Severe depression Cardiovascular disorders Systemic lupus; Breast tumours; Epilepsy; TB; PID; Stevens Johnson Syndrome	*If breastfeeding.* It can be used after the woman stops breastfeeding *If not breastfeeding.* At least 3 weeks after childbirth when the risk of thromboembolism is reduced, after the pregnancy test indicates that she is not pregnant *After TOP.* Immediately after uncomplicated first or second trimester TOP
Progesterone-only pills (POPs) Progesterone-only or mini pill are oestrogen-free oral contraceptives containing a very low dose of progesterone. They are appropriate for breastfeeding women and women who experience oestrogen-related side effects or where COCs are contraindicated. POPs are very effective when taken every day at the same time	40% of women may ovulate Cervical mucus thickens thus preventing penetration by sperm The endometrium becomes unreceptive to implantation of the fertilised ovum Possibility of interference with ovum transportation in the Fallopian tube Effect on ovulation varying from complete suppression of ovulation to normal ovarian activity	No serious side effects Disrupt menstrual pattern Possibility of occasional development of ovarian cysts due to unreliable suppression of ovulation Less effective in protecting against tubal pregnancy *Non-menstrual side effects.* Headache, breast tenderness, weight gain, nausea and vomiting, depression	Pregnancy Undiagnosed irregular vaginal bleeding Previous ectopic pregnancy Liver disease Severe arterial diseases	*If breastfeeding.* Can be used at 6 weeks postpartum, later at any time if confirmed not pregnant. *If not breastfeeding.* Can be used immediately although it would be most beneficial to wait until after 3 weeks postdelivery to reduce the possibility of bleeding disturbances. *After TOP.* Can be used immediately after first or second trimester TOP and later if confirmed not pregnant

continued

Table 49.1

Contraceptive methods (continued)

Method	Mode of action	Disadvantages/side effects	Contraindications	Use after birth
Injectable contraceptives				
Progesterone (DMPA) for injection *Progesterone-only injectables are* safe and effective methods of contraceptives which contain synthetic progesterone and are administered by deep intramuscular injection. Two progesterone-only injectables available are: Depo-medroxy-progesterone acetate (DMPA) which is usually given in a dose of 150 mg every 12 weeks and norethisterone oenathane (Nur-Isterate (NI) which is given every 8 weeks in a dose of 200 mg. Injectables are popular because they are highly effective, easy to comply with, require only periodic clinic visits and no supply needs to be kept at home	*Inhibition of ovulation.* When the serum level of progesterone reaches maximum at about 7 days, it reduces the pituitary output of FSH and LH. Ovulation does not occur *Suppression of endometrium.* inhibition of proliferation of the endometrium which make the endometrium unfavourable for implantation *Effects on cervical mucus.* Alteration of cervical mucus which makes sperm penetration difficult *Alteration of tubal function.* Abolish cyclical changes in the tubal mucosa, making it unfavourable for sperm and ovum transport and sperm nutrition It has antioestrogen activities	Disrupts the menstrual pattern Delayed return to fertility *Other side effects.* Lassitude, headache, nausea, breast tenderness, loss of libido, weight gain	Arterial disease Pregnancy Thromboplastic disease Undiagnosed abnormal uterine bleeding Secondary amenorrhoea Suspected hormone-dependent breast and genital organ malignancies Trophoblastic disease Psychiatric problems Liver disease Migraine Diabetes mellitus Porphyria	Breastfeeding mothers Suitable for older women not wanting sterilisation
Intravaginal contraceptives				
Progesterone ring A ring containing levonorgestrel (1 mg) and natural oestrogen (50 mg) is available which the woman can insert herself in the upper vagina. It remains in the vagina for about three months, during which the hormone is released slowly	All action is local The method is well accepted Women have control over the method It is effective	May cause irregular uterine bleeding Some women object to examining themselves	Undiagnosed vaginal bleeding	Breastfeeding

Inplants				
Subdermal inplant contraceptives				
Progesterone inplants Inplants consist of flexible tubes containing progesterone. They are placed under the skin on the inside of the woman's upper or lower arm. The hormone is released slowly over several years (levonorgestrel)	The contraceptive effect of the implant is similar to that of the POPs. Ovulation occurs in about 10% of cycles in the first year. With time, blood levels of the progestin decline, and ovulation occurs more often (30–75% of cycles) However, like other hormonal methods, implants thicken the cervical mucus. This prevents sperm from getting into the uterus and makes fertilisation of the egg unlikely. The changes in the cervical mucus are more consistent compared with POPs	May cause irregular uterine bleeding	May cause irregular bleeding Healthcare personnel required for insertion and removal	Breastfeeding Five-year implants are now being given to teenagers in the USA who have a high risk of becoming pregnant. Five tubes implanted under the skin slowly release their hormones
Transdermal contraceptives				
The skin patch The skin patch is applied once a week for three weeks. The fourth week is patch free	As far as COCs, it does not go through the liver and has fewer side effects	No side effects	Same as for COC	Same as for COC
Intrauterine Devices (IUDs)				
Numerous devices (over 200) have been developed and experimentation continues. IUDs can be classified as inert or bio-active, the latter being either copper-containing or steroid-containing. The basic core is made of polythelyne and comes in a variety of shapes. IUDs are now easier to insert than they used to be, are more effective and may have fewer complications, but the penalty for these changes has been an increase in cost and somewhat more frequent replacement. They are still more effective than non-medicated IUDs though (see Figure 49.11)				

continued

Table 49.1

Contraceptive methods (*continued*)

Method	Mode of action	Disadvantages/side effects	Contraindications	Use after birth
Copper-containing IUDs *Copper T or Multiload* Each different device contains different levels of copper. Some recent innovations include a silver core to the copper wire *Examples.* Gynae T 380 slimline, Multiload and Flexiguard (can stay *in situ* for 10 years) **Progesterone-containing IUDs** *Levonorgestrel (LNG)* Releases a low dose each day *Examples.* Progestasert® and Nova T® (can stay *in situ* for 5 years)	IUDs with progesterone cause the cervical mucus to thicken, and also interfere with the development of the decidua, thereby inhibiting implantation IUDs prevent implantation of the ovum and makes the endometrium unreceptive for the ovum IUDs with copper have an effect on sperm activity and motility and transport Increased macrophage activity affecting ova and sperms If pregnancy does occur with the device *in situ* the risk of abortion is 50%	These contain reservoirs of progesterone which is slowly released into the uterus. These copper-containing devices cause fewer side effects than the non-medicated devices but have to be replaced more frequently *Mortality.* 1–10 per million users per year. Almost all deaths have been due to sepsis *Other* Bleeding Spotting Pain Pelvic inflammatory disease (PID) x 4 time more likely Vaginal discharge Perforated uterus Ectopic pregnancy Discomfort to partner Migration of the device to other organs Loss of the device with menstruation	Effectiveness depends on correct fitting of the device, so the skill of the person inserting the device is important Facilities, skill and training are required for insertion. *Other associated problems.* Severe infections Caesarean section Bicornuate uterus *Other abnormalities of the uterus* Vaginal infections Malignancies of the uterus HIV History of two times expulsions Septic abortion Anaemia Cardiac vulva disease (risk of bactereamia)	Women who forget to take the pill *Post coital.* Within 5 days of unprotected intercourse *Post abortion.* Directly after evacuation of the uterus if no infection is present *Post delivery.* Best used after 6–8 weeks when the uterus has involuted if not contraindicated
Surgical methods Male and female sterilisation can be performed to permanently prevent reproduction.				
Female 33% of married women Most commonly used method	Total hysterectomy will cause permanent sterilisation as the uterus, tubes and ovaries are removed	It is permanent Women under 30 without children are advised to wait 99% effective	Young woman who have not completed their families It is a major surgical procedure that requires anaesthesia and a short hospital stay	Hysterectomy during caesarean section is usually due to life-saving emergency procedures Tube ligation can be done directly after birth or any time after that.

Hysterectomy Removal of a portion or total uterus with tubes and ovaries (total hysterectomy) *Bilateral salpingectomy* Removal of tube (ectopic) *Tubal ligation* Isthmus closest to the uterus through surgery, clips, silicone rings and electrocoagulation *Non surgical* Pressure placed in tubes to block them	Tube ligation can be permanent through the removal of a part of the Fallopian tubes on both sides of the uterus to prevent the ova and sperm meeting Using clips to clamp the ovaries to restrict blood flow and cause scarring Silicone rings block the tubes mechanically	Tubal reversal not always successful	May be done under local as outpatient on request. If pregnancy occurs 33% will be ectopic Costly More complications than vasectomy	
Male *Vasectomy* This is a minor surgical procedure wherein the vasa deferentia are severed, and then tied/sealed in such a manner so as to prevent sperm from entering the seminal stream (ejaculate)	When the vasectomy is complete, sperm cannot exit through the penis. Sperm is still produced by the testicles, but is broken down and absorbed. Much fluid content is absorbed by membranes in the epididymis, and much solid content is broken down by the responding macrophages and re-absorbed via the blood stream. After vasectomy, the membranes increase in size to absorb and store more fluid; this triggering of the immune system causes more macrophages to be recruited to break down and re-absorb more of the solid content. Most men post-vasectomy quickly develop antisperm antibodies	Less sex drive in 20% of cases In some cases, vasitis nodosa, a benign proliferation of the ductular epithelium, can also result Sperm build-up increases pressure in the vas deferens and epididymis Haematoma can form Postvasectomy pain syndrome with chronic pain of the scrotum may occur 1 in 2 000 vasectomies may end in a pregnancy	Few reasons not to do a vasectomy It is cheap and easier than female sterilisation Contraindications include: a varicocele a large hydrocele a local scar an inguinal hernia genital tract infection diabetes recent coronary heart disease filariasis	Most medical practitioners who perform vasectomies recommend one (sometimes two) post-procedural semen specimens to verify a successful vasectomy Can be done whenever a couple requires it

continued

Table 49.1

Contraceptive methods (*continued*)

Natural method of contraception Male and female natural methods can be used as contraception, but are not very effective.				
Method	**Mode of action**	**Disadvantages/side effects**	**Contraindications**	**Use after birth**
Coitus interruptus involves withdrawal of the entire penis from the vagina before ejaculation	Fertilisation is prevented by lack of contact between spermatozoa and the ovum	Effectiveness of this method of natural contraception is *really low* and depends largely on the man's ability to withdraw prior to ejaculation	Unreliable. The contraception failure rate is estimated to be approximately 4% in the first year of perfect use. In typical use of this natural contraception, the unwanted pregnancy rate is approximately 19% during the first year of use	Advantages of this method of natural contraception include immediate availability, no devices, no cost, no chemical involvement, and a theoretical reduced risk of transmission of sexually transmitted infections (STIs)
Natural contraception by periodic abstinence (rhythm method) This involves abstaining from sexual intercourse during the fertile period *Temperature card.* The basal body temperature is taken each morning before arising. Basal body temperature rises from a relatively lower level before ovulation to a somewhat higher level, usually >37 °C after ovulation. *Cervical mucus.* Detection of an increased amount of cervical mucus (usually near the time of ovulation)	*Rhythm.* Ovulation occurs about 14 days before onset of the next menstrual period. Although the human ovum may be fertile for only about 24 hours, motile sperm have been identified up to 7 days after coitus; fertilisation has occurred following coitus 3 days before ovulation. *Temperature.* The couple abstains from intercourse until at least 48 to 72 hours after the temperature rise. Mucus. Intercourse every second day after menses until mucus secretion is detected Abstain for 4 days after peak	High motivation needed Interferes with normal sexual functioning	This natural rhythm contraception method efficacy *is low*	Available and cheap Can only be used after delivery once cycle has started and woman is not breastfeeding

Condom (barrier methods)				
Male and female barrier methods are available.				
Female The female condom is a pouch with flexible rings at each end	Before intercourse, the ring inside the pouch is inserted deep into the vagina, holding the condom in the vagina. The penis is directed into the pouch through the ring at the open end, which stays outside the vaginal opening during intercourse. It is a barrier contraceptive	Less effective than male condoms if not used correctly More expensive Sound and visibility during use may be a problem for users Risk of pregnancy 26%	No contraindications	Use as soon as sexual intercourse is started after birth, usually after 6 weeks
Male Latex sheath to be placed over penis	Prevents sperm entering vagina	It can break or slip Defective products Risk of pregnancy 16% When used perfectly the risk is 2%	There are no contraindications to use	If used correctly every time it is effective against pregnancy, HIV and other STIs

49.8 Conclusion

The role of the midwife in maternity care includes contraception, the assessment of women's health status, the counselling of women, the empowerment of women to make appropriate choices and the education of young women to delay pregnancy. Termination of pregnancy (TOP) care has become incorporated into the function of the midwife. The midwife is often the primary caregiver of women in public healthcare facilities in South Africa and should have the knowledge, skill and competency to deliver effective reproductive healthcare services and care.

Section Nine

Perinatal and other infections in obstetrics

50 Infections in childbirth

51 Prevention of mother-to-child transmission of HIV

CHAPTER

50 Infections in childbirth

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- identify and explain infections that threaten women and infants' health in pregnancy, birth and the postnatal periods
- institute appropriate assessment strategies to identify these infections
- institute measures to prevent infections and related complications in pregnancy, birth and the newborn period
- institute the appropriate management and care for women and newborns who are suffering from a known infection
- describe the role and function of a midwife in preventing cross-infection in a labour ward, postnatal ward and neonatal care unit.

KNOWLEDGE ASSUMED TO BE IN PLACE

Basic knowledge of infections, prevention and treatment, immunity and antimicrobial treatment

KEYWORDS

TORCH • Prenatal infections • Puerperal infection • Milk fever • Chorioamnionitis • Sexually transmitted infections • Hospital-acquired infections

50.1 Introduction

Infections and sepsis have been identified as one of the major causes (fourth out of the big five) of maternal mortality in pregnancy and birth in South Africa. Pregnancy can predispose women to some infections because of the associated anatomical and physiological changes, which include relative anaemia, altered Ph of the vagina and masked symptoms of infection. Other infections such as HIV, amnionitis and urinary tract infections (UTI) may be asymptomatic until complications arise. Infections may not affect the mother but can have adverse effects on the development of the baby and may lead to congenital abnormalities, spontaneous abortion or premature birth. The early identification of infections in pregnancy and birth and their prevention is particularly important. Midwives need to know the symptoms and signs of these infections and how to treat them, or where appropriate, prevent them.

Midwives are not yet permitted in South Africa to independently prescribe antibiotics, but may be able to administer antiretroviral drugs as part of the nurse-led roll-out of antiretroviral programmes. Thorough knowledge of drugs and their side effects and contraindications in pregnancy is needed for safe and effective care of women and babies (see Chapter 54).

This chapter discusses the common infections that a midwife usually encounters in practice that may compromise the mother and baby's wellbeing. These infections may co-exist with HIV, in which case any drug interactions or other HIV-related factors must be taken into account during the care and management.

50.2 Categories of infection in pregnancy

Infections in pregnancy can be categorised according to the source, period infected and potential effect on pregnancy, birth and the postnatal period on the mother, the fetus and the newborn. Many infections and their adverse effects are preventable, if managed correctly.

Non pregnancy-related infections include sexually transmitted infections, HIV, TB and waterborne diseases, respiratory conditions, including colds and influenza. Other conditions include malaria, worm infestation and other infectious diseases such as hepatitis, measles and meningitis.

Pregnancy-related conditions include chorioamnionitis, vaginal infections, UTI (urinary tract infection often asymptomatic in pregnancy), pyelonephritis, mastitis and puerperal fever, cellulitis and septicaemia. Conditions associated with a high fever may lead to abortion or preterm birth because the fetus is very sensitive to the mother's core temperature. A high fever in a pregnant woman needs to be treated immediately.

These are conditions that are specifically related to the pregnancy and postpartum period.

Perinatal infections may cause congenital abnormalities in the fetus if contracted in the first trimester and may not be life threatening to the mother. Examples are the TORCH infections (toxoplasmosis, rubella, cytomegalovirus and herpes simplex). These infections are known to affect the development of organs *in utero* and can cause spontaneous abortion or major fetal abnormalities, including blindness, deafness, mental retardation and cardiac defects.

Infections can be categorised according to:

- the pathogen: virus, bacteria, protozoa or parasite. Viruses are smaller than bacteria and can cross the placenta more easily (bacterial, viral, protozoa, helmints and fungal)
- the systems or organs involved: local (e.g breast abscess) or systemic (e.g. HIV)
- acute or chronic status (malaria or HIV)
- the stage of the pregnancy when the infection was contracted. Infections in the first trimester can cause congenital abnormalities. Infections later in pregnancy can lead to premature birth (malaria, as a result of high temperature in the mother), infection in the newborn (e.g. measles or hepatitis) and complications postdelivery.

50.1 TORCH

This is a group of infections known to cause damage to the fetus *in utero*:
Toxoplasmosis
Rubella
Cytomegalovirus
Herpes Simplex Type 2

Complications

The midwife needs to understand the complications of the condition for the mother and the fetus and any possible complications during the pregnancy itself. The midwife also needs to understand how the condition is treated and any side effects of the treatment. All conditions of infection are referred to a medical practitioner for appropriate investigation and treatment.

Source of infection

Infections can be:

- *Endogenous*. These infections can be by organisms that are normally present in the body that only become pathogenic under specific circumstances, for example *Candida albicans* and *E.coli*.
- *Exogenous*. These are infections from external pathogens, such as cold and influenza viruses.
- *Autogenous*. Pregnancy causes a degree of immunocompromise and dormant infections such as cytomegalovirus or hepatitis B may flare up. Women who suffer frequent UTIs may find that these worsen during pregnancy.
- *Nosocomial*. These are infections that are acquired in hospitals or other healthcare institutions. Midwives must pay strict attention to the rules of hygiene and asepsis.

Predisposing factors

Factors that predispose mothers to infection in pregnancy are:

- *Socioeconomic factors*. This includes poverty resulting in poor infrastructure, low levels of education, lack of safe water supplies and poor housing.
- *Poor nutritional status*. This leads to vitamin A deficiency and anaemia.
- *Availability of healthcare*. Accessibility, affordability, accommodation and acceptability of quality healthcare services.

The most common conditions that complicate pregnancy are briefly presented below.

50.3 Common infections complicating pregnancy, birth and the newborn

Bacterial infections

Urinary tract infection (UTI)

Urinary tract infection is one of the most common medical conditions in pregnancy. It is estimated that about 11% of all pregnant women have bacteriuria. The urethra, the bladder,

the ureters and the renal pelvis are affected, but the infection can also often involve the renal parenchyma.

It is important to understand the changes in the renal system during pregnancy. Progesterone relaxes the smooth muscles and so causes dilatation and atony of the bladder, of the ureters (with kinking) and of the renal pelvis.

Women have a short urethra (3.5 cm) in close proximity to the rectum, the perineum and the vagina. The urethra is subjected to pressure from 12–20 weeks. At 20 weeks the uterus dextroverts to the right, causing extra pressure on the right ureter, which is usually the first to be affected in cases of pyelonephritis. At 38 weeks, engagement of the fetal head will also subject the urethra to pressure.

Trauma can occur during labour, as the bladder base and neck are fixed structures. They become bruised, resulting in damage and atony leading to urinary stasis.

UTI may be asymptomatic in pregnant women until a substantial bacteriuria is present (100 000 colonies/ml). This means that a UTI can progress and develop into pyelonephritis in about 10% of women.

Below is a summary of infections in the urinary system, including acute pyelonephritis.

Disturbances of the urinary tract during pregnancy: first trimester (20 weeks)

- *Frequency of urine*. This is due to the increased blood flow through the kidneys. It requires no treatment.
- *Retention of urine*. This is caused by retroversion and incarceration of the gravid uterus. The uterus is displaced backwards, pulling on the anterior vaginal wall and stretching the urethra. If the uterus is incarcerated the woman will have retention of urine and a full bladder is very painful. After the diagnosis is made the woman will be catheterised on prescription. **Bladder infections occur after cathererisation and therefore women are not catheterised in pregnancy as a rule.** (Catheretisation is a part of the regime and protocol of care in eclampsia and in emergencies.)

Disturbances of the urinary tract during pregnancy: second trimester (20–30 weeks)

Asymptomatic bacteriuria. About 30% of affected women develop clinical renal tract infection in pregnancy, therefore it is important to test the urine of all pregnant women at each antenatal visit. The organism is cultured in the urine, but the patient has no signs and symptoms of a urinary tract infection. A specimen of urine containing 100 000 colonies per ml of organisms is significant. This is a common condition and can become dangerous in pregnancy. Women with a history of previous preterm births, IUD, postpartum infections, reoccurring uterine and vaginal infections, STD's and HIV are high-risk patients for UTI.

Other pregnant women at risk are diabetics, cardiac patients and anaemic women. A mid-stream specimen should be sent for any dipstick urine specimen that is not normal.

Disturbances of the urinary tract during pregnancy: third trimester (30–40 weeks)

Acute pyelonephritis. In acute pyelonephritis, the woman can become severely ill and will require intensive care facilities in some cases.

- *Signs and symptoms*. These include
  - fevers, rigors and pyrexia
  - headaches
  - tachycardia
  - pain in one or both loins, leading down to the groin in some cases. There is costo-vertebral angle tenderness on fist percussion
  - burning on micturition, frequency and dysuria
  - hypotension
  - oliguria in the first 24–36 hours, which is due to oedema and congestion of the renal parenchyma, the tubules, the renal pelvis and the ureters, and to dehydration as a result of the nausea and vomiting.
- *Diagnosis*. This is based on the clinical picture and history:
  - tenderness over kidney area
  - midstream clean catch specimen
  - microscopic culture and sensitivity (MC&S)
  - blood test.
- *Treatment*. This is as follows:
  - hospitalised on bed rest
  - IV therapy Ringer's lactate (125 ml/h)
  - appropriate antibiotics
  - strict intake and output of at least 30 ml/hr
  - symptomatic pain management
  - suppression of uterine contractions
  - **Beware:** Temp 38 °C, pulse 120, BP 90/50 (septic shock).

Disturbances of the urinary tract during pregnancy: Postnatal – (6 weeks)

Women are more likely to get a UTI postdelivery due to:

- infections of the urinary tract in pregnancy
- anaemia
- catherisation during the second stage of labour and during epidural and caesarean section.

Note that a urine test postnatally is contaminated with blood and gives dubious information on infection. **A clean catch midstream specimen is needed for diagnosis.**

Antibiotic prophylaxis. Women with UTI and pyelonephritis in pregnancy will continue with the antibiotics used postnatally sometimes for 6 weeks. Women with complicated birth such as APH, PPH, caesarean section, manual removal of placenta, forceps, ventouse, or cervical tears and episiotomy receive routine IV prophylactic antibiotics often in labour. Women with a history of infections such as sexually transmitted infections, chorioamnionitis, preterm birth and other perinatal infections including HIV may need treatment.

50.2 Collecting a clean catch midstream urine specimen

A midstream specimen is almost impossible to collect without contamination. A clean-catch specimen, however, if meticulously carried out, is preferable.

- The patient is fully instructed and supervised during the procedure.
- A sterile pack and saline solution are provided and carefully opened by the nursing staff
- The patient is instructed to wash her hands thoroughly and to dry them on sterile towels provided.
- The vulva is swabbed with sterile swabs and saline, working from the front of the labia to the back.
- The patient is instructed to hold open the labia while the vestibule is swabbed carefully from front to back.
- The patient is then instructed to pass urine while holding the labia open.
- The patient must stop urinating halfway and hold the urine.
- A sterile container kidney dish is then placed in position and the middle portion of the urine is collected in the kidney dish and transferred to a clean urinary specimen bottle and sent for MC&S

Pelvic inflammatory disease (PID)

- *Cause. Neisseria gonorrhoea,* Chlamydia, *Mycoplasma hominis, Gardnerella vaginalis,* Trichomonis.
- *Pathology.* Infection of the female organs due to ascending infection from the vagina. More common in nulliparas between the ages of 15–39. Seventy percent of affected women are under 25 years of age and 50% of the partners have urethritis.
- *Signs and symptoms.* These include:
  - abdominal pain - this varies from aching, to burning, to cramping and stabbing pains
  - abnormal vaginal bleeding
  - adnexal, uterine and cervical tenderness
  - dyspareunia
  - purulent pelvic discharge
  - fever
  - gastrointestinal tract symptoms: Nausea, vomiting, diarrhea, constipation and straining
  - urinary tract infections
  - dysuria
  - frequency of micturition.
- *Diagnosis.* This is made from:
  - excluding pregnancy
  - white cell count, Hb and status for syphilis (Wassermann reaction)
  - serum C reactive protein
  - cervical culture
  - endometrial culture
  - Fallopian tube culture
  - laparoscopy, to diagnose acute salpingitis
  - urine specimen, clean catch specimen for bilharzia and renal tract tuberculosis
  - stool examination for amoebiasis
  - X-rays
  - sonar.
- *Treatment.* This includes:
  - intensive/high care
  - broad spectrum antibiotic (Gram-positive organisms as well as the Gram-negative and the anaerobes)
  - adequate pain relief (pethidine, morphine)
  - antipyretics after diagnosis is made
  - anti-inflammatory
  - deep heat to the pelvis
  - high protein diet, vitamin B complex, vitamin A and C
  - IV and central venous pressure line
  - physiotherapy to prevent venousthrombosis.
- *Complications – primary.* These include:
  - cervicitis
  - endometritis
  - parametritis
  - salpingitis
- *Complications – secondary.* These include
  - diverticulitis
  - appendicitis

- septicaemia
- chronic pelvic pain, Reiter syndrome (sexually acquired reactive arthritis), cervical cytologic atypia
- tubal pregnancy
- infertility.

Villitis

Villitis is an inflammatory process that involves the villi of the placenta. In many cases no organisms are isolated. In a small portion of cases villitis is associated with rubella, herpes, varicella, *Toxoplasma gondii* and syphilis. The only bacterium widely recognised as causing villitis is *Listeria monocytogenes*. Stillbirths are three times more common when villitus is present.

Chorioamnionitis (Mycoplasma)

Chorioamnionitis is the inflammation of the chorion, amnion and amniotic fluid that occurs when bacteria gain access to the amniotic fluid and grow. This access can occur when the membranes rupture. It is the most frequent cause of premature labour, fetal distress and placental oedema. It affects both the mother and the baby postdelivery.

Viruses rarely cause the condition, which is usually associated with anaerobic bacteria. The condition is found in about 10% of pregnancies and is often subclinical and asymptomatic in the early stages.

- *Routes of infection.* The main route of infection is through the cervix. Other routes are amniocentesis, fetoscopy, intrauterine infusion, cervical cerclage and premature rupture of membranes (PROM). Frequent vaginal examinations late in the pregnancy can also cause the condition. (*Premature rupture of* membranes (PROM) is defined as the rupture of membranes before the onset of contractions. The inflammation that occurs with chorioamnionitis can contribute to 50% of cases of PROM. If the membranes rupture before 36 weeks it is classified as pPROM - pre-premature rupture of membranes.)
- *Diagnosis.* Diagnosis is based on the level of antimicrobial activity of the amnion and chorion and the presence of the leucocytes in the amniotic fluid. The leucocytes come from the mother and the fetus.
- *Clinical diagnosis.* Often chorioamnionitis is subclinical and asymptomatic. One of the signs of the condition is preterm labour. In 10% of cases the woman may show:
  - tachycardia
  - pyrexia
  - fetal tachycardia
  - tender uterus
  - foul smelling amniotic fluid
  - elevated white blood cell count.
- *Pathogenesis.* Inflammation is always present at the membranes near the cervical os. In twins the first born twin is most affected. If the organism is of low virulence the membranes remain intact. The infection reaches the placenta within 12–24 hours along the chorionic cell layer and bacteria are shed into the amniotic fluid.

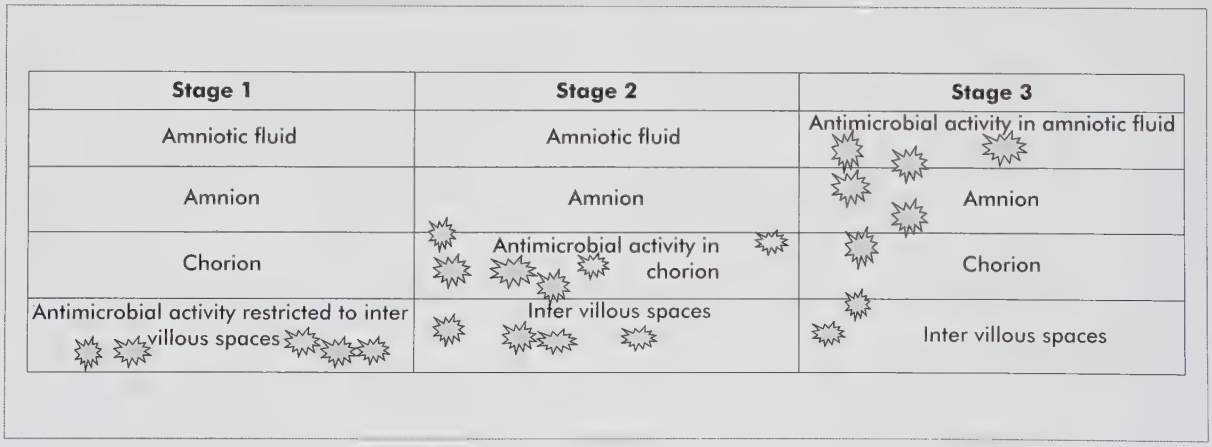


Figure 50.1 The progression of infection from the chorion to the amniotic fluid

- *Stages of inflammation.* In acute amnionitis the inflammation of the chorionic plate is illustrated by the polymorphonuclear leukocytes infiltration of the chorion to the amnion (Black: 1981 in Naeye, et al 1987). When the leucocytes reach the amnion it is classified as stage 3. The diagnosis can only be made by a pathologist, usually by examining the placenta postdelivery. Antimicrobial activity appears in the second trimester and increases with progression of the pregnancy. Figure 50.1 illustrates the progression of infection from the chorion to the amniotic fluid.
- *Treatment.* Once the diagnosis is made birth is facilitated. If the patient is in premature labour the delivery will proceed. A caesarean section is not desirable unless there is an obstetric reason due to the risk of infection. The mother and fetus need close observation during labour using hourly vital signs and electronic monitoring of the baby. It is advisable to start Ringer's lactate intravenous infusion at 125 ml/hr and to notify the paediatrician of the risk.

  If birth is anticipated within two hours antibiotic therapy is delayed until after the birth. This gives the paediatrician time to identify the organism so that treatment can be more effective. The mother receives a broad-spectrum antibiotic intravenously during the third stage of labour. The amniotic fluid is cultured, and cultures from the maternal and fetal side of the placenta and the cord are taken. Antibiotic therapy continues until the temperature is normal within 24–48 hours. The baby is transferred to high care, and as soon as the organism is identified specific treatment is started. Care is given according to the baby's gestational age, weight and Apgar score.
- *Outcomes.* If the mother is untreated she may develop:
  - infections in the pelvic region and the abdomen
  - endometritis
  - blood clots in the pelvis and lungs.

The main outcome of chorioamnionitis is premature labour. The effect on the fetus depends on the stage of the condition and the virulence of the bacteria.

The most common problems associated with a virulent organism are:

- preterm birth - the neutrophils and bacteria release phospholipase that releases prostaglandins from the fetal membranes
- infants born prematurely as a result of choriomanionitis are often ill with infections of the lungs, the brain, and gastrointestinal tract. They are often hypoxic. If the affected amniotic fluid is aspirated, this can lead to pneumonia, bacteraemia and septicaemia
- hypoxia - there is a high incidence of fetal hypoxia due to placental villous oedema associated with infection. Most neonatal morbidity and mortality are due to hypoxia.

Puerperal infections

Puerperal sepsis, previously called puerperal fever, is an infection of the mother's genital tract within 42 days of delivery.

Puerperal infection is defined as: A temperature of 38 °C on two occasions within the first two weeks postdelivery or within the first 24 hours.

The prevalence is difficult to determine but is estimated to be between 1–7%.

50.3 Infections of the postnatal period

Cervicitis, vaginitis, vulvitis, endometritis, parametritis, pelvic abscess, septic thrombophlebitis, UTI, pyelonephritis, mastitis, breast abscess, respiratory infections, post-epidural infections, endocarditis, hepatitis, septic shock, colitis, wound breakdown, HIV/Aids complications.

- *Risk factors.* Risk factors that predispose women to puerperal sepsis are determined and assessed by taking a thorough history and screening women starting in the antenatal period. Risk factors in the history include:
  - history of previous infections
  - nutritional status, weight and anaemia
  - ante- and postpartum haemorrhage
  - bacterial vaginosis
  - sexually transmitted infections
  - any other infection in previous births
  - previous abortions, still births, perinatal deaths or abnormal babies
  - previous preterm births
  - recurring UTIs
  - HIV/AIDS (special counselling required)
  - diabetic women or previous infants of 3.5–4kg birth mass.
- *Special investigations.* These should be carried out as part of screening for risk factors:
  - Hb and full blood count, HIV testing, RPR or VDRL
  - midstream urine for high-risk cases in the second trimester.

- *Risk factors identified in the acute situation (the current birth).*
  - any infection present at birth (asymptomatic bacteriuria, UTI or chorioamnionitis)
  - ruptured membranes for more than 24 hours, (> 4 hours in HIV-positive women)
  - long labours with repeated vaginal examinations
  - operative interventions, episiotomy, forceps/ventouse, caesarean section and manual removal of the placenta
  - low Hb, ante- and postnatal haemorrhage
  - placental pathology such as retained placenta and membranes
  - any other infection based on clinical picture and history (HIV, syphilis).
- *Signs and symptoms.* Any temperature of 37.8 °C in 24 hours or a rise in temperature to 38 °C in two days following birth indicates puerperal infection. Other symptoms are:
  - offensive lochia and subinvolution (2.5 cm a day)
  - pelvic or other pain in the abdomen, legs or genitalia
  - malaise.
- *Early discharge.* This often means that women leave before signs and symptoms are present. Women who are at high risk of pueperal infection should not be discharged early.
- *Infection pathway.* The infection usually spreads from the vagina into the uterus, and involves the endometrium, parametrium and Fallopian tubes and spreads into the pelvis or into the circulation (septicaemia). Figure 50.2 shows the spread of infections after birth.
- *Pathogens.* The following organisms may be involved:
  - Graom-negative and Gram-positive aerobic organisms and anaerobic organisms. Examples are Streptococci, Staphylococci, *E. coli. Neisseria gonorrhoeae,* Klebsiella, Enterobacter, Proteus and Gardnerella. Women that are suspected of having a puerperal infection need to be admitted in hospital for a thorough assessment by a medical practitioner.
- *The clinical picture of puerperal infection.* The clinical picture and history picture varies due to severity, type of organism and stage of the development of the condition. Signs and symptoms include:
  - tachycardia
  - malaise and lack of appetite
  - lower abdominal pain
  - or pain around the caesarean scar
  - headaches
  - nausea and vomiting.

  If untreated the woman may go into septic shock when the organism enters the bloodstream (see Chapter 33).
- *Septic shock - the early or warm phase.* This is characterised by:
  - tachycardia (140 bpm or more)
  - a raised temperature of at least 40 °C
  - hypotension
  - decreased urine output
  - patient orientated and aware.
- *Septic shock - late cold phase.* If untreated the following will set in:
  - profound hypotension
  - cyanosis
  - oliguria (less than 30 ml/hour)
  - respiratory symptoms
  - confusion.

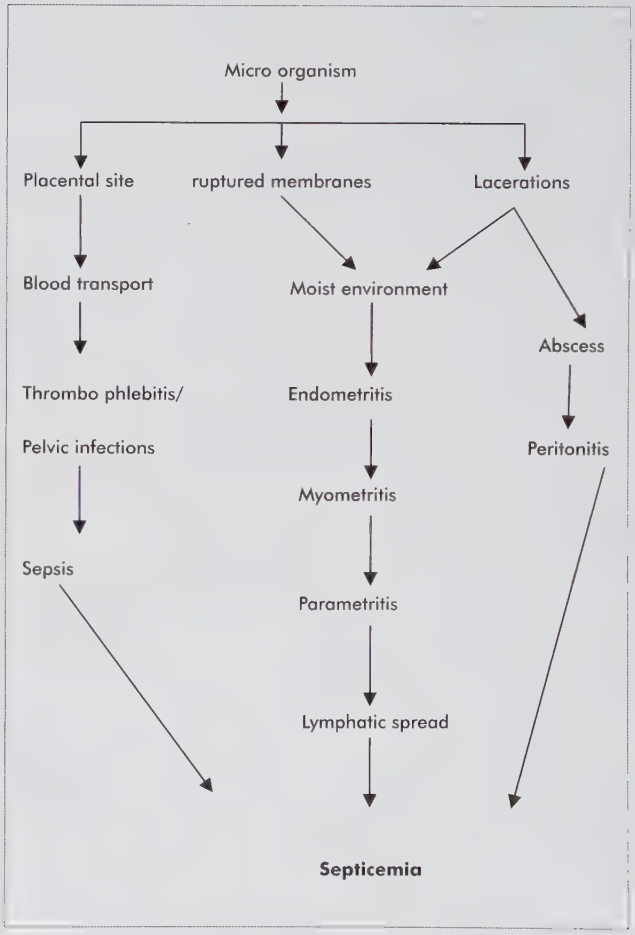


Figure 50.2 The spread of infection postpartum

- *Irreversible shock.* If untreated the women will go into irreversible shock characterised by:
  - clammy and cold skin
  - grey colour (cyanotic)
  - multi-organ failure
  - heart failure
  - anuria
  - respiratory distress
  - acidosis and disseminated intravascular coagulation (DIC).

  This has an almost 100% mortality.

  The pathology of septic shock is shown in Figure 50.3.
- *Special diagnostic examinations.* These include:
  - blood cultures
  - FBC, Hb and haematocrit
  - platelets, fibrinogen, clotting time
  - electrolytes
  - urea and creatinine
  - liver function tests
  - serum protein
  - blood gasses
  - cultures including, swabs from vagina, wound and breast milk and urine M C& S.
- *Imaging.* This includes chest X-ray and ultrasound of the uterus and pelvis.
- *Management.* Treatment starts immediately and includes a broad-spectrum intravenous antibiotic. The woman is admitted to high care.
- *Complications of peurperal fever.* These are infertility and death. The medical management of puerperal fever is indicated in Figure 50.4.

Breast infections

Mastitis is the acute inflammation of the breast. There are two types of mastitis: cellulitis and adenitis.

- *Cause.* The causative organism is usually *Staphylococcus aureas,* but can be a Gram-positive organism or Pseudomonas.
- *Risk factors.* These include:
  - cracked nipples
  - nasal discharge in the baby
  - eye infection in the baby
  - infection in the mother
  - poor hygiene.
- *Prevention of breast infections prior to delivery.* This includes:
  - preparation of the breasts in the antenatal period
  - wearing of nipple shields if necessary

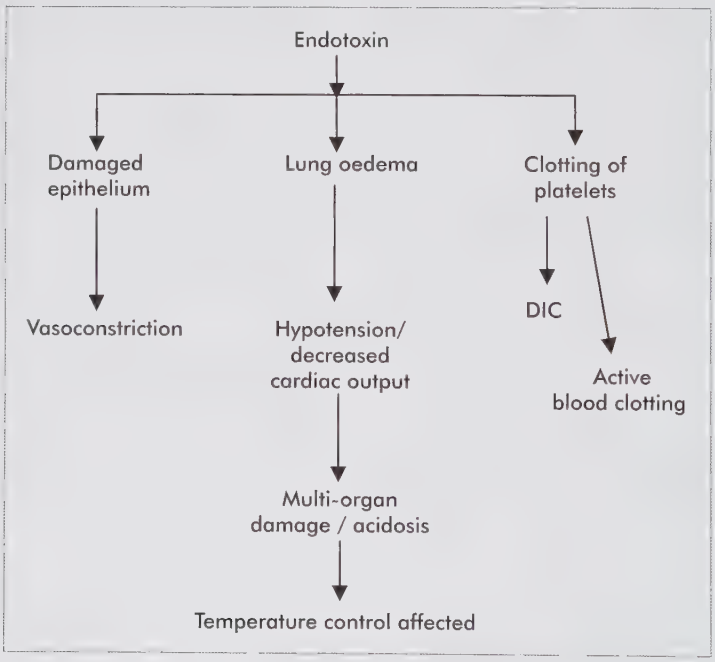


Figure 50.3 Pathology of septic shock

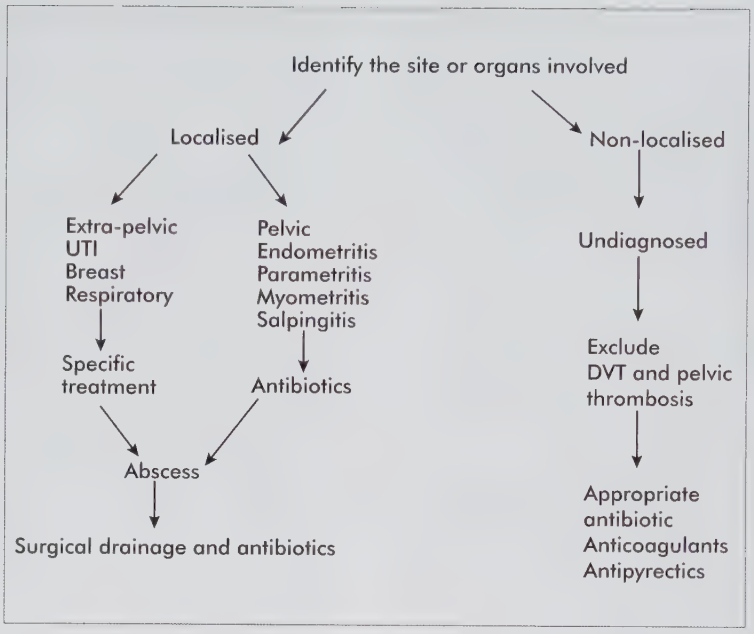


Figure 50.4 Medical management of puerperal fever

- expression of a little colostrum every few days from 36 weeks
- health education on breast care and personal hygiene.

◗ *Prevention of breast infections during feeding.* This includes:

- washing of hands before feeding and after changing the baby remains the most important preventive measures
- gentle expression of the breasts if the breasts are too uncomfortable. The breasts need to be emptied to prevent engorgement and infection
- commencement of breastfeeding within one hour postdelivery
- frequent demand feeding to prevent engorgement and to stimulate neurohormonal reflexes
- prevention of cracked nipples by proper latching and unlatching of the baby on the breast.

Acute cellulitis. Acute cellulitis is a common breast condition where the infection affects the interlobular connective tissue. The milk-secreting apparatus is not primarily affected, so it is not possible to express pus from the ducts. Usually only one breast is affected, often from a cracked nipple. Stasis of milk will cause the duct to become blocked.

◗ *Signs and symptoms.* These include:

- pyrexia of 38–39 °C
- tachycardia
- enlarged glands in the axilla
- the affected breast tissue is tender to the touch, painful and indurated
- the skin is red and flushed
- headaches and general malaise are common
- rigors may be present.

◗ *Management of breast cellulitis.* This includes:

- regular inspection of the breasts in the postnatal period is required to prevent complications
- the treatment of any infection in the mother and her baby is needed to prevent the breasts from becoming infected. Antibiotics and analgesics can be prescribed by a medical practitioner as required
- a manual expression of a sample of breast milk is sent to the laboratory for analysis to identify the causative organism
- early identification and treatment of cracked nipples
- wearing of a well-supporting bra
- if infected the breast is manually expressed until the infection has cleared up, usually 24 hours after the commencement of antibiotic therapy
- the application of hot or cold packs to the breasts can be very soothing
- the use of ultrasound on the breast in selected institutions is of value.

Acute adenitis. This is an uncommon breast condition in which there is primary infection of the milk-secreting apparatus. Organisms ascend through the lactiferous ducts, passed on by the infant from the upper respiratory tract. Both breasts may be affected.

- *Cause.* The condition is usually caused by *Streptococcus pyogenes* and *Staphylococcus aureus.*
- *Signs and symptoms.* These include:
  - pyrexia
  - tachycardia
  - infected area of the breast tissue is red, hot and tender
  - pus that can be expressed from the ducts.
- *Management.* This includes:
  - isolating the mother and her baby
  - sending a specimen of breast milk to the laboratory
  - discontinuing breastfeeding but in very severe cases, lactation is suppressed
  - giving antibiotics
  - wearing a well-supporting bra
  - applying hot packs to the affected area to bring relief.

Breast abscess. If adenitis is not recognised and treated early, a breast abscess may form. This usually occurs on about the 10th–14th day after delivery.

- *Signs and symptoms.* These include:
  - the breast is hard and painful.
  - there is an abscess formation
  - the patient feels ill, with pyrexia and malaise.
- *Medical treatment.* This includes:
  - intravenous or oral antibiotics
  - incision and drainage of the abscess
  - suppression of lactation is sometimes prescribed by the medical practitioner.

Granuloma inguinale (Donovanosis)

- *Cause.* A Gram-negative bacilli, *Donovania granulomatis.* This forms Donovan bodies in monocytes, histiocytes and plasma cells.
- *Pathology.* Incubation is 2–8 weeks. It is particularly common in the tropics and is seen in the eastern regions of Gauteng.
- *Signs and symptoms.* Small painless red papules developing into indurate granulomatous ulcers with rolled edges, which become large beefy-red velvety lesions. Initially non-painful but eventually contain extensive foul-smelling subcutaneous pus. The lesions enlarge and often coalesce to form a single large ulcer. This results in chronic recurrent ulcers found mainly on the vulva, urethra, perinea, anal and inguinal regions. The cervix, uterus and ovaries can be involved and a malodorous vaginal discharge is present. Lymphatic involvement results in inguinal swelling and the formation of abscesses (buboes).
- *Diagnosis.* This is based on the clinical picture and history findings and is confirmed by microscopic examination with Wright or Giemsa stained scrapings from an ulcer.
- These lesions can become malignant, and therefore a biopsy is performed for histology.
- *Treatment.* Erythromycin 500 mg (q.i.d.) orally for 14–21 days. Three weeks' treatment is important – or – cotrimoxazole 2 tablets (b.d.), orally for 10 days – or – IMI gentamicin 3.5 mg/kg (b.d.) for at least 21 days
- *Complications.* These include:
  - marked scarring
  - severe deformity of genitalia
  - dyspareunia
  - massive chronic swelling of labia
  - secondary infection
  - fever
  - anaemia
  - debility
  - cachexia (with abnormally low weight, weakness and debility)
  - death.

Chancroid

Chancroid (also known as soft chancre and ulcus molle) is a sexually transmitted infection characterised by painful sores on the genitalia. Chancroids are known to be spread from one to another individual through sexual contact and is very common in southern Africa.

- *Cause.* A streptobacillus *Haemophilus ducreyi* which is a Gram-negative organism.
- *Pathology.* Incubation is less than one week, usually 3–7 days. The condition is seen more in males than females, and where there are poor hygienic conditions. Sites of lesions in females:
  - vagina
  - peri-urethral area
  - fourchette.
- *Signs and symptoms.* Erythema, leading to numerous general ulcers. They are painful and irregular in shape, with undermined edges. They are soft, granulomatous and friable (bleed very easily) and contain a yellowish purulent exudate and are highly infectious. After about a week, lymphadenopathy occurs. The nodes become

enlarged, malted, painful and suppurating with sinus formation.

- *Diagnosis.* Dark field examination. Culture on special media.
- *Treatment.* Cotrimoxazole 2 tablets (b.d.) for 14 days – or – Erythromycin 500 mg (q.i.d.) for 14 days.
- *Complications.* Destructive lesions leading to fistula formation, gangrene and secondary infections.

Group 13 beta-hemolytic Streptococci

- *Cause.* A Gram-positive cocci *S. Agalactiad* that is present in the vagina, with relative resistance to the acid environment of the vagina. It also thrives in amniotic fluid, therefore it is important that it be treated adequately before labour and delivery. The transmission occurs at or near birth, or from an ascending infection through the genital tract.
- *Pathology.* This mainly affects preterm babies that are less than 35 weeks gestation. Males are more affected. The disease can be present within a few hours of birth, in the newborn up to 72 hours of life, or from 7 days to 12 weeks after delivery.
  In some areas, high percentages of pregnant women are colonised, in others not, therefore vaginal colonisation can vary enormously from area to area. The cocci have been isolated from the urogenital tract of asymptomatic women postpartum and from the urethra of spouses of colonised females.
- *Cause.* Septic abortion, stillbirth and premature labour, due to chorioamnionitis and premature rupture of membranes.
- *Signs and symptoms – maternal.* The disease in adults is usually asymptomatic but is associated with:
  - vaginitis
  - cervicitis
  - urethritis
  - cystitis
  - pyelonephritis.
- *Signs and symptoms – newborn.* These include:
  - respiratory distress that is sudden, unexplained and without decrease of lung compliance
  - signs of shock
  - apnoea
  - tachycardia
  - lethargy
  - jaundice
  - bulging fontanelles, meningitis
  - coma.
- *Diagnosis – maternal.* Done by high vaginal swab when rupture of membranes occurs before 36 weeks for more than 24 hrs.
- *Diagnosis – newborn.* Includes cultures from lumbar puncture, urine, serology and tracheal aspirate. Screening: swabs from ears, umbilicus and rectum for culture.
- *Treatment – maternal.* Prophylactic treatment includes antibiotics for women with pPROM before 36 weeks. There is a 95% risk of infecting the baby. Intravenous administration of antibiotics in labour may be prescribed.
- *Treatment – newborn.* Admit in ICU and treat with appropriate antibiotics.
- *Complications – maternal.* Puerperal sepsis.
- *Complications – newborn.* This is the most common infection in newborns. Severe neonatal septicaemia/ pneumonia and meningitis.

Tuberculosis in pregnancy

- *Cause. Mycobacterium tuberculosis* (Koch's bacillus). This infectious disease is transmitted by sputum and spreads rapidly in congested unhygienic conditions. It is not transferred across the placenta.
- *Pathology.* This is an extremely debilitating disease and pregnancy does not adversely affect the course and prognosis of the disease.
- *Signs and symptoms.* These include:
  - pyrexia
  - night sweats
  - weight loss
  - anorexia
  - purulent sputum
  - haemoptysis
  - low grade fever
  - general malaise
  - chest pain.
- *Diagnosis.* Consider:
  - family history
  - based on clinical picture and history symptoms
  - sputum investigations: examination for acid fast bacilli
  - X-rays (of the chest in lung tuberculosis) should only be done if the diagnosis is strongly suspected – the baby must be protected by a lead apron
  - once diagnosed, the family and immediate household must be fully investigated and treated if they have the disease
  - Mantoux at 6–8 weeks on the baby.
- *Treatment – maternal.* Includes:
  - antenatal screening
  - treatment with directly observed treatment (DOT)
  - streptomycin and rifampicin are **not** used in pregnancy

- the aim of treatment is to make the sputum negative by the time the baby is born
- assisted delivery
- check for anaemia.

- *Treatment – newborn.* Take note of the following:
  - give BCG (Bacilli-Chalmette-Guerin) vaccine
  - allow breastfeeding
  - commence prophylactic treatment – Isoniazid syrup 25 mg/kg/day.
- *Complications – maternal.* Includes possible:
  - death
  - abscesses
  - extremely resistant TB.
- *Complications – newborn.* Includes possible:
  - deafness of fetus
  - neural tube defects
  - 50% risk of fetus getting the disease if not treated
  - long term complication if not treated
  - any organ can have TB in the body in childhood
  - brain abscess with a high mortality.

Bacterial vaginosis

- *Cause.* Gardnerella or Haemophilus an anaerobic Gram-variable rod.
- *Pathology.* 20% incidence. Bacterial vaginosis, also called BV, is the most common vaginal infection in women of childbearing age. It happens when the normal balance of bacteria in the vagina is disrupted and replaced by an overgrowth of certain bacteria called Gardnerella. Lactobacilli need an 'acidic' environment to survive.
- Many studies have demonstrated the relationship of *Gardnerella vaginalis* with other bacteria in causing BV. BV is known to be a synergistic polymicrobic infection. Some of the associated bacteria include Lactobacillus species and anaerobes, including Mobiluncus, Bacteroides, Peptostreptococcus, Fusobacterium, Veillonella, and Eubacterium species. *Mycoplasma hominis, Ureaplasma urealyticum,* and *Streptococcus viridans* may also play a role in BV. *Atopobium vaginae* is now recognised as a pathogen associated with BV.
- *Signs and symptoms.* An abnormal greyish vaginal discharge attached to the mucosa with an unpleasant odour (strong fish-like odour, especially after sexual intercourse). The discharge can be white (milky) or gray and thin. Other symptoms may include burning when urinating, itching around the outside of the vagina, and irritation. However, these could be symptoms of another infection too. Some women with bacterial vaginosis have no symptoms at all.
- *Diagnosis.* This is based on:
  - the clinical picture and history
  - a sample of vaginal fluid for laboratory examination for the type of bacteria linked to BV
  - a wet mount preparation of physiologic saline mixed with vaginal secretions should be examined under low-power and high-power objectives
  - few white blood cells and lactobacilli. The characteristic 'clue cells' are identified as numerous stippled or granulated epithelial cells. This appearance is caused by adherence of almost uniformly spaced *G. vaginalis* organisms on their surfaces
  - clumps of *G. vaginalis* organisms may also be noted attached to the edges of epithelial cells or floating free in the preparation. Cultures are seldom necessary to establish a diagnosis.
- *Treatment.* Resolves with standard oral metronidazole, 500 mg twice daily for 6 days. A single dose of 2 g has proved effective in treatment of adolescent patients, but in general a 5–7 day course of treatment is more effective.
- *Complications.* These include:
  - long-standing or untreated BV: endometritis, salpingitis, pelvic inflammatory disease, or complications of pregnancy, including premature rupture of membranes, premature labour, chorioamnionitis, and postpartum endometritis
  - BV leads to an increased risk for acquiring HIV
  - post-gynecologic post-abortion infection
  - suspect concomitant infections (such as *Candida vaginitis*) or newer, resistant organisms (*Atopobium vaginae*) in patients whose symptoms do not resolve after treatment of BV.

Syphilis (Acquired) – Primary infection

- *Cause.* Syphilis is a curable infection caused by a bacterium called *Treponema pallidum*, a cork-screw shaped spirocheate. This infection is sexually transmitted, and can also be passed on from a mother to her fetus during pregnancy. As a cause of genital ulcer disease, syphilis has been associated with an increased risk of HIV transmission and acquisition.
- *Pathology.* Incubation – primary infection 9–90 days. In early syphilis, the organisms are present in large numbers in the blood and tissues are very infectious, whereas in late syphilis, there are only a few organisms in the blood and tissues, and the condition is non-infectious. Syphilis occurs twice as often in males as in females. Half of infected females are asymptomatic, and the lesion can be missed on cursory examination. Within 30 minutes of

penetration of intact mucus membranes, the treponemaes spread to lymph nodes in the groin where they rest for a while, they then invade the bloodstream, multiplying rapidly every 30–33 hours.

Syphilis in pregnancy

- *Pathology*. This depends on the stage of the disease and stage of pregnancy. Successive pregnancies are less affected. Placentas are severely affected. The placenta can act as a barrier till 18 weeks of pregnancy although the baby may be affected earlier.
- *The infection may be asymptomatic.*
- *Signs and symptoms – primary*. A pimple on the vulva or cervix becomes a macule, then a papule and eventually an ulcer known as a chancre. The ulcers can be single or multiple, well circumscribed and round, painless, highly infectious, oozing serous fluid teeming with Treponemae. If untreated, these heal within three weeks, leaving a scar. A few days after the lesion appears, lymph nodes can be felt in the groin; swollen round, small, rubbery, discrete and bilateral. The site of the lesions can be the cervix, labia, clitoris, tongue, lips, tonsils, fingers, nipples.
- *Signs and symptoms – secondary (6–8 weeks)*. Malaise, fever, headaches, pharyngitis, joint pains, and anorexia. 80 % of cases develop a widespread skin rash which lasts 2–3 weeks. A variable maculopapular rash is found on the limbs, palms of the hands, soles of the feet, the stomach, face, occasionally across the forehead, and this is known as the 'Crown of Venus'. It can also appear as a faint dusky-red, non-irritant rash on the ribs and trunk.
- *Diagnosis*. This is made from:
  - a non-specific (non-treponemal) test, such as the Rapid Plasma Reagin (RPR) test or Venereal Disease Reference
  - laboratory (VDRL) test (false positive/negative)
  - any reactive positive to be followed by a specific (treponemal) test, such as the Treponema Pallidum Haemagglutination test assay (TPHA) or Treponema Pallidum Particle Agglutination Assay (TPPA) or FTA-ABS
- *Treatment – primary syphilis – (1 year duration)*.
  - IMI 2.4 million units (MU) Benzathine Penicillin G as a stat dose - or -
  - IMI 4.8 million units (MU) Procaine Penicillin for 8 days - or -
  - if allergic to penicillin - Erythromycin Stearate 500 mg orally four times a day (q.i.d.) for 15 days, (this is less effective, and only used if penicillin is contraindicated).
- *Treatment – secondary syphilis – (more than 1 year duration)*. Includes:
  - Benzathine penicillin G, 2.4 million units (MU) IMI weekly for 3 weeks
  - if there is an allergy: Erythromycin Stearate 500 mg for 30 days, (q.i.d.) orally.
- *Treatment – tertiary syphilis (neurosyphills)*. Includes:
  - Aqueous Crystalline Penicillin G. 12–24 million units (MU) IMI daily for 10 days followed by Benzathine Penicillin G IMI 2.4 million units (MU) weekly for 3 weeks.
- *Complications – Tertiary syphilis (latent 2–20 years)*. Gumma now appear. This is a non-infectious stage in which all tests are positive. Tumours which are gray, punched out, sloughy-based, rubbery, hard and non-suppurative. These gumma ulcerate, becoming painful, rotting in and under the skin and bone. They can perforate the hard palate and nasal septum causing nose bridge destruction. As the disease progresses, the patient will develop cardiovascular and neurosyphilis (becomes insane).
- *Complications – in pregnancy*. There is a 40% risk for:
  - abortion
  - intrauterine death
  - IUGR
  - stillbirth
  - neonatal death
  - congenital syphilis.

Congenital syphilis

On 22 February 1991 in Regulation No 328, Congenital syphilis was declared a notifiable medical condition in South Africa.

- *Cause*. Transferred from mother to child. The disease is totally preventable. In the developed world pregnancy is rarely complicated with syphilis. The developing world is facing a crisis with STD's and syphilis which are poorly controlled. It is a major problem in sub-Saharan Africa. The transplacental infection of the fetus occurs in pregnancy at all stages. The effect on the fetus depends on:
  - the stage of the pregnancy
  - the stage of the disease
  - gravity (number of pregnancies)
  - treatment available and instituted.
- *Pathology*. Vertical transmission can occur at any stage of pregnancy. Incidence is 60–100%.Transplacental transmission can occur as soon as 6 weeks *in utero*. The inflammatory processes usually do not occur in the first trimester (and organogenesis is not involved). Typically and usually the fetus is affected after 18 weeks during

the second trimester. After 24 weeks 66% of fetuses will be affected mainly in the secondary stages of the disease and have a higher transmission than a primary infection. Congenital syphilis does not have a primary stage. Intense *inflammatory responses* and prostaglandins induced by fetal infection may be responsible for fetal death or pre-term delivery and severe growth retardation or other manifestations of congenital syphilis. The placenta is severely affected and the following noted:

- large and oedematous placenta
- chronic villitis
- acute chorioamnionitis

- *Signs and symptoms – in utero.* Placental involvement and abnormal hepatic function occur *in utero*. This is followed by amniotic fluid infection and haematological abnormalities, ascites and hydrops fetalis (anaemia and cardiac failure). Intrauterine death (IUD), the baby may die *in utero*.
- *Signs and symptoms – after birth.* The baby may be normal and asymptomatic but develop symptoms within weeks (thus appearing normal but having the disease). Look for:
  - poor feeding
  - snuffles are early signs
  - failure to thrive
  - pneumonia
  - rash in palm of hands, feet and anus/bullous skin/copper coloured rash
  - chronic saddle nose
  - nasal fluid highly infectious
- *Signs and symptoms of seriously affected babies at birth.* These include:
  - all organs are involved
  - hepatosplenomegaly in 100% of cases
  - jaundice
  - skin sores
  - a very runny nose that is sometimes bloody (and infectious)
  - slimy patches in the mouth
  - inflamed arms and legs
  - swollen liver
  - anaemia
  - jaundice
  - pneumonia
  - a small head
  - hydrops fetalis (cardiac failure).
- *Diagnosis.* All women that have not been tested in pregnancy are tested and treated in labour.

Newborn testing is problematic because of the maternal IgG that blur results. A correct diagnosis is possible on 6 months. The following apply:

- history and antenatal test of mother
- RPR Rapid test
- ART (Reagin test)
- VDRL antibody.

- *Treatment – preventive.* Antenatal screening is required for all pregnant women in first trimester (of pregnancy (Rapid test). High-risk cases are re-tested in the third trimester. All infected mothers are treated in pregnancy. All women's syphilis status (Wassermann reaction) must be known at birth.
- *Treatment – newborn.* All newborns of positive mothers receive Procaine Penicillin G 50 000 U/kg/d IMI once for 10 days – or – IV Penicillin G 100 000 – 150 000 U/kg/d IV for 7 days to complete 10 days.
- *Complications.*
  - 40% will be still born
  - 40–70% are infected
  - 12% of infected newborns die from the disease
  - 25% can be intrauterine death (IUD)
  - 25–30% perinatal deaths.
- *Complications – late onset of the disease.* Develops from scaring related to early infection and symptoms can appear as late as 40 years later: Complications include neurosyphilis involving:
  - teeth (widespread upper central teeth)
  - bones (facial deformities)
  - eyes (blindness)
  - 8th cranial nerve (deafness).

Gonorrhoea

- *Cause.* Gram-negative, intracellular diplococcus: *Neisseria gonococcus*. This is the second most common infectious disease in the world. It is spread by sexual intercourse.
- *Pathology.* Incubation 3 days–5 weeks. Gonorrhoea is out of control due to the following facts:
  - most females are asymptomatic
  - it is difficult to diagnose in the female
  - there is no blood or screening test for gonorrhoea
  - there is no natural immunity to gonorrhoea, the patient can be re-infected
  - increased promiscuity promotes the condition, as sexually transmitted diseases are behavioural diseases
  - there is a short incubation period
  - the treatment is less conclusive than that for syphilis

- male to female infection ratio is 3:1. In South Africa two-thirds of the people attending sexually transmitted disease clinics have gonorrhoea.

- *Signs and symptoms.* These include:
  - 50% of women are asymptomatic
  - diagnosis is difficult to confirm
  - cervicitis may be present, with an offensive profuse, greenish and watery, irritating discharge
  - cystitis, urethritis resulting in frequency and dysuria
  - Bartholinitis leading to abscess formation
  - vulvitis
  - NB: The discharge comes from the cervix, there is no vaginal discharge as the organism cannot invade the squamous epithelium
  - the patient complains of lower abdominal pain and backache
  - pelvic peritonitis causing infertility
  - acute salpingitis
  - abdominal tenderness
  - lateral fornix mass and tenderness
  - pyosalpinx
  - pelvic abscess
  - acute pelvic inflammatory disease
  - fever
  - shivering
  - chills
  - malaise
  - rectal infection common in women.
- *Diagnosis – maternal.* A Gram-stained smear is only sensitive in 60% of women, therefore an endocervical swab in Stuart's medium for a culture should be done in women. Blood for STD's is taken before treatment.
- *Diagnosis – newborn.* A swab of eyes if infected is taken.
- *Treatment – maternal.* Explain the condition to the woman and explain that partners also need treatment. Repeat the STD test 3-monthly. Treatment is a single dosage of Ceftriaxone 250 mg IM and Doxycycline 100 mg orally bid for 7 days - or - Procaine Penicillin G: 4.8 million units IMI stat. (That is 2.4 million units into each buttock.)
- *Treatment – newborn.* This includes:
  - Erythromycin or Tetracycline eye ointment
  - intravenous Crystalline Penicillin 50 000 units/kg/day in two divided doses for seven days.
- *Complications – maternal.* Chronic pelvic infection, and sterility.
- *Complications – newborn.* It causes Ophthalmia neonatorum when the baby is infected during the passage through the birth canal. If left untreated, the ophthalmia will cause corneal ulceration and permanent blindness.

Viral infections

Flu and the H1N1 virus

- *Cause.* Viral and seasonal flu. It can be epidemic and is increased through travelling.
- *Pathology.* Pregnant women are no more likely to get the H1N1 flu virus than the rest of the population, but they are more likely to have complications. Most pregnant women who get the H1N1 flu experience mild symptoms of influenza. They will be sick for a few days with fever and cough, and then recover. A small number may become severely ill and require hospitalisation. As with seasonal influenza, pregnant women, especially those in the second and third trimester, and women up to 6 weeks after delivery are at a higher risk of developing complications from influenza (e.g., pneumonia).
- *Signs and symptoms.* These include:
  - rapid onset of fever
  - new/ worse cough or shortness of breath
  - sore throat
  - aching muscles
  - aching joints
  - extreme exhaustion.
- *Diagnosis.* This is based on the clinical picture and history.
- *Treatment – preventive.* Consider the following points:
  - Vaccine for pregnant women must not be live virus. Specific vaccine for H1N1 vaccine is needed.
  - Practise frequent and thorough hand hygiene using soap and water or alcohol-based hand sanitation containing 60 to 90% alcohol.
  - Cough and sneeze into a tissue or sleeve and encourage all close contacts to practise hand hygiene and correct cough/sneeze etiquette.
  - Avoid touching eyes, nose or mouth.
  - Keep common surfaces and items clean and disinfected.
  - Be aware of early flu-like symptoms and advise the pregnant woman to contact her healthcare provider or if she starts feeling ill with flu-like symptoms.
  - Avoid being the primary caregiver of infected persons.
  - Stay 2 metres from any infected person.
  - Stay home if sick and remain at home until the fever is no longer present and the pregnant woman is feeling well. Pregnant women who have a cough but no other symptoms can return to work.

- Talk to the pregnant woman's healthcare provider and develop a personal plan to reduce the effect of H1N1 on mother and unborn child, including: how to reduce exposure to the flu, including H1N1, in the home, community and workplace; and how to get treatment if flu-like symptoms develop.

- *Treatment.* If very sick, the pregnant woman is admitted in hospital for treatment to prevent complications.
- *Complications.* Pregnant women are more prone to develop complications from an influenza infection. There is a high mortality rate of pregnancy when H1N1 is reported.

Condylomata Acuminata

- *Cause.* Human papilloma virus (HPV).
- *Pathology.* Incubation period of 6 months. Infected areas are:
  - vulva, the inner aspects of the labia
  - vagina
  - cervix
  - perineum.
- *Signs and symptoms.* Red-pink, pinhead in size lesions. The lesions enlarge, reproduce rapidly, become pedunculated and coalesce to form firstly, mulberry-like (in appearance) growths in single or multiple clusters and eventually large cauliflower-like masses.
- *Diagnosis.* This is based on the clinical picture and history of lesions noted. In addition:
  - dark field microscopy
  - colposcopy
  - PAP smear
  - biopsy.
- *Treatment.* Candidias and Trichomoniasis are always also tested for, as they are often present as well. The growths are painted with 10–25 % podophyllum in liquid paraffin. This is cytotoxic, so the surrounding skin is covered in vaseline. This is left on the growths for four hours and then washed off and is repeated weekly until the lesions resolve. It is contra-indicated in pregnant women. Large lesions are treated by cautery, cryotherapy and carbon dioxide laser therapy. (Laser therapy is not used on anal or rectal lesions.) Women are advised to have a Pap smear every six months as there is an association with cancer of the cervix in this condition.
- *Complications.* These include:
  - large, giant warts which are unsightly and embarrassing
  - complications of labour if very extensive.
  - an association with cervical intra-epithelial neoplasia and squamous cell carcinoma
  - a possibility of juvenile laryngeal papillomatosis in the infant.

Herpes Simplex Virus (HSV)

- *Cause.* HSV Type 1 is mainly in the oral pharynx. Herpes Simplex virus Type 2 is mainly genital. It is transmitted person-to-person and associated with high risk behaviour. It is a sexually transmitted condition (Genital Herpes). It has a 62% mortality risk for newborns.
- *Pathology.* Incubation 2 to 21 days, but 6 to 12 days in some cases. It is a very common condition in the Western world. The virus is neurotropic, it becomes latent in the dorsal root nerve ganglia of the spinal cord and can re-emerge to cause recurrent clinical disease. The primary attack is more severe and lasts longer, about 3 weeks. Recurrences are likely to be progressively milder, less frequent and resolve more rapidly. It can be transmitted to the fetus *in utero* (rare), intrapartum and postpartum.

  A very demoralising condition and re-activation is due to:
  - stress: emotional or physical
  - certain stages of the menstrual cycle
  - lowered resistance to infection
  - exposure to artificial sunlight
  - friction
  - pregnancy
  - coitus.
- *Signs and symptoms.* It can be asymptomatic. The labia, cervix and vulva are the areas most commonly affected, predominantly the cervix.
- *Signs and symptoms first attack.* These include:
  - headache
  - malaise
  - anorexia
  - pyrexia
  - muscle pains
  - enlarged, painful bilateral inguinal glands.
- *Signs and symptoms thereafter.* Itching and burning followed by small rounded transient vesicles. These burst to form single or multiple red, painful shallow erosions, which eventually form shallow non-indurated tender ulcers which can be very painful. They usually heal within four weeks, average 10–14 days. Painful regional lymphadenopathy is also present. Leucorrhoea that can become a purulent vaginal discharge. Dysuria and retention of urine is also common. The lesions are highly

infectious and there can be rectal and laryngeal involvement as well. The virus may persist in the vagina for up to 3 months.

- *Diagnosis.* This is based on:
  - the clinical picture and history
  - examination of fluid from vesicles, by an electron microscope; Tzanck test.
  - tissue culture (results after 24-48 hours)
  - a rising antibody titre, which indicates current active disease or re-activation.
- *Treatment.* This includes:
  - Acyclovir cream applied to all lesions 6 times a day for 7 days
  - Acyclovir tablets 500 mg 5 times a day for 5 days. This is not used in pregnancy as it is expensive and does not prevent the recurrence.
  - Side effects: nausea, vomiting, diarrhoea, headaches and dizziness.
  - Analgesics can be prescribed as and when required.
  - A vaginal delivery is avoided in at term cases if the patient has a primary attack at the time, or recurrent active genital infection. **A caesarean section is performed under these circumstances so that the baby does not become infected.**
- *Patient education.* Educate women about care and risks including:
  - good personal hygiene and the importance of keeping the lesions clean and dry and avoidance of sexual intercourse until the lesions have disappeared
  - the use of ice and/or warm saline washes that can be very soothing
  - the need to get plenty of rest
  - the positive effect of exposing the lesions to the air for periods during the day
  - the need to treat the sexual partner
  - the use of condoms, which is extremely important in the latent periods
  - the use of a mild antiseptic solution for cleaning lesions
  - the need for an annual Pap smear
  - the need to wash hands after going to the toilet and after treating the lesions.
- *Complications – maternal.* The patient may feel guilty and anxious at this time. If there are active lesions, a non-immune partner will be affected. If the partner has no history of genital herpes, a condom should be used.
- *Complications – newborn.* These include:
  - subclinical infection
  - conjunctivitis
  - pharyngitis
  - aseptic meningitis
  - sacral neuralgia
  - secondary bacterial infection.

Rubella (German Measles)

- *Cause.* Rubeola virus was isolated in America in 1961, with the vaccine produced in 1966. Rubella is endemic in most countries and immunity is lifelong in nearly all cases. It is spread by droplet infection.
- *Pathology.* Incubation 14–21 days. The viraemia produces IgM and IgG and the virus thrives in the fetus. After 14 weeks' gestation, the fetus's immune-competence develops, and the effects are less evident. Malformations occur due to the invasion of fetal cells by the virus at rapid organogenesis. This leads to an inflammatory reaction in the cytoplasm altering the genome. Those organs forming at the time of infection are the most affected.
  - 2–4 weeks 50% abortion
  - 4–6 weeks ocular damage
  - 6–10 weeks cataracts
  - 4–9 weeks heart chamber
  - 8–12 weeks deafness.
- *Signs and symptoms.* These include:
  - a rash, which first appears on the face, and consists of pink-red maculas and papules and lasts for 1 to 5 days. The patient is highly infectious one week before the rash appears, and for two weeks after the appearance of the rash
  - joint pains, swelling of the wrists and fingers, enlarged glands in the neck and occipital regions
  - thrombocytopenia and purpura may also be present
  - when infection occurs, haemaglutination-inhibiting antibodies develop with the rash and reach a peak at 14 weeks
  - the virus is excreted in the nose, the throat and the urine.
- *Diagnosis.* Made from:
  - a single radial haemolysis (SRH) test
  - serology
  - culture from the pharynx, the CSF, and the urine
  - if the test is positive: that is, the results are greater than 15 000 IU/ℓ or ratio 1:10, the patient is immune or has had the vaccination
  - if the test in the antenatal period is less than ratio 1:8, the patient is susceptible, and therefore she should be vaccinated post-delivery
  - weakened live virus: vaccination given during pregnancy can result in fetal anomalies.

- *Treatment.* The mother and baby are isolated. Treatment is therapeutic. Vaccine prevention:
  - all children at 15 months (Measles, Mumps and Rubella)
  - all girls 11 to 14 year old
  - all women planning pregnancies, and then postpone falling pregnant for three months
- *Treatment:* If the mother thinks she has, or has been in contact with rubella treat as follows:
  - take specimens of blood and urine and pharyngeal swabs for culture of the virus
  - take blood for antibody titre, and take blood again 2 weeks later (the titre increases 4 fold if there has been a recent infection)
  - immune-globulin may be given to the mother
  - depending on the stage of infection, therapeutic abortion can be offered by the medical practitioner.
- *At delivery:*
  - take cord blood, and then take blood again 2 weeks later
  - take neonatal throat swab and also send a urine specimen for viral culture
  - take maternal blood for antibodies – (the mother and the baby should have the same levels of IgG)
  - if the IgM is positive in the baby, it shows that the baby has been affected and has made its own antibodies
  - treatment of the baby is symptomatic.
- *Complications.* Congenital Rubella syndrome (eyes and ear and heart defects).
- *Complications later in pregnancy.*
  - CNS: Mental retardation, microcephaly.
  - Cardiovascular: myocarditis, necrosis.
  - Liver: Hepatitis, enlarged liver, jaundice.
  - Blood: Thrombocytopaenia, anaemia, bone marrow damage.
  - Gastrointestinal: Pyloric stenosis.
  - Kidneys: Nephritis. Renal artery stenosis.
  - Bones: Osteitis.
  - Lungs: Pneumonitis.
  - Eyes: Retinopathy, glaucoma, cloudy cornea, microphthalmia.
  - General: intrauterine growth restriction (IUGR), and small-for-gestational age babies (SGA)
  - Babies are infectious for months postdelivery due to virus in urine.

Cytomealic inclusion disease or mononucleosis

- *Cause.* Cytomegalovirus (Sexually transmitted). This is also found in saliva and in urine of babies.
- *Pathology.* Incubation 1 week. The patient can be infected at any time during pregnancy. The infection can become recurrent after having being dormant for a period. If the patient is symptomatic at the birth of the fetus, there is a 90% chance of neonatal complications.
- The patient can be infected at any time during pregnancy. The baby can be affected during delivery from the virus in the cervical secretions or, after delivery, from the breast milk. There will be lifelong infection if untreated. The infection becomes dormant but can flare up from time to time. Laboratory tests show interstitial inflammatory cells and giant cells revealing cytoplasmic inclusions.
- *Signs and symptoms – maternal.* These can be:
  - asymptomatic or
  - acute febrile illness
  - pyrexia
  - malaise
  - lethargy
  - influenza-like symptoms
  - lymphadenopathy
  - abnormal blood lymphocytes
  - anorexia
  - mild leucorrhoea.
- *Signs and symptoms – newborn.* These include:
  - CNS: microcephaly, hydrocephaly.
  - Psychomotor spasticity, epilepsy, mental retardation in children (X-ray shows a small head and intracranial calcification and periventricular necrosis).
  - Ear, Nose and Throat: Deafness (5–10%, 50% is bilateral, choroidoretinitis.
  - Liver: Hepatosplenomegaly, jaundice.
  - Blood: Thrombocytopenia, anaemia (haemolytic), purpura, melaena stools.
  - Lungs: Interstitial pneumonitis.
  - General: Intrauterine growth restriction (IUGR) hydrops features in some cases
- *Diagnosis.* This is made from:
  - blood test
  - viral culture from salivary glands, and from fresh urine
  - cervical smear and a smear of the father's semen
  - occasionally from breast milk.
- *Treatment* – Acute in mother – Immunoglobulin.
- *Treatment – newborn.* If this condition is suspected in the newborn, cord blood is taken at delivery for IgM. If this is raised, then the diagnosis is confirmed by culture of the virus from urine and naso-pharyngeal swab. Medication – corticosteroids. Immune serum globulin may be helpful. The baby is treated symptomatically, and the parents are given supportive therapy.

- *Complications – maternal.* These include:
  - long term infection
  - Rhenitis lymphadenopathy
- *Complications – newborn.* These include:
  - congenital CMV (newborn)
  - low birth weight babies
  - premature labour
  - intrauterine death
  - neonatal death
  - 20–30 % mortality rate
  - abortion and stillbirth.

The baby excretes the virus in the urine for many months, therefore the baby is a potential danger to any pregnant woman. Preterm babies can be infected from a blood transfusion, which results in pneumonitis.

Chickenpox (Varicella)

- *Cause.* Varicella zoster virus, which is highly contagious.
- *Pathology*
  - Incubation 10–20 days
  - The perinatal mortality rate is 20 %
  - Abortion may occur in early pregnancy
  - The perinatal mortality rate is 20 %.
  - If contracted in third trimester, the baby is infectious at birth.
- *Signs and symptoms.* These include:
  - sore throat
  - fever
  - malaise
  - rash/blister itching.
- *Diagnosis.* This is based on the clinical picture and history.
- *Treatment.* Zoster immune globulin (ZIG) is given within 72 hours, to prevent or to attenuate the disease, 0.1 ml/kg stat is given once only IMI. Isolate baby and mother for 20 days.
- *Complications.* Postdelivery vaginal haemorrhage is common. The newborn may be affected.

Measles (Morbilli)

- *Cause.* Paramyxovirus, which is highly contagious.
- *Pathology.* Incubation 10 days.
- *Signs and symptoms.* These include:
  - fever
  - malaise
  - conjunctivitis
  - rhinitis
  - tracheobronchitis
  - Koplik's spots on the mucous membranes of the mouth or labial mucosa
  - a maculopapular rash on the face, ears, upper trunk and neck. By day 3, it appears on the lower trunk.
- *Diagnosis.* This is based on clinical picture, history, and serology.
- *Treatment.* Take isolation precautions. Treat complications.
- *Complications.* Possible abortion and premature labour in pregnancy. The baby may be born with the virus.

Hepatitis B (Complex condition)

This is a blood-borne infection which is also present in vaginal secretions, semen, saliva, sweat, urine, faeces and menstrual blood. It is sexually transmitted and caused by drug abuse. Healthcare professionals are at risk.

- *Cause.* Infective 'Dane' particle/Hepatitis D virus. 10% of people in Europe are infected. Incubation 6–25 weeks.
- *Pathology.* Hepatitus B is readily transmitted to the infant, and therefore all women and especially pregnant drug addicts should be screened, especially if the condition is prevalent in the area. Infection can result in chronic liver disease, and/or the sufferer can become an asymptomatic carrier. Infection in first trimester can cause:
  - fetal anomalies
  - fetal and/or neonatal hepatitis
  - premature labour
  - intrauterine death
  - maternal death
  - baby infected in birth canal.
- *Signs and symptoms.* Manifestations may be more severe and prolonged when the disease occurs in advanced pregnancy. Signs and symptoms include:
  - low grade fever, with general malaise and fatigue
  - marked anorexia
  - abdominal pain due to enlarged liver
  - nausea, vomiting
  - jaundice occurs once the patient starts feeling a little better, leading to chronic liver disease
  - dark urine
  - pale stools.

The onset is abrupt and of short duration, with the early appearance of antibodies.

- *Diagnosis.* Test the patient for HbsAg, (Virus is present) Ground glass hepatocyes, Aminotransferase (AST GOST) is elevated. The patient is then screened for fibre HbAg (HB antigen), as this indicates that the disease is highly infectious. Liver function tests are performed to check on the hepatocellular damage.
- *Treatment – antenatal.* Note the following points:

- Screen high risk cases, such as drug users and those with STDs.
- Give Hepatitis B vaccine.
- There is no special treatment.
- **All staff need to have the Hepatitis B vaccine and repeat 4–yearly.**
- Give routine vaccination of newborns.
- HBIG to be given to accidental needle prick 0.06 ml/kg within 24 hr after incident and repeat after one month.
- Newborns of HBsAg positive mothers to be given HBIG 0.5ml within 12 hours after birth coupled with BCG. This is 70% effective
- Provide adequate precaution during labour and cesarean. Treat as septic.
- Allow bed rest till symptoms are over.
- Strictly no alcohol.

◗ *Complications.* These include:
- liver cirrhosis/cancer later in life
- hepatocellular carcinoma
- reoccurring hepatitis
- jaundice
- remains a carrier for life
- the patient can develop a postpartum haemorrhage due to liver damage, as she is unable to produce prothrombin and other blood products.

Coxsakie virus

◗ *Cause.* Coxsackie B virus. This group of viruses is spread person-to-person. The signs and symptoms usually occur within 10 days of birth in the newborn. The onset is usually acute.

◗ *Pathology.* This virus is able to pass through the placenta and/or it can infect the newborn soon after birth. A mother or a member of the staff, or a visitor, with Coxsackie virus infection poses a hazard to all newborn babies. This is a very infectious disease and is often fatal in the newborn.

◗ *Signs and symptoms – maternal.* These are:
- flu-like signs and symptoms
- pleurodynia or severe chest pains
- aseptic meningitis, with the CSF under pressure, but containing no puss cells.

◗ *Signs and symptoms – newborn.* These include:
- pyrexia
- diarrhoea - often a green, frothy, explosive stool
- poor feeding
- morbilliform rash may be present.
- hepatosplenomegaly.

◗ *Diagnosis.* Depends on virus isolation.

◗ *Treatment.* On an outbreak of Cocsakie virus, visitors are restricted in maternity sections and neonatal units. Outbreaks occur mostly in warm months.

◗ *Complications – maternal.* These include:
- conjunctivitis
- respiratory disease
- myocarditis
- paralysis
- aseptic meningitis.

◗ *Complications – newborn.* These include:
- myocarditis
- tachycardia (gallop rhythm)
- cardiac enlargement
- murmur and cardiac failure
- meningo-encephalitis
- convulsions and coma (the CSF shows a raised cell count)
- jaundice.

Protozoan, Helminth and Fungal infections

Malaria in pregnancy

◗ *Cause.* A Plasmodium, of which there are four species: *P. malariae, P. ovale, P. vivax, P. falciparum.* The vector is the female Anopheles mosquito which is found in stagnant pools and bush surroundings. The female mosquito injects the sporozoites in man.

◗ *Pathology.* Incubation 2–4 weeks. It invades the red blood cells (1%) and may persist in the liver. If untreated the person is sick for months. Malaria is endemic in northern Gauteng, KwaZulu-Natal and in the countries lying north of the Republic of South Africa. Most cases of malaria are reported from Northern KwaZulu-Natal, and the Ingwavuma and Ubombu areas adjacent to the Mozambique border.

◗ *Signs and symptoms.* Malaria is a common cause of pyrexia, a very high fever and chills (the fever has a specific cycle, and is diagnostic of the type of malaria.) The patient is very ill with rigors. Also:
- anorexia
- sweating
- headaches
- generalised aches and debilitation
- vomiting and diarrhoea
- jaundice
- anaemia.

◗ *Diagnosis.* Random blood smears are taken in high-risk areas. If the organism is found in blood smears, antimalarial drugs are commenced. The diagnosis is based on the level of antimicrobial activity of the amnion and

chorion and presence of the leucocytes in the amniotic fluid. The leucocytes come from the mother and the fetus. More than 90% of women that are malnourished in the poor and underdeveloped conditions have antibacterial activity in the amniotic fluid.

- *Treatment.* Malaria can occur in spite of prophylactic measures in some instances:
  - Chemoprophylaxis: Pyrirmethamine is given to suppress malaria
  - Chloroquine 25 mg/kg - or -
  - Pyrimethamine 2.5 mg/kg over 3 days. There is the possibility of chloroquine resistant strains developing in some areas (to falciparum malaria)
  - Dapsone can be used if the patient cannot tolerate chloroquine.
- *Complications.* These include:
  - premature labour, abortion (due to hyperpyrexia and ill health)
  - low birth weight babies (due to parasitisation of the placenta)
  - cerebral malaria
  - anaemia
  - pulmonary oedema
  - spontaneous abortion
  - stillbirth
  - death
  - impact negatively on HIV-positive women's health.

Trichomoniasis

- *Cause. Trichomonas vaginalis,* a unicellular anaerobic oval or pear-shaped four-flagellate protozoan with an undulating lateral membrane.
- *Pathology.* This is a sexually transmitted condition. Incubation 4–21 days.
- *Signs and symptoms.* These include:
  - vaginal discharge that can vary greatly from a mild watery discharge to a profuse, white, greenish-yellow frothy offensive discharge
  - there may be excoriation of the skin around the inner thighs, vulval area and perineum
  - pruritus may be troublesome
  - severe dysuria and cystitis can occur
  - dyspareunia is common
  - severe vaginitis may result known as a 'strawberry vagina'
  - cervicitis, with occasional bleeding from the cervix, especially during pregnancy
  - pain is experienced when a speculum is passed during examination
  - the sexual partner is often asymptomatic and it must be remembered that many women (about 10 %) also remain asymptomatic
  - dysuria.
- *Diagnosis.* This is based on the clinical picture and history. A Pap smear is taken and confirmed by examination of a drop of vaginal fluid mixed with warmed saline under a microscope. It can be cultured on a suitable medium.
- *Treatment.*
  - The patient is referred to a doctor
  - Medication: Metronidazole (Flagyl) 2 grams orally in a single dosage.
  - Avoid coitus for 7 days after treatment.
  - Do not take alcohol for 3 days after treatment.
  - Educate on medication side effects (GTI disturbance, furred tongue, dizziness, hallucinations).
- *Complications.* These include:
  - bartholinitis
  - skenitis (rare)
  - pyelitis
  - super infection of *Candida albicans.*

Chlamydia

- *Cause. Chlamydia trachomatis.*
- *Pathology.* Incubation period 7–21 days. It is now known that 40 % of women and 20 % of men suffering from gonorrhoea have chlamydia as well. Clamydia ophthalmia neonatorum is recognised in babies born of infected mothers.
- *Signs and symptoms.* Note that two thirds of females can be asymptomatic. Signs and symptoms include:
  - vaginal discharge that is yellowish and mucopurulent
  - the cervix is inflamed, swollen, congested, and may have an erosion
  - dysuria
  - urethritis
  - bartholinitis
  - if left untreated, it can spread from the uterus to the Fallopian tubes, scarring them, causing severe lower abdominal pain, ectopic pregnancy and sterility. It is a major cause of pelvic inflammatory disease. However, many women can be carriers and asymptomatic.
- *Diagnosis.* Confirmed by laboratory findings of tissue culture using special cell culture; intra-cellular inclusion bodies (which stain with iodine) are seen.
- *Treatment – maternal.* This is:
  - Erythromycin 500 mg (q.i.d.) for 14 days, in pregnancy.
  - The sexual partner must be treated.
  - If salpingitis is present, Oxytetracycline 500 mgs (q.i.d.) x 14 days, with metronidazole (Flagyl) is used.

- No intercourse until cured.
- Follow-up patients after treatment.

- *Treatment – newborn.*
  - Tetracycline ointment to eyes.
  - Erythromycin syrup 50 mg/kg/day in 4 divided doses, for 14 days.
- *Complications – maternal.* These include:
  - salpingitis
  - infertility.
- *Complications – neonatal.* These include:
  - about 10 days after birth, the baby may develop conjunctivitis
  - an acute afebrile pneumonia develops at about 2–3 months of age
  - nasopharyngitis
  - otitis media.

Candidiasis/Thrush/Monilia

- *Cause.* A fungus (yeast-like organism) called *Candida albicans*. It is not sexually transmitted.
- *Pathology.* This is a normal organism in the body that overgrows when the Ph changes or after broad spectrum antibiotic treatment, as well as:
  - hot humid weather
  - oral contraceptives
  - pregnancy/hormones
  - diabetes mellitus
  - broad spectrum antibiotic therapy
  - immunosuppressant therapy
  - corticosteroid therapy
  - pernicious anaemia
  - immune compromised patients (AIDS).
- *Signs and symptoms.* The vaginal discharge is a scanty white condition with a 'cottage cheese' consistency. The discharge has a slightly offensive odour and covers the vaginal walls in thick white plaques with raw areas present. The vulva may be swollen with pruritis.
- *Diagnosis.* This is based on the clinical picture and history and examination of the white cottage cheese layer on the mucous membrane of the affected organ (mouth/vagina). Bleeding can occur when removed. The vaginal pH is less than 4.5. On a vaginal smear Gram-negative spores (oval-like cells with elongated pseudohyphae) are visible.
- *Treatment.* All women must receive probiotics with any course of antibiotic treatment to prevent overgrowth. Diet and balanced blood sugar is important to maintain the Ph balance.
  - Vaginal infection treat with one time per day clotrimazole 100 mg vagina tab for 6 days or 200 mg for 3 days – or -miconazole 200 mg/day intravaginally 3 days – or – butaconazole 2% cream 5 mg (3 days)
  - take care not to infect the breasts and baby
  - hand washing is essential.
- *Complication.* Candidiasis may be a cause of premature rupture of membranes, intrauterine infection, and occasionally spontaneous abortion. The baby may be infected when passing through the infected birth canal. The breasts and nipples can be infected. The condition can become systemic.

Scabies

- *Cause. Sarcoptes scabiei* – an itch mite. Infection occurs through close personal contact (bedding and clothing) and/or sexual intercourse.
- *Pathology.* The disease appears in epidemics every 12–15 years. The female mite burrows under the skin and lays eggs. The infection comprises about 10–15 burrows. With severe infections, there can be as many as 100 mites.
- *Signs and symptoms.* An erythematous papular rash on hands, face, elbows, breasts, axillae, waist, and genital region.
- *Diagnosis.* This is based on the clinical picture and a history of exposure to the condition. Laboratory findings: scrapings, cutaneous biopsy.
- *Treatment.* This includes:
  - a hot soapy bath, scrubbing lesions thoroughly with Tetmosol (GBH) soap
  - the application of creams, for example Crotamiton (Eurax) 10 %, or sulphur 6 % in petroleum (follow the instructions given for use)
  - NOTE: Benzyl benzoate is NOT used in pregnancy
  - wash the baby with Tetmosol soap
  - apply 10% Eurax cream all over the body, leave for 24 hours, re-wash and re-apply cream
  - wash bedding in hot water, or dry-clean if possible
  - dry the clothing in a tumble dryer if possible
  - treat all sexual contacts and household members
  - follow instructions for treatment very carefully
  - teach the patient about good personal hygiene.
- *Complications.* These include severe excoriations due to intense itch, and possible secondary infection.

Hook worm

- *Cause.* Intestinal nematode from contaminated soil and uncooked meat. Approximately 1 billion people are infected. One third of women in developing countries are infected in pregnancy.
- *Pathology.* Adult hookworms reside in the human small intestine, where they attach themselves by gripping

intestinal lining with their mouths. They ingest blood and cause bleeding at the attachment site. Female worms produce eggs, which are delivered to the outside world in the faeces. If faeces are deposited on the ground, and the weather is warm, larvae develop and emerge in about two days. In warm soil with sufficient moisture, larvae mature in about a week, and can survive for long periods if conditions are right. Larvae that come in contact with bare human skin, burrow in and travel to the lungs in the blood or lymph. By travelling up the air passages to the throat, the larvae are swallowed. They pass through the stomach into the small intestine. Larvae attach to the intestinal lining and mature to adult worms. At about five months of age, worms begin producing eggs.

- *Signs and symptoms.* These are:
  - asymptomatic
  - weight loss
  - tiredness and weakness
  - anemia
  - abdominal pain
  - malnutrition.
- *Diagnosis.* This is based on the clinical picture and history of eggs in stool.
- *Treatment – prophylaxis.* Advise as follows:
  - cook meat well
  - buy from a reliable source
  - wear shoes.
- *Treatment.* Mebendazole has benefits for the pregnancy in spite of the risks.
- *Complications.* These include maternal death related to:
  - anaemia
  - APH and PPH
  - IUGR
  - low immunity
  - asthma
  - diarrhoea
  - viral and bacterial infections.

Tape worm (Cestodes)

- *Cause.* Eating raw and uncooked meat. Cestodes (tapeworms); bladder worms, pork tapeworms, broad fish, dog tapeworms, dwarf and rat tapeworms. Broad fish tapeworms may grow to 35 feet long and live ten years inside the person's intestines. Some tapeworms can lay as many as one million eggs per day. Their bodies are in separate segments with hooks and suction cups on their skull.
- *Pathology.* Eggs laid by adult tapeworms living in the intestines of definitive hosts are excreted with faeces into the environment and ingested by an intermediate hosts (typically another species), in which larvae develop, enter the circulation, and encyst in the musculature or other organs. When the intermediate host (i.e. pork meat) is eaten, cysts develop into adult tapeworms in the intestines of the definitive host, restarting the cycle.
- *Signs and symptoms – adults.* Note that it is not transferred to the fetus. Symptoms include:
  - few symptoms
  - anaemia
  - severe symptoms depending on the organs affected.
- *Diagnosis.* Adult tapeworm infections are diagnosed by identifying eggs or gravid proglottid segments in stool. Larval disease is best identified by imaging (e.g., brain CT or MRI) and, for some species, serologic tests.
- *Treatment.* This includes:
  - prevention – cook meat at 135°C, inspect meat for infestation
  - Praziquantel and niclosamide
  - 90% effective
  - secreted in breastmilk
  - many interactions e.g. Rifampisine
- *Complications.* In contrast to adult tapeworms, larvae can cause severe and even lethal disease, most importantly in the brain, but also in the liver, lungs, eyes, muscles, and subcutaneous tissues.

Tetanus neonatorum

- *Cause.* Tetanus develops when *Clostridium tetani*, an anaerobic, Gram-positive rod that is motile and readily forms endospores. It enters a wound in a non-immunised individual such as the newborn mainly through the umbilical stump, often due to poor hygiene.
- *Pathology.* Incidence is 0.54 per million deaths in South Africa. Incubation period is 5–10 days. Tetanus is polysystemic in terms of pathology and management. Most body organs, as well as the nervous system, are severely affected by tetanus toxins. Tetanospasmin (exotoxin) is taken up by the neuronal end plates and prevents neurotransmitter release at the synaptic junction. This leads to spasms and is irreversible. Recovery requires the formation of new neurons and may take months.
- *Signs and symptoms.* These include:
  - muscle rigidity
  - irritability
  - dysphagia
  - restlessness
  - facial grimacing
  - muscle spasms
  - poor sucking ability.

- *Diagnosis.* This is based on the clinical picture and history: rigid muscles and the newborn's head pulled back. *C. tetani* can sometimes be cultured from the wound, but the culture is not sensitive.
- *Treatment – preventive.* Immunisation of all pregnant women with Tetanus toxoid - 2 or 3 doses in pregnancy.
- *Specific treatment – newborn.* This includes:
  - adequate ventilation
  - antibiotics
  - human tetanus immunoglobulin
  - antitoxin
  - control seizures.
- *Complications.* These include:
  - 80–90% mortality if untreated
  - asphyxia
  - exhaustion
  - death.

Toxoplasmosis

- *Cause.* A protozoa parasite *Toxoplasmosis gondii.*
- *Pathology.* Incubation period is 2 weeks. Antibodies peak after 8 weeks and remain high for months. Infection comes from cat faeces and/or contaminated soil of cats or raw and uncooked meat. The infection is worldwide. The parasite invades and multiplies asexually in the cytoplasm of the nuclei of the host and increases the immunity in host. Tissue cyst forms. Primary infection in pregnancy can be acute or sub acute.
- *Signs and symptoms – maternal.* This is mainly asymptomatic. Acute symptoms may be:
  - encephalitis
  - hepatitis
  - pneumonitis
  - myocarditis
- *Signs and symptoms – newborn.* In congenital toxoplasmosis the baby has a poor prognosis.
- *Diagnosis.* Done by serological IgM antibodies (IFA procedure). There is a 4–fold rise in IgG
- *Treatment – maternal.*
  - trisulfapyrimidines or sulfadiazine 2–6 mg/day or
  - pyramedthamine 25–50 mg/day (adult) for 3–4 weeks
- *Treatment – newborns.*
  - trisulfapyrimidines or sulfadiazine 100–200 mg/kg/day
  - pyramedthamine 25–50 mg/day 2 mg/kg/day for 2days (newborn) then 1 mg/kg/day for 4 weeks
  - congenital infections treated for a year
  - HIV infected women remain on the treatment
- *Complications.* These include:
  - abortion
  - IUD or still birth
- *Complications – newborn.* These include:
  - baby is born with the disease and it can become chronic
  - convulsions
  - blindness
  - severe mental retardation
  - hydro/microcephalic
  - hepatosplenomegaly
  - thrombocetopenic purpera
  - jaundice
  - intercerebral calcification.

50.4 Conclusion

The role of the midwife relating to infections in obstetrics is firstly preventive: his or her role can be summarised in the following points:

- Standard evidence-based protocols for antenatal, intrapartum and postpartum care should be in place and maintained at all times.
- Taking a history and identifying risk factors are important in all the stages of childbirth.
- Improving the nutritional status of women is a primary function of the midwife, through health education and supplementation with vitamins.
- A functional referral system should be in place to diagnose and treat infections appropriately. Protocols for the diagnosis and treatment of infections should be visible in all clinics and units. Special attention is needed for the screening of anaemia, vaginal infections, Pap smears, and sexually transmitted disease.
- The midwife must have expert knowledge of the infective conditions complicating childbirth and the treatment thereof to advise and support women during therapy. The midwife must observe, listen, advise and support the women and family.
- Adherence to a high level of antiseptic care and sterility is required during labour and care of the newborn.
- The prevention and treatment of infections is not the exclusive function of the midwife; he or she will function within a multidisciplinary team and care for the mother and baby, adding value as a clinician, emotional supporter, adviser and coordinator of care.
- An important function for the midwife is to link care between various members of the multidisciplinary team and also support the women by referring effectively. This can often save lives.

CHAPTER

51

Prevention of mother-to-child transmission of HIV

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- apply knowledge of the impact of HIV on pregnancy, birth, the postnatal period and the newborn
- institute appropriate interventions and antiretroviral treatment for women in all stages of pregnancy, birth and in the newborn according to DoH guidelines
- prevent HIV-related complications in pregnancy, birth and in the newborn
- institute 'best practice' for PMTCT for HIV.

KNOWLEDGE ASSUMED TO BE IN PLACE

Basic knowledge of HIV infection, prevention and treatment (see Chapter 52)

KEYWORDS

Prevention of mother-to-child transmission of HIV (PMTCT) • Perinatally acquired HIV • Antiretroviral therapy • Human immunodeficiency virus (HIV)

51.1 Introduction

HIV infection is preventable. The condition cannot be cured, but can be managed as a chronic illness. Transmission in southern Africa is usually through heterosexual sex practices.

HIV infection is generally asymptomatic in the early phase of the disease and mothers who do not know their status may unknowingly pass HIV on to their child. Prevention of mother-to-child transmission of HIV (PMTCT) is a priority in South Africa and has prompted the roll-out of PMTCT services across the country according to guidelines published in 2010, which propose a change to routine testing for HIV and to roll-out nurse-initiated antiretroviral therapy across the country. This chapter provides an overview of the current guidelines for PMTCT.

Prevalence of HIV

Over 33 million people are living with HIV, most of them in sub-Saharan Africa. More than 50% of those infected are women in their reproductive years. HIV-related diseases may account for over 75% of annual deaths in the 15–60 age group within the next 15–20 years in sub-Saharan Africa. Life expectancy in countries severely affected by the HIV epidemic has dropped significantly and is around 40 in South Africa. Currently, AIDS has increased infant mortality by 25% and under-five mortality by over 100% in those regions most affected by the disease. To date, 8.2 million children have lost their mothers or both parents to AIDS, at least 95% of whom have been African. Globally, 1.3 million children will be infected through perinatally acquired HIV (PAH) (more than 1 600 per day). Women account for 18% of AIDS cases and are more susceptible to HIV infections. Antenatal testing in South Africa shows that 20% of women tested HIV positive. The estimated risk of mother-to-child transmission of HIV, without prophylaxis, is 35%.

HIV remains the most important preventable cause of maternal deaths. In South Africa the Confidential Enquiry into Maternal deaths in 1998–2007 reported the following increasing maternal death rates (see Table 51.1).

The number of women tested for HIV in pregnancy has risen to 95% in South Africa. Not all deaths of HIV-positive women are related to their HIV status; 97% of the deaths were related to HIV and 3% were caused by direct obstetric complications (Saving Mothers Report 2005–2007:14–15) See Table 51.1.

Table 51.1

Maternal deaths related to HIV in South Africa

Saving Mothers reports	Maternal deaths related to HIV
1998	14.5%
1999–2001	31.4%
2002–2004	37.8%
2006–2008	43.7%

The Department of Health strategy (2010) to reduce these maternal deaths includes:

- HIV testing of all pregnant women presenting to healthcare facilities.
- Initiation of appropriate antiretroviral therapy by nurses in all levels of healthcare.

51.2 HIV in pregnancy

Women are three times more likely to be infected by HIV. The Langerhans' cells of the cervix may provide a portal of entry for HIV and it has been suggested that some HIV serotypes may have higher affinity for these. The main mode of infection is unprotected sex.

The following modifiable risks are associated with an increased risk of MTCT of HIV infections in pregnancy:

- low immune status – women with low CD4 counts (< 200 cells/ml)
- vitamin A deficiency (currently under investigation)
- smoking, drug use, unprotected intercourse
- placental infection
- mode of delivery – risks lowest with elective caesarean section
- breastfeeding
- fetal trauma
- prematurity
- high HIV viral load.

Potential effects of HIV on the outcomes of pregnancy

Pregnancy itself does not appear to accelerate the progress of HIV (see Box 51.1). The effects of HIV on the pregnancy are discussed below.

Risk of mother-to-child transmission of HIV

Reported rates of transmission of HIV from mother-to-child range from around 15–25% in Europe and the USA to 25–40% in some African studies. Besides the modifiable factors mentioned, there are several other factors that increase the risk of MTCT. These can be divided into early transmission (antenatal) and late transmission (labour and postnatal period, breastfeeding). The risk of PMTCT of HIV is shown in Table 51.2 (without antiretroviral therapy).

51.1 Reported effects of HIV on pregnancy outcomes

- three-times higher risk of spontaneous abortion. 50% of fetuses of mothers that aborted had affected thymus glands
- increased risk of ectopic pregnancy
- 33% of HIV-positive women also have syphilis
- increased risk of all infections, including TB
- twice the risk of preterm labour
- twice the risk of stillbirth
- increased risk of postpartum infections
- increased risk of placental abruption
- 35% risk of PMTCT without maternal treatment or prophylaxis.

The best practice for PMTC of HIV resulting in less than 2% MTCT transmission is:

- universal testing of pregnant women (see Table 51.2)
- antiretroviral therapy from 14 weeks of pregnancy
- delivery by caesarean section
- replacement feeding (bottle).

Evidence-based care and best practice in prevention of MTCT of HIV

In line with World Health Organisation (WHO) recommendations, current South African guidelines are:

- Rapid initiation of lifelong antiretroviral therapy in all pregnant women with:
  - CD4 count ≤ 350 cells/mm^3 or
  - WHO stage 3 or 4 disease, irrespective of gestational age.
  - Newborns born to HIV-infected women receiving antiretroviral therapy for their own health should receive daily nevirapine (NVP) (15 mg, or 10 mg if birth weight < 2.5 kg) from birth until six weeks, irrespective of infant feeding choice.
- All HIV-infected pregnant women who do not meet these antiretroviral therapy eligibility criteria should receive:
  - Zidovudine (AZT) 300 mg orally 12 hourly start antiretroviral therapy from as early as 14 weeks gestation (second trimester) or as soon as possible when women present late in pregnancy, labour or at delivery.

Table 51.2

Risks for MTCT during the phases of childbirth

Period/Factors increasing the risk for PMTC	Risk	Best practice	Reduced risk
Early transmission			
In utero Risk for transmission from 8 weeks Increased risk Highest in late pregnancy Amniocentesis APH	27% Virus present within 48 hrs confirmed on 28 weeks post-delivery	Universal testing Start triple antiretroviral therapy irrespective of viral load from 14 weeks One must be a protease inhibitor	67–70%
Late transmission			
In labour 50% of babies are negative at birth Increased risk Vaginal birth increases the risk Rupture of membranes for more than 4 hours First born twin has twice the risk of acquiring the virus Premature labour APH Interventions like IOL or episiotomy	65% Virus presents after 7–90 days in case of vaginal birth	Caesarean section (c/s) only if it is a safe option Avoid rupture of membranes Intervene after 4 hours of ROM Avoid interventions like IOL and episiotomy	C/s reduces the risk by 50%
Postnatal *Breastfeeding* Increased risk after 3 months 5% increased risk with mixed feeding for each 6 months Double risk after 18 months (local study) Volume of milk taken by baby Viral load Oral thrush and breast infections Premature infants	12–22% Virus is present in cellular and cell-free portions of breast milk	Replacement feeding (bottle) safest feeding mode Low resource settings (rural areas with unclean water) Exclusive breastfeeding ≥ 6 months (No mixing of feeds)	No risk if replacement feeding Risk of HIV at 6 months with mixed feeding is 6%

- At onset of labour/rupture of membranes (or 2– 4 hours before caesarean section), NVP 200 mg single oral dose and continue AZT 300 mg orally every three hours until delivery.
- Postdelivery of infant, the mother should receive tenofovir (TDF) (300 mg) and emtriciabine (FTC) (200 mg) single oral dose.
- Newborn receives once daily NVP (15 mg, or 10 mg if birth weight < 2.5 kg) from birth to six weeks, irrespective of infant feeding choice. Breastfeeding infants who test HIV PCR negative at six weeks continue once daily NVP for the duration of breastfeeding (six weeks to six months: 20 mg/day; six months to nine months: 30 mg/day; nine months to the end of breastfeeding: 40 mg/day).

Guidelines for low resource settings

Figure 51.1 provides an algorithm for the choices available to HIV-positive women in resource-poor settings.

These choices are based on:

- the prevalence of the condition in the community
- local views on testing and subsequent discrimination, which may influence the choices women can make particularly around infant feeding

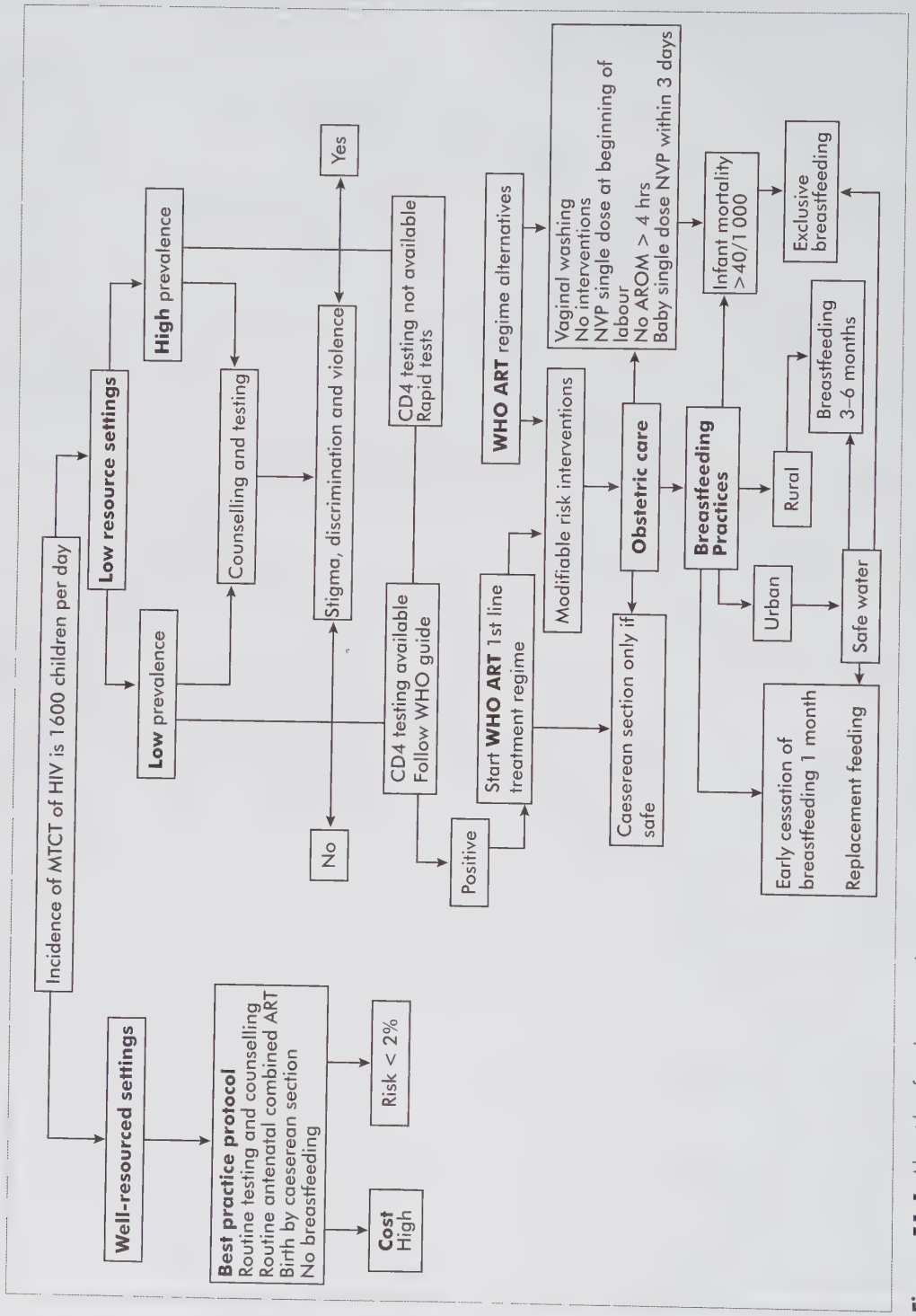


Figure 51.1 Algorithm for choices in low resource settings versus best practices

- whether in an urban or rural setting (services and resources are more available in urban areas)
- the availability of investigations and laboratories
- the availability of antiretroviral therapy
- the availability of medical practitioners and theatres for the performance of *safe* caesarean section
- decisions around feeding will be influenced by availability of safe water supplies and affordability.

Pasteurisation of expressed milk is another option for safe infant feeding by HIV-positve women (see Box 51.2).

51.2 Pretoria pasteurisation/ flash pasteurisation

This is a cheap and easy way to pasteurise breast milk:
- Express breast milk in clean peanut butter glass jar.
- Put 450 ml water (coke tin full) in aluminum pot.
- Bring to the boil.
- Put jar with milk into the boiling water.
- Boil for 15 minutes (Temp. between 56–62°C).

The process has been tested and is reliable under a range of conditions. The HIV virus is illiminated.

Source: Department of Health National guidelines

51.3 Midwifery, HIV and antiretroviral therapy

Midwives are often the only healthcare professionals that a woman will encounter, which means that midwives may be the preferred provider to initiate antiretroviral therapy.

The AIDS Alliance for Midwives was established to support and train midwives in HIV care in pregnancy and birth. In 2010 the DoH 2010 released updated guidelines for HIV care and antiretroviral therapy in South Africa, which is to be nurse-initiated (see Tables 51.3, 51.4 and 51.5).

The specific objectives of the programme are shown in Box 51.3.

Management of antiretroviral therapy

When a woman is on antiretroviral therapy the risk of transmission of the virus to the baby is less than 10%. Table 51.5 gives a list of antiretroviral drugs used in HIV and AIDS during pregnancy.

Antiretroviral therapy consists of at least three drugs, of which one must be a protease inhibitor. Only certain drugs can be used in pregnancy (see Table 51.5). Tables 51.3 and 51.4 give the national guidelines for the management of HIV in pregnancy and in infants less than one year.

51.3 Objectives of the nurse-initiated antiretroviral programme

To prioritise antiretroviral therapy for:
- Patients with CD4 counts < 200 cells/mm^3 or with severe HIV disease irrespective of CD4 count
- Patients co-infected with TB
- Pregnant women with CD4 < 350 cells/mm^3 for lifelong antiretroviral therapy and those with CD4 > 350 cells/mm^3 for prophylaxis
- To test all HIV-exposed children under one year and treat all those found to be infected with HIV
- To standardise first and second line therapy for children, adolescents, and adults (public and private)
- To reduce the use of stavudine
- To expand the use of fixed-dose and co-packaged formulations
- To enable nurses to initiate antiretroviral therapy for treatment and prevention
- To enable primary healthcare (PHC) facilities to initiate, manage, monitor and refer patients.

Source: Department of the Health National guidelines

Counselling

The Johannesburg Community AIDS Centre uses the following counselling guidelines.

Before testing:
- Take the patient to a private setting for counselling.
- Assure the patient that counselling will be confidential.
- Explain or determine the reasons for HIV testing.
- Elicit information about the person's current and previous risk behaviour in a sensitive manner.
- Provide information about HIV, the antibody test, including information about the window period.
- Review the implications of a positive test result for the patient.
- Discuss possible responses to a positive test result.
- Discuss the implications of a negative test result.
- Provide information about test procedures.
- Obtain informed consent.

After testing:
- See the patient personally to give the result – no telephonic results and preferably not before a weekend.
- Give the result as soon as possible after the test is done.
- Deal with the feelings arising from a negative result and explore prevention of infection and the window period.
- Deal with the feelings arising from a positive result.
- Identify the person's immediate concerns.

- Discuss how the patient plans to spend the next few hours and days.
- Identify what support the patient has.
- Discuss who the patient may want to tell about the result and risks to sexual partners.
- Identify what difficulties or problems the patient foresees and how to deal with them.
- Encourage the patient to ask questions.
- Provide information on a healthy lifestyle, medical follow-up, local support systems.
- Refer for follow-up care and counselling.

The delay between taking the test and giving the result should be as short as possible.

Table 51.3

National guidelines for management of HIV in pregnant women

Standard regime for pregnant women	Antiretroviral therapy regime	Fast track	Standard monitoring of pregnant women
Eligible for antiretroviral therapy (i.e. CD4 < 350 or clinical stage 3 or 4)	TDF + 3TC/FTC + NVP Start lifelong antiretroviral therapy within 2 weeks	Pregnant women eligible for lifelong antiretroviral therapy Patients with very low CD4 (<100) Stage 4, CD4 count not yet available MDR/XDR TB	Initial HIV test Clinical staging Screen for TB Do CD4 count Hb or FBC
Currently on antiretroviral therapy	Continue antiretroviral therapy Substitute EFV with NVP if in first 12 weeks of pregnancy		*Follow-up* CD4 done in last 6 months Clinical staging Screen for TB
Contraindication to TDF (renal disease)	AZT+ 3TC + NVP		*Eligible for antiretroviral therapy* Serum creatinine if starting on a TDF-based regimen CD4 of less than 50 refer ALT if starting on a NVP-based regimen *If ALT raised, do HepBSAg and avoid NVP* Hb or FBC if available if starting on an AZT-based regimen. If less than 8 g/dl refer to medical practitioner
Not eligible for antiretroviral therapy, i.e. CD4 > 350	AZT from 14 weeks NVP during labour TDF + FTC single dose after delivery		*On antiretroviral therapy* Do CD4 count 6 months 1 yr and yearly *VL* 6 months 1 yr and yearly *ALT* if on NVP and develops rash or symptoms of hepatitis *FBC* at months 1, 2, 3 and 6 if on AZT *Creatinine* at month 3 and 6 then every 12 months if on TDF *Fasting cholesterol* and triglycerides at month 3 if on LPV/r
Unbooked and presents in labour	NVP during labour. Assess for antiretroviral therapy eligibility before discharge TDF + FTC single dose after delivery		

Table 51.4

National guidelines for management of HIV in infants under one year (see Chapter 54)

Standard regime for infants	**All children under one year**	**Fast track**	**Standard monitoring for infants**
Mother on life-long antiretroviral therapy	NVP at birth and then daily for 6 weeks irrespective of infant feeding choice	Start within 2 weeks Children less than 1 year of age Stage 4 MDR or XDR-TB	Initial Check HIV status Ensure that national testing algorithm including HIV DNA PCR and HIV viral load (RNA) for infants and children less than 18 months has been followed *Weight and height* *Screen for TB* *CD4* *HB*
Mother on AZT for MTCT prophylaxis	NVP at birth and then daily for 6 weeks continued as long as **any** breastfeeding If formula fed baby can stop NVP at 6 weeks		
Mother did not get any antiretroviral therapy before or during labour	NVP as soon as possible and daily for at least 6 weeks continued as long as **any** breastfeeding Assess for ART eligibility within 2 weeks		*Routine* Weight and height Screen for TB CD4 (in 6 months) HB
Unknown maternal status, orphaned or abandoned	HIV antibody test Give immediate NVP if baby is HIV-antibody positive (i.e. HIV exposed) Follow up 6 week HIV DNA PCR		*Eligible for antiretroviral therapy* *ALT* if starting on a NVP-based regimen If ALT raised, do *HepBSAg* and avoid NVP *Hb or FBC* if available if starting on an AZT-based regimen If less than 8 g/dl refer
			ON antiretroviral therapy *Height + weight + development* *Clinical stage* *CD4* at month 6, 1 year into antiretroviral therapy, and then every 12 months *VL* at month 6, 1 year into antiretroviral therapy, then every 12 months *ALT* if on NVP and develops rash or jaundice FBC at month 1 2 and 3 if on AZT

Table 51.5

FDA classification of antiretroviral drugs for use in pregnancy

Drug	FDA Category in pregnancy	Health risks
Nucleoside reverse transcriptase inhibitors		
Zidovudine (ZDV, AZT)	C	High risk of anaemia
Abacavir (ABC)	C	High risk of lactic acidosis. Discontinue. Other fever, pruritis, GIT effects, pharynchitis. Lymphadenopathy
Didanosine (ddI)	B	High risk for pancreatitis. Periphiral neuropathy, headache and anxiety
Stavudine (d4T)	C	Do not use with didanosine Lactic acidosis, hyperlactataemia 2–5 mmol/l neuropathy, fatty liver
Lamivudine (3TC)	C	Pheripheral neuropathy, GIT side effects, headache and other
Tenovir	B	Nephrotoxic, GIT (mild symptoms)
Non-nucleoside reverse transcriptase inhibitors		
Nevirapine	C	Rash and altered liver functions
Efavirenz	D	Teratogenic CNS effects insomnia, dreams, depression, nausea, gynaecomastia, liver enzymes increased
Protease inhibitors		
Retonavir/lopinavir	B	Interact with ergot and oral contraceptives High risk of anaphylaxis, dry mouth, GIT effects, vasodilatation, hypotension, hepatitis and pancreatitis

A: Adequate and well-controlled studies of pregnant women fail to demonstrate a risk to the fetus during the first trimester of pregnancy (and there is no evidence of risk during later trimesters).

B: Animal reproduction studies fail to demonstrate a risk to the fetus but well-controlled studies of pregnant women have not been conducted.

C: Safety in human pregnancy has not been determined, animal studies are either positive for fetal risk or have not been conducted, and the drug should not be used unless the potential benefit outweighs the potential risk to the fetus.

D: Positive evidence of human fetal risk based on adverse reaction data from investigational or marketing experiences, but the potential benefits from the use of the drug in pregnant women may be acceptable despite its potential risks.

X: Studies in animals or humans have demonstrated fetal abnormalities and/or there is positive evidence of human fetal risk based on adverse reaction data from investigational or marketing experience, and the risks involved in the use of the drug in pregnant women clearly outweigh potential benefits.

Testing for HIV

HIV testing is hampered by the availability of laboratories. Therefore advances in technology have led to the development of a wide variety of rapid HIV tests, including agglutination assays, dipstick assays, flow-through membrane assays, and lateral flow membrane assays. Many of these tests are presented as strips or cartridges incorporating the reagents and do not require additional equipment. They are suitable for the performance of single tests, are easy to use and can be carried out by any healthcare worker who has received appropriate training. Most rapid HIV test kits can be stored at room temperatures of up to 20–30 °C. Furthermore, the diagnostic performance of high-quality rapid tests are comparable to that of traditional ELISA test.

Whole blood finger-prick test

Rapid test kits that use whole blood from finger-prick samples may be preferred because such tests are easy to obtain. They require minimal equipment and can be performed by appropriately trained counsellors. Used lancets must *not* be re-used. They must be disposed of in an appropriate sharps container and the puncture site must be covered. Depending on the algorithm being used, an additional finger-prick sample may be necessary if a positive result is obtained.

Serum specimens

In contrast to the use of whole blood finger-prick specimens, the use of serum specimens requires venous blood to be drawn by means of syringes and collection tubes (e.g. vacutainers) and the serum to be separated from the blood. This takes much longer and involves staff who are more highly trained. Moreover, collecting venous blood samples is costly. However, there is a wider range of rapid tests that can be used with serum specimens and only one sample has to be collected.

Routine antenatal care is provided as for a high-risk pregnant woman. (See Chapter 52 for specific nutritional requirements.)

51.4 Neonatal care

All newborns should receive standard immediate care. Thereafter, newborns should be nursed in their own micro-environment. All babies should be considered infected unless the mother's status is known.

Infant feeding should be discussed with all mothers and HIV-positive mothers need specific advice on their choices (see Box 51.4).

51.4 Types of feeding methods for newborns

Breastfeeding
Most studies show that non-exclusive (mixed) breastfeeding increases the risk of HIV transmission by 5% every six months. If a mother gives food to the baby this increases the risk for vertical transmission by 35%. Exclusive breastfeeding for 3–6 months is recommended. Replacement feeding (bottle) reduces the risk for transmission of the HIV virus and is only beneficial if it is a safe option. The types of infant feeding practices are listed as follows.

Exclusive breastfeeding
The infant has received only breast milk from his/her mother or a wet nurse, or expressed breast milk and no other liquids, or solids with the exception of drops or syrups consisting of vitamins, mineral supplements, or medicines.

A child may be exclusively breastfed with expressed human milk from the mother, a breast milk donor or from a milk bank.

Predominant breastfeeding
The infant's predominant source of nourishment has been breast milk. However, the infant may also have received water or water-based drinks (sweetened or flavoured water, teas, infusions, etc.); fruit juice; oral rehydration salts (ORS); drop and syrup forms of vitamins, minerals, and medicines; and folk fluids (in limited quantities).

Breast milk substitute
Any food being marketed or otherwise presented as partial or total replacement from breastmilk, whether or not suitable for that purpose.

Complementary feeding
Any food, whether manufactured or locally prepared, suitable as a complement to breast milk or to infant formula, when either become insufficient to satisfy the nutritional requirements of the infant. Such food is commonly called 'weaning food' or 'breastmilk supplement'

Partial breastfeeding
Means giving a baby some breastfeeds, and some artificial feeds, either milk or cereal, or other food.

Replacement feeding
Means the process of feeding a child who is not receiving any breastmilk with a diet that provides all the nutrients the child needs.

The midwife needs to determine the woman's lifestyle and choices and respect these while counselling the women on the best possible options for her and her infant.

Testing the baby for HIV

Babies born to a HIV-positive mother are seen at six weeks when immunisation starts. A PCR test can distinguish between a positive HIV test because the baby carries maternal antibodies and true HIV infection. Testing can also be delayed until the baby is nine months old, when conventional antibody testing will reveal the baby's status. Screening can be repeated at 18 months.

Immunisation

All newborns of HIV-positive mothers and babies testing positive for HIV should receive all the usual immunisations.

Prophylaxis

Prophylactic treatment against *Pneumocystis jirovecii* infection and other bacterial infections should be given to all babies born to mothers testing HIV positive. Treatment is started at six weeks with cotrimoxazole syrup. It can be stopped at one year of age in well infants or in infants whose HIV screening test has become negative or who have a negative PCR test six weeks or more after the last breastfeed. Cotrimoxazole syrup is usually given as a 5 ml dose (10 ml after three months) on three days of the week (Monday, Wednesday and Friday). Prophylaxis against tuberculosis is usually not given (see Box 51.5).

51.5 Cotrimoxazole prophylaxis

The recommended dose of cotrimoxazole for a newborn is weight related: 5 ml below 5 kg, 7.5 ml from 5–9.9 kg, 10 ml 10–19.9 kg, and 20 ml from 20 kg.
Use recommanded from 6–8 weeks of age due to the risk of adverse side effects.

51.5 Postpartum care

The routine postpartum care of HIV-positive women should be similar to that for uninfected patients. They do not require separate nursing facilities.

HIV-positive women are more prone to postpartum infectious complications – including urinary tract, chest, episiotomy and caesarean section wound infections. Midwives should be aware of this and observe for signs of infection. Women should have prophylaxis for infections and be discharged with appropriate treatment after birth. Mothers should be given information on the early symptoms of infection at the time of discharge, especially where the postpartum hospital stay is short. All mothers should be given instructions on perineal care and the safe handling of lochia and blood-stained sanitary pads or materials. Mothers should be given information on how to care for their babies without the risk of exposure to infection, and there should be full discussion on the risks and benefits of infant feeding choices. If, after counselling, the mother chooses not to breastfeed, she should receive full information on suppression of breast milk, adequate replacement feeding up to two years of age, and guidance on breast care until lactation stops. Safe bottle feeding is explained.

Mothers who choose to breastfeed should be advised of the possible increased transmission risk in the presence of cracked nipples, mastitis, breast abscess or oral lesions in the child and should be taught how to prevent such problems through adequate breastfeeding techniques. Reduced duration of breastfeeding and early cessation may be encouraged to reduce the risk of transmission where this can be achieved safely. The mother should be counselled on the need for follow-up care for her and her child, and the available options for testing the child. She should be given information about and referred to local HIV support groups.

Contraception

Contraceptive advice should be given and early arrangements made to start with an appropriate method. Contraceptive advice is particularly important when a mother does not breastfeed because of the loss of the contraceptive properties of breastfeeding. Special consideration is given to interaction between contraceptives and antiretroviral therapy.

Tuberculosis treatment regimes for pregnant women (South African National Tuberculosis Guidelines 2008)

Untreated tuberculosis represents a far greater hazard to pregnant women and the fetus than the treatment of the disease. It is important to know if a woman is pregnant before starting antiretroviral therapy or TB treatment. Most TB drugs are considered safe in pregnancy, but streptomycin is ototoxic to the fetus and should not be used in pregnancy.

Breastfeeding and women with TB

A woman who is breastfeeding and has TB should receive a full course of TB treatment. Proper and timely applied chemotherapy is the best way to prevent transmission of tubercle bacilli to the baby. All the TB drugs are compatible with breastfeeding.

A baby born to a mother with tuberculosis

A baby born to a mother who has been diagnosed with TB in the last two months of pregnancy or who has a documented smear conversion needs to be carefully managed.

- *The baby should not receive BCG at birth.* The baby requires either full TB treatment if TB disease is diagnosed or INH prophylaxis if asymptomatic.
- If the baby is symptomatic the baby should be referred to a hospital for evaluation to exclude TB. If the baby has TB, the baby should receive a full course of TB treatment with regime three:
  - Intensive phase: two months of RHZ (rifampicin, isoniazid, pyrazinamide) according to the mass of the child given seven days a week for two months.
  - Continuation phase: four months of RH according to the weight of the child, for seven days a week.
  - TB treatment must be started in a referral centre to ensure correct doses.

If the baby is asymptomatic:

- The baby needs preventive therapy: isoniazid (10 mg/kg/day) for six months.
- The baby should not receive initial BCG vaccination.
- If the baby continues to be asymptomatic the BCG is administered after completion of the preventive treatment (unless the child is HIV infected or has symptoms suggestive of HIV infection).
- If tuberculin is available the child can be tested after three months on INH treatment. If the tuberculin test is negative and the mother has become sputum smear-negative, the INH can be stopped and the child given BCG (unless the child is HIV infected or has symptoms suggestive of HIV infection).
- An HIV-negative mother on TB treatment should be encouraged to breastfed. An HIV-positive mother should be counselled about exclusive feeding options (exclusive breastfeeding or exclusive formula feeding). Although antituberculosis drugs are secreted in breast milk, the concentrations are very low and do not affect the baby but the concentrations are also too low to protect the baby.

Multidrug-resistant tuberculosis (MDR-TB) is defined as tuberculosis disease caused by strains of *Mycobacterium tuberculosis* that are resistant to both rifampicin and isoniazid, with or without resistance to other drugs. MDR-TB is a laboratory diagnosis made only by TB culture and drug susceptibility, in a patient with proven TB who is not improving clinically. One positive culture with resistances to rifampicin and isoniazid is diagnosed as MDR-TB. A laboratory result that is not consistent with the clinical picture should be repeated if necessary.

Extensively-drug resistant tuberculosis (XDR-TB) refers to resistance *in vitro* to isoniazid and rifampicin and/or any of the fluoroquinolones and one or more of the second-line injectable drugs (capreomycin, kanamycin, amikacin).

The diagnosis of XDR-TB is a laboratory diagnosis made through second-line drug susceptibility testing (DST).

All XDR-TB patients must be referred to the MDR-TB hospital for admission.

If the mother is infectious (both smear-positive and smear-negative PTB) the child should receive prophylactic isoniazid (10 mg/kg/day) for six months and continue breastfeeding. BCG vaccination should be postponed until the end of the isoniazid prophylaxis as the TB treatment and INH can destroy the vaccine.

51.6 Conclusion

The new DoH guidelines mean that midwives will be involved in the roll-out of antiretroviral therapy for women and their babies.

Section Ten
Nutrition

52 Nutrition in pregnancy, birth and lactation

CHAPTER

52 Nutrition in pregnancy, birth and lactation

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- demonstrate knowledge of the requirements of human nutrition in pregnancy and birth
- develop skills to assess nutritional risk factors in pregnancy and birth
- demonstrate competence in assessment of the nutritional status of a pregnant or lactating woman
- do an accurate assessment of a woman's BMI and weight gain in pregnancy
- give advice to a pregnant or lactating woman on nutrition.

KNOWLEDGE ASSUMED TO BE IN PLACE

The basic anatomy and physiology of human nutrition

KEYWORDS

Nutritional supplementation • Micronutrients • Vitamins • Basic metabolic rate (BMR) • Recommended Dietary Allowances (RDAs)

52.1 Introduction

Nutrition influences health from the beginning of conception and plays an important role in the reproductive ability, lactation and healthcare outcomes of women and infants. Nutrition during sensitive and critical growth periods can influence normal growth and childhood development. Nutrition can influence physical and mental status, immunology and general wellbeing. Nutrition is region and culturally based, carries an emotional value and is associated with satisfaction, love and community. However, food may be non-nutritional and even harmful.

In general, women have specific nutritional needs during pregnancy and lactation that may be aggravated by factors such as teenage pregnancy, anaemia, dietary preference such as a vegetarian diet, and diseases such as hypertension, cardiac disease, diabetes and HIV and AIDS.

This chapter aims to give an overview of the physiological basis for nutrition in pregnancy and lactation from a scientific point of view. The basic nutritional requirements and supplementation during pregnancy are considered, as well as special nutritional concerns in pregnancy.

52.2 Nutrition-related physiology of pregnancy

From the time of conception and throughout pregnancy, anatomical and physiological changes occur in the mother's body to support, protect and nourish the developing fetus and to prepare the mother for delivery and lactation. The growing fetus depends entirely on the mother, not only to meet every need during pregnancy, but also to lay down metabolic stores such as iron, subcutaneous fat and glycogen, which are needed in the early neonatal period.

The assessment of maternal and fetal wellbeing includes taking a history and the physical assessment of the growth and development of the pregnancy and, indirectly the fetus, by assessing weight gain, which indicates fetal growth.

Weight gain in pregnancy

The gain in weight during pregnancy results from maternal anatomical and physiological changes and the growth of the fetus. Weight gain must be carefully monitored to ensure the health of the mother during pregnancy and lactation and optimal growth and development of the fetus.

Weight gain varies widely. Previously, the recommended weight gain during a healthy term pregnancy was approximately 25% of the prepregnancy weight or 12.5 kg for a normal weight woman. It is now, however, widely accepted that both underweight and overweight mothers are more at risk of complications than normal weight mothers. The most recent recommendations for pregnancy weight gain are based on the mother's prepregnancy body mass index (BMI). The BMI is calculated as mass (kg)/height (m^2) and is used as an indicator of whether or not a person has a healthy or unhealthy weight. A mother who is underweight (BMI < 18.5 kg/m^2) should gain more weight than a mother whose prepregnancy BMI is in the normal range (18.5 to 24.9 kg/m^2). In contrast, a mother who is overweight (BMI: 25.0 to 29.9 kg/m^2) or obese (BMI > 30 kg/m^2) should gain less weight than a normal weight mother. Table 52.1 shows the ranges and rate of weight gain according to BMI classification.

Weight gain during the first trimester (1–1.5 kg) is low. The rate of weight gain increases gradually during the second and third trimester to approximately 0.5 kg/m^2 per week, but slows towards term. The critical period of weight gain is the third trimester when the fetus has accelerated growth.

The distribution of weight gain during pregnancy is shown in Figure 52.1 and detailed below:

- The fetus, placenta and amniotic fluid account for slightly less than half of the total weight gain.
- The deposition of fat and protein stores account for approximately one third of the weight gain.
- The increase in size of the breasts, uterus and other maternal tissues account for 20% of the weight gain.
- The remainder of the weight gain is due to increased blood volume, fluid and electrolyte changes.

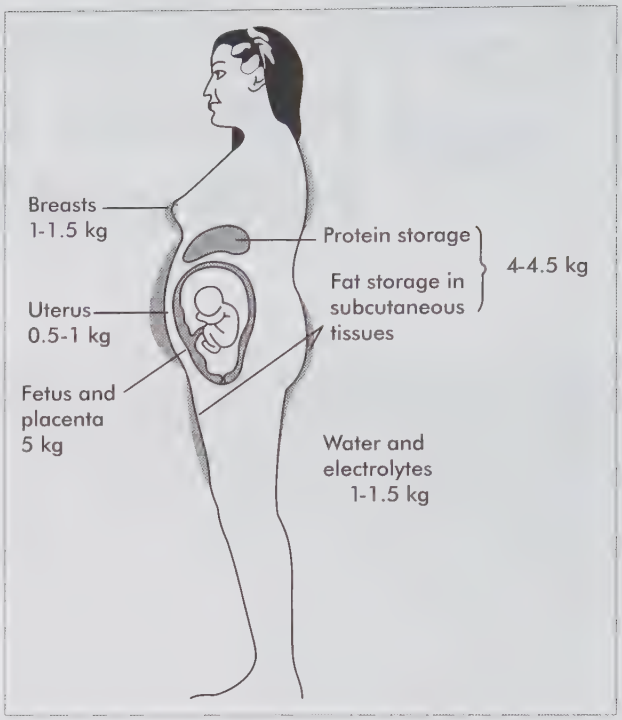


Figure 52.1 Distribution of weight gain during pregnancy
Source: Hanretty KP. 2010. *Obstetrics illustrated*. 7th ed. Churchill Livingstone. Elsevier: UK

Table 52.1

Recommendations for total and rate of weight gain during pregnancy according to prepregnancy BMI

Prepregnancy BMI	Classification	Total weight gain Range in kg	Rate of weight gain 2nd and 3rd trimester Range in kg/week
< 18.5 kg/m^2	Underweight	12.5–18	0.4–0.6
18.5–24.9 kg/m^2	Normal weight	11.5–16	0.35–0.5
25.0–29.9 kg/m^2	Overweight	7–11.5	0.2–0.3
≥ 30 kg/m^2	Obese	5–9	0.2–0.3

Source: Ramussen & Yaktime, 2009

Weight gain must be monitored throughout pregnancy. Weight may be plotted on a chart showing weight gain according to prepregnancy weight and month of gestation. Weight gain charts provide a quick way of ascertaining whether the mother's weight gain is optimal (see Figure 52.2). Failure to achieve an adequate weight gain during pregnancy is associated with increased perinatal morbidity and mortality. Fetal growth may be compromised, resulting in preterm delivery and low birth weight, both of which have long-term consequences for the infant. Guidelines for monitoring weight gain are given in Box 52.1.

52.1 Monitoring weight gain during pregnancy

- Measure the woman's height without shoes using a fixed stadiometer (height measure).
- Weigh woman in light clothing using an accurate scale and correct procedures at the first antenatal visit.
- Make sure to use the same equipment and procedures at all subsequent visits.
- Calculate her BMI using the formula: weight (kg)/height (m^2)
- Estimate the gestational age from the onset of her last period.
- Set weight gain goals together with the mother taking account of her prepregnancy BMI and other considerations.
- Monitor the woman's weight gain at each visit by plotting her weight on a weight-gain chart.
- Identify and investigate any abnormality in the pattern of weight gain.

Source: Rasmussen & Yaktime, 2009

Physiological changes

Blood volume and concentration

One of the major changes in pregnancy involves changes in the cardiovascular system. Plasma volume starts to increase from about six weeks of pregnancy and reaches a maximum of 50% more than the nonpregnant volume at 30–32 weeks. Red blood cell (RBC) volume increases slowly from approximately 10 weeks and continues throughout pregnancy. Since there is only a 20% increase in RBC volume, compared to the 50% in blood volume, the concentrations of haemoglobin and serum albumin and other proteins are lower than in the nonpregnant state. This lowering of the haemoglobin concentration is known as the physiological anaemia of pregnancy. This peaks at the period when the blood volume is at its highest at 30–32 weeks, meaning that the haemoglobin (Hb) will be at the lowest at 30–32 weeks of pregnancy, if untreated.

The lowered serum albumin levels may contribute to oedema (the accumulation of extracellular fluid). The expanded blood volume also leads to lowered concentrations of the water soluble vitamins. On the other hand, serum levels of the fat soluble vitamins and lipid factions such as cholesterol, triglycerides and free fatty acids are elevated.

Gastrointestinal function

During pregnancy, changes in the gastrointestinal tract may affect the food intake and nutrition of the mother. Early in pregnancy hormonal changes result in loss of appetite, nausea and vomiting (morning sickness) and consequently in reduced food intake. This period is followed by increased appetite, thirst, changes in taste, and food aversions and cravings.

The high levels of progesterone needed to relax the smooth muscle of the uterus, also relax the smooth muscles of the gastrointestinal tract. This leads to decreased motility and longer transit time throughout the gastrointestinal tract. This is an advantage in the upper gastrointestinal tract as absorption of nutrients is increased. In the large intestine, however, increased water absorption and reduced motility may give rise to constipation. Indigestion may result from relaxation of the oesophageal sphincter and pressure on the stomach from the growing fetus. In late pregnancy pressure of the uterus on the gastrointestinal tract makes consuming large meals difficult, making small, frequent meals necessary.

Metabolic changes

The basal metabolic rate (BMR) increases by 15% during pregnancy. The thyroid enlarges in pregnancy and high levels of hormones are synthesised and metabolised in the system. This increase is due to the increase in the amount of metabolically active tissue of the fetus, placenta and mother, the higher level of effort needed by the mother (for example cardiovascular and respiratory work) and tissue synthesis. The metabolism of the macronutrients (carbohydrates, proteins and fat) is adapted to shift nutrients to the fetus for growth, to meet the increased needs of the mother during pregnancy and to build up maternal stores needed by the mother during lactation.

The most marked changes occur in carbohydrate metabolism. Insulin secretion is increased during early pregnancy. This promotes the storage of energy as fat for use later in gestation and during lactation. Fasting blood glucose levels are 10 to 20% lower during pregnancy due to the constant uptake of glucose by the fetus.

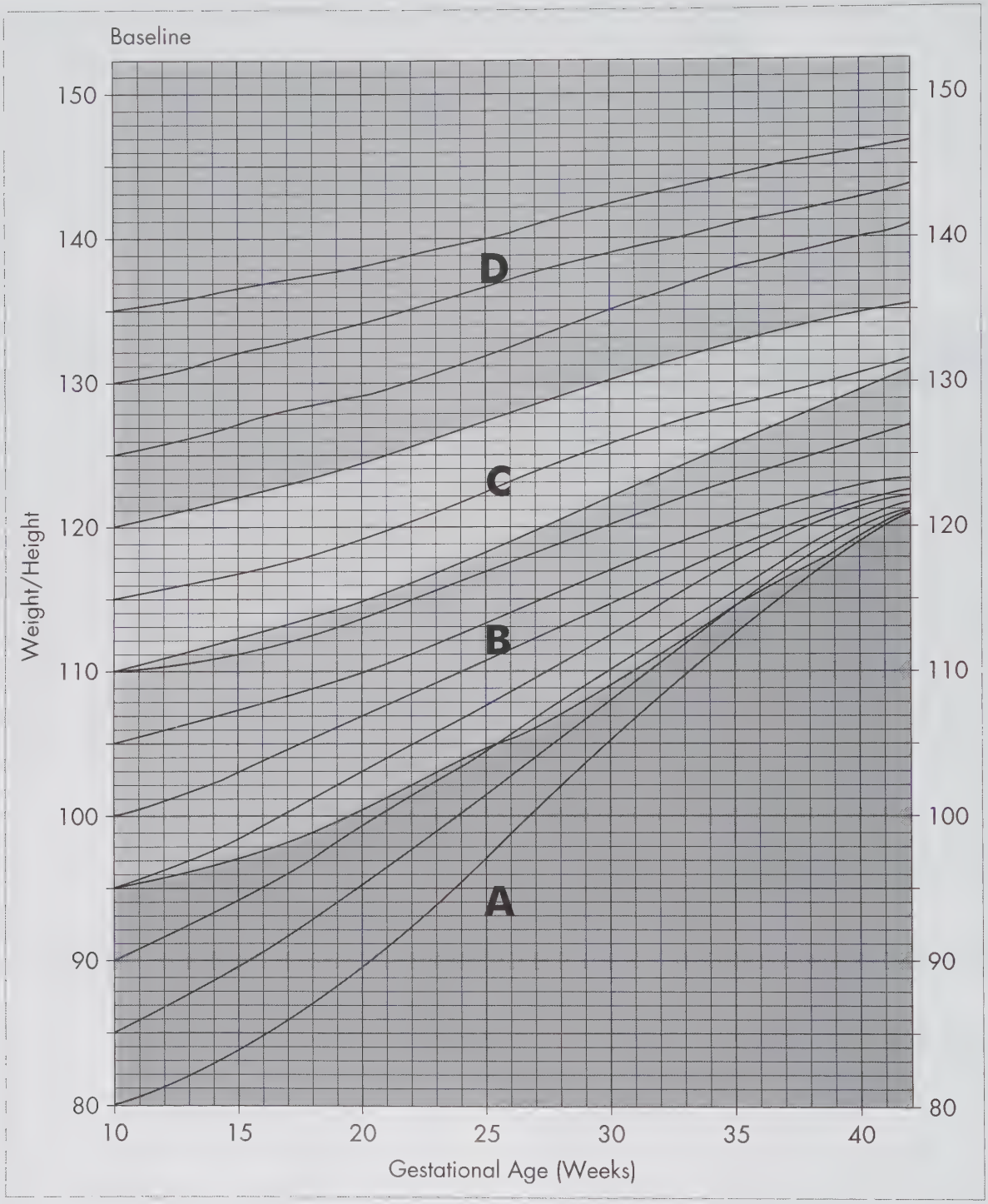


Figure 52.2 Chart of weight gain during pregnancy. A: Underweight; B: Normal weight; C: Overweight; D: Obese
Adapted from: Ramussen, K M & Yaktime, A L. (eds). 2009. *Mass gain during pregnancy: re-examining the guidelines.* Washington DC: The National Academies Press

Blood glucose levels remain higher than normal following a meal, thus allowing more time for the placenta to take up glucose and transfer it to the fetus. In addition, there is reduced tissue sensitivity to insulin, that is, the uptake of glucose by the tissues is reduced, resulting in higher glucose blood levels and more glucose available to the fetus. High glucose levels in the renal blood and increased glomerular filtration rate may result in glucosuria (glucose in the urine), which is commonly seen in pregnancy.

All the physiological changes place a nutritional demand on the woman that is easily met by a well-nourished body with a balanced diet. The nutritional requirements have been scientifically determined.

52.3 Nutritional requirements during pregnancy

As a result of the anatomical, metabolic and physiological changes in the mother and the growth of the fetus, nutritional requirements are increased during pregnancy. Failure to meet these needs can have serious consequences for the mother, fetus and infant. The Institute of Medicine (IOM, 1997, 1998, 2001, 2002) has published Recommended Dietary Allowances (RDAs) for energy and nutrient intakes for different ages, genders and life stages. The RDAs are set to meet the needs of almost all individuals in a specific age, life stage and gender group. Thus, a pregnant woman whose energy and nutrient intake meets the RDAs is likely to meet her nutritional requirements. Since many factors affect nutritional requirements, it is vital that each woman is carefully monitored throughout pregnancy and her diet modified to meet her specific individual needs. Table 52.2 compares the RDAs for pregnancy and lactation with those for nonpregnant women and adolescents.

Energy

Energy requirements vary widely among women and are affected by factors such as age, prepregnancy weight, height and physical activity levels. Energy requirements during the first trimester are the same as for the nonpregnant woman, then increase by 1 400 to 1 500 kJ/day (340 to 350 kcal/day) during the second trimester and by a further 470 kJ/day (110 kcal/day) during the third trimester. In general, energy intakes of 11 500 to 12 000 kJ/day (2 730 to 2 850 kcal/day) during the second and third trimesters are adequate for most healthy pregnant women. Since requirements vary widely, monitoring weight gain, individual adjustment of energy intake and dietary counselling are essential to ensure that energy requirements are met.

Protein

Optimality

An optimal protein intake is essential for the growth of the fetus and the maternal tissues. Proteins are essential components of the cell membranes, transport carriers, hormones, enzymes, the immune system and genetic material. Approximately 42% of protein is deposited in the fetus, with the remainder being taken up by the uterus (17%), blood (14%), placenta (10%) and breasts (8%). Most protein deposition occurs during the second half of pregnancy. Requirements therefore increase from the start of the second trimester and peak during the third trimester. The RDA for protein during the second and third trimesters of pregnancy is 25 g/day higher than for a nonpregnant woman. This is equivalent to an intake of 71 g of protein per day. Protein should supply 12 to 15% of the total energy intake in the diet.

An optimal mix of protein and carbohydrates is needed. Protein intake cannot be separated from the total energy intake. If the energy obtained from carbohydrates and fat is inadequate to meet the energy requirements, proteins will be utilised as an energy source instead of being utilised for tissue growth and other vital functions. Thus, an adequate energy intake is essential for optimal protein utilisation.

Quality

The optimal quality of the protein in the diet must also be considered. The basic units of proteins are *amino acids*. Most amino acids can be synthesised by the body and are known as the *non-essential amino acids*. There are, however, a number of amino acids that the human body cannot synthesise and which must be supplied by the diet. These are the essential amino acids. The quality of a dietary protein is determined by its amino acid composition. Foods that provide all the essential amino acids are said to be high quality or complete proteins and include meat, fish, poultry, eggs, milk and milk products. Proteins obtained from plant sources such as vegetables and whole grains do not contain all these essential amino acids and therefore are known as *incomplete proteins*. Some plant proteins such as those in dried beans and soya are known as *complementary proteins* since, when combined with other plant proteins, they provide a *high-quality protein*. It is very important that the diet during pregnancy not only provides an adequate amount of protein, but also an optimal mixture of proteins. Vegetarians and women whose animal food intake is limited need to be advised on how best to combine their food to obtain an optimal mix of essential and non-essential amino acids.

Table 52.2

Recommended dietary allowances

	14–18 years	19–50 years	Pregnant	Lactating
Energy (kcal)	2 368	2 403	+0 1st trimester + 340 2nd trimester + 452 3rd trimester	+ 330 1st 6 months + 400 2nd 6 months
Energy (kJ)	9 950	10 100	+1 430 2nd trimester +1 900 3rd trimester	+1 390 1st 6 months +1 680 2nd 6 months
Protein (g)	46	46	71	71
Vitamin A (μg RE)	700	700	770 (>18 yr) 750 (≤18 yr)	1 300 (>18 yr) 1 200 (<18 yr)
Vitamin D (μg)	5	5	5	5
Vitamin E (mgμ-TE)	8	15	15	19
Vitamin K (μg)	55	90	90 (>18 yr) 75 (≤18 yr)	90 (>18 yr) 75 (≤18 yr)
Vitamin C (mg)	60	75	85 (>18 yr) 80 (≤18 yr)	120 (>18 yr) 115 (≤18 yr)
Thiamin (mg)	1	1.1	1.4	1.4
Riboflavin (mg)	1	1.1	1.4	1.6
Niacin (mg NE)	14	14	18	17
Vitamin B_6 (μg)	1.2	1.3	1.9	2
Folate (μg)	400	400	600	500
Vitamin B_{12} (μg)	2.4	2.4	2.6	2.8
Biotin (μg)	25	30	30	35
Pantothenic acid (mg)	5	5	6	7
Calcium (mg)	1 300	1 000	1 000 (>18 yr) 1 300 (≤18 yr)	1 000 (>18 yr) 1 300 (≤18 yr)
Phosphorus (mg)	1 250	700	700 (>18 yr)	700 (>18 yr)
Magnesium (mg)	360	310	1 250(≤18 yr) 350 (>18 yr) 400 (≤18 yr)	1 250 (≤18 yr) 310 (>18 yr) 360 (≤18 yr)
Fluoride (mg)	3	3	3	3
Iron (mg)	15	18	27	9 (>18 yr) 10 (≤18 yr)
Zinc (mg)	9	8	11 (>18 yr) 12 (≤18 yr)	12 (>18 yr) 13 (≤18 yr)
Iodine (μg)	150	150	220	290
Selenium (μg)	55	55	60	70

Source: IOM, 1997, 1998, 2000, 2001, 2002

Carbohydrates

Carbohydrates are a major source of energy to the body. The fetus uses glucose as its major energy source with 17 to 26 g being transferred from the mother to the fetus per day. Thus, it is essential that the carbohydrate intake is sufficient to meet the energy requirements of the mother and of the fetus. The IOM (2002) recommends carbohydrate intakes of *175 g/day* during pregnancy to provide sufficient energy and to maintain appropriate glucose blood levels. Between 55 and 60% of the total daily energy intake should be supplied by carbohydrates. These can be fruits.

Fat

Dietary fats are an important and concentrated source of energy and in the body, fat is the major energy store. In addition, fats are essential for the absorption of the fat soluble vitamins (vitamins A, D, E and K) and phytochemicals such as the carotenoids and to provide the essential fatty acids (fatty acids which the body cannot synthesise). Fats serve other vital functions in the body, including forming part of cell membranes, cushioning and holding internal organs in place and providing a subcutaneous insulation to preserve body temperature. During pregnancy, maternal fat stores are built up to provide the mother with energy needed during pregnancy and lactation.

There is not an RDA for fat intake during pregnancy. The amount of fat in the diet depends on the energy requirement and adequate weight gain. As a rule, fat should not provide more than 30% of the total energy intake. The IOM (2002) does, however, give recommendations for the essential fatty acids, linoleic acid and alpha-linolenic acid: the recommendation is 13 g and 1.4 g per day respectively.

Fibre

Adequate fibre intake helps prevent constipation, a common problem during pregnancy. The RDA for fibre during pregnancy is *28 g/day*. This can be met by increasing intakes of wholewheat bread and cereals, wholegrain products, legumes, nuts, vegetables and fresh and dried fruit. Fluid intakes of six to eight glasses per day are needed to form soft stools with the increased fibre intake.

Minerals

While requirements for all minerals are increased during pregnancy, particular attention needs to be given to calcium, iron, zinc and iodine.

Calcium

Calcium is essential for the formation and maintenance of bones and teeth and plays a role in vascular and muscle contraction and nerve transmission. Approximately *30 g of calcium* accumulate during pregnancy. Of this, 25 g is deposited in the fetal skeleton, mostly during the third trimester, and the remainder stored in the maternal skeleton. From Table 52.2, it can be seen the recommendations for calcium intake during pregnancy are the same as those for nonpregnant women of the same age (*1 300 mg/day* for adolescents and *1 000 mg/day* for adults). This is because hormonal changes during pregnancy result in increased absorption and use of calcium. Calcium intakes lower than the recommendation may result in lowered bone density in the fetus and in loss of calcium from the mother's skeleton. Inadequate calcium intakes may also result in pre-eclampsia and hypertension. The best dietary sources of calcium are milk and milk products.

Iron

Iron plays an essential role in many body functions including red blood cell formation and function, myoglobin activity and in enzyme activity. During pregnancy, red blood cell volume is increased by approximately 20%, necessitating greatly increased iron intakes. In total, an additional *700 to 800 mg* of iron is required during pregnancy. Of this, 500 mg is used for haematopoiesis (red blood cell formation) and 250 to 300 mg for fetal and placental tissues. Maternal and fetal demands are highest from week 20 of pregnancy.

Inadequate intakes of iron during pregnancy result in anaemia (serum haemoglobin (Hb) of below 10 g/dl). The risks of haemorrhage, maternal death, premature delivery, low birth weight (LBW) and perinatal mortality are increased in the presence of anaemia.

The RDA for iron during pregnancy is *27 mg/day*, 50% higher than that for nonpregnant women and almost double that of a nonpregnant adolescent. Most women do not have sufficient iron stores at the beginning of pregnancy to meet their increased needs. Thus an adequate intake of iron is vital. The best dietary sources of iron are liver, kidney, heart, lean meat, poultry and fish. Dried beans and some vegetables are also good sources of iron, but the availability of the iron to the body is lower than that of iron from animal sources. In South Africa, fortified bread and maize meal provide an important source of iron. The high dietary requirement of iron during pregnancy, however, is difficult to meet by diet alone. It is recommended that, in addition to a well-balanced diet, all pregnant women receive preventive iron supplementation as ferrous sulphate. The recommended iron supplementation protocol of the South African Department of Health is shown in Table 52.3. Milk, tea

Table 52.3

Recommended iron supplementation protocol

	Prevention	Treatment (Mild anaemia)	Treatment (Severe anaemia)
Serum haemoglobin level	≥ 10 g/dl	7.0–9.9 g/dl	< 7.0 g/dl
Dosage: Ferrous sulphate (200 mg tablets containing 60 mg iron)	Single pregnancy: 200 mg daily (1 tablet) Multiple pregnancy: 200 mg twice daily (2 tablets)	200 mg 3 times daily (3 tablets)	Refer to hospital

Source: Department of Health, 2008

and coffee interfere with iron absorption and should not be consumed with the supplement. Beverages containing vitamin C, such as fresh orange juice, increase iron absorption.

Zinc

Zinc plays a role in a wide range of catalytic, structural and regulatory functions in the body. Zinc requirements are 40–50% higher than normal during pregnancy. Zinc is accumulated in the fetal and maternal tissues throughout pregnancy, reaching a peak in the last months of pregnancy. Pregnant women whose diets lack adequate zinc, are unable to mobilise zinc stored in the skeleton and are at high risk of developing zinc deficiency. The RDAs for zinc during pregnancy are *11 g and 12 g per day* for adults and adolescents respectively. Good dietary sources of zinc are meat, fish, poultry, milk and milk products, wholegrain cereals, dried beans, and fortified maize meal and bread flour.

Iodine

Iodine is essential for brain development and for production of thyroxin, a hormone secreted by the thyroid gland. Iodine plays a vital role in number of functions including the maintenance of body temperature, brain function, reproduction and growth. The requirement for iodine during pregnancy is 47% higher than for the nonpregnant women, giving an RDA of *220 µg/day*. Inadequate iodine intakes during early fetal development can adversely affect neurological development, resulting in impaired cognitive function in infants. The most important sources of dietary iodine are iodated salt, fish, milk and milk products meat and eggs.

Vitamins

As in the case of the minerals, the requirements for all vitamins are increased during pregnancy and can be met by a well-balanced and varied diet. Some vitamins, however, are of particular concern during pregnancy.

Vitamin A

Vitamin A plays a role in gene differentiation and proliferation and thus in the development of the fetus. It also is essential for a healthy immune system. It is estimated that the fetal liver accumulates 50 µg/day vitamin A during pregnancy. The RDA for vitamin A is *750 µg/day* and *770 µg/day* for adolescents and adults respectively during pregnancy, slightly higher than the RDA of 700 µg/day for the nonpregnant state. The richest sources of vitamin A are liver and red meat. Dark green and orange vegetables and fruit are good sources of betacarotene, which is converted to vitamin A in the body. Excessive vitamin A intakes during pregnancy may be harmful to the fetus.

Folate (folic acid)

Folate is required by the enzymes that produce the DNA for normal cell division and growth. Folate requirements increase by 50% during pregnancy to provide for the high rate of cellular division and for deposition in the fetus. In the mother, folate deficiency results in megaloblastic anaemia, eclampsia and preterm delivery. For the fetus, inadequate folate intakes are associated neural tube defects (NTD), a congenital defect that affects three out of 1 000 infants born in South Africa annually. Folate deficiency is also linked to other congenital defects such as clubbed foot and cleft palate. Folate deficiency developed over a period of 18 weeks of low folate diet or can develop due to folate antagonist (medication that prevents the absorption of folate).

Dietary sources of folate include liver, green leafy vegetables and fortified bread flour and maize meal. Lean meat, wholewheat bread and dried beans are also good sources. It is, however, difficult to achieve the RDA of *600 µg/day* from the diet alone. The South African Department of Health recommends routine preventive supplementation for all pregnant women of 5 mg folic acid per day.

Vitamin B12

Vitamin B12 (cobalamin) functions as a co-enzyme in metabolic reactions and adequate intakes are needed for normal blood formation and neurological functions. Absorption of vitamin B12 from food depends on the secretion of intrinsic factors by the stomach, but a small percentage of vitamin B12 may be absorbed by simple diffusion. Thus conditions which may decrease gastric secretion could lead to vitamin B12 deficiency. Absorption of vitamin B12 appears to be reduced during pregnancy as the drop in serum levels during the first trimester is greater than would be expected from haemodilution alone. Transfer of vitamin B12 by the placenta to the fetus is very efficient, resulting in fetal levels twice those of the mother.

The RDA for vitamin B12 during pregnancy is *2.6 µg/day*, 0.2 µg/day more than the nonpregnant recommendations. Vitamin B12 is found only in foods of animal origin, with the highest concentration in liver. Diets which provide sufficient protein from animal sources will therefore also provide adequate vitamin B12 and even a fairly small intake of these foods should be adequate to meet the requirements. Supplementation of vitamin B12 is needed for vegans (people who consume no animal products) or when intake of animal foods has been very limited over a long period.

Other B-complex vitamins

As can be seen from Table 52.2, the RDAs for all the B-complex vitamins (thiamin, riboflavin, niacin, vitamin B6, pantothenic acid and biotin) are increased during pregnancy. As a group, the B-complex vitamins play essential roles in all metabolic processes by acting as cofactors in the various enzyme systems that produce energy from food. It follows that higher intakes during pregnancy are needed to produce energy from the greater food intake and to provide for the high energy needs of the mother and fetus.

Vitamin B6 requirements

Vitamin B6, also known as pyridoxine, helps the body metabolise protein, fats and carbohydrates. It also helps form new red blood cells, antibodies, and neurotransmitters, and is vital for the fetus' developing brain and nervous system. Research shows that very high doses of vitamin B6 may relieve nausea or vomiting for some women during pregnancy. Since high doses of vitamin B6 may have harmful side effects, it should only be administered under the supervision of a medical practitioner. Pregnant women need about *1.9 mg* per day and breastfeeding women, *2.0 mg* daily.

A woman need not take the recommended amount of vitamin B6 every day. Instead, she can aim for that amount as an average over the course of a few days or a week.

Beans, nuts, lean meat, and fish are good sources of vitamin B6. (Note that an 85 g serving of meat or fish is about the size of a deck of cards.) Fortified breads and cereals can also be good sources (check the labels).

Some high-potency multivitamins contain vitamin B6 in large amounts and even without taking a supplement a woman can get too much B6 in her diet if she eats a lot of fortified foods. Read the labels of energy drinks and bars, for example – they sometimes have several times the RDA for B6.

Excessive amounts of vitamin B6 can cause numbness and nerve damage. The tolerable upper intake level for the vitamin – the maximum amount considered safe by the Food and Nutrition Board of the Institute of Medicine – is 100 mg for women (including pregnant and nursing women) 19 years and older, and 80 mg for women 18 years and younger.

The B-complex vitamins are present in a wide range of animal and plant foods, in addition to being added to fortified foods such as breakfast cereals. In South Africa, maize meal and bread flour are fortified with B-complex vitamins and therefore serve as an important dietary source. As already stated, mothers must be encouraged to consume a variety of foods to ensure that all their nutrient requirements are met.

Ascorbic acid (Vitamin C)

The RDA of *80 to 85 mg/day* for ascorbic acid during pregnancy is 10 mg higher than the RDA for nonpregnant females. Ascorbic acid serves multiple functions in the body, including the formation of collagen, repair of damaged tissues, facilitation of iron absorption and in the immune system. Rich sources of ascorbic acid include fruit such as oranges, guavas, paw-paw, mangoes and tomatoes.

In most healthcare systems there are preparations of vitamins and minerals designed for pregnant women that have been tested for safety. Women are encouraged only to use prescribed substances that are declared safe.

52.4 Food guide during pregnancy

The increased energy and other nutrient requirements can be met by following the Daily Food Guide outlined in Table 52.4. Food guides translate the recommended energy and nutrients into a simple, practical guide on the types and quantities of foods needed for optimum nutrition. Their main purpose is to assist individuals in choosing foods that will meet nutritional requirements.

Usually the food guides are based on food groups, specifying the amounts of foods from each group required to meet nutrient requirements.

Maize, rice and bread

Maize, rice and bread are mostly starchy staple foods which are the basis of most diets, making up 55–60% of what one eats. Foods in this group include wholegrain cereals for example maize, rice, millet, sorghum, oats, wheat and bread. They are rich in complex carbohydrates and good sources of fibre if unrefined and some micronutrients, as well as some protein. At times they are fortified with some key micronutrients. The group also includes starchy roots and tubers for example potato, sweet potato, cassava, and starchy fruits such as bananas. It is recommended that a pregnant woman consume 7–11 servings of these foods each day in pregnancy. One serving is approximately one slice of bread, or half a cup of cooked cereal, rice, pasta and one cup of ready-to-eat cereals.

Legumes, oilseeds and nuts

Legumes, oilseeds and nuts are good sources of proteins, carbohydrates, fibre and micro-nutrients. Some high-fat legumes, oilseeds and nuts are also rich in good fats and oils. Examples of foods in this group are: dried beans, dried peas, lentils, nuts, groundnuts, mung beans, soya beans and pumpkin seeds.

Vegetables

Vegetables are a good source of a large number of micronutrients, such as vitamins, vitamin A and C, folic acid; minerals including potassium, magnesium, and the best source of fibre especially if eaten raw and with peels. Pregnant woman must consume a large variety of vegetables such as:

- dark green leafy vegetables, for example *imifino* or *morogo*, spinach, beetroot leaves, pumpkin leaves
- orange and deep yellow vegetables, carrots, pumpkins, butternut, squash, orange fleshed sweet potatoes
- starchy vegetables, yellow corn, potatoes
- legumes (which includes a large variety of beans, such as green beans).

A pregnant woman should consume at least three servings of vegetables per day. Half a cup of cooked or chopped vegetables, and one cup of raw vegetables is considered one serving.

Fruit

Fruit is the best source of vitamins A and C, potassium and fibre. Citrus fruits (for example oranges, lemons, grapefruit, naartjies), morula fruit and guava are particularly high in vitamin C. The orange or deep yellow fruits, such as paw-paw, mango, apricots and yellow peaches, are rich in vitamin A. It is recommended that at least two servings per day be consumed, with one serving being half a large fruit, or one medium size or two small fruits, and half a cup of canned or cooked fruits. Seeing that some of the nutrients may be destroyed during preparation and cooking fruit is best eaten whole and raw.

Meat, poultry, organ meat, fish and insects

Meat, poultry, organ meat, fish and insects are good sources of complete proteins, a large number of minerals such as iron, zinc and vitamin A. Foods in this group include beef, mutton, animal organs (*mala*, *mogodu*, *dikilana le maotwana* including liver), chicken, tinned fish and eggs. Most of the foods in this group are expensive and thus may be unaffordable. Furthermore some religious practices forbid the consumption of animal foods, which complicates the situation. Caution should be exercised in selecting foods from this group, as they contain saturated fats and cholesterol which is bad fat. Meat should be selected from a safe source and be well cooked in pregnancy as it can transmit diseases.

Milk, yoghurt and cheese

Milk, yoghurt and cheese are rich sources of mineral calcium, but are also good sources of protein, carbohydrates, vitamin B, vitamin A and vitamin D. Full-cream milk products also contain saturated fats and cholesterol, and at times it may be better to choose low-fat or fat-free (skimmed) milk, which has the fats removed, in pregnancy. Two or three servings of these foods should be included in a pregnant women's daily food intake. The serving size is one cup of milk, amasi, buttermilk or yoghurt or 30 g cheddar or Gouda cheese (the size of a matchbox).

Fats and oils

Fats and oils, for example butter, margarine, vegetable oil and mayonnaise are a major source of energy, and contain a number of fat soluble vitamins, such as vitamin A and E. Generally foods from animal sources such as meat and milk contain saturated fats, while most plant sources (maize, sunflower, peanuts, ground nuts, oilseeds and olives) contain unsaturated fats. There are no serving recommendations, but items in this group should be used sparingly, because of their very high energy content and low nutrient content.

Sugar and sweet foods

Sugar and sweet foods, including sugar, honey, molasses, jam, soda and many types of food with sugar added such as biscuits, provide empty calories. In this case there are no recommended servings, but it advisable to use them sparingly.

Table 52.4

Daily Food Guide and serving sizes during pregnancy and lactation

Food group	Number of servings per day			Serving size
	Nonpregnant	Pregnant	Lactating	
Bread, cereal, maize, rice	6–11	7–11	8–11	1 slice of bread (30–40 g); ½ cup cooked cereal, 1 cup ready-to-eat cereal, ½ large bun; 3 crackers; medium-sized muffin
Vegetables	3	3	3	150 ml vegetable juice; ½ cup cooked and 1 cup raw vegetables
Fruit	2	2	2	1 medium size fruit (apple, orange, banana, ½ large-sized fruit, 1 cup chopped fruit)
Milk	2	3	3–4	1 cup milk, amasi, yoghurt, 60 g hard cheese (the size of a match box)
Meat, poultry, fish, eggs	2	2	2	70–80 g meat, fish, chicken, organ meat, 2 eggs
Legumes, dry beans, lentils	1	1	1	½ cup cooked/canned beans lentils, 1 tablespoon peanut butter
Fats, oils, butter	Use sparingly	Use sparingly	Use sparingly	1 teaspoon or 5 g oil, margarine, mayonnaise
Sugar, jam, honey	Use sparingly	Use sparingly	Use sparingly	1 teaspoon (5 g)
Water	8 glasses	8 glasses	8 glasses	–

Water and other fluids

Currently there are no scientifically based recommendations for water needs as with energy and other nutrients, as water requirements are regulated by thirst. Fluids from beverages of various types, fruit and vegetables and other foods are sources of water, but if still thirsty, drink water. Breastfeeding mothers require more fluid than normal to replace water lost in the infant's milk.

Sample menu plan

With judicious selections of foods from each group, a balanced diet can be planned to ensure supply of the necessary nutrients. A sample menu plan demonstrates how the food guide can be translated to food on the plate and Table 52.5 offers an example of a sample menu for pregnant and lactating women. It is recommended that mothers eat five to six meals a day starting with breakfast, followed by a midmorning snack, then lunch followed by an afternoon snack and then supper, if necessary then a late night snack.

52.5 Nutrition-related concerns during pregnancy

The physiological changes during pregnancy may cause much of the discomfort experienced by the pregnant women. The following section briefly describes nausea, vomiting, constipation, heartburn and pica and how they can be relieved (see Box 52.2).

Nausea and vomiting

Nausea occurs during the first trimester of pregnancy. It is commonly known as 'morning sickness', and usually passes quickly as the pregnancy proceeds to the second trimester. In rare cases, the nausea and vomiting persists and becomes

Table 52.5

Sample menu

Main meals	Snacks
Breakfast	
1 cup cereal	
1 cup milk	
2 teaspoon sugar	**Mid-morning**
	1 medium fruit in season
Lunch	
2 slices wholewheat bread	
1 tablespoon peanut butter	
1 cup fruit juice (100% juice)	**Afternoon**
	6 crackers/2 cups magewu
	Jam/sugar to taste
Supper	
1½ samp and beans (umgqusho)	
90 g stewed chicken with vegetable	
1 cup cooked spinach/any morogo	**Late evening**
	Boiled/braised corn on cob OR
	Sweet potato, preferably orange fleshed
	1 cup milk/amasi

severe and life threatening. It is then called hyperemesis gravidarum, and the pregnant woman may be hospitalised and given parental nutrition.

Constipation

Constipation during pregnancy may be caused by relaxation of gastrointestinal muscle tone and motility related to increased progesterone levels, or it may result from pressure of the fetus on the intestines. Other contributory factors may include a decrease in physical activity and an inadequate intake of fluid and fibre. Constipation may also be a side effect of the consumption of iron supplements. If iron supplementation is a contributory factor, the woman may be advised to reduce of the dosage or frequency of the supplement, if possible.

Heartburn

Heartburn is a common complaint during pregnancy. Some of the contributing factors would include decreased gastric motility, relaxation of the cardiac sphincter and pressure of the uterus on the stomach.

Pica

Pica is a psycho-behavioural disorder characterised by the abnormal craving for non-food substances such as starch, clay (soil) or ice. The causes of pica are unknown, but there are a number of misconceptions about its causes. It may displace the intake of nutritious foods or interfere with nutrient absorption. Other potential complications vary depending on the items consumed, and include lead poisoning, faecal impaction, parasitic infection, toxaemia, prematurity, perinatal mortality, low birth weight and anaemic infants.

Whatever the causes may be, pica should be discouraged, because it increases the risk of nutritional inadequacies. When counselling the pregnant woman, determine what is ingested and why, remain non-judgemental but stress the importance of an adequate diet, the use of iron supplements and the potential danger of pica.

52.6 Concerns during pregnancy related to disease

Some diseases during pregnancy can endanger the health of the mother and the fetus. If diagnosed early, many diseases can be managed and controlled, and the damage minimised.

Anaemia

Anaemia in pregnancy is mostly based on nutritional problems or diseases that cause anaemia. Fifty percent of women are anaemic in pregnancy, which has serious consequences for the outcome of the pregnancy. The two main types of anaemia are iron deficiency and megoblastic or folic acid insufficiency. Folic acid insufficiency is based on a poor diet that lasted over an 18 week period or the interference in absorption due to medication. Hyperemesis gravidarum, if longstanding, may cause anaemia. A healthy woman, without a risk factor for anaemia, should be able to absorb enough iron and folic acid from a balanced diet. However, to prevent anaemia, all pregnant women should receive prophylactic iron and folic acid. Blood haemoglobin levels are monitored during pregnancy and labour. If the levels are too low, therapeutic iron is prescribed or administered in a total dose infusion or if needed a blood transfusion is done. A haemoglobin level of 6 g/dl is associated with a high mortality.

52.2 Tips to alleviate common discomforts of pregnancy

To alleviate nausea in pregnancy:
- On awakening, get up slowly
- Eat dry toast, crackers or dry cereal
- Chew gum or suck hard candies
- Eat small frequent meals
- Avoid foods with offensive smells
- Avoid drinking liquid with meals
- Avoid coffee, tea and spicy foods
- Limit intake of high fat foods.

To prevent or alleviate constipation:
- Increase fibre intake by eating wholegrain breads and cereal
- Drink at least eight glasses of liquid per day
- Participate in regular exercise
- Try hot water with lemon or prune juice.

To prevent or relieve heartburn:
- Relax and eat slowly
- Eat small frequent meals
- Avoid liquid intake just before meals, with meals or immediately after meals
- Drink liquid between meals, at least two hours before and after a meal
- Avoid spicy high-fat foods
- Sit up while eating
- Avoid lying down or bending over an hour after meals.

Pregnancy-induced hypertension

Pregnancy-induced hypertension (PIH) usually occurs in the third trimester of pregnancy. It is characterised by high blood pressure, proteinuria, rapid weight gain and marked oedema due to fluid retention affecting the whole body. Almost one in twenty pregnant women may be affected by PIH, which has been identified as a major cause of prematurity or maternal fetal death. The causes of PIH are unknown, but it is known to affect young woman of poor socioeconomic status, poor prenatal care and poor dietary intake, especially of protein.

No specific therapy has been proven effective in preventing or delaying PIH. Nutrition support includes provision of a well-balanced diet with adequate amounts of protein to replace losses in proteinuria.

Diabetes mellitus

Every pregnant woman should be tested for diabetes mellitus during their first antenatal visit and then again between 16 and 28 weeks of gestation, to identify those women at risk. Some women may already have diabetes mellitus, while others may develop gestational diabetes mellitus during pregnancy. In most cases gestational diabetes mellitus disappears after the infant is born. Either type increases the risk of physiological or mental defects in the infant, stillbirths and macrosomia, unless blood glucose levels are carefully monitored and maintained within acceptable limits.

Approximately 5–10% of all infants of diabetic mothers are born with congenital abnormalities. Some of the major defects reported include cardiac defects, nervous system defects including neural-tube defects, kidney malformation and skeletal abnormalities. Other risks include fetal dystocia, operative delivery, neonatal hypoglycaemia and neonatal respiratory distress syndrome.

Careful control and maintenance of blood glucose levels within acceptable levels may decrease the prevalence of many of the maternal and fetal complications associated with diabetes mellitus. Pregnant woman with pre-existing diabetes mellitus should achieve tight glucose control before conception and throughout pregnancy. Control includes blood glucose monitoring, adherence to diet, moderate exercise and strict adherence to prescribed insulin.

Pregnant diabetics require the same nutrients and weight gain as nondiabetic pregnant woman. The diets of pregnant diabetics are usually individualised, and therefore should be planned by a registered dietician, because the diet will depend on the type of insulin, its timing and number of injections. Pregnant diabetics, even those who were not normally on insulin, may require insulin during pregnancy to control blood glucose levels. Oral hypoglycaemic agents are not recommended during pregnancy and have teratogenic effects on the fetus.

Teenage pregnancy

A pregnant adolescent presents a special case of intensive nutrient needs as the teenager may already have a poor diet.

Many teenagers enter pregnancy with a deficiency of nutrients that puts themselves and their fetus at risk. Pregnant adolescents are also at risk due to their physical, psychological, social and economic circumstances. Pregnant adolescents are at greater risk of pregnancy-induced hypertension, which can cause cardiovascular and kidney problems in later life. Pregnant teenagers are at a greater risk of miscarriages, premature deliveries, stillbirths and low birth weight infants, than pregnant adult women.

Adequate nutrition is an indispensable component of the special care for pregnant teenagers to meet their nutritional requirements (see Table 52.2).

They need emotional support and counselling as well and close monitoring.

HIV infection

HIV-infected pregnant and lactating woman are at high risk of mal- and undernutrition, and thus require close monitoring. Improving nutrition prior to pregnancy should be the main goal to minimise the impact of HIV on the pregnancy outcome. This is unfortunately a huge challenge, because many woman have unplanned pregnancies and only become aware of their HIV status once they are pregnant, while some women enter pregnancy with poor nutritional status.

Effects of HIV on nutritional status

HIV affects nutrition by decreasing food consumption, impairing nutrient absorption and causing changes in metabolism. Poor nutritional status can speed up progression of HIV disease.

HIV-positive pregnant woman, especially from developing communities, are vulnerable to nutrient deficiencies mainly due to increased nutrient requirements associated with HIV and the demands of pregnancy. Therefore HIV increases the risk of maternal malnutrition, which in turn increases the risk of mother-to-child transmission, and ultimately increases maternal and fetal morbidity and mortality. HIV in association with other infections, such as diarrhoea or tuberculosis over a long period of time results in wasting.

Effect of pregnancy on HIV

The 2005 World Health Organization Consultation on Nutrition and HIV/AIDS in Africa, documented that 'pregnancy and lactation do not hasten the progression of the HIV infection to AIDS'.

Nutritional assessment during pregnancy

As with HIV-negative women, body weight measurements remain the most commonly used method to assess gestational weight changes, although there is an argument that weight alone may not be a good assessment indicator, because of increased total body water. In addition to weight, recommended measurements may include height, BMI, mid-upper arm circumference and skin fold thickness may be useful. Cut-off points for HIV-positive pregnant and lactating woman have not yet been developed.

Nutritional requirements of HIV-infected pregnant and lactating woman

During pregnancy and lactation, the requirements for energy, protein and various micronutrients increase to meet the demands for adequate weight gain during pregnancy and milk production during lactation.

Energy

The recommended increase in energy intake in HIV-infected pregnant and lactating woman is the same as for non-pregnant, non-lactating woman. The recommended increase for HIV-positive women during the asymptomatic phase is 10%, and that increases to 20–30% with signs of AIDS and other infections.

For example, a nonpregnant HIV-negative woman requires 10 800 kJ (2 400 calories) daily, therefore an asymptomatic HIV-infected pregnant woman will require approximately 10 800 kJ (2 400 calories) + 1 080 kJ (240 calories) (10% increase due to HIV) + the usual extra 1 432 kJ (340 calories) (due to pregnancy) = 13 312 kJ (3 270 calories) daily. If she is experiencing any symptoms related to HIV such as fever, then she will require 20–30% additional energy 2 160–3 240 kJ (440–660 calories), and then still add 1 428 kJ (340 calories) for pregnancy.

For HIV-infected lactating woman, 1 680 kJ (400 calories) should be added for lactation, in addition to 10% in asymptomatic women and 20–30% in symptomatic women.

Protein

There is no current recommendation for HIV-infected pregnant and lactating woman to increase protein intake as a result of HIV infection. Protein requirements are 12–15% of energy intake, the same as for noninfected people.

Micronutrients

There is inadequate evidence to estimate the micronutrient requirements of HIV-positive pregnant and lactating woman. However, there are studies that have shown that multi-micronutrient supplementation containing 100% of the daily requirements of all micronutrients is associated with improved health outcomes for HIV-infected pregnant and lactating women.

Generally, the HIV-positive pregnant woman gains less weight than the HIV-negative woman and even the rate of weight gain is low. The rate of weight gain decreases progressively during pregnancy. It is therefore very important that weight gain during pregnancy should be closely monitored. *Pregnancy weight gain of less than 1.5 kg per month in the second and early third trimester, or less than 10.5 kg during the entire pregnancy, is of a serious concern.*

52.7 Drugs and other substances in pregnancy

The fetus is affected in some way by most of the substances administered to, ingested by or inhaled by the pregnant

woman. The breastfed newborn baby will also be affected by the substances contained in the breast milk. In addition, if tobacco or any other drug is smoked in the vicinity of the baby, the baby may be affected by some of the chemical constituents. The baby, therefore, is greatly affected by the lifestyle of the parents, and the effects of many unhealthy parental habits are forced upon the fetus and the newborn baby.

Social habits and pregnancy and lactation

Tobacco smoking and inhalation

Tobacco smoking and the subsequent inhalation of nicotine, can take the form of smoking cigarettes, cigars or pipes or snuff. There is now clear evidence to show that cigarette smoking during pregnancy does have detrimental effects upon the fetus and the newborn infant.

There is a definite increase in the following conditions and therefore also in the subsequent complications of these conditions: small-for-gestational age babies, a low average placental weight at birth (compared to non-smokers), spontaneous abortion, preterm labour and therefore preterm babies, and an increase in the perinatal mortality rate.

There is a possible increase in the following conditions: congenital malformations (particularly neural tube defects), respiratory problems in the neonate and infant and a possible increase in the neonatal and infant morbidity and mortality rates. These ill-effects of nicotine intake to the fetus can be prevented if pregnant women can be persuaded not to smoke. It would be even better to discourage all smoking. Women who smoke often also have affected taste and lower food intake.

The midwife should, at every opportunity, explain the dangers of smoking and encourage pregnant women to give up smoking or in the case of heavy smokers, at least to reduce the number of cigarettes to less than five a day.

Alcohol

It has been suspected for centuries that alcohol has potential teratogenic effects; however, it was only in 1973 that a specific pattern of malformations was described, which are now known as the Fetal Alcohol Syndrome (FAS). Almost half of the infants born to chronic alcoholic mothers will show some features of the syndrome. The most debilitating effects of alcohol consumption are upon the central nervous system of the fetus, causing impaired mental function. See Box 52.3 for the clinical features of fetal alcohol syndrome.

Alcohol consumption during pregnancy may possibly be one of the leading causes of mental retardation in South Africa, and yet this syndrome is totally preventable.

52.3 Clinical features of fetal alcohol syndrome

Defects in growth:

- Almost all the children afflicted with fetal alcohol syndrome are small in height, weight and head size.

Central nervous system dysfunction:

- More than 80% of patients with fetal alcohol syndrome, who were tested, had IQs of more than two standard deviations below the mean.
- It has also been noted that the most severely physically affected children have the greatest degree of mental retardation.

The abnormal facial characteristics of fetal alcohol syndrome:

- Those with fetal alcohol syndrome have certain distinctive facial features. These are: short palpebral fissures (the length of the eye-opening or eye-slit is reduced and epicanthic folds are often present). A flattened or absent philtrum (the furrow running from the base of the nose to the centre of the upper lip is shallow or absent). A hypopiastic upper lip with a thin vermilion border (an under-developed upper lip).

Cardiac abnormalities:

- 25–50% have cardiac abnormalities. These include atrial and ventricular septal defects, patent ductus arteriosus and Fallot's tetralogy.

Associated abnormalities:

- Further abnormalities which have been associated with fetal alcohol syndrome include abnormalities of the neuroskeletal, the urogenital and the cutaneous systems. There also appears to be an association between chronic alcoholism of the mother and fetal liver damage.

The dangers of alcohol consumption during pregnancy should be widely publicised and midwives should do their utmost to discourage this practice. In fact, women should be educated to understand that if they intend or are likely to become pregnant, then they should abstain from all alcohol, because the first month of pregnancy is the most critical.

Women suffering from chronic alcoholism should be encouraged to take effective birth control measures. Pregnant women suffering from alcoholism should be advised and helped to limit their daily alcohol intake to 30 ml of spirits,

that is one strong drink per day, or 60 ml of wine or 250 ml of beer. It has also been suggested that chronic alcoholism could or should be an indication for termination of pregnancy. Adverse effects of alcohol consumption include interference with vitamin A absorption. In addition alcohol abusers also tend to be malnourished and prone to unhealthy habits that include unhealthy sexual behaviour, smoking and drug abuse. Women are also more prone to alcohol problems due to their low body weight and composition of protein and water.

Dependence-producing drugs

Narcotics and hallucinogenic drugs have detrimental effects upon the fetus and the newborn infant. However, it is difficult to estimate the actual harm done by these drugs alone, because the pregnant women using these drugs are usually also subject to other problems such as malnutrition, alcoholism, tobacco smoking and general neglect. To add to these problems, the newborn infant will often be reared in this same environment. The drugs are excreted through breast milk in toxic levels. The effects of narcotics on the fetus are probably similar to those of smoking tobacco, but with an increased risk of fetal abnormalities. In addition, there is likely to be difficulty with the initiation and maintenance of respiration at birth and there are also the problems of neonatal drug withdrawal.

The effects of smoking dagga (marijuana, pot, hashish) are still being evaluated. It must be assumed, therefore, that the ill-effects are at least the same as those of tobacco smoking.

In South Africa the use of the drug tik (crystal meth) is very popular among young people and the poor. It is very dangerous because it is mixed with unknown substances that can be more dangerous than tik itself.

The midwife should be able to recognise this problem during history taking and examination at the first antenatal visit, although these women may go to great lengths to hide their problem. Dilation of the pupils, reddened eyes and an over-stimulated or excited state could be suggestive of dagga or other hallucinogenic substances, while pinpoint pupils and a depressed and unresponsive state could be suggestive of narcotics. The withdrawal signs of any of these substances may be an over-excited state, with tremors, sweating and hallucinations. Once the problem has been diagnosed, the woman should be referred to expert specialist care and the Social Welfare authorities should be notified.

Prescription drugs

All pregnant and breastfeeding women should be instructed not to take any unnecessary medication. Even medicines which can be bought without prescription and from supermarkets can have adverse effects upon the fetus and the breastfed baby.

If the woman has any minor ailments, such as a cold or cough, she should check with a qualified pharmacist before taking any medicine, to make sure that it is not harmful to the fetus. Any woman who is pregnant and has to be seen by a medical practitioner (or dentist), must inform that medical practitioner that she is pregnant and she should take any medication ordered exactly as prescribed. Should any medication have an adverse effect, the woman should notify her medical practitioner immediately.

Every woman who has some disorder and is on medication should inform her medical practitioner or midwife if she intends to try to become pregnant and also as soon as she thinks she may be pregnant. If the medication she is taking could be detrimental to the fetus, the medical practitioner will substitute the medicine.

52.8 Conclusion

Midwives in South Africa are often the only healthcare professional the woman sees during pregnancy and birth and therefore have an important role to play in assessing women's nutritional needs within the boundaries of their socio-economic circumstances and cultures. Women need to be supported and provided with appropriate advice and information to maintain their health during pregnancy and lactation. If problems are identified, the woman needs to be referred for nutritional support from a registered nutritional specialist.

Section Eleven

Medication used in childbirth

53 Complementary and alternative medicines

54 Principles of pharmacology in obstetrics and the neonatal period

CHAPTER

53

Complementary and alternative medicines

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- identify safe complementary and alternative medicines (CAMs) and traditional practices useful in obstetrics
- develop skills to advise and educate women on the use of CAMs in pregnancy and birth

KNOWLEDGE ASSUMED TO BE IN PLACE

General knowledge of traditional substances and practices in communities related to health

KEYWORDS

Complementary • Alternative • Traditional medicine • Allied Health Professions Council of South Africa (AHPCSA)

53.1 Introduction

Complementary or alternative medicines (CAMs) and/or therapies are two of the many terms used to describe any approach to healing that is not traditional in western medicine, though they may have a long history of use in many countries.

Traditional medicines refer to objects, substances and customs used in traditional health practice by traditional healers and traditional birth attendants for the diagnosis, treatment or prevention of a physical or mental illness.

It is important for midwives to understand the role of CAMs, traditional medicines and customs in pregnancy, labour and baby care.

Background

People's increasing desire to self-medicate (a move worldwide to the use of alternative medicine) and the greater affordability of natural remedies are factors contributing to their growing popularity. In South Africa there is still a strong traditional medicine influence and regulation of these is a particularly sensitive subject. The Traditional Health Practitioners Bill will be used to regulate four groups of traditional healers, *sangomas* (diviners), *izinyangas* (herbalists), traditional birth attendants and *iingcibi* (traditional surgeons). The current trend seems to be not to overregulate but to encourage self-regulation, improve traditional practices with health knowledge and primary care and promote a culture of tolerance and mutual respect.

There are ten therapies or modalities that have statutory recognition in South Africa and which fall under the authority of the Allied Health Professions Council of South Africa (AHPCSA). Complementary and alternative medicines (CAMs) are the specific term for medicines and remedies used by 'natural' therapists or the public for self-treatment. These include herbs, homeopathic remedies, flower essences, vitamins and minerals, sport and nutritional supplements, weight management products and even energy devices. Given the substantial increase in public support for CAMs (the South African market is growing at about 12–15% per annum), it is encouraging that government has taken increasing steps towards appropriate regulations for the industry.

While the AHPCSA is empowered to monitor the treatment modalities that fall under its auspices and each also has its own professional regulatory body, OTC (over the counter) products and remedies are not controlled by either. The Health Products Association of South Africa (HPASA) is a body that acts as a mouthpiece for the CAMs market and

has collaborated with the Department of Health to formulate revised regulations. HPASA regularly communicates with member companies, practitioners and other interested parties to advise on regulatory changes, encourage ethical practices and promote manufacturing standards.

In an era when there is a move to integrative medicine, not only is regulation of CAMs important, but western health professionals need to increase their knowledge of CAMs and the role that traditional healers and natural health practitioners can play in the health field.

53.2 Important perspectives for nurses and midwives

It is the author's standpoint that mothers are growing the next generation, shaping humankind's future and nurturing tomorrow's leaders. In short, they are doing *the* most important job on Earth! Midwives and maternal and child health nurses are in the privileged and powerful position to help them and natural therapies can be a powerful tool and catalyst in their hands. Furthermore, midwives and nurses are in a unique position to use their instinctive and trained skills to make a vast difference to their patients' experience. Recognising individuality, respecting preferences, working with nature, truly caring about the families in their care, promoting breastfeeding and being knowledgeable about natural therapies will make all the difference necessary to provide superior care and service. The word midwife means 'with women' – probably the most important role possible, second only to mothering itself!

Midwives and nurses as skilled birth attendants can improve maternal and newborn health at grass roots community level too. The role of skilled birth attendants in caring for pregnant women and conducting deliveries is acknowledged and they should be encouraged to promote practices that help achieve the Millennium Development Goals through sound primary healthcare practices. In particular, prevention, early recognition and emergency treatment of the major contributors to high maternal and child mortality is in the hands of midwives and nurses, who can influence traditional birth attendants and mothers to healthier practices.

53.1 Use of CAMs

Alternative and supplementary therapies are incorporated in most nurses' repertoire of care. A study in the USA in 2009 indicated that 78% of healthcare workers reported using CAMs in their practices. The respondents were middle-aged and qualified to Master's level.

53.3 Terminology

The many terms used in complementary and traditional medicine need to be understood from the outset.

Terminology particular to CAMs

Complementary medicine

The word complementary literally means 'in addition to' but usually implies an active choice to use 'natural' remedies or a measure resorted to when conventional medicine is not successful.

Natural medicines or remedies

The word natural is unfortunately abused with most people assuming something that possesses no potential for adverse reactions. Many naturally occurring substances have toxicity and require in-depth knowledge to be assured of correct use. The use of natural substances without knowledge can cause damage and death.

Phytotherapy

This literally means plant medicine, derived from the Greek word for plant or 'that which grows'–*phyton*. Herbal and other plant remedies fall in this category and are in all likelihood the most common category of medicinal substance known and their use is widespread. Phytotherapy encompasses many different approaches and systems, like traditional Chinese medicine, Ayurvedic remedies, western herbal medicine and traditional plant remedies used by rural cultures.

Homeopathy

This is the term for a widely used complementary therapy derived from the two Greek words *homoios* (similar) and *pathos* (suffering). Homeopathy literally means 'similar suffering' and gives a clue to its foundational diagnostic and therapeutic approach, which uses the principle that every substance has the power to heal or to harm and that in-depth analysis of the symptoms with which a patient presents is essential in the selection of remedies, which must be based on the central Law of Similars (see page 725).

Allopathic medicine

This is what many alternative health practitioners call conventional western medicine and the term is derived from the Greek word *allos* meaning different or other. It is used to encapsulate the approach of using substances to treat conditions based on the principle of counteracting the perceived cause of pathology and its effects, and is thus directly opposite to homeopathy's approach.

Neutraceuticals

These medicines are also considered to be foods.

Other important background terminology

Vital force

This is the term that many alternative health therapies call 'the inherent energy' that keeps one in a state of dynamic wellbeing. It is not quantifiable, nor can it be seen with the naked eye, yet it is acknowledged by most disciplines to be present in all living beings from birth. It is comparable with the 'chi' in Chinese medicine.

Holism

This is a theory of health based on the approach of the importance of taking a person's complete physical, mental and social conditions into account in the understanding and treatment of illness.

Teratogenic

This is a substance that can cause abnormalities of the fetus during its development. Derived from the Greek words *teratoit* meaning monster and *genesis* meaning generation or producing.

Abortifacient

This is anything used to induce abortion of a fetus.

Traditional birth attendant (TBA)

This is a person (usually a woman) who engages in traditional health practice and is registered under the Traditional Health Practitioners Bill. In remote and very small communities there may be no TBAs and many women still deliver by themselves or with the help of a close female relative or friend. In cultures where there are TBAs, their work is often restricted to one extended family and they may do as few as 20 deliveries a year. Very few TBAs have a practice big enough to make it their main means of living. Those who do may deliver up to 120 babies per year. In the Limpopo province in about 20% of births the caretaker or assistant is unknown, leaving the impression that traditional birth attendants are still practising in this area.

53.4 A brief overview of some complementary therapies

Complementary therapies (and in all likelihood traditional medicine too) operate on the principle that healing is performed by the human body *and* mind. Any therapy, such as a remedy taken, therapeutic massage done or procedure performed (that has positive effects on a person) is considered as merely a catalyst that triggers the restoration of balance or good health to the body and mind. This does not mean that illness is perceived to be all in the mind, as so many critics of complementary or natural therapies suppose. The basis for the success of some therapies is not always clear. Women generally have less trouble accepting natural therapies, probably because they seek the gentlest and most effective way of restoring their families to health. As is true in conventional medicine, the therapy is only as good as the practitioner and the quality of the remedies; users need to ask relevant questions when choosing a practitioner or remedy.

An important cornerstone of complementary or alternative therapy is the emphasis laid on holism and the responsibility of the individual to get actively involved with his or her own health. Consider for a moment the word 'disease'. Separate it into syllables and re-read it – dis–ease translated into a condition of discomfort. CAMs and natural therapies have the intention of returning mind and body back to a state of ease. It does not claim to have all the answers or cure all conditions but is of assistance to bring balance physiologically and between body and mind. The concept 'psychosomatic' in western medicine acknowledges the link between the mind and the body that cannot be cured with medicine.

Some complementary therapies incorporating medicinal substances in treatment

In this section, we will take a brief look at some therapies that actively use remedies or medicinal substances as the cornerstone of their treatment regimes. This will help readers to understand the rationale behind the different CAMs available, within the context of the specific therapy. At the same time, it will become clear why it is important to distinguish between the mode of action, the benefits and the risks of individual therapies and the best way to select, use and monitor the use of CAMs.

Aromatherapy

Aromatherapists use essential oils, which are very potent oil extracts, from a great variety of plants and these have physical and psychological effects. In plants these oils acts as pesticides, fungicides, and bactericides and may also have hormone-like properties. The complex oils extracted are esters, alcohols, aldehydes, ketones and terpenes. Essential oils are diluted with an inactive base oil before treatment.

Essential oils affect the body in two ways. As they are applied to the body, one breathes in the vapours which are then absorbed by the blood vessels in the lungs and rapidly

transported throughout the body. The skin also absorbs the oils at the point of application if clean and well prepared. Each type of oil has specific properties that have a direct physiological effect on the body. Some stimulate activity, others relax the body processes and others have healing properties.

Once absorbed the oils are dispersed to the extracellular fluid. They are excreted mainly through the lungs and the kidneys, and some are altered in the body just like with drugs. Some are toxic and the correct therapeutic dosage is important.

Not only are the inhaled vapours absorbed in the lungs, but the olfactory nerve in the nasal mucous membranes registers their presence and transmits their message to the centre in the brain responsible for emotional control and the memory process. Emotions are then affected by the treatment, depending on the properties of the oils. Aromatherapists believe that it is essential that one instinctively likes the aroma of the oils used, for maximum benefit.

The concentration of essential oils does hold potential for side effects, which is of particular importance in pregnancy. Therapists must be chosen with care for their knowledge and experience. Some of the essential oils to be avoided in pregnancy are pennyroyal, basil, hyssop, marjoram, sage, cedarwood, rosemary, fennel, cinnamon and citronella. Despite the possibility of side effects, expectant women can profit from skilled aromatherapy treatment. As with all direct touch therapies, the relaxation induced by the treatment enhances the therapeutic value.

Most commercially available aromatherapeutic creams, lotions and oil products contain very diluted quantities of essential oils, if any at all, and pose no risk in pregnancy beyond topical allergy reactions to the base substances. Checking pack inserts and with manufacturers provides added safeguards.

Herbal substances

Herbal remedies, also called phytotherapy, herbalism and plant medicine, have a history as old as humankind. All herbal remedies need to be used with caution as these may have harmful as well as beneficial properties and accumulation of active ingredients in the body is possible. Preparation methods may in some instances also pose risks and different people may react differently. Some herbal medicines are strictly contraindicated in pregnancy and lactation and in small children – some may have teratogenic effects, some are abortifacients and some are highly toxic. Herbal remedies have an action that is similar to traditional drugs, which also have potential for adverse effects. The quality of raw material used, agricultural methods, quality of manufacture and remedies themselves as well as the expertise and practices of the therapist all influence outcomes achieved with herbal remedies.

Important general precautions include:

- choose products that are manufactured from registered and approved sources
- keep strictly to dosage instructions, and
- use for limited periods, thereafter take a break to avoid accumulation in the body.

Nonetheless, some herbal products can be used safely in pregnancy but advice should be taken from an expert in the field. Topical cosmetic and treatment products containing well-known herbal ingredients are mostly less problematic in pregnancy although some may cause allergy symptoms associated with base substances.

Culinary use of herbs, spices and teas will seldom pose a problem unless significant quantities or extremely concentrated amounts are used quite frequently. When herbs are turned into medicines, the product is very concentrated and more likely to have adverse effects. A rule of thumb with herbal teas, to ensure safety, is to have no more than two or three cups a day and ensure a weak infusion.

Homeopathy

Since the formalised inception of its principles in 1786, homeopathy has repeatedly proved its worth in the field of healing. Modern orthodox medicine is in fact a very new discipline by comparison, although it too developed in part from the age-old medicinal use of herbal remedies. There is a common misperception that the discipline's roots are in the East but as can be seen from history, its origins can be traced back to Europe.

Homeopathy is often mistakenly taken to be the same as herbal medicine. Although certain herbs and plants are sources of homeopathic remedies, there are significant differences, the main one being the absence of adverse effects of homeopathic remedy use.

Dr Samuel Hahnemann, a physician, chemist and visionary in Germany, is recognised as the initiator of modern homeopathic practice. After 10 years of meticulous experimentation and documentation of his findings when using common medicinal substances, he formulated the Law of Similars. This stated that a substance that will relieve a set of symptoms in an ill person will cause those same symptoms in a healthy individual. Remarkable as this might seem, the principle is not unknown to orthodox medicine. For instance, the plant substance digitalis, which is used to regulate heart arrhythmias, requires patients to undergo regular blood tests, as too high levels put them at risk of heartbeat irregularities.

In other words, the healing agent can become a toxic agent and a medicinal substance has the potential to both relieve and cause similar symptoms!

Hahnemann coined the name 'homeopath'–deriving it from the two Greek words *homoios* (similar) and *pathos* (suffering). He realised that over-dosage was an inherent risk with traditional substances used medicinally. He understood the concept of 'energy medicine' and proceeded to evolve the idea of potentising remedies which involves diluting the original substance (called a mother tincture in homeopathy) and then succussing it (or shaking vigorously). This process transfers the molecular healing energy of the substance to the carrier base. In the process of dilution any potential for adverse effects was removed. In short, one could say that homeopathy harnesses and transfers the healing essence of a substance through succussion to the base ingredient and discards potential toxicity by diluting to the stage of no material substance remaining (concentration is 10^{-6}).

The efficacy of this form of healing cannot merely by ascribed to placebo effect as is possibly most easily demonstrated by the regularity with which both animals and babies respond positively to treatment. One of the many myths about homeopathy is that it can only be used for minor complaints like colds. The correctly chosen remedy can, however, relieve acute symptoms of illnesses like tonsillitis, otitis media, conjunctivitis, bladder infection (cystitis) and premenstrual tension within a few hours. Chronic conditions like rheumatism and emphysema will take longer to respond, due to long-term effects on the body. In pregnancy, during labour and for treatment of babies and children, homeopathy provides a safe and effective therapy.

The important thing is to understand the difference between herbal and homeopathic remedies. For instance, one of the common concerns in pregnancy is the use of the remedy arnica, which is known to promote bleeding when used in herbal form. Homeopathic arnica, however, would not pose any risk. As a very basic rule of thumb, if the ingredient units used are D6, 6x, 30CH, etc, the remedies are homeopathic. If measured in micrograms, milligrams, grams, etc. or one is advised to take a 'teaspoon' or medicine measure of the product, it is likely to be a herbal preparation. Homeopathic substances are taken in minute forms or drops.

Homeopathy is not an esoteric system, nor is it linked to any religious belief. No mystical process is used to manufacture remedies. Scepticism usually comes in two forms – scientific criticism for supposed lack of research evidence and religious resistance from some sectors of the Christian community. The latter generally believe that the discipline is linked to Eastern religions (simply not the case) and that the manufacturing process includes occult practices. A distinction must be drawn between individual practitioners who might follow a religion or cult contrary to one's own and the discipline they practise professionally. There are no doubt western health practitioners who have beliefs that might also concern some religious groups, yet seldom would their professional activities be questioned. Increasing numbers of western health practitioners study and use homeopathy and alternative healthcare in and out of hospitals and also in obstetrics.

Fulltime homeopathic training in South Africa, recognised as one of the best in the world, is presented by the Johannesburg School of Homeopathy and the Durban Institute of Technology. The programme runs over five years followed by one internship year. The first three years are very similar to medical school, except for surgery modules. A research project is a necessity to qualify.

None other than Mahatma Gandhi had this to say: 'Homoeopathy cures a greater number of people than any other method of treatment' and in the words of the WHO: 'Homoeopathy seems well suited for use in rural areas where the infrastructure, equipment and drugs needed for conventional medicine cannot be provided'.

In short, homeopathy is the only medicinal therapy that can claim no adverse effects, has no cumulative drug effects, can be taken with other treatments and is totally safe in pregnancy, breastfeeding and for babies.

Tissue salt therapy

Tissue salts are basically homeopathically prepared mineral compounds and as a result, they possess or cause no adverse effects. Tissue salts are related in some way to mineral therapy and are often more easily accepted by health practitioners and the public alike.

Some two or three hundred years ago we didn't know that the human body was made of water, inorganic and organic matter in perfect proportion. The concept of tissue cells was also foreign. That all changed when Dr Wilhelm Schuessler, a medical doctor, homeopath, physicist and biochemist, recognised the importance of twelve inorganic compounds in the body. Dr Schuessler lived and worked in Germany in the 19th century and although he was not the only scientist active in this field, the tribute for tissue salt therapy goes to him. He noted that these 'salts', or chemical compounds, were present in minute doses in the body and that they were essential to correct cell and body functioning.

In modern times medical and nutritional scientists have developed mineral supplementation into a gigantic industry and there are times when conventional mineral supplementation is vital. The 12 tissue salts have proven to be of immense

benefit in preventive and healing therapy. Table 53.1 gives details of their use in obstetrics.

Flower essences

Flower essences are made in a number of places in the world. English flower essences are possibly the best known and originally introduced by Dr Edward Bach in the 1930s. In South Africa flower essences, utilising the plants from the amazing floral kingdom of the Cape Peninsula, have been commercially manufactured since 1995 and are distributed and used in eighteen different countries.

Like homeopathy, flower essences are taken orally and work on the principle of vibrational healing, a form of energy medicine.

Flower essences are totally safe in pregnancy and lactation.

Selected non-remedy complementary therapies

Reflexology

This therapy traces its roots to ancient Egypt, where artwork depicts foot massage therapy taking place. Central to reflexology is the belief that every organ and every part of the body has invisible but corresponding reflexive endings on the feet and the hands. A specific massage technique has the dual benefits of greatly relaxing the person while stimulating the healing processes of the body at the same time. This therapy operates on the basis that humans all have energy fields that are intricately linked to both health and illness. The healing power of relaxation has been proven over and over by all disciplines and in pregnancy especially, this is important.

Reflexology is safe for mother and baby but certain parameters should be adhered to. Choose a therapist whose touch is not uncomfortably firm. The reflex area to the womb should not be stimulated. It is unlikely that this would bring on premature labour, but the area would be very sensitive and no chance should be taken. The patient should not lie on her back during treatment from about the fifth month of pregnancy to ensure good circulation to her baby. Reflex areas to endocrine glands (like the thyroid and ovaries) are usually more sensitive – this does not mean that something is wrong. Reflexology does not tickle, a concern many people have before they first try a treatment. Reflexology does not claim to treat specific complaints, although it certainly can aid the body in its own healing processes and is very relaxing and rejuvenating. Many pregnant women report finding relief from bladder and vaginal infections and some experience substantial help with varicose veins and swelling due to poor circulation in pregnancy. Most women report an increase in their overall sense of wellbeing. Used for colic and restless infants after birth, gentle reflexology is a wonderful and soothing therapy. Constipation in babies also responds very well to treatment.

Acupuncture

Based on the concepts of traditional Chinese medicine, acupuncture has a history of more than 3 000 years. Acupuncture works on the basis of stimulating points on the body's surface to positively affect the physiological functioning of the whole body or specific parts. The ancient Chinese believed that we are born with inherent energy called qi (or chi as it is pronounced and mostly written) circulating in our bodies through 12 invisible channels or interconnected pathways called meridians. Each meridian pertains to a different organ system. This energy flows from one meridian to another, completing a cycle every 24 hours. Acupuncture points are located along these meridians. The goal of this technique is to maintain balance throughout a person's body to prevent illness and restore health, while activating the body's own healing abilities.

Thin needles are inserted into different points along the meridians to redirect and regulate the flow of energy, creating balance and allowing organ systems to function properly. Therapists might also use electro-acupuncture, in which minimal electric currents are sent to meridian points, or moxibustion in which points are heated to increase energy flow. Between six and twenty needles are used during therapy and they are normally left in for at least 30 minutes.

Chiropractic

In South Africa chiropractic practitioners graduate after six years of study and training, with a Masters Degree in Chiropractic, either from the University of Johannesburg or Durban University of Technology. Chiropractors use gentle pressure and manipulation of the spine to relieve irritation on the nerves which run through the centre of the spinal column. The spinal cord carries information throughout the body and is responsible for all bodily functions, so if the vertebrae are even slightly twisted or misaligned, this can cause a knock-on effect in the rest of the body. Spinal misalignment in babies usually occurs due to intrauterine position, difficult labour or delivery. Skeletal and muscle manipulation restores the alignment of the body to prevent blockages, much like in acupuncture.

Chiropractors must be informed of pregnancy and will then avoid certain techniques at different stages of pregnancy. Techniques used with babies differ somewhat from adults, due

to bone structure and strength. Patients should be encouraged to choose experienced practitioners.

53.5 Common remedies used in pregnancy, birth and childcare

Phytotherapeutic or herbal remedies used in childbirth

Raspberry leaf

Raspberry leaf tea is one of the better-known herbal remedies for easing the process of labour. Raspberry plants (*Rubus idaeus*) are native to many parts of Europe and Northern America and the leaves have been used in pregnancy and lactation since the sixth century. They are a rich source of iron, calcium, manganese and also magnesium, a mineral which helps to strengthen the uterine muscles and prevents uterine irritability. Raspberry leaf is also a valuable source of vitamins B1, B3 and E, which are important in pregnancy and lactation.

Raspberry leaf tea, according to folklore, has broad usage in the female reproductive years. It is used to help regulate the menstrual cycle, aid fertility, ease the symptoms of morning sickness and lessen discomfort from Braxton-Hicks contractions. Raspberry leaf does not appear to induce labour as such, but might well assist in more efficient progress and dilation of the cervix. Women and their traditional birth attendants or midwives report that labour is generally easier and shorter when using raspberry leaf tea in pregnancy and first stage of labour. The uterus appears to contract more efficiently after birth and lactation is improved. Raspberry leaf tea has some clinical research to back up its use in labour, specifically from Australia (Parsons: 2000). Studies were initially observational, followed by a randomised controlled trial. Results showed clinically significant benefits, although statistically research is not that compelling. The remedy was found to have a uterine stimulant and tonic action. Consensus is that raspberry leaf shortens second stage of labour, helps avert artificial rupture of membranes, reduces the need for assisted delivery by forceps or vacuum and lowers the caesarean rate. No adverse effects to usage throughout pregnancy were observed in the observational study, though in the clinical study, the remedy was only used from 32 weeks, also with no adverse effects being noted.

The stimulant action of raspberry leaf is why it should be avoided in the first trimester and not used in excess at any stage. Raspberry leaf tea can be taken in a tea bag, loose leaf, tablet or tincture form and is available from most herbalists and health food stores. The safest usage seems to be as follows:

- Use only in the last trimester and preferably from six weeks before due date.
- Between six and three weeks before the due date, a woman can use one cup a day (or the tablet equivalent according to dosage instructions).
- From three weeks the amount can be gradually stepped up to four cups spread over the course of a day.
- Once labour starts raspberry leaf tea can be sipped throughout.
- Raspberry leaf tablets, 2.4 g per day from 32 weeks, produced no side effects in the Parsons research. Preparations must not be confused with the safe use of the homeopathic form which always goes by the name of *Actea racemosa*.

Black cohosh

Black cohosh, a perennial herb, is also known as black snakeroot, *Actea racemosa* and *Cimicifuga racemosa* and is used in many part of the worlds in female healthcare, with specific application in traditional labour assistance and menopause. Black cohosh is used for dysmenorrhoea and it helps raise the pain threshold in labour. Recovery from birth is generally better and it is useful in treatment of mild depression of both the postnatal period and the menopause. It has oestrogen-like activity due to the isoflavonoids and triterpenoids and acts to relieve hot flushes and other common menopausal symptoms.

Black Cohosh can potentially be over-dosed or used inappropriately if not under guidance of a trained or experienced herbalist.

Excessive intake may cause nausea and vomiting, dizziness, diarrhoea, tremors, depressed heart rate and miscarriage. More than 5 g of the substance can be toxic.

Other herbs

Many herbs stimulate the uterus and are unsafe in concentrated usage in pregnancy. It must be noted that this doesn't mean that some of these can't be used as condiments. However, in concentrated essences, they could have adverse effects. These include aloe vera, rosemary, rue, sage, southernwood, thuja, parsley seed, pennyroyal, pokeweed, blue cohosh, celery seed, cinnamon and devil's claw.

Parsley, celery and rocket in their natural form are useful for their vitamin and mineral properties, but use of their seeds must be avoided in pregnancy. Chamomile tea is fairly safe in pregnancy in moderation although babies will react sensitively, with restlessness and digestive discomfort, if ingesting too much. Chewing a mint leaf for heartburn is an effective home cure and a few drops of peppermint essence in a cup of hot water is another safe way of using this common garden

herb. Fenugreek, fennel, caraway and milk thistle are all traditionally used to promote lactation.

Rooibos remains a firm South African favourite and is proven to be totally safe and has wonderful antioxidant and other health benefits. Drinking vast quantities is sometimes thought to be linked to anaemia, especially in babies. Green tea is considered to be a very healthy drink for all ages and is safe to use in moderation in pregnancy too. Fennel and ginger tea can help for nausea and indigestion in pregnancy and chamomile tea (used sparingly) assists safely with restful sleep and anxiety.

Homeopathic remedies during pregnancy, labour and childcare

Homeopathic remedies for pregnancy and labour

Remedies used in pregnancy and birth need to be chosen correctly to get maximum effect: it is best to consult a trained homeopathic practitioner before use. In labour remedies are mainly used for their effect to support the natural birth process, with the effect that labour time is usually reduced and coping ability improved. Homeopathic remedies do not have a drug-type action, so will not remove pain altogether. They act to relax a stubbornly tight cervix and stabilise labour contractions. They are also used to reduce the length and severity of the contractions (pain). Homeopathic remedies also address specific tendencies in a particular woman that might increase discomfort, like an anxious nature. The choice of remedy is specific to the individual woman and the experience in labour. Some remedies can be used prior to labour to help prepare the womb or address issues like anxiety. The baby will suffer no negative side effects.

Caulophyllum

This is one of the better known labour remedies and a wide range of women can profit from its use. It relaxes a tight cervix mouth, decreasing the muscular effort needed to dilate, and consequently the duration and pain of labour. It will also help for sharp pains that seem to fly in all directions and not effectively allowing labour to progress. If labour seems to come and go (erratic and uncoordinated) this is the indicated remedy. It can be used prior to the onset of labour to prepare the uterus for the work ahead, but is mostly taken as labour starts, a dose every half to one hour. Nausea in labour also responds well to this substance. The potency range used is 30CH to 200CH.

Actea racemosa

As mentioned, black cohosh in herbal form helps raise the pain threshold. Women who are inherently wary of pain will probably need it. It should also be taken if there is great restlessness during labour, the woman that seems to be uncomfortable to find the right position or has a tendency to feel hysterical during labour finds benefit with the use.

Pulsatilla

This remedy is indicated for extreme anxiety, irritability and tearfulness in labour. It also gives direction to a slow starting labour and strengthens a woman's resolve.

Nux vomica

This widely used homeopathic remedy is helpful for a mother with an intense nature (almost as if she is working against the labour). This remedy will allow the mother to relax sufficiently to allow Mother Nature to do her job. It will also help for queasiness in labour.

53.2 Homeopathic remedies for the postnatal period

A brief pointer only is given in this regard:

- *Arnica*. Promotes rapid healing, reduces swelling and helps prevent infection in the mother.
- *Hypericum*. Helps prevent infection, relieves nerve pain in the perineal area and heals cracked nipples.
- *Baryta carb*. Assists premature babies to catch up on milestones and thrive.
- *Calendula*. Excellent for infection prevention, skin rashes and cracked nipples.
- *Chamomilla*. Used for frequent crying, colic and teething in babies.
- *Ignatia*. Used for mild depression and to help cope with loss (for instance after miscarriage or stillbirth).

Tissue salts for the perinatal period

Tissue salt remedies provide a trusted and unique approach to health and offer safe, natural treatment of the minor complaints of pregnancy, can support labour progress and relieve many postpartum and baby problems. Table 53.1. gives a summary of useful tissue salt and their use in obstetrics.

Traditional customs and herbal remedies used during pregnancy and labour

Many plants and herbs are used by rural women as traditional remedies in the reproductive years in most parts of the world.

Table 53.1

Tissue salts used in obstetrics

Pregnancy	Labour and birth	Mother postnatally	Baby
Calc fluor for stretchmarks, ligament pain, varicose veins, constipation, dental health of mother and baby *Calc phos* for growth of baby, immunity, anaemia, skeletal strength, dental health of mother and baby *Calc sulph* for acne in pregnancy *Ferr phos* for strength of ligaments, as an anti-inflammatory in case of any infections, anaemia, oxygenation, acne *Kali mur* (together with *Calc sulph*) for vaginal thrush *Kali phos* for baby's central nervous system development, emotions of pregnancy, for aches and pains *Mag phos* for uterine irritability, leg muscle cramping, baby hiccups in the womb, headaches *Nat mur* for dry itchy skin, weepiness and depression, dry stools, mild swelling *Nat phos* for nausea in pregnancy, heartburn, indigestion *Nat sulph* for nausea, mild swelling	*Kali phos* allays anxiety, raises pain threshold *Mag phos* as an anti-spasmodic offers pain relief, soothes cramping muscles *Ferrum phos* for burning pain, strength of spirit and body in labour and perineal protection during labour	*Ferrum phos* taken as an anti-inflammatory may reduce swelling and the chance of infection, prolapse of womb and vagina, anaemia, pain relief *Kali phos* for nerve repair in birth canal, healing, maternal anxiety *Nat mur* for third day blues or postnatal depression	*Calc fluor* for stronger teeth *Calc phos* for slow teething, large anterior fontanelle which is slow to close, or for a baby who is ill often *Calc sulph* for green, lumpy mucus and together with *Ferrum phos* for sore throat *Ferrum phos* for fever, inflammation and infection *Kali mur* for thick, white to grey mucous, 'glue ear,' oral thrush, cradle cap *Kali phos* for anxiety, very restless behaviour *Kali sulph* for chronic skin rashes, yellow sticky mucus *Mag phos* for colic, hiccups, cramps *Nat mur* for watery mucus, excessive crying, constipation or diarrhoea to balance digestive system *Nat phos* for sour-smelling possetting, milia (*babasuur*) *Silicea* to strengthen a scrawny body with a big head, weak neck and back control

These have often become part of folklore and are handed down from one generation to another, mostly through the maternal line. Traditional birth attendants and/or healers are also custodians of customs, practices and remedies used to improve female health, promote or delay conception, induce abortion, trigger delayed labour onset, promote the labour process, ensure effective uterine contraction after birth and to promote lactation. While some remedies are specific to a region, many are customary across various parts of the world. Remedies are frequently used in combination with other practices including incantations, visualisation, ancestral communication and culture-specific rituals. These customs and remedies often seem shrouded in secrecy simply because they are more prevalent in remote areas and because western medicine mostly censures their use and they are often not talked about to outsiders.

Some traditional customs

Midwives, nurses and TBAs cannot control customs and rituals that have been in practice from time immemorial but should be alert to assess if there is harm or risk for either mother or baby. Rituals often promote emotional support, relax the mother and relieve anxiety and in the absence of risk are to be encouraged. A few common customs are as follows:

- If there is a bundle of wood in the house or any other knotted items, TBAs or relatives accustomed to helping at deliveries will ask for these to be untied, believing that this will 'loosen up everything' in the woman and promote easy birth.
- The umbilical cord that eventually detaches from the baby is kept safe by the mother by tying it on the cloth that she has around her stomach and this she must then give to her mother-in-law and say 'here is the child's mercy'. The cord is hung up from the roof which signifies that this is the baby's home and that he/she will 'know where his/her home is when grown up and will not give problems'.
- Every child born is greeted with the traditional praise cry *hala-la* before being washed.
- The process of birth, greeting and hanging of the umbilical cord is followed by *ukusoka*, the giving of presents which also ensures that the baby will know where home is and have respect for this place.
- A man from the family will take some hair from a cow's tail in the kraal, go to the woman's home where she has given birth and roll it into a belt that will be tied around the baby's waist and neck. Various rituals then ensue and the mother and baby are both covered with a blanket so that people cannot see the mother's face. It is only once the belt is finished and worn by the baby that the mother can show her face again.
- *Efukweni* is a custom that causes some concern. Some women are told not to go to hospital to get antiretroviral treatment for two weeks after birth until the umbilical cord falls off to avoid exposing the child to evil spirits.
- Another concerning custom is the belief that a newborn baby should be given *isicakati* as a first feed for a few days, increasing risk of transmission of HIV from mother to baby when breastfeeding commences thereafter.
- In some cultures it is believed that a newborn baby should be taken to *ilawini*, a traditional healer to get a remedy for the removal of evil spirits, *umoya uphumile*.
- In the Muslim culture the baby will have a prayer said into the ear by a male after birth and is given a drop of holy water and a tiny piece of dates from *Mecca* if available.

These and other practices need to be respected by midwives.

Harmful practices like putting cow dung on the umbilical cord is discouraged through health education.

Traditional herbal remedies

The use of herbs, traditional remedies and customs are often frowned upon and considered unscientific. This calls for an approach that respects both practices and seeks to incorporate traditional customs safely in to healthcare.

The remedies in particular are not simply either placebos or toxic agents, but studies have been done and are emerging in increasing numbers, clearly demonstrate that there is a scientific basis to the innate knowledge of traditional healers and the plant remedies of their geographical areas. Surveys also show that many women who have moved to urban areas use a combination of traditional herbal remedies and western medical care. Some of these are discussed below.

Isihlambezo is a term commonly used in South Africa, especially among Zulu women, to describe a herbal compound used during pregnancy and labour. *Imbelekisane* is another frequently encountered traditional concoction for female health. There is circumstantial and research evidence of their tonic effect and specific application in the perinatal period, as well as evidence suggesting potential toxicity and negative effects of ingestion on maternal and fetal health.

Pharmacological studies seem to confirm both therapeutic and harmful consequences of *isihlambezo* and *imbelekisane* use. It seems that the popularity of *isihlambezo* and *imbelekisane* among urban women is attributable to high cost and inferior quality of clinic care, the use perceived as easing adaptation to urbanisation and as a sign of how rural cultures integrate into new sociocultural situations and contribute to emerging cultural patterns.

The primary benefits of *isihlambezo* are said to be ensuring adequate fetal growth, promotion of general maternal health and promoting an uncomplicated labour. There is some concern about the toxicity of some of the plants used, which total about 60 species in various *isihlambezo* and *imbelekisane* mixtures.

TBAs prepare *imbelekisane* before touching a pregnant woman and then rub it in their hands when examining her. This is often combined with shaking the woman's belly to make the baby move and change position in case of breech, transverse or posterior lie, a procedure that is not without risk.

The World Health Organization (WHO) has recognised traditional medicine as a positive integration of medical know-how and cultural (or ancestral) experience. Many countries are proactively studying these remedies to understand all their effects and make sure that they can be used safely, rather than simply being ignored or condemned.

This is a brief overview of the effects of some well-known plants traditionally used in *isihlambezo* and *imbelekisane*:

- *Agapanthus africanus*. Also known as *ubani*, *leta-la-phofu*, blue lily, agapanthus and *bloulelie*, it is a common attractive flowering plant found in many gardens. Preliminary studies show it to have direct smooth muscle activity, distinct uterotonic action and a mild laxative effect. The rhizome is utilised to induce labour and water in which

the plant is grown is used in pregnancy and labour. Both rectal and oral administration is known.

- *Gunnera perpensa.* Also known as *ugobho*, river pumpkin, wild rhubarb and *rivierpampoen* this is often found in gardens with leaves similar to that of the pumpkin plant. The rhizome is mostly used and it has a strong oxytocic effect. It is widely used for fertility, during pregnancy in small doses and postpartum to help expel the placenta. Incidences of severe contraction of the lower segment have been reported when using during labour, leading to fatalities.
- *Rhoicissus tridentata.* Also known as *isinwazi*, wild grape and *bobbejaantou*, this plant is commonly found in the eastern parts of southern Africa. The San used the tuberous roots medicinally and it can be seen on rock art. It is known to relieve various digestive symptoms of pregnancy, initiate labour and to help expel a retained placenta. Macerated leaves in water are used as an abortifacient. A number of fatalities caused by central nervous system depression and respiratory failure have been linked to its use.
- *Combretum paniculatum.* Also known as 'Flame Creeper' this plant is used to expel a retained placenta. The fruits of the genus are regarded as toxic, avoided by wild animals and not used by healers. Fatalities have been reported from vaginal insertion of some species of Combretum.
- *Clivia miniata* (*umanyimi*). Also known as *umayime*, orange lily and *boslelie* it is a popular plant in shady gardens with orange flowers being the most common. Only two varieties of Clivia are used as traditional remedies. The action is reportedly to initiate overdue labour and facilitate the process of labour. Leaf extracts have been shown to have uterotonic effects. Alkaloids like lycorine are contained in the rhizomes and are very toxic.
- *Adansonia digitata.* Also known as baobab. The fruit pulp of the boabab is used as a porridge if lactation is deficient after birth.
- *Amaranthus caudatus.* Also known as *marog* it is a common food in Africa. The leaves of *marog* are used as an abortifacient, but also yield a rich supply of protein (26–30%), iron, calcium and Vitamin A.
- *Aloe zebrine.* Stems and leaves of this plant (also known as *kgopalmabalamantsi*) are used in a mixture to help expel the placenta and 'cleanse' the system. The species Aloe ferox in concentrated doses can cause severe purging and promote abortion.
- *Chironia baccifera.* Also known as *bitterbos*, is extensively used by the Khoi and others in a wide range of common ailments. An infusion of leaves, stems and fruits helps expel a retained placenta but may cause non-severe diarrhoea. Toxicity in animals has been encountered but seemingly not in humans.
- *Erythrina lysistemon.* Also known as common coral tree, *umsinsi*, *muvale* and *koraalboom*. Strips of the bark are cut from all four sides of the trunk, bound together and used to make an infusion to ease labour pains during birth. Alkaloids present in the substance are known to be highly toxic. Traditional usage supports the belief that the infusion has analgesic, antibacterial and anti-inflammatory properties.

53.6 Conclusion

Caring for women in pregnancy can become a challenge. Any registered drug or unregistered substance (over-the-counter medication), traditional medicine or illicit drugs cross the placenta and can have serious consequences for the wellbeing of the fetus. Knowledge of the drugs, the contraindications, the effects and side or adverse effects is essential for safe practice and optimum outcomes for the mother and child.

A range of known and unknown substances are used by women in pregnancy. It is the task of the midwife to give advice on substances that may be harmful for the fetus. The rule is to only use substances that are tested and prescribed for the first trimester. Midwives also need to be trained in the use of CAMs if they are to incorporate them into practice and not just follow common beliefs.

All patients should be asked about the use of CAMs because these have a risk of interaction with prescription medication. Recommendation of CAMs therapies should be carefully considered when clear supportive evidence for safety and efficacy is lacking, particularly in pregnancy. Pregnant women should be clearly informed of the toxic potential of botanicals especially where there is a lack of quality and dose control, particularly in the first trimester. CAMs therapies need to be clearly addressed in nurse and midwifery education programmes with reference to existing empirical evidence.

CHAPTER

54

Principles of pharmacology in obstetrics and the neonatal period

LEARNING OBJECTIVES

On completion of this unit the learner must be able to:

- apply the principles of drug therapy during pregnancy, birth and the puerperium, as well as in the neonate
- identify drugs to be avoided during pregnancy
- describe drugs commonly used in the newborn
- use the knowledge gained about drug therapy in pregnancy, birth, lactation and the neonate to assist with the facilitation of competent, safe and responsible practice.

KNOWLEDGE ASSUMED TO BE IN PLACE

Basic knowledge and understanding of the principles of pharmacology with specific reference to the two major subdivisions, namely pharmacodynamics and pharmacokinetics.
A sound knowledge of the principles, routes and methods of drug administration.
The ability to access and interpret specific drug information, with particular reference to registered indications, warnings, contraindications, side effects and recommended dosing regimens.
Knowledge of pregnancy and fetal development, the birthing process and lactation, as well as the basic needs and developmental challenges of the newborn

KEYWORDS

Pharmacodynamics • Pharmacokinetics • Pharmacotherapy • Teratogenesis

54.1 Introduction

One of the major medical challenges facing the practices of midwifery and neonatal nursing is that of drug therapy (also referred to as pharmacotherapy). A very important reason for this is the fact that drug therapy (i.e. the use of medication to attain certain clinical outcomes) may pose a significant risk during each of the vulnerable periods in the human reproductive cycle discussed below.

Fertilisation of the ripened ovum and the attainment of complete implantation

During this period the two greatest risks would be a spontaneous abortion or the reabsorption of the products of conception, which will both probably go unnoticed. This period will last for about two weeks (see Figure 54.1).

Intrauterine life

Drugs may cross the placental barrier and reach the systemic blood circulation of the unborn child with potential adverse effects (see Figure 54.1).

Embryonic development and organogenesis

The embryonic period lasts until the end of the eighth week after fertilisation, and is exceptionally vulnerable to structural abnormalities.

Fetal development and maturation

During the second and third trimester, drugs usually only affect the growth and maturation of the fetus, since organogenesis is completed by the end of the embryonic period, although the development of the external genitalia continues into the second

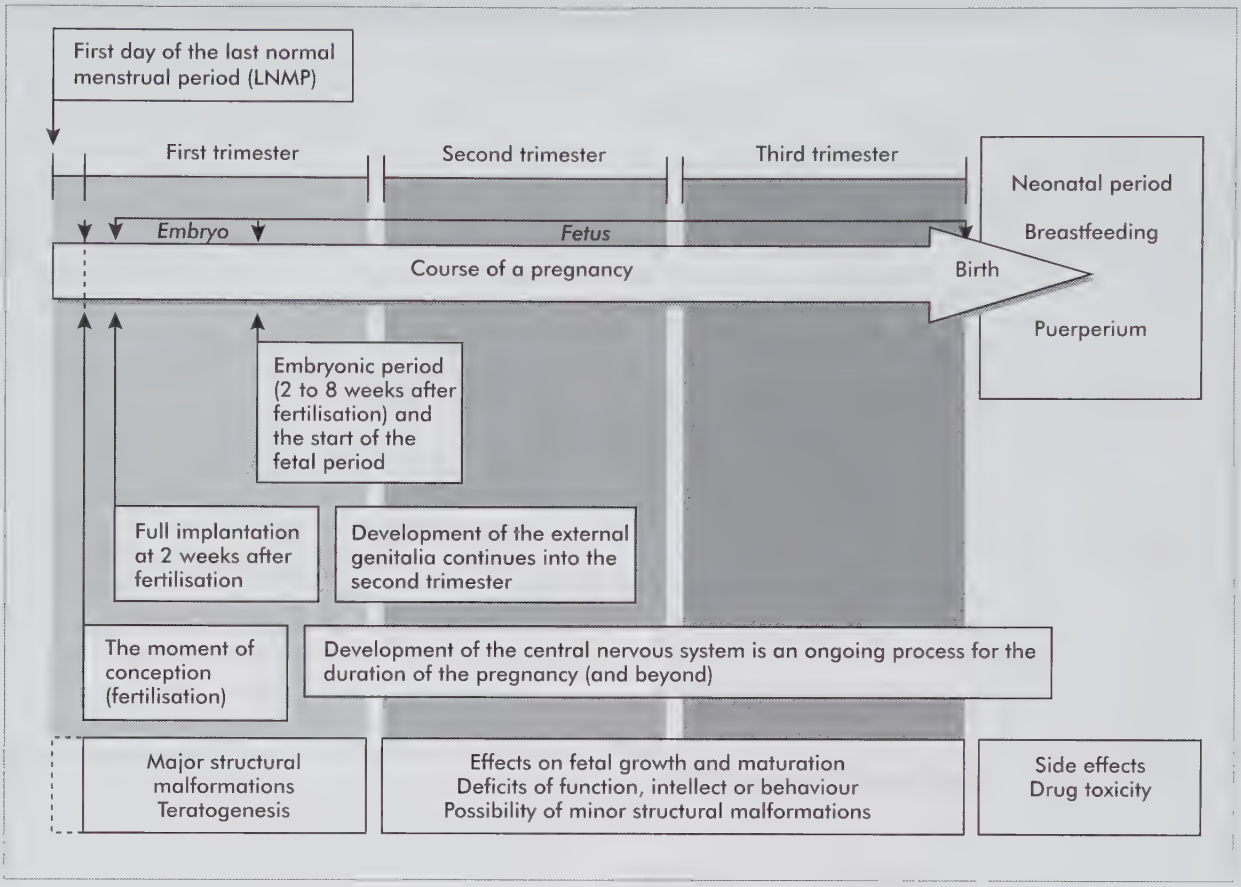


Figure 54.1 The vulnerability of the unborn child and neonate to drug therapy (See colour illustration Figure 7.19, **C2**)

trimester and the development of the central nervous system is an ongoing process for the duration of the pregnancy (and beyond).

Mother and infant

The birthing process

Drugs used to manage the intrapartum period may have direct effects on the fetus during and directly after birth (e.g. administering pethidine to a mother during labour may cause respiratory depression in the newborn).

Breastfeeding

Drugs may be excreted in the mother's breast milk.

The development of the newborn child

All newborns are vulnerable, whether they are of normal gestational age and birth weight, or not. Factors contributing to the challenges that pharmacotherapy pose, include their smaller body size and the higher percentage of body water in newborns, the fact that liver biotransformation, for example, is slower in the neonate, and that the neonate also displays a slower rate of renal elimination of certain drugs (due to the immaturity of the kidneys and the liver). Premature babies have an even higher percentage of body water than neonates do (see Figure 54.3).

Pharmacology is a broad and complex subject. Therefore, this chapter will only focus on the principles of pharmacotherapy as they apply to pregnancy, childbirth, lactation and the neonatal period. The basic pharmacokinetic and pharmacodynamic terminology referred to in this chapter has been summarised in Table 54.1. Specific drug treatment aimed at specific conditions is discussed in the corresponding chapters and sections that deal with the various disorders and emergencies in question.

54.2 Drug therapy during pregnancy, childbirth and lactation

Pharmacotherapy during pregnancy, childbirth and lactation may be required for a number of reasons, including:

- pregnancy, labour and lactation-related interventions (e.g. using drugs to induce labour or to strengthen uterine contractions), disorders and emergencies (e.g. the drug management of eclampsia)
- acute illness or trauma during the course of a pregnancy (e.g. a motor vehicle accident, perinatal infection, or an acute episode of upper respiratory tract infection)
- chronic illness or disability, including a few conditions that are of particular importance in this setting and that may impact upon maternal and perinatal mortality (even when treated), namely:
  - HIV infection and AIDS
  - diabetes mellitus
  - hypertension
  - asthma
  - epilepsy
  - migraine headaches
  - mental health disorders (including depression and anxiety)
  - conditions requiring long-term anticoagulant therapy (e.g. atrial fibrillation)
- In a few instances the fetus may actually be the target of the drug therapy given to the mother (as part of a so-called fetal therapy regimen)
- cancer.

In these settings, as with any other healthcare setting, it is of vital importance to carefully weigh up the possible benefits and risks of pharmacotherapy against the possible outcomes (for both mother and child) of not treating the condition at all. The decision to opt for drug therapy should always be a sound and rational one. The outcomes that the clinician is aiming to achieve should be realistic and take into consideration what the available drugs, under the specified conditions, may be reasonably expected to do when given to the patient in question. Furthermore, it has to be mentioned that treatment cannot necessarily be interrupted, postponed or avoided altogether, merely because a female is pregnant or breastfeeding. This poses a complex clinical challenge that requires expert opinion and balanced, evidence-based decision-making (see Figure 54.2).

The following aspects need to be considered when medication is administered:

- *Physiological changes during pregnancy that may affect drug action and kinetics.* Certain physiological changes during pregnancy have implications for drug therapy and may affect any of the four basic kinetic processes, namely absorption, distribution, metabolism and elimination/excretion (i.e. the ADME-processes). Therefore, the following aspects could alter the way in which drug molecules are handled by the body (i.e. alter their pharmacokinetic profiles):
  - Increased progesterone levels cause a decrease in gastrointestinal motility (with resultant constipation), as well as a decrease in oesophageal sphincter pressure (which causes heartburn). In addition, placenta-derived human chorionic gonadotropin (HCG) causes nausea and vomiting. The altered gastrointestinal functioning caused by these changes could influence the rate and extent of drug absorption for orally administered drugs.
  - Pregnancy also results in increased lung perfusion and pulmonary alveolar drug transfer (due to the improved cardiac output described below), meaning that the absorption will be improved for drugs that are administered via the pulmonary route (i.e. via nebulisers and inhalers).
  - Drug distribution may be affected due to the increased plasma volume that accompanies pregnancy and which may result in an increased volume of distribution (V_d) of certain drugs. Furthermore, pregnancy brings about a decreased blood albumin level, which could result in an increased fraction of free drug molecules. This may be especially significant in the case of drugs that are highly protein-bound, also increasing their V_d and altering other kinetic properties. Note that only the free, unbound fraction will be able to cross the placental barrier. In these instances the higher fraction of free drug molecules implies that there are higher levels of the active drug in circulation (for both mother and unborn child), and this increases the likelihood of drug toxicity.
  - Altered liver functioning may affect the plasma concentrations of drugs that follow hepatic metabolism.
  - The increased plasma volume, in turn, increases cardiac output (CO), renal blood flow and glomerular filtration rate (GFR). This could increase the renal excretion of drugs that are significantly eliminated via this route.

Table 54.1

Basic pharmacokinetic and pharmacodynamic terminology

Term	Definition
Pharmacokinetics	The study of the kinetics of drug absorption, distribution, metabolism and elimination/excretion in humans and animals. In other words, that which happens to the drug in the body.
Pharmacodynamics	The study of the biological effects resulting from the interaction between drugs and biological (body) systems. In other words, what the drug does to the body.
Biopharmaceutical properties	The relationship between the physical and chemical properties of a drug, in a specific dosage form, and the pharmacological, toxicological or clinical effects that are observed following its administration. This information can be used to optimise drug availability at its site of action.
Therapeutic drug monitoring (TDM)	• The mathematical relationship between a drug dosing regimen and its resulting serum concentrations (pharmacokinetics). • The relationship between drug concentrations at the site of action and the resultant pharmacological response (pharmacodynamics). • The use of serum drug concentrations to optimise drug therapy in individual patients, in conjunction with their clinical status and response to therapy.
Apparent volume of distribution (V_d)	The apparent volume into which a drug distributes in the body's fluid compartments at equilibrium. This is the volume into which the specific drug dosage will need to be dissolved for it to reach the same concentration as it does in the plasma.
Clearance *(CL)*	The volume of body fluid which is totally cleared of drug per unit of time.
Systemic bioavailability *(F)*	Defined as the fraction of an orally administered dosage which reaches the systemic blood circulation of the patient. It reflects the extent of absorption and presystemic elimination.
Elimination half-life ($t_{½}$)	This is the time it takes for the drug's plasma concentration to be reduced by 50%.
Plasma steady-state concentration (Cp_{ss})	Implies a stable plasma drug level (or plateau concentration) during which the drug's rate of absorption is equal to its rate of elimination (i.e. the drug's input equals its output). It takes approximately four to five half-lives to reach steady-state.
Absorption	This may be defined as the process by which a drug proceeds from its site of administration to the central blood circulation (the site of measurement within the body). This process is not restricted to oral administration only, but is equally applicable to events that follow other routes of administration, i.e. intramuscular and subcutaneous injection, rectal administration, etc. However, intravenously injected drugs enter the bloodstream directly and, therefore, do not require any absorption to take place.

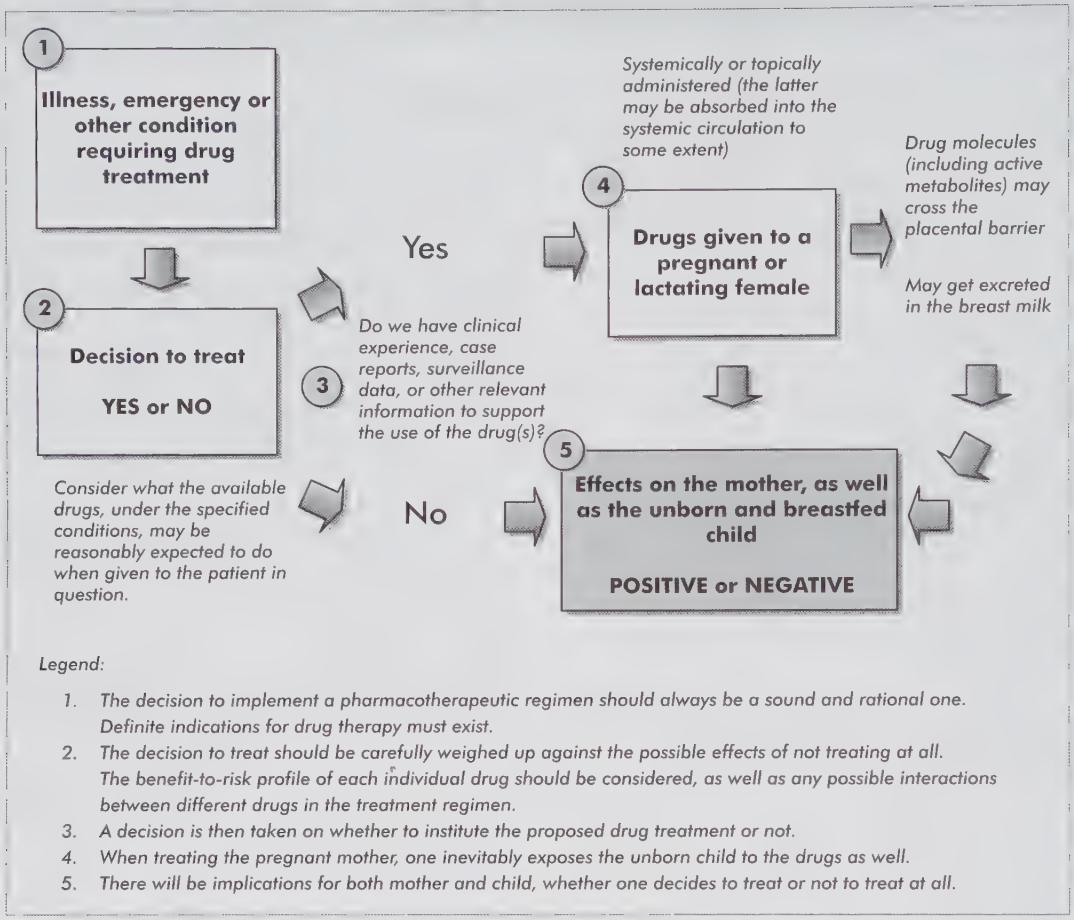


Figure 54.2 Pharmacotherapeutic decision-making during pregnancy, childbirth, lactation and the neonatal period (this is a simplified diagram to illustrate the intricacies of clinical decision-making when considering drug therapy in any of these vulnerable patient populations)

- Drugs and their metabolites may also be excreted in breast milk. A nursing infant may therefore be exposed to the drug via the mother's milk, which could also apply to recreational drugs (such as dagga/cannabis) and environmental toxins.

Drug toxicity during pregnancy. Drugs may be toxic to the developing embryo and fetus. The first trimester of pregnancy (i.e. the stage of embryonic development and organogenesis) is of particular importance, since the teratogenic effects of certain drugs will influence normal development of the unborn child on a structural or functional level (see Figure 54.1). A teratogen is a drug (or other chemical substance) that may affect normal embryonic development and cause recognisable congenital (birth) defects. During the very early stages of pregnancy the expectant mother may not even be aware of the fact that she is carrying a developing embryo (the excessive use of drinking alcohol, or ethanol, is of particular importance here). She may unknowingly harm her unborn child through the careless or indifferent use of drugs and other substances, including over-the-counter (OTC) medicines and other remedies. Therefore, this is an important topic to include in preconception care. Many pregnancies, however, are unplanned or unexpected, implying that preconception care would not have been rendered at all. Also note that for drugs, that have been shown to pose a significant risk to an unborn child, or in the case of drugs with insufficient evidence of relative safety during pregnancy, sufficient precautions in the form of patient education and the use of highly effective contraceptive methods need to

be instituted when treating women of childbearing age or potential. Some drugs even need to be avoided in men who may father children whilst being treated with them.

- *Cross-placental transfer of drug molecules (and their metabolites).* Drug treatment during pregnancy implies that the unborn child will be exposed to either the effects of the drug on the mother, the direct effects of the drug on the embryo or fetus, or a combination of both. The placenta acts as a barrier between the circulatory systems of mother and child throughout the duration of the pregnancy. However, in terms of drug molecules, this barrier is not very efficient, implying that when such molecules enter the maternal blood circulation they have the potential of crossing this barrier and entering the fetal circulation as well. Lipid-soluble drugs are capable of crossing the placenta via simple diffusion. However, most water-soluble drugs can also cross the placenta, because of the relative inefficiency of the barrier. Heparin is an exception. Box 54.1 highlights the four characteristics of drug molecules that are most likely to cross the placenta.

54.1 The four characteristics of drug molecules that are most likely to cross the placental barrier

- A high degree of fat-solubility (i.e. lipophilic molecules)
- A low degree of ionisation (i.e. molecules that do not carry charges)
- A low level of protein binding in the maternal blood stream (drugs that are highly protein-bound have only small fractions of free molecules capable of crossing membranes)
- Low molecular mass (i.e. small molecules), especially in the case of water-soluble drugs. It is generally agreed that drug molecules with a molecular mass < 500 Da will readily cross the placenta, molecules of 500 to 1 000 Da will cross very slowly, while molecules of > 1 000 Da will not cross the placental barrier at all.

- *Excretion in breast milk.* During lactation, drugs may pass from the bloodstream to the breast milk, especially if they are lipid-soluble or basic drugs (basic drugs will tend to ionise in the breast milk since it is more acidic than blood), or if they are water-soluble molecules with a relative molecular mass of less than 100 daltons (the dalton, or Da, is the unit of measurement used to express molecular mass and is indicative of the size of a molecule).
- *Drug safety during pregnancy and lactation.* There is limited data at our disposal on the actual safety profiles of many drugs during pregnancy and lactation (there are many reasons for this, similar to the ones that apply to drug therapy in the newborn). Drugs should therefore always be used with caution. The classification used by the US Food and Drug Administration (FDA) is often quoted and uses five different categories, namely A, B, C, D and X, where category A drugs are considered to be relatively safe to use during pregnancy and category X drugs are absolutely contraindicated. The FDA is, however, in the process of introducing a new *'Rule on Pregnancy and Lactation Labeling'*, with pregnancy and lactation subsections.

54.2 Activity

Learners are advised to visit http://www.fda.gov/Drugs/DevelopmentApprovalProcess/DevelopmentResources/Labeling/ucm093307.htm for more information.

It is important to consult suitable drug references when prescribing and administering medicines to pregnant or lactating mothers. Known teratogens should obviously be avoided during pregnancy. However, situations may arise where the benefits of treating the mother with a certain drug may outweigh the possible harm that the drug may or may not do. For example, when aggressive cancer is endangering the life of an expectant mother, the decision to treat the mother's cancer may pose a considerable and unacceptable risk to the fetus, which could lead to the decision to abort the pregnancy to avoid the risk.

The package inserts and patient information leaflets of registered medicines should also be consulted for specific information on the use of such agents in the treatment of pregnant and lactating women, or even in women who are of childbearing potential but not yet pregnant (see Table 54.2 for more information on accessing and interpreting drug information via the approved package insert and patient information leaflet).

Well-known examples of teratogenic drugs include: isotretinoin (used in the treatment of severe forms of acne), methotrexate (an antineoplastic and immunosuppressant agent), the antiepileptic agents, phenytoin and valproate, the antiretroviral agent efavirenz, and warfarin (an oral anticoagulant). Using ethanol (drinking alcohol) during pregnancy may cause fetal alcohol syndrome. There are many more examples (see Table 54.3 and Chapter 52).

Table 54.2

Interpreting drug information from package inserts and patient information leaflets

Package inserts and patient information leaflets have to contain all of the information regarded as essential and applicable to the registration status of a specific drug or medicinal product by the relevant regulatory authority. Information that may be found in an approved package insert and its accompanying patient information leaflet can be used to answer the following questions relating to the medicine's use in clinical practice.

What type of product is it and how does it work?

- Consider the *pharmacological classification* and description of the drug's *mechanism of action* and relevant pharmacodynamic properties.
- Information on the *composition* of the product or medicine will include all of the active pharmaceutical ingredients (i.e. the drug, or drugs that make up the product in the case of a fixed-dose combination), as well as all of the excipients (i.e. the inactive ingredients used in the pharmaceutical formulation) required by the regulatory authority. The active ingredients (i.e. the actual drugs) are identified by their generic or non-proprietary names for ease of reference.

What is or can this product be used for?

- It is of vital importance that the *approved indications* are carefully considered.
- For each of the listed indications, scientific evidence of the drug, medicine or product's efficacy and safety would have been provided to the regulatory authority. Products may only be marketed and sold in accordance with their approved label, i.e. those indications that emerged from a comprehensive development plan and subsequently passed the scrutiny of the regulatory authorities.
- It does, however, happen that drugs are sometimes used for other reasons or indications than those that have already been approved. In these situations the drug or product concerned is being used off-label, which needs to be in the patient's best interest at all times, and should preferably be evidence-based (i.e. backed by scientific evidence or proof).

What will the body do to the drug(s)?

- Consider all of the relevant biopharmaceutical and pharmacokinetic properties of the drug or drug-combination that are described in relation to the kinetic processes, as well as important pharmacokinetic parameters, where applicable. These may include aspects such as the bioavailability, elimination half-life, hepatic or renal clearance, information on active drug metabolites, etc.

How safe and effective is the product?

- At the recommended dosage a drug's efficacy or therapeutic benefit should outweigh its possible risks or detrimental effects. However, certain adverse drug reactions (or side effects) may be life-threatening and even fatal, albeit rare. Many factors contribute towards a drug's risk-to-benefit ratio, including aspects such as age, gender, *pregnancy and lactation*, concomitant medication and other treatments, as well as co-morbid (i.e. coexisting) and intercurrent (occurring during the course of the illness already being treated) illnesses.
- In the light of the above, careful consideration must be given to the following important aspects of the package insert:
  Boxed warnings are of significant importance and will be found as bold-type text enclosed in a text box, if and when required by the regulatory authorities. Read these warnings very carefully since they could have a significant impact on the risk-to-benefit ratio for specific patients in given situations.
  Contraindications may be absolute or relative and need to be considered against the background of the patient's health status and risk assessment, since *relative contraindications* only apply in certain patient populations or in the presence of specific risk factors. Relative contraindications are listed or described under warnings. *Absolute contraindications*, however, will prohibit the use of a specific drug, medicine or product, if and when they are present. This includes known hypersensitivity to any of the ingredients contained in the product. Certain drugs may also be contraindicated for use together with the specific product due to the likelihood of serious, dangerous or life-threatening drug interactions that could occur. *Furthermore, the product or medicine may be contraindicated during pregnancy and lactation if appropriate.*
  Warnings (including relative contraindications), *adverse reactions* (side effects), *special precautions, drug interactions* and the use of the specific product in *special patient* populations, which could include pregnant or breastfeeding mothers, infants and children, the elderly, patients with hepatic or renal impairment, gender and race (if applicable), the smoking habit, implications for fertility and women of childbearing potential, and porphyria.

continued

Clinically significant interactions may also be listed for certain foodstuffs and beverages (e.g. grapefruit juice), as well as certain herbal remedies (e.g. St John's Wort). A description of the effects of the product or medicine on the patient's ability to drive a motor vehicle or to operate machinery may be required by the regulatory authority. Also consider any statements on specific circumstances or instances for which safety and efficacy of the product have not been established.

How should the drug be administered to the patient, what dosage should the patient receive and how often?

- The package insert will provide clear instructions on any special preparations that need to be made before administering the product to a patient, such as reconstitution, as well as the route of administration for each individual dosage form, the recommended dosage for each of the approved indications, dosing intervals and the recommended duration of treatment.
- Aspects such as dosing adjustments for specific patients or clinical conditions, as well as dosing adjustments for specific age groups may be included. Information on maximum recommended dosages, correct usage, taking of the product or medicine in relation to meals, dose *titration*, dose tapering, and monitoring of the patient's reaction to the treatment may be included as needed, or as required by the regulatory authority.

Other useful information:

- Regulatory authorities have different ways of limiting consumer access to medicinal products, which may be based on their potential to be abused or the perceived dangers involved in using them without the guidance and supervision of a qualified healthcare professional who is authorised to prescribe such medication. A clear distinction is made between over-the-counter (OTC) medicines and prescription-only medicines. The package insert will, therefore, reflect the status of the product in relation to the above-mentioned explanation. In South Africa, for example, the package insert will reflect the product's *scheduling status* in accordance with the applicable legislation.
- The information on a *drug overdose*, whether accidental or intentional, contained in the package insert is aimed at describing the clinical manifestations and possible complications of an overdose, as well as recommendations on how such an overdose should be managed. Management may include the administration of a known antidote if applicable, interventions aimed at limiting the patient's exposure to the active ingredient(s), careful monitoring of the patient's condition and the use of standard symptomatic and supportive treatment.
- The package insert will also contain information on how the product may be identified, its packaging and presentation, the relevant storage instructions and guidance on how the product should be handled.
- Information aimed directly at the consumer is contained in the patient information leaflet.

Other sources of drug information include pharmacopoeias, medicine formularies, essential drugs (medicines) lists and treatment guidelines, pharmacology textbooks, peer-reviewed research papers, investigator drug brochures and the Internet.

Source: Schellack, G. 2010. *Pharmacology in clinical practice: application made easy for nurses and allied health professionals.* 2nd ed. Cape Town: Juta & Co

Many different factors determine *the choice and possible outcomes of* drug therapy during pregnancy, childbirth and lactation. These factors include:

- age, obstetric history and gestation
- physical characteristics (e.g. size and body mass index)
- diet and nutritional status
- gene pool and genetic factors
- previous responses and reactions to drug treatment (including allergic reactions and anaphylaxis)
- other drugs already in use, which may give rise to drug interactions, including over-the-counter (OTC) medicines and herbal remedies
- the influence of current and pre-existing illness
- health status and general standards of living
- unwanted and toxic effects of the drugs in question
- patient compliance
- the pharmacological profile of the drug in question, since the altered physiology during pregnancy may alter the way in which the body responds to the drug, as well as how the body deals with the drug molecules and their metabolites.

The following *treatment principles* may be applied when considering or continuing drug therapy during pregnancy and lactation:

- Preferably choose drugs that are well known to be safe and effective during pregnancy and lactation.
- Use the lowest possible dosage of the drug with the shortest plasma half-life, for the shortest possible duration of treatment.

Table 54.3

Examples of known teratogenic drugs to avoid during pregnancy (NB: drugs that are not listed here are not necessarily safe to use)

Teratogen	Effect
Alcohol	Fetal alcohol syndrome (FAS), abnormal functioning of the central nervous system (CNS) and disturbances of behaviour.
Anticonvulsants	Valproate is associated with neural tube defects, so is carbamazepine. Phenytoin may cause malformations in the CNS and adversely affect fetal growth.
Anticoagulants	Warfarin is associated with haemorrhage in the fetus, as well as malformations in the CNS and skeletal system.
Antihypertensive agents	ACE-inhibitors cause renal damage and may restrict normal growth patterns in the unborn child.
Antineoplastic (anticancer, or chemotherapeutic) drugs	High risk of multiple congenital malformation.
Antiretroviral (ARV) agents	Efavirenz is associated with neural tube defects.
Isotretinoin (acne)	High risk of multiple congenital malformations.
Misoprostol	Malformations of the CNS and limbs.
Neuroleptic drugs	Lithium is associated with congenital defects of the cardiovascular system.
Non-steroidal anti-inflammatory drugs (NSAIDs)	Premature closing of the ductus arteriosus.
Tetracyclines	Malformations of teeth (as well as permanent discolouration) and bone.
Thalidomide	Malformations of the internal organs and limbs.
In addition, the following drugs are associated with withdrawal symptoms in the newborn infant: ◗ Barbiturates ◗ Benzodiazepines ◗ Opioid analgesics ◗ Tricyclic antidepressants	

- Avoid new drugs due to a lack of data and clinical experience.
- For women of childbearing potential, all known teratogens (e.g. excessive dosages of vitamin A) should be avoided, even when not yet pregnant, and sometimes even in fertile males.
- Discourage self-medicating practices and the indiscriminate use of OTC drugs, herbal and traditional remedies, and nutritional supplements.
- Carefully consider possible drug interactions, e.g. commonly-used concomitant medications in pregnancy including the use of antacids, for example, which may interfere with drug absorption from the gastrointestinal tract.
- Always refer to the most up-to-date information available on each and every drug in question.

Also note that drugs should never be administered to a pregnant woman, or any other patient, without performing a proper assessment, including history taking, current medication use, drug and food allergies, and other relevant information.

54.3 Drug therapy in the newborn

A newborn infant is exceptionally vulnerable to the effects of drugs and cannot communicate the adverse effects being experienced in the way that older children and adults would. Great care needs to be exercised when administering medication to a newborn.

Several drugs are prescribed and administered to newborns in spite of a lack of clinical evidence in this patient population. Infants treated in intensive care units may often receive at

least one unlicensed (a drug which is not yet registered by the regulatory authority in question, which is possibly still under clinical investigation) or off-label (i.e. when a drug is used for an indication or a reason other than what has already been approved) drug. There are several reasons for this, many of which pertain to the relative scarcity of clinical trial data in this patient population. This is due to factors such as:

- The nature of the patient population in question, which is very limited, high-risk and extremely vulnerable.
- Difficulties in conducting suitable clinical trials, both on ethical and technical grounds.
- In view of the aforementioned factors, the fact that clinicians have to rely on preclinical trial data (derived from animal testing), case reports and surveillance data, which make it difficult to predict the effects and possible outcomes of drug therapy in certain circumstances.

Newborn infants form part of the broader paediatric patient population and many of the general principles of paediatric pharmacotherapy apply to neonates, in addition to those principles that aim to address their unique needs. The broader paediatric patient population comprises a diverse group of patients with a variety of characteristics, ranging from the preterm newborn to the adolescent on the brink of adulthood (see Table 54.4).

Neonatal prescribing and dosing

Drug prescribing in this population has to follow the general principles of rational drug use, as prescribed by the National Drug Policy (NDP) in South Africa. These include:

- correct drug (for the illness or infection being treated)
- appropriate indication
- appropriate drug (for the patient and condition being treated)
- appropriate dosage, administration, and duration of treatment
- appropriate patient.

Table 54.4

Simplified classification of the paediatric patient population by age

Neonates	Birth – 28 days old
Infants/Newborn	29 days – 1 year
Toddlers	1 – 3 years
Children	3 – 12 years
Adolescents	13 – 18 years

A practitioner should also consider giving drugs at the lowest possible cost to the patients and their communities of concern. The general principles and the decision-making process are similar to what has been described in Figure 54.2.

Paediatric dosing handbooks use various methods to calculate the correct drug dosage for paediatric patients. The patient's age, weight, height and body surface area (BSA), as well as relevant pharmacokinetic principles may be taken into consideration. The BSA may be calculated by using Mosteller's formula.

54.3 Mosteller's formula

Mosteller's formula for calculating body surface area (BSA):

$$BSA\ (m^2) = \sqrt{[weight\ (kg) \times height\ (cm)] \div 3\ 600}$$

The BSA refers to the total skin surface area covering the human body. Clinically, the BSA has huge application value, from calculating accurate drug dosages in neonates, to determining ideal fluid intake, renal clearance and other parameters. Mosteller's formula uses body weight (in kg) and height (in cm), or length in the case of infants, in a simplified method of calculating the BSA. The average BSA value for a neonate is 0.25 m^2 and for an adult woman it is 1.6 m^2.

The BSA is of particular importance when calculating the dosages of certain antiretroviral (ARV) agents in paediatrics, e.g. didanosine (ddI) and the lopinavir/ritonavir (LPV/rtv) combination.

Additionally, in the neonatal population specific factors such as gestational age and birth weight need to be taken into consideration. The specific terminology relating to the calculation of neonatal dosages are presented in Table 54.5.

Pharmacokinetics and pharmacodynamics in the neonate

Drug therapy, prescribing and dosing should consider the differences between the preterm neonate, full-term neonate and young infant in terms of drug disposition (absorption, distribution, metabolism and elimination/excretion).

Absorption

The neonatal period is characterised by problems related to drug disposition, as the digestive system is undergoing major adjustments, and the absorption of any orally administered substance is variable. A relative achlorhydria (the absence of hydrochloric acid from the gastric secretions) is present for

Table 54.5

Neonatal dosing terminology

Term	Definition
Gestational age (GA)	◗ **By dates:** The number of weeks from the onset of the mother's last normal menstrual period (LNMP) until birth ◗ **By examination:** Assessment of gestation (time from conception until birth) using a physical and neuromuscular examination
Low birth weight (LBW)	Birth weight < 2 500 g
Very low birth weight (VLBW)	Birth weight < 1 500 g
Appropriate-for-gestational age (AGA)	Birth weight between the 10th and 90th percentile for gestational age
Large-for-gestational age (LGA)	Birth weight > 90th percentile for gestational age
Preterm neonate/infant	< 37 completed weeks GA at birth
Full-term neonate/infant	38 to 42 weeks GA at birth

the first 10–15 days after birth. Compared to that of an adult, gastric emptying is also delayed. The reduced gastric acid secretion increases the bioavailability of acid-labile drugs (e.g. penicillin) and decreases the bioavailability of weak acidic drugs (e.g. phenobarbitone).

The intramuscular administration of drugs in the neonate is generally not used because it is considered to be too painful. In addition, intramuscular absorption is erratic in neonates due to scarce muscle and adipose tissue. Transdermal absorption may be a preferred method of delivering drugs to the systemic circulation as it bypasses the immature gastrointestinal system. However, physiological factors such as the presence of brown fat under the skin surface, the presence of pigmented lesions on the skin, and conditions such as hyperbilirubinaemia, hyperviscosity or vasculitis may lead to inter-individual variation in drug absorption from one infant to the next. The skin surface-to-bodyweight ratio is approximately three times greater in infants than in adults. Premature neonates have an incompletely formed stratum corneum and this can lead to systemic toxicity due to absorption of toxic compounds such as aniline dyes, hexachlorophene and alcohol through the skin.

Distribution

The volume of distribution (V_d) also differs with age (see Figure 54.3 for an illustration of these differences from the neonatal period to the elderly). Even the water content differs between a preterm infant (80%) and a full-term infant (70%). These differences are important when determining suitable dosages for drugs such as the aminoglycosides. The V_d of the aminoglycosides is approximately 0.6 ℓ/kg in the neonate, whereas in adults the V_d is 0.2 to 0.3 ℓ/kg.

Figure 54.3 also shows that the premature neonate has lower total protein contents than the other paediatric age groups. Neonates have decreased levels of protein binding when compared to adults. This influences drug availability. The comparative protein binding for the newborn versus the adult in the case of ampicillin, for example, is 10% vs 18% and for theophylline it is 36% in neonates vs 56% in adults.

The risk of the neonate developing kernicterus (bilirubin encephalopathy) is also increased since they have decreased blood albumin levels. There are several drugs that are thought to compete with or displace bilirubin from its binding site on the albumin molecule, which increases the risk of developing kernicterus. The antibacterial agent, ceftriaxone, is an example of a drug that displays one of the highest levels of bilirubin displacement.

Metabolism

Some drugs may pass through the body entirely unchanged, or they may be biotransformed (metabolised) into some other substance (i.e. a metabolite). The metabolite can be either pharmacologically active or inactive, and will be more water-soluble than the administered drug (or parent compound), so that it is excreted more rapidly. The conversion of theophylline to caffeine is an example of the formation of an active metabolite, and is of significant importance in the neonatal population, since caffeine has an elimination half-life of 100 hours and this can result in significant accumulation of the active metabolite.

The cytochrome P450 (CYP) enzyme system is an extremely important system for drug metabolism. Furthermore, the CYP system can be induced or inhibited by certain drugs such as

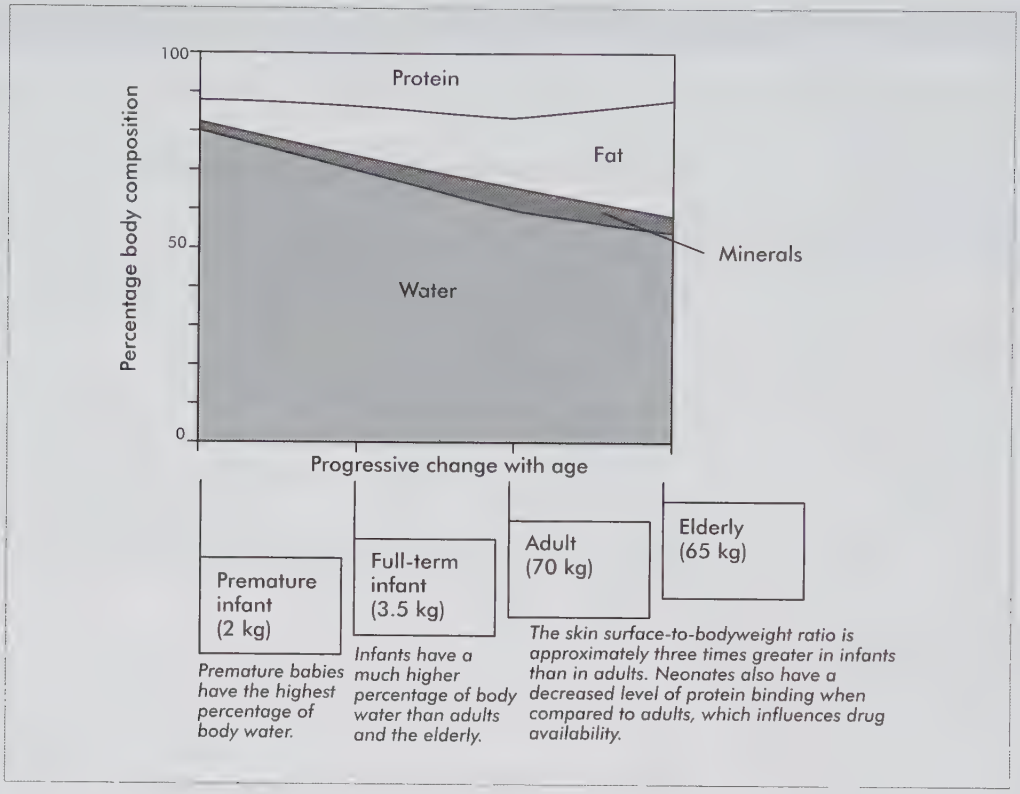


Figure 54.3 Proportionate changes in body composition with age
Adapted from: Puig M. 1996. 'Body composition and growth' in *Nutrition in Pediatrics*, 2nd ed. WA Walker & JB Watkins. Hamilton Ontario: BC Decker

phenobarbitone, which induces enzyme activity, not only increasing its own hepatic elimination (an example of auto-induction), but also that of other substances such as bilirubin.

Elimination/excretion

The renal system is not the only system responsible for excretion. Other systems involved in drug excretion include the biliary system and the pulmonary system. The exocrine glands can also participate in this process. Excretion is the last of the four kinetic processes.

Renal plasma flow is low at birth (12 ml/min) and gradually reaches the adult level of 140 ml/min by the age of one year. Renal excretion includes three processes, namely glomerular filtration, active tubular secretion and passive tubular reabsorption. The first two processes reach adult values at about six months of age. The changes in the half-life of theophylline clearly illustrates the changes in these processes. Its half-life is 30 hours in the preterm infant, 14 hours in the full-term infant less than six months of age, 4.6 hours in infants between six and 11 months of age, and 3.4 hours in children between one and four years old. These differences are due to the maturation of kidney and liver function. A better understanding of these processes could prevent inadvertent overdose in infants younger than one year of age and the risk of suboptimal dosing in children of one to four years of age.

Drugs used in the neonatal period

Table 54.6 summarises the most widely used classes of drugs in the neonatal setting. These are described with reference to their generic names, mechanisms of action, clinical uses and special nursing implications (which incorporates adverse effects that are of particular interest, as well as special precautions, warnings and contraindications). The Anatomical Therapeutic Chemical (ATC) classification system of the World Health Organization (WHO) has been used to organise the content. The ATC classification system divides drugs into different groups according to the organ and system on which they act and their pharmacological, therapeutic and chemical characteristics (visit http://www.who.int/classifications/atcddd/en/ and http://www.whocc.no/atc_ddd_index/ for more information on this classification system).

Table 54.6

Commonly encountered pharmacotherapeutic agents used in the neonate (according to the main groupings of the ATC classification system)

Generic name	Mechanism of action/Uses	Nursing implications
A → Alimentary tract and metabolism		
Metoclopramide (nausea/vomitting) Maxalon®	Gastrointestinal dysmotility/gastro-oesophageal reflux disease (GORD): used as a prokinetic agent to promote enteral feeding, to treat and manage gastric stasis. The prokinetic effects may be due to dopamine receptor (D_2) antagonism, but also due to its effect on acetylcholine release from the postganglionic nerve terminal; peripherally related to the drug's effect on the smooth muscle of the gastro-intestinal tract. In higher dosages it may be used for its anti-emetic properties in older children and adults	The adverse effects seem to be related to the dosage given, with higher dosages that may lead to a higher likelihood of side effects. High dosages may precipitate extrapyramidal effects (e.g. oculogyric crisis with torticollis and neck pain) Should be administered six-hourly, 30 minutes prior to a feeding (for optimum effectiveness)
Ranitidine (acid-reflux control) Tegamet®	To increase gastric pH in patients at risk of gastrointestinal haemorrhage, e.g. gastro-oesophageal reflux disease (GORD), etc. Competitive antagonist of histamine at the H_2-receptors, including receptors on the gastric cells	Less drug interactions with ranitidine than with cimetidine Do not co-administer with antacids, delay administration of ranitidine after administration of an antacid Dosages should be adjusted in patients with renal or hepatic impairment, since ranitidine is excreted primarily by the kidneys and metabolised by the liver
B → Blood and blood-forming organs		
Vitamin K_1 (phytonadione)	Prophylaxis and treatment of haemorrhagic disease of the newborn (HDN) Important in the synthesis of coagulation factors II, VII, IX and X	Intramuscular administration (an exception to the general guideline) of vitamin K, seems to prevent both early and late presentation of HDN, and IM administration seems to be more effective than the oral administration Administer within 1 hour after birth.
C → Cardiovascular system		
Furosemide Hasix®	High-ceiling (loop) diuretic Used to treat oedema in renal, hepatic, pulmonary and heart disease May be used to treat neonatal hypertension and hypercalcaemia	Used when a greater diuretic effect is needed than thiazide diuretics May cause dehydration and electrolyte imbalances (especially potassium and sodium depletion). Supplement these when needed When used with an aminoglycoside may potentiate the risk of developing ototoxicity Monitor glucose levels as it may cause hyperglycaemia and glycosuria

continued

Hydrochlorothiazide	Low-ceiling thiazide diuretic Used for neonatal hypertension Often used in combination with spironolactone to treat pulmonary fluid accumulation in chronic lung diseases, e.g. bronchopulmonary dysplasia (BPD)	May cause dehydration Electrolyte disturbances (e.g. hyponatraemia and hypokalaemia) when administered on its own Caution should be taken when administering with spironolactone since it may cause hyperkalaemia
Dopamine	Inotropic drug Dosage-related effects are seen Diuretic effects are seen at 1 mcg/kg/min (< 2 mcg/kg/min) Cardiac output is increased with 2 to 10 mcg/kg/min Causes elevations in blood pressure due to increased peripheral vascular resistance (> 10 mcg/kg/min)	Correct any fluid deficit prior to administration Side effects are dosage related Adverse effects are usually seen at dosages above 20 mcg/kg/min May cause blanching along the vein into which it is administered and this it is not harmful Avoid extravasation (infusing the drug into the tissue), as it may cause gangrene
H → Systemic hormonal preparations (excluding sex hormones and insulins)		
Dexamethasone	Anti-inflammatory agent used to prevent chronic lung diseases Used as an immunosuppressant For bronchopulmonary dysplasia (shortened period required for mechanical ventilation) Long-acting corticosteroid	Monitor for hypertension, hyperglycaemia immediately after administration of the dosage If used for a prolonged period of time monitor for signs of infection, especially fungal infections If used for prolonged periods of time monitor growth parameters and neurodevelopment markers Use the lowest dosage for the shortest period of time
J → Anti-infectives for systemic use		
J01 → Antibacterials for systemic use		
J01C → Beta-lactam antibacterials, penicillins		
Benzylpenicillin	Beta-lactam antibiotic Used in combination with an aminoglycoside as empirical treatment to prevent early sepsis	Observe IV site in order to prevent extravasation Observe for hypersensitivity reactions The intravenous infusion should be diluted with dextrose 5% or normal saline Do not mix with other drugs, especially the aminoglycosides. Aminoglycosides are inactivated by high dosages of intravenous benzylpenicillin

continued

Table 54.6

Commonly encountered pharmacotherapeutic agents used in the neonate (according to the main groupings of the ATC classification system)(*continued*)

Generic name	Mechanism of action/Uses	Nursing implications
Amoxicillin	Beta-lactam antibiotic, an extended-spectrum penicillin with more or less the same spectrum as ampicillin Preferred over ampicillin for oral therapy as it causes less gastrointestinal side effects, requires smaller daily dosages and is better absorbed orally Often used in combination with either an aminoglycoside or a cephalosporin for the management of meningitis in the neonate due to *Lysteria monocytogenes* Used for urinary tract infection prophylaxis in infants younger than 1–2 months of age Also used for the prevention of bacterial endocarditis	Observe for hypersensitivity reactions Monitor for diarrhoea Do not mix in the same syringe as the aminoglycosides, or administer in the same intravenous line as the risk of inactivation of the aminoglycosides exists
Piperacillin and tazobactam combination	Piperacillin is an antipseudomonal penicillin The combination with tazobactam extends the spectrum to include beta-lactamase-producing bacteria When used in combination with an aminoglycoside, synergism is achieved	Do not mix in the same syringe as the aminoglycosides, or administer in the same intravenous line as the risk of inactivation of the aminoglycoside exists Monitor for signs of oedema or hypernatraemia and hypokalaemia
J01D → Other beta-lactam antibacterials		
Meropenem	Broad-spectrum antibiotic has excellent Gram-negative activity Only registered for use in infants over 3 months of age, although kinetic studies have been done in infants younger than 3 months In children over 3 months of age used for serious infections (e.g. meningitis)	Do not use routinely to prevent possible resistance Monitor for the occurrence of rash
Cephalosporins (cefotaxime and ceftazidime)	Third-generation cephalosporins Semi-synthetic beta-lactam antibiotics Empiric antibiotic therapy for suspected meningitis Should preferably be used in combination with an aminoglycoside to prevent resistance	Resistance is a major problem with the cephalosporins and they should be used judiciously Monitor for rash, diarrhoea

continued

J01E → Sulphonamides and trimethoprim		
Cotrimoxazole	Broad-spectrum antibiotic Prophylaxis and treatment of *Pneumocystis jirovecii* (formerly *P. carinii*)	Should preferably only be used from 6 weeks of age due to an increased risk of developing kernicterus in the jaundiced infant Prevent dehydration in the infant receiving cotrimoxazole Monitor for rash, diarrhoea
J01F → Macrolides, ketolides and lincosamides		
Erythromycin	Used for atypical infections in the neonate caused by *Chlamydia trachomatis pneumonitis, Ureaplasma urealyticum* and other atypical organisms Is also used for its prokinetic effects	Monitor for signs and symptoms of gastric intolerance, it can cause infantile hypertrophic pyloric stenosis Can cause pain at the site of infusion and vein irritation, monitor the IV site Monitor for signs of diarrhoea
J01G → Aminoglycoside antibacterials		
Amikacin Gentamicin	Broad-spectrum protein synthesis inhibitor Most often used in synergistic relationship with a penicillin Has excellent Gram-negative coverage	Therapeutic drug monitoring should be requested to establish safety (it can cause oto- and nephrotoxicity) Should not be administered in the same syringe or intravenous line as the penicillins Monitor renal function In patients with impaired renal function therapeutic drug monitoring should be done to preserve renal function Should be infused over 30 minutes Once daily administration
Tobramycin	As for gentamicin, however, comparison between tobramycin and gentamicin has suggested less nephrotoxicity with tobramycin. Tobramycin also has greater activity against *Pseudomonas spp.* These comparisons were done in adults	As for gentamicin
J01M → Quinolone antibacterials		
Ciprofloxacin	Broad-spectrum antibiotic (may be reserved for *Pseudomonas aeruginosa* and *Klebsiella pneumoniae*), acts by inhibiting DNA gyrase Use in paediatrics where the benefits outweigh the risk Restricted in neonates and children due to the potential side effects on joint cartilage	Recent studies have suggested that it may be used with caution in neonates with septicaemia due to multi-drug resistant organisms

continued

Table 54.6

Commonly encountered pharmacotherapeutic agents used in the neonate (according to the main groupings of the ATC classification system)(*continued*)

Generic name	Mechanism of action/Uses	Nursing implications
J01X → Other antibacterials		
Vancomycin	Bacterial cell wall synthesis inhibitor Should be reserved for serious Staphylococcus infections especially methicillin-resistant *Staphylococcus aureus* (MRSA) and *S. epidermidis* (MRSE) In neonates it is also effective against *Listeria monocytogenes*	Routine therapeutic drug monitoring in the neonate is not indicated Causes ototoxicity, refer for regular audiological examination. Not as frequent if vancomycin levels are kept within the therapeutic range Nephrotoxicity is not as frequent anymore, however, it is important to monitor urinary output and renal markers 'Red man syndrome' (or 'red baby') may develop due to rapid infusion of vancomycin. A rapid infusion causes massive histamine release from mast cells. Infuse slowly and dilute well
J02 → Antimycotics for systemic use		
Fluconazole	Fungistatic and is a member of the azole class of antifungal agents It is an inhibitor of ergosterol in the fungal cell membrane Used as the main alternative to amphotericin B when treating neonatal candidiasis Used in the prevention of cryptococcal meningitis	Resistance is developing from overuse. Monitor for gastrointestinal symptoms like diarrhoea and feeding intolerance Monitor liver functions, especially in patients with jaundice
Amphotericin B	Polyene macrolide antibiotic Fungicidal effects through binding to the sterol moiety (ergosterol) in sensitive fungi leading to leakage of the intracellular ions which eventually results in cell death Most species of Candida are considered susceptible; however, resistance is emerging in *C. krusei* and *C. glabrata* for example Drug of choice for all life-threatening mycotic infections	Infusion-related toxicity is a reaction that consists of fever, chills, muscle spasms, vomiting, headache and hypotension Premedicating with antipyretics, antihistamines and corticosteroids could be helpful. Do *not* administer rapidly. Administer over 4 hours Renal toxicity has been described as dosage-dependent, ensure good hydration and monitor renal markers Monitor potassium and magnesium levels (may cause hypokalaemia and hypomagnesaemia) Monitor liver functions weekly, may cause liver damage Administration of a test dose is a contentious issue and should be gauged by the clinical condition of the patient Do not mix with saline solution, dextrose is recommended

continued

J05 → Antivirals for systemic use (see Chapter 51)		
M → Musculo-skeletal system		
Indomethacin	Non-steroidal anti-inflammatory drug Used in the pharmacological closure of patent ductus arteriosus in preterm infants Also used in the prevention of intraventricular haemorrhage	Ibuprofen has been proven to be equally effective with fewer side effects (e.g. oliguria) Monitor renal function as renal impairment has been noted, and can be clinically monitored by monitoring urinary output May have gastrointestinal effects, e.g. abdominal distention, bleeding and even perforation, when abdominal distension is noted discontinue the drug Inhibition of platelet aggregation has been noted, monitor platelet counts A regimen of indomethacin normally constitutes three IV doses, staggered at 12–24 hourly intervals, if unsuccessful and if urine output is normal a second course (1–2 doses) may be administered
Pancuronium	Non-depolarising, neuromuscular blocking agent Used for skeletal muscle relaxation during surgery (anaesthesia) and for mechanical ventilation	The drug should only be administered by an experienced medical practitioner if facilities for intubation, artificial ventilation and oxygen supplementation are available. The medical practitioner should be prepared to assist and support ventilation Neonates are very sensitive to non-depolarising skeletal muscle relaxation agents, and should be tested (with a test dose) for responsiveness Long-term use of pancuronium has been associated with methaemglobinaemia and prolonged severe skeletal muscle weakness Antagonists like pyridostigmine and neostigmine in combination with atropine should be readily available
N → Nervous system		
Midazolam	Short-acting benzodiazepine Used as a sedative in infants undergoing procedures in the intensive care unit, e.g. mechanical ventilation Does not provide any pain relief	Continued use in the NICU is not justified and may provide unpleasant withdrawal symptoms

continued

Table 54.6

Commonly encountered pharmacotherapeutic agents used in the neonate (according to the main groupings of the ATC classification system)(*continued*)

Generic name	Mechanism of action/Uses	Nursing implications
Midazolam (*continued*)		Gestational age has a marked effect on the drug's half-life and clearance changes rapidly within the first few weeks of life When administering high dosages, rapid administration, or concurrent use with an opioid, there is an increased chance of respiratory depression If used continuously for more than 1 week the risk of physiological dependency is increased. The dosage must be tapered to minimise withdrawal symptoms. Withdrawal can be achieved by tapering the dosage every second day, decreasing the dosage by about 10% as tolerated Use the lowest effective dosage for the shortest period of time Antidote for midazolam is flumazenil
Pethidine (also known as meperidine)	Opioid analgesic Management of severe pain in the neonate, e.g. postoperative pain Best if used in conjunction with a neonatal pain scale to assess severity of pain Morphine is an alternative to pethidine for the management of severe pain	Increasing the dosage or concurrent use with a benzodiazepine may increase the risk of respiratory depression Antidote for pethidine is naloxone Can cause addiction, do not discontinue abruptly Tolerance develops to the drug The toxic metabolite is norpethidine, which may cause seizures In neonates, however, the rate of accumulation is slow Accumulation is more likely in neonates with renal failure, or when extremely high dosages of pethidine are administered After administration observe blood pressure and heart rate Observe sedation and level of pain relief After long-term administration observe and monitor for withdrawal symptoms

continued

Phenobarbitone (also known as phenobarbital)	Barbiturate anticonvulsant Used in the management of neonatal seizures Therapeutic drug monitoring (TDM) is recommended, especially in infants with hepatic disorders Hepatic enzyme inducer, may not only increase elimination of certain other drugs and bilirubin, but of phenobarbitone itself (auto-induction)	The prophylactic use of oral phenobarbitone in preventing phototherapy in jaundiced patients lacks evidence and has not been proven by evidence-based medicine Monitor the patient for respiratory depression, especially if used with other opioids or benzodiazepines Taper the drug carefully, abrupt withdrawal may cause seizures
P → Antiparasitic products, insecticides and repellents		
Metronidazole	Used for anaerobic sepsis in the neonate (anaerobic Gram-positive and anaerobic Gram-negative bacteria (e.g. *Bacteroides fragilis*) and protozoa	Best if used in combination with other antimicrobials as it does not include aerobic organisms in its spectrum of activity Monitor for clinical improvement Used in prophylaxis of high-risk abdominal surgery Monitor full blood count for neutropaenia
R → Respiratory System		
Aminophylline	Methylxanthine Used in the prevention of apnoea of prematurity (AOP) in the neonatal population (caffeine may be preferred for this indication) May also be used to reduce the risk of bronchopulmonary dysplasia The proposed mechanism of action for this indication is via adenosine antagonism, which increases the sensitivity of the respiratory centres to carbon dioxide, thus acting as a driver of inspiration	Therapeutic range is narrow and serum levels should be monitored The lowest possible therapeutically active dosage should be given to avoid adverse effects Adverse effects include tachycardia, tachypnoea, hyperactivity, nausea, vomiting and headache Central nervous system side effects may be more frequent with increased dosages Monitor heart rate and if above 180 beats per minute, it may be due to aminophylline toxicity and should be investigated, and the next dosage skipped. Re-evaluate In patients with necrotising enterocolitis (NEC) oral theophylline should be discontinued.
Caffeine	Methylxanthine Used in the prevention of apnoea of prematurity (AOP) in the neonatal population Stimulates the respiratory centres via adenosine antagonism, increasing the sensitivity to carbon dioxide, thus acting as a driver of inspiration	Therapeutic drug monitoring of caffeine remains controversial as the drug is usually well tolerated Monitor for clinical signs of toxicity, e.g. tachycardia (> 180 beats per minute), jitteriness, irritability and feeding intolerance

continued

Table 54.6

Commonly encountered pharmacotherapeutic agents used in the neonate (according to the main groupings of the ATC classification system)(*continued*)

Generic name	Mechanism of action/Uses	Nursing implications
Poractant alfa (Curosurf®)	Porcine surfactant consisting of 99% polar lipids (mainly phospholipids) and 1% hydrophobic proteins of low molecular weight Used to reduce the morbidity and mortality associated with respiratory distress syndrome (RDS, or hyaline membrane disease)	For endotracheal administration only Monitor saturation whilst administering drug as desaturation may occur whilst administering the drug Transient episodes of bradycardia and hypotension may occur upon administration of drug Follow manufacturer's guidelines Store drug in medicine fridge (2–8 °C), warm to room temperature prior to use Protect from light and do **not** shake, if dispersion of particles occur swirl vial
Beractant (Survanta®)	Natural bovine lung extract Contains phospholipids, neutral lipids, fatty acids, and surfactant-associated proteins to which colfosceril palmitate, palmitic acid and tripalmitin have been added These are added to mimic naturally occurring human surfactant with surface lowering properties Used in respiratory distress syndrome (RDS, or hyaline membrane disease)	For endotracheal use Frequent monitoring of saturation is necessary as rapid improvements in oxygenation may occur. Frequent monitoring prevents hyperoxia Follow manufacturer's guidelines for administration of drug Do **not** shake vial, if dispersion of particles occur swirl vial Artificial warming techniques should not be followed, the drug should be warmed to room temperature 20 minutes prior to administration or warmed in the hand for at least 8 minutes Store in the refrigerator between 2–8 °C, do not remove from the fridge for more than 24 hours Bradycardia and desaturation may occur whilst administering the drug, ensure proper monitoring. Protect from light Hypo- or hypertension may occur

54.4 Conclusion

The use of drug therapy in pregnancy, childbirth, lactation and in the newborn infant requires careful consideration by all healthcare practitioners involved. Altered physiology changes the pregnant woman and neonate's ability to absorb, transport, metabolise and excrete drugs. Optimal therapeutic dosages and safety parameters have not been established in this population for several drugs, leaving practitioners, pregnant women and neonates at potential risk. For this reason midwives need a thorough understanding of the use of medication in obstetrics and neonatalogy, and the potential dangers to both mother and baby.

Annexure A : ICD 10 Codes

The International Statistical Classification of Diseases and Related Health Problems 10th Revised Version for 2007 is a system to classify the health status of a person for statistical purposes and to determine health profiles and healthcare costs for healthcare planning. It assists in standardising diagnosis and care.

The ICD 10 codes have been accepted and have been used in the public sector in South Africa since 2004. The private healthcare sector uses the system.

All medical practitioners are required by medical insurances to indicate the correct codes of the conditions that a person presents with or is diagnosed with.

The ICD codes indicate:

- primary diagnosis
- secondary diagnosis
- comorbidities
- events.

CPT4 codes are related to the ICD 10 codes and are the interventions (medical and nursing) to treat the condition.

The complete diagnostic possibility is arranged in systems and linked to the alphabet.

Gynaecology and obstetrics are represented from N to Q as indicated.

The conditions are listed from 0–99 for each alphabetical category

The specific description is further indicated, for example 0.0; 0.1; 0.2.

The following tables give the main categories of conditions for gynaecological and obstetric conditions only.

Comorbidities from any other system can be added.

Chapter XIV	N00-N99	**Diseases of the genitourinary system**
Chapter XV	O00-O99	**Pregnancy, childbirth and the puerperium**
	O00-O08	Pregnancy with abortive outcome
	O10-O16	Oedema, proteinuria and hypertensive disorders in pregnancy, childbirth and the puerperium
	O20-O29	Other maternal disorders predominantly related to pregnancy
	O30-O48	Maternal care related to the fetus and amniotic cavity and possible delivery problems
	O60-O75	Complications of labour and delivery
	O80-O84	Delivery
	O85-O92	Complications predominantly related to the puerperium
	O94-O99	Other obstetric conditions, not elsewhere classified
Chapter XV1	P00-P96	**Certain conditions originating in the perinatal period**
	P00-P04	Fetus and newborn affected by maternal factors and by complications of pregnancy, labour and delivery
	P05-P08	Disorders related to length of gestation and fetal growth
	P10-P15	Birth trauma
	P20-P29	Respiratory and cardiovascular disorders specific to the perinatal period
	P35-P39	Infections specific to the perinatal period

(continued)

(continued)

	P50-P61	Haemorrhagic and haematological disorders of fetus and newborn
	P70-P74	Transitory endocrine and metabolic disorders specific to fetus and newborn
	P75-P78	Digestive system disorders of fetus and newborn
	P80-P83	Conditions involving the integument and temperature regulation of fetus and newborn
	P90-P96	Other disorders originating in the perinatal period
Chapter XV11	Q00-Q99	**Congenital malformations, deformations and chromosomal abnormalities**
	Q00-Q07	Congenital malformations of the nervous system
	Q10-Q18	Congenital malformations of eye, ear, face and neck
	Q20-Q28	Congenital malformations of the circulatory system
	Q30-Q34	Congenital malformations of the respiratory system
	Q35-Q37	Cleft lip and cleft palate
	Q38-Q45	Other congenital malformations of the digestive system
	Q50-Q56	Congenital malformations of genital organs
	Q60-Q64	Congenital malformations of the urinary system
	Q65-Q79	Congenital malformations and deformations of the musculoskeletal system
	Q80-Q89	Other congenital malformations
	Q90-Q99	Chromosomal abnormalities, not elsewhere classified

Each ICD 10 code consists of seven alphanumeric characters. The second through seventh characters mean the same thing within each section, but may mean different things in other sections. Each character can be any of 34 possible values, the ten digits 0-9 and the 24 letters A-H,J-N and P-Z may be used, in each character. The letters O and I are excluded to avoid confusion with the numbers 0 and 1. There are no decimals in ICD-10-PCS. For more information visit http://apps.who.int/classifications/apps/ICDIOonline/

Key for obstetrics

- Character 1 = Section
- Character 2 = Body System
- Character 3 = Root Operation
- Character 4 = Body Part
- Character 5 = Approach
- Character 6 = Device
- Character 7 = Qualifier

Glossary

Abdominal pregnancy: an extrauterine, intra-abdominal pregnancy.
Abortion: the termination of a pregnancy before the fetus is 'viable'.
Afterpains: cramp-like pains of the uterus, which may occur after the birth of the child.
AGA (appropriate for gestational age): newborn babies with a birth weight between the 10th and 90th percentiles.
AIDS: Acquired Immune Deficiency syndrome
Alpha-fetoprotein (AFP): the major circulating protein of the early human fetus.
Amelia: the absence of a limb.
Amniocentesis: the insertion of a needle abdominally into the amniotic sac for the removal of amniotic fluid.
Amnion: the inner of the two membranes forming the sac that contains the amniotic fluid and the fetus.
Amniotic fluid: the fluid contained within the amniotic sac and surrounding the fetus.
Amniotic fluid embolism: maternal embolism caused by amniotic fluid being forced into the maternal circulation at birth.
Amniotomy (AROM): artificial rupture of membranes, or surgical induction.
Anaphylaxis: a life-threatening physiological immunological reaction (including drug hypersensitivity) to a known or unknown agent.
Android pelvis: a 'male-type' pelvis.
Anencephaly: a congenital abnormality resulting in an absence of the cranial vault and the brain.
Anoxia: the absence of oxygen in the body tissues.
Antenatal: prenatal or preceding birth.
Antepartum: preceding labour.
Anterior fontanelle: the larger diamond-shaped fontanelle situated anteriorly and also known as the bregma.
Anthropoid pelvis: a pelvis in which the anteroposterior diameters are enlarged and the transverse diameters are reduced.
anti-D: a specific gamma globulin (1gG) containing anti-Rhesus V antibodies. This is obtained by a cold alcohol method of fractionation of carefully screened human plasma (RHOGAM) and is used in the prevention of Rhesus isoimmunisation.
Apgar score: a numeric description of the condition of the newborn designed for rapid assessment at birth, developed by Dr Virginia Apgar.
Apnoea: a temporary cessation of breathing.
apnoea neonatorum: the disturbance of the respiratory mechanism in an infant at birth or shortly after.
ART: antiretroviral therapy.
Asphyxia neonatorum: a condition in which a viable newborn infant fails to initiate and/or sustain respiration after delivery.
Asynclitism: the lateral tilting of the fetal head in order to channel the head through the pelvic brim.
Atelectasis: the partial or complete non-expansion of the lungs of a newborn baby.
Atresia: congenital closure of a usual opening or canal such as an oesophageal atresia.
Attitude of the fetus: the relation of the fetal parts to one another *in utero*.
Auscultation: assessment by listening to sound within the body, for example, the fetal heart.
Baby friendly: conditions that consider the needs of a baby.
Ballottement: a technique of palpation to detect or examine a floating object in the body, for example, the fetal head in the amniotic fluid.
BANC: Basic antenatal care.
Bandl's ring: a pathological uterine retraction ring, seen abdominally in obstructed labour.
Bartholin's glands: two small mucus-secreting glands situated one on either side of the vaginal opening, to which they are connected by small ducts.
Bicornuate uterus: a congenital uterine abnormality where the uterine fundus is divided into two parts.

Betamimetics: Any drug that mimics the stimulation of the beta-adrenergic receptors of the sympathetic nervous system. (In childbirth mainly used for suppression of contractions and fetal lung maturity.)
Better Birth Initiative: principles of evidence-based care related to childbirth.
Biophysical profile: a sophisticated means of assessing the fetal wellbeing.
Bonding: the relationship process that links two individuals.
BMR: basal metabolic rate.
Brachial palsy: partial or complete paralysis of a portion of a baby's arm resulting from a difficult delivery, for example Erb-Duchenne and Klumpke's paralyses.
Brandt-Andrews' manoeuvre: modified controlled cord traction used to remove the placenta after the delivery of the baby.
Braxton-Hicks contractions: painless uterine contractions during pregnancy.
Breast engorgement: excessive fluid and swelling in the breasts in the puerperium.
Breech presentation: where the buttocks and possibly the feet of the fetus, instead of the head, lie in the lower pole of the uterus.
Bregma: the large, diamond-shaped anterior fontanelle.
Brown fat: a source of energy for heat production unique to the neonate but reduced or absent in the preterm baby.
Caesarean section: the surgical removal, by abdominal incision, of the products of conception as a viable fetus.
CAMs: complementary and alternative medicines.
Caput succedaneum: an oedematous subcutaneous swelling on the presenting part of the fetal head caused by pressure during labour.
Cardiomyopathy: pathological enlargement of the cardiac muscle.
Cardiotocography: monitoring of the fetal heart and the maternal uterine contractions using an electronic monitoring machine. Used in high-risk pregnancies.
Caul: the portion of the amnion which covers the baby's face if the baby is born with the membranes intact.
Cephalhaematoma: a swelling on the head of the newborn caused by bleeding under the periosteum of the skull, usually the parietal bone/s.
Cephalopelvic disproportion (CPD): disproportion between the size of the fetal head and the size of the mother's pelvis.
Cervical dystocia: non-dilatation of the cervix in the presence of efficient uterine contractions, and resulting in difficult labour.
Cervical os: the internal and/or external opening of the cervical canal.
Chloasma: 'the mask of pregnancy': brown pigmentation on the skin of the face during pregnancy and in some women who are taking oral contraceptives.
Choanal: pertaining to the nose.
Chorioamnionitis: inflammation of the fetal membranes due to infection in the liquor amnio.
Chorioepitheliorna: a rapidly developing malignant condition of the epithelium of the chorionic villi, and may be found after hydatidiform mole.
Chorion: the outer fetal membrane.
Coitus: sexual intercourse, copulation.
Colostrum: yellow secretion from the breasts during pregnancy and prior to true lactation.
Colloids: particles do not break down in water larger than 30(kDa)3 (used in hypovolaemia).
Competency: knowledge, skill or attitude that enables one to effectively perform the activities of a given occupation or function to the standards expected in employment.
Conceptus: the products of conception.
Confinement: the period of labour, the delivery and the early puerperium.
Congenital: present or existing in the baby, before and at birth.
Conjoined twins: twins who are physically joined, Siamese twins.
Constriction ring: an internal localised spasm of the uterine muscle, for example an 'hour-glass' constriction ring.
Contraction and retraction: the tightening and shortening of the uterine muscle fibres during labour.
Coomb's test: a test to determine the presence of Rhesus positive antibodies.
Couvelaire uterus: bleeding into the uterine muscle due to placental abruption.
CPAP (continuous positive airway pressure): a method of artificial respiration.
CPD: see Cephalopelvic disproportion.
Craniostenosis (craniosynostosis): premature closure of the sutures of the skull bones in the newborn.
Crowning of the head: the distending of the vaginal orifice by the widest diameter, the biparietal diameter, of the fetal head during birth.
Crystalloids: substances from crystals (sodium and chloride) that break down in water with a weight 30 kilodaltons (kDa) (used as an intravenous volume expander).
Curve of Carus: the pathway which the fetus takes as it passes through the pelvis (the 90° curve of the birth canal).
Decidua: the lining of the uterus (the endometriurn) during pregnancy.

Delivery: the birth of the baby, the placenta and membranes.
Denominator: that part of the 'presentation' which gives the 'position' its name.
Deprivation: to be suffering due to absence of something essential.
Desquamation: shedding of the epithelial cells of the skin and mucous membranes.
Dextrocardia: a congenital abnormality where the heart is situated on the right-hand side of the thorax.
Dextrorotation of the uterus: the pregnant uterus is usually rotated slightly towards the right-hand side by 20 weeks, because it is displaced by the rectum and sigmoid colon on the left-hand side of the body.
Diagonal conjugate: an important measurement, gauged digitally, and used to assess the size of the pelvis. The measurement is taken from the lower border of the symphysis pubis to the 'promontory of the sacrum'.
Diaphragmatic hernia: a congenital abnormality of the diaphragm, allowing the abdominal organs to protrude into the thoracic cavity.
Diastasis of the rectus abdominis muscles: a parting along the centre of the rectus abdominus muscles, often found after repeated pregnancies.
DIC (disseminated intravascular coagulation): fibrin degradation products in the blood circulation, resulting in severe haemorrhage.
Dilatation of the cervix: the dilating of the cervix during labour brought about by uterine contraction and retraction.
Disparate twins: twins who are noticeably different in weight and colour, as found in 'twin transfusion syndrome'.
Dizygotic twins: binovular or non-identical twins.
Doderlein bacillus: the Gram-positive bacterium found in normal vaginal secretions.
Double-headed-monster: an extreme form of conjoined twins.
Doula: an assistant who provides non-medical and non-midwifery support (physical and emotional) in childbirth.
Down's syndrome (mongolism or trisomy 21): a chromosomal defect resulting from the presence of an extra chromosome on the 21st pair.
Dubowitz assessment: a set of criteria used to assess the gestational age of the newborn baby.
Ductus arteriosus: a temporary duct between the aorta and the pulmonary artery in the fetal circulation.
Ductus venosus: a temporary connection between the umbilical vein and the inferior vena cava in the fetal circulation.
Dyspareunia: painful and/or difficult sexual intercourse.
Dystocia: very painful, difficult and/or prolonged labour.
Eclampsia: a severe complication of pregnancy arising from a pre-eclamptic condition of unknown cause, characterised by hypertension, proteinuria and often generalised oedema, culminating in convulsions.
Ectoderm: the outer layer of cells in the developing embryo, which gives rise to the nervous system, skin, nails and hair.
Ectopic pregnancy: an extrauterine pregnancy.
EDD: estimated date of delivery.
Effacement of the cervical canal: shortening and thinning (taking up) of the cervical canal.
Embryo: the developing conceptus from the beginning of the 4th week to the end of the 8th week.
Endoderm: inner layer of cells of the embryo that gives rise to the internal organs.
Endometrium: the mucous membrane lining the inner surface of the uterus in the nonpregnant state.
Engagement of the fetal head: when the largest diameters of the presenting part of the fetal head, including the biparietal diameter, have passed through the pelvic brim or inlet.
Epidural analgesia: analgesia now used extensively during labour, and given by administering a local anaesthetic into the epidural space.
Episiotomy: an incision into the perineum in order to increase the size of the vaginal orifice to facilitate delivery and to avoid severe laceration.
Ergometrine: an oxytocic substance resulting in a long, sustained contraction of the uterine muscle, and which may only be used after delivery for contracting the uterus.
Erythroblastosis fetalis: an abnormal condition affecting the newborn baby as a result of Rhesus isoimmunisation, and characterised by a raised serum bilirubin level. Haemolytic disease of the newborn.
ESMOE: essential steps in the management of obstetric emergencies.
ESR: erythrocyte sedimentation rate.
Eutoscia: normal labour.
Exchange transfusion of the newborn: 70–80% of circulating blood in the newborn baby suffering from erythroblastosis fetalis will be replaced with group O Rh–, donor blood.
Exomphalos: a congenital anomaly characterised by the absence of the anterior abdominal wall and resulting in protrusion of abdominal viscera.
Exsanguination: loss of a large quantity of blood.
Face presentation: where the face of the fetus, instead of the vertex, lies in the lower pole of the uterus.
False labour: unequal, arythmical, early uterine contractions which do not result in cervical dilatation.
False pelvis: that portion of the pelvis situated above the pelvic brim or inlet.

Ferguson reflex: reflex contractions of the uterus after stimulation of the cervix by a well-fitting presenting part.
Ferning: the appearance of a branching pattern in dried smears of uterine cervical mucus in the presence of oestrogen.
Female genital mutilation: female circumcision.
Fetal acidosis: (see 'Asphyxia Neonatorum' in the text.)
Fetal alcohol syndrome (FAS): a syndrome caused by maternal alcohol ingestion and resulting in a typical neonatal face, possible mental retardation and personality disorders later on in life.
Fetal growth restriction: see 'Intrauterine growth retardation'.
Fetus: the conceptus from the beginning of the ninth week after conception, to term.
Fetus papyraceous: a twin that has died *in utero* and been retained to term, when it is expelled with the placenta. The body fluids will have been reabsorbed and the fetus will have a flattened and 'paper-like' appearance.
Fistula: an abnormal passage, for example, a tracheo-oesophageal fistula.
Flexion: bending or being bent; the opposite of extension.
Fontanelle: a space at the intersection of the sutures in the fetal skull.
Footling presentation: the extension of a leg in a breech presentation.
Foramen ovale: a temporary opening in the interatrial septum of the heart, in the fetal circulation.
Frank breech presentation: the fetus lies as a breech presentation, with both legs flexed at the hips but extended at the knee.
Fundus: the upper portion of the uterus, between the Fallopian tubes.
Funic: pertaining to a cord such as the umbilical cord.
Galactagogue: an agent causing an increase in the flow of milk.
Galactocaemia: an inability in infants to metabolise lactose and galactose.
Galactorrhoea: the excessive secretion of milk.
Gender violence: the social pathology of violence between genders.
Genetics: a branch of biology concerned with the study of heredity (the transmission of characteristics from parents to their offspring) and the variation (the differences observed between living things).
Gestation: pregnancy.
Gestational age: the age of the embryo or fetus estimated from the first day of the last normal menstrual period.
Gestational diabetes: diabetes mellitus that becomes apparent during pregnancy.
Glabella: that part of the sinciput situated above the root of the nose and between the eyebrows.
Grande multipara: a woman who has had five or more viable babies.
Gravid: pregnant.
Gravida: a pregnant woman.
Gynaecoid pelvis: a typical female pelvis.
HAART: Highly effective antiretroviral therapy.
Haemorrhagic disease of the newborn: a bleeding disorder in the newborn due to a lack of vitamin K.
HCG (human chorionic gonadotrophin): a hormone of pregnancy produced by the chorionic villi.
Hegar's sign of pregnancy: a method to detect early pregnancy and to determine an approximate gestational age of the fetus.
HELLP syndrome: a complication of pre-eclampsia and eclampsia characterised by haemolysis, elavated liver enzymes and low platelets.
HIV: Human immunodeficiency virus
Human placental lactogen: a hormone that is only found in pregnant woman, which has growth hormone properties.
Hyaline membrane disease: a hyaline membrane forms in respiratory distress syndrome and on autopsy is found lining the lungs.
Hydatidiform mole: proliferation of the trophoblast resulting in grape-like vesicles and vaginal bleeding. There is usually no development of the embryo.
Hydrocephaly: a condition in which excessive cerebrospinal fluid in the brain leads to rapid head growth
Hydrops fetalis: the most severe form of erythroblastosis fetalis causing severe oedema and cardiac failure, which is usually fatal.
Hyperbilirubinaemia: excessive amounts of serum bilirubin.
Hypercapnia: an increased amount of carbon dioxide in the arterial blood.
Hyperemesis gravidarum: excessive vomiting during pregnancy after the first trimester.
Hypofibrinogenaernia: low levels of fibrinogen in the blood.
Hypogastric arteries: also known as the umbilical arteries and are temporary structures carrying deoxygenated blood from the fetus to the placental tissues.
Hypoxia: an inadequate level of oxygen in the blood.
Hysterectomy: surgical removal of the uterus.
Hysterotomy: surgical incision into the uterus, performed to remove the products of conception before viability.
Iatrogenic: an abnormality caused by medical treatment, for example, retrolental fibroplasia.
Ichthyosis: a congenital skin disease characterised by the desquamation of plaques or scales of smooth, dry, horny skin.

Imperforated anus: there is no anal opening to the rectum at birth and this condition may be associated with a fistula.
Implantation: the attachment of the products of conception to the uterine wall in a normal pregnancy.
Incidental antepartum haemorrhage: antepartum haemorrhage other than placenta praevia or placental abruption.
Incompetent cervix: a cause of habitual abortion or preterm labour where the cervix is unable to retain the products of conception.
Incoordinate uterine action: a type of disordered, arhythmical uterine action, where the fundal dominance is lost, for example in a 'colicky' uterus.
Induction: the artifical initiation of labour.
Infant mortality: death of the child in the first year of life.
Intertuberous diameter: the distance between the ischial tuberosities, used in the assessment of the pelvic outlet.
Intervillous spaces: open maternal blood spaces within the placenta allowing materno-fetal exchange to occur.
Intrauterine anoxia: an absence of oxygen to the fetus.
Intrauterine growth restriction (IUGR): usually caused by placental insufficiency and resulting in a 'small-for-gestational age' baby (SGA).
Introitus: an opening, particularly the entrance to the vagina.
Inversion of the uterus: where the uterus is turned inside out after the delivery of the baby, and is usually acute.
Inverted nipple: an abnormal condition where the nipple does not protrude from the breast.
Involution (of the uterus): the gradual process whereby the uterus and other reproductive organs resume their normal size and function after delivery.
IPPV (intermittent positive pressure ventilation): a type of artificial respiration.
Ischial spines: spines situated on the ischial bones and protruding into the birth canal on either side.
ISI: Incontinence severity index.
Isoimmunisation: the development of antibodies in the mother against an antigen from the fetus, for example, the Rhesus factor.
Karyotype: the arrangement of the chromosomes in a set pattern or order.
Kernicterus: circulating high levels of unconjugated bilirubin in the bloodstream causing staining of the basal ganglia of the brain, and resulting in athetoid paralysis or death.
Ketosis: the presence of ketone bodies in the blood detected by urinalysis.
Klinefelter's syndrome: a sex chromosomal defect resulting in karyotype XXY, with three sex chromosomes being present, that is, there are 47 instead of 46 chromosomes. The individual is a male with some female characteristics and the condition is compatible with life.
KMC (Kangaroo-mother-care): care of a small infant needing incubation by placing them skin-to-skin on the mother's chest 24 hours a day.
Labour: the process whereby the conceptus is expelled from the uterus and delivered. Also known as parturition or confinement.
Lactation: the process of milk secretion and excretion.
Lactiferous sinus: distended area of the lactiferous ducts located just beneath the areola of the breast.
Lactosuria: the presence of lactose in the urine during late pregnancy and lactation. May be confused with glycosuria during lactation.
Lanugo: fine, soft hair which often covers the fetus from about 20 weeks until birth.
Lecithin: a phospholipid that lowers the surface tension of the alveoli of the lungs and which is important in respiratory distress syndrome (RDS). The lecithintsphingomyelin test is used to determine fetal lung maturity and the presence of surfactant.
Left lateral position: when the mother lies in this position during pregnancy and early labour, the oxygen supply to the fetus is increased, preventing 'supine hypotensive syndrome'. During labour this position facilitates more controlled labour and easier access by attendants, and is also known as the Queen Charlotte or the Rotunda position for delivery.
Let-down: this is the milk ejection reflex, also known as the 'draught'.
Leucorrhoea: normal vaginal discharge.
Levator ani muscles: large specialised muscles of the pelvic floor which direct the fetus in the mechanism of labour.
LGA (large-for-gestational age): where the fetus is unusually large in relation to gestational age (above the 90th percentile). Also known as macrosomia and often found in mothers with diabetes mellitus.
Lie of the fetus: the relationship of the long axis of the fetus to the long axis of the uterus. May be longitudinal, transverse or oblique.
Lightening: the descent of the uterus within the abdominal cavity around 36 weeks, which results in a lowering of the fundal height and therefore a reduction of pressure on the diaphragm.
Linea nigra: a brown pigmented line on the skin of the anterior abdominal wall, which runs from the umbilicus to the symphysis pubis and which occurs during pregnancy.
Liquor amnii: the fluid contained within the amniotic sac and surrounding the fetus.

Lithotomy position: the woman lies on her back with her knees drawn up and her feet in stirrups which are attached to lithotomy poles.
Litigation: legal action against a person
Living ligatures: the middle, criss-cross layer of uterine muscle fibres which are arranged in such a way that they ligate the maternal blood vessels in the third stage of labour and prevent postpartum haemorrhage.
Lochia: the vaginal discharge during the puerperium.
Lovset's manoeuvre: the remedial manoeuvre used when there are extended arms in the nuchal position, in a breech delivery.
Low forceps delivery: the application of forceps to lift the fetal head out once it has passed the midpelvis and has reached the perineum.
Macerated fetus: the process of degeneration of a fetus that has died *in utero*.
Macrosomia: a condition where the baby is large-for-gestational age, 'LGA'
Malposition: a posterior position in a vertex presentation.
Malpresentation: when the presentation is other than a normal vertex presentation.
Mastitis: inflammation of breast tissue.
Mammary gland: compound milk-secreting gland of the female breast.
Maurice Smellie-Veit manoeuvre: the remedial manoeuvre used for an extended head in a breech delivery, and which may be used for delivery of the head in any breech presentation.
MC&S: microscopic culture and sensitivity.
Meatus: an external opening to an internal passage leading to an organ. For example, the urinary meatus of the urethra.
Mechanism of labour: a series of passive movements by which the fetus is moved through the birth canal.
Meconium: the greenish-black contents of the fetal bowel and the first stools of the neonate.
Meconium aspiration syndrome: an obstruction of the airways in the baby at birth due to the aspiration of meconium into the lungs.
Meconium flown: an obstruction of the bowel of the newborn caused by the compaction of viscid meconium in babies suffering from cystic fibrosis.
Meconium-stained fluid: the presence of meconium in the liquor amnii as a result of hypoxia in the fetus.
Meiosis: cell division occurring in germ (sex) cells.
Mendelson's syndrome: a potentially fatal complication in pregnancy and birth where stomach contents are aspirated.
Meningomyelocele: a congenital neural tube defect where both the meninges and the spinal cord protrude through the non-union of the spinous processes of one or more vertebrae (spina bifida).
Mentum: the 'denominator' in a face presentation, for example right mentoanterior (RMA).
Mesoderm: the middle layer of cells in the developing embryo, which gives rise, for example, to muscles, the circulatory system and epithelial tissue.
Metritis: inflammation of the uterine wall.
Microcephaly: an abnormally small head.
Micrognathia: an abnormally small lower jaw.
Micturition: passing of urine.
Midcavity forceps delivery: the use of forceps when the head is held up in the midcavity of the pelvis, especially in posterior positions of the vertex when the ischial spines are prominent.
Millia: tiny white spots seen on the face of the neonate, particularly around the nose. They are of no significance and soon disappear.
Missed abortion: this is when the fetus dies *in utero* but the products of conception are not aborted.
Mitosis: cell division occurring in somatic cells.
Mongolian spot: a pigmented area found on the lower back and buttocks of some newborn babies and which is of no significance.
Mongolism: see 'Down's syndrome'.
Moniliasis: infection of the mucous membrane by *Candida albicans* (thrush).
Monozygotic twins: uniovular or identical twins.
Montgomery's follicles: sebaceous glands in the areola surrounding the nipple which hypertrophy during pregnancy and appear as small lumps.
Morbidity: sequelae of abnormal conditions.
Morning sickness: nausea, sometimes vomiting, occurring in early pregnancy. It is a normal condition and can occur at any time of day. If it should become abnormal, it results in 'hyperemesis gravidarum'.
Moro reflex: the 'startle' reflex found in the normal neonate.
Mortality: death.
Morula: the ball of cells, looking rather like a tiny mulberry, which normally develops in the uterine tubes as a result of cell division after fertilisation.
Moulding: the shaping of the fetal head as it passes through the birth canal. The presenting diameters are decreased by the overlapping of the skull bones at the sutures and fontanelles.
Müllerian ducts: two tubular embryonic structures from which the female genital organs evolve.

Multigravida: a woman who is pregnant for the second or any subsequent time.
Multipara: a woman who has had more than one 'viable' baby.
Mutation: a change in a chromosome or gene.
Myoepithelial (M-E) cells: contractile cells around the alveoli in the breast, facilitating the expression of milk into the mammary ducts.
Myometrium: the muscle layers of the uterus.
Naegele's rule: to establish the approximate estimated date of delivery (EDD), seven days and then nine months (or one year less three months, plus seven days) are added to the first day of the last normal menstrual period.
Naevus: a birthmark.
NCEMD: National Confidential Enquiry into Maternal Deaths.
Necrotising enterocolitis: a rare condition resulting in necrosis of the bowel in the newborn. It may occur in artificially fed babies and following umbilical catheterisation.
Neonatal mortality: death of the infant in the first four weeks of life.
Neonate: an infant from birth until four weeks of age.
Non-shivering thermogenesis: the process by which the newborn produces heat by increasing the metabolic rate.
Non-stress test: a test for fetal wellbeing using the cardiotocograph machine.
Nosocomial: pertaining to a hospital.
Nulligravida: a woman who has never been pregnant.
Nullipara: a woman who has never delivered a 'viable' baby.
Nurse midwife: a midwife that is also trained as a general professional nurse.
Obstructed labour: no descent of the presenting part in the presence of efficient uterine contractions, usually due to cephalopelvic disproportion. (See 'Bandl's ring'.)
Occipitoposterior position: the malposition of the occiput, with the occiput lying in a posterior segment of the mother's pelvis.
Occiput: the most posterior skull bone, which is also the 'denominator' in a vertex presentation.
Oligohydramnios: an insufficiency of amniotic fluid.
Oliguria: diminished secretion of urine.
Omphalitis: inflammation of the umbilicus.
Oogenesis: maturation of the ova.
Operculum: a mucus plug sealing off the cervical canal during pregnancy.
Ophthalmia neonatorum: gonococcal infection of the eye in the newborn, which can result in blindness.
Orifice: an opening, for example, the anus.
Ortolani's manoeuvre: a procedure to detect congenital dislocation of the hip in the newborn.
Os: an opening or mouth, for example, the external cervical os.
Osteogenesis imperfecta: a congenital abnormality characterised by brittle bones.
Outlet dystocia: the fetus has difficulty in negotiating an inadequate pelvic outlet.
Oxytocic: a substance which stimulates uterine contractions.
$PaCO_2$: arterial carbon dioxide tension.
PaO_2: arterial oxygen tension.
Palpation: physical examination using the hands.
Papanicolaou's test (Pap smear): a test for cervical cancer.
Para: a woman who has delivered one or more viable infants.
Parent: a biological/nonbiological person who takes care of a child.
Parity: the number of viable infants that a woman has delivered.
Parous: a woman who has delivered one or more viable infants.
Partograph (cervicograph): a graphic representation of the progress of labour used in the active management of labour for the early detection of abnormalities.
Parturition: the process of giving birth.
Patent: open.
Pawlik's grip: a grip used in abdominal palpation to determine the presenting part of the fetus.
PCO_2: carbon dioxide tension.
PCV: packed cell volume or haematocrit.
PEEP (positive end expiratory pressure): used in artificial respiration.
Pelvic axis: an imaginary line which bisects all the antero-posterior diameters of the pelvis and is the pathway which the fetus takes as it passes through the pelvis. (See 'Curve of Carus.')
Pelvic brim or inlet: The plane of division between the true and the false pelvis.
Pelvic outlet: the diamond-shaped outlet of the pelvis.
Pelvimetry: assessment of pelvic size.
Pendulous abdomen: the uterus falls forward due to lack of muscle tone of the rectus abdominis muscles. The condition is also known as anterior obliquity of the uterus.
Perimetrium: a layer of peritoneum covering the uterus.
Perinatal mortality: death of the infant during the first week of life, including stillbirths.
Perineal body: a triangular-shaped wedge of muscle situated behind the perineum and between the vagina and rectum.
Perineorrhaphy: suturing of the perineum.

Perineum: the surface area between the vagina and the anus.
Period of gestation: the length of a particular pregnancy calculated in days, weeks or months.
Persistent occipitoposterior position: when the occiput fails to rotate forward in an occipitoposterior position. It is commonly known as a 'face-to-pubes' delivery
Pharmacodynamics: the study of the physiological effects of drugs on the body.
Pharmacokinetics: the study of what the body does to a drug.
Pharmacotherapy: is the treatment of disease through the administration of drugs.
Phenylketonuria: an inherited autosomal recessive trait resulting in a defect in the metabolism of the amino acid phenylalanine and if untreated will result in mental retardation.
Phimosis: excessive tightness of the penile foreskin.
Phocomelia: a genetic anomaly resulting in the shortening or absence of the long bones of the limbs.
Phototherapy: the use of light energy to dispel the bilirubin present under the skin of a jaundiced infant.
Pica: the craving to eat unusual substances, such as mud.
Pierre-Robin syndrome: a congenital abnormality characterised by micrognathia, a small tongue, a cleft palate and possibly a cleft lip.
Pinna: the cartilaginous portion of the ear.
Placenta: a temporary organ which links the mother and the fetus during pregnancy. and, among other functions, facilitates the exchange of substances.
Placenta accreta: a morbidly adherent placenta. The use of the terms 'increta' and 'percreta' indicate the depth of adherence.
Placental abruption: partial or total premature separation of a normally situated placenta.
Placental infarcts: various abnormal areas sometimes found on the placenta.
Placental insufficiency: placental dysfunction.
Placenta praevia: a placenta implanted in the lower, instead of the upper, uterine segment and which almost always results in antepartum haemorrhage.
Platypelloid pelvis: the anteroposterior diameter of the pelvis is reduced.
Plethoric: congested and dark red in colour.
PMTCT: prevention of mother-to-child transmission of HIV.
Polycythaemia: an increase in the number of red blood cells.
Polydactyly: a congenital anomaly characterised by extra digits on the hands and/or feet.
Polyhydramnios: an excess of amniotic fluid.
Porphyria: a group of disorders that involve the biosynthesis of haem and cause an excessive renal excretion of porphyrins, or their precursors.
Position (of the fetus): the relationship of the denominator to the brim of the mother's pelvis.
Posterior fontanelle: the small triangular fontanelle situated posteriorly and also known as the lambda.
Postpartum (postnatal): after childbirth.
Postpartum haemorrhage: excessive bleeding after the birth of the baby and/or in the puerperium.
Post-term: a pregnancy lasting longer than forty-two full weeks. ('Postmature infant' is suggestive of an abnormal condition.)
PPIP: The Perinatal Problem Identification Programme.
Precipitate labour: an unusually short labour.
Pre-eclampsia: a complication of pregnancy characterised by hypertension, proteinuria and possibly oedema, which may culminate in eclampsia. The cause of this condition is not known.
Premature rupture of the membranes: rupture of membranes before the onset of labour.
Premonitory (prodromal) signs: signs or symptoms serving as a warning.
Prepuce: foreskin.
Presentation: that part of the fetus which lies over the brim of the pelvis.
Presenting part: that part of the 'presentation' lying over the internal cervical os.
Preterm infant: a 'viable' infant born before thirty-seven full weeks' gestation.
Primigravida: a woman pregnant for the first time.
Primipara: a woman who has delivered one 'viable' baby.
Progesterone: a female hormone
Prolactin: a hormone produced by the anterior pituitary gland responsible for the manufacture of milk. It is inhibited by the presence of high levels of oestrogen in the blood.
Prolonged pregnancy: a pregnancy lasting more than forty-two completed weeks' gestation.
Promontory of the sacrum: that part of the sacrum which juts into the pelvic brim at the junction of the superior surface of the sacrum and the inferior surface of the fifth lumbar vertebra.
Prone: lying flat, face downwards.
Prostaglandins: stimulate contractions of smooth muscles particularly the uterine muscles.
Proteinuria: the presence of protein in the urine.
Pruritis: itching.
Pseudocyesis: false pregnancy (a woman labouring under a misconception!).
Psychoprophylaxis: one of the methods of preparation for labour.

Ptyalism: an excessive amount of saliva, which may occur during early pregnancy.
Pudendal nerve block: the injection of local anaesthetic around the pudendal nerve on either side of the pelvis.
Puerperal infection (sepsis): infection of the genital tract following childbirth.
Puerperium: a period of time extending from the end of the third stage of labour to the end of the sixth week following delivery.
Quickening: the movements of the fetus *in utero* which are felt by the mother. Fetal movements only become apparent to the mother between the 16th and 20th weeks when the uterus becomes an abdominal organ, although slight movements have been taking place since early fetal development.
Recommended Dietary Allowances (RDAs): the evidence-based level of intake of food substances that is required and safe.
Recto-vaginal fistula: see 'vesico-vaginal fistula'.
Regulatory authority: the MCC (i.e. the Medicines Control Council) is the South African drug regulatory authority, which registers new medicines and approves their package inserts and patient information leaflets.
Relaxin: a hormone of pregnancy causing a relaxation of smooth muscle and cartilage.
Respiratory distress syndrome (RDS): in the newborn, this condition is due to a lack of surfactant in the lungs. (See also 'Hyaline membrane disease' and 'Lecithin'.)
Restitution: resumption of the original position, for example. external restitution after internal rotation of the fetal head during birth.
Retraction of uterine muscle: a property unique to the uterine muscle. Retraction is a progessive shortening of each longitudinal muscle fibre with every successive 'contraction'.
Retraction ring: an imaginary physiological ring being the demarcation between the upper and lower uterine segments. (For pathological retraction ring see 'Bandl's ring'.)
Retrolental fibroplasia: an iatrogenic condition in the newborn causing blindness, which is due to a high arterial oxygen tension. The preterm baby is more susceptible.
Rhesus factor: a group of antigens which may be present on the envelope of the red blood cells.
Rhonchi: coarse, snoring, ausculatory sounds made when mucous plugs obstruct the passage of air in the lungs.
Ringer's lactate: Sodium chloride, sodium lactate, potassium
Ripening of the cervix: softening of the cervix as the pregnancy approaches term and labour.
Rooting reflex: the instinctive turning of a normal newborn's mouth towards any facial sensory stimulant, such as the nipple.
Rotation of the head, internal and external: some of the passive movements of the fetal head made during the 'Mechanism of labour'.
Safe Motherhood Initiative (SMI): the movement to make birth a safer process.
Sagittal suture: the suture situated between the parietal bones and running into the anterior and posterior fontanelles.
SGA (small-for-gestational age): where the fetus is unusually small in relation to gestational age (below the 10th percentile).
Sheehan's syndrome: a condition that develops after hypovolaemic shock in birth where the pitituiry gland function is damaged.
Shoulder girdle dystocia (impacted shoulders): obstruction of the shoulders by the bony pelvis after the head is born in a cephalic lie.
Show: the appearance of the displaced 'operculum' at the vaginal introitus. This is sometimes accompanied by a small amount of blood.
Simian crease: a single palmar crease usually found in infants with Down's syndrome.
Sims' position: the lateral positioning of the body. Exaggerated Sim's position is used in 'umbilical cord prolapse'.
Sinciput: the forehead or brow in the fetus, that is, the two frontal bones.
Souffle: the swishing sound, detected on abdominal auscultation, of blood passing through the arteries: funic (umbilical), placental and uterine souffles may be detected.
Spalding's sign: the overlapping of the skull bones detected in a 'macerated fetus' on X-ray.
Spina-bifida: the lack of fusion of the spinous processes of a vertebra.
Station of the presenting part: the level of the descending presenting part in relation to the ischial spines.
Stem cells: are cells found in all multicellular organisms. They are characterised by the ability to renew themselves through mitotic cell division
Striae gravidarum: the stretch marks occurring on the mother's skin in pregnancy.
Stripping of the membranes: a means of inducing uterine contractions by digitally stripping the membranes from around the cervical os.
Subinvolution of the uterus: an abnormal reduction in the rate of 'involution of the uterus'.
SUI: Stress urinary incontinence: when the bladder leaks when coughing or laughing.
Supernumerary nipples (auxiliary breasts): additional nipples with or without breast tissue found in some women.
Supine: lying flat, face upwards.

Supine hypotensive syndrome: a restriction of venous blood flow from the uterus and lower limbs due to pressure exerted on the inferior vena cava when the woman adopts a supine postion. This results in maternal hypotension and a reduced oxygen supply to the fetus.
Surfactant: a combination of enzymes which lowers the surface tension of the alveoli of the lungs.
Sutures of the fetal skull: the membranous spaces situated between the skull bones of the fetus or newborn, where ossification has not yet taken place.
Symphysiotomy: artificial or spontaneous division of the ligaments of the symphysis pubis resulting in enlargement of the diameters of the bony pelvis.
Syndactyly: webbing or fusion of the fingers or toes.
Tachypnoea: an excessively rapid respiration rate.
Talipes: a congenital abnormality of the feet, such as clubfoot.
Teratogen: any environmental agent causing a malformation of the developing embryo or fetus.
Term: the full gestational period of 40 weeks in the human. The period from the beginning of 38 weeks, to 42 completed weeks' gestation, is also considered to be normal.
Tetanic contraction of the uterus: a uterine contraction that is longer and stronger than normal, usually resulting from the misuse of oxytocics.
Third degree tear: a laceration of the perineum extending through the muscles of the anal sphincter.
Thrush in the newborn: a fungal infection of the oral mucous membranes of the newborn caused by *Candida albicans*.
Titration: sequentially administering carefully measured amounts or dosages of a drug until the desired effect is achieved.
Tocolytic drug: a drug used to suppress uterine contractions in preterm labour.
Tonic contractions: see Tetanic contraction of the uterus'.
Tonic neck reflex: a normal reflex of the newborn resulting in the so-called fencing position.
TOP: Termination of pregnancy (by medical indication or by choice).
TORCH organisms: a group of organisms causing intrauterine and neonatal infections that may cause fetal abnormality or death.
Trial of labour: continuous careful assessment of the progress of labour in possible `Cephalopelvic disproportion'. Any labour, particularly primigravid labour, may also be regarded as a 'trial of labour'.
Trimester: the nine month gestational period is divided into three trimesters of three months each.
Trisomy 21: see 'Down's syndrome'.
Trophoblast: by the seventh day after fertilisation, the morula has developed two specialised outer layers of cells and is known as the trophoblast.
True pelvis: that portion of the pelvis forming the bony passage of the birth canal.
Turner's syndrome: a sex chromosomal defect resulting in karyotype X0, with only one sex chromosome being present, that is, there are only 45 instead of 46 chromosomes. The individual has a female appearance and the condition is compatible with life but serious physical defects may be present.
Twin transfusion syndrome (parabiotic syndrome): an abnormal condition which occasionally occurs in identical twins when there is anastomosis of the fetal blood vessels causing feto-fetal blood transfer. One twin receives most of the blood and becomes polycythaemic while the other twin suffers from anaemia. Occasionally the anaemic twin may die and be retained and may give rise to a fetus papyraceous.
Ultrasonography: the use of an ultrasound waves to visualise soft tissue by means of sound waves, and to record these photographically.
Umbilical catheterisation: the insertion of a catheter into the umbilical vein in order to feed the critically ill newborn baby and to enable blood tests, such as the Astrup test, to be performed (an umbilical artery may also sometimes be used) and also to administer medication.
Umbilical cord (funis): the cord which connects the fetus to the placenta.
Umbilical cord presentation: the cord lies in front of the presenting part with the membranes intact.
Umbilical cord prolapse: the cord lies in front of the presenting part with the membranes ruptured.
Uterine inertia: disordered, hypotonic uterine action, most commonly occurring in the nullipara. In primary uterine inertia there is ineffective uterine action resulting in little or no dilatation of the cervix, while in secondary uterine inertia, the uterus has become exhausted due to obstructed labour and the contractions have ceased temporarily.
Uterine tetany: tonic contraction of the uterus brought about by the misuse of oxytocic medications.
Vacuum extraction: the extraction of the fetal head from the birth canal by means of a vacuum cup or Ventouse extractor.
Valsalva manoeuvre (bearing-down): this is forcible exhalation effort against a closed glottis: the resultant increase in intra-thoracic pressure interferes with the venous return to the heart.

Vasa praevia: this condition occurs in a velamentous insertion of the cord where the fetal blood vessels, which run through the membranes, lie in front of the presenting part. The danger is rupture of the fetal vessels and possible fetal exsanguination.
Velamentous insertion of the cord: the cord is abnormally inserted into the membranes instead of into the substance of the placenta.
Vernier caseosa: a cheeselike, greasy-white substance which is secreted by the fetal sebaceous glands from the second trimester of pregnancy and which protects the fetal skin *in utero*. It is present at term and acts as a lubricant during the birth.
Version: the turning of the fetus so that there is a different presenting part. Version can be either spontaneous or by manipulation.
Vertex: the highest portion of the fetal skull, which is bounded by the anterior fontanelle in front, the posterior fontanelle at the back and the parietal eminences at the sides. It is this portion of the fetal skull which presents in a normal well-flexed vertex presentation.
Vesico-vaginal fistula: a fistula occurring between the bladder or urethra and the vagina as a result of obstructed labour. A recto-vaginal fistulae can also occur between the rectum and the vagina.
Viability: the ability of a fetus to sustain life outside the uterus. This is six months or 26 weeks after conception according to South African law.
WCC: white cells count.
Wharton's jelly: the jelly-like substance contained within the umbilical cord and surrounding the umbilical blood vessels.

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