Primary Newborn Care

A learning programme for professionals

Developed by the Perinatal Education Programme

Clear learning objectives help you understand the most important lessons to be learned.

Theoretical knowledge is presented in an easy, problem-solving way.

Clear, step-by-step guides through definitions, causes, diagnoses, prevention, dangers and management.

Case studies in story-form let you apply your new knowledge to solve common problems.

Multiple-choice questions help you monitor your progress.

This balanced and up-to-date guide to common and important clinical conditions can be used as a training course or as a reference manual for professionals and students.

Developed by the Perinatal Education Programme, which has brought effective continuing training to thousands of midwives, neonatal nurses and doctors.
Primary Newborn Care

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www.ebwhealthcare.com
VERY IMPORTANT

We have taken every care to ensure that drug dosages and related medical advice in this book are accurate. However, drug dosages can change and are updated often, so always double-check dosages and procedures against a reliable, up-to-date formulary and the given drug’s documentation before administering it.

Primary Newborn Care: A learning programme for professionals

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Introduction

AIM OF THE PERINATAL EDUCATION PROGRAMME

The aim of the Perinatal Education Programme (PEP) is to improve the care of pregnant women and their newborn infants in all communities, especially in poor periurban and rural districts of southern Africa. Although the Programme was written as a distance-learning course for both midwives and doctors in district and regional health care facilities, it is also used in the training of medical and nursing students.

The authors of the Perinatal Education Programme consist of nurses, obstetricians and paediatricians from South Africa. This ensures a balanced, practical and up-to-date approach to common and important clinical problems. Many colleagues in South African universities and health services were also consulted with a view to reaching consensus on the management of most perinatal problems.

PERINATAL EDUCATION

If all three levels of perinatal care are to be efficiently provided within a perinatal health care region, continuous education and training of all professional staff is essential. Unfortunately this often is achieved in the large, centralised tertiary-care hospitals only and not in the rural secondary- or primary-care centres. The providers of primary care in rural areas usually have the least continuing education as they are furthest away from the training hospitals in urban centres. It is not possible to send teachers to all these rural areas for long periods of time while staff shortages and domestic reasons make it impractical to transfer large numbers of doctors and nurses from primary- and secondary-care centres to centralised tertiary hospitals for training.

Ideally all medical and nursing staff should have regular training to improve and update their theoretical knowledge and practical skills. One way of meeting these needs in continuing education is with a self-help, outreach educational programme. This decentralised method allows health care workers to take responsibility for their own learning and professional growth. They can study at a time and place that suits them. Participants in the programme can also study at their own pace. The education programme should be cheap and, if possible, not require a tutor.

PERINATAL EDUCATION PROGRAMME BOOKS

Initially the Perinatal Education Programme was presented as two books only. The first PEP book, Maternal Care, deals with problems experienced by women during and after pregnancy while the second PEP book, Newborn Care, deals with problems in the newborn infant. Both books should be studied
to improve your knowledge of all aspects of perinatal care.

Now six additional, supplementary books have been prepared to address further common and important problems related to both pregnant women and their newborn infants.

**BOOK 1: MATERNAL CARE**

This book addresses all the common and important problems that occur during pregnancy, labour and delivery, and the puerperium. It includes booking for antenatal care, problems during the antenatal period, monitoring and managing the mother, fetus and progress during labour, medical problems during pregnancy, problems during the three stages of labour and the puerperium, family planning after pregnancy, and regionalised perinatal care. Skills workshops teach the general examination, abdominal and vaginal examination in pregnancy and labour, screening for syphilis and HIV, use of an antenatal card and partogram, measuring blood pressure and proteinuria, and performing and repairing an episiotomy. *Maternal Care* is aimed at professional health care workers in level 1 hospitals or clinics.

**BOOK 2: NEWBORN CARE**

*Newborn Care* was written for health professionals providing special care for infants in regional hospitals. It covers resuscitation at birth, assessing infant size and gestational age, routine care and feeding of both normal and high risk infants, the prevention, diagnosis and management of hypothermia, hypoglycaemia, jaundice, respiratory distress, infection, trauma, bleeding, and congenital abnormalities, as well as communication with parents. Skills workshops address resuscitation, size and gestational age measurement, history, examination and clinical notes, nasogastric feeds, intravenous infusions, use of incubators, measuring blood glucose concentration, insertion of an umbilical catheter, phototherapy, apnoea monitors and oxygen therapy.

**BOOK 3: PERINATAL HIV/AIDS**

The HIV epidemic is spreading at an alarming pace through many developing countries, increasing the maternal and infant mortality rates, and adding to the financial burden of providing health services to all communities. Nowhere is the devastating effect of this infection more obvious than in the transmission of HIV from mothers to their infants. In order to decrease this risk, all health care workers dealing with HIV positive mothers and infants will need to receive additional training. *Perinatal HIV/AIDS* was written to address this challenge.

This book will enable midwives, nurses and doctors to care for pregnant women and their infants in communities where HIV infection is present. Special emphasis has been placed on the prevention the mother-to-infant transmission of HIV.

Chapters have been written on HIV infection, antenatal, intrapartum and infant care, and counselling. Colleagues from a number of hospitals and universities in South Africa were invited to review and comment on the draft document in order to achieve a well balanced text. It is hoped that this training opportunity will help to stem the tide of HIV infection in our children.

**BOOK 4: PRIMARY NEWBORN CARE**

This book was written specifically for nurses and doctors who provide primary care for newborn infants in level 1 clinics and hospitals. *Primary Newborn Care* addresses the care of infants at birth, care of normal infants, care of low birth weight infants, neonatal
emergencies, and important problems in newborn infants.

BOOK 5: MOTHER AND BABY FRIENDLY CARE

With the recent technological advances in modern medicine, the caring and humane aspects of looking after mothers and infants are often forgotten. This book describes better, gentler, kinder, more natural, evidence-based ways that care should be given to women during pregnancy, labour and delivery. It similarly looks at improved methods of providing infant care with an emphasis on kangaroo mother care and exclusive breastfeeding. A number of medical and nursing colleagues in South Africa contributed to this book.

BOOK 6: SAVING MOTHERS AND BABIES

Saving Mothers and Babies was developed in response to the high maternal and perinatal mortality rates found in most developing countries. Learning material used in the book is based on the results of the annual confidential enquiries into maternal deaths and the Saving Mothers and Saving Babies reports published in South Africa. It addresses the basic principles of mortality audit, maternal mortality, perinatal mortality, managing mortality meetings, and ways of reducing maternal and perinatal mortality rates. This book should be used together with the Perinatal Problem Identification Programme (PPIP).

BOOK 7: BIRTH DEFECTS

This book was written for health care workers who look after individuals with birth defects, their families, and women who are at increased risk of giving birth to an infant with a birth defect. Special attention is given to modes of inheritance, medical genetic counselling, and birth defects due to chromosomal abnormalities, single gene defects, teratogens and multifactorial inheritance. This book is being used in the Genetics Education Programme which has been developed to train health care workers in genetic counselling in South Africa.

BOOK 8: PRIMARY MATERNAL CARE

This book addresses the needs of health care workers who provide both antenatal and postnatal care but do not conduct deliveries. The content of these chapters is largely taken from the relevant chapters in Maternal Care. It contains theory chapters and skills workshops. This book is ideal for staff providing primary maternal care in level 1 district hospitals and clinics.

FORMAT OF THE PERINATAL EDUCATION PROGRAMME

Throughout this Programme the participant takes full responsibility for his or her own progress. This method teaches participants to become self-reliant and confident.

1. The objectives

At the start of each chapter the learning objectives are clearly stated. They help the participant to identify and understand the important lessons to be learned.

2. Questions and answers

Theoretical knowledge is taught by a problem solving method which encourages the participant to actively participate in the learning process. An important question is asked, or problem posed, followed by the correct answer or explanation. In this way,
the participant is led step by step through the definitions, causes, diagnosis, prevention, dangers and management of a particular problem.

It is suggested that the participant cover the answer for a few minutes with a piece of paper or card while thinking about the correct reply to the question. This method helps learning. Simplified flow diagrams are also used, where necessary, to indicate the correct approach to diagnosing or managing a particular problem. Copies of these flow diagrams may be of value in the labour ward or nursery.

Different forms of text are used to identify particular sections of the Programme:

Each question is written in bold, like this, and is identified with the number of the chapter, followed by the number of the question, e.g. 5-23.

4. Multiple-choice questions
An in-course assessment is made at the beginning and end of each chapter in the form of a test consisting of 20 multiple-choice questions. This helps participants manage their own course and monitor their own progress by determining how much they know before starting a chapter, and how much they have learned at the end of the chapter. The results will help the participant decide whether they have successfully learned the important facts in that chapter and will also draw the participant’s attention to the areas where their knowledge is inadequate.

In the multiple-choice tests the participant is asked to choose the single, most correct answer to each question or statement from four possible answers. A separate loose sheet should be used to record the test answers before (pre-test) and after (post-test) the chapter is studied. The list of correct answers also indicates which section should be restudied for each incorrect post-test answer.

On the website, the multiple-choice questions are only made available to participants who wish to complete a PEP course and have obtained an exam code (more on this below).

3. Case problems
A number of clinical presentations in story-form are given at the end of each chapter so that the participant can apply his/her newly learned knowledge to solve some common clinical problems. This exercise also gives the participant an opportunity to see the problem as it usually presents itself in the clinic or hospital. A brief history and/or summary of the clinical examination is given, followed by a series of questions. The participant should attempt to answer each question before reading the correct answer. The knowledge presented in the cases is the same as that covered earlier in the chapter. The cases, therefore, serve to consolidate the participant’s knowledge.

4. Study groups
It is strongly advised that the Programme courses are studied by a group of participants and not by individuals alone. Each group of 5 to 10 participants should be managed by a local co-ordinator who is usually a member of the group, if a formal trainer is not available. The local co-ordinator arranges the time and venue of the group meetings (usually once every three weeks). At the meeting the chapter just studied is discussed and the pre-tests and post-tests are done. The skills workshops should also be demonstrated and practiced at the meetings. In this way the group manages all aspects of their course. The principles of peer tuition and co-operative learning play a large part in the success of PEP.
THE IMPORTANCE OF A CARING AND QUESTIONING ATTITUDE

A caring and questioning attitude is encouraged. The welfare of the patient is of the greatest importance, while an enquiring mind is essential if participants are to continue improving their knowledge and skills. The participant is also taught to solve practical problems and to form a simple, logical approach to common perinatal problems.

COPYRIGHT

To be most effective, the Perinatal Educational Programme course should be used under the supervision of a co-ordinator. Using part of the Programme out of context will be of limited value only, while changing part of the Programme may even be detrimental to the participant’s perinatal knowledge. Therefore, copyright on all PEP materials means that no portion of the Programme can be altered. However, for teaching and management purposes only, parts or all of the Programme may be photocopied provided that recognition to the Programme is acknowledged. If the routine care in your clinic or hospital differs from that given in the Programme, you should discuss it with your staff.

FINAL ASSESSMENT

On completion of each book, participants may apply to write a formal multiple-choice examination on the course website – www.ebwhealthcare.com – to assess the amount of knowledge that they have acquired. All the questions will be taken from the tests at the end of each chapter. The content of the skills workshops will not be included in the examination. Successful examination candidates will be able to print their own certificate which states that they have successfully completed that course. Credit for completing the course will only be given if the final examination is successfully passed. A separate examination is available for each book and a certificate will be given to participants who pass each final examination. A mark of 80% is needed to pass the final examinations. Any official recognition for completing a PEP course will have to be negotiated with your local health care authority.

To write the examination on the website, a participant first has to obtain an exam code, which can be obtained through the course website.

OBTAINING AN EXAM CODE

To obtain an exam code, visit this website:

www.ebwhealthcare.com

An exam code is a unique number for one participant and one course. An exam code enables a participant to test their knowledge and write the final examination online. The fee and how to pay for exam codes is explained on the website.

MANAGING YOUR OWN COURSE STEP-BY-STEP

1

Before you start each chapter, take the test for that chapter at the back of the book. Do the test by yourself even if you are studying with a group of colleagues. Choose the best answer for each multiple-choice question and note your answers on a piece of loose paper. This is called your ‘pre-test’ for that chapter. There is an answer sheet that you should use to mark your completed pre-test. Record your pre-test mark out of a possible 20.
Now work through the chapter. Read each question and answer, and make sure you understand it. Pay particular attention to the facts in grey boxes as these are the main messages. Read the case studies to check whether you have learned and understand the important information.

If you are part of a study group, use this opportunity to discuss with your colleagues any difficulties you may have experienced. Talking about what you have read is a very important part of the learning process. If the book includes skills workshops, these should be conducted at the time of the group meetings. Invite an experienced colleague who can help you master the particular skill.

When you have learned all the knowledge in that chapter, take the same test again. This second test is called your ‘post-test’. Now mark the post-test and compare your pre-test and post-test marks. Your marks should have improved considerably. In the answers section of the book, opposite each correct answer, is the number of the section where the question was taken from. Re-read and learn the sections for any post-test answers you got incorrect. Now you are ready to move on to the next chapter.

Repeat steps 1 to 4 for each chapter as you work your way through the book. This enables you to obtain the knowledge, monitor your progress, and measure how much you are learning. Most people will take about 2 to 4 weeks per chapter.

Once you are confident that you have mastered all the main lessons in the book, you can write the final examination online at www.ebwhealthcare.com. To write the final examination you will need to have an exam code. This is a unique number that entitles you to write the examination for a course. If you don’t have one yet, you or your group can buy exam codes. The fee and how to pay is described on the website. This exam code will only work once for one examination.

You will be able to write the examination, consisting of 75 multiple-choice questions, on the website. You will only have a limited time to answer each question and you will not be able to go back and check previous questions. Set aside at least an hour to write the examination. When you write the examination, do not use the book to look up the correct answers. Remember, you are your own teacher, so be strict with yourself!

Your examination answers will automatically be marked as soon as you have completed the last question. If you get 80% or better you have passed and will be able to print your own certificate which states that you have successfully completed the course. However, if you have failed to achieve 80%, you can purchase another exam code to write the examination again.

Tips
- Work through the course with a group of friends or colleagues.
- One person in your group (your co-ordinator or ‘convenor’) should take responsibility for organising meetings to discuss each chapter before you write the post-test.
- Set yourself targets, such as ‘two units a month’.
- Keep your book with you to read whenever you have a chance.
- Write the examination only when you feel ready.
UPDATING OF THE PROGRAMME

Based on the comments and suggestions made by participants and other authorities, the chapters and skills workshops of the Programme will be regularly edited to make them more appropriate to the needs of perinatal care and to keep the Programme up to date with new ideas and developments. Everyone studying the Programme is invited to write to the editor-in-chief with suggestions as to how the books could be improved. You can also send your comments on parts of the books on the website www.ebwhealthcare.com.

USING THE BOOK AS A WORK MANUAL

It is hoped that as many participants as possible will use these books as work manuals after they have completed the course. The flow diagrams should be most useful in managing difficult problems and for planning management. A further benefit of the books will be to standardise the documentation and management of certain clinical problems. This is particularly useful when patients are referred within or between health care regions. It is further hoped that all those who use these books will enjoy learning about new and better methods of caring for mothers and newborn infants. Every opportunity to share knowledge with both patients and colleagues should be used. By doing this you will find your career more fulfilling and you will help to improve the perinatal care in your region.

PERINATAL EDUCATION TRUST

Books developed by the Perinatal Education Programme are provided as cheaply as possible. Writing and updating the Programme is both funded and managed on a non-profit basis by the Perinatal Education Trust.

FURTHER INFORMATION

Further information on the Perinatal Education Programme can be obtained in the following ways:

By post
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By phone
From within South Africa:
- 021 671 8030 (PEP Distribution Manager)
- 021 786 5369 (Editor-in-Chief)

By email
pepcourse@mweb.co.za

Online
www.ebwhealthcare.com
www.pepcourse.co.za

COMMENTS AND SUGGESTIONS

The Perinatal Education Programme has been produced by a group of perinatal specialists in South Africa, after wide consultation with colleagues who practice in both rural and urban settings, in an attempt to reach consensus on the care of mothers and newborn infants. The Programme is designed so that it can be improved and altered to keep pace with current developments in health care. Participants using
books developed by the Programme can make an important contribution to its continual improvement by reporting factual or language errors, by identifying sections that are difficult to understand, and by suggesting improvements to the contents. Details of alternative or better forms of management would be particularly appreciated. Please send any comments or suggestions to the Editor-in-Chief at the above address.
Objectives

When you have completed this unit you should be able to:
• Manage a normal infant at birth.
• Promote early bonding between mother and infant.
• Diagnose neonatal asphyxia at birth.
• Assess an Apgar score.
• Prepare for resuscitation.
• Resuscitate an infant.
• Prevent meconium aspiration.

1-1 What care should you give a normal infant immediately after delivery?

1. Dry the infant, especially the head, with a warm towel. Then wrap the infant in a second warm, dry towel. This will help to prevent the infant from getting cold after delivery.

2. It is not necessary to suction the nose and mouth of a normal infant who is breathing well. If the infant has a lot of secretions, turn the infant onto the side for a few minutes.

3. Clamp the umbilical cord.

4. Assess the Apgar score at 1 minute.

5. A quick physical examination should be done to assess the infant for size, serious congenital abnormalities or other obvious clinical problems.

6. When the above have been completed, give the infant to the mother.

1-2 When is the best time to clamp the umbilical cord?

It is best to allow the infant to cry well a few times before clamping the cord. Therefore, dry the infant well first and only then clamp the cord with surgical forceps. Drying the infant usually stimulates crying.

Delaying clamping the cord, until the infant breathes well, allows the infant to receive some extra blood from the placenta. This extra blood may help prevent iron deficiency anaemia later in the first year of life. Before clamping the cord, keep the infant on the bed at the same level as the mother.

The umbilical cord must be clamped or tied about 3 to 4 cm from the infant’s abdomen. Once the infant has been dried and assessed, the surgical forceps can be replaced with a sterile, disposable cord clamp or a sterile cord tie.

1-3 When should you give the infant to the mother?

It is important for the mother to see and hold her infant as soon as possible after delivery. If
the infant appears to be normal and healthy, the infant can be given to the mother after the 1 minute Apgar score has been assessed and the initial examination made. After delivery, both the infant and mother are in an alert state. The infant’s eyes are usually open and looking around.

The mother will usually hold the infant so that she can look at its face. She will talk to her infant and touch the face and hands. This initial contact between a mother and her infant is an important stage in BONDING. Bonding is the emotional attachment that develops between mother and child, and is an important step towards good parenting later. Where possible, it is important that the father also be present at the delivery so that he can be part of this important phase of the bonding process.

1-4 When should the normal infant be put to the breast?
If possible the mother should put the infant to her breast within minutes after delivery because:

1. Studies have shown that the sooner the infant is put to the breast, the greater is the chance that the mother will successfully breast feed.
2. Nipple stimulation, by putting the infant to the breast, may speed up the third stage of labour by stimulating the release of maternal oxytocin.
3. It reassures the mother that her infant is healthy and helps to promote bonding.

Some women want to hold and look at their infants but do not want to breast feed soon after delivery. Their wishes should be respected. During a complicated third stage, or during the repair of an episiotomy, some mothers would rather not hold their infants.

1-5 How should the mother keep her infant warm?
When the infant is given to the mother, she should hold the infant, skin-to-skin, against her chest and cover the infant with the towel. This will keep the infant warm. Skin-to-skin care (kangaroo mother care) is important to promote bonding and breast feeding. The infant must not be left alone in a cot.

1-6 When do you identify the infant?
Once the parents have had a chance to meet and inspect their new infant, formal identification by the mother and staff must be done. Labels with the mother’s name and folder number, together with the infant’s sex, date and time of birth are then attached to the infant’s wrist and ankle. Twins must be labelled ‘A’ and ‘B’. Once correctly identified, other routine care can then be given.

1-7 Should all infants be given vitamin K?
Yes. It is important that all infants be given 1 mg of vitamin K1 (0.1 ml of Konakion) by intramuscular injection into the anterolateral aspect of the mid-thigh after delivery. Never give the Konakion into the buttock as it may damage nerves or blood vessels that are just under the skin in infants. Konakion will prevent haemorrhagic disease of the newborn. Be very careful not to give the infant the mother’s oxytocin (Syntocinon) in error. To avoid this mistake, some hospitals give Konakion in the nursery and not in the labour ward. Do not use oral Konakion.

1-8 Should antibiotic ointment be placed in the infant’s eyes?
Yes, it is advisable to place chloromycetin ointment routinely into both eyes to prevent Gonococcal conjunctivitis as an infant’s eyes may become infected when the infant passes through the cervix and vagina. This is particularly important if gonorrhoea is common in that community. Many women with Gonococcal infection have no symptoms.
1-9 Should all infants be weighed and measured?

Yes, it is important to measure the infant's weight and head circumference after birth. The parents are usually anxious to know the infant's weight. The infant's length is usually not recorded, as it is very difficult to measure accurately. Weighing all infants helps to identify low birth weight infants (less than 2500g) who may need special care.

1-10 What care and management should be documented?

Accurate notes should be made after the infant has been delivered. It is important to document the following observations and procedures:

1. Apgar score
2. Any action taken to resuscitate the infant
3. Any abnormality or clinical problem noticed
4. Identification of the infant
5. Whether the infant is male or female
6. Administration of Konakion
7. Whether prophylactic eye ointment was given
8. Birth weight and head circumference

1-11 Should the infant stay with the mother after delivery?

Yes. If the mother and infant are well, they should not be separated. The infant should be kept skin-to-skin on the mother's chest, as this is the best way to keep an infant warm. The infant can stay with the mother in the labour ward and should be transferred with her to the postnatal ward. If the infant is cared for by the mother, the staff will be relieved of this additional duty.

The mother and infant should remain together after delivery, if both are well.

1-12 Should the infant be bathed after delivery?

There is no need to bath an infant immediately after delivery. It is much better if the infant stays with the mother and only be bathed later. Vernix protects the infant's skin and helps to prevent skin infection.

MANAGEMENT OF THE INFANT WITH NEONATAL ASPHYXIA

1-13 When does a normal infant start breathing after delivery?

The normal, healthy newborn infant usually starts to breathe immediately after birth. Sometimes gentle stimulation, such as drying, is needed before the infant breathes well. By 1 minute after delivery the infants should be breathing well or crying.

1-14 What is neonatal asphyxia?

If an infant does not breathe well by 1 minute after birth, the infant is said to have neonatal asphyxia (asphyxia neonatorum).

Neonatal asphyxia is defined as the failure to breathe well within one minute after delivery.

1-15 What important clinical signs should be looked for in the infant after delivery?

There are 5 important clinical signs, which should be present after birth. These are called vital signs:

1. Breathing
2. Heart rate
3. Colour
4. Tone
5. Response
1-16 What is the Apgar score?
The Apgar score uses the 5 vital signs at birth to give a score, which is very useful in assessing an infant’s condition after delivery. It also helps to decide which infants need resuscitation. The famous Apgar score is named after Virginia Apgar, who described the score in 1953.

1-17 How is the Apgar score measured?
Each of the 5 vital signs is given a score of 0, 1 or 2. If the sign is normal a score of 2 is given. Mildly abnormal signs are given a score of 1. If the vital sign is very abnormal a score of 0 is given.
The scores for each vital sign are then added together to give the Apgar score out of 10. The best possible Apgar score is 10 and the worst is 0.

1-18 How should you assess an infant’s breathing after birth?
Look at the infant’s chest movements. Both sides of the chest should move well when the infant breathes. A normal infant will cry or take at least 40 breaths a minute.
If the infant breathes well or cries a score of 2 is given. If there is poor or irregular breathing, or the infant only gives an occasional gasp, a score of 1 is given. A score of 0 is given if the infant makes no attempt to breathe.

1-19 How should you count an infant’s heart rate after birth?
Feel the base of the umbilical cord or listen to the infant’s heart with a stethoscope to count the heart (pulse) rate. It often is very difficult to feel peripheral pulses immediately after birth. The normal infant has a heart rate of 140 (120 to 160) beats per minute. It saves time to count the heart rate for 30 seconds and then multiply the rate by 2 to give the heart rate per minute. A wall clock is useful when counting the heart rate.
If the heart rate is above 100 per minute a score of 2 is given. A score of 1 is given if a heart beat is present but the rate is slower than 100 per minute, while a score of 0 is given if no heart beat can be heard or umbilical pulse felt.

1-20 How should you assess an infant’s colour after birth?
Look at the infant’s tongue and also at the hands and feet. The tongue should always be pink. It is not helpful to look at the colour of the lips or mucus membranes. If the tongue is blue the infant has central cyanosis. This shows that important organs like the brain are not getting enough oxygen. Almost all newborn infants have peripheral cyanosis with blue hands and feet immediately after delivery. This is normal and within minutes the hands and feet should become pink. A pink tongue indicates that enough oxygen is reaching the brain.
If the hands and feet are pink a score of 2 is given. If the tongue is pink, but the hands and feet are still blue, a score of 1 is given. When the tongue, hands and feet are all blue a score of 0 is given.

1-21 How should you assess an infant’s tone after birth?
Normal infants should have good muscle tone at birth and move their arms and legs actively. They should not lie still. Normally the arms and legs are flexed and held above the body, with the knees held together, in a term infant.
If the infant moves well a score of 2 is given. If there is only some movement, and the arms and legs are not pulled up against the body or lifted off the surface, a score of 1 is given. A score of 0 is given if the infant is completely limp and does not move at all.

1-22 How should you assess an infant’s response to stimulation after birth?
If you handle or gently stimulate the infant there should be a good response. Usually the infant moves a lot or cries. The best method of stimulation is to dry the infant well with a towel. Smacking the infant or flicking the feet are not recommended.
1-23 When should the Apgar score be measured?

All infants should have their Apgar score measured at 1 minute after delivery. The 1 minute Apgar score is a good method of measuring the infant’s general condition after birth and is one of the best ways of deciding whether the infant needs resuscitation. If the Apgar score is normal, the score usually does not need to be repeated. However, in many clinics and hospitals the Apgar score is still repeated routinely at 5 minutes. Unfortunately many of these normal infants are needlessly removed from their mother’s skin-to-skin care to have the 5 minute Apgar score determined.

However, if the 1 minute Apgar score is low, the score must be repeated every 5 minutes while the infant is being resuscitated. This gives a very good assessment of the success or failure of the attempts at resuscitation. With successful resuscitation the Apgar score will increase to normal.

1-24 What is a normal Apgar score?

The Apgar score at 1 minute should be 7 or more out of a possible 10. As almost all infants have blue hands and feet immediately after birth, a 1 minute Apgar score of 10 is rare. The Apgar score at 5 minutes, and thereafter, should be 7 or more.

A 1 minute Apgar score of 4 to 6 indicates moderate asphyxia while a score of 0 to 3 indicates severe neonatal asphyxia.

A low 5 minute Apgar score is worrying as it suggests that the infant is not responding well to resuscitation. The longer the score remains low, the greater is the risk of death or brain damage.

1-25 What are the important causes of a low Apgar score?

1. Fetal hypoxia
2. Maternal general anaesthesia
3. Maternal sedation or analgesia with pethidine or morphine given within the last 4 hours
4. Excessive suctioning of the infant’s mouth and throat
5. Delivery of a low birth weight infant
6. Difficult or traumatic delivery
7. Severe respiratory distress
1-26 What is hypoxia?
Hypoxia is defined as too little oxygen in the cells of the body. If the infant fails to breathe well after delivery the infant will develop hypoxia. As a result of hypoxia, the infant’s heart rate falls, breathing is poor, central cyanosis develops and the infant becomes hypotonic (floppy) and unresponsive. Neonatal asphyxia, if not correctly managed, will lead to hypoxia and possible brain damage or death.

1-27 What is fetal hypoxia?
If the placenta fails to provide the fetus with enough oxygen, fetal hypoxia will result. Fetal hypoxia presents with meconium stained liquor and late fetal heart rate decelerations or bradycardia. These are the signs of fetal distress (or more accurately, stress). Therefore, fetal hypoxia results in fetal distress. As hypoxia may damage or kill the fetus, it is very important that each infant is well monitored during labour so that any signs of fetal distress can be detected, as soon as possible, so that the correct management can be given.
Fetal hypoxia is an important cause of neonatal asphyxia.

1-28 Are neonatal asphyxia and fetal hypoxia the same condition?
No. Neonatal asphyxia and fetal hypoxia are not the same although severe fetal hypoxia usually results in neonatal asphyxia after delivery. Some infants with mild fetal hypoxia breathe well after birth and do not have neonatal asphyxia. There are also many causes of neonatal asphyxia other than fetal hypoxia. Therefore, some infants have neonatal asphyxia even though they have not had fetal hypoxia.

1-29 Can neonatal asphyxia be prevented?
Good management during labour and the early detection of fetal distress are the best methods of preventing neonatal asphyxia. However, some cases of neonatal asphyxia cannot be predicted nor prevented.

1-30 How is neonatal asphyxia managed?
Neonatal asphyxia is corrected by resuscitating the newborn infant. Only about 5% of newborn infants have asphyxia and, therefore, need resuscitation.

RESUSCITATION

1-31 What is resuscitation?
Resuscitation is a series of actions taken to establish normal breathing, heart rate, colour, tone and response in an infant with abnormal vital signs, i.e. a low Apgar score.

1-32 Which infants need resuscitation?
All infants who do not breathe well by 1 minute after delivery, or have a 1 minute Apgar score below 7, need resuscitation. The lower the Apgar score the more resuscitation is usually needed. Any infant who stops breathing or has abnormal vital signs at any time after delivery or in the nursery also requires resuscitation.

All infants with neonatal asphyxia, or a 1 minute Apgar score below 7, require resuscitation.

1-33 Can you anticipate which infants will need resuscitation at birth?
Yes. Any of the conditions which cause neonatal asphyxia may result in the infant needing resuscitation. However, neonatal asphyxia cannot always be predicted before delivery. Remember that any infant can be born with neonatal asphyxia without any previous warning. It is essential, therefore, to be prepared to resuscitate all newborn infants. Everyone who delivers an infant must be able to perform resuscitation.

Any infant can have neonatal asphyxia at birth without warning signs during labour and delivery.
1-34 What is needed to resuscitate a newborn infant?
1. A suitable, warm area with good lighting
2. The correct, clean and functioning equipment
3. The knowledge and skills

1-35 What is a suitable resuscitation area?
A warm area with good light and a working surface at a comfortable height is needed. In a clinic or hospital, some source of oxygen and suction should be available together with storage space for the equipment. Make sure there is no draught. The temperature of the resuscitation area should be at least 25 °C.

A warm, well lit corner of the delivery room is ideal for resuscitation. A heat source, such as an overhead radiant warmer or wall heater, is needed to keep the infant warm. A good light, such as an angle-poise lamp, is essential so that the infant can be closely observed during resuscitation. A firm, flat surface at waist height is best for resuscitating an infant. There is no need to have the infant lying head down, and the neck must not be overextended. It is very useful to have warm towels to dry the infant.

1-36 What equipment do you need for infant resuscitation?
It is essential that you have all the equipment needed for basic infant resuscitation. The equipment must be clean, in working order and immediately available. The equipment must be checked daily.

The following essential equipment must be available in the delivery room:
1. **Suction apparatus**: An electric or wall vacuum suction apparatus is ideal but the vacuum pressure should not exceed 200 cm water. Soft F 10 end-hole suction catheters are needed. A simple mouth suction apparatus (mucus extractor) can also be used. It consists of a 2 soft plastic catheters attached to a 20 ml plastic container. Although it is effective, there is a small risk that the staff could become infected with HIV if the secretions get into the mouth of the person suctioning the infant.
2. **Oxygen**: Whenever possible, a cylinder or wall source of 100% oxygen should be available. However, oxygen is not essential for resuscitation.
3. **Self-inflating bag and mask**: A simple neonatal self-inflating bag and mask, e.g. Samson, Laerdal, Ambu, Penlon or Cardiff resuscitator, must be available to provide mask ventilation. Direct mouth-to-mouth resuscitation is dangerous due to the risk of becoming infected with HIV.
4. **Naloxone**: Ampoules of naloxone (Narcan 0.4 mg in 1 ml). Small syringes and needles will be needed to administer the drug. Neonatal Narcan is no longer used, as the concentration of drug is too small.
5. **Wall clock or watch**: To time the assessment of the Apgar score.

Although not essential for basic resuscitation, it is very useful to have an infant laryngoscope and endotracheal tubes so that infants with severe neonatal asphyxia can be intubated, if bag and mask ventilation is not adequate. If possible, everyone who regularly resuscitates newborn infants should learn how to intubate them.

1-37 How should you stimulate respiration immediately after birth?
After birth, all infants must be quickly dried in a warm towel and then placed in a second warm, dry towel. This must also be done to infants with neonatal asphyxia, before starting resuscitation. Drying the infant prevents rapid heat loss due to evaporation. Handling and rubbing the newborn infant with a dry towel is usually all that is needed to stimulate the onset of breathing. Stimulation alone will start breathing in most infants.

1-38 Should all infants be routinely suctioned after delivery?
No. Infants who breathe well at delivery should *not* have their mouth and throat routinely suctioned, as suctioning sometimes
causes apnoea. Infants born by caesarean section also need not be routinely suctioned.

It is not necessary to routinely suction the mouth and nose of infants after delivery.

1-39 Which infants should be suctioned after delivery?
1. Infants who do not breathe well after stimulation
2. Meconium-stained infants

1-40 When should you start to resuscitate an infant?
If the infant does not breathe well and fails to respond to stimulation after drying and clamping the umbilical cord, then the infant must be actively resuscitated. Drying and clamping the cord usually takes about 1 minute. These infants will have a low 1 minute Apgar score. Although resuscitation usually starts after 1 minute, if the infant obviously has severe neonatal asphyxia, resuscitation should be started sooner.

1-41 Can resuscitation of an infant with severe neonatal asphyxia result in survival with brain damage?
Some people are worried that resuscitation may result in a live, but brain damaged infant, who would have died without resuscitation. This is very uncommon. Not all infants with severe neonatal asphyxia die. Therefore, it is better to give good resuscitation early to all infants with neonatal asphyxia and reduce the risk of brain damage that may occur if no resuscitation is given. The only infants who may not be offered resuscitation are those with a lethal congenital abnormality, such as anencephaly.

1-42 Who should resuscitate the infant?
The most experienced person, irrespective of rank, should resuscitate the infant. However, everyone who conducts deliveries must have the skills and equipment to resuscitate infants.

It is very helpful to have an assistant during resuscitation.

1-43 How do you resuscitate an infant?
There are 4 main steps in the basic resuscitation of a newborn infant. They can be easily remembered by thinking of the first 4 letters of the alphabet, 'ABCD':

1. Airway
2. Breathing
3. Circulation
4. Drugs

Step 1: Clear the airway
Gently clear the throat. The infant may be unable to breathe because the airway is blocked by mucus or blood. Therefore, if the infant fails to breathe after stimulation, gently suction the back of the mouth and throat with a soft F 10 catheter. Too much suctioning, especially if too deep in the region of the vocal cords, may result in apnoea and bradycardia. This can be prevented by holding the catheter 5 cm from the tip when suctioning the infant's throat. There is no need to suction the nose. Simply turning the infant onto the side will often clear the airway.

If wall suction or a suction machine are not available, a mucus extractor can be used to suction the infant's mouth and throat. Because of the small risk of HIV infection, wall suction or a suction machine is best.

Correctly position the head. The upper airway (pharynx) can be opened by placing the infant's head in the correct position. With the infant lying on its back on a flat surface, slightly extend the neck so that the face is pointing towards the ceiling. Do not overextend the neck.

If the infant is not breathing well after the airway have been suctioned and the head correctly positioned, stop suctioning and move to step 2.

Step 2: Start the infant breathing
If stimulation and suctioning and correct position of the head fail to start breathing,
**mask and bag ventilation must be started.**

Giving mask oxygen alone often does not help. Keep the infant’s neck slightly extended and hold the mask firmly over the infant’s face. Most infants can be adequately ventilated with a neonatal bag and mask, such as a Samson, Laerdal, Ambu, Penlon or Cardiff resuscitator. Ventilation is the most important part of resuscitation. Usually mask and bag ventilation is given with room air.

**Ventilation is more important than oxygen.**

Respiratory stimulants, such as Vandid, must not be used, as they are dangerous and do not help.

**Step 3: Obtain a good circulation**

If the heart rate remains below 80 beats per minute after effective ventilation has been started, apply external cardiac massage at about 120 times a minute.

**Step 4: Drugs to reverse pethidine and morphine**

If the mother has received either pethidine or morphine during the 4 hour period before delivery, the infant’s poor breathing may be due to drug depression. If so, the respiratory depression caused by the analgesic can be rapidly reversed with Narcan (a 1 ml ampoule contains 0.4 mg nalozone). Narcan 0.1 mg/kg (i.e. 0.25 ml/kg) can be given by intramuscular injection into the anterolateral aspect of the thigh. Intramuscular Narcan takes a few minutes before it starts to act. Do not use Neonatal Narcan, as this preparation requires too big a volume.

Narcan will not help resuscitate an infant if the mother has not received a narcotic analgesic during labour, or has received a non-opioid general anaesthetic, barbiturates or other sedatives.

**Mask and bag ventilation is the most important step in resuscitating an infant.**

**1-44 How do you give oxygen to an infant?**

Oxygen is given if the infant is centrally cyanosed. Usually wall oxygen is used. Otherwise an oxygen cylinder or an oxygen concentrator is needed. Oxygen is best given by mask and bag ventilation. It is safer to only use room air for resuscitation and only give oxygen if the central cyanosis is not corrected by mask ventilation.

**Room air is safer than oxygen for most resuscitations.**

**1-45 How should you use a self-inflating bag and mask to ventilate an infant?**

1. **The position of the infant:** The infant must lie face up on a flat surface. The infant’s neck should be slightly extended. Do not over extend the neck. The infant’s face should look towards the ceiling. Infants should be kept in a warm towel during resuscitation.

2. **The apparatus:** A number of bag and mask sets are suitable, such as the Samson, Laerdal, or Ambu resuscitators. Make sure that both the bag and mask are designed for newborn infants. If required, the bag should be attached to an oxygen source providing 5 litres per minute. It is important that the correct size mask is used to cover the nose and mouth.

3. **The position of the mask:** The mask must be placed over the infant’s mouth, nose and chin. Hold the mask tightly against the face so that there are no air leaks.

4. **Using the self-inflation bag:** The mask should be held in place with the left hand while the bag is squeezed at about 40 breaths per minute with the right hand. If the little and ring finger of the left hand are placed under the angle of the jaw, the jaw can be gently pulled upwards to keep the tongue from falling back. The position of the mask is the same with all types of bag. When giving mask and bag ventilation, watch the movement of the chest. Squeeze the bag hard enough to move the chest
with each inspiration. Continue giving mask and bag ventilation at about 40 breaths per minute until the infant starts to cry or breathes well. A small percentage of infants with severe neonatal asphyxia will not respond to mask ventilation and need intubation and ventilation.

1-46 How do you give cardiac massage?
Place the infant on its back with the head towards you. Place both hands under the infant’s back and press on the lower half of the sternum with both your thumbs. This will depress the sternum by about 2 cm. Push down on the sternum about 100 times a minute. Pressing on the sternum squeezes blood out of the heart and causes blood to circulate to the lungs and body.

It takes 2 people to both mask ventilate and give cardiac massage. An assistant should ventilate the infant while you give cardiac massage. After every third push on the sternum the assistant should squeeze the bag to give 1 breath after every 3 heart beats. Continue cardiac massage until the infant’s heart rate increases to 100 or more beats per minute. If you are resuscitating an infant on your own, good mask ventilation is more important than cardiac massage.

1-47 How can you assess whether the resuscitation has been successful?
The 4 steps in resuscitation are followed step by step until the 3 most important vital signs of the Apgar score have returned to normal:

1. A pulse rate above 100 beats per minute.
   Easily assessed by palpating the base of the umbilical cord or listening to the chest with a stethoscope.
2. A good cry or good breathing efforts.
   This assures adequate breathing.
3. A pink tongue. This indicates a good oxygen supply to the brain. Do not rely on the colour of the lips.

With good resuscitation the Apgar score at 5 minutes should be 7 or more. This suggests that the infant did not suffer severe hypoxia before delivery.

1-48 When is further resuscitation hopeless?
Every effort should be made to resuscitate all infants that show any sign of life at delivery. The Apgar scores at 1 and 5 minutes are not good indicators of the likelihood of hypoxic brain damage or death. If the Apgar score remains low after 5 minutes, efforts at resuscitation should be continued. However, if the infant has not started to breathe, or only gives occasional gasps, by 10 minutes the chance of death or brain damage is high. Resuscitation is usually stopped if the Apgar score at 20 minutes is still low with no regular breathing. It is best if an experienced person decides when to abandon further attempts at resuscitation.

Resuscitation will not save all infants with neonatal asphyxia, but it will help most.

1-49 What post resuscitation care is needed?
All infants that require resuscitation with bag and mask ventilation must be carefully observed for at least 12 hours. Their temperature, pulse and respiratory rate, colour and activity should be recorded and their blood glucose concentration measured. Keep these infants warm and provide fluid and energy, either intravenously or orally. Usually these infants are observed in a closed incubator. Do not bath the infant until the infant has fully recovered.

Careful notes must be made describing the infant’s condition at birth, the resuscitation needed and the probable cause of the neonatal asphyxia.

1-50 What about the mother during resuscitation?
It is very frightening for a mother to know that her infant needs resuscitation. Therefore, it is important to tell the mother that her infant needs some help and to explain to her what is
being done to the infant. Remember that the mother may start bleeding while the staff are busy resuscitating the infant.

1-51 How is the resuscitation equipment cleaned?

It is important that all the resuscitation equipment is kept clean and in good working order. After a resuscitation all the equipment must be cleaned to prevent the spread of infection. The masks and mucus extractors must be washed with water and soap or detergent and rinsed. The self-inflating bags, e.g. Laerdal, Ambu and Penlon must be sterilised.

MANAGEMENT OF THE MECONIUM-STAINED INFANT

1-52 Does the meconium stained infant need special care?

Yes. All infants that are meconium stained at birth need special care to reduce the risk of severe meconium aspiration. Whenever possible, all these at-risk infants should be identified before delivery by noting that the liquor is meconium stained.

1-53 Why does the meconium stained infant need special care?

As a result of fetal hypoxia, the fetus may make gasping movements and pass meconium. Before delivery, meconium in the amniotic fluid can be sucked into the upper airways. Fortunately most of the meconium is unable to reach the fluid filled lungs of the fetus. Only after delivery, when the infant inhales air, does meconium usually enter the lungs.

Meconium contains enzymes from the fetal pancreas that can cause severe lung damage and even death if inhaled into the lungs at delivery. Meconium also obstructs the airways. Meconium aspiration results in respiratory distress after delivery.

Meconium often burns the infant’s skin and digests away the infant’s eye lashes! Therefore, imagine the damage meconium can cause to the delicate lining of the lungs.

1-54 How can you prevent meconium aspiration at delivery?

Before delivery of all meconium stained infants, a suction apparatus and an F 10 end hole catheter must be ready at the bedside. If possible, the person conducting the delivery should have an assistant to suction the infant’s mouth when the head delivers.

After delivery of the head, the shoulders should be held back and the mother asked to breathe fast and not to push. This should prevent delivery of the trunk. The infant’s face is then turned to the side so that the mouth and throat can be well suctioned. The nose can be suctioned after the mouth and throat. The infant should be completely delivered only when no more meconium can be cleared from the mouth and throat.

If the infant cries well after delivery, no further resuscitation or suctioning is needed. However, some infants develop apnoea and bradycardia as a result fetal hypoxia of the suctioning and, therefore, need ventilation after delivery. If a meconium stained infant needs ventilation, the throat should again be suctioned before ventilation is started.

This aggressive method of suctioning is very successful in preventing severe meconium aspiration in meconium stained infants.

When a meconium stained infant is delivered by caesarean section, the mouth and throat must similarly be suctioned with a F10 end-hole catheter, before the shoulders are delivered from the uterus. After complete
delivery, move the infant immediately to the resuscitation table. If the infant does not breathe well, further suctioning is needed before stimulating respiration or starting ventilation.

1-55 What care should you give to meconium stained infants after birth?

All meconium stained infants should be observed for a few hours after delivery as they may show signs of meconium aspiration. Most meconium stained infants have also swallowed meconium before delivery. Meconium is a very irritant substance and causes meconium gastritis. This results in repeated vomits of meconium stained mucus.

Meconium gastritis may be prevented by washing out the stomach with 2% sodium bicarbonate (mix 4% sodium bicarbonate with an equal volume of sterile water). Five ml of 2% sodium bicarbonate is repeatedly injected into the stomach via a nasogastric tube and then aspirated until the gastric aspirate is clear. This should be followed by a feed of colostrum. Only heavily meconium stained infants should have a stomach washout on arrival in the nursery. Routine stomach washouts in infants with mildly meconium stained liquor are not needed.

CASE STUDY 1

An infant is delivered by spontaneous vertex delivery at term. Immediately after birth the infant cries well and appears normal. The cord is clamped and cut and the infant is dried. The infant has a lot of vernix. As the infant appears healthy and the mother has no vaginal discharge, chloromycetin ointment is not put in the infant's eyes. The infant is placed in a cot beside the mother.

1. When should the infant be given to the mother?

As soon as the infant is dried, the cord cut, the 1 minute Apgar score determined and a brief examination indicates that the infant is a normal, healthy term infant. The mothers should give skin-to-skin care of her infant after birth. The infant should not be left in a cot. The father should also be present to share this exciting moment.

2. When should the mother be encouraged to put the infant to her breast?

As soon as she wants to. This is usually after she has had a chance to have a good look at her infant. There are advantages to putting the infant to the breast soon after delivery.

3. Should the vernix be washed off immediately after delivery?

Infants should not be bathed straight after delivery, as they often get cold, while vernix should not be removed as it helps protect the infant's skin from infection. It would be better to bath the infant later, in the mother's presence, when most of the vernix will have cleared.

4. Do you agree that this well infant does not need chloromycetin eye ointment?

No. All infants should be given chloromycetin eye ointment, especially if gonorrhoea is common in the community. Gonococcal infection may be asymptomatic in the mother.

5. Should the infant stay with the mother after delivery?

Yes, if possible the mother and her infant should not be separated after delivery.

CASE STUDY 2

After a normal pregnancy, an infant is born by spontaneous vertex delivery. There are no signs of fetal distress during labour. The mother received pethidine 2 hours before delivery. Immediately after delivery the infant is dried and placed under an overhead radiant warmer. At 1 minute after birth the infant has a heart rate of 80 beats per minute, gives irregular gasps, has blue hands and feet but a
pink tongue, has some muscle tone but does not respond to stimulation. At 5 minutes the infant has a heart rate of 120 beats per minute and is breathing well. The tongue is pink but the hands and feet are still blue. The infant moves actively and cries well.

1. What is the infant’s Apgar score at 1 minute?
The Apgar score at 1 minute is 4: heart rate=1, respiration=1, colour=1, tone=1, response=0.

2. Does this infant have neonatal asphyxia? Give your reasons.
Yes, the infant has neonatal asphyxia because the infant failed to establish adequate, sustained respiration by 1 minute. The diagnosis of neonatal asphyxia is supported by the low Apgar score at 1 minute.

3. What is the probable cause of the neonatal asphyxia?
Sedation due to the maternal pethidine given 2 hours before delivery. These sedated infants usually respond rapidly to resuscitation. If not, Narcan can be given to reverse the sedative effect of the pethidine.

4. What should be the first 2 steps in resuscitating this infant?
If respiration cannot be stimulated by drying the infant then the following 2 steps must be taken:
1. Clear the airway by gently suctioning the throat.
2. Breathing must be started with mask and bag ventilation.

5. Should oxygen be given?
Room air is usually adequate for resuscitation unless the infant remains centrally cyanosed.

6. What is this infant’s Apgar score at 5 minutes?
The Apgar score at 5 minutes is 9: heart rate=2, breathing=2, colour=1, tone=2, response=2. This indicates that the infant has responded well to resuscitation.

7. Why is this infant very unlikely to have suffered brain damage due to hypoxia?
Because there is no history of fetal distress to indicate that this infant had been hypoxic before delivery.

8. What should be the management of this infant after resuscitation?
The infant should be kept warm and be transferred to the nursery for observation. As soon as the infant is active and sucking well it should given to the mother to breast feed.

CASE STUDY 3

A woman with an abruptio placentae delivers at 32 weeks in a clinic. Before delivery the fetal heart rate was only 80 beats per minute. The infant has a 1 minute Apgar score of 1 and is ventilated with bag and mask. Cardiac massage is also given. With further efforts at resuscitation, the Apgar score at 5 minutes is 5 and at 10 minutes is 9.

1. What is the probable cause of neonatal asphyxia in this infant?
Fetal distress caused by hypoxia. Abruptio placentae (placental separation before delivery) is a common cause of fetal distress.

2. What is the significance of the Apgar scores at 5 and 10 minutes?
The good responds indicates that the resuscitation is successful. If the Apgar score is still low at 5 minutes it is important to repeat the score every 5 minutes. The normal score at 10 minutes indicates the infant’s response to the resuscitation.
3. Is this child at high risk of brain damage due to hypoxia?

The good response to resuscitation suggests that this infant will not have brain damage due to fetal hypoxia.

4. When should all attempts at resuscitation be abandoned?

If the Apgar score remains low at 20 minutes, attempts at resuscitation may be stopped.

**CASE STUDY 4**

After fetal distress has been diagnosed, an infant is delivered vaginally after a long second stage of labour. At delivery the infant is covered with thick meconium. The infant starts to gasp before 1 minute. Only then are the mouth and throat suctioned for the first time. The Apgar score at 1 minute is 3. By 5 minutes the Apgar score is 6.

1. **What are the probable causes of the low 1 minute Apgar score?**

Fetal distress, as indicated by the passage of meconium before delivery. The prolonged second stage may have caused fetal hypoxia. Inhaled meconium may have blocked the airway and prevented the infant from breathing.

2. **What mistake was made with the management of this infant?**

The infant’s mouth and throat should have been well suctioned before the shoulders were delivered. This should reduce the risk of severe meconium aspiration as the airway is cleared of meconium before the infant starts to breathe.

3. **What size catheter would you have used to suction this infant’s mouth and throat?**

A large catheter (F 10) must be used as a small catheter will block with meconium.

4. **Should this infant be given a bath and stomach washout in labour ward after it starts to breathe spontaneously?**

No. These should not be done until the infant has been stable for a number of hours in the nursery.

5. **What 2 complications is this infant at high risk of?**

This infant may develop meconium aspiration syndrome as it probably inhaled meconium into its lungs after birth. It may also suffer brain damage due to hypoxia causing fetal distress during labour. The poor response to resuscitation suggests that some brain damage may be present. It would be important to repeat the Apgar score every 5 minutes until 20 minutes after delivery.
Objectives

When you have completed this unit you should be able to:
- Manage normal newborn infants.
- Diagnose and treat common minor problems.
- Manage breast feeding.
- Promote baby friendly care.
- Discharge a normal infant.

2 Care of normal infants

Normal infants are at low risk of developing problems in the newborn period and, therefore, require primary care only. About 80% of all newborn infants are normal.

Normal newborn infants are at low risk of developing problems and require only primary care.

2-2 Should all normal infants be kept with their mothers?

Yes, all normal infants should stay with their mothers and not get cared for in the nursery. This is called rooming-in. The infant is either nursed in a cot next to the mother’s bed or is given skin-to-skin care (Kangaroo Mother Care or KMC). The advantages of infants staying with their mothers are:

1. The mother remains close to her infant all the times and gets used to caring for her infant. This strengthens bonding.
2. It encourages breast feeding.
3. It builds up the mother’s confidence in her ability to handle her infant.
4. It prevents the infant being exposed to the infections commonly present in a nursery.
5. It reduces the number of staff needed to care for infants.

The father should be present at the delivery to share this exciting moment.

Caring for normal infants

2-1 What is a normal infant?

A normal infant has the following characteristics:

1. The infant is born at term (37 to 42 weeks gestation).
2. The 1 minute Apgar score is 7 or more and no resuscitation is needed after birth.
3. The infant weighs between 2500 g and 4000 g at birth.
4. On physical examination the infant appears healthy with no congenital abnormalities or abnormal clinical signs.
5. The infant feeds well.
6. There have been no problems with the infant since delivery.
Mothers and infants should stay together.

2-3 When should the infant receive the first bath?
There is no need to routinely bath all infants after delivery to remove the vernix. Vernix will not harm the infant and disappears spontaneously after a day or two. Vernix protects the skin and kills bacteria. Many infants also get cold if they are bathed soon after delivery. The only indication for an infant to be washed or bathed soon after birth is severe meconium staining or contamination with maternal blood or stool.

It is, however, important that all primiparous mothers learn how to bath their infants before they go home. If these infants have to be bathed on the first day of life, it is preferable that this be delayed until they are a few hours old.

2-4 What is the appearance of a newborn infant’s stool?
For the first few days the infant will pass meconium, which is dark green and sticky. By day 5 the stools should change from green to yellow, and by the end of the first week the stools should have the appearance of scrambled egg. The stools of breast fed infants may also be soft and yellow-green but should not smell offensive.

Some infants will pass a stool after every feed while others may not pass a stool for a number of days. As long as the stool is not hard, the frequency of stools is not important.

2-5 How many wet nappies should an infant have a day?
A normal infant should have at least 6 wet nappies a day. If the infant has fewer than 6 wet nappies a day, you should suspect that the infant is not getting enough milk. However, during the first 5 days, infants may have fewer wet nappies as infants normally pass little urine in the first few days. This protects them from dehydration at a time when many mothers produce only small amounts of milk.

2-6 What routine cord care is needed?
The umbilical cord stump is soft and wet after delivery and this dead tissue is an ideal site for bacteria to grow. The cord should, therefore, be kept clean. It should also be dried out as soon as possible by 6 hourly applications of surgical spirits (alcohol). It is important to apply enough spirits to run into all the folds around the base of the cord. There is no need to use antibiotic powders. If the cord remains soft after 24 hours, or becomes wet and smells offensively, then the cord should be treated with surgical spirits every 3 hours. Do not cover the cord with a bandage. Usually the cord will come off between 1 and 2 weeks after delivery.

2-7 Can a vaginal discharge be normal in an infant?
Yes. Many female infants have a white, mucoid vaginal discharge at birth, which may continue for a few weeks. Less commonly the discharge may be bloody. Both are normal and caused by the secretion of oestrogen by the infant before and after delivery.

2-8 May normal infants have enlarged breasts?
Yes. Many infants, both male and female, have enlarged breasts at birth due to the secretion of oestrogen. The breasts may enlarge further after birth. Breast enlargement is normal and the breasts may remain enlarged for a few months after delivery. Some enlarged breasts may secrete milk. It is very important that these breasts are not squeezed as this may introduce infection resulting in mastitis or a breast abscess.

2-9 Which birth marks are normal?
1. A blue patch over the sacrum is very common and is called a ‘mongolian spot’.
It is seen in normal infants and is due to the delayed migration of pigment cells into other areas of the skin. It is not a sign of Down syndrome (mongolism). Sometimes similar patches are seen over the back, arms and legs and may look like bruises. They need no treatment and disappear during the first few years of life.

2. It is common for an infant to have a few small pink or brown marks on the skin at birth. These are normal and disappear in a few weeks.

3. Many infants also have pink areas on the upper eyelid, the bridge of the nose and back of the neck that become more obvious when the infant cries. These marks are called ‘angel's kisses’ and ‘stork bites’. They are also normal and usually disappear within a few years.

4. Some infants develop one or more raised red lumps on their skin during the first few weeks. These ‘strawberry patches’ grow for a few months and take a few years to disappear. They are best left alone and not treated.

2-10 Are cysts on the gum or palate normal?

Small cysts on the infant's gum or palate are common and almost always normal. They do not need treatment and disappear with time. They must not be opened with a pin or needle as this may introduce infection.

2-11 Can infants be born with teeth?

Yes, some infants are born with teeth. These are either primary teeth or extra teeth. Primary teeth are firmly attached and should not be removed. Extra teeth are very small and usually very loose. A tooth that is very loose, and is only attached by a thread of tissue, can be pulled out. It will be replaced later by a primary tooth.

2-12 Should ‘tongue tie’ be treated?

Many infants have a web of mucous membrane under the tongue that continues to the tip. As a result the infant is not able to stick the tongue out fully and, therefore, is said to have ‘tongue tie’. This does not interfere with sucking and usually corrects itself with time. Do not cut the membrane as this may cause severe bleeding. Refer the child to a surgeon if the tongue does not appear normal by 2 years.

2-13 Does an umbilical hernia need treatment?

Infants commonly develop a small umbilical hernia after the cord has separated. This does not cause problems and usually disappears without treatment when the infant starts to walk. If the hernia is still present at 5 years the child should be referred for possible surgical correction.

2-14 Do normal infants commonly have a blocked nose?

Yes, a blocked nose is common due to the small size of the nose in a newborn infant. Normal infants also sneeze. Usually a blocked nose does not need treatment. However, some infants may develop breathing difficulties or apnoea if both nostrils are completely blocked. Nose drops containing drugs can be dangerous as they are absorbed into the blood stream and can cause a rapid heart rate. Sodium bicarbonate 2% or saline nose drops can be used. The blocked nose is usually not caused by a cold.

2-15 Are wide fontanelles and sutures common?

Many normal infants have wide fontanelles and sutures. This is particularly common in low birth weight infants. The anterior fontanelle may also pulsate. If the anterior fontanelle bulges and the infant's head appears too big, the infant must be referred to a level 2 or 3 hospital as hydrocephaly is probably present. If you are uncertain, repeat the head circumference measurement in 2 weeks. It should not increase by more than 0.5 cm per week.

2-16 Are extra fingers or toes normal?

Extra fingers that are attached by a thread of skin are common and occur in normal infants.
There is often a family history of extra digits. Extra fingers or toes should be tied off as close to the hand or foot as possible with a piece of surgical silk. If the extra digit contains cartilage or bone and is well attached with a broad base, it must not be tied off. These infants have a high risk of other abnormalities and, therefore, should be referred to a level 2 or 3 hospital.

2-17 Should an infant’s nails be cut?
If an infant’s fingernails become long they may scratch the face. Long nails should, therefore, be cut straight across with a sharp pair of scissors. Do not cut the nails too short. Never bite or tear the nails. Nail clippers are dangerous.

2-18 Should the foreskin of an infant’s penis be pulled back?
No. The foreskin is usually attached to the underlying skin and, therefore, should not be pulled back to clean the glans. All newborn, male infants have erections of the penis. They also have larger testes than older infants. These signs usually disappear within a few months and are due to the secretion of male hormones.

2-19 When should the normal infant be fully examined?
Weighing and examining all newborn infants are important parts of primary care. A full examination should be done after the mother and infant have recovered from the delivery, which usually takes about 2 hours. The infant must be examined in front of the mother so that she is reassured that the infant is normal. It also gives her a chance to ask questions about her infant. The infant is also briefly examined immediately after birth to identify any gross abnormalities.

2-20 How should the infant be dressed?
It is important that the infant does not get too hot or too cold. Usually an infant wears a cotton vest and a gown that ties at the back or a ‘baby grow’. A disposable or washable nappy is worn. If the room is cold, a woollen cap should be worn. Woollen booties are sometimes also worn. It is important that the clothing is not too tight. Infants should be dressed so that they are comfortable and warm. Usually a single woollen blanket is adequate.

2-21 Must the birth be notified?
The birth of every infant must be notified by the hospital, clinic or midwife. The parents later must register the infant’s name with the local authority.

2-22 Should all infants receive a Road-to-Health Card?
Yes. All newborn infants must be given a Road-to-Health Card (preschool card), as this is one of the most important advances in improving the health care of children. The relevant information must be entered at birth. Mothers should be told the importance of the card. Explain the idea of the Road-to-Health Card to her. She must present the card every time the infant is seen by a health care worker. It is essential that all immunisations be entered on the card. A record of the infant’s weight gain is also very important as poor weight gain or weight loss indicates that a child is not thriving.

2-23 Should newborn infants be immunized?
The schedule of immunisations varies slightly in different areas but most newborn infants are given B.C.G. and polio drops within 5 days of delivery. It is safe to give polio drops to infants of HIV positive mothers. However, their B.C.G. immunisation is often delayed until it can be established that they are not HIV infected. Sick and preterm infants are usually given B.C.G. and polio drops when they are ready to be discharged home.
FEEDING THE NORMAL INFANT

2-24 What milk can be given to a normal infant?

- **Breast milk.** Human breast milk meets all the nutritional needs of a healthy term infant.
- **Formula feeds.** These powdered feeds are made from cow's milk or soya bean and are modified to have similar constituents to breast milk.

Whenever possible mothers should breast feed their infants.

2-25 What are the benefits of breast feeding?

Breast feeding provides many benefits to both the infant and mother. The main benefits are:

**Benefits to the mother**

1. Breast feeding is much cheaper than buying formula feeds.
2. Breast milk is instantly available at all times. No sterilising of bottles and teats, and preparation of formula is needed.
3. It is emotionally satisfying for the mother to successfully breast feed her infant and helps to form a strong bond between mother and infant.
4. Breast feeding helps the involution of the uterus and reduces the amount of bleeding during the puerperium.
5. Breast feeding helps the mother to lose excessive weight gained during pregnancy. Pregnancy, not breast feeding, alters the breast shape of a primiparous woman.

Breast feeding is cheap and ensures an adequate, safe supply of food. It, therefore, decreases the incidence of malnutrition.

Breast feeding may increase the risk of HIV transmission from mother to infant. This must be taken into account when discussing breast feeding with a mother.

**Benefits to the infant**

1. Breast milk is the ideal feed for term infants as it provides all the nutrients in the correct amount and proportion for normal growth and development.
2. Breast milk is easily digested and absorbed.
3. Breast milk is clean and warm, and avoids the dangers of a contaminated water supply, inadequately sterilised bottles and teats, and lack of refrigeration facilities.
4. Breast milk avoids the danger of diluted or concentrated formula.
5. Breast milk contains many anti-infective factors and decreases the risk of infections, especially gastroenteritis, a major cause of death of infants in poor communities.
6. Breast milk decreases the risk of allergy in the infant, especially if there is a strong family history of allergy.

Breast feeding decreases the incidence of gastroenteritis and lowers the infant mortality rate in poor communities.

2-26 Why do some mothers not breast feed successfully?

Breast feeding is not always easy, as the ‘natural art of breast feeding’ has to be learned. Some mothers do not breast feed or fail to breast feed successfully because:

1. They believe that they do not have enough milk because it takes a number of days before the supply of milk increases.
2. They do not know the advantages of breast feeding.
3. They think that their milk is too thin, or their breasts too large or too small.
4. They develop cracked nipples or engorged breasts due to an incorrect method of feeding.
5. They want to return to work and do not realise that many working mothers can continue to breast feed successfully.
6. They are afraid of breast feeding.
7. They have flat or inverted nipples.
8. Traditional beliefs may result in unsuccessful breast feeding, e.g. incorrect beliefs that colostrum is not good for the infant, intercourse spoils the milk, and delayed feeding causes the milk to become sour in the breast.
9. Poor sleeping or excessive crying by the infant is blamed on the quality or supply of the breast milk.
10. They are HIV positive and elect not to breast feed.

2-27 How can breast feeding be promoted?

Breast feeding should be promoted as the normal, natural method of feeding an infant. This can be achieved by:

1. Encouraging a positive attitude towards breast feeding in the home during childhood and adolescence by seeing other infants being breast fed.
2. Teaching the advantages of breast feeding in schools.
3. Promoting breast feeding in the media (radio, TV, books).
4. Teaching the advantages and method of breast feeding in all antenatal clinics.
5. Starting breast feeding groups run by mothers who have themselves breast fed.
7. Discouraging bottle feeding in hospital. Rather use cups for expressed breast milk or formula feeding.

Further information on breast feeding in South Africa can be obtained from a local breast feeding support group or local branches of the Breastfeeding Association, La Leche League, and National Childbirth Education and Parenting Association.

Breast is best.

2-28 How can breast feeding be encouraged in hospitals and clinics?

Staff should be convinced that breast feeding has many benefits for the mother and infant, they should feel comfortable and not embarrassed when speaking to patients about breast feeding, and they must have the knowledge and skills to teach mothers how to breast feed. Mothers must be helped individually with kindness and patience.

Facilities for rooming-in must be provided, and the mother allowed unlimited access to her infant to demand feed. The national baby friendly hospital initiative encourages breast feeding.

2-29 What is the value of a local breast feeding support group?

Often the best person to advise and help a breast feeding mother is someone who has successfully breast fed herself. A number of mothers who have breast fed and are interested in helping others to breast feed can form a local support group. With help and training by midwives and doctors they can provide a very helpful service.

2-30 What preparation does a mother need for breast feeding?

1. The decision to breast feed should be taken before her infant is born. If she is still undecided at delivery, she should be encouraged to breast feed.
2. No routine preparation of breasts and nipples before delivery is necessary.
3. A good, supportive bra should be worn. Breast size is no indication of a woman's ability to breast feed.

2-31 How can you treat flat or inverted nipples?

If a woman's' nipples appear flat or inverted during pregnancy, they can be corrected by the infant sucking after delivery.
2-32 Should the infant be put to the breast immediately after delivery?

Yes, the mother should breastfeed her infant as soon as possible after delivery as the infant's sucking drive is usually strongest in the first hour after birth. Early suckling promotes bonding between the mother and infant. It also stimulates milk production and encourages successful breastfeeding. The small amount of colostrum in the first few days satisfies the infant and is very rich in antibodies.

2-33 Should clear feeds be given during the first few days?

Sterile water or dextrose water should not be given before starting breast or formula feeds on day 1. A breastfed infant does not need additional clear feeds. If the mother wants to breastfeed, no bottle feeds should be given to the infant as a teat can confuse the infant and cause it to reject the nipple.

Unlike a bottlefed infant, that sucks the milk out of the teat, a breastfed infant holds the nipple against the hard palate and compresses the milk ducts in the areola with the gums. The breastfed infant, therefore, makes a chewing movement while feeding (suckling).

Routine clear feeds are not needed on day 1.

2-34 What is the best position to hold an infant while feeding?

The correct position of the infant while feeding is important. The mother should be warm and comfortable. Usually she sits up and holds her infant across her body in front of her. The infant is held in one arm, and should lie on its side with its mouth facing the nipple. The breast is held in the other hand to offer the nipple to the infant.

Mothers should be encouraged to try different feeding positions in order to find which is most comfortable. Some mothers prefer to lie down while they feed. Other mothers prefer to tuck the infant under an arm like a rugby ball.

2-35 How should an infant fix at the breast?

One of the commonest mistakes made when breastfeeding is that the infant is not held and fixed correctly (latched) at the breast. The infant must take the whole nipple and most of the pigmented areola into the mouth. Sucking or chewing on the nipple causes pain and damages the nipple. The mother should let her nipple touch the infant's cheek, so that the infant will turn towards the breast with an open mouth to take the nipple. Make sure that the infant's nose is not covered by the breast.

The infant must take the whole nipple and most of the areola into the mouth when fixing at the mother's breast.

2-36 Should infants be demand fed?

Yes. Whenever possible infants should be demand fed. This means that the infant is put to the breast whenever hungry. A normal breastfed infant will usually feed every 2 to 4 hours during the day for the first few weeks. Demand feeding prevents engorged breasts.

2-37 What is the let down reflex?

When an infant is put to the breast, the pituitary gland in the mother's brain responds by producing the hormones prolactin and oxytocin. Prolactin stimulates the breast to secrete milk while oxytocin produces the 'let down reflex.' This reflex produces a tingling feeling in the breast, and results in milk being pumped into the infant's mouth by the contraction of muscle cells that surround the milk ducts under the areola. Milk may leak from the other nipple during feeds. The release of oxytocin helps the uterus to involute by causing the uterus to contract. It may also produce abdominal pain during feeding for the first few days after delivery. Tension, anxiety and a lack of sleep may inhibit the let down reflex.
2-38 How do you manage leaking breasts?
Milk leaking from the breasts is common in the first few weeks of feeding. Leaking of the opposite breast during feeding can be stopped by pressing on that nipple. Cotton handkerchiefs or pads can be used for leaking between feeds. They should be changed frequently as dampness may cause sore nipples.

2-39 Can a mother’s milk be too strong or too weak?
No, but the appearance of breast milk varies. There are 3 different types of breast milk:

1. **Colostrum.** This is a milky fluid produced in small quantities for the first few days after delivery. However, it contains a lot of protein and provides all the infant’s nutritional needs. After 3 to 5 days the milk supply suddenly increases and the breasts feel full. This is due to the production of mature milk, which consists of foremilk and hind milk.

2. **Foremilk.** This is produced at the start of each feed. It appears very weak and thin as it consists mainly of water with little fat. On a hot day a thirsty infant will take frequent, small feeds of foremilk.

3. **Hindmilk.** This is only produced towards the end of a feed. It looks thick and rich, and contains a lot of fat. A hungry infant will empty the breast to obtain the hindmilk.

2-40 Do all mothers produce enough breast milk?
Most mothers produce enough milk for their infant if breast feeding is managed correctly. Unfortunately many mothers stop breast feeding during the first 5 days because they are incorrectly advised that they do not have enough milk or because the infant is losing weight. Milk supply is normally best in the morning and poorest in the late afternoon and early evening.

The mother is probably not producing enough milk if:

1. Her breasts do not feel full before feeds after day 5.
2. The infant continues to lose weight after day 5.
3. The infant loses more than 10% of its birth weight.
4. The infant is not gaining weight by 2 weeks.
5. The infant does not wet 6 or more nappies in 24 hours (after day 5), is very restless and appears hungry.

If you are worried that an infant is not getting enough milk, then the infant can be test weighed before and after a feed. After the first week of life, most term infants will gain about 25 g per day. Weight gain is best determined over a few days.

2-41 Is it normal for an infant to lose weight after birth?
Yes. Most breast fed infants will lose weight for the first few days after birth due to the small volume of breast milk being produced. Colostrum, however, will meet the infant’s nutritional needs. Once the milk ‘comes in’, between days 3 and 5, the infant will start to gain weight. Most breast fed infants regain their birth weight by day 7. This weight loss is normal and does not cause the infant any harm. The normal infant does not usually lose more than 10% of the birth weight. Marked weight loss suggests that the infant is ill or not getting enough milk.

2-42 Is it necessary to weigh a normal infant every day?
No. The normal infant should be weighed at delivery and again on days 3 and 5 if still in hospital. Weight at discharge must be recorded. At every clinic visit the infant’s weight should be measured and recorded. Ill infants should be weighed every day until well.

2-43 How can you improve a mother’s milk supply?
1. Reassurance, support and encouragement that she will be able to breast feed. Also ensure that she is getting enough sleep and
is not under too much stress, as anxiety is a major cause of poor milk production. Anxiety also inhibits the let down reflex. Many mothers are more relaxed in their own homes.

2. Make sure that she is fixing the infant correctly to the breast and that the infant is sucking correctly.

3. Put the infant to the breast frequently during the day until a good milk supply is established. If the infant is not demand feeding 3 to 4 hourly, it should be woken for feeds. The best stimulus to milk production is the infant sucking frequently and for prolonged periods.

4. The mother should rest for a while in the afternoon and drink adequate fluids.

5. Stop any bottle feeds.

The best stimulus for milk production is frequent feeding.

2-44 Should infants be routinely test weighed?

No, there is no need to test weigh all infants. The amount of milk an infant takes varies widely between feeds. A small feed, which is common in the afternoon or when the mother is tired, may cause maternal anxiety. Test weighing may be useful to assess a mother’s milk production if the infant does not gain weight.

2-45 Should the infant always feed on both breasts?

It is best to empty one breast first before putting the infant to the opposite breast. This ensures that the infant gets the rich hind milk. Start each feed on alternate breasts. However, for the first few days it is useful to allow the infant to feed on both breasts to stimulate the milk production.

2-46 What should you do if an infant refuses the breast?

Some infants may reject the breast and refuse to fix on the nipple and suck. Common causes are a sore mouth due to thrush, the infant being ill or upset, or the milk flow being too fast. These problems should be looked for and treated.

Do not hold the infant’s head too tightly or push the face towards the breast, as the infant will turn towards your hand instead of the nipple. It may help to squeeze a little breast milk onto the nipple before placing it in the infant’s mouth.

2-47 What may causes an infant to choke while feeding?

During the first few weeks the mother may have a lot of milk and the milk may flow too fast causing the infant to choke or gag when feeding. As a result the infant may refuse to feed or overfeed and become restless. It may help for the mother to lie back at the start of the feed with the infant across her chest so that the milk has to flow upwards against gravity. The mother may have to express a bit before starting the feed, or feed the infant more frequently. Too much milk and milk that flows too quickly settles with time.

2-48 How should you manage swollen or painful breasts?

A normal, full breast feels tense and heavy, but is not painful and any discomfort is relieved by feeding. Breasts that are swollen, tender, hard, lumpy and painful are caused by either engorgement or mastitis.

Both engorgement and mastitis result from an obstruction in milk flow:

1. Engorged breasts

Both breasts are swollen, hard and painful but the mother does not feel ill. The milk does not flow freely. Engorged breasts usually occur between days 3 and 5 when the mother’s milk suddenly ‘comes in’. Engorged breasts are
common if the infant does not room-in and if the mother does not demand feed.

Treatment consists of emptying the breast by expressing or allowing the infant to suck. The infant should be fed on the most painful breast first. Sponging the breasts with warm water or standing under a warm shower relieves the discomfort, while a mild analgesic like paracetamol (Panado) is helpful. Often the infant is not able to fix correctly if the breast is engorged as the nipples become flattened by the swelling. If some milk is first expressed from the breast, the infant will usually fix well. Breast engorgement should be prevented by frequent feeds.

2. Mastitis (milk fever)

Mastitis is an inflammation of the breast due to infection in blocked milk ducts. It causes a swollen, painful, red area of one breast. The mother feels ill and may have a temperature.

Treat with rest, warm compresses and a mild analgesic. It is most important that the infant continues to suck frequently on the affected breast, as this will help the milk to flow. Altering the feeding position often helps to drain the affected area. Mastitis is not dangerous for the infant. If the signs and symptoms do not improve within 24 hours an antibiotic (penicillin or cloxacillin) should be prescribed for 5 days. If a fluctuant mass develops then a breast abscess has formed. This should be surgically drained. Due to the pain of a breast abscess, feeding may have to be stopped on that breast for a few days. If possible, feeding can be continued however.

2-50 How should you treat painful nipples?

Nipples are often painful during the first few days of breast feeding, especially if the infant is very hungry or is not fixing on the breast correctly. Do not let the infant sleep at the nipple until the nipples have toughened. Cracked nipples are very painful and should be prevented by correctly fixing the infant to the breast and avoiding engorged breasts. Treat cracked nipples with colostrum or hind milk and mild analgesics. Alter the position of the infant on the nipple so that it does not suck on the tender area. It may be necessary to stop feeding on that side for 24 hours and express the breast instead. Frequent short feeds when the infant is not hungry are preferable. Reassure the mother that painful nipples heal very quickly. Mothers with painful nipples need a lot of support if they are to continue breast feeding.

2-51 Do breast fed infants need complementary feeds?

Most breast fed infants do not need complementary (additional) feeds of formula. Complementary feeds may decrease the production of breast milk and the teat may confuse the infant. Only if an infant fails to gain weight, after management to improve the mother’s milk supply has been tried, should complementary feeds be used. Some mothers will give complementary feeds if they have to leave their infant for more than a few hours. However, expressing milk into a bottle for the missed feed would be preferable. Expressed breast milk can be safely stored up to 6 hours.
in a cool place or for 48 hours in a fridge. Breast milk can be safely frozen and stored for 2 weeks in a fridge freezer or 6 months in a deep freeze. Frozen milk should be thawed slowly by placing the container in warm (not hot) water.

2-52 Can working mothers continue to breast feed?
Yes. Mothers can continue to breast feed for many months while working. Breast milk can be expressed at work and this or formula is given to the infant during the day. When at home the mother breast feeds frequently. Ideally it should be possible to take the infant to work or leave the infant in a creche at or near the place of work.

2-53 Do drugs cross into the breast milk?
Almost all drugs that the mother takes by mouth will cross into the breast milk in very small quantities that will not affect the infant. Breast feeding mothers should only take medication that is necessary.

2-54 When should an infant not be breast fed?
1. If, after counselling, the mother has decided that she definitely does not want to breast feed, then the infant should be fed formula.
2. If a mother is unable to breast feed because she is separated from her infant, she should express her milk, manually or with a breast pump, for the infant to be cup fed.
3. If the mother has an inadequate milk supply despite advice and support, and if the infant is not gaining weight by 2 weeks, then complementary feeds should be started to ensure normal growth.
4. If the mother is very ill.
5. If the mother is HIV positive and decides, after counselling, to formula feed her infant.

2-55 What formula feed should be used for a term infant?
A number of formula feeds are available for term infants (NAN 1, S26, Similac, Lactogen 1, SMA). They are very similar and, therefore, the milk available at the local clinic or the cheapest milk should be bought. Unaltered cows milk, evaporated milk and skimmed milk are not suitable for infants under 6 months of age. Milk creamers must never be used to feed infants.

Bottle fed infants should be fed on demand. If fed according to a schedule, most infants will need to be fed 6 times a day, at 06:00, 10:00, 14:00, 18:00, 22:00 and 02:00. After the first few weeks the 02:00 feed can be missed. Most term infants will take about 100 ml per feed after the first week.

2-56 How is formula made up?
If a mother decides to formula feed her infant, it is very important that she knows how to mix formula correctly. She must also have a source of clean water and know how to clean a cup or bottle and teat.

A level scoop of milk powder (scraped level with a knife and not packed down) is added to 25 ml of clean water in a feeding bottle. The water should have been boiled beforehand and allowed to cool. The bottle and teat must have been cleaned and sterilised by boiling or standing in a disinfecting agent (Milton or half-diluted Jik). Shake the bottle well to mix the feed. Bottles should not be used if they cannot be cleaned properly.

One of the great dangers of formula feeds is to make the mixture too strong or too weak. If too much milk powder is added, the infant may receive too much salt which can be dangerous. If too little milk powder is added, the infant may become malnourished. Another danger is gastroenteritis caused by infected water or dirty bottles and teats. These and other problems of formula feeds can be avoided by breast feeding.

Formula fed infants should be offered a few clear feeds daily if the weather is very hot. Bottle fed infants must be held while feeding. The bottle should not be propped.
Many of the dangers of infection when using bottles and teats can be avoided if cup feeds are used instead.

2-57 What are the advantages of cup feeding over bottle feeding?

If an infant cannot be breast fed it is better to cup feed than to bottle feed. The greatest advantage of cup feeding is that a cup can be easily cleaned with soap and water. A cup also dries easily, especially if placed in the sun, which helps to sterilise the cup. This is most important when clean or boiling water is not available for washing bottles. A cup feed usually takes less time than a bottle feed. It is also easier to wean a preterm infant from tube feeds onto cup feeds than onto bottle feeds as many infants can swallow well before being able to suck. Any small plastic cup or dish can be used to feed an infant. Breast milk can be expressed directly into the cup before a feed is given to a preterm infant. Mothers who do not breast feed should be shown how to cup feed before they are discharged home after delivery.

In some infants bottle feeding may cause problems with breast feeding as the mechanism of sucking from a bottle is different from feeding at a breast. This is often called ‘nipple confusion’.

2-58 Iron and vitamin supplements needed?

A normal term infant born to a healthy mother on a good, mixed diet and regularly exposed to sunlight does not need supplements in the first 6 months of life. Additional iron and vitamin supplements may, however, be of benefit in poor communities when iron drops 0.3 ml (or syrup 5 ml) and multivitamin drops 0.3 ml (or syrup 5 ml) can be given daily. Supplements given to well term infants are not harmful. Remember that all preterm infants need more supplements (0.6 ml).

2-59 When should solids be introduced?

Normally breast milk or formula feeds will meet all the infant’s nutritional needs until 6 months of age. Thereafter, milk alone is not enough and solids should be introduced. If possible, an infant should be entirely breast fed for 6 months. Even if the mother can only breast feed for a few weeks or months, this will be of benefit to both her and her infant. Introducing solids reduces the anti-infectious properties of breast milk.

Some mothers continue to partially breast feed up to 2 years. It is best to continue breast feeding after solids have been introduced. This practice is particularly important in poor communities as breast milk provides the infant with a good source of protein and helps reduce the risk of pregnancy in the mother. Weaning should be done over a few weeks by dropping one feed per week.

Whenever possible infants should be entirely breast fed for 6 months.

THE BABY FRIENDLY APPROACH

2-60 What is a baby friendly hospital?

The idea of a ‘Baby Friendly Hospital’ or clinic was introduced by the World Health Organisation to promote the advantages of breast feeding. An agency is available to registers hospitals as baby friendly. To become registered as a Baby Friendly Hospital all the ‘Ten steps to successful breast feeding’ have to be implemented.

2-61 What are the ten steps to successful breast feeding?

1. Have a written breast feeding policy that is frequently communicated to all the health care staff.
2. Train all the health care staff in the skills needed to implement successful breast feeding.
3. Inform all pregnant women about the benefits of breast feeding.
4. Help mothers to start breast feeding within 30 minutes of delivery.
5. Show mothers how to breast feed and teach them how to maintain lactation even if they are separated from their infants.
6. Do not give newborn infants formula or water feeds unless this is indicated for medical reasons.
7. Allow mothers and their infants to remain together all the time from delivery to discharge.
8. Encourage demand feeding.
9. Discourage the use of dummies, teats and nipple shields.
10. Promote the formation of breast feeding support groups and refer mothers to these groups on discharge from hospital or clinic.

2-62 What are the advantages of the baby friendly approach to the care of infants?

It promotes exclusive breast feeding and bonding between mother and infant. This is particularly important in communities where malnutrition, gastroenteritis and child abuse are common. The baby friendly way of infant care is also kinder, gentler, cheaper and better. Every effort must be made to make all hospitals and clinics baby friendly.

If HIV positive mothers decide to breast feed, then exclusive breast feeding may reduce the risk of mother to child transmission of HIV. If they decide to formula feed, many of the practices which encourage bonding can still be practised.

**DISCHARGING A NORMAL INFANT**

**2-63 When can an infant be discharged from the hospital or clinic?**

Most normal newborn infants can be discharged 6 hours after delivery. Before discharging an infant from either a hospital or clinic, you should ask yourself the following questions:

1. Does the infant appear normal, active and healthy?
2. Does the infant feed well?
3. Can the mother feed and care for her infant?
4. Does the infant weigh 1800 g or more?

If the answer to any of these questions is ‘No’ the infant should not be discharged.

**2-64 What advice should the mother be given about an infant at discharge?**

Before discharge all mothers must be advised about:

1. Feeding their infant.
2. Bathing and dressing their infant.
3. Follow-up appointments and arrangements.
4. Reporting immediately if the infant appears ill or behaves abnormally.
5. The importance of the Road-to-Health Card (preschool card).

**2-65 Should normal infants be followed up after discharge?**

If the infant is discharged before 7 days of age, the infant should be seen at home or at a clinic on days 2 and 5 to assess whether:

1. The infant appears healthy or sick.
2. The infant is feeding well and receiving enough milk.
3. The mother is managing to care for her infant.
4. The cord is clean and dry.
5. The infant is jaundiced.
6. The mother has any problems with her infant.

After the age of one week, the normal infant should be followed at the local ‘well baby’ clinic to assess the infant's weight gain and general development, and to receive the required immunisations. These details must be noted on the Road-to-Health Card.

**CASE STUDY 1**

An infant is delivered by spontaneous vertex delivery at term. Immediately after birth
the cord is clamped and cut and the infant is dried. The infant cries well and appears normal. The infant has a lot of vernix and a blue mark is noticed over the lower back. The infant passes urine after delivery but does not pass urine again for 24 hours.

1. **When should the infant be given to the mother?**

As soon as the infant is dried, the cord cut, the Apgar score determined and a brief examination indicates that the infant is a normal, healthy term infant. The father should also be present to share this exciting moment.

2. **What is the blue mark over the infant’s back?**

A ‘mongolian spot’, which is normal. It is important to explain to the mother that it is not a bruise. It disappears over a few years.

3. **Should the vernix be washed off immediately after delivery?**

Infants should not be bathed straight after delivery, as they often get cold, while vernix should not be removed as it helps protect the infant’s skin from infection. It would be better to bath the infant the following day, in the mother’s presence, when most of the vernix will have cleared.

4. **Should the infant stay with the mother after delivery?**

Yes, if possible the mother and her infant should not be separated after delivery.

5. **Does it matter if the infant only passes urine once in the first 24 hours?**

No. During the first few days a normal infant often does not pass urine frequently. However, after day 5, an infant should have at least 6 wet nappies a day.

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**CASE STUDY 2**

Starch powder is sprinkled onto the umbilical cord of a newborn infant twice a day to hasten drying. The cord is then covered with a linen binder. The mother is worried that the infant has enlarged breasts. As the ward is cold at night, she puts the infant into her bed.

1. **What do you think of the method of cord care in this infant?**

The cord should be dried with surgical spirits and not covered with starch powder. Covering the umbilical cord with a binder is incorrect as it prevents the cord drying out.

2. **What treatment is needed for the infant’s enlarged breasts?**

No treatment is needed and the mother must not squeeze the breasts. The mother must be reassured that breast enlargement resolves spontaneously in a few months.

3. **What would you advise the mother about sleeping with her infant?**

If the ward is cold and there is no simple way of keeping the infant warm, then the infant should sleep with the mother. It is important that infants do not get cold. Kangaroo mother care is a very effective method of keeping the infant warm.

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**CASE STUDY 3**

A normal infant weighs 3000 g at birth. By day 4 the infant appears well but the weight has dropped to 2850 and it is suggested that formula be started. The next day the mother has painful, engorged breasts. The policy in the hospital is to keep all normal infants in the nursery where the mothers can visit at feeding time.
1. Is the weight loss of 150 g normal for this infant?
Yes. An infant may normally lose up to 10% of the birth weight in the first 5 days after delivery.

2. Should formula feeds be started?
No. Within a day or two the mother should have enough milk and the infant will start to gain weight.

3. How should the mother’s engorged breasts be managed?
Stop formula feeds and allow the infant to breast feed frequently.

4. What do you think of normal infants being kept in the nursery?
Normal infants should room-in with their mothers.

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**Case Study 4**

A well newborn infant is given clear feeds of 5% dextrose for the first day. As the mother is tired after the delivery, the infant is immediately sent to the nursery. On day 3 the mother is advised to bottle feed as her milk appears to be too weak. She is a poor woman who plans to return to a rural district. It is suggested that the infant starts solids at 1 month.

1. Should clear feeds be used in a healthy newborn infant?
No. Feeds should be started with breast milk or full strength formula.

2. Why should the infant not be sent immediately to the nursery?
It is important for the mother to hold her infant after the delivery. This promotes breast feeding and bonding. It is best if mother and infant be kept together.

3. Why is it incorrect to advise formula feeds if the breast milk appears to be weak?
Both foremilk and colostrum often appear weak. This is normal and never an indication for formula feeds.

4. What are the dangers of a poor rural woman giving bottle feeds?
She may not be able to clean the bottle and teat correctly. Cup feeds would be safer if formula is used as a cup is easier to clean. This mother should be encouraged to breast feed.

5. Why is it important that this woman breast feed her infant?
She will not be able to buy formula as she is poor and probably does not live close to a shop. As a result the infant is at high risk of gastroenteritis and malnutrition. These problems can usually be prevented by breast feeding.

6. When should the infant be given solids?
This mother should breast feed for as long as possible. It would probably be best if solids were only started at 6 months.
3

Care of low birth weight infants

Objectives

When you have completed this unit you should be able to:
- Identify and manage low birth weight infants.
- Define preterm and underweight for gestational age infants.
- List the complications of low birth weight infants.
- Prevent hypothermia and hypoglycaemia.
- Prevent recurrent apnoea.
- Manage anaemia of prematurity.
- Provide kangaroo mother care (KMC).
- Keep good patient notes.
- Assess patient care.

3-1 What is a low birth weight infant?

A low birth weight (LBW) infant is an infant that weighs less than 2500g at birth. The weight of all infants must be measured at birth so that low birth weight infants can be identified.

It is important to weigh all infants after delivery.

3-2 Why is it important to identify all low birth weight infants?

Because these infants are at an increased risk of problems and may need more than primary care. All low birth weight infants must be carefully assessed after birth.

Low birth weight infants are at an increased risk of problems and may need special care.

3-3 Why are some infants born with a low birth weight?

Most infants weigh between 2500 and 4000g at birth. However, some infants have a low birth weight (less than 2500g) as a result of one or both of the following 2 important problems during pregnancy:
- They are born too soon.
- They weigh less than expected for the duration of pregnancy (i.e. they are underweight for their gestational age).

3-4 Which infants are born too soon?

The gestational age of an infant is measured from the first day of the mother’s last normal menstrual period to the day of delivery. The average gestational age is 40 weeks (280 days) with a range of 37 weeks (259 days) to 42 weeks (293 days). Infants with a gestational age between 37 and 42 weeks are called term infants. Preterm infants are born before 37 weeks while post term infants are born after 42 weeks.
Any infant born before 37 weeks (i.e. preterm) is regarded as being born too soon. About 5% of all infants are born preterm in a wealthy community and often more than 20% in a poor community.

Preterm infants are born before 37 weeks.

3-5 What is an underweight for gestational age infant?

Infants with a birth weight which is less than expected for their gestational age are called underweight for gestational age infants. When plotted on a birth weight for gestational age chart (a 'fetal growth chart'), underweight for gestational age infants have a birth weight which falls below the 10th centile. Normally grown infants (appropriate for their gestational age) have a birth weight between the 10th and 90th centiles.

Underweight for gestational age infants have a birth weight below the 10th centile.

Infants may be underweight for gestational age because of one or both of the following:

- They have grown too slowly during pregnancy.
- They have lost weight during the last weeks of pregnancy.

3-6 Which infants have grown too slowly during pregnancy?

Infants that have been growing too slowly during pregnancy, have a birth weight, length and head circumference that fall below the 10th centile (length is not routinely recorded as it is difficult to measure accurately). Therefore, all their measurements are less than would be expected for their gestational age.

These small infants are called growth restricted (or growth retarded) infants as they have suffered fetal growth restriction (intrauterine growth retardation). It is very useful to measure the head circumference of all underweight for gestational infants because it helps to identify those infants who are growth restricted (grown too slowly).

In poor communities the commonest cause of low birth weight is slow fetal growth.

Growth restricted infants have a head circumference below the 10th centile.

3-7 Which infants have lost weight during the last weeks of pregnancy?

Some infants lose weight in the last few weeks of pregnancy because the placenta is not supplying them with enough food from the mother. As a result of the weight lost, these infants have loose, dry, peeling skin and thin arms and legs at birth. They look as if they have been starved and are called wasted infants. Post term infants are often wasted. Weight loss (wasting) during the last weeks of pregnancy can, therefore, be identified by examining the infant.

If only the infant’s weight, but not head circumference, is below the 10th centile then the infant is wasted but not growth restricted. Therefore, they are thin and underweight for their size.

Some infants have a low birth weight because of 2 or more of these fetal problems, e.g. they may be born too soon (preterm) and also have grown too slowly (growth restricted). Other low birth weight infants may have grown too slowly and then lost weight in the last few weeks of pregnancy (wasted).

Infants are no longer described as premature, post mature or dysmature as these descriptions are difficult to define and only cause confusion.

3-8 How do you assess the gestational age of an infant?

1. If possible the gestational age should be determined before delivery from the mother’s menstrual history and clinical (or ultrasound) examination in early pregnancy.
2. If the duration of pregnancy is unknown or uncertain, the gestational age can be roughly estimated by simply observing the newborn infant’s appearance and behaviour.

3. The Ballard method can be used to score an infant’s gestational age. This scoring method is based on the infant’s physical appearance and behaviour.

**3-9 What are the clinical features of preterm infants?**

1. They have decreased muscle tone and, therefore, lie flat with straight arms and legs or in a frog position.
2. If their arms are gently pulled into an extended position and then released, they do not immediately flex back at the elbow into a bent position.
3. They suck poorly.
4. Their skin is thin and blood vessels can be seen through their skin.
5. They have few creases on the soles of their feet.
6. They have no or small nipple nodules.
7. Boys have undescended testes and girls have poorly formed labia majora.

**3-10 What are the common causes of an infant being born preterm?**

1. The mother may develop preterm labour or prelabour rupture of the membranes. This is usually due to chorioamnionitis, which is a bacterial infection of the amnion and chorion cause by the spread of vaginal bacteria through the cervical canal. Many of these women do not have the clinical signs of severe chorioamnionitis (i.e. fever, abdominal tenderness or an offensive vaginal discharge) and there is no obvious cause of the preterm labour or prelabour rupture of the membranes. Most of these women have mild chorioamnionitis. The reason why some women develop chorioamnionitis is not understood.

2. Maternal illness such as hypertension, diabetes or heart disease. Many of these women have an induced labour or caesarean section before term.

3. Problems with the pregnancy such as placenta praevia, placental abruption or cervical incompetence.

4. Multiple pregnancy or polyhydramnios.

**3-11 What are the common complications of preterm infants?**

These infants have immature organs because they are born too soon. Most of the complications in preterm infants are because of organ immaturity. They are also small and fragile and can, therefore, be easily damaged during labour and delivery.

The common neonatal complications in infants born preterm are:

- Asphyxia (breathing poorly at birth)
- Hypothermia
- Hypoglycaemia
- Recurrent apnoea
- Poor feeding
- Respiratory distress
- Jaundice
- Anaemia
- Separation from parents

Less common complications are infection, periventricular haemorrhage in the brain, bruising and patent ductus arteriosus.

Preterm infants are, therefore, at high risk of many complications after birth and need special care. Many preterm infants die as a result of these complications, especially if they are not correctly managed.

**Preterm infants often have immature organs.**

**3-12 What are the clinical features of underweight for gestational age infants?**

1. Their weight is less than that expected for their gestational age (i.e. their weight falls below the 10th centile on a weight for gestational age chart.

2. Infants who have been growing slower than expected during pregnancy, will also with a head circumference below the 10th centile.
3. Infants who have lost weight during the last few weeks of pregnancy will be wasted with loose, dry, peeling skin and thin arms and legs.

4. They are often meconium stained, especially if born at term or post term.

3-13 What are the causes of infants being born underweight for gestational age?

There are both maternal and fetal causes, which may result in the birth of an underweight for gestational age infant:

1. **Maternal causes**
   1. Low maternal weight
   2. Poverty and manual labour
   3. Smoking
   4. Excess alcohol intake
   5. Hypertension or pre-eclampsia

2. **Fetal causes**
   1. Multiple pregnancy
   2. Chromosomal abnormalities, e.g. Down syndrome
   3. Severe congenital abnormalities
   4. Chronic intra-uterine infections, e.g. syphilis
   5. Post term delivery

However, in many cases no obvious cause can be found. Maternal height and race alone probably have little effect on fetal growth. An abnormal placenta is rarely the primary cause of slow fetal growth or wasting.

Pregnant women should not smoke or drink alcohol.

3-14 What are the common complications of an underweight for gestational age infant?

All underweight for gestational age infants, whether they have grown too slowly or are wasted or both, are at an increased risk during the first weeks of life because they have often received too little food and oxygen during pregnancy. As a result, underweight for gestational age infants commonly have the following complications:

1. Asphyxia
2. Organ damage due to lack of oxygen before delivery (fetal hypoxia)
3. Meconium aspiration
4. Hypothermia
5. Hypoglycaemia

3-15 Why is it important to decide whether a low birth weight infant is born preterm or underweight for gestational age?

Because the causes and the complications of these two conditions may be different. Therefore, they often have different clinical problems, which need different forms of management. However, some complications, such as asphyxia, hypothermia and hypoglycaemia, are common in both preterm and underweight for gestational age infants.

3-16 What is the management of a low birth weight infant?

1. Good resuscitation if the infant has asphyxia.
2. Prevent hypothermia.
3. Prevent hypoglycaemia.
4. Start early feeds or an intravenous 10% dextrose infusion.
5. Prevent apnoea.
6. Monitor the infant carefully and treat any of the common complications of low birth weight infants.
7. Keep the mother and infant together and promote bonding.
8. Decide whether the infant needs to be transferred to a level 2 or 3 unit.

Unless the infant is extremely small with fused eyes, it should be regarded as possibly viable and actively managed. With good emergency management and good transport many very small infants can survive without long term complications.
3-17 What is hypothermia?
The normal temperature of a newborn infant is 36.0 °C to 36.5 °C, if the abdominal skin temperature is taken, and 36.5 °C to 37.0 °C, if a digital (or low reading mercury) thermometer is placed in the axilla (armpit). If either temperature is lower than the normal range (36.0 °C for skin temperature or 36.5 °C for axillary temperature) the infant has hypothermia. A body temperature below 35 °C is particularly dangerous. It is very important to prevent hypothermia, which causes many clinical problems and can kill the infant if it is severe.

3-18 Which infants are at an increased risk of hypothermia?
1. All low birth weight infants
2. Infants who are not dried well after birth
3. Infants in a cold room or cool incubator
4. Infants lying near cold windows
5. Starved infants

3-19 How can you prevent hypothermia?
1. Identify all infants at high risk of hypothermia.
2. Provide energy (calories) by giving milk feeds or intravenous fluids. This is very important in low birth weight infants who are born with little body fat. Early feeding with breast milk or undiluted formula feeds helps to reduce the risk of hypothermia by providing the infant with energy needed to produce heat.
3. Provide a warm environment for all infants. The smaller the infant, the warmer the required environment. Most infants under 1800 g need an incubator or skin-to-skin care (kangaroo mother care). You should:
   - Never place an infant in a cold incubator.
   - Keep the incubator ports closed.
   - Keep the room warm.
   - Never nurse an infant near a cold window.
   - Have curtains in the nursery.
   - Never bath small or sick infants.
4. Insulate the infant. Dress the infant and use a woollen cap. The naked head of a newborn infant loses a lot of heat. A woollen cap is particularly important if an infant is receiving headbox oxygen. Infants in incubators should wear a woollen cap.
5. All wet infants must be dried immediately and then wrapped in another, warm, dry towel. Do not leave an infant in a wet towel. Remember to dry the infant’s head.
6. Monitor the temperature in all infants who are at an increased risk of hypothermia. It is essential to detect any drop in skin temperature as soon as possible.

A woollen cap prevents heat loss from an infant’s head.

3-20 What is the best environmental temperature?
The best environmental (room or incubator) temperature depends on:
1. The weight and gestational age of the infant. The lower the weight and the earlier the gestational age, the higher is the required environmental temperature. Small, preterm infants need a very warm environment.
2. The postnatal age of the infant. The lower the postnatal age, the higher is the required environmental temperature, i.e. a younger infant needs a warmer environmental temperature.
3. Illness. Sick infants need a higher environmental temperature.

The environmental temperature for each infant should be adjusted in order to give a normal abdominal skin or axillary temperature. This can be achieved automatically if a servo-controlled incubator is used. Skin-to-skin care will also provide the infant with the correct temperature. Infants of 1500 g need an
incubator temperature of about 35.0 °C during the first few days after delivery.

The infant’s energy and oxygen needs are lowest when the skin temperature is **normal** and the infant is nursed at the correct environmental temperature. Both energy and oxygen needs increase if the infant’s skin temperature is either above or below normal.

**The environmental temperature should be adjusted to give a skin temperature of 36–36.5 °C.**

### 3-21 How can you keep an infant warm?

There are a number of ways to keep an infant warm:

1. **A warm room.** Most healthy, infants above 1800 g can be nursed in a cot in a warm nursery, ward or home. The room temperature should be about 20 °C. The infant should be dressed in a nappy, jacket, woollen hat and booties to prevent heat loss. A woollen cap is most important. Most infants below 1800 g can be kept warm in a cot if they are nursed in a room where the temperature is kept at 25–30 °C. The smaller the infant, the higher the required room temperature will be. Do not let the infant get too hot.

2. **A closed incubator (or radiant warmer).** This is the way most small or sick infants are nursed in hospital as the temperature can be carefully controlled. Often infants in closed incubators are also dressed. A transparent perspex shield can be placed over an infant in an incubator to help reduce heat loss.

3. **Maternal skin-to-skin care** (kangaroo mother care). Many low birth weight infants can be kept warm by placing them naked against the mother’s naked breasts. This method is very successful and particularly useful when closed incubators are not available. The mother’s skin will become warmer or cooler to keep the infant’s temperature normal.

4. **Thermal blanket.** An infant can be kept warm for hours if wrapped in a thermal blanket, silver swaddler or heavy gauge aluminium foil normally used for cooking. This is an effective method of preventing heat loss during transport if the mother cannot give skin-to-skin care and a transport incubator is not available. The infant must be warm and dry before being wrapped in a thermal blanket. Never put a cold infant into a thermal blanket or use a thermal blanket in an incubator.

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**PREVENTION OF HYPOGLYCAEMIA**

### 3-22 What is the normal concentration of glucose in the blood?

The normal concentration of glucose in the blood of newborn infants is 2.0 mmol/l to 7.0 mmol/l. (These levels are less than those for serum glucose). It is best to keep the blood glucose concentration above 2.5 mmol/l.

### 3-23 What is hypoglycaemia?

A blood glucose concentration below 2.0 mmol/l (or serum glucose concentration below 2.5 mmol/l) is abnormal and, therefore, defined as hypoglycaemia.

**Hypoglycaemia is defined as a blood glucose concentration below 2.0 mmol/l.**
3-24 How is blood glucose measured in the nursery?

The quickest, cheapest and easiest method to measure the blood glucose concentration in the nursery is to use reagent strips such as Haemoglukotest, Glucotrend or Dextrostix. Only a drop of blood is needed for a reagent strip. After a minute it is either wiped off with cotton wool or washed off with water and then blotted dry, depending on the regent strip used. The colour of the reagent strip is then compared to the colour range on the bottle to determine the blood glucose concentration. A far more accurate method to screen for hypoglycaemia is to read the colour of the reagent strip with a glucose meter such as reading Haemoglukotest strips with a Reflolux meter.

3-25 Which infants are at an increased risk of developing hypoglycaemia?

Infants that have **reduced energy stores** or **reduced intake** and infants with **increased energy needs** are at risk of hypoglycaemia.

Infants with reduced energy stores of glycogen in the liver, protein in muscles, and fat under the skin include:

1. **Preterm infants.** They are born too soon before adequate amounts of glycogen, protein and fat are stored in the tissues. The fetus gets most of its energy stores from the mother in the last 6 weeks of pregnancy.
2. **Underweight for gestational age** or **wasted infants.** They have used up most of their own energy stores before delivery because they have not been getting enough glucose from their mother.
3. **Starved infants.** Infants that are not fed, either orally or intravenously soon after delivery, rapidly use up their energy stores.

Infants with increased energy needs include:

1. **Infants with respiratory distress.** Their respiratory muscles require a lot of glucose to provide the energy needed for respiration.
2. **Hypothermic infants.** These infants use large amounts of glucose to produce heat in an attempt to correct their body temperature.
3. **Infants of diabetic mothers.** Before delivery these infants get used to receiving large amounts of glucose across the placenta, especially if the maternal diabetes is poorly controlled. Often the fetus becomes obese. At delivery the supply of glucose from the mother suddenly stops when the umbilical cord is clamped. As a result, these infants commonly develop hypoglycaemia because their high energy needs are no longer being provided for.

3-26 How can you prevent hypoglycaemia?

The following steps must be taken to prevent hypoglycaemia:

1. Identify all infants at high risk of developing hypoglycaemia, e.g. low birth weight infants as they have little fat, muscle and glycogen stores.
2. Monitor the blood glucose concentration of these infants with reagent strips so that a falling blood glucose can be detected before hypoglycaemic levels are reached.
3. Feed all infants as soon as possible after delivery, especially low birth weight infants and infants of diabetic women. If possible, feed the infant within the first hour.
4. Whenever possible, milk feeds should be given. Sometimes nasogastric feeds may be needed. Both clear feeds and oral 5% dextrose feeds should not be used in newborn infants as they have less energy than milk.
5. If milk feeds cannot be given, then an intravenous infusion of 10% glucose (Neonatalyte) should be started.
6. Prevent hypothermia.
RECURRENT APNOEA

3-27 What is apnoea?

Apnoea is the stopping of respiration for long enough to cause bradycardia together with cyanosis or pallor. Usually apnoea for 20 seconds or longer is needed to produce these clinical signs. The infant may have a single apnoeic attack but usually the episodes of apnoea are repeated.

In some preterm infants the respiratory centre in the brain is immature and this results in repeated attacks of apnoea. This is called apnoea of immaturity. These infants are usually less than 34 weeks of gestation. Less commonly, apnoea may be caused by respiratory distress, infection, hypoxia, hypothermia, hypoglycaemia or convulsions.

Apnoea should not be confused with periodic breathing, which is a normal pattern of breathing in preterm infants. Infants with periodic breathing frequently stop breathing for less than 20 seconds, which is not long enough to cause bradycardia, cyanosis or pallor.

Apnoea can be detected with the aid of an apnoea monitor, which is usually set to trigger if the infant does not breathe for 20 seconds.

3-28 How should you manage apnoea of immaturity?

Apnoea of immaturity can be largely prevented and treated with the use of oral theophylline or caffeine. Theophylline is usually given via a nasogastric tube as Nuelin liquid. A loading dose of 4 mg/kg is given, followed by a maintenance dose of 2 mg/kg every 12 hours. Prophylactic theophylline is given routinely to all infants born before 34 weeks of gestation and can usually be stopped at 35 weeks. An overdose of theophylline presents with tachycardia, vomiting or convulsions.

During an attack of apnoea, breathing can be restarted in most cases by simply stimulating the infant. Infants with repeated apnoea, in spite of theophylline, should be referred to a level 2 or 3 hospital for investigation. They may need mask and bag ventilation before being transported.

It is dangerous to give head box oxygen to infants with apnoea of immaturity, as they do not need oxygen.

FEEDING LOW BIRTH WEIGHT INFANTS

3-29 What determines an infant’s fluid needs?

The daily fluid requirements of an infant depends on:

1. **The body weight.** Fluid requirements are expressed in ml per kg of body weight. Heavy infants, therefore, need more fluid than do light infants.
2. **The age after delivery.** Fluid requirements increase gradually from birth to 5 days and then remain stable.

3-30 How much fluid do most infants need?

Most infants need:

- 60 ml/kg on day 1
- 75 ml/kg on day 2
- 100 ml/kg on day 3
- 125 ml/kg on day 4
- 150 ml/kg on day 5 and thereafter.

Note that the fluid requirements are given in ml per kg body weight, and that they increase gradually from day 1 to day 5. After day 5 there is no further increase in the daily fluid needs per kg body weight. As the infant’s weight increases, so the total amount of fluid a day will increase although the amount of fluid per kg remains constant at 150 ml/kg. Only rarely do infants need more than 150 ml/kg if they are kept warm and well dressed.

These daily fluid volumes meet the need of both normal and low birth weight infants. They are used when infants receive either oral or intravenous fluids. The fluid volumes...
needed by breast feeding infants do not need to be calculated as they are met by the increasing milk production by the mother during the first few days after delivery.

The fluid requirements per day increase from 60 ml/kg on day 1 to 150 ml/kg on day 5.

3-31 Why do the daily fluid needs increase during the first 5 days?
For the first few days after delivery the mother’s breasts do not produce a lot of milk. To prevent dehydration, the kidneys of the newborn infant, therefore, produce little urine during this period. As a result the infant does not need a lot of fluid in the first few days of life. However, the infant’s fluid needs gradually increase from day 1 to 5. By day 5 the kidneys are functioning well and a lot of urine is passed. Giving 150 ml/kg during the first 4 days to infants may result in overhydration.

3-32 What milk feeds should be given to a low birth weight infant?
Whenever possible, every effort should be made to feed a low birth weight infant with breast milk. Infection, especially in preterm infants, can be largely prevented by using breast milk.

If breast milk is not available, then formula (powdered milk) should be used. Infants weighing 1500 g or more can be given a standard newborn formula such as Nan 1 or S26. However, infants weighing less than 1500 g should be given a special preterm formula such as Prenan or S26 LBW. Cows milk is not suitable for newborn infants.

If the correct volume of breast milk or formula is given, the infant will receive the correct amount of nutrients and energy. Diluted feeds are not used.

Healthy term infants of normal birth weight should be demand fed at the breast.

3-33 What route should be used to feed a low birth weight infant?
Most preterm infants born after 35 weeks are able to suck well and, therefore, take all their feeds by mouth. If possible, they should be breast fed. A cup rather than a bottle should be used to give feeds if expressed breast milk or formula is used.

Preterm infants that are not able to suck should be fed via a nasogastric tube. They usually start to suck between 32 and 34 weeks.

If the infant is fed via a nasogastric tube, the mother must manually express her milk every 4 hours during the day. A breast pump, if available, can also be used. The milk can be safely stored for 48 hours in a household fridge. It should stand at room temperature for 15 minutes to warm before feeding.

3-34 How often should a low birth weight infant be fed?
1. If below 1500 g: feed every 2 hours (i.e. 12 feeds a day).
2. If 1500–1800 g: feed every 3 hours (i.e. 8 feeds a day).
3. If above 1800 g: feed every 4 hours (i.e. 6 feeds a day).

Infants below 1500 g or sick infants may need intravenous fluids for the first few days before milk feeds are started.

3-35 What are the dangers of milk feeds in low birth weight infants?
Giving too big a feed may cause:
1. Vomiting
2. Abdominal distension
3. Aspiration of the feed

It is best to nurse infants on their backs as this lowers the risk of ‘cot deaths’. Raising the mattress below the head of the infant and giving smaller, more frequent feeds usually prevents vomiting. Any infant that continues to vomit or develops a distended abdomen should be referred as it may be infected.
3-36 What supplements are needed by low birth weight infants?

Infants who have a gestational age below 37 weeks are often deficient of both vitamins and iron and should receive the following:

1. Multivitamin drops 0.6 ml daily should be started when the infant reaches 150 ml/kg milk feeds. This should be continued until the infant is 6 months old. Vitamin drops can be given into the infant’s mouth with breast feeding or into the formula feed. The extra vitamins prevent vitamin deficiencies such as rickets.

2. Iron drops 0.3 ml daily should be started when the infant is old enough to suck well. When the infants is discharged from hospital, the dose should be increased to 0.6 ml daily. This should be continued until the infant is 6 months old. The added iron prevents iron deficiency anaemia.

Low birth weight infants born at term usually do not need any nutritional supplements.

ANAEMIA

3-37 What is anaemia?

Anaemia is defined as a haemoglobin concentration (Hb) or packed cell volume (PCV) which is below the normal range. The normal PCV at birth is 45–65% and the Hb 15–25 g/dl. After delivery the PCV and Hb fall slowly until about 8 weeks of age and then slowly increase again. The Hb should not fall below 10g/dl and the PCV below 30%. If the Hb and PCV fall below these levels the infant has anaemia.

The commonest cause of anaemia in newborn infants is anaemia of prematurity. Less common causes are bleeding, infection and haemolytic disease of the newborn.

3-38 What is anaemia of prematurity?

The PCV and Hb of the preterm infant are normal at birth but fall faster and to lower levels than those in the term infant. Therefore, preterm infants after a few weeks of age may have a PCV below 30% and a Hb below 10 g/dl. This condition is called anaemia of prematurity as it caused by an immature bone marrow, which does not produce enough red blood cells.

3-39 How should you manage anaemia of prematurity?

There is no simple, cheap way of preventing anaemia of prematurity. Giving oral iron to preterm infants does not help prevent or treat anaemia of prematurity. These infants should be discussed with the referral hospital, as they may need a blood transfusion, especially if the PCV falls to below 25% and the Hb below 8g/dl or they stop gaining weight. Most infants with anaemia of prematurity recover after a few weeks without any treatment.

KANGAROO MOTHER CARE (KMC)

3-40 What is kangaroo mother care (KMC)?

Kangaroo mother care is a method of nursing infants skin-to-skin against the mother’s chest. The infant, who is kept naked except for a woollen cap and nappy, is placed vertically between the mother’s bare breasts. The infant is then covered with a blanket, towel or the mother’s clothing. The mother can wear a belt, or tuck her vest, shirt, T-shirt or blouse into her trousers, to prevent the infant from falling. Special clothes are not needed although a KMC baby carrier can be used. Other members of the family should also be encouraged to give the infant KMC. This is particularly important for the father.

3-41 Which infants should receive KMC?

1. Small infants in incubators who are still too immature to be nursed in a cot. The parents can give KMC while they visit the infant in the nursery. Even very small infants can be safely given KMC once their condition is stable.
2. Continuous KMC should be given to small infants when they reach about 1600 g and start to breast feed. They are taken out of the incubator and the mother provides KMC day and night. These mothers and infants should be cared for in a special KMC ward. The mother and infant can be discharged home when the infant breast feeds well and the mother is confident to manage her infant. These infants should continue to be given KMC at home until they weigh 2000 g.

3. KMC can also be given to normal infants.

3-42 What are the advantages of KMC?

1. It keeps the infant warm.
2. It allows the mother (and father) to play a major role in caring for the infant.
3. It promotes breast feeding.
4. It reduces the risk of infection in the infant.
5. It allows the mother and infant to be discharged home earlier.
6. It reduces the work load of the nursing staff.
7. It improves weight gain.

Many studies have shown that the infant’s temperature, respiration and heart rate remain very stable with KMC. Apnoea is reduced. Serious infection in hospital is uncommon as the infant is colonised with bacteria from the mother’s skin and breast milk rather than by with dangerous nursery bacteria which are often resistant to many antibiotics. KMC is safe and should be widely practised.

Therefore, they should be written in an orderly, logical way so that all staff members can understand them.

Whenever notes are written, it is important to give the date and the time that the record is made. It is then possible to know when the care was given.

Every time you write clinical notes you should sign your name. The rest of the health team then knows who wrote the notes.

3-44 What is the SOAP method of writing notes?

When an infant is examined for the first time the clinical notes should include:

1. The Story
2. The Observations
3. The Assessment
4. The Plan

In order to remember these important steps in writing clinical notes, remember the word SOAP. The letters in SOAP stand for Story, Observations, Assessment, Plan.

3-45 What is the story?

Good notes should always start with the story (i.e. the history of the pregnancy, labour, delivery and events after delivery). A history should always be taken before examining an infant. Include any problems recorded during the pregnancy, labour and delivery, the Apgar score and any resuscitation needed, the antenatal assessment of the gestational age and any problems that occurred since delivery.

3-46 What are the observations?

The observations include the findings of the physical examination and the results of any additional investigations done, e.g. temperature or blood glucose measurement.

An assessment of the gestational age should be made in all low birth weight infants.

KMC is one of the most important recent advances in infant care.

KEEPING GOOD PATIENT NOTES

3-43 What are good clinical notes?

Good clinical notes, which form the patient record, should be accurate, brief and easy to read. In addition, they must be systematic.
3-47 What is the assessment?

Once you have recorded the results of the history, the physical examination and the investigations, you must make an assessment of the infant's condition. For example, you should ask yourself:

1. Is the infant sick or well? Is it normal or abnormal?
2. Is the infant at high risk or low risk for clinical problems?
3. What clinical problems does the infant have at present?

The assessment must not be forgotten, as a carefully recorded history and examination are of little value if you are unable to assess what this information means. The management depends on an accurate assessment of the infant's problems. If you cannot identify the problems, you will not be able to plan the correct treatment. Assessing an infant's problems correctly takes a lot of practice. Once the assessment is made, it is very helpful to compile a problem list.

3-48 What is a problem list?

Each clinical problem that you identify from the story and observations must be listed separately. A typical problem list looks like this:

1. Unmarried, teenage mother.
2. Preterm delivery.
3. Jaundice.

You now have a good idea of the clinical problems that require management.

3-49 How should the plan of management be decided?

Once the history, examination, investigations and assessment have been completed, the plan of management must be decided. The management consists of the nursing care, the observations needed, the medical treatment, and the management of the parents. It may be important to discuss the patient with the referral hospital and decide whether transfer is needed. When deciding on the plan of management, each item on the problem list must be considered.

3-50 An example of good SOAP notes.


S

O
Male infant. Weight 2000g. Assessed gestational age 36 weeks. Active. Skin temperature 36 °C. RS Respiratory distress with recession and a respiratory rate of 65 breaths per minute. Infant needs 50% head box oxygen to remain pink. CVS Heart rate 150/min. GIT Abdomen normal. CNS Appears normal. Fontanelle flat. Blood glucose 3.0 mmol/l. PCV 60%.

A
1. Preterm delivery.
2. Asphyxia.
3. Respiratory distress.

P
1. Incubator.
2. Neonatalyte IVI at 4 dpm.
4. Routine observations.
5. Head box oxygen.
6. Speak to parents.
7. Arrange transfer to level 2 hospital.

Signed: Sr. Mowtana

These brief notes give all the important information in a simple and systematic manner. Try to write your notes using the SOAP method.
**ASSESSING PATIENT CARE**

3-51 Why should patient care be assessed?

It is very important to regularly assess the range of problems seen in a level 1 unit and evaluate the standard of care provided. This is the best method of ensuring that the highest standard of practice is maintained. Usually the low birth weight rate, stillbirth rate, early neonatal mortality (death) rate and perinatal mortality rate of each service are recorded.

Infants weighing less than 500 g (about 22 weeks) at birth are regarded as miscarriages and, therefore, are not included in these rates. Perinatal information (data) is usually divided into 500 g categories.

3-52 What is the low birth weight rate?

The low birth weight rate is the number of liveborn infants weighing less than 2500 g at birth per 1000 liveborn deliveries. The low birth weight rate is often expressed as a percentage, e.g. 15%.

3-53 How many infants are born with a low birth weight?

In a wealthy community about 5 % of infants are low birth weight. However, in poor communities up to 40% of all infants may have a low birth weight. The percentage of low birth weight infants in a community can be used to assess the socioeconomic status of that community.

3-54 What is the stillbirth rate?

The stillbirth rate is the number of stillborn infants per 1000 total deliveries (i.e. liveborn and stillborn). The international definition of stillbirth, used for collecting information on perinatal mortality, is an infant that is born dead and weighs 500 g or more. In a developed country the stillbirth rate is about 5 per 1000. In a developing country, however, the stillbirth rate is usually more than 20 per 1000.

The legal definition of stillbirth in South Africa is an infant born dead after ‘6 months of intrauterine life’ (i.e. 28 weeks since the start of the last period or 1000 g, if the gestational age is not known). Therefore, only legally defined stillborn infants require a stillbirth certificate and must be buried or cremated. However, for the collection of information on perinatal mortality, the international definition of stillbirth is used.

3-55 What is the early neonatal mortality rate?

An early neonatal death occurs if a liveborn infant dies during the first 7 days after delivery. Therefore, the early neonatal mortality rate is the number of infants that die in the first week of life per 1000 liveborn deliveries. A liveborn infant is defined as an infant that shows any sign of life at birth (i.e. breathes or moves). However, liveborn infants below 500 g at birth are usually regarded as abortions. The early neonatal mortality rate in a developed country is usually about 5 per 1000. In a developing country the early neonatal mortality rate is usually more than 10 per 1000.

3-56 What is the perinatal mortality rate?

The perinatal mortality rate is the number of stillbirths plus the number of early neonatal deaths per 1000 total deliveries (i.e. both stillborn and liveborn). The perinatal mortality rate is about the same as the stillbirth rate plus the early neonatal mortality rate. Most developed countries have a perinatal mortality rate of about 10/1000 while most developing countries have a perinatal mortality rate of more than 30/1000.

Note that the low birth weight rate and early neonatal mortality rate are expressed per 1000 live births while the stillbirth rate and perinatal mortality rate are expressed per 1000 total births (i.e. live births plus stillbirths).
3-57 What is the value of knowing these rates?

It is very important to know the low birth weight, stillbirth, neonatal and perinatal mortality rates in your service as these rates reflect the living conditions, standard of health, and quality of perinatal health care services in that region. It is far more important to know the mortality rate for the region than simply the rates for one clinic or hospital in the region.

Increased low birth weight and stillbirth rates suggest a low standard of living with many socio-economic problems, such as undernutrition, poor maternal education, hard physical activity, poor housing and low income in the community. An increased early neonatal mortality rate, especially if the rate of low birth weight infants is not high, usually indicates poor perinatal health services. Both a poor standard of living and poor health services will increase the perinatal mortality rate.

An increased low birth rate reflects poor socio-economic conditions while a high early neonatal mortality rate indicates poor perinatal health services.

3-58 What are the main causes of perinatal death?

In a developing country, the main causes of perinatal death are:

1. Preterm labour
2. Abruptio placentae
3. Syphilis
4. Fetal (intra-uterine) growth restriction
5. Bacterial infection after delivery

Many of these causes are preventable with good perinatal care in level 1 hospitals and clinics. It is essential that you determine the common causes of perinatal death in your area. The avoidable causes of perinatal death should then be identified and steps taken to correct these causes.

3-59 What is a perinatal mortality and morbidity meeting?

This is a regular meeting of staff to discuss all stillbirths and early neonatal deaths at that clinic or hospital. Clinic deaths must include infants who died after transfer to a level 2 or 3 hospital as the cause of death may be the management received at the clinic. Management problems with sick infants who survived can also be discussed.

Perinatal mortality meetings are held weekly or monthly. The aim of a perinatal mortality meeting is, not only to establish the cause of death, but also to identify problems in the service and, thereby, to improve the management of mothers and infants. Care must be taken to review the management so that lessons can be learned rather than to use the meeting to blame individuals for poor care. The disciplining of staff should be done privately and never at a perinatal mortality meeting.

Avoidable factors should be looked for whenever there is a stillbirth or neonatal death. The avoidable factors may be divided into problems with:

1. The mother, e.g. failure to attend antenatal clinic
2. The staff, e.g. the fetal heart was not monitored during labour
3. The service, e.g. there was no transport

Some causes of death are avoidable (e.g. hypothermia) while others are not avoidable (e.g. abruptio placentae). By identifying avoidable factors plans can be made to improve the perinatal care provided.

3-60 Should referred infants also be discussed?

Every infant referred from a level 1 clinic or hospital to a level 2 or 3 hospital must be recorded and reviewed. The infant’s weight, age and reason for referral must be known as well as the outcome at the referral hospital. The adequacy of resuscitation and management before transfer is important. Comment on the management and condition
of the infant on arrival at the referral hospital is very useful. With this information, problems with management and transport can be identified, protocols improved and plans made for appropriate training.

It is very helpful if staff from the referral hospital can be involved in perinatal mortality and morbidity meetings.

**CASE STUDY 1**

A female infant weighs 2200 g at birth. The mother is unbooked and does not know the date of her last menstrual period. She smokes 20 cigarettes a day. The infant has loose, wrinkled, dry skin and scores at 40.5 weeks. When plotted on a weight for gestational age chart, the infant falls below the 10th centile.

1. **What is the explanation for the appearance of this infant’s skin?**

The loose, wrinkled, dry skin suggests wasting due to a poor supply of food to the fetus during the last weeks of pregnancy.

2. **Why was it important to score the gestational age of this infant?**

Because the infant weighed less than 2500 g and the patient did not know the duration of pregnancy.

3. **How would you classify this infant by gestational age alone?**

The scored age of 40.5 weeks indicates that the infant was born at term.

4. **How would you classify this infant by weight for gestational age?**

This infant is underweight for gestational age as the birth weight falls below the 10th centile.

5. **Why is it important to identify this infant as being underweight for gestational age and wasted?**

Because it indicates that the infant is at high risk of asphyxia, meconium aspiration, hypothermia and hypoglycaemia. The infant may also have organ damage due to the lack of oxygen before delivery (fetal hypoxia).

6. **What is the probable cause of this infant being underweight for gestational age?**

The mother’s heavy smoking.

**CASE STUDY 2**

A 5 day old term infant is bathed in a cold ward. Afterwards the infant appears well but feels cold. A reading in the axilla with a digital thermometer gives a result of 34.5 °C. The infant, who weighed 2400 g at birth and is clinically wasted, is rapidly warmed by placing it next to a wall heater.

1. **What is your diagnosis?**

Hypothermia because the infant’s axillary temperature was below 36.5 °C.

2. **Give probable reasons why this infant became hypothermic.**

The infant is underweight for gestational age and wasted. This may cause hypothermia as the infant has little fat. In addition the infant probably became cold after the bath because of the cold room.

3. **What important complication may result from the hypothermia?**

Hypoglycaemia. A cold infant uses a lot of energy in an attempt to keep warm. This may use up the infant’s energy stores and result in hypoglycaemia.
4. When should this infant be fed?
This infant should be fed as soon as possible. This will help to prevent hypoglycaemia. Feeds will also provide the infant with energy to produce heat.

5. How should the infant be kept warm during the next few days?
The infant should be dressed and given a woollen cap. If the room becomes cold at night, the infant can be kept warm with skin-to-skin care in the mother's bed.

**CASE STUDY 3**

A preterm infant of 1700 g is born in a level 1 hospital. The infant is nursed in a closed incubator but no feed is given for 2 hours. At 1 hour after birth the Haemoglobutest reading with a Reflolux meter is normal but at 2 hours after birth the reading indicates hypoglycaemia.

1. What is the definition of hypoglycaemia?
A blood glucose concentration below 2 mmol/l.

2. Why is this infant hypoglycaemic?
The infant is preterm and, therefore, has little energy store. In addition, the infant has not been fed for 2 hours after birth. The infant had energy stores to last 1 but not 2 hours.

3. How could the hypoglycaemia have been prevented?
Breast or formula feeds should have been started within an hour of delivery.

4. Are 5% dextrose feeds better than milk feeds at preventing hypoglycaemia?
No. Milk feeds contain more energy than 5% dextrose feeds.

5. Do all hypoglycaemic infants present with abnormal neurological signs?
No. Often hypoglycaemia is asymptomatic and can only be diagnosed with blood screening.

**CASE STUDY 4**

A 1900 g, healthy preterm infant is born by normal vertex delivery after a 34 week gestation.

1. What method should be used to feed this infant?
Tube feeds should be started after delivery. There is no indication to give intravenous fluids. In a week or two, when the infant starts to suck, breast or cup feeds can be introduced.

2. What type of feed would you choose?
Breast milk should be used if possible. If this is not available, then a standard infant formula (e.g. NAN 1) should be given.

3. What volume of feed will be needed on day 1?
60 ml/kg = 60 \times 1.9 = 114 ml over 24 hours. Thereafter the volume will be increased daily until 150 ml/kg is reached on day 5.

4. How often should feeds be given to this infant?
4 hourly (i.e. 6 feeds a day). Therefore, the volume of each feed will be 114/6 = 19 ml.

5. What supplements does this infant need?
A multivitamin liquid 0.6 ml daily should be started on day 5, while iron drops 0.3 ml should be started when the infant feeds orally. Both should be continued for 6 months. The dose should be increased to 0.6 ml per day on discharge.
CASE STUDY 5

It is decided to determine the perinatal health and care status of a region. Therefore, all the birth weights, together with the number of live births and perinatal deaths, in the hospitals, clinics and home deliveries in that region are recorded for a year. Only infants with a birth weight of 500 g or more are included in the survey. Of the 2000 births, 50 infants were stillborn and 1950 were born alive. Of the live born infants, 25 infants died in the first week of life. One hundred and twenty infants liveborn infants weighed less than 2500 g at birth.

1. Why were infants between 500 g and 1000 g not also excluded?

Because some of these infants may live if they are given emergency management and then transferred to a level 2 or 3 hospital. Therefore, all infants with a birth weight of 500 g or more must be included in a perinatal survey.

2. What was the stillbirth rate for this region?

There were 50 stillbirths and 2000 total births. Therefore, the stillbirth rate was $50/2000 \times 1000 = 25$ per 1000.

3. Is this stillbirth rate typical of a developed or developing country?

It is typical of a developing country, which usually has a stillbirth rate above 20/1000. In contrast, a developed country usually has a stillbirth rate of about 5/1000.

4. What was the early neonatal mortality rate?

Of the 1950 infants who were born alive, 25 died during the first week of life. Therefore, the early neonatal mortality rate was $25/1950 \times 1000 = 12.8$ per 1000.

5. What is the expected early neonatal mortality rate for a developing country?

Above 10/1000. Therefore, the rate of 12.8/1000 is what you would expect in a developing country.

6. What was the perinatal mortality rate for this region?

There were 50 stillbirths and 25 early neonatal deaths with 2000 total deliveries. Therefore, the perinatal mortality rate was $50 + 25/2000 \times 1000 = 37.5$ per 1000.

7. What is the low birth weight rate for this region?

Of the 1950 infants born alive during the year, 120 weighed less than 2500 g at delivery. Therefore, the low birth weight rate was $120/1950 \times 1000 = 61.5$ per 1000 or 6.15%.

8. Is the low birth weight rate typical of a developing country?

No. Most developing countries have a low birth weight rate of more than 100/1000 or 10%.

9. How do you interpret the finding of a high perinatal mortality rate with a low birth weight rate of only 6.15%?

It suggests that the living conditions of the mothers in the study region are satisfactory but the perinatal services are poor. Every effort must be made, therefore, to improve these services.
4

Emergency management of infants

Objectives

When you have completed this unit you should be able to:
- Manage hypothermia.
- Manage hypoglycaemia.
- Manage respiratory distress.
- Use oxygen correctly.
- Transfer an infant.

4-1 What is the emergency management of a newborn infant?

Some newborn infants develop serious problems which often cannot be managed in a level 1 clinic or hospital where only primary care is available. These infants need to be carefully assessed and stabilised before they can be moved to a level 2 (special care unit) or level 3 (intensive care unit) hospital that has the staff and facilities to provide the care needed. Emergency management is the care that must be given to these infants in a level 1 hospital or clinic before they are transferred. Staff working in level 1 hospitals and clinics must be able to give emergency care.

4-2 Which infants need emergency management?

1. Infants with hypothermia.
2. Infants with hypoglycaemia.
3. Infants with respiratory distress.

THE MANAGEMENT OF HYPOTHERMIA

4-3 How do you measure an infant’s temperature?

An infant’s skin temperature, rather than its oral or rectal temperature, is usually used. The axillary or abdominal skin temperature should be measured.

Skin temperature can be measured with either:

1. A low reading mercury thermometer. The thermometer is placed in the infant’s axilla (armpit) for 2 minutes before the reading is taken. Thermometer should be stored dry when not in use to prevent cross infection. Make sure it is a low reading thermometer.
2. A telethermometer. This is an electrical thermometer. The probe is placed on the skin over the left, lower abdomen or the lower back. Avoid the right, upper abdomen as the liver produces a lot of heat and this may give too high a reading.

4-4 What is the normal range of body temperature?

This depends on the site where the temperature is measured:

1. The normal axillary temperature is 36.5–37 °C.
2. The normal abdominal skin temperature is 36–36.5 °C.

4-5 What is hypothermia?

Hypothermia (low body temperature) is defined as an axillary temperature below 36.5 °C or an abdominal skin temperature below 36 °C.

4-6 Which infants are at high risk of hypothermia?

1. Infants who are not dried well after birth
2. Infants in a cold room or cool incubator
3. Low birth weight infants
4. Infants lying near cold windows
5. Infants who are not fed

4-7 How do you recognise an infant with hypothermia?

Hypothermic infants present with the following signs:

1. They are cold to the touch.
2. They are lethargic, hypotonic, feed poorly and have a feeble cry.
3. Their hands and feet are usually pale or blue, but their tongue and cheeks are often pink. The pink cheeks may incorrectly suggest that the infant is well.
4. Peripheral oedema or sclerema (a woody or plastic feel to the skin).
5. Shallow, slow respiration or signs of respiratory distress.
6. Bleeding from the mouth, nose or needle punctures.

4-8 What problems are common in hypothermic infants?

1. **Hypoglycaemia.** This is a common cause of death in cold infants and the most important complication of hypothermia. Cold infants use a lot of energy in an attempt to warm themselves. As a result they use up all their energy stores, resulting in hypoglycaemia.
2. **Hypoxia.** The infant’s haemoglobin does not carry oxygen normally when the red blood cells are very cold.  

3. **Haemorrhage.** When infants are very cold their blood does not clot normally and they commonly bleed.

**Hypothermic infants may die of hypoglycaemia.**

4-9 How do you treat hypothermia?

1. **Warm the infant** in a closed incubator, overhead radiant warmer or warm room. The incubator temperature should be set at 37 °C until the skin temperature returns to normal. If these are not available, place the infant naked against the mother’s skin and wrap both in a blanket to give skin-to-skin care.
2. **Provide energy** while the infant is being warmed. Hypoglycaemia may occur during warming. Energy can be given as oral or nasogastric milk, or intravenous maintenance fluid containing 10% dextrose water (e.g. Neonatalyte).
3. **Provide oxygen.** Give 30% oxygen by headbox while the infant is being warmed, even if the infant is pink.
4. **Notify** the referral level 1 or 2 unit as this infant may need to be transported. Discuss the management of the infant with the staff of the referral hospital.
5. **Observations.** Monitor and record the infant’s temperature, pulse, respiration, skin colour and blood glucose concentration until they are normal and stable.
6. **Keep the infant warm** once a normal body temperature is reached. It is very important to keep the infant warm during transport.

4-10 How should you keep an infant warm during transport?

Infants should be kept warm during transport by nursing them in a transport incubator or keeping them warm by skin-to-skin care. If the mother cannot be moved, a nurse, doctor or ambulance attendant can give skin-to-skin care. Warm infants can also be dressed and then wrapped in a silver swaddler or tin foil. The infant must be warm before transport.
4-11 What is glucose?

Glucose is an important type of sugar. Many forms of food (e.g. milk formula) contain glucose. Infants also get glucose from lactose in breast milk and from the breakdown of starch when solids are added to the diet. Glucose is an essential source of energy to many cells of the body, especially the brain. Glucose is stored as glycogen in the liver. Glucose can also be stored as fat and protein. The liver can change stores of glycogen, fat and protein back into glucose.

The amount of glucose available to the cells can be assessed by measuring the concentration of glucose in the blood.

4-12 How is blood glucose measured in the nursery?

The quickest, cheapest and easiest method to measure the blood glucose concentration in the nursery is to use a reagent strip such as Haemoglukotest, Glucotrend or Dextrostix. However, a far more accurate method to screen for hypoglycaemia is to read the colour of the reagent strip with a glucose meter such as reading Haemoglukotest strips with a Reflolux meter. It is important to carefully read the instructions which are packed with the reagent strips as the correct method must be used.

4-13 What is the normal concentration of glucose in the blood?

The normal concentration of glucose in the blood of newborn infants is 2.0 mmol/l to 7.0 mmol/l.

4-14 What is hypoglycaemia?

Hypoglycaemia is defined as a blood glucose concentration below 2.0 mmol/l. Mild hypoglycaemia is defined as a blood glucose concentration between 1.5 to 2.0 mmol/l in an infant without any abnormal neurological signs. Severe hypoglycaemia is defined as a blood glucose concentration of less than 1.5 mmol/l or hypoglycaemia with abnormal neurological signs.

Hypoglycaemia is defined as a blood glucose concentration below 2.0 mmol/l.

4-15 What are the dangers of hypoglycaemia?

Hypoglycaemia is extremely dangerous, especially when the blood glucose concentration is below 1.5 mmol/l and the infant has abnormal neurological signs. When the blood glucose concentration is low the cells of the body, particularly the brain, do not receive enough glucose and as a result cannot produce energy for their metabolism. With severe hypoglycaemia the brain cells can be damaged or die, causing cerebral palsy, mental retardation or death. Mild hypoglycaemia is important as it may rapidly progress to severe hypoglycaemia. Every effort must, therefore, be made to treat mild hypoglycaemia promptly.

Hypoglycaemia may cause brain damage.

4-16 Which infants are at risk of developing hypoglycaemia?

Infants that have reduced energy stores, reduced energy intake (feed poorly) or increased energy needs are at risk of hypoglycaemia.

Hypothermia causes hypoglycaemia.

4-17 What are the clinical signs of hypoglycaemia?

Hypoglycaemia may produce no clinical signs or present with only non-specific signs. This makes the clinical diagnosis of hypoglycaemia very difficult. When present, the clinical signs of hypoglycaemia are:
1. The infant may be lethargic and hypotonic, feed poorly, have a weak cry, apnoea, cyanosis or an absent Moro reflex.
2. The infant may be jittery with a high pitched cry, a fixed stare and fisting, have abnormal eye movements or convulsions.
3. Excessive sweating. This sign may not be present, however, especially in preterm infants.

Often an infant has both signs of decreased brain function, such as lethargy and poor feeding, as well as signs of excessive brain function, such as jitteriness and convulsions. The clinical presentation of hypoglycaemia is very variable which makes the clinical diagnosis of hypoglycaemia difficult. Therefore, the diagnosis of hypoglycaemia can be easily missed.

### Hypoglycaemic infants may have no abnormal clinical signs.

#### 4-18 How can you diagnose hypoglycaemia?

As the clinical diagnosis is difficult and often missed, it is essential that all infants at risk of hypoglycaemia, and infants with clinical signs that may be caused by hypoglycaemia, be screened with reagent strips. Whenever possible, use a glucose meter rather than reading the reagent strip by eye. Ideally a diagnosis of hypoglycaemia made with reagent strips should be confirmed with a laboratory blood glucose measurement.

#### 4-19 How can you prevent hypoglycaemia?

Every effort must be taken to prevent hypoglycaemia by:

1. Identifying all infants at high risk of developing hypoglycaemia.
2. Monitoring the blood glucose concentration of these infants with reagent strips.
3. Feeding all infants as soon as possible after delivery, especially low birth weight infants and infants of diabetic women.
4. Whenever possible, milk feeds should be given. Both clear feeds and dextrose feeds should not be used in newborn infants as they are low in energy and may result in hypoglycaemia.
5. If milk feeds cannot be given, then an intravenous infusion of 10% glucose (e.g. Neonatalyte) should be started.
6. Prevent hypothermia.

With a policy of breast feeding as soon as possible after delivery, most cases of hypoglycaemia can be prevented.

**Early breast feeding can usually prevent hypoglycaemia.**

#### 4-20 How should you treat an infant with mild hypoglycaemia?

Infants with a blood glucose concentration between 1.5 mmol/l and 2.0 mmol/l and no clinical signs of hypoglycaemia usually need milk feeds urgently to prevent severe hypoglycaemia:

1. If they tolerate oral or nasogastric feeds, give 10 ml/kg breast milk or milk formula immediately. Do not give 5% or 10% dextrose orally as the energy content is less than that of breast milk or milk formula.
2. Repeat the reagent strip reading 30 minutes after the feed to determine whether the blood glucose concentration has returned to the normal range. If it is still in the mild hypoglycaemia range, repeat the feed with an added 5 g sugar (1 teaspoon) per 30 ml milk and repeat the reagent strip measurement after another 30 minutes.
3. When the blood glucose concentration has returned to normal, continue with regular milk feeds and continue to monitor with reagent strips hourly for 3 hours.
4. If the blood glucose concentration falls below 1.5 mmol/l then treat as for severe hypoglycaemia.
5. If the infant is too small or too ill to tolerate milk feeds, start an intravenous infusion of 10% glucose (e.g. Neonatalyte) and transfer to a level 2 or 3 hospital.
Most infants with mild hypoglycaemia respond well to milk feeds and do not need to be transferred. Establish breast feeding as soon as possible to prevent hypoglycaemia recurring.

4-21 How should you treat an infant with severe hypoglycaemia?

All infants with a blood glucose concentration below 1.5 mmol/l, or hypoglycaemia with abnormal clinical signs, have severe hypoglycaemia. This is a medical emergency and must be treated immediately. The management of severe hypoglycaemia consists of the following steps:

1. The treatment of choice is to start an intravenous infusion of 10% glucose (e.g. Neonatalyte) at a drip rate calculated to give 100 ml/kg in the first 24 hours. Give a bolus of 2 ml/kg of the 10% glucose over 5 minutes at the start of the infusion.
2. If you cannot rapidly put up a peripheral intravenous line, insert an umbilical vein catheter.
3. Repeat the reagent strip measurement after 15 minutes. If the blood glucose concentration has not returned to normal, dilute 5 ml of 50% dextrose with 5 ml of the 10% dextrose infusion fluid to give a 30% glucose solution. Inject 5 ml of this 30% glucose solution over 5 minutes into the plastic bulb of the infusion set. It is not advisable to inject 50% dextrose, as it is extremely hypertonic.
4. If the blood glucose concentration still has not returned to normal within a further 15 minutes phone your referral hospital. They may ask you to give 5 mg hydrocortisone intravenously or glucagon 0.3 mg/kg intramuscularly.
5. In an emergency, if you are unable to give intravenous dextrose, give the infant 10 ml/kg breast milk or formula (or sweetened cow's milk if neither is available) by mouth or via a nasogastric tube. You can add 5 g (a teaspoon) of sugar or 5 ml of 50% dextrose per 10 ml feed to increase the glucose concentration. Do not give pure 50% dextrose orally, as it will cause vomiting.
6. Keep the infant warm.
7. The infant now needs to be referred urgently to the referral hospital. It is very important that the infant's blood glucose remains normal during transport.

4-22 How frequently should you measure the blood glucose concentration?

1. In most infants at high risk of hypoglycaemia, the blood glucose concentration should be measured hourly with reagent strips for the first 3 hours, then 3 hourly until 100 ml/kg/day milk feeds have been established which is usually in 24 to 48 hours.
2. Infants with mild hypoglycaemia should be monitored every 30 minutes until the blood glucose concentration has returned to the normal range. Readings should then be made hourly for 3 hours to ensure that the blood glucose concentration does not fall again. Thereafter, measure the blood glucose concentration 3 hourly until milk feeds are established.
3. Infants with severe hypoglycaemia should have their blood glucose concentration measured every 15 minutes until it has increased above 1.5 mmol/l. Then measure the blood glucose concentration hourly until the infant arrives at the referral unit.

4-23 What is the prognosis after hypoglycaemia?

The risk of brain damage depends on the severity, duration and number of hypoglycaemic attacks. The prognosis is worst if the hypoglycaemia has produced clinical signs, especially convulsions.

MANAGEMENT OF RESPIRATORY DISTRESS

4-24 What is respiratory distress?

Respiratory distress is a collection of clinical signs, which indicate that the infant has
difficulty breathing. The 4 most important clinical signs of respiratory distress are:

1. **Tachypnoea.** A respiratory (breathing) rate of 60 or more breaths per minute (normal respiratory rate is about 40).
2. **Central cyanosis.** A blue tongue in room air.
3. **Recession.** The in-drawing of the ribs and sternum during inspiration (also called retraction).
4. **Grunting.** A snoring noise made in the throat during expiration.

If an infant has central cyanosis plus 1 or more of the above clinical signs, the infant is said to have respiratory distress.

**4-25 What are the important causes of respiratory distress?**

Respiratory distress in newborn infants is usually caused by one of the following conditions:

1. Hyaline membrane disease
2. Wet lung syndrome
3. Meconium aspiration
4. Pneumonia

Other less common causes of respiratory distress include hypothermia and anaemia.

There are many different causes of respiratory distress.

**4-26 What is hyaline membrane disease (HMD)?**

At term the fetal lungs are mature and ready to be filled with air after delivery. The alveoli (air sacs) of these mature lungs secrete a substance called surfactant that prevents them collapsing at the end of expiration. This allows the infant to breathe air in and out with very little physical effort.

In contrast, many preterm infants have immature lungs, which do not have adequate amounts of surfactant at birth. As a result the alveoli collapse with expiration and the infant is unable to expand them again during inspiration. Collapsed alveoli, due to the lack of surfactant, result in respiratory distress. This condition is known as hyaline membrane disease (HMD).

**Hyaline membrane disease is caused by too little surfactant in immature lungs.**

**4-27 What is the shake test?**

The amount of surfactant in the fetal lung can be determined after birth by doing a shake test on a sample of gastric aspirate obtained within 30 minutes after delivery. A positive shake test indicates that adequate surfactant is present in the lungs of the newborn infant. A negative test indicates inadequate surfactant and strongly suggests that the infant has hyaline membrane disease.

It is important to pass a nasogastric tube and aspirate the stomach of all preterm infants soon after birth. The sample should be sent in a syringe or test tube with the infant when it is referred to a level 2 or 3 unit so that the shake test can be done at the referral hospital. The result is very useful in managing an infant with respiratory distress.

The stomach aspirate can also be used to help diagnose congenital pneumonia when pus cells and bacteria can often be seen under the microscope.

**4-28 How do you diagnose hyaline membrane disease?**

1. The infant is preterm.
2. The infant develops respiratory distress at or soon after delivery. The signs of respiratory distress gradually become worse.
3. The infant usually moves very little and commonly develops peripheral oedema.
4. The shake test on gastric aspirate is negative indicating inadequate surfactant.
4-29 What is the clinical course in hyaline membrane disease?

The degree of respiratory distress gets worse during the first 48 hours after birth and the concentration of inspired oxygen, needed to keep the infant pink, increases for the first 2 to 3 days (48 to 72 hours). During this time some infants will die of hyaline membrane disease. Otherwise the respiratory distress starts to improve. As the respiratory distress can be expected to get worse during the first few days, it is important the infant be transferred to a level 2 or 3 unit as soon as possible.

**Hyaline membrane disease gets worse before it gets better.**

4-30 What is the wet lung syndrome?

Before delivery the fetal lungs are not collapsed but filled with lung fluid. At vaginal delivery, most of this fluid is squeezed out of the lungs as the chest is compressed in the birth canal. After birth the remaining fluid is coughed up or is absorbed within a few minutes. In some infants this rapid removal of fetal lung fluid does not take place resulting in the wet lung syndrome which presents after delivery as respiratory distress. The wet lung syndrome is the commonest cause of respiratory distress. It is also important because during the first day of life it can easily be confused with hyaline membrane disease.

The wet lung syndrome is usually seen in term infants, especially after fetal distress, maternal sedation, caesarean section and polyhydramnios. In these infants the normal clearance of lung fluid is often delayed for many hours resulting in the wet lung syndrome.

4-31 How can you diagnose the wet lung syndrome?

1. These infants are usually born at term.
2. They develop respiratory distress from delivery.
3. They have a typical clinical course.

4. The shake test on the gastric aspirate is positive, which excludes hyaline membrane disease.

**The wet lung syndrome is the commonest cause of respiratory distress.**

4-32 What is the clinical course of the wet lung syndrome?

The respiratory distress in infants with the wet lung syndrome gradually improves during the first 24 hours and usually recovers by 72 hours. Oxygen is needed for a few hours to 3 days only. Usually less than 40% oxygen is required. The clinical course of the wet lung syndrome, therefore, is very different from that of hyaline membrane disease.

**The wet lung syndrome is important because it can be confused with hyaline membrane disease.**

4-33 What is the meconium aspiration syndrome?

If the fetus is hypoxic in utero it may become distressed, pass meconium, and make gasping movements, which suck the meconium stained liquor into the larynx and trachea. If the airways are not well suctioned after the infant's head is delivered, the meconium can be inhaled into the smaller airways and alveoli with the onset of breathing. This results in the meconium aspiration syndrome. Many cases of severe meconium aspiration syndrome can be prevented by carefully suctioning the upper airways of meconium stained infants before they breathe at birth. The risk of the meconium aspiration syndrome is particularly high if the meconium is very thick.

**The airways of all meconium stained infants should be well suctioned before delivering the shoulders.**
4-34 How do you diagnose the meconium aspiration syndrome?

1. The infant is usually born at term or post term but only rarely preterm.
2. The liquor is meconium stained.
3. Meconium may be suctioned from the mouth and upper airways at birth and the infant is usually meconium stained.
4. Respiratory distress is present and the chest usually appears hyperinflated (over expanded).

4-35 What is the clinical course of the meconium aspiration syndrome?

From birth the meconium stained infant has respiratory distress which, in severe cases, gets progressively worse and may kill the infant. Milder cases will gradually recover over days or weeks. Infants who survive severe meconium aspiration often have damaged lungs that may take months to recover.

4-36 What are the common causes of pneumonia?

An infant may be born with pneumonia (congenital pneumonia) as a complication of chorioamnionitis. Other infants may develop pneumonia in the days or weeks after delivery, due to the spread of bacteria in a nursery. Preterm infants are at an increased risk of pneumonia.

4-37 How can you diagnose pneumonia?

1. The infant develops signs of respiratory distress and also appears clinically ill.
2. The diagnosis of congenital pneumonia complicating chorioamnionitis is suggested by seeing pus cells and bacteria in a Gram stain of the gastric aspirate after delivery.

4-38 How should you manage an infant with respiratory distress?

The principles of care are the same, irrespective of the cause of the respiratory distress. Therefore, all infants with respiratory distress should receive the same general management:

1. Keep the infant warm, preferably in an incubator.
2. Handle the infant as little as possible, because stimulating the infant often increases the oxygen requirements. There is no need to routinely suction the airways.
3. Provide energy, to prevent hypoglycaemia. Preferably give an infusion of 10% glucose (e.g. Neonatalyte). Milk feeds by nasogastric tube can be given to infants with mild respiratory distress.
4. Treat central cyanosis by giving oxygen. Give oxygen therapy correctly.
5. Record the following important observations every hour and note any deterioration:
   - respiratory rate
   - presence or absence of recession and grunting
   - presence or absence of cyanosis
   - percentage of oxygen given
   - heart rate
   - both the skin and incubator temperature
6. Consult the staff of the nearest level 2 or 3 hospital, as the infant may need to be transferred. This is particularly important in hyaline membrane disease where early transport is best. A chest X ray at the referral hospital will help decide the cause of the respiratory distress.
7. If the infant develops recurrent apnoea, or if oxygen fails to keep the infant pink, then mask and bag ventilation should be started.
8. Parenteral antibiotics must be given if pneumonia is diagnosed. Either ceftriaxone 50mg/kg daily by IM or IV injection or a combination of daily benzyl penicillin 50 000 units/kg/day IV plus gentamicin 7.5 mg/kg IM daily.
9. Unfortunately there is no specific treatment for the infant with respiratory distress caused by meconium aspiration.
10. Transfer is not as urgent in infants with wet lung syndrome as they usually improve after the first few hours and rarely need more than 40% oxygen.
11. Infants who do not need to be transferred should be nursed in an incubator and given oxygen as required. Three hourly
feeds by nasogastric tube, rather than an intravenous infusion, can usually be given to these infants.

THE CORRECT USE OF OXYGEN THERAPY

4-39 Why does the body need oxygen?
Oxygen is needed by all the cells of the body. Without enough oxygen the cells, especially of the brain, will be damaged or die. However, too much oxygen is also dangerous and can damage cells. In the body, oxygen is carried by red blood cells from the lungs to all the other organs. When loaded with oxygen the red blood cells are red in colour. With too little oxygen they are blue.

Too little oxygen can cause brain damage.

4-40 How do you measure the amount of oxygen in the blood?
1. This can be roughly assessed clinically as the infant appears peripherally and centrally cyanosed if there is not enough oxygen in the red cells. This clinical method may be inaccurate and should, whenever possible, be confirmed by measuring the oxygen saturation.
2. At the bedside the oxygen saturation can be measured with a saturation monitor (i.e. pulse oximeter), which simply clips onto the infant’s hand or foot and measures the oxygen saturation through the skin. The oxygen saturation is given as a percentage. It indicates the amount of oxygen being carried by the red cells.
3. In a laboratory the amount of oxygen in the blood can also be measured accurately in a sample of arterial blood.

4-41 How much oxygen is needed by the normal infant?
The normal oxygen saturation in a newborn infant is 86 to 92%. This indicates that the infant is breathing the correct amount of oxygen. If the saturation is less than 86% the infant is not getting enough oxygen while a saturation above 92% indicates that the infant may be getting too much oxygen. A saturation monitor is very useful to assess whether a newborn infant with respiratory distress is getting the correct amount of oxygen.

The normal saturation of oxygen in the blood is 86 to 92%.

4-42 When does an infant need extra oxygen?
An infant needs extra oxygen if it becomes centrally cyanosed or if the saturation of oxygen falls below 86%.

4-43 Can you give too much oxygen?
Yes. If too much oxygen is given the oxygen saturation will rise above 92%. Preterm infants, especially infants below 34 weeks gestation, are at risk of oxygen damage to the eyes (known as retinopathy of prematurity) if excessive amounts of oxygen are given. The damage to the retina is done by too much oxygen in the blood and not due to the direct effect on the infant's eyes of oxygen in the headbox.

At resuscitation it is probably safe to use oxygen for a short period only until the infant is pink and breathing well.

Too much oxygen is dangerous as it may cause blindness.

4-44 When should you give an infant extra oxygen?
1. During resuscitation if the infant does not respond rapidly to mask ventilation with room air
2. When there is respiratory distress
3. When the infant has central cyanosis
4. When the oxygen saturation is less than 86%

4-45 Which infants do not need extra oxygen?

1. Infants with normal Apgar scores at birth
2. Infants with peripheral but not central cyanosis. If there is peripheral cyanosis only, the cause is usually cold hands and feet with poor perfusion, rather than hypoxia.
3. Preterm infants with a normal oxygen saturations

4-46 What methods can you use to administer oxygen?

1. Oxygen is most commonly given into a perspex head box. This is the best method of administering oxygen in a level 1 unit, as it is a simple, cheap and highly effective method.
2. At resuscitation oxygen is given via a mask and bag.
3. In a level 2 or 3 unit, oxygen is sometimes given via nasal prongs to infants with respiratory distress syndrome. Other infants may need to be intubated and ventilated.

Oxygen should not be given directly into a closed incubator as this method is wasteful, high concentrations cannot be reached and the concentration of oxygen drops every time an incubator port is opened. Giving 100% oxygen via a cardboard cup is extremely dangerous, especially if used for a long time, as it is almost impossible to control the percentage of oxygen accurately.

4-47 How can you measure the amount of extra oxygen given?

The amount of oxygen being given in a headbox can be measured with an oxygen monitor. The probe of the oxygen monitor is placed in the headbox and the display on the monitor box shows the amount of oxygen that the infant is breathing.

4-48 How much oxygen should you give?

The percentage of oxygen given in the headbox should be increased until:

1. Central cyanosis is corrected (the tongue is pink).
2. The oxygen saturation is 86–92%.

The required percentage of oxygen given to keep different infants pink may vary from 21 to 100%. For example, an infant with severe hyaline membrane disease may need 90% oxygen while another infant with mild wet lung syndrome may need only 25% to achieve a normal oxygen saturation. Do not confuse the percentage of oxygen given in a headbox with the oxygen saturation in the infant's blood.

4-49 How can you control the amount of oxygen given?

As there are dangers in giving too much or too little oxygen, it is important to give oxygen correctly.

In a level 1 hospital or clinic, oxygen is usually given by headbox. Whenever possible, an air/oxygen blender should be used so that the percentage of oxygen in the headbox can be accurately controlled. If a blender is not available, a venturi can be used. The venturi is a plastic gauge, which controls the amount of air and oxygen being mixed. Some venturis mix pure oxygen with room air to give any required percentage of oxygen while others only give a fixed percentage.

Whenever possible, an oxygen monitor should be used to accurately measure the percentage of oxygen in the headbox. It is very dangerous to attempt to control the percentage of oxygen given into a head box by simply altering the flow rate.
Always give headbox oxygen via a blender or venturi.

4-50 Should you humidify oxygen?
Yes. Oxygen should always be humidified, as oxygen from a cylinder is very dry. Dry oxygen irritates the airways. Usually it is not needed to warm oxygen if it is given by a headbox.

4-51 What flow rate of oxygen should you use?
When oxygen is given into a headbox, either directly or via a blender or venturi, the flow should be 5 litres per minute. A high flow rate wastes oxygen and cools the infant.

**TRANSFERRING A NEWBORN INFANT**

4-52 Why should newborn infants be transferred?
If pregnant women are correctly categorised into low risk and high risk groups during pregnancy and labour, low risk infants can be delivered at level 1 hospitals and clinics with the necessary staff and equipment to care for them. However, when maternal categorisation is incorrect, when unexpected problems present during or after delivery, or when a mother with a complicated pregnancy or labour arrives in advanced labour at a level 1 hospital or clinic, then the infant may need to be transferred to a hospital with a level 2 or 3 unit.

If possible, it is better for the infant to be transferred before delivery than after birth. The mother is the best incubator during transfer.

It is better to transfer the mother before delivery than to transfer the infant after birth.

4-53 What is the aim of care during transfer?
The aim is to keep the infant in the best possible clinical condition while it is being moved from the clinic to the hospital. This is achieved by providing the following:

1. A warm environment
2. An adequate supply of oxygen
3. A source of energy
4. Careful observations

This greatly increases the infant’s chance of survival without brain damage.

4-54 Which infants should be transferred to a level 2 or 3 hospital?
All infants that need management, which cannot be provided at a level 1 hospital or clinic, must be referred to the nearest level 2 hospital with a special care unit or a level 3 hospital with an intensive care unit. The following infants should be transferred:

1. Preterm infants, especially infants less than 36 weeks gestation
2. Infants with a birth weight under 1800 g. Most infants between 1800 g and 2500 g do not need to be referred and can be sent home.
3. Infants with asphyxia that require ventilation during resuscitation
4. Infants who need emergency management for hypothermia, hypoglycaemia or respiratory distress
5. Infants with problems such as severe infection, marked jaundice, trauma or bleeding
6. Infants with major congenital abnormalities, especially if urgent surgery is needed

Any infant needing possible referral must first be discussed with the staff at the referral hospital. Each region should establish its own referral criteria so that the staff knows which infants need to be transferred.

Each region must draw up its own referral criteria.
4-55 Why should the infant be resuscitated and stabilized before being transferred?

It is very important that the infant is fully resuscitated and stabilised before being transferred. The infant must be warm, well oxygenated and given a supply of energy before being moved. Transferring a collapsed infant will often kill the infant. The clinic staff and the transfer personnel should together assess the infant and ensure that the infant is in the best possible condition to be moved.

4-56 How should the transfer be arranged?

If possible, the hospital staff that will receive the infant should make the transfer arrangements. The hospital staff can then advise on management during transfer and be ready to receive the infant in the nursery. The unexpected arrival of an infant at the hospital must be avoided. The clinical notes and a referral letter must be sent with the infant. A sample of gastric aspirate, collected soon after delivery for microscopy and the shake test, is very helpful, especially in preterm infants, infants with respiratory distress and infants with suspected congenital pneumonia. Consent for surgery should also be sent if a surgical problem is diagnosed.

4-57 What are the greatest dangers during transfer?

1. **Hypothermia**: Infants must be kept warm during transfer and their skin temperature should be regularly measured. A transport incubator is the best way to keep the body temperature normal. If an incubator is not available, hypothermia can be prevented by using skin-to-skin care or by dressing the infant and then wrapping the infant in a silver swaddler (space blanket) or heavy gauge tin foil.

2. **Hypoglycaemia**: Some supply of energy must be provided during transfer. Either milk feeds or intravenous fluids should be given. The blood glucose concentration should be regularly measured with reagent strips.

3. **Hypoxia**: It is essential that infants receive oxygen during transfer if this is needed. All the equipment required for the safe administration of oxygen should be available. Infants who do not need extra oxygen must not be given oxygen routinely while being transferred. Some infants with respiratory distress or apnoea need ventilation during transfer.

4-58 Who should transfer a sick infant?

Vehicles to transfer infants must be provided by the local authority in each region. Ideally an ambulance should be used. If possible, ambulance personnel should be trained to care for infants during transfer. When this service is not available, the referral hospital should provide nursing or medical staff to care for the infant while it is being moved from the clinic to the hospital. A transport incubator, oxygen supply and emergency box of essential resuscitation equipment should always be available at the referral hospital for use in transferring newborn infants. Only as a last resort should the clinic provide a vehicle and staff to transfer a sick infant to hospital.

4-59 Should the mother also be transferred to hospital?

Yes, whenever possible, the mother should be transferred to hospital with her infant.

**CASE STUDY 1**

A 1500 g infant is brought to an outlying clinic on a cold winters day. The mother delivered 30 minutes before and has remained at home. The infant’s axillary temperature is 34.5 °C but the infant appears active. The clinic does not have an incubator.

1. **What error was made in the management of this infant?**

The infant should have been kept warm. Skin-to-skin care is very effective in keeping an
infant warm after delivery. An infant should never be allowed to get cold after delivery.

2. How can you warm this infant in the clinic?

You can use an incubator or a warm room to correct the infant's temperature. The staff can also give skin-to-skin care themselves.

3. When should the infant be moved to hospital?

If possible, it is best to warm the infant first before moving it to hospital.

4. How can the infant be kept warm in the ambulance?

If possible, a transport incubator should be used. If this is not available, use skin-to-skin care. Otherwise, the infant should be warmly dressed and wrapped in a blanket. A thermal blanket (or aluminium foil) can also be used. Remember that the infant must be warmed before it is placed in a thermal blanket.

CASE STUDY 2

A term infant is brought to a rural clinic after having been born at home. The infant is cold and wasted but otherwise appears well. A Haemoglukonost reagent strip, read by naked eye, gives a reading between 1.5 and 2 mmol/l.

1. What is your interpretation of the blood glucose concentration?

The infant has mild hypoglycaemia.

2. What is the danger of mild hypoglycaemia?

The infant is at high risk of developing severe hypoglycaemia.

3. Why does this term infant have a low blood glucose concentration?

Because the infant is cold. Hypothermic infants often become hypoglycaemic as they rapidly use up all their energy stores such as glycogen and fat. In addition this infant is wasted and, therefore, was born with reduced energy stores.

4. What are the clinical signs of hypoglycaemia?

Often there are no clinical signs. Severe hypoglycaemia may cause neurological signs such as lethargy, decreased tone, poor feeding, a weak cry, absent Moro, jitteriness and convulsions.

5. How would you treat this infant at the clinic?

Give the infant a feed of breast milk or formula. If neither is available, sweetened cow's milk may be used. The infant must also be warmed. The blood glucose concentration should have returned to normal in 15 minutes. If not, repeat the feed and arrange urgent transport to the nearest hospital. If the infant develops severe hypoglycaemia an infusion 10% dextrose (e.g. Neonatalyte) must be started. It is very important to start treatment before referring the infant to hospital.

CASE STUDY 3

A male infant is born at 32 weeks gestation in a level 1 hospital. Soon after delivery his respiratory rate is 80 breaths per minute with recession and expiratory grunting. The infant's tongue is blue in room air. A gastric aspirate is collected 10 minutes after delivery.

1. Which clinical signs indicate that the infant has respiratory distress?

Tachypnoea, recession, grunting and central cyanosis in room air.
2. What is the probable cause of the respiratory distress?

The infant probably has hyaline membrane disease due to immature lungs. Hyaline membrane disease is common in infants born preterm.

3. What is the value of collecting a sample of gastric aspirate?

Diagnosing the cause of the respiratory distress is often helped if a sample of gastric aspirate is collected soon after delivery. The diagnosis of hyaline membrane disease is supported by a negative shake test, which indicates immature lungs. A Gram stain showing pus cells suggests that the infant has congenital pneumonia as a complication of chorioamnionitis.

4. Should this infant remain at the level 1 hospital?

No, he should be moved as soon as possible to a level 2 or 3 hospital with staff and facilities to care for sick infants. Hyaline membrane disease deteriorates for 2 to 3 days before improving. Therefore, this infant should be transferred as soon as possible.

5. How would you manage this infant before transfer to a larger hospital?

Keep the infant warm and give just enough oxygen via a head box to keep the tongue pink. If a saturation monitor is available, keep the oxygen saturation between 86 and 92%. Handle the infant as little as possible after starting an intravenous infusion of 10% dextrose (e.g. Neonatylite). Carefully observe his respiration rate and pattern, colour, heart rate and temperature. Ventilate with a bag and mask if the infant develops apnoea or remains cyanosed in 100% oxygen.

6. How should the amount of oxygen in the infant’s blood be measured?

With a saturation monitor.

CASE STUDY 4

A 3 day old, term infant has pneumonia in a level 1 hospital and is nursed in an incubator. The infant is cyanosed in room air and needs oxygen therapy.

1. What equipment should be used to administer the oxygen?

The best method to give this infant oxygen would be a perspex head box. Giving oxygen directly into the incubator is unsatisfactory as it uses a lot of oxygen. In addition, high concentrations of oxygen cannot be given and the amount of oxygen in the incubator drops if a porthole is opened.

2. How should you measure the amount of oxygen given?

The concentration of oxygen in the head box should be measured with an oxygen monitor. The amount of oxygen given must not be measured in litres per minute with a flow meter, as this is an extremely inaccurate method of estimating the amount of oxygen being given.

3. How should you control the percentage of oxygen given?

With an oxygen-air blender or a venturi.

4. Why should the oxygen be humidified?

Because unhumidified gas is very dry and will irritate the linings of the nose, throat and airways.

5. What flow rate of oxygen should be given into the head box?

A flow rate of 5 litres per minute is best. This is measured on the flow meter.
CASE STUDY 5

A 1700 g infant is born in a rural clinic. The clinic staff call for an ambulance to take the infant to the nearest hospital. The hospital is not contacted. The infant, which appears well, is wrapped in a blanket and not given a feed. The note to the hospital reads 'Please take over the management of this small infant'.

1. **How should the transfer of this infant have been arranged?**

The clinic staff should have contacted the referral hospital and discussed the problem with them. The hospital staff should have advised the clinic staff as to further management. Only then should the infant have been transferred.

2. **What was wrong with the management of the infant at the clinic?**

The infant should have been fed before referral. A transport incubator or silver swaddler should have been used to prevent hypothermia on the way to hospital. Skin-to-skin care could also have been used.

3. **Why was the referral note inadequate?**

The referral letter should give all the necessary details of the pregnancy, the delivery and the infant’s clinical condition.
Objectives

When you have completed this unit you should be able to:
• Manage a jaundiced infant.
• Manage an infant with infection.
• Manage an infant with trauma.
• Manage a bleeding infant.
• Manage an infant with convulsions.
• List the common congenital abnormalities.

5-1 What are the important complications of infants born in a level 1 clinic or hospital?

1. Asphyxia
2. Hypothermia
3. Hypoglycaemia
4. Respiratory distress
5. Jaundice
6. Infection
7. Trauma
8. Bleeding
9. Convulsion
10. Congenital abnormalities

It is important that the nursing and medical staff at these clinics and hospitals are able to prevent, diagnose and manage these conditions.

5-2 Can these complications be prevented?

Many of these complications can be prevented with good antenatal and labour care, together with good care of the infant after delivery. Whenever possible, women who are at risk of delivering an infant with complications should be identified before delivery. These women can then be referred for delivery at a level 2 or 3 hospital where special care for the infant is available.

5-3 What is the management of these complications if the infant is born in a level 1 clinic or hospital?

1. They should be prevented antenatally if possible.
2. The mother should be transferred to a level 2 or 3 hospital before delivery if possible.
3. The condition should be prevented after birth if possible.
4. The condition should be diagnosed as soon as possible after delivery.
5. Emergency management must be given.
6. The infant should be discussed with the staff of the referral hospital.
7. A decision must be made as to whether the infant should be transferred or continue to be managed at the level 1 clinic or hospital.
8. Infants kept at the level 1 clinic or hospital must be correctly managed.
MANAGEMENT OF AN INFANT WITH JAUNDICE

5-4 What is jaundice?
Jaundice is a yellow colour of the skin caused by deposits of bilirubin in the skin. Jaundice is a clinical sign and not a laboratory measurement.

5-5 What is bilirubin?
Red cells in the blood contain a red pigment called haemoglobin, which carries oxygen. Red cells live for a few months only. Therefore, the body is continually forming new red cells in the bone marrow and destroying old red cells in the liver and spleen. The haemoglobin in old red cells is broken down into a yellow pigment called bilirubin. As newborn infants normally have a high haemoglobin concentration, they produce a lot of bilirubin.

5-6 What is hyperbilirubinaemia?
Hyperbilirubinaemia is defined as a concentration of total serum bilirubin that is higher than the normal range. Normally the bilirubin concentration in the serum is low at birth, as it has been rapidly removed by the placenta during pregnancy. The bilirubin concentration climbs steadily for the first few days after delivery, before returning to an adult level by 2 weeks.

5-7 How is bilirubin excreted?
After birth, bilirubin is carried by the blood stream to the liver where a special enzyme changes the bilirubin into a water soluble form. This chemical process is called conjugation. Only when the bilirubin is water soluble (i.e. conjugated) can the liver cells excrete it into the small bile ducts. From here the conjugated bilirubin is carried in the bile to the small intestine, where it is broken down further by bacteria and is excreted in the stool. During the first weeks of life the enzyme system, that conjugates bilirubin in the liver, functions slowly. Therefore, the amount of bilirubin increases in the serum and the newborn infant may become jaundiced as the excess bilirubin is deposited in the skin. After a few days the rate of conjugation in the liver increases and much more bilirubin is excreted. As a result, the amount of bilirubin in the serum slowly returns to the normal adult range and any jaundice disappears.

Some of the bilirubin that is conjugated and excreted by the liver in the first weeks of life is often broken down (unconjugated) by another enzyme in the intestine. This bilirubin is then reabsorbed back into the blood stream, adding to the hyperbilirubinaemia. The reabsorption of bilirubin from the intestine is greater in starved and breast fed infants.

5-8 How is bilirubin measured?
It is both difficult and inaccurate to assess the concentration of bilirubin in the serum by clinical examination of the degree of jaundice, especially in an infant with a dark skin. Therefore, it is important to measure the bilirubin concentration of the serum if an infant is very jaundiced. Usually a sample of blood is collected into a capillary tube and spun down to separate the serum from the red cells. The total serum bilirubin (TSB) is then measured with a bilirubinometer and expressed in µmol/l.

The total serum bilirubin (TSB) cannot be estimated accurately by assessing the degree of jaundice in the skin.

5-9 What is physiological jaundice?
This is the mild jaundice that is seen in up to 50% of all healthy, term infants during the first 2 weeks of life. Many of these infants are breast fed. These infants are well and do not need any treatment. Physiological jaundice in newborn infants is the result of:

1. The normally high haemoglobin concentration which results in a lot of bilirubin being produced.
2. The slow rate of conjugation of bilirubin by the liver, which results in only small, amounts being excreted.
3. The reabsorption of bilirubin from the intestines during the first few weeks after birth.

All these factors usually disappear by 2 weeks and the jaundice disappears.

**Many healthy infants have mild jaundice.**

5-10 When is jaundice abnormal?

1. If the TSB increases above the upper limit of the normal range or the infant looks severely jaundiced. The phototherapy line shown in Figure 1 is the upper limit of normal for TSB. Jaundice of the palms and soles suggests severe jaundice.
2. If the infant appears jaundiced in the first 24 hours.
3. If the infant is still jaundiced after 1 month.
4. If the infant is clinically sick or anaemic.

It is very important to decide whether the jaundice is physiological or abnormal.

5-11 What causes jaundice which is abnormal and not physiological?

1. When too much bilirubin is produced from haemoglobin because:
   - The concentration of haemoglobin is very high (i.e. polycythaemia).
   - Bilirubin is absorbed from a cephalhaematoma or area of bruising.
   - There is a very rapid break down of red blood cells (i.e. haemolysis).
2. When the excretion of bilirubin is too slow:
   - Preterm infants who have an immature liver.
   - About 10% of clinically healthy, term infants have slower conjugation than normal.
   - Congenital hypothyroidism. Due to the absence of a thyroid gland and low concentrations of thyroid hormone, the enzymes in the liver function very slowly.
3. When the infant has hepatitis due to:
   - Congenital syphilis.
   - Septicaemia.
4. When too much bilirubin is reabsorbed from the intestines:
   - Starved infants.
   - Some breast fed infants.

It is not uncommon for otherwise healthy breast fed infants to remain jaundiced for more than 2 weeks.

All these conditions may cause an abnormally high TSB and a very jaundiced infant.

5-12 What is haemolytic disease of the newborn?

Haemolytic disease of the newborn is a condition where antibodies from the mother cross the placenta into the fetal blood stream. Here these antibodies destroy the fetal red cells (i.e. haemolysis), causing anaemia and an increased production of bilirubin in the fetus and newborn infant. The 2 most important causes of haemolytic disease of the newborn are:

1. ABO haemolytic disease.
2. Rhesus haemolytic disease.

In haemolytic diseases of the newborn the blood group of the infant is different to that of the mother as it is inherited from the father.

5-13 What is ABO haemolytic disease?

Red cells have blood group proteins on their surface. A, B, O and D (Rhesus) are the most important blood group proteins. ABO haemolytic disease occurs when the mother is blood group O and her fetus is blood group A or B. For reasons unknown, some group O mothers start producing antibodies to the A or B proteins. These antibodies cross the placenta and cause haemolysis in the fetus by damaging the fetal red cells. With ABO haemolytic disease, the haemolysis is not severe enough to cause anaemia in the fetus but may cause severe jaundice and anaemia in the newborn infant.
The haemolysis results in anaemia (low haemoglobin concentration and low packed cell volume) and jaundice in the newborn infant. An infant with ABO haemolytic disease usually appears normal at delivery but becomes jaundiced within the first 24 hours. The TSB may increase rapidly and reach dangerous levels. Due to the haemolysis, the infant may also become anaemic. ABO haemolytic disease cannot be prevented.

5-14 What is Rhesus haemolytic disease?
Rhesus haemolytic disease is a form of haemolytic disease of the newborn, which may occur when the mother is Rhesus negative (she has no D protein on her red cells) and her fetus is Rhesus positive (it has D protein on its red cells). Rhesus haemolytic disease is caused by maternal antibodies to the D (i.e. Rhesus or Rh) protein on the red cells of the fetus. Only if fetal red cells accidentally cross the placenta, and enter the mother’s blood stream, will she produce antibodies to the D protein of her fetus. This process is known as sensitisation and may occur in a Rhesus (Rh) negative woman during a delivery, miscarriage or placental abruption. Rhesus haemolytic disease is more severe than ABO haemolytic disease. Therefore, the fetus may develop severe anaemia and die before birth. If born alive, the newborn infant rapidly becomes jaundiced and anaemic.

5-15 How can you prevent Rhesus haemolytic disease?
All pregnant women must have their blood group tested at the start of antenatal care. All Rhesus negative women must be given 100 µg (4 ml) of anti-D immunoglobulin by intramuscular injection within 72 hours of delivery, miscarriage or placental abruption. This prevents sensitisation.

5-16 When is jaundice dangerous?
Jaundice can become dangerous when the concentration of bilirubin in the blood becomes very high. Bilirubin may now enter the brain of the newborn infant and cause bilirubin encephalopathy (also called kernicterus). The risk of bilirubin encephalopathy depends on the severity of the hyperbilirubinaemia. In well, term infants the TSB becomes dangerous and may cause bilirubin encephalopathy above 350 µmol/l while in preterm infants the TSB becomes dangerous above 250 µmol/l.

5-17 How can bilirubin encephalopathy be prevented?
By not allowing the TSB to reach dangerous levels. A number of methods can be used to reduce the TSB:
1. Give early milk feeds (to reduce bilirubin reabsorption from the intestine).
2. Prevent preterm delivery.
3. Give anti-D immunoglobulin to all Rhesus negative mothers after delivery, a miscarriage or abruptio placentae.
4. Give phototherapy when the TSB approaches dangerous levels.
5. Do an exchange transfusion when phototherapy cannot keep the TSB below dangerous levels.

Early milk feeds help lower the total serum bilirubin.
5-18 What is phototherapy?
Phototherapy uses white or blue light to change bilirubin in the skin into a water soluble form of bilirubin. This water soluble bilirubin is then carried in the blood to the liver, from where it can be excreted without having to be conjugated. Phototherapy is, therefore, able to lower the TSB.

5-19 What equipment is used to give phototherapy?
Phototherapy is usually given with a phototherapy unit, which consists of a row of fluorescent tubes. Daylight tubes, white tubes or blue tubes are used. They should be changed after being used for 1000 hours because their effectiveness decreases with time, even if they still appear bright. A perspex (clear plastic) sheet must be placed below the tubes to reduce heat and filter out any ultraviolet light. A perspex sheet also protects the infant if a fluorescent tube breaks or comes loose.

Although exposure to sunlight also lowers the TSB, an infant placed in the sun may rapidly become too hot. Therefore, this form of phototherapy must be used with great caution.

5-20 When should you give phototherapy?
Whenever the TSB is above the normal range and approaches dangerous levels, or if the infant appears very jaundiced. In practice a simple chart is used to decide when to give phototherapy. If the TSB concentration reaches the phototherapy line, treatment should be started. The phototherapy line is the same as the upper limit of normal for the TSB and increases from birth to day 4 then levels off. Phototherapy is usually started earlier in preterm or sick infants. It is not necessary to give phototherapy to healthy, term infants who are jaundiced with a TSB below the phototherapy line. Therefore, phototherapy should not be given to well infants with physiological jaundice. It is very difficult to use phototherapy safely if the TSB cannot be measured.

See Figure 1 for a phototherapy chart showing the phototherapy line for term infants.

Prophylactic phototherapy is given when the TSB is still below the phototherapy line but either the TSB is expected to increase rapidly or the infant is at an increased risk of bilirubin encephalopathy. Therefore, prophylactic phototherapy is started immediately after birth if haemolytic disease of the newborn is suspected or diagnosed. Prophylactic

![Figure 1: Phototherapy chart showing the phototherapy line for term infants.](image-url)
phototherapy is often given to preterm infants when their TSB gets near the phototherapy line.

**5-21 How do you give phototherapy?**

1. Switch on the phototherapy unit and make sure the tubes are all working. Check the age of the tubes and ensure that the perspex sheet is in position.
2. Place the infant naked in an incubator or bassinet so that the infant is about 40 cm from the phototherapy tubes. The infant must not wear a cap or nappy. Instead, a nappy can be placed under the infant.
3. Cover the infant’s eyes with pads as the bright light often worries the infant. Remove the eye pads during feeding so that the eyes can be checked for infection and to allow the infant and mother to see each other.
4. Turn the infant over every hour. Frequent turning will make the phototherapy more effective as more skin is exposed to the light.
5. Feed the infant milk, at least every 3 to 4 hours. Breast feed if possible.
6. Monitor the infant’s skin temperature hourly, weigh daily and measure TSB daily or more frequently if it approaches dangerous levels.
7. Allow the mother unrestricted visiting. If possible, the infant should be given phototherapy next to the mother in the postnatal ward.

It is difficult to give phototherapy safely if the TSB cannot be measured.

**5-22 For how long should you give phototherapy?**

Continue phototherapy until the TSB has been under the phototherapy line for 24 hours. Sometimes the TSB rises above the line again after the phototherapy has been stopped. If so, the phototherapy should be restarted.

**5-23 What are the problems with phototherapy?**

1. The infant may become too hot or too cold.
2. The infant may pass large, loose, green stools.
3. The infant’s eyes pads may cover its nose or prevent conjunctivitis being noticed.
4. Phototherapy may interfere with maternal bonding if the infant is separated from the mother.
5. The clinical jaundice may disappear even though the TSB remains high.
6. Skin rashes are common.

*The total serum bilirubin should be measured in all infants receiving phototherapy.*

If the TSB cannot be measured at the level 1 clinic or hospital, a heparinized capillary tube of blood should be sealed at both ends with plasticine and placed in a box to keep light away. It must be sent to the nearest laboratory, which should phone the result to the clinic or hospital, as soon as it is available. While waiting for the result, phototherapy should be started.

**5-24 When should an infant with jaundice be transferred?**

1. Whenever there are any signs of abnormal jaundice, such as jaundice in the first 24 hours, severe jaundice or jaundice in an ill infant, ie. when the jaundice is not physiological.
2. If the TSB is more than 100 µmol/l above the phototherapy line.
3. If the TSB is above 350 µmol/l.

These infants should be discussed with the staff of the referral hospital before transfer.

**INFECTION IN THE NEWBORN INFANT**

**5-25 What infections are important in newborn infants?**

1. Conjunctivitis
2. Umbilical cord infection
3. Skin infection
4. Oral thrush
5. Septicaemia
6. Congenital syphilis
7. HIV infection

5-26 Why is infection common in newborn infants?

Because they have an immature immune system and are exposed to infectious organisms during pregnancy, delivery and in the nursery. The risk of infection in the newborn infant is much higher than in older children or adults. Infection is important as it is one of the commonest causes of death in infants during the first few months of life.

5-27 How can you prevent infection in newborn infants?

There are many simple ways in which infections can be prevented in the newborn infant:

1. Do not separate mothers and their infants unless absolutely necessary. Use skin-to-skin care.
2. Breast feeding. Breast milk contains cells and antibodies, which help to protect the infant from infections.
3. Vernix has antibacterial properties and, therefore, should not be washed off routinely after delivery. It is rapidly absorbed by the skin.
4. Hand spraying or hand washing before touching an infant is the most important method of preventing the spread of infection in the nursery. Before handling an infant spray your hands with an antiseptic spray (e.g. D-germ). There is no evidence that gowns or masks reduce cross infection. In the home, the family must wash their hands well after using the toilet.
5. Routine care of the umbilical stump with alcohol (surgical spirits) helps prevent infection.
6. Routine prophylactic eye care after delivery with chloromycetin ointment prevents conjunctivitis resulting from infection with Gonococcus during delivery.
7. If formula feeds are being used, the aseptic preparation of formula feeds, and the boiling of cups, bottles and teats is essential to prevent contaminated feeds. Use a cup rather than a bottle to give formula feeds.
8. Stethoscopes and other instruments should be sprayed with an antiseptic spray before an infant is examined.
9. Immunization of all pregnant women with tetanus toxoid prevents neonatal tetanus complicating cord infection.
10. Avoid overcrowding in nurseries by keeping normal infants with their mothers whenever possible.

Infection is a common cause of death in young infants.

Breast milk protects against infections.

It is not necessary to restrict visits of parents and family in the nursery provided that strict hand washing and hand spraying is enforced. There is no need for visitors to wear masks or gowns. If possible, family and staff with coughs, colds and ‘flu should not handle infants. Herpes infection (fever blisters) can cause a very serious infection. Infants should not be kissed.

5-28 What are the signs of conjunctivitis?

Conjunctivitis presents with:

1. A discharge from the eyes (mucous or pus).
2. Redness of the conjunctivae.
3. Oedema of the eyelids.

The degree of conjunctivitis can be divided clinically into mild, moderate and severe:

1. Mild conjunctivitis consists of a slight discharge. The eyelashes tend to stick together.
2. Moderate conjunctivitis presents with redness of the conjunctivae with an obvious discharge. Pus is present in the eye when the lids are separated.
3. Severe conjunctivitis has a marked discharge with oedema of the eyelids. Pus spurts from the eye and runs down the cheeks when the eyelids are opened. In
the most severe cases, it is not possible to separate the eyelids due to the swelling. The pus may soften the cornea and cause it to perforate (burst), severely damaging the eye.

 Conjunctivitis is usually mild. It is difficult to clinically identify the organism causing conjunctivitis although severe conjunctivitis is usually caused by Gonococcus from the mother’s cervix and vagina. Therefore, the management depends on the severity rather than the cause.

5-29 What is the management of conjunctivitis?

1. **Mild conjunctivitis** can usually be treated by cleaning the eye with saline or warm water at feeding times or when the lashes become sticky. A local antibiotic is usually not needed.

2. **Moderate conjunctivitis** should be treated by cleaning the eye and then putting in chloromycetin ointment 3 hourly or more frequently if needed.

3. **Severe conjunctivitis** is a medical emergency as it can lead to blindness if not promptly and efficiently treated. The infection is usually due to the Gonococcus and treatment consists of irrigating the eye and giving *parenteral penicillin*:
   - The pus must be washed out of the eye with saline, warm water or penicillin drops. This must be started immediately and repeated frequently enough to keep the eye clear of pus. The simplest way of irrigating the eye is to use a vacolitre of normal saline and an administration set. Penicillin drops can also be used. They can be made up in the nursery by adding 1 ml of benzyl penicillin to 50 ml sterile water or normal saline. The mixture must not be kept for more than 24 hours.
   - Benzyl penicillin intravenously 6 hourly or procaine penicillin intramuscularly 12 hourly must be given for 3 days. The dose of both benzyl and procaine penicillin is 50 000 units/kg per day. Penicillin eye drops alone are inadequate for treating severe conjunctivitis as the infection may have already spread to involve the whole eye. Start this treatment before referring the infant urgently to a level 2 or 3 hospital for further management.

**Gonococcus causes severe conjunctivitis which may result in blindness.**

5-30 What are the signs of an infected umbilical cord?

A healthy umbilical cord stump is white and soft at delivery. With good cord care it becomes dark brown and dehydrated within a few days, and at no stage does it smell offensive or produce pus. The aim of good cord care is to dry the cord and keep it clean.

Infection of the umbilical cord (omphalitis) presents with:

1. An offensive (smelly) cord with a discharge of pus.
2. Failure of the cord to become dehydrated (i.e. the cord remains wet and soft).
3. Redness of the skin around the base of the cord (a flare).

The commonest site of infection is at the base where the cord meets the skin. When the infection is localised to the cord only, there is no oedema of the skin around the base of the cord and the infant is generally well. Umbilical cord infection may spread to the anterior abdominal wall from where it may cause a peritonitis or septicaemia. Signs that the infection of the umbilical cord has extended to the abdominal wall are:

1. Redness and oedema of the skin around the base of the cord and spreading onto the abdomen (cellulitis).
2. Abdominal distension often with decreased bowel sounds and vomiting (peritonitis).
3. The infant is generally unwell with the features of septicaemia.

Cellulitis, peritonitis and septicaemia are serious infections and the infant may die if
not treated immediately with intramuscular or intravenous antibiotics. Infection of the umbilical cord may also cause tetanus in the newborn infant.

5-31 How do you treat umbilical cord infection?

With good preventative cord care, infection of the umbilical cord should not occur. Prevention consists of routine applications of alcohol (surgical spirits) to the cord every 6 hours until it is dehydrated. Antibiotic powder is not used. Do not put aspirin or other home remedies on the cord. Never cover the cord with the nappy or a bandage as this keeps it moist.

If the infection is localised to the umbilical cord, and there are no signs of cellulitis, peritonitis, septicaemia or tetanus, then treatment consists simply of cleaning the cord with surgical spirits every 3 hours to clear the infection and hasten dehydration. Neither local nor systemic antibiotics are needed. Special attention must be paid to the folds around the base of the cord, which often remain moist. Within 24 hours the infection should have cleared. Keep a careful watch for signs that the infection may have spread beyond the umbilicus.

5-32 What is tetanus?

Tetanus in the newborn infant (tetanus neonatorum) is caused by bacteria, which infect dead tissues such as the umbilical cord. Tetanus bacteria usually occurs in soil and faeces, which may be placed on the cord or other wounds as a traditional practice. They produce a powerful toxin that affects the nervous system.

Tetanus presents with:

1. Increased muscle tone (spasm), especially of the jaw muscles and abdomen.
2. Generalised muscle spasms and convulsions, often precipitated by stimulation such as handling or loud noises.
3. Respiratory failure and death in untreated infants, due to spasm of the respiratory muscles.

5-33 How do you manage tetanus?

Tetanus can be prevented by:

1. Good cord care.
2. Immunising all pregnant women with tetanus toxoid if tetanus is common in the region. All children should be fully immunised.

The emergency treatment of tetanus consists of:

1. Keeping the airway clear and giving oxygen.
2. Not stimulating the infant.
3. Stopping spasms with 1 mg diazepam (Valium) rectally. This may have to be repeated until the spasms stop. You may have to mask and bag ventilate the infant.
4. Transferring the infant urgently to the nearest level 2 and 3 hospital.

5-34 What are the signs and causes of skin infection?

The 2 commonest forms of skin infection in the newborn infant are:

1. **Impetigo** caused by Staphylococcus, which presents as pus filled blisters usually seen around the umbilicus or in the nappy area.
2. **A monilial rash** caused by a fungus (Candida or Monilia). This almost always occurs in the nappy area and presents as a red, slightly raised, ‘velvety’ rash which is most marked in the skin creases. In contrast, a nappy rash due to irritation of the skin by stool and urine usually affects the exposed areas of the skin and not the creases.

A sweat rash, due to excessive sweating, may look like an infection. It presents as small, clear blisters on the forehead or a fine red rash on the neck and trunk. Treat, by washing the infant to remove the sweat, and prevent overheating.

5-35 How do you treat skin infections?

Pay strict attention to hand washing and spraying, and do not routinely wash off vernix. Then skin infection should not be a problem in a nursery.
5-36 What are the clinical signs and management oral thrush?

Oral thrush is caused by a fungus (Candida or Monilia). It presents as a patchy, white coating on the tongue and mucus membrane of the mouth. Unlike a deposit of milk curds, sometimes seen after a feed, thrush cannot be easily wiped away. Mild thrush is very common, especially in breast fed infants and usually requires no treatment. In contrast, with severe thrush the tongue and mucus membrane are red and covered with a thick white layer of fungus. The infant feeds poorly due to a painful mouth. The infant appears miserable and may lose weight or even become dehydrated.

Severe thrush should be treated with 1 ml mycostatin drops (Nystatin) into the mouth after each feed. Mycostatin ointment can also be used and should be wiped onto the oral mucous membrane with a swab or clean finger. Treatment should be continued for a week. Gentian violet can be used on the thrush if mycostatin is not available. In a breast fed infant the source usually is monilial infection of the mother’s nipples. Mycostatin ointment should be smeared on the nipple and areolae after each feed. If the mother has a monilial vaginal discharge, this should be treated with mycostatin vaginal cream to reduce the amount of Candida on the mother’s skin. In bottle fed infants, the bottles and teats must be boiled after the feed. Disinfectant solutions such as Milton and Jik are very useful to prevent bacterial contamination of bottles but may not kill Candida. Dummies should be boiled or thrown away.

5-37 What are the signs of septicaemia?

The clinical signs of septicaemia are often non-specific, making the early diagnosis of septicaemia difficult. The common clinical signs are:

1. Lethargy and appearing generally unwell.
2. Poor feeding. The infant may also fail to gain or even lose weight.
3. Abdominal distension and vomiting.
4. Pallor (appear pale), jaundice and purpura (small red or blue spots due to bleeding into the skin).
5. Recurrent apnoea.
6. Hypothermia.
7. Oedema or sclerema (a woody feel to the skin).

The infant may also have signs of pneumonia, meningitis or necrotising enterocolitis.

5-38 How should you treat septicaemia?

Management of septicaemia consists of:

1. General supportive care of a sick infant (i.e. keep the infant warm, monitor the vital signs, give oxygen and intravenous fluids if necessary).
2. Antibiotics. Usually ceftriaxone or cefotaxime 100 mg/kg/day IM alone, or benzyl penicillin 50 000 units/kg/day IM or IV plus gentamicin 7.5 mg/kg/day IM or IV. Intramuscular ceftriaxone, gentamicin and benzathine penicillin are given daily, while intravenous benzyl penicillin and cefotaxime are given 8-hourly.
3. Discuss the infant urgently with the referral hospital and arrange transfer.

5-39 What are the signs of congenital syphilis?

An infant born with congenital syphilis may have one or more of the following signs:

1. Low birth weight
2. Blisters and peeling of the hands and feet
3. A distended abdomen due to an enlarged liver and spleen
4. Pallor due to anaemia
5. Purpura (petechiae) due to too few platelets
6. Jaundice due to hepatitis
7. Respiratory distress due to pneumonia
8. A heavy, pale placenta weighing more than a fifth of the weight of the infant

Some infants that have recently acquired congenital syphilis may have no clinical signs yet. If untreated, most of these asymptomatic infants will develop clinical signs of syphilis within a few months. Infants with congenital syphilis will have a positive VDRL or RPR test.

5-40 How do you treat congenital syphilis?

The method of treatment depends on whether the infant has or has not clinical signs of congenital syphilis:

1. If the infant has clinical signs of syphilis give 50 000 units/kg of procaine penicillin daily by intramuscular injection for 10 days. These infants are often very sick and need good general supportive care in a level 2 hospital.
2. If the mother has untreated syphilis or has not received a full course of treatment (3 weekly doses of benzathine penicillin), and the infant has no clinical signs of syphilis, then the infant can be treated with a single intramuscular dose of 50 000 units/kg of benzathine penicillin.
3. If the mother has received a full course of penicillin and the infant has no signs of syphilis, then the infant requires no treatment.

5-41 Can an infant get AIDS?

Yes. If a woman with HIV infection falls pregnant, or gets infected with HIV during pregnancy or while still breast feeding, the infant may also become infected with HIV. If the mother is HIV positive, the risk of infection in the infant is about 25%. HIV transmission from mother to infant usually takes place during labour and delivery. At birth infants infected with HIV usually appear healthy. Weeks to months or even years later they will develop signs of HIV infection.

The risk of HIV infection in the infant is greatly reduced with antiretroviral prophylaxis. All HIV-exposed infants must be identified at birth and correctly managed.

TRAUMA IN THE NEWBORN INFANT

5-42 What are the important types of trauma in the newborn infant?

1. Cephalhaematoma
2. Brachial plexus injury (Erb's palsy)
3. Bruising

5-43 What is a cephalhaematoma?

A cephalhaematoma is a collection of blood under the periosteum of the parietal bone of the skull. It is common, appears within hours of delivery as a soft swelling on the side of the head, and may be on one or both sides. A cephalhaematoma is caused by damage to capillaries under the periosteum and, therefore, never extends beyond the edges of the bone. Cephalhaematomas are usually small and need no treatment. The absorption of blood may cause jaundice, however, which may require treatment by phototherapy. It can take up to 3 months before the cephalhaematoma disappears. Never aspirate a cephalhaematoma as it may result in further bleeding or infection.

Never aspirate or drain a cephalhaematoma.

In contrast, a subaponeurotic haemorrhage is a collection of blood under the scalp. Fortunately a subaponeurotic haemorrhage is not common as it rapidly results in shock due to blood loss.
5-44 What is a brachial plexus injury?

A brachial plexus injury (or Erb's palsy) is caused by excessive pulling on the head and neck during delivery. The infant is usually large and born at term with difficulty delivering the shoulders. Brachial palsy may also complicate a poorly managed breech delivery. By over stretching the neck, the brachial plexus of nerves in the infant's neck is damaged.

Immediately after birth it is noticed that the infant does not move one arm due to weakness at the shoulder and elbow. The arm remains fully extended and held beside the body. The infant is unable to flex that arm at the elbow or lift the arm off the bed. Movement of the hand and fingers is normal, however. The infant also has a markedly asymmetrical Moro reflex. Unless there is an associated fracture, there is no tenderness, pain or swelling of the arm.

Usually the weakness is much better by a week and full movement and power return by a month. If the weakness is not much improved by a week, refer the infant to a level 2 or 3 hospital for assessment. Keeping the arm above the head will not help recovery.

A facial palsy presenting with weakness of one side of the face after delivery is not common and usually recovers within a few days.

5-45 What causes bruising?

Bruising is common after difficult deliveries, especially breech delivery in a preterm infant. The bruise is due to bleeding into the skin. A tight umbilical cord around the neck commonly causes severe congestion and bruising of the face. The bruise fades after a week or two and needs no treatment. The absorbed blood may cause jaundice, requiring phototherapy.

Rarely, fractures of the clavicle (collar bone), humerus or even femur occur after a very difficult delivery. These fractures usually heal well without splinting. Paracetamol (Panado syrup 2.5 ml) should be given for pain relief in all fractures.

THE MANAGEMENT OF BLEEDING IN THE NEWBORN INFANT

5-46 What is the commonest cause of bleeding?

Bleeding from the cut umbilical cord due to a slipped cord clamp or cord tie. Therefore, it is very important to make sure that the cord is clamped or tied correctly, or the infant may bleed severely.

5-47 What is haemorrhagic disease of the newborn?

Haemorrhagic disease of the newborn is bleeding due to a lack of vitamin K, which is needed by the infant to produce clotting factors in the liver. During pregnancy the fetus does not get much vitamin K from the mother and there is not much vitamin K in breast milk.

Infants with haemorrhagic disease of the newborn usually bleed from their umbilical cord, vomit blood or have blood in their stools during the first week of life. If severe, the infants can bleed to death. Any infant presenting with bleeding must be given 1 mg of Konakion (vitamin K) and urgently referred to a level 2 or 3 unit. If very pale and shocked, the infant must first be resuscitated and given intravenous fluid.

5-48 How do you prevent haemorrhagic disease of the newborn?

By giving all infants 1 mg (0.1 ml) of Konakion by intramuscular injection after delivery. This is best given into the lateral thigh (NOT into the buttock).

All babies must be given intramuscular konakion after delivery.
Oral Konakion should not be used, as it cannot be relied on to prevent haemorrhagic disease unless it is given repeatedly.

5-49 What is purpura?

Purpura (or petechiae) are small bleeds under the skin presenting as pink or blue spots. Purpura usually only occurs over part of the body and is caused by pulling and squeezing of the arms or legs during a difficult delivery. It disappears after a few days. If purpura occurs over the whole body there is probably some abnormality with the infant’s platelets. These infants must be urgently referred to a level 2 or 3 hospital for investigation and treatment. Do not confuse purpura with the blue patches (Mongolian spots) commonly seen over the back.

MANAGEMENT OF CONVULSIONS (FITS)

5-50 How can you recognise a convulsion in a newborn infant?

A convulsion (fit) may present as:

1. Twitching of part of the body (e.g. a hand), one side of the body, or the whole body (a generalised fit).
2. Extension (spasm) of part of the body (e.g. an arm) or the whole body.
3. Abnormal movements (e.g. mouthing movements, turning the eyes to one side or cycling movements of the legs).

It is often very difficult to recognise a convulsion in a newborn infant as infants usually do not have a grand mal fit (generalised extension followed by jerking movements) as seen in older children and adults.

Jitteriness and the movements normal infants make while asleep must not be confused with convulsions. Unlike convulsions, jitteriness can be stimulated by handling the infant. In addition, jitteriness can be stopped by holding that limb.

5-51 What are the important causes of convulsions?

The important causes of convulsions in the newborn infant are:

1. Fetal hypoxia (hypoxia during labour)
2. Hypoglycaemia
3. Meningitis

Convulsions in the first few days of life are usually due to hypoxia during labour.

5-52 How do you treat a convulsion?

1. Clear the mouth and throat by suction and remove any vomited milk. Then give oxygen by face mask. Mask and bag ventilation will be needed if the infant is not breathing or has central cyanosis.
2. Empty the stomach by a nasogastric tube to prevent vomiting.
3. Stop the convulsion with phenobarbitone 20 mg/kg given intravenously, if possible, or by intramuscular injection. If the fit does not stop in 15 minutes, diazepam (Valium) 0.5 mg/kg can be given rectally with a syringe and nasogastric tube.
4. Measure the blood glucose concentration and treat hypoglycaemia, if present, before transferring the infant.
5. All infants that have had a fit must be transferred urgently to a level 2 or 3 hospital for investigation and treatment.

CONGENITAL ABNORMALITIES

5-53 What are the common congenital abnormalities?

1. Extra fingers: These are usually attached by a thin thread and can be tied off with suture material. One of the parents often has also had extra fingers at birth.
2. Hypospadias in boys: The underside of the foreskin is missing, the penis is bent
down and the opening of the urethra is not at the end of the penis. These infants should be referred, as should infants with undescended testes at term. Infants with abnormal genitalia and uncertain gender must be referred urgently.

3. Birth marks: Blue marks over the lower back (Mongolian spots) are common and disappear in a few years. Bright red, raised strawberry spots appear in the first few weeks. They enlarge for a few months and then disappear by 5 years.

4. Clubbed feet: They cannot be twisted back into a normal position unlike feet that are simple squashed by too little amniotic fluid. The infant must be referred for treatment.

5. Cleft lip or palate: These infants may need to be fed by tube or cup for the first few days. They must be referred for treatment.

6. Bowel abnormalities: Infants who dribble or choke because they cannot swallow must be transferred urgently as must infants who vomit bile, develop a distended abdomen or have no anus.

7. Infants with an abnormal face: Infants with Down syndrome and fetal alcohol syndrome can be recognised at birth by experienced staff. They have an abnormal appearance to their face and may have other abnormalities. They must be referred for a specialist opinion.

CASE STUDY 1

A well, breast fed, term infant develops jaundice on day 3. The TSB (total serum bilirubin) is 120 µmol/l, which falls into the normal range for day 3. Both the mother and infant are blood group 0 positive.

1. What is the probable cause of this infant’s jaundice?

This infant probably has physiological jaundice caused by slow bilirubin conjugation by the liver and increased bilirubin reabsorption by the intestines.

2. Why does the infant not have jaundice caused by ABO or Rhesus haemolytic disease?

Because both the mother and infant have the same ABO and Rhesus blood groups.

3. Does this infant have hyperbilirubinaemia? Give reasons for your answer.

No, this infant does not have hyperbilirubinaemia because the TSB falls within the normal range for day 3.

4. What is the correct management of this infant?

The infant should be managed as for a healthy, normal infant except that the TSB should be repeated daily until it starts to fall.

5. Should this infant receive phototherapy?

No. There is no reason for phototherapy.

6. Should the mother stop breast feeding? Explain your answer.

No, she should continue to breast feed. Although breast feeding may result in a slightly higher TSB, it is not necessary to stop breast feeding.

CASE STUDY 2

The mother delivers a 2000 g infant at home. On day 2 the infant develops bilateral purulent conjunctivitis. When he is brought to the local clinic his eyelids are swollen. Otherwise the infant is well with no other abnormal signs. However, it is noticed that the mother was VDRL positive during her pregnancy and was not treated.
1. What is the probable cause of the conjunctivitis?
Gonococcus. This is the commonest cause of severe conjunctivitis. The infant was probably infected during delivery.

2. How could the conjunctivitis have been prevented?
By placing chloromycetin ointment into the infant’s eyes after delivery.

3. Why should you call this severe conjunctivitis?
Because the eyelids are swollen and the eyes are filled with pus.

4. What is the danger of severe conjunctivitis?
The cornea may become soft and perforate, causing blindness.

5. What is the correct treatment of severe conjunctivitis?
The eyes must be washed out with saline or water. They should then be washed out or irrigated repeatedly until the pus stops forming. In addition, procaine penicillin 100 000 units must be given by intramuscular injection daily for 3 days. Only when the eyes are clean and the first dose of penicillin has been given should the infant be referred to hospital for further treatment.

6. Why is it important to know that the mother had a positive VDRL test during pregnancy?
Because it indicates that she probably has syphilis. If the mother has not been fully treated, the infant must be treated as he may have asymptomatic syphilis infection.

7. What is the treatment if the infant appears well but the mother has untreated syphilis?
If the infant has no clinical signs of syphilis the treatment is a single intramuscular dose of 50 000 units/kg benzathine penicillin. If the infant had clinical signs of syphilis the treatment would be procaine penicillin 50 000 units/kg IM daily for 10 days.

CASE STUDY 3
An infant weighing 5000 g is born in a level 2 hospital. The shoulders are delivered with great difficulty. After birth it is noticed that the infant does not move her right arm much and has an asymmetrical Moro reflex.

1. What do you think is wrong with her arm?
She probably has a brachial plexus injury (Erb’s palsy) caused by excessive downward traction (pulling) on the neck during the difficult delivery of the shoulders.

2. How would you confirm this diagnosis?
The infant will have weakness of the shoulder and elbow and will be unable to lift her arm off the bed or flex the elbow against gravity. Movement and power in the hand will be normal. Unless there is a fracture, there should be no tenderness.

3. Will the weakness recover?
Usually the weakness is much improved by a week.

4. What is the correct treatment?
If the weakness is not much better after a week, the infant must be referred to a level 2 or 3 hospital for further management.
CASE STUDY 4

A preterm infant weighing 1500 g is born at home. The infant is transferred to hospital but the staff forget to give Konakion. On day 5 the infant passes a lot of fresh blood in the stool, has a small dark brown vomit and appears pale.

1. Why does this infant have blood in the vomitus and stool?
   The infant probably has haemorrhagic disease of the newborn.

2. Is this condition preventable?
   Yes. Haemorrhagic disease of the newborn should not be seen if Konakion is given routinely to all infants.

3. What is Konakion?
   Vitamin K1. This must be given to all infants at birth by intramuscular injection into the thigh.

4. What is the correct management of this infant?
   Give 1 mg Konakion immediately. Start an intravenous infusion if the infant appears pale and shocked. Discuss the infant with the staff at the referral hospital and transfer the infant as soon as possible.
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