NATIONAL GUIDELINES FOR NEWBORN CARE

VOLUME I

- Care of the normal newborn at birth and beyond
- Hypothermia and thermal control
- Breastfeeding
- Fluid management
- Low birth weight babies
- Hypoglycaemia

MINISTRY OF HEALTH
2014
• Care of the normal newborn at birth and beyond
• Hypothermia and thermal control
• Breastfeeding
• Fluid management
• Low birth weight babies
• Hypoglycaemia
These guidelines are published by the Family Health Bureau, Ministry of Health, 231, De Seram Place, Colombo 10, Sri Lanka.

Web: www.family health.gov.lk

Prepared by: the Sri Lanka College of Paediatricians

Edited by:
Dr Medha Weerasekera, Consultant Paediatrician
Dr Ranmali Rodrigo, Lecturer in Paediatrics
Dr Nishani Lucas, Consultant Neonatologist/Lecturer in Paediatrics
Dr Dhammica Rowel, Consultant Community Physician

Editorial Assistance:
Dr Kaushalya Edirisuriya, Medical Officer

Copyright@2014 Ministry of Health


Statement of Intent

The main purpose of these guidelines is to improve the quality of clinical care provided by the health care providers at all levels. These parameters of practice should be considered recommendations only. The ultimate judgment regarding a particular clinical procedure or a treatment plan must be made by the clinician in light of the clinical data gathered from the patient and the diagnosis and treatment options available.

Printed by Vishwa Graphics (Pvt) Ltd
Preface

As the year 2015 is around the corner, we are focusing our attention on reaching targets beyond the Millennium Development Goals and the goals set by the Every Newborn Action Plan of 2014. This national guideline on neonatal care is very well timed as a greater emphasis is being given for improving the quality of neonatal care services for further reduction of neonatal morbidity and mortality in Sri Lanka. Some of the guidelines are adopted from SAARC Development Fund Facility Based Care of the Sick Newborn training guidelines and some sections include newly developed guidelines. This is an attempt to improve the quality and uniformity of clinical care with efficiency, cost effectiveness and accountability.

I highly appreciate the contribution made by the Consultant Paediatricians and Consultant Neonatologists from the Sri Lanka College of Paediatricians and Consultant Community Physicians of the Family Health Bureau in adopting and developing these guidelines. Further these guidelines have been developed considering the national policy, strategies and standards as well as facilities and resources available in the country. As such this set of guidelines are national guidelines for the conditions described.

Dr P.G. Mahipala
Director General of Health Services,
Ministry of Health,
Sri Lanka.
Sri Lanka emerged from a 30 year old war in 2009 and five years have elapsed since then. It is not late even today to plan for long term development of the health sector like roads and townships. The health service also has improved but not clearly in a planned manner.

Our Neonatal Mortality Rate has declined to be around 5.9/1000 live births. Yet it accounts for over 70% of under 5 mortality of our children. Global average contribution of neonatal mortality to under 5 mortality is 45%. Therefore it is appropriate that we focus on improving neonatal care. Care of the preterm remains a serious challenge. 12% still die of perinatal asphyxia. 20% of deaths are due to congenital abnormalities. Sepsis remain a serious threat to even healthy term low risk babies discharged from the hospital. This is despite a lot of effort put into training of human resources and improving infrastructure. Focusing on the neonate specifically in these areas is a priority which cannot be postponed.

Simple interventions like preconception folic acid, antenatal corticosteroids for preterm delivery, preventing inadvertent oxygen administration and using a pulse oxymeter for neonatal resuscitation, delayed cord clamping, delivery onto abdomen of the mother, using plastic bags for preterm babies, preventing hypothermia, simple inflation and ventilation breaths by the midwife or nurse in unexpected situations, passive head cooling for asphyxia, promotion of exclusive breast feeding on demand could be practiced in low resource settings. Truth is these simple interventions will reduce our NMR further if the coverage could be improved to over 90%.

A team of Consultant Paediatricians, Consultant Neonatologists and Consultant Community Physicians have been working on these newborn care guidelines for several months. These guidelines for newborn care will go a long way to bring uniformity in standards of neonatal care across the country. The health care providers in different
parts of this country should be able to care for newborns in the same way using the best standards of care where ever they are. These newborn care guidelines will help them in doing so. It is not difficult, especially to provide basic care and reduce morbidity and mortality using these guidelines even in a low resource setting.

I express my sincere gratitude towards all who worked hard to publish this and congratulate the FHB and the team for their achievement. I am certain that, this booklet will go a long way to reduce mortality and both short and long term morbidity of newborns in Sri Lanka.

**Prof Sujeewa Amarasena**  
President,  
Sri Lanka College of Paediatricians
Guideline Development Committee

Prof Sujeewa Amarasena, Professor of Paediatrics
Dr Sandya Bandara, Consultant Paediatrician
Dr Girlie de Silva, Consultant Paediatrician
Dr Ramya de Silva, Consultant Paediatrician
Dr Sandya Doluweera, Consultant Paediatrician
Dr Nalin Gamaathige, Consultant Neonatologist
Prof Dulani Gunasekera, Professor of Paediatrics
Dr Anoma Jayathilaka, Consultant Community Physician
Dr Saman Kumara, Consultant Neonatologist
Dr Nishani Lucas, Consultant Neonatologist
Dr Nalika Menike, Consultant Neonatologist
Dr Ranmali Rodrigo, Lecturer in Paediatrics
Dr Dhammica Rowel, Consultant Community Physician
Dr Rajeev Sathanantharajah, Consultant Neonatologist
Dr Sarojini Viknarajah Mohan, Consultant Paediatrician
Dr Medha Weerasekera, Consultant Paediatrician
Dr Kapilani Withanaarachchi, Consultant Paediatrician
## Content Page

<table>
<thead>
<tr>
<th>Chapter 1</th>
<th>Care of the normal newborn at birth and beyond</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 Introduction</td>
<td>3</td>
</tr>
<tr>
<td>1.2 Aims of neonatal care following birth</td>
<td>3</td>
</tr>
<tr>
<td>1.2.1 Attendance by skilled health care professional</td>
<td>3</td>
</tr>
<tr>
<td>1.2.2 Ten steps in the immediate care of the newborn</td>
<td>4</td>
</tr>
<tr>
<td>1.2.3 Care of umbilical cord</td>
<td>4</td>
</tr>
<tr>
<td>1.2.4 Baby identification marking</td>
<td>5</td>
</tr>
<tr>
<td>1.2.5 Initial weight recording</td>
<td>5</td>
</tr>
<tr>
<td>1.2.6 Initiation of breastfeeding</td>
<td>5</td>
</tr>
<tr>
<td>1.2.7 Vitamin K</td>
<td>6</td>
</tr>
<tr>
<td>1.2.8 Iron supplementation</td>
<td>6</td>
</tr>
<tr>
<td>1.2.9 Clinical screening at birth</td>
<td>6</td>
</tr>
<tr>
<td>1.2.10 No stomach wash at birth</td>
<td>7</td>
</tr>
<tr>
<td>1.2.11 Communication with the family</td>
<td>7</td>
</tr>
<tr>
<td>1.3 Concept of golden hour</td>
<td>7</td>
</tr>
<tr>
<td>1.4 Identification of ‘neonates at risk’</td>
<td>8</td>
</tr>
<tr>
<td>1.5 Care beyond birth</td>
<td>8</td>
</tr>
<tr>
<td>1.6 Developmental variations &amp; physiological conditions</td>
<td>9</td>
</tr>
</tbody>
</table>
1.7  Possetting, pattern of passing urine, stools and crying 11
1.8  Advice at discharge 13
1.8.1  Maintenance of body temperature 13
1.8.2  Breastfeeding 13
1.8.3  Skincare/bathing 14
1.8.4  Care of the umbilical stump 14
1.8.5  Care of the eyes 14
1.8.6  Immunizations 15
1.9  Practices to be discouraged 15
1.10  Danger signs 15
1.11  Check list before discharge 16
1.12  Discharge and follow up policy 18
1.13  Domiciliary care and field postnatal care 18

Chapter 2
Hypothermia and thermal control 23

2.1  Introduction 23
2.2  Why are newborns prone to develop hypothermia? 23
2.2.1  Mechanisms of heat loss 23
2.3  Concept of warm chain 24
2.4  Assessment of hypothermia 25
2.4.1  What is hypothermia? 25
2.4.2  Temperature recording 25
2.4.3  Clinical signs and symptoms 26
2.5  Situations where hypothermia can occur 27
2.6  Prevention of hypothermia 27
2.6.1  Steps to prevent heat loss in the delivery room 27
2.6.2  Kangaroo mother care (KMC) 27
2.6.3  Wrapping the baby 29
2.7     Management of hypothermia     29
2.8     Fever (Hyperthermia)     31
2.9     Discharge advice and follow-up     33

Chapter 3
Breastfeeding     37

3.1     Introduction     37
3.2     Advantages of breastfeeding     38
3.3     Breastfeeding technique     39
3.4     Breastfeeding for sick / small newborns     42
3.5     Situations when breastfeeding is not initiated     46

Chapter 4
Fluid Management     49

4.1     Introduction     49
4.2     Intravenous (IV) fluid therapy     49
4.3     Special situations     54
4.4     Adjusting IV fluids with enteral feeding     54

Chapter 5
Low Birth Weight Babies
Preterm And Small For Gestational Age     59

5.1     Introduction     59
5.2     Definitions     59
5.3     Identification of a preterm baby     60
5.4     Problems in preterm and small for gestational age neonates     66
5.5     General management of low birth weight (LBW) babies     67
5.6     Keeping LBW babies warm     69
5.7 Nutrition and fluids 69
5.8 Feeding techniques 71
5.9 Nutritional supplements 75
5.10 Discharge planning 76
5.11 Prognosis and prevention of complications 77

Chapter 6
Hypoglycemia 83

6.1 Introduction 83
6.2 Definition of hypoglycaemia 83
6.3 Prevention and management of hypoglycaemia 84
6.4 Screening for hypoglycaemia 84
6.5 Treatment of hypoglycaemia 87
6.6 Referral to a paediatric endocrinologist 88
6.7 Glucose Infusion Rate 93
6.8 Post discharge advice and follow up 93
## List of Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANS</td>
<td>Antenatal steroids</td>
</tr>
<tr>
<td>APH</td>
<td>Antepartum haemorrhage</td>
</tr>
<tr>
<td>BCG</td>
<td>Bacillus Calmette-Guerin</td>
</tr>
<tr>
<td>CPAP</td>
<td>Continuous positive airway pressure</td>
</tr>
<tr>
<td>DPT</td>
<td>Diphtheria, Pertussis, Tetanus</td>
</tr>
<tr>
<td>DT</td>
<td>Diphtheria, Tetanus</td>
</tr>
<tr>
<td>EBM</td>
<td>Expressed breast milk</td>
</tr>
<tr>
<td>GIR</td>
<td>Glucose infusion rate</td>
</tr>
<tr>
<td>IM</td>
<td>Intramuscular</td>
</tr>
<tr>
<td>IQ</td>
<td>Intelligence quotient</td>
</tr>
<tr>
<td>IUGR</td>
<td>Intrauterine growth restriction</td>
</tr>
<tr>
<td>IV</td>
<td>Intravenous</td>
</tr>
<tr>
<td>IVH</td>
<td>Intra ventricular haemorrhage</td>
</tr>
<tr>
<td>JE</td>
<td>Japanese Encephalitis</td>
</tr>
<tr>
<td>KMC</td>
<td>Kangaroo mother care</td>
</tr>
<tr>
<td>LBW</td>
<td>Low birth weight</td>
</tr>
<tr>
<td>MEN</td>
<td>Minimal enteral nutrition</td>
</tr>
<tr>
<td>MMR</td>
<td>Measles, Mumps, Rubella</td>
</tr>
<tr>
<td>MOH</td>
<td>Medical officer of health</td>
</tr>
<tr>
<td>NG</td>
<td>Nasogastric</td>
</tr>
<tr>
<td>NNS</td>
<td>Non nutritive sucking</td>
</tr>
<tr>
<td>OFC</td>
<td>Occipitofrontal circumference</td>
</tr>
<tr>
<td>OPV</td>
<td>Oral polio vaccine</td>
</tr>
<tr>
<td>PHM</td>
<td>Public health midwife</td>
</tr>
<tr>
<td>PMO</td>
<td>Pressure monitoring</td>
</tr>
<tr>
<td>RDS</td>
<td>Respiratory distress syndrome</td>
</tr>
<tr>
<td>ROP</td>
<td>Retinopathy of prematurity</td>
</tr>
<tr>
<td>SCBU/NICU</td>
<td>Special Care Baby Unit/ Neonatal Intensive Care Unit</td>
</tr>
<tr>
<td>SGA</td>
<td>Small for gestational age</td>
</tr>
<tr>
<td>VLBW</td>
<td>Very low birth weight</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organization</td>
</tr>
</tbody>
</table>
List of Tables

Table 1.1  National Immunization Schedule
Table 4.1  Neonatal fluid requirement (ml/kg/day)
Table 5.1  Guidelines for modes of providing fluids and feeding
Table 6.1(a):  Achieving required glucose infusion rates for neonates with birth weight ≥1500g using a mixture of 5% dextrose (D5) and 25% dextrose (D25)
Table 6.1(b): Achieving required glucose infusion rates for neonates with birth weight <1500g using a mixture of 5% dextrose (D5) and 25% dextrose (D25)
Table 6.2(a): Achieving required glucose infusion rates for neonates with birth weight ≥1500g using a mixture of 10% dextrose (D10) and 25% dextrose (D25)
Table 6.2(b): Achieving required glucose infusion rates for neonates with birth weight <1500g using a mixture of 10% dextrose (D10) and 25% dextrose (D25)

List of Figures

Figure 1.1  Mechanisms of heat loss in a newborn
Figure 3.1  Risk of diarrhoea by feeding method among Philippine infants aged 0 – 2 months
Figure 3.2  Good attachment
Figure 3.3  Different methods of holding the baby for breastfeeding
Figure 3.4  Identifying hunger cues in newborn babies
Figure 5.1  New Ballard Score for gestational age assessment
Figure 5.2a  Modified Fenton growth chart – boys
Figure 5.2b  Modified Fenton growth chart – girls
Figure 5.3  Ear cartilage
Figure 5.4  Breast Nodule of a preterm (left) and term (right) infant
Figure 5.5  Sole Creases of a preterm (left) & term (right) infant
Figure 5.6 a  Male external genitalia
Figure 5.6 b  Female external genitalia
Figure 6.1  Heel prick - site and method of sampling
Disclaimer

These guidelines are based on current best available evidence and consensus opinion of the Consultants involved in the development of Guidelines. They are neither intended to replace the process of critical evaluation of every case and nor is it intended to dictate an exclusive course of management or treatment. It must be interpreted with reference to individual patient needs, available resources and limitations unique to the institution and variations in local populations.

This guideline on Neonatal Care has been developed based on the best available evidence at the time of preparation. It is the responsibility of the users of the guideline to keep updated with the latest evidence relevant to the management of patients under their care.
Introduction

Clinical guidelines are systematically developed statements which assist clinicians in making decisions about appropriate treatment for specific conditions based on the best scientific evidence at the time of development. Guidelines are not intended to limit the clinical freedom. However, clinicians are expected to follow these recommendations as the basis for their decision making. Availability of resources, the existing situations and the expectations of individual families under their care need to be considered by the clinicians.

These guidelines are developed by the group of consultants in the guidelines development committee. The sources of information that were used as references in preparing the guidelines included the UK NICE (National Institute for Clinical Excellence) guidelines, American Academy of Pediatrics guidelines, SDF Facility Based Care for the Sick Newborn manual, Roberton’s Text book of Neonatology, and relevant research papers from peer reviewed journals. The information from these sources were combined with our local expert opinion and knowledge of available technical facilities in the country when formulating the guidelines. The latest available scientific evidence based recommendations have been made as far as possible. The draft guidelines were presented to the wider forum of paediatricians and neonatologists, in order to obtain feedback after which a consensus was arrived at. The guidelines were then presented to the Technical Advisory Committee on Newborn and Child Health of the Ministry of Health and consensus was arrived at with the participation of a multi-disciplinary team including medical administrators, provincial health authorities, representatives of the Sri Lanka College of Paediatricians and other relevant professional colleges and national programme managers and senior nursing officers.

Scope

The guidelines are intended to assist all health care professionals at all levels of institutions where newborn care is being provided, in the clinical management of normal and sick newborns.
CARE OF THE NORMAL NEWBORN AT BIRTH AND BEYOND
Chapter 1

CARE OF THE NORMAL NEWBORN AT BIRTH AND BEYOND

1.1 Introduction

Birth is the crucial period of transition from inutero dependent life to exutero independent existence. Effective care at birth is needed in anticipation of problems with this transition and to provide support to ensure stabilization. Large majority of newborns after birth would be transferred to the postnatal wards for rooming-in with their mothers.

All babies need to be monitored because they are at continued risk of hypothermia and need to establish breastfeeding during the first few days of life. These babies can also become sick and develop danger signs, for which they would require appropriate treatment.

1.2 Aims of neonatal care following birth

- Establishment of respiration (as per Newborn life support guidelines)
- Prevention of hypothermia (Refer Chapter 2)
- Establishment of breastfeeding (Refer Chapter 3)
- Prevention of infection (Refer Chapter 9)
- Detection of danger signs

1.2.1 Attendance by skilled health care professional

- A skilled birth attendant (Medical Officer / Nursing Officer / Midwife) should be responsible for every mother and baby
- The care at birth is same irrespective of birthing place or person in attendance at the birth
- At least one health care provider trained in basic neonatal resuscitation must be physically available at the time of birth of all infants irrespective of risk status.
This person must actually be present in the delivery room before the birth of the baby.

The baby’s details such as time of birth, weight, gender and any other relevant information should be documented in all cases.

1.2.2 Ten Steps in the immediate care of the newborn

• Call out the time of birth
• Dry baby with a warm clean towel or a piece of cloth; wipe eyes
• Assess the baby’s breathing while drying
• Delayed cord clamping – clamp the umbilical cord at least 1 minute after the birth (while holding the baby at or below placenta level), if the baby does not require resuscitation. If resuscitation is required clamp and cut the cord immediately. Change gloves before clamping the cord.
• Deliver baby on to mother’s abdomen after clamping the cord.
• Cover mother and baby with a warm cloth
• Put a cap on the baby’s head.
• Allow the baby to remain between mother’s breasts for skin to skin contact.
• Place an identity tag on baby
• Encourage first breastfeed within one hour of birth

1.2.3 Care of umbilical cord

• Clamp the umbilical cord at least 1 minute after birth provided the baby does not need to be resuscitated and the mother does not have a post-partum haemorrhage
• Umbilical cord should be clamped / tied by a sterile cord clamp / tie
• Cut the umbilical cord with a sterile blade, 2-3 cm (approximately 2 finger breaths) above skin level.

• The cord should be inspected frequently during the initial few hours after birth for early detection of any bleeding / oozing from the cord.

• Nothing should be applied on the stump (e.g. antiseptic)

• Keep the cord dry and clean (avoid being covered by nappy)

1.2.4 Baby identification marking

• Two discs containing the same number is used for this purpose.

• One is tied on the left wrist of the mother and the other on the newborn.

• The mother should be informed of the number on the disc.

1.2.5 Initial weight recording

• Not necessary to weigh immediately – by 2 hours is adequate. The completion of the first breast feed should be given priority over weighing.

• All the infants should be weighed after stabilisation on a scale with at least 5 gram sensitivity. A digital scale measuring in kilograms to 3 decimal places is the preferred instrument

• A single-use paper towel or a sterile cloth towel should be placed on the weighing scale beneath the infant.

• The weighing scale must be periodically (at least weekly) calibrated.

1.2.6 Initiation of Breastfeeding

• Breastfeeding must be initiated as early as possible,
within one hour of birth. The time of initiation should be documented in the Neonatal Examination Format.

- Health providers should assist the mother to breastfeed the baby.
- The mother and baby should be kept with skin to skin contact after initial drying, so that the baby can breastfeed when he/she is ready.

1.2.7 Vitamin K

- Vitamin K should be administered intramuscularly on the antero-lateral aspect of the thigh using a 26 gauge needle and 1ml syringe.
- Dose to be used is 0.5 mg for babies weighing less than 1000g and 1.0 mg for those weighing above 1000 g at birth.

1.2.8 Iron supplementation

Term Baby –
Fe supplementation at 6/12 or when complementary feeding is started

Dose – 3 mg/kg/day for 3 months

(1 ml containing 50 mg elemental iron - 0.3 ml or 1 ml containing 25 mg elemental iron- 0.6 ml)

1.2.9 Clinical screening at birth

- Should be quick but thorough to identify any life threatening congenital anomalies and birth injuries.
- The infant should be examined for oesophageal patency by passing an orogastric tube if the mother has a history of polyhydramnios or there is frothing or excessive salivation.
- Rule out anorectal anomalies by inspecting the anal opening ensuring it is at the normal site.
• The oral cavity must be examined to exclude a cleft palate.

• Displacement of the heart towards the right side in association with respiratory difficulty and difficult resuscitation is suggestive of either diaphragmatic hernia or pneumothorax on the left side.

• Examine the back for any swelling or anomaly over the spine.

1.2.10 **No stomach wash at birth**

• Do not perform stomach wash in babies at birth

• It is not useful even in babies born through meconium stained liquor

1.2.11 **Communication with the family**

• The health care provider must communicate the time, birth weight, gender and condition of the infant to the mother and other family members.

• The infant should be shown to the family with particular attention to the gender and the identity tag on the infant.

1.3 **Concept of golden hour**

By the end of the first hour, the following should have been taken care of.

- Respiration and cardiovascular stability
- Maintenance of body temperature
- Breastfeeding
- Administration of Vitamin K before sending to the ward

Stabilisation within the first hour of life is vital in ensuring the best possible outcome in newborns.
1.4 **Identification of ‘neonates at risk’**

The following babies need management in SCBU/NICU

- Babies with birth weight < 1800 gms
- Babies with gestation < 35 weeks
- Babies with major congenital malformations
- Babies with asphyxia (needing post-resuscitation care)
- Babies with breathing difficulty

1.5 **Care beyond birth**

The baby should be observed in the postnatal ward at least thrice daily by a medical officer and by the nurse in the postnatal ward at frequent intervals. The baby should be observed for adequacy of breast feeding, maintenance of temperature, jaundice, passage of urine/meconium, activity and danger signs.

**Weight record**

Most healthy term babies lose weight during the first 2 to 3 days of life. The weight loss can be up to 5 to 10 percent of the birth weight by day 5. The weight remains static during the next one to two days and birth weight is regained by 7-10 days of life. Delayed feeding and unsatisfactory feeding schedule may be associated with excessive weight loss, with associated hypernatraemia.

- However, preterm babies experience 2-3% weight loss daily up to a maximum of 10-15%.
- Any weight loss >5% in a 24-hour period is abnormal.

A preterm newborn should regain birth weight by 10-14 days of age.

- The average daily weight gain in term babies is around 30g/day in the first 3 months and 20g/day from 4-6 months.
Evaluation for jaundice

- All infants must be examined for development and severity of jaundice twice a day on the first few days of life.
- Visual assessment in daylight is the preferred method of clinical examination.

1.6 Developmental variations & physiological conditions

Knowledge of developmental variations, physiological conditions and their evolution in newborns is important for advising and reassuring the mother. Mothers observe their babies very carefully and are often worried by minor physical peculiarities, which may be of no consequence and do not warrant any therapy.

Mastitis neonatorum

- Engorgement of breasts occurs in term babies of both sexes on the third or fourth day and may last for days or even weeks. This is due to persistence of maternal hormones for some time.
- Local massage, fomentation and expression of milk should not be done as it may lead to infection. Mother should be reassured that this regresses on its own.

Vaginal bleeding

- Vaginal bleeding may occur in female newborns about three to five days after birth due to withdrawal of maternal hormones. The bleeding is mild and lasts for two to four days.
- Additional vitamin K is unnecessary, but check that it was administered at birth.
**Mucoid vaginal secretions**

- Most female babies have a thin, grayish, mucoid, vaginal secretion, which should not be mistaken for a purulent discharge.

**Erythema toxicum**

- These lesions are poorly demarcated erythematous macules, surmounted by central pale papules. It appears on the second or third day in term neonates, over the face and spreads down to the trunk and extremities in about 24 hours. The rash can be extensive. This should be differentiated from pustules which need treatment.

- It disappears spontaneously after two to three days without any specific treatment. The exact cause is not known.

**Normal phenomena in new born**

- **Peeling skin:** Dry skin with peeling and exaggerated transverse sole creases is seen in all post term and some term babies.

- **Milia:** Yellow-white spots on the nose or face due to retention of sebum, are present in practically all babies and disappear spontaneously.

- **Stork bite marks** (Salmon patches or nevus simplex): These are discrete, pinkish-gray, sparse, capillary hemangiomata commonly seen on the nape of neck, upper eyelids, forehead and root of the nose. Those on the face disappear after a few months while the ones on the nape of the neck get covered by hair.

- **Mongolian blue spots:** In babies of Asian and African origin irregular blue areas of skin pigmentation are often present over the sacral area and buttocks, though extremities and rest of the trunk may also be affected.
These spots fade considerably by puberty, but may remain the same through life.

- **Subconjunctival haemorrhage:** Semilunar arcs of subconjunctival haemorrhage is a common finding in babies born vaginally. The blood gets reabsorbed after a few days without leaving any pigmentation.

- **Epstein pearls:** These are white spots, usually one on either side of the median raphe of the hard palate. Similar lesions may be seen on the prepuce. They are of no significance.

- **Sucking callosities:** The presence of these button like, cornified plaques over the centre of upper lip has no significance.

- **Tongue tie:** It may be in the form of a fibrous frenulum with a notch at the tip of the tongue. This generally does not interfere with sucking or later speech development.

- **Non retractable prepuce:** The prepuce is normally nonretractable in all male newborn babies and should not be diagnosed as phimosis. The urethral opening is often pinpoint and is visualized with difficulty. The mother should be advised against forcibly retracting the foreskin.

- **Hymenal tags:** Mucosal tags at the margin of hymen are seen in two-third of female infants.

- **Umbilical hernia:** Umbilical hernia may manifest after the age of two weeks or later. Most of these disappear spontaneously by one or two years of age.

### 1.7 Possetting, pattern of passing urine, stools and crying

**Possetting**

- Many normal babies posset or spit out some amount of milk, this regurgitation or vomiting seen soon after feeds can be due to faulty technique of feeding and aerophagy. Proper advice regarding feeding and burping must be imparted to all mothers.
• If there is persistent vomiting, which is projectile, or bile stained, the baby should be investigated further.

**Pattern of passing urine**

• On days 1-4 of life babies are expected to pass urine at least 1-4 times a day respectively.

• An adequately fed baby passes urine at least 5 to 6 times in a day after breast feeding is established, i.e after day 3 or 4. This amount should therefore not be expected in babies discharged earlier.

• A baby should not be discharged until urine has been passed.

• Many babies pass urine (even stools) after each feed during the first 3 months of life.

**Pattern of passing stools**

• Any baby who has not passed meconium for 48 hrs after birth needs to be evaluated. Baby should not be sent home until meconium is passed.

• Transitional stools are passed by the third and fourth day after birth. The frequency is increased and these are often semi-loose and greenish-yellow. Delay in passage of transitional stools indicates inadequate breastfeeding.

• Breastfed babies pass frequent golden yellow, sticky, semisolid stools.

• Many babies pass stools while being fed or soon after a feed due to exaggerated gastrocolic reflex which may persist for a couple of weeks. These infants continue to gain weight satisfactorily & mother should be reassured.

• The increased frequency of breast milk stools is normal and should not be confused with diarrhoea. Some breastfed babies may pass stools infrequently (once every few days); this is not constipation. Formula fed babies generally have more formed stools.
Excessive crying

- During the first few days of life babies sleep throughout the day and are usually awake and may cry more often in the night.

- Babies cry when their early hunger cues have not been met or when they are in discomfort due to any other reason.

- Discomfort may be due to the unpleasant sensation of a full bladder before passing urine, painful evacuation of hard stools or mere soiling by urine and stools.

- An experienced mother or nurse can usually distinguish between the cry due to hunger and the cry of discomfort.

- Persistent crying needs examination and detailed evaluation for inflammatory conditions and other causes.

1.8 Advice at Discharge

1.8.1 Maintenance of body temperature

- Keep the baby dry at all times.

- If the climate is cold the linen and clothes of the baby should be pre-warmed before dressing. Cover the baby adequately using cap, socks and mittens. Keep the room warm with the help of a heater if necessary.

- During warm weather, depending on the environmental temperature, the baby should be dressed in loose cotton clothes and kept indoors as far as possible.

- Exposure of the baby to direct sunlight can lead to serious hyperthermia.

1.8.2 Breastfeeding

- The mother should be advised to feed on demand when the baby shows early hunger cues, eight times or more during 24 hours both day and night. Each feed is expected
to last at least 5 min and baby is expected to be satisfied for at least 1.5 hours after each feed if breast feeding has been established. If baby is coming off the breast in a few minutes or demanding feeds before 1.5 hours the feeding technique needs to be reviewed and mother supported.

- During each feed, allow to feed from one side until baby lets go on his/her own and offer the other breast thereafter.
- There is no need for additional water or other fluids in the first 6 months of life.

1.8.3 Skin care/Bathing

- Special precautions must be taken during the bath to prevent baby becoming cold. Bathing should take less than five minutes.
- Keep the baby clean and dry.
- If the weather is very cold, instead of bathing, the baby can be sponged daily to avoid unnecessary exposure and risk of hypothermia.

1.8.4 Care of the umbilical stump

- The cord must be left open without any dressing. Do not apply any medication on the cord. The cord usually falls after 4 to 10 days. Nappy should be worn below the cord so that the cord is covered loosely with the baby shirt.

1.8.5 Care of the eyes

- Some neonates may develop persistent epiphora (watering) due to blockage of the nasolacrimal duct by epithelial debris. The mother should be advised on massaging by applying gentle pressure with a finger over the common canaliculus and stroking firmly downwards. Suggest 10 strokes twice daily.
- Avoid application of any substance to the eye unless specifically prescribed by a medical practitioner.
1.8.6 Immunizations:

- BCG vaccine should be administered before leaving the hospital, preferably within the first 24 hours after birth. If a scar is not present a 2nd dose could be offered after 6 months up to 5 years.
- Table 1.1 depicts the National Immunisation Schedule.

Table 1.1: National Immunization Schedule

<table>
<thead>
<tr>
<th>Age</th>
<th>Vaccine</th>
</tr>
</thead>
<tbody>
<tr>
<td>At Birth</td>
<td>BCG</td>
</tr>
<tr>
<td>2 months</td>
<td>OPV &amp; Pentavalent (1st dose)</td>
</tr>
<tr>
<td>4 months</td>
<td>OPV &amp; Pentavalent (2nd dose)</td>
</tr>
<tr>
<td>6 months</td>
<td>OPV &amp; Pentavalent (3rd dose)</td>
</tr>
<tr>
<td>9 months</td>
<td>Live JE</td>
</tr>
<tr>
<td>12 months</td>
<td>MMR (1st dose)</td>
</tr>
<tr>
<td>18 months</td>
<td>OPV, DPT (4th dose)</td>
</tr>
<tr>
<td>3 yrs</td>
<td>MMR (2nd dose)</td>
</tr>
<tr>
<td>5 yrs</td>
<td>OPV &amp; DT (5th dose)</td>
</tr>
</tbody>
</table>

1.9 Practices to be discouraged

A variety of traditional practices are common in many communities. These can range from being beneficial (eg: oil massage), inconsequential (eg: putting black mark on forehead) to a variety of harmful practices such as those listed below which should be actively discouraged,

- giving liquids (water, kalke) other than breast milk to newborn babies
- applying any substances on the cord

1.10 Danger signs

- Mothers should be advised on danger signs in newborn
babies for which urgent medical attention should be sought

### Danger Signs

- Bleeding from any site,
- Appearance of jaundice within 24 hours of age, jaundice visible in palms or soles, jaundice persisting beyond 2 weeks in term babies
- Failure to pass meconium or urine within 24 hours
- Persistent vomiting
- Poor feeding
- Undue lethargy
- Excessive crying
- Drooling of saliva or choking during feeding
- Respiratory difficulty, apnoeic attacks or cyanosis
- Sudden rise or fall in body temperature
- Seizures
- Evidence of superficial infections such as conjunctivitis, pustules, umbilical sepsis (redness at base of the stump and discharge), oral thrush

#### 1.11 Check list before discharge

Ideally infant should be discharged after 24 hours once all of the following criteria are fulfilled:

- Newborn examination by a medical officer is mandatory prior to discharge
- Infant should be free from any clinically detectable illness including significant jaundice
- The infant is immunized with BCG vaccination
- Baby has passed urine and opened bowels
• It is not possible to ensure that breast feeding is established before 24 hours, we can check if positioning and attachment are satisfactory and the weight loss on day 1 is < 5%, but important fact is to review these babies,
- within 1 week for babies with good positioning and attachment and < 5% weight loss on day 1 and
- within 2-3 days if babies had problems with positioning or attachment

• In addition to above, if the baby is in hospital for longer or is being reviewed after discharge in the first 2 weeks, the following can be utilised to assess adequacy of breastfeeding.
  o Passage of urine > 5 times after day 5
  o Onset of transitional stools by day 3-4,
  o Baby sleeping for 1.5-2 hours after feeding.
  o Most importantly check weight. Loss of > 8-10% by 3-5 days may indicate inadequate breastfeeding.

• Mother is free from any significant illness and confident to take care of her infant.

• Advice to inform area public health midwife as soon as possible after going home.

• Ensure mother has access to and knows a contact in case of problems with breastfeeding or any other medical issues (eg: phone number of Lactation Management Centre (if available) or the postnatal ward, SCBU. (Postnatal ward / SCBU / maternity home number should be given whenever available)

• Hypothyroidism screening by heel-prick for TSH, prior to discharge, have a clear follow up plan for reviewing and informing of result.
1.12 Discharge and follow up policy

**Normal baby (POA ≥ 37 weeks and/or BW ≥ 2.5kg)**
- Discharge after 24 hours of birth
- Refer to the postnatal clinic at the MOH office at 4-5 weeks

**Baby with a POA < 37 weeks and/or BW < 2.5kg**
Minimum 48 hours stay in hospital
Refer to well-baby clinic at 2 weeks.
Babies discharged after 2 weeks of age will be referred to the high risk clinic as determined by Consultant Neonatologist/ Paediatrician
Immediate Newborn Examination at labour room within 2 hours – by medical officer
Develop a chart to record findings of newborn as for mother
Pulse oximetry to be done by a nurse
Complete newborn examination before discharge by medical officer

1.13 Domiciliary care and field postnatal care

- Postnatal care in Sri Lanka consists of domiciliary care and clinic care. The area public health midwife (PHM) is responsible for the postnatal home visits while hospital or field clinics manned by a qualified medical officer (MOH) is responsible for clinic care.
- The PHM should make the first home visit as early as possible (preferably within the first 3 days after the newborn arrives at home) with 2 visits in the first 10 days and one visit between 15-21 days.
- Each newborn is followed up in the field clinic for assessment of growth and development, early diagnosis and management of illnesses and health education of parents. The newborn examination at 4-5 weeks has to be done by the MOH.
It is preferable that every baby is seen and assessed by a health worker at each immunization visit. The developmental assessment should be organized both in the community and the facility.

**Summary**

- Care of a normal newborn includes immediate care at birth with maintenance of normothermia, cord care, early initiation of breastfeeding, initial screening examination and administration of Vitamin K.
- Ensuring correct positioning and attachment during breastfeeding, full examination of the newborn, and identifying newborns at risk are essential prior to discharge.
- Mother should be advised on danger signs, whom and how to contact to get help, further follow up and immunisation at time of discharge.

**Reference**

HYPOTHERMIA AND THERMAL CONTROL
Chapter 2
HYPOTHERMIA AND THERMAL CONTROL

2.1 Introduction

Provision of warmth to prevent hypothermia is one of the cardinal principles of newborn care. Hypothermia can lead to hypoglycaemia, bleeding diathesis, pulmonary haemorrhage, acidosis, apnoea, respiratory failure, shock and even death. Neonatal hypothermia which is a very important cause of neonatal deaths continues to be a problem even in warm countries due to lack of attention by health care providers.

2.2 Why are newborns prone to develop hypothermia?

A newborn is more prone to develop hypothermia because of a large surface area per unit of body weight.

Low birth weight (LBW) babies, are more prone to hypothermia as they have decreased thermal insulation due to less subcutaneous fat and reduced amount of brown fat.

- Larger surface area
- Decreased thermal insulation due to lack of subcutaneous fat (LBW infant)
- Reduced amount of brown fat (LBW infant)

2.2.1 Mechanisms of heat loss

Temperature inside the mother’s womb is 38°C. When the baby is delivered to a relatively colder environment the baby immediately starts to loose heat.

A newborn looses heat by evaporation (particularly soon after birth due to evaporation of amniotic fluid from skin surface), conduction (by coming in contact with cold objects – towels, cloths, tray, etc.),
convection (by air currents in which cold air replaces warm air around baby - open window, fans) and radiation (to colder solid objects in vicinity - walls) (Fig 1.1).

**Figure 1.1: Mechanisms of heat loss in a newborn**

2.3 Concept of warm chain

In order to prevent the heat loss which can occur in a newborn after delivery, the baby must be kept warm at all times right from birth. Satisfactory control of temperature demands both prevention of heat loss and promotion of heat gain. The ‘warm chain’ is a set of ten interlinked procedures carried out at birth and later, which will minimize the likelihood of hypothermia in all newborns.

1. Warm delivery room (26-28°C)
2. Warm resuscitation
3. Immediate drying and covering of baby including removal of wet towels and covering of the head with a cap.
4. Skin-to-skin contact between baby and the mother
5. Breastfeeding
6. Bathing and weighing postponed
7. Appropriate clothing and bedding
8. Mother and baby together
9. Warm transportation
10. Training/awareness-raising of healthcare providers

2.4 Assessment of hypothermia

2.4.1 What is hypothermia?

Normal axillary temperature is 36.5 - 37.5°C (97.7 -99.5°F). In hypothermia the temperature is below 36.5 degrees centigrade. It can be categorised as below:

**Grading of hypothermia**

- Cold stress : 36.1-36.4°C (96.9 – 97.5°F)
- Moderate hypothermia : 32.0 - 36.0°C (89.6 – 96.8°F)
- Severe hypothermia : <32.0°C (<89.6°F)

![Temperature scale](image)

2.4.2 Temperature recording

Following methods are used to assess the temperature of a newborn

1. **Axillary temperature** is as good as rectal and safer (less risk of injury or infection).

   (a) **Digital thermometer**: A digital thermometer needs to be switched on for recording the temperature. Temperature
is recorded by placing bulb of the thermometer against the roof of dry axilla. Baby’s arm is held close to the body to keep thermometer in place. The temperature is read when the thermometer beeps.

(b) **Mercury thermometer:** These are being phased out due to environmental pollution by mercury.

2. **Skin temperature:** In a baby being nursed under a radiant warmer, the baby’s temperature is usually recorded by a thermistor probe. The thermistor probe is attached to the skin over upper abdomen. The thermistor senses the skin temperature and displays it on the panel.

3. **Human touch:** Baby’s temperature can be assessed with reasonable precision by human touch, the reliability of which can be enhanced by training. Abdominal temperature is representative of the core temperature and it is reliable in the diagnosis of hypothermia. The warm and pink feet of the baby indicate that the baby is in thermal comfort, but when feet are cold and abdomen is warm, it indicates that the baby is in cold stress. In hypothermia, both feet and abdomen are cold to touch.

Using a digital thermometer or thermistor probe are the most reliable methods of assessing a newborn’s temperature.

### 2.4.3 Clinical signs and symptoms

The signs and symptoms in a hypothermic baby may be subtle and nonspecific; therefore it is essential to have a high index of suspicion for hypothermia especially in low birth weight and preterm babies. The common signs and symptoms in a hypothermic baby are lethargy, irritability, poor feeding and breathing difficulty (tachypnoea / apnoea / grunting). Severe hypothermia may manifest with hypoglycaemia, sclerema, disseminated intravascular coagulation and internal bleeding.
2.5 Situations where hypothermia can occur

I. At birth (delivery room)

ii. During changing of nappy/clothes

iii. Malfunctioning heat source or removing the baby from heat source

iv. While transporting a sick baby

2.6 Prevention of hypothermia

2.6.1 Steps to prevent heat loss in the delivery room

- Warm room. (26-28°C)
- Immediately dry the newborn with a dry, sterile and warm towel
- Skin-to-skin contact
- Keep the baby naked on the mother’s chest and cover both of them with a warm towel
- Ensure head is well covered
- Keep the baby with the mother (mother’s warmth will keep the baby warm)

2.6.2 Kangaroo mother care (KMC)

KMC is a technique used to keep the baby warm. The neonate is held, skin-to-skin, with mother or any other adult caretaker. Kangaroo mother care should be given to all babies at risk of hypothermia whenever and wherever possible for a maximum duration of time.

KMC helps in,

1. Better thermal protection of neonates

(2) Increasing milk production

(3) Increasing the exclusive breastfeeding rates.
(4) Reducing respiratory tract and nosocomial infections
(5) Improving weight of the baby
(6) Improving emotional bonding and
(7) Reducing hospital stay

Assessing the eligibility for KMC

Mother/Father or any adult caretaker who is free of illness and maintains good hygiene can provide KMC.

Baby: KMC can be initiated immediately in all babies except those requiring active resuscitation. The ongoing medical support, like ventilation, oxygen therapy, IV fluids and tube feeding are not contraindications to KMC.

Technique & position

1. Counsel the mother regarding KMC
2. Advice to wear suitable clothing
3. Provide privacy to the mother
4. Request the mother to sit or recline comfortably

Place the baby between the breasts of the mother with skin-to-skin contact in upright position. Turn the head to one side to prevent airway obstruction. Slightly extended position of the head facilitates eye contact with the mother. Ensure that the abdomen of the baby is in close proximity to the epigastrium of the mother. Regular respiratory movements of the mother prevents the occurrence of apnoea. The hips should be flexed and the bottom of the baby should be supported, in this way the baby clings to mother in a frog-like position.

Clothing for the mother and baby

The mother can wear whatever she finds comfortable as per the environmental temperature prevailing at that time, provided the dress accommodates the baby, i.e. keeps the baby comfortably in contact with her skin. Special garments are not needed unless traditional ones
are too tight. The baby is placed naked in kangaroo position, except for a diaper, cap, socks and mittens.

**Duration of KMC**

KMC should be provided for as long as possible. Each session should be at least for one hour. KMC may be continued as long as the baby finds it comfortable. Mother also needs to be prepared and comfortable for that duration.

KMC is usually used until the baby reaches term gestational age or 2500g by which time the baby outgrows the need.

When the baby on KMC wriggles, pulls limbs out and cries, KMC can be discontinued for that session and gradual weaning from KMC commenced.

**2.6.3 Wrapping the baby**

The baby should be comfortable and clothed in multiple layers if ambient temperature is low, e.g. in an air conditioned special care baby unit or in areas where night time temperature drops below 22°C. Head should be covered with a cap and then the baby should be wrapped in 1-2 layers of sheets/blankets.

If the environmental temperature is high multiple layers may not be required as babies can also become hyperthermic.

**2.7 Management of hypothermia**

Diagnosis of hypothermia should be confirmed by recording actual body temperature. A hypothermic baby has to be rewarmed as quickly as possible. The method selected will depend on the severity of hypothermia and availability of staff and equipment.
**Management of mild hypothermia (cold stress)**

- Provide supervised Kangaroo Mother Care (KMC) as skin to skin contact is the best method to re-warm a baby with mild hypothermia.
- Cover adequately and ensure to replace the cold clothes of the baby with warm clothes.
- Keep the room warm (26 – 28°C) and draught free
- Continue breast feeding
- If KMC is not practiced, use a radiant heater or other appropriate heating device
- Monitor temperature and capillary re-filling time during re-warming
- Watch for apnoea and monitor for hypoglycaemia.
- Monitor axillary temperature every ½ hour till it reaches 36.5 °C, then hourly for next 4 hours, 2 hourly for 12 hours thereafter and 3 hourly as a routine.

Most of the babies will regain their temperature. However, if the baby remains hypothermic one hour after supervised KMC, or if danger signs appear at any stage of monitoring, sepsis should be suspected and treated accordingly.

**Management of moderate and severe hypothermia (temperature <36.0°C)**

- Remove cold clothes from the baby and replace with warm clothes.
- Place under radiant warmer / use incubator.
- Monitor axillary temperature every 15-30 minutes until it reaches 36.5 °C, then hourly for next 4 hours, 2 hourly for 12 hours thereafter and 3 hourly as a routine. Adjust incubator / radiant warmer temperatures as required.
- An incubator (if available) may be used to warm baby. When using incubators it is essential to understand the
different temperature modes available in an incubator (1. ‘baby’ or ‘servo’ mode where the incubator adjusts its temperature according to what we have set to be the requirement of the baby’s skin temperature; 2. ‘air’ mode where the temperature of the air within the incubator is set and maintained. When setting up an incubator in ‘air’ mode, temperatures within the ‘neutral thermal range’, according to the baby’s weight and age should be used once the baby is rewarmed and normothermic.

While the baby is hypothermic the air mode should be used with temperatures set above the neutral thermal range (35.0°C to 38.0°C).

- At times, KMC may be the only option.
- Hot water bottles are not a recommended form of management; however in the absence of any other method they can be used with utmost caution. The bottle should not touch the baby directly to prevent the baby getting burnt.
- Monitor blood pressure, heart rate and glucose (if facilities are available).

In addition, for severe hypothermia

- Start IV 10% Dextrose
- If perfusion is poor, give 10ml/kg of 0.9% NaCl
- Give Vitamin K (refer Chapter 1)
- Maintain oxygen saturation
- Treat cause e.g. sepsis

2.8 Fever (Hyperthermia)

Fever (temperature above 37.5°C) in a neonate is usually due to dehydration. However as fever can be the first sign of infection in a neonate an assessment of the maternal history and thorough examination of the baby is necessary.
Common causes of hyperthermia

- Dehydration
  - Poor breastfeeding technique
  - Non-establishment of breastfeeding

- Environmental
  - Surroundings too hot for the baby
  - Baby is over-dressed: wrapping the baby in too many layers of clothes, especially in hot, humid climate.
  - Leaving baby under/close to heating devices i.e. radiant warmer, incubator, phototherapy, hot water bottles etc. that are malfunctioning properly and/or are not checked regularly.

- Sepsis

Management of hyperthermia

- First check the environment to rule out any environmental causes and make adjustments if required.
  - If the baby is wrapped in several layers of clothing remove a layer or two, use light loose clothes
  - Remove the baby from any direct sources of heat (heater, radiant warmer).
  - Check incubator temperature settings and the temperature sensor probes.

- If the environment is not overheated
  - Assess clinical condition of baby and consider risk factors for sepsis in the history.
  - Assess weight loss

- Management of the cause (if not environmental)
  - If the baby appears ill, screen and treat for sepsis
- If the baby appears well and weight loss is >5% the most probable cause is dehydration fever. All that is required is to support breast feeding. Temperature will normalise as breast feeding is established.

- Management of the temperature
  - When the temperature is 37.5°C – 39.0°C, undressing and exposing the neonate to room temperature will usually be adequate.
  - Recheck the temperature in 30-60 minutes and then as guided by clinical state 0-60 minutes and then as guided by clinical state.

**2.9 Discharge advice and follow-up**

At home, in term babies, ensure that the baby is adequately covered and breastfeeding is continued.

In case of low birth weight (LBW) and preterm babies, however, extra care is required to maintain the body temperature.

Baby should be provided with skin to skin contact via KMC. If this is not possible, the baby should be nursed next to the mother, as the mother herself is a good source of warmth for the baby.

The room where a baby (even normal weight term baby) is nursed should be kept warm. The baby should be clothed adequately depending on environmental temperature.

If the room is not warm enough, for example in colder areas of the country especially at night, a woolen sweater should also be put on. Feet should be covered with socks, hands with mittens and head with a cap. Besides, a blanket should be used to cover the baby.

When bathing a neonate warm water should be used; the entire baby should not be exposed at once during bathing, especially in cooler areas - small areas of the baby can be washed at a time leaving the
rest of the baby covered. Dry and wrap the baby immediately after bathing.

Avoid unnecessary exposure when attending to baby’s needs like changing nappies.

Advice mother on other danger signs like poor feeding and lethargy which might indicate sepsis and need for urgent medical review. (Refer Chapter 9)

Summary

- Hypothermia is a common problem in newborns – especially preterm and low birth weight babies.
- An increase in mortality is associated with hypothermia in newborns.
- It may be a sign of sepsis in neonates
- Hypothermia can be prevented easily if anticipated and monitored
- Commonest cause of hyperthermia in a neonate is dehydration; but the clinician should be alert about the possibility of sepsis.

References

BREASTFEEDING
Chapter 3

BREASTFEEDING

3.1 Introduction

Breast milk is species specific and is tailor made to suit the requirements of the human baby. Human milk has the highest content of lactose among mammalian milk in order to facilitate the rapid brain growth occurring in the first 3 years of life. Therefore breast milk is best for healthy as well as sick term and preterm babies.

It is estimated that over one million babies from 0 to 2 months die each year from diarrhoea, respiratory and other infections because exclusive breast feeding and continuation of breast feeding has not been carried out as per international recommendations.

The Baby Friendly Hospital Initiative (BFHI) of the World Health Organization (modified in 2009) was launched to promote breastfeeding.

The 10 steps of the BFHI include:-

1. Have a written Breastfeeding policy that is routinely communicated to all health care staff
2. Train all health care staff in skills necessary to implement the policy
3. Inform all pregnant women about benefits & management of breastfeeding. Antenatal classes involving influential family members as well.
4. Help mothers initiate Breastfeeding within one hour (2009 modification) of birth
5. Show mothers how to breastfeed and how to maintain lactation even if they are separated from their infants
6. Give newborn infants no food or drink other than breast milk unless medically indicated
7. Practice rooming in-allow mothers and infants to remain together-24 hours a day
8. Encourage Breastfeeding on demand
9. Give no artificial teats or pacifiers (also called dummies or soothers) to breastfeeding infants.
10. Foster the establishment of breastfeeding support groups and refer mothers to them on discharge from the hospital or clinic

3.2 Advantages of breastfeeding

It provides the optimum nutrition for growth and development of the neonate. Studies have shown that breast milk fed children are smarter (7 - 10 IQ points higher) with preterm infants gaining even higher benefit from breastfeeding. Children who had consumed mother’s milk in the early weeks of life had a significantly higher IQ at 7.5-8 years than did those who received no maternal milk with an 8.3 point advantage in IQ remaining even, after adjustment for differences in mother’s education and social class. The same study showed that there was a dose-response relation between the proportion of mother’s milk in the diet and subsequent IQ.

Protection against infection: provides immunity via maternal antibodies, live neutrophils, macrophages and a variety of anti-infective agents in colostrum and mature breast milk. This is the first immunisation of the newborn baby.
Breastfeeding reduces the risk of death and illness from sepsis, diarrhoea, pneumonia, necrotising enterocolitis, ear infections, sudden infant death syndrome, skin allergies, asthma, leukaemia, diabetes type I and obesity\(^2\).

Breast milk is easily digested and is available at the appropriate temperature at all times.

Breastfeeding mothers are at a reduced risk of – breast cancer, ovarian carcinoma, type II diabetes and postpartum depression. Breastfeeding also enhances the emotional bonding between mother and baby\(^2\).

### 3.3 Breastfeeding technique

**Correct positioning**

This is important because it will ensure correct attachment and effective suckling which prevents sore nipples and breast engorgement. The mother can adopt different positions that are preferred by the baby especially when sick or with special needs (cleft palate, hypotonia etc) provided that:

1. Baby’s head neck and body are in a straight line
2. The baby’s face is facing the breast, with the nose opposite the nipple
3. The mother is holding baby’s body close to hers
4. The mother is supporting baby’s bottom, and not just the head and shoulders if the baby is a newborn

**Correct attachment**

The four signs of good attachment are:

1. Baby’s mouth is wide open
2. Lower lip is turned outwards
3. Baby’s chin touches mother’s breast
4. Majority of areola is inside the baby’s mouth, with there being more areola visible above the mouth than below
Effective suckling

Effective suckling is when the infant shows slow deep sucks, cheeks puffing out, with pauses in between. The pauses signify that baby is swallowing milk that is in his mouth.

If not sucking well, then look for ulcers, white patches in the mouth and blocked nose.

Methods of holding the baby

Different methods can be used to suit each situation.
Demand feeds

Demand feeding based on early hunger cues of a baby is the ideal frequency of breastfeeding. Mother should be advised on identifying early cues and not to wait till baby cries, which is a late hunger cue.

![Identifying hunger cues in newborn babies](image)

**Figure 3.4: Identifying hunger cues in newborn babies**

At the same time mothers need to be aware of smaller babies who may need to be woken up for feeds and the others who are crying for reasons other than hunger.

**Special situations**

The principles of caring for babies with special needs (such as cleft lip and palate, Down syndrome, congenital hypotonia, severe IUGR even with absent end diastolic flow, low APGAR score) are the same as for all babies:

- Encourage the mother to begin breastfeeding as soon as possible after birth
- Position and attach the baby well and help him to take a big mouthful of breast
- If baby cannot suckle strongly show the mother how to obtain expressed breast milk (EBM)
- Feed the EBM with a cup until he is able to suckle well
- It is important to let a baby explore the breast and try to attach in his own way. Some babies with disabilities manage much better than we expect them to.
3.4 Breastfeeding sick / small newborns

- Initiate breastfeeding soon after (within one hour of) birth in all babies who are born in good condition (who do not require resuscitation at birth) and have a sucking reflex along with coordinated swallowing (more than 32-34 weeks gestation). Preterm babies more than 32-34 weeks should be breast fed before they are sent to the neonatal unit as soon as they are stabilized.

- Babies who are resuscitated can be breast fed as soon as the baby is stabilized.

- Ensure exclusive breastfeeding (feeding only breast milk and not even water; but medications are allowed) during first 6 months of life.

- Do not introduce kalke, gripe water, honey or animal milk as prelacteal feeds, supplements or as a home remedy. They will introduce infection and allergies, reduce the breast milk intake by the baby (stomach volume is very small about 5ml at birth), and thereby reduce the breast milk production.

- Breastfeed day and night on demand by responding to early hunger cues from the baby. The number of times a baby feeds will vary. A baby who takes a large feed will sleep for longer and feed less frequently than a baby who takes smaller feeds more frequently. A baby will fall into a regular pattern of feeding about 8 to 12 times a day once the milk production increases after 48 to 72 hours.

- Allow baby to feed at one breast till the baby stops sucking and releases the breast. Then offer him the other breast if the baby is still hungry. However, if he does not feed from this breast now, offer this breast first at the next feeding session.
• The adequacy of milk intake can be assessed by counting the number of wet nappies per day (≥6times/day) after the milk comes in (i.e. after 72 hours postpartum), and weight gain (babies may take up to 2 weeks to regain the birth weight and thereafter gain 10-15g/kg/day in the first 2 months).

• If a sick baby or small baby sleeps for more than 4 hours at a stretch more than once a day, baby may need to be woken up for feeds. Undressing the baby can be used for waking up.

• Babies may tend to sleep at the breast when sick. They may also pull off the breast frequently when they have a blocked nose etc. Mothers should be advised to give shorter feeds more frequently to overcome these problems. The normal pattern of breastfeeding should be re-established as soon as the baby is better.

• If a baby falls asleep as soon as the baby is put to the breast some of the things that can be used to wake up the baby are – undressing (leaving only the nappy on) and holding skin-to-skin, holding in a different manner (e.g.: football hold rather than cradle hold) or switching sides. Do not tickle the ear, rub on the cheek or stimulate the sole in this situation.

• The baby may refuse to suckle at the breast or suckle less efficiently when sick or preterm. In this instance mothers should be advised to express the milk and feed preferably via a cup, failing which a gastric tube may need to be used.

• If the baby cannot take oral feeds due to medical reasons advice mothers to empty their breasts by expression 3 hourly to maintain the milk supply until the baby is able to resume oral feeds.

**Why do babies stop feeding when they are ill?**

• Blocked nose due to respiratory infection (common cold)
- Sore mouth (candida infection)
- Loss of appetite
- Feeding may be withheld in babies who undergo surgery

**Misconceptions held by mother or health worker**

- Breastfeeding during diarrhoea is harmful
- Breastfeeding should be stopped if stools are positive for reducing substances.
- Formula supplementation is indicated in babies who present with dehydration fever and early neonatal jaundice.
- All babies with cleft palate need bottle feeds

These misconceptions can significantly interfere with establishment and exclusivity of breastfeeding.

**Breastfeeding should be continued for sick babies due to the following reasons:**

- Baby continues to get the best nourishment
- Looses less weight
- Recovers more quickly
- Baby receives more anti-infective agents via breast milk to fight any infection
- Comforted by suckling
- Breast milk production continues
- Baby is more likely to continue breastfeeding when he/she is well
- Supporting establishment of lactation (positioning, attachment, suckling pattern) and giving cup feeds where indicated is helpful in alleviating dehydration fever and early neonatal jaundice.
Counseling mothers of sick/small babies

Giving birth to a small baby or a newborn falling sick is challenging for any mother. They will require extra support. This should be provided using listening and learning skills and helping the mother build and maintain her confidence in her new role.

Listening and learning skills

- Active listening – to not only what the mother is verbalising but also try to understand what is actually concerning her
- Use helpful nonverbal communication – correct posture, pay attention, remove barriers, unhurried approach, touch appropriately
- Ask open questions
- Use gestures and responses which show interest
- Reflect back what mother says
- Empathize
- Avoid judging words
- ‘Not enough milk’ is often the commonest complaint of psychologically distressed mothers, therefore ask questions to exclude serious psychological morbidity

Building confidence skills

- Accept what the mother thinks and feels – use reflection and simple responses
- Recognise and praise what the mother and baby are doing right
- Give practical help
- Give a little, relevant information
- Use simple language
- Make one/two suggestions, not commands
3.5 Situations when breastfeeding is not initiated

- Antenatally (or immediate post-natally) diagnosed or suspected:
  - Congenital diaphragmatic hernia
  - Oesophageal atresia / trachea-oesophageal fistula
  - Intestinal obstruction
  - Imperforate anus
  - Gastrochisis / omphalocele
- Mother on chemotherapeutic medication or recent / current use of radioactive substances
- Mother having human T-cell lymphotrophic viral infection, untreated brucellosis
- Mother having untreated (not yet sputum negative) open tuberculosis (can express and feed)

Summary

- Breast milk is the most suitable nutrition for newborn babies
- It has immunological, long term medical and, psychological advantages for the baby, and mother; along with financial advantages for the family and country.
- Proper positioning and attachment are important in establishment of breastfeeding

References

FLUID MANAGEMENT
Chapter 4

FLUID MANAGEMENT

4.1 Introduction

Maintenance of fluid and electrolyte balance is an integral aspect of neonatal care. Breast milk is sufficient to maintain fluid balance in most clinically stable newborns who can be fed orally. However, sick newborns require intravenous fluids and electrolytes to sustain their life. The goal of early fluid management is to allow normal weight loss while ensuring physiological stability.

4.2 Intravenous (IV) fluid therapy

Indications

- Any sick baby not tolerating enteral feeds
- Moderate to severe breathing difficulty
- Shock
- Surgical condition contraindicating enteral feeds

Choice of fluids

Electrolyte-free fluids such as 10% dextrose are used in first 48 hours of life. Sodium supplementation is not required in first 48 hours unless intravascular expansion is necessary as in shock. After 48 hours, if the baby is passing urine at least 5 – 6 times a day, use 10% dextrose with added electrolytes (Na\(^+\) 3-5mmol/kg/day, K\(^+\)1-3mmol/kg/day) or 0.45% NaCl with added potassium. When 0.45% NaCl is being used ensure baby is not receiving excessive amount of sodium (>6mmol/kg/day). 100ml of 0.45% NaCl contains 7.7mmol of sodium. Therefore, sodium input could be calculated on this basis.

Calcium is best administered as an infusion when required. It should be given with caution to avoid extravasation. Calcium is given from day
1 for infants of diabetic mothers and for those with hypoxic ischaemic encephalopathy. Calcium should not be added in the same drip with sodium bicarbonate.

Parenteral nutrition if indicated should be included in the daily fluid calculations and given as per unit guidelines.

**Administration of IV fluids**

- Syringe or infusion pump is the preferred and reliable method of delivering small volume of fluids and medications in sick babies. In this device, a pressure monitoring (PMO) line connects syringe containing fluid to the IV cannula. Fill PMO line with infusate to ensure rapid delivery of medication to the baby.

- If an infusion or syringe pump is not available a micro drip infusion set (Burette set) can be used. In this device, one ml is equal to 60 micro drops and number of drops per minute is equal to ml of fluid per hour e.g. if a baby needs 6ml/hour provide six micro drops/minute.

- Use aseptic precautions including sterile gloves while filling syringe pump/infusion pump or micro drip set with fluid.

- Calculate and prepare fluids for 8 hours. The burette of micro drip set should contain fluid for no more than 8 hours and should be refilled every nursing shift.

- Maintain strict input/output chart and review it every 6-8 hours. Include the volume of medications and IV flushes in the total fluid calculations.

- Avoid bladder catheterization if baby is passing urine spontaneously and it is not essential to know urine output hourly.

- Secure the IV cannula properly.

- Before infusing IV fluid, check:-
– expiry date of the fluid
– seal of the infusion bottle for its intactness
– that the fluid is clear and free from any visible particles
– that syringe, PMO line and micro drip infusion set and fluid bag are changed every 24 hours to avoid contamination and nosocomial infection.

**Volume of IV fluids to be given**

- Volume of fluids depends on birth weight, gestational age and postnatal age. Fluid needs of preterm newborns are greater when compared to term babies due to higher insensible losses.

- Use birth weight for all calculations as long as baby’s postnatal weight remains below birth weight. Once birth weight is regained use actual body weight for weight based calculations.

- In neonates with certain cardiac and respiratory conditions fluid restriction is necessary to a maximum of 140ml/kg/day in those <1500g and 130ml/kg/day in those ≥1500g.

**Table 4.1 Neonatal fluid requirement (ml/kg/day)**

<table>
<thead>
<tr>
<th>Day of life</th>
<th>Birth weight ≥1500 g</th>
<th>Birth weight &lt;1500 g</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>60</td>
<td>80</td>
</tr>
<tr>
<td>2</td>
<td>75</td>
<td>95</td>
</tr>
<tr>
<td>3</td>
<td>90</td>
<td>110</td>
</tr>
<tr>
<td>4</td>
<td>105</td>
<td>125</td>
</tr>
<tr>
<td>5</td>
<td>120</td>
<td>140</td>
</tr>
<tr>
<td>6</td>
<td>135</td>
<td>150</td>
</tr>
<tr>
<td>7</td>
<td>150</td>
<td>150</td>
</tr>
</tbody>
</table>
Example

Calculation of IV fluids for a 4 day old neonate with birth weight of 1.2kg:

Total fluid requirement on day 4 of life as per Table 4.1:
125 ml / kg /day
= 125 x 1.2 = 150 ml /day = 150 ml/24 hours =6.2 ml / hour (fill 50 ml for 8 hrs at a time)
Fluid order: 150 ml in 24 hr @ 6.2mL/hr with a syringe pump OR 6 micro drops/min with a micro drip set

Monitoring of babies receiving IV fluids

- Inspect the infusion site every hour.
- Look for redness and swelling around the insertion site of the cannula, which indicates that the cannula is not in the vein and fluid is leaking into the subcutaneous tissues.
- If redness or swelling is seen at any time, stop the infusion, remove the cannula, and establish a new IV line in a different vein.
- Check volume of fluid infused and compare to prescribed volume; record findings every 2 hours in the fluid monitoring chart.
- Measure blood glucose at every nursing shift, i.e. 8 hourly. If the blood glucose is less than 45 mg/dl, treat for low blood glucose. If the blood glucose is more than 150 mg/dl on two readings one hour apart- reduce the Glucose infusion rate (GIR) and check blood glucose after 30 mins. (See Chapter 6)
- Daily monitoring:

Weight

- Weigh the baby, preferably using electronic weighing scale.
- If the daily weight loss is more than 5%, increase the total volume of fluid by 10 ml/kg body weight for one day and then reassess. If there is no weight loss or there is weight gain in the initial 3 days of life, do not give the daily increment, keep the fluid rate the same as the previous day. However, if there is excessive weight gain (3-5%) decrease the fluid intake by 15 – 20 ml/kg/day.

Urine output

- Urine output can be roughly estimated by counting the frequency of passage of urine, or more accurately by weighing wet nappies (commercial non-leaking nappies) on an electronic weighing scale or using a urobag.
- Oliguria is defined as urine output <1 ml/kg/hr over a 6-hour period beyond 48 hours of age. If there is oliguria and weight loss, increase daily fluid intake by 10-20 ml/kg. However, if there is oliguria with weight gain, decrease daily fluid volume by 10 ml/kg and evaluate for renal failure.
- In case of acute kidney injury, replace insensible losses and urine output. Choice of IV fluids should be a combination of 10% dextrose with added sodium (without potassium) to maintain normoglycaemia and normal blood chemistry. During fluid restriction, glucose infusion rate should not be below 4 mg/kg/min to avoid hypoglycaemia. This may necessitate giving higher dextrose concentrations.

Signs of over hydration

- puffiness of eyelids, excessive weight gain
4.3 Special situations

**Intestinal obstruction**

Aspirate should be replaced using 0.9% NaCl with added potassium on volume basis every 8 hours. (replace nasogastric losses with 0.9% NaCl + 10 mmol KCl/ per 500ml bag)

**Dehydration**

- Serial recording of weight is the most reliable way to assess the severity of dehydration. However upto 10% weight loss maybe normal during the first week in a newborn.
- Physical signs of dehydration are less reliable in newborns.
- Dehydration is corrected slowly in newborns unless there are features of shock when fluid boluses would be indicated. The deficit, maintenance fluids and ongoing losses need to be provided.
- Addition of potassium can be done after reviewing electrolyte reports and once urine output is established.
- Babies with sepsis, necrotising enterocolitis and dehydration due to excessive trans epidermal losses or inadequate intake often require fluid boluses for which normal saline (0.9% NaCl) is used.
- If baby is hypernatraemic/hyponatraemic get expert advice.

4.4 Adjusting IV fluids with enteral feeding

**Term, appropriate for gestational age babies**

- As soon as baby’s clinical condition is stable, begin breast milk/breastfeeding provided there is no concern regarding intestinal pathology. If the baby cannot be
breastfed, give expressed breast milk as cup feeding or tube feeding.

- If the baby has accepted 2-3 breastfeeds well, reduce the amount of IV fluid gradually. If breastfeeding has been satisfactory for 12 hours, decrease IV fluids by one-half. After 24 hours of adequate breastfeeding, discontinue IV fluids.

**Preterm / small for gestational age babies**

- If the baby is tolerating cup or tube feeds, increase the volume of feeds by 24-36ml/kg/day (lower range for VLBW), while decreasing the volume of IV fluid to maintain the total daily fluid volume according to the baby’s daily requirement.
- Calculate the total fluid requirement per day. Subtract the daily volume of feeds and give the remaining as IV fluid.
- Discontinue the infusion of IV fluid when the baby is receiving 100 ml/kg/day or about two-thirds of the daily fluid volume as oral feeds.

**Summary**

- Use 10% dextrose in first 48 hours of life.
- After 48 hours of life use 10% dextrose with added sodium, potassium and calcium as maintenance fluid.
- Use of syringe/infusion pump or microdrip infusion set facilitates the accurate administration of small volume of IV fluids.
- Serial weight recording and urine output are useful in assessing fluid balance in newborns.
- Initiate enteral feeding when baby is hemodynamically stable.
LOW BIRTH WEIGHT BABIES
PRETERM AND SMALL FOR GESTATIONAL AGE
Chapter 5
LOW BIRTH WEIGHT BABIES
PRETERM AND SMALL FOR GESTATIONAL AGE

5.1 Introduction

Low birth weight or LBW denotes birth weight of less than 2500g. In Sri Lanka about 16% infants born are LBW. Low birth weight is central to most of the neonatal deaths. Even after recovering from neonatal complications, some LBW babies may remain more prone to malnutrition, recurrent infections, and neurodevelopment handicaps. LBW, therefore, is a key risk factor of adverse outcome in early life. Appropriate care of the LBW infants, with adequate attention to feeding and nutrition can improve their survival.

5.2 Definitions

When a baby is born, two parameters should be considered.

1. Birth weight of the baby
2. The gestation or maturity of the baby
   Pre-term  : < 37 completed weeks
   Term      : 37 to 41wks + 6days
   Post-term : > 42 completed weeks

Classification of low birth weight babies

A newborn baby can be LBW because of two reasons.

1) Prematurity
2) Intrauterine growth retardation (IUGR). These babies are defined as small for gestational age (SGA), if their weight is below the 10th percentile on the chart, for that gestational age. A preterm growth chart eg: modified Fenton growth chart is used for this purpose (Figure 5.2 a & b)
3) Babies who are preterm as well as small for gestational age are more at risk of adverse outcomes than the baby who is only preterm. A large proportion of preterm babies are SGA as well.

5.3 Identification of a preterm baby

- The gestational age of a baby can be estimated by the mother’s last menstrual period and antenatal sonography (especially 1st trimester).

- An accurate estimation is also possible by doing a detailed physical and a neuromuscular examination after birth. Assessment of gestational age should be done as soon as possible in order to arrive at an accurate estimate and for decisions regarding management and prognostication.

- The Expanded Ballard Score can be used for clinical assessment of gestational age. (Figure 5.1)

Classification of preterm babies

- The WHO classification of preterm babies is as follow
  - < 28 weeks: extremely preterm
  - 28 + 0 to 31 + 6 weeks: very preterm
  - 32 + 0 to 36+6 weeks: moderate to late preterm
**Figure 5.1 New Ballard Score for gestational age assessment**

### Neuromuscular Maturity

<table>
<thead>
<tr>
<th>Score</th>
<th>-1</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Posture</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Square window (wrist)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arm recoil</td>
<td>180°</td>
<td>140°-180°</td>
<td>110°-140°</td>
<td>90°-110°</td>
<td>&lt; 90°</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Popliteal angle</td>
<td>180°</td>
<td>160°</td>
<td>140°</td>
<td>120°</td>
<td>100°</td>
<td>90°</td>
<td>&lt; 90°</td>
</tr>
<tr>
<td>Scarf sign</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heel to ear</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Physical Maturity

<table>
<thead>
<tr>
<th>Skin</th>
<th>Sticky, friable, transparent</th>
<th>Gelatinous, red, translucent</th>
<th>Smooth, pink, visible veins</th>
<th>Superficial peeling and/or rash; few veins</th>
<th>Cracking, pale areas; rare veins</th>
<th>Parchment, deep cracking; no vessels</th>
<th>Leathery, cracked, wrinkled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lanugo</td>
<td>None</td>
<td>Sparse</td>
<td>Abundant</td>
<td>Thinning</td>
<td>Bald areas</td>
<td>Mostly bald</td>
<td>Maturity Rating</td>
</tr>
<tr>
<td>Plantar surface</td>
<td>Heal-toe: 40–50 mm: -1</td>
<td>40–50 mm: -1</td>
<td>&lt; 40 mm: -2</td>
<td>&gt; 50 mm, no crease</td>
<td>Faint red marks</td>
<td>Anterior transverse crease only</td>
<td>Creases, anterior 2/3</td>
</tr>
<tr>
<td>Breast</td>
<td>Imperceptible</td>
<td>Barely perceptible</td>
<td>Flat areola, no bud</td>
<td>Stippled areola, 1–2 mm bud</td>
<td>Raised areola, 3–4 mm bud</td>
<td>Full areola, 5–10 mm bud</td>
<td>Maturity Rating</td>
</tr>
<tr>
<td>Eye/Ear</td>
<td>Lids fused loosely: -1</td>
<td>Tightly: -2</td>
<td>Lids open; pinna flat, stays folded</td>
<td>Slightly curved pinna, soft, slow recoil</td>
<td>Well curved pinna, soft but ready recoil</td>
<td>Formed and firm, instant recoil</td>
<td>Thick cartilage, ear stiff</td>
</tr>
<tr>
<td>Genitalia (male)</td>
<td>Scrotum flat, smooth</td>
<td>Scrotum empty, faint rugae</td>
<td>Testes in upper canal, rare rugae</td>
<td>Testes descending, few rugae</td>
<td>Testes down, good rugae</td>
<td>Testes pendulous, deep rugae</td>
<td></td>
</tr>
<tr>
<td>Genitalia (female)</td>
<td>Clitoris prominent, labia flat</td>
<td>Clitoris prominent, small labia minora</td>
<td>Clitoris prominent, enlarging minora</td>
<td>Majora and minora equally prominent</td>
<td>Majora large, minora small</td>
<td>Majora cover clitoris and minora</td>
<td></td>
</tr>
</tbody>
</table>
Figure 5.2a: Modified Fenton growth chart - boys
Physical maturity

The following parameters are used in gestational assessment.

Skin: The skin of a preterm neonate is thin, transparent and gelatinous whereas that of a term neonate is thick, non-gelatinous and keratinized.

Hair: The back and upper arms of a preterm baby have abundant growth of fine hair called lanugo. The hairy areas turn bald as the gestation matures.
Ear Cartilage: The external ear (pinna) is soft and devoid of cartilage in preterm neonates and hence, it does not recoil back promptly on being folded. In a term baby there is instant recoil (Fig 5.3).

![Figure 5.3: Ear Cartilage](image)

Breast Nodule: Breast nodule measures less than 5mm in preterm neonates and 5 mm or more in term babies (Figure 5.4)

![Fig. 5.4: Breast Nodule of a preterm (left) and term (right) infant](image)

Sole Creases: In preterm infants the soles are initially smooth with minimal creases and as the gestation advances a single deep transverse crease is seen in the anterior one third. Term neonates have multiple creases over the anterior 2/3 of sole (Figure 5.5).
External genitalia of preterm infants: In males (Figure 5.6a), the scrotum does not have rugae and testes are not descended into the scrotum. In female infants (Figure 5.6b), the labia are widely separated, not covering the labia minora, resulting in the prominent appearance of the clitoris.

Figure 5.5: Sole Creases of a preterm (left) & term (right) infant

Figure 5.6 a: Male external genitalia

Figure 5.6 b: Female external genitalia
5.4 Problems in preterm and small for gestational age neonates

Preterm neonates

The basic underlying feature of the preterm LBW infant is immaturity of its organ systems. These babies are prone to develop,

- **Hypothermia**
- **Asphyxia** necessitating resuscitation.
- **Respiratory distress syndrome (RDS):** Preterm babies especially those less than 34 weeks have immature lungs, hence they develop RDS characterized by rapid and laboured respiration, in drawing of the chest, grunting and cyanosis.
- **Feeding problems** - Preterm neonates less than 34 weeks of gestation may not be able to co-ordinate sucking and swallowing. Therefore, they may be unable to feed from the breast.
- **Apnoeic spells:** The immaturity of the respiratory control mechanisms in these babies increases the tendency for apnoeic spells. In an apnoeic spell the baby stops breathing, develops a slow heart rate and turns blue.
- **Intra-ventricular haemorrhage (IVH):** Preterm infants also have an immature vascular bed around the brain ventricles. These delicate vessels may rupture and cause intra-ventricular haemorrhage.
- **Hypoglycaemia** - Immature metabolic pathways of preterm infants predispose them to develop hypoglycaemia.
- **Hyperbilirubinaemia**
- **Infection** is another major problem among preterm babies and indeed an important killer because they are immuno-compromised hosts.
- **Retinopathy of prematurity (ROP):** Preterm infants may develop ROP because of abnormal blood vessel
growth due to exposure to excess oxygen. This can result in blindness.

**Small for gestational age (SGA) neonates**

The basic underlying problem amongst them is in-utero under nutrition and hypoxia. They are more prone to:

- Fetal distress, meconium passage in utero and birth asphyxia.
- Polycythaemia
- Hypothermia.
- Hypoglycaemia
- Congenital malformations

**5.5 General management of low birth weight (LBW) babies**

**Delivery of LBW babies**

Ideally, the delivery of an anticipated LBW baby should be conducted in a hospital with established newborn care facilities. The in-utero transfer of a LBW fetus is far more desirable, convenient and safe than transport after birth.

**Where to manage a LBW baby**

Early separation from the mother is detrimental to both mother and baby and all over the world babies are admitted unnecessarily to neonatal units when their mothers can look after them just as well. The best criteria for admission to a neonatal unit (SCBU / NICU) should be:

- Illness in the baby
- Birth weight less than 1.8kg

The weight cut-off needs to be agreed upon with the postnatal ward staff.
LBW babies weighing ≥1800g:

- These babies can be kept with the mother in the postnatal ward provided they are otherwise well. However, they require extra assistance and monitoring including temperature, blood sugar and assessment for respiratory distress.

- The mothers of these babies need to be educated and supported on a regular basis by the health care providers on the postnatal ward. The training of mother during her stay should include,
  (1) Kangaroo mother care (KMC) and assessment of temperature by touch technique or training on how to use a digital thermometer
  (2) Breastfeeding and expression of milk
  (3) Recognition/reporting of danger signs and
  (5) Provision of inputs into all her queries related to care of a LBW baby

- Low birth weight babies in the post-natal ward should be discharged from hospital only when breastfeeding is established. This will require at least 3-4 days.

- Once the mother and the family are confident that they can care for the LBW baby and the baby is clinically well, the LBW baby can be discharged and managed at home.

- A baby who is unable to feed from the breast and cup or is sick should be immediately admitted to the SCBU/NICU.

LBW babies less than 1800g:

These babies should be monitored and cared for in the neonatal unit - SCBU or NICU as the case may be. The period of care in the unit may be for a very short period or for several days depending on the sickness level of the baby.
5.6 Keeping LBW babies warm

At home

Baby should be nursed next to the mother and the room should be kept warm. The baby should be clothed well (2-3 layers of clothes). If the room is not warm enough, a woolen sweater should also be put on. Feet should be covered with socks, hands with mittens and head with a cap. Besides, a blanket should be used to cover the baby. The mother should be trained to monitor the baby’s temperature by a digital thermometer or hand touch. The baby in cold stress should be given additional warmth immediately.

In the hospital

Apart from the above methods, overhead radiant warmer or an incubator may be used to keep the baby warm. Regular monitoring of axillary temperature at least once every 6-8 hours should be carried out in all hospitalized babies.

5.7 Nutrition and fluids

Breast milk feeds are initiated as soon as the baby is stabilized. The following aspects regarding the feeds should be addressed,

(1) Quantity of feeds
(2) Frequency of feeding and
(3) Modality of feeding that is appropriate for the baby

Quantity of feeding

Total daily requirements can be estimated from the table on fluid requirements. In a stable, growing LBW baby daily intake of feeds
should be increased to 150 ml/kg as made available by the mother and increased thereafter if needed (generally up to 180mL-200ml/kg in babies < 1500 gms). The quantity delivered should be monitored and charted.

**Frequency of feeding**

LBW babies should initially be fed every 2 hours starting as soon as possible after birth. When the mother’s breast milk volume increases feeds should be given 3 hourly and later on demand.

**Mode of feeding**

**Term SGA baby:**

- These babies have all the reflexes and therefore the skill necessary to obtain an adequate amount of milk but get tired easily.
- Therefore the breastfeed should be limited to 10-15 min and the baby given a rest by giving the remainder of the feed by cup (breastfeeding expends more energy than a cup feed). However when the baby grows and is bigger and stronger he will be able to extract more from the breast and cup feeds can be weaned.
- Demand feeds has to be done once baby is predominantly breast fed and timed 3 hourly feeds should be stopped.

**Preterm baby**

- The mode of feeding will be decided depending on the maturity.
- The neonate at 30 weeks attains the ability to co-ordinate swallowing with respiration, but still has no suck-swallow coordination. Hence, most neonates less than 30 weeks (or 1200g), need to be tube fed.
- However since each baby is different, the baby can be assessed with regard to the readiness to cup feed when
stable, by an experienced health personnel. If baby is deemed to be ready, a small amount of feed can be offered via cup and amount increased gradually as the baby matures.

- At 34 -35 weeks, the suck-swallow co-ordination is gained. Hence, babies >34 weeks can be breastfed and those less than 34 weeks but more than 30 weeks can be fed by cup.
- A baby should be put to suckle the empty breast when baby is showing sucking movements and hunger cues during skin to skin contact by KMC.
- When the baby is assessed to have suck swallow co-ordination baby can be given to feed on a partially filled breast and gradually progress onto a full breast.

### Table 5.1: Guidelines for modes of providing fluids and feeding

<table>
<thead>
<tr>
<th>Birth weight (g)</th>
<th>Gestation (wks)</th>
<th>&lt;1200g &lt;30 weeks</th>
<th>1200-1800g 30-34 weeks</th>
<th>&gt;1800g &gt;34 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial</td>
<td>IV fluids</td>
<td>NG</td>
<td>Breast or cup</td>
<td></td>
</tr>
<tr>
<td>After 1-3 days</td>
<td>IV + NG</td>
<td>NG+ Cup</td>
<td>Breast &gt;cup</td>
<td></td>
</tr>
<tr>
<td>After 1-3 weeks</td>
<td>NG</td>
<td>Cup+ breast</td>
<td>Breast</td>
<td></td>
</tr>
<tr>
<td>After 3 weeks</td>
<td>Cup</td>
<td>Breast</td>
<td>Breast</td>
<td></td>
</tr>
</tbody>
</table>

IV= intravenous fluids; NG = nasogastric tube

The gestational age and weight cutoffs are general guidelines only with a safety margin. The baby’s condition should guide decision on mode of feeding.

### 5.8 Feeding Techniques

**Non-nutritive sucking**

An infant born prematurely develops the sucking behaviour (coordinated sucking, swallowing and breathing) over time to be able
to feed on the breast. This transition may be facilitated by encouraging non-nutritive sucking (NNS) in these small babies. NNS is initiated by allowing the baby to suck on an empty breast (after expression). NNS may be started right from the time the baby is on gavage feeds. NNS may encourage the development of sucking behaviour, improve digestion of the feed and has shown to reduce hospital stay.

**Nasogastric feeds/orogastric feeds**

Nasogastric feeding is the preferable method of feeding. Orogastric is recommended for the babies on nasal CPAP or on nasal prong oxygen.

Using a naso/orogastric tube for gavage feeding

- A 5-6 French size polyethylene feeding catheter is placed naso/oro gastrically.
- At the time of feeding, the outer end of the tube is attached to a 10 ml syringe (without plunger) and milk is allowed to trickle by gravity.
- The baby should be placed in the left lateral position for 15 to 20 minutes after a feed to avoid regurgitation. There is no need to burp a tube-fed baby.
- The tube may be left in situ for 2 or 3 days.
- While pulling out a feeding tube, it must be kept pinched and pulled out gently to avoid trickling of gastric mucus into the trachea.
- The position of the tube should be always checked if in doubt. This can be done by small aspiration of gastric contents or by injecting one ml of air and listening for a gurgling noise with a stethoscope placed over the stomach.

Tube feeding may be risky in very small babies. They have small stomach capacities and the gut may not be ready to tolerate feeds. Tube-fed babies may develop regurgitation and aspiration, hence it is important to take precautions during feeding.
If the abdomen is distended but soft, and aspiration reveals only milk or altered milk and baby is otherwise clinically well, feeds should be continued.

If the distended abdomen is tense or tender or the aspirate is bile stained (provided the tube has not passed through to the duodenum) or blood stained discontinue feeds.

Routine pre-feed gastric aspiration is not recommended

**Method of feeding by a cup**

- Hold the baby sitting upright or semi-upright on your lap
- Hold the small cup of milk to the baby’s lips. The cup should rest lightly on the baby’s lower lip.
- Tip the cup so that the milk just reaches the baby’s lips and touches the baby’s upper lip.
- The baby becomes alert and opens his mouth and eyes – A LBW baby starts to take the milk into his mouth with his tongue. A full term baby sucks the milk.
- DO NOT POUR the milk into the baby’s mouth. Just hold the cup to his lip and let him take it himself.
- When the baby has had enough, he closes his mouth and will not take any more. If he has not taken the calculated amount he may take more next time, or you may need to feed him more often.
- Measure the intake over 24 hours – not just at each feed.

**Breastfeeding**

The method of breast feeding is essentially the same as for the normal weight babies. LBW babies may be slow in sucking and take longer to feed. Mother may need extra support in positioning and attachment.
**Intravenous fluids**

The fluid requirements of neonates are detailed in Chapter 4

(i) On the first day the fluid requirements range from 60 to 80 ml/kg.

(ii) The daily increment in all the groups is around 15 ml per kg till 150 ml/kg is reached.

(iii) Adequacy of therapy is indicated by weight pattern in the expected range.

**Adequacy of nutrition**

- The key measure of optimal feeding is the weight pattern of the baby. A preterm LBW baby loses up to 1 to 2 percent weight every day amounting to 10 percent cumulative weight loss during the first week of life. Birth weight is regained by the 14th day.

- SGA-LBW babies who are otherwise healthy should not have any appreciable weight loss at all and they should start gaining weight early.

- It is desirable to weigh all LBW babies at 2 weeks (to check regaining of the birth weight). Once the baby has regained birth weight, the LBW baby should gain 10-15g/kg/day in the first couple of months. Hospitalised LBW babies should be weighed 2-3 times a week using the same weighing machine.

- Excessive weight loss, or inadequate weight gain indicates inadequate feeding, cold stress, excessive insensible water loss, sodium depletion or systemic illness (like anaemia, sepsis, late metabolic acidosis etc).

**Trophic feeds (Minimal enteral nutrition)**

Minimal enteral nutrition (MEN) or trophic feeds are small volumes of expressed breast milk (typically 12 to 24 ml/kg/day every 1 - 3 hours) delivered intra-gastric, starting early in sick babies. These feeds
enhance gut growth, hormone secretion and gut motility. The clinical benefits of MEN are; reduction in the days required for attaining full feeds and decreased hospital stay.

The augmentation of feeds after MEN may be done as per guidelines in Chapter 4.

5.9 Nutritional supplements

Vitamin K

A LBW <1000g should receive 0.5mg IV, (if IM is not possible) at birth. Other babies should receive 1 mg IM.

Vitamin D

All LBW infants who exclusively breastfeed should receive 400IU daily of vitamin D from first few days of life once they accept full feeds. This supplementation should continue until 6 months of age. Larger doses (800-1000) may benefit the smaller babies (<1500g).

Vitamin A

Vitamin A is necessary for visual development and immunological functions. Preterm infants have a low Vitamin A status at birth which has been associated with an increased risk of chronic lung disease. A dose of 400 – 1000µg/kg/d is recommended for preterm infants.

Multivitamin drops 0.3ml/day from the time the baby receives full enteral feeds.

Calcium and phosphorous

All VLBW (1500g) should receive calcium 100-220mg/kg/d and phosphorus at 60-140mg/kg/day^3 (Syrup Ostocalcium 5ml = 81mg Ca and 42mg PO_4) in 2 divided doses. This may be continued till 40 weeks post conceptual age or 3.5 to 4 kg.
Iron supplementation

< 37 weeks and/or < 2.5 kg – give Fe supplementation
- Can start at 2 weeks of age in babies on full feeds
- 3mg elemental iron /kg /day single dose drops up to 2 years
- If discharged prior to 2 weeks, start at the 2 week follow up clinic

5.10 Discharge planning

The discharge of a LBW babies should be planned and the following points should be considered prior to discharge

- The weight gain should be consistently demonstrated for 2-3 consecutive measurements if the baby is more than 1 week old (or weight loss should be less than 10%). The weight, head circumference and the length should always be recorded at the time of discharge.
- Mother should be confident in feeding the neonate with any alternate feeding method like cup.
- Babies who are discharged before a weight gain is evident should be reviewed in 2 to 3 days with regard to feeding and then monitored closely until they demonstrate a steady weight gain.
- The required nutritional supplements should have been started prior to discharge.
- The baby should have received BCG prior to discharge.
- The methods of temperature regulation like KMC and any other necessary skills should have been explained and mastered by the mother with adequate practice in the hospital under supervision.
- All danger signs (as below) should be explained in detail to the parents with information regarding whom and where to contact being mentioned on the discharge slip.
- Feeding difficulty
- Fast or difficult breathing
- Fever or cold to touch
- Mother feels that the baby is unwell sick

- The babies who are very low birth weight (<1500g) or <34 weeks gestation at birth should be advised on screening for ROP, at 3-4 weeks of postnatal age and hearing evaluation at 40 weeks of corrected gestational age

**Immunisation**

Immunisation schedule is same for LBW babies. However BCG may be delayed if they are sick.

If the baby is completing 2 months at the time of discharge, give BCG and Pentavalent and OPV on the same day to two sites.

First pentavalent and OPV to be given after completing one month following BCG if the BCG was delayed more than one month.

**Growth monitoring**

The weight of all LBW babies should be checked two to three times a week and OFC weekly during NICU/SCBU stay. Serial growth monitoring allows early identification of growth faltering. A preterm growth chart should be used for the growth monitoring.

**5.11 Prognosis and prevention of complications**

Mortality of LBW babies is inversely related to gestation and birth weight and directly to the severity of complications. In general, over 90% of low birth weight babies who survive the newborn period have no neurodevelopment handicaps. Therefore, essential care of the LBW neonates is a highly rewarding experience.
Prevention of complications of prematurity

- The incidence of prematurity is around 10 to 12% in all parts of the world. The complications related to preterm birth and mortality can be significantly (30-50%) decreased by giving antenatal steroids (ANS) to the mother. The ANS recommended are 4 injection Betamethasone 12 mg IM every 24 hours (2 doses) OR Dexamethasone 6 mg IM every 12 hours (4 doses). The ANS have optimal benefit when given to mothers with preterm labour or APH, before 35 weeks and when delivery occurs between 24 hours to 7 days after completing therapy.

There is no role for giving steroids to the baby after birth to prevent the complications of prematurity

- Recent evidence has shown that antenatal magnesium sulphate therapy given to women at risk of preterm birth substantially reduced the risk of cerebral palsy in their children.

Summary

- Low birth infants may be premature, growth restricted or both.
- These infants are more prone to complications such as hypothermia and feeding problems.
- Gestational age assessment should be done in all low birth weight babies.
- Mothers of LBW babies need additional support in establishing breastfeeding, mastering other techniques of feeding and advice on avoiding hypothermia.
- LBW babies need nutritional supplements.
- Growth and nutritional status of these babies should be monitored.
References


4. Royal College of Obstetricians and Gynaecologists. Antenatal corticosteroids to reduce neonatal morbidity and mortality. Green-top guideline no. 7, October 2010
HYPOGLYCAEMIA
Chapter 6

HYPOGLYCAEMIA

6.1 Introduction

Blood glucose levels are frequently monitored in neonates but definitions and management varies between units. This guideline is based on latest evidence available in international literature as it is important to anticipate and avoid hypoglycaemia severe enough to cause neurological damage while at the same time ensuring not to overtreat leading to separation of baby from mother. Newborn babies are capable of using other energy sources such as ketone bodies effectively, hence the lower values used in the definition.

6.2 Definition of hypoglycaemia

Although the WHO definition of hypoglycaemia is blood glucose levels less than 45mg/dl (2.6 mmol/l) the blood glucose level that causes neurological injury is still controversial.

Asymptomatic hypoglycemia as low as 30 mg/dL is observed during postnatal physiological adaptation of healthy term infants without apparent adverse consequence, and the capacity to mobilise and use alternative cerebral fuels when blood glucose is low varies between patient groups. Glucose levels generally increase to more than 45 mg/dL by 12 hours after birth.

Operational threshold

The blood glucose level below which a baby is predisposed to neuronal injury. Blood glucose levels below 18mg/dl (1.0 mmol/l) that are persistent beyond 1–2 h (or are recurrent) and are associated with acute neurological dysfunction present the greatest risk for cerebral injury and brief episodes of hypoglycaemia in the absence of acute neurological dysfunction or an associated disorder are less likely to lead to cerebral injury and poor outcome.
6.3 Prevention and management of hypoglycaemia

Ensure adequate energy provision after birth

- Breastfeed the baby within the first 30 min to 1 hour after birth.
- Ensure plenty of skin to skin contact and actively support breast feeding to facilitate establishment of breastfeeding
- Feed at a maximum of 3 hourly intervals
- Direct breastfeeding is best.
- If the baby is unable to suck, expressed breast milk may be given via a cup.
- If the mother is critically ill and is not medically fit to breast feed or express milk, a formula feed calculated at up to 100ml/kg/day should be given to the baby.
- Breast milk is preferred over formula milk as it promotes ketogenesis, which is an important alternate source of energy to the brain.
- Intravenous glucose infusions have been shown to reduce the hepatic glucose output as well as reduce the glucose utilisation by the tissues compared to enteral feeds which have been shown to improve the glucose utilisation rate.
- Therefore enteral feeds are more beneficial than intravenous glucose to treat hypoglycaemia and the former should be used in preference to intravenous fluids in all cases of hypoglycaemia unless the baby is symptomatic.
- Enteral feeds should not be stopped during the administration of intravenous fluids.
- Ensure normothermia (36.5 – 37.5°C)

6.4 Screening for hypoglycaemia

A screening policy for hypoglycemia during the initial hours after birth is necessary to detect hypoglycemia.
Who should be screened?

- Premature and low birth weight neonates, especially those weighing less than 2.0 kg
- Infants of diabetic mothers
- Sick neonates (perinatal asphyxia, hypothermia, poor or delayed feeding, sepsis, shock, respiratory distress and polycythaemia).

How do we screen?

Although the most accurate method of glucose measurement is laboratory testing, bedside reagent test-strips are used for screening as it gives instant results. However these results may vary from the actual glucose level by 10 to 20 mg/dL.

Estimation of blood sugar using a glucometer

- Things needed for performing dextrostix: a) soap and water to wash hands or sterillium, b) alcohol for skin preparation, c) test strips d) glucometer and e) lancet or 26 gauge needle.
- Heel is the commonly used site for performing dextrostix. One can also directly prick over the vein to obtain blood sample. This is less painful compared to the heel prick.
- Make sure heel is not cold. Heel can be warmed by holding it in your hand for a few minutes.
- Prepare the site with 70% isopropyl alcohol / spirit, using a scrubbing / circular motion.
- Allow spirit to dry. Contamination by alcohol may lead to erroneously high values.
- Do not use povidone / betadine, as specimen contamination may alter results.
Figure 6.1: Heel prick - site and method of sampling

- Make a skin puncture on the postero-lateral aspect of heel, ideally using the lancet, or a needle. Avoid pricking the middle portion of heel and avoid making deep punctures.

- Follow the instruction on the dextrostix bottle or glucometer for obtaining blood for analysis.

- If blood glucose is low by dextrostix, send blood sample to laboratory for confirmation. However, treatment should be started immediately based on dextrostix estimation. Plasma glucose is 10-18% higher than blood glucose.

Delay in lab analysis of blood sample may result in fall of plasma glucose level by 14-18 mg/dl/hour.

When should we start and stop screening?

- Measure blood glucose pre second feed and 4 to 6 hourly for the first 24 to 48 hours.

- Stop monitoring when 2 consecutive readings are more than 36mg/dl (2mmol/l; 3mmol/L for hyperinsulinism) and the baby is clinically normal and feeding is established.
6.5  Treatment of hypoglycaemia

Indications for enteral feeds alone

If the glucose level is between 18mg/dl - 36 mg/dL (1mmol/l to 2mmol/l) and the baby is asymptomatic, then ensure adequate energy provision via enteral feeds.

Indications for the use of intravenous glucose

Blood glucose level between 18mg/dl - 36 mg/dL (1mmol/l to 2mmol/l) with acute neurological dysfunction

Blood glucose level <18mg/dl (1mmol/l) even if asymptomatic

Acute neurological dysfunction

Includes jitteriness, cyanosis, seizures, apnoea, tachypnoea, weak/high-pitched cry, floppiness or lethargy, poor feeding, irritability, exaggerated Moro reflex, fits and coma.

Use of intravenous glucose

Immediate therapy with 3mL/kg bolus of 10% dextrose over 5-10 minutes (faster administration may result in intracranial haemorrhage) should be followed by a continuous infusion of dextrose at an infusion rate of 6-8 mg/kg/min.

Failure to follow up a bolus with an infusion may result in rebound hypoglycaemia as a result of heightened pancreatic insulin release triggered by the glucose bolus.

Monitor blood glucose hourly.

If the glucose levels remain <36 mg/dL (2mmol/l) repeat the dextrose bolus 3ml/kg followed by an increase in the dextrose infusion by 2 mg/kg/min, until blood sugar measurements are consistently above 36mg/dl (2mmol/l). The amount of glucose administered can be increased via increasing the volume or concentration of dextrose solution.
• The maximum volume recommended within the first 24 hours is 100ml/kg/day

• If the desired glucose target is not achieved by increasing the volume, the dextrose concentration should be increased

• If the infant requires a dextrose concentration of more than 12.5%, central venous access (umbilical venous catheter / long line) should be obtained to avoid venous sclerosis.

Continued enteral feedings hasten improvement in glucose control because of the presence of protein and fat in the milk.

Hydrocortisone therapy may be required for ongoing hypoglycaemia despite glucose administration of 12mg/kg/min.

Once the infant’s glucose levels have been stable for 12 hours, IV glucose may be tapered by 1-2 mg/kg/min, depending on maintenance of pre-prandial glucose levels higher than 36 mg/dL.

Do not discharge the baby until he can maintain pre-feed blood glucose over 45mg/dl over several fast feed cycles over the next 24 to 48 hours.

6.6 Referral to a paediatric endocrinologist

Infants with persistent hypoglycaemia of less than 45 mg/dL despite administering a glucose load of more than 12mg/kg/min should be assessed for hyperinsulinemic hypoglycaemia with an insulin level during hypoglycaemia. The threshold for intervention and target blood glucose is different in these babies with hyperinsulinemic hypoglycaemia and a paediatric endocrinologist should be consulted regarding the management of these babies.
Table 6.1(a): Achieving required glucose infusion rates for neonates with birth weight $\geq 1500g$ using a mixture of 5% dextrose (D5) and 25% dextrose (D25)

<table>
<thead>
<tr>
<th>Volume (ml/kg/d)</th>
<th>Glucose infusion rate</th>
<th>Glucose infusion rate</th>
<th>Glucose infusion rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6 mg/kg/min</td>
<td>8 mg/kg/min</td>
<td>10 mg/kg/min</td>
</tr>
<tr>
<td></td>
<td>D5 D25 0.9% NaCl Sterile water</td>
<td>D5 D25 0.9% NaCl Sterile water</td>
<td>D5 D25 0.9% NaCl Sterile water</td>
</tr>
<tr>
<td>60</td>
<td>28 32 0 0</td>
<td>17 43 0 0</td>
<td>0 58 0 2</td>
</tr>
<tr>
<td>75</td>
<td>53 22 0 0</td>
<td>36 39 0 0</td>
<td>22 53 0 0</td>
</tr>
<tr>
<td>90</td>
<td>44 26 20 0</td>
<td>17 43 20 10</td>
<td>10 60 20 0</td>
</tr>
<tr>
<td>105</td>
<td>44 26 20 18</td>
<td>48 37 20 0</td>
<td>10 60 20 15</td>
</tr>
<tr>
<td>120</td>
<td>44 26 20 33</td>
<td>48 37 20 15</td>
<td>48 48 20 4</td>
</tr>
<tr>
<td>135</td>
<td>44 26 20 48</td>
<td>48 37 20 30</td>
<td>48 48 20 19</td>
</tr>
<tr>
<td>150</td>
<td>44 26 20 63</td>
<td>48 37 20 45</td>
<td>48 48 20 34</td>
</tr>
</tbody>
</table>
Table 6.1(b): Achieving required glucose infusion rates for neonates with birth weight <1500g using a mixture of 5% dextrose (D5) and 25% dextrose (D25)

<table>
<thead>
<tr>
<th>Volume (ml/kg/d)</th>
<th>Glucose infusion rate</th>
<th>Glucose infusion rate</th>
<th>Glucose infusion rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6 mg/kg/min</td>
<td>8 mg/kg/min</td>
<td>10 mg/kg/min</td>
</tr>
<tr>
<td></td>
<td>D5 D25 0.9% NaCl Sterile water</td>
<td>D5 D25 0.9% NaCl Sterile water</td>
<td>D5 D25 0.9% NaCl Sterile water</td>
</tr>
<tr>
<td></td>
<td>in (ml/kg/d)</td>
<td>in (ml/kg/d)</td>
<td>in (ml/kg/d)</td>
</tr>
<tr>
<td>80</td>
<td>55 25 0 0</td>
<td>42 38 0 0</td>
<td>27 53 0 0</td>
</tr>
<tr>
<td>95</td>
<td>75 20 0 0</td>
<td>60 35 0 0</td>
<td>47 48 0 0</td>
</tr>
<tr>
<td>110</td>
<td>44 26 20 20</td>
<td>48 37 20 5</td>
<td>10 60 20 20</td>
</tr>
<tr>
<td>125</td>
<td>44 26 20 35</td>
<td>48 37 20 20</td>
<td>10 60 20 35</td>
</tr>
<tr>
<td>140</td>
<td>44 26 20 50</td>
<td>48 37 20 35</td>
<td>48 48 20 24</td>
</tr>
<tr>
<td>150</td>
<td>44 26 20 60</td>
<td>48 37 20 45</td>
<td>48 48 20 34</td>
</tr>
</tbody>
</table>
Table 6.2(a): Achieving required glucose infusion rates for neonates with birth weight ≥1500g using a mixture of 10% dextrose (D10) and 25% dextrose (D25)

<table>
<thead>
<tr>
<th>Volume (ml/kg/d)</th>
<th>Glucose infusion rate 6 mg/kg/min</th>
<th>Glucose infusion rate 8 mg/kg/min</th>
<th>Glucose infusion rate 10 mg/kg/min</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>D10</td>
<td>D25</td>
<td>0.9% NaCl</td>
</tr>
<tr>
<td>60</td>
<td>60</td>
<td>42</td>
<td>4</td>
</tr>
<tr>
<td>75</td>
<td>75</td>
<td>68</td>
<td>7</td>
</tr>
<tr>
<td>90</td>
<td>90</td>
<td>60</td>
<td>10</td>
</tr>
<tr>
<td>105</td>
<td>105</td>
<td>85</td>
<td>0</td>
</tr>
<tr>
<td>120</td>
<td>120</td>
<td>86</td>
<td>0</td>
</tr>
<tr>
<td>135</td>
<td>135</td>
<td>86</td>
<td>0</td>
</tr>
<tr>
<td>150</td>
<td>150</td>
<td>86</td>
<td>0</td>
</tr>
</tbody>
</table>
Table 6.2(b): Achieving required glucose infusion rates for neonates with birth weight <1500g using a mixture of 10% dextrose (D10) and 25% dextrose (D25)

<table>
<thead>
<tr>
<th>Volume (ml/kg/d)</th>
<th>Glucose infusion rate</th>
<th>Glucose infusion rate</th>
<th>Glucose infusion rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6 mg/kg/min</td>
<td>8 mg/kg/min</td>
<td>10 mg/kg/min</td>
</tr>
<tr>
<td></td>
<td>D5</td>
<td>D25</td>
<td>0.9% NaCl</td>
</tr>
<tr>
<td>80</td>
<td>76</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>95</td>
<td>87</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>110</td>
<td>87</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>125</td>
<td>87</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>140</td>
<td>86</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>150</td>
<td>86</td>
<td>0</td>
<td>20</td>
</tr>
</tbody>
</table>
6.7 Glucose Infusion Rate

The Glucose infusion rate (GIR) is calculated using the following equation. The same can also be used to crosscheck the GIR used using Table 6.1 a & b.

\[
\text{ml/kg/day} \times \% \text{ dextrose} \times 0.007 = \text{mg/kg/min (GIR)}
\]

6.8 Post discharge advice and follow up

Babies who have had hypoglycaemia, whether symptomatic or asymptomatic, are at risk of neurodevelopmental sequelae such as seizures, developmental delay and cognitive deficits. Therefore these babies should have close follow-up of their neurodevelopmental status.

Summary

- Hypoglycaemia is a common problem in preterm/LBW infants, sick newborns, and infants of diabetic mothers.
- Hypoglycaemia can produce brain injury with long-term neurodevelopmental consequences.
- Newborns at risk of hypoglycaemia should be screened using dextrostix.
- The symptoms of hypoglycaemia are nonspecific and can be confused with other common neonatal problems.
- Initiation of breast feeding within one hour of birth and frequent breast feeding help prevent hypoglycaemia.
- Newborns with hypoglycaemia should be followed up for neuro developmental status
References


