## Block 3

### NURSING CARE OF HIGH RISK NEONATE-I

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As a health care provider you have an important role in perinatal-neonatal care at all levels of care. You may have to demonstrate skills while attending birth of a newborn, provide appropriate care to normal, low birth weight and sick neonate, identify congenital anomalies, make appropriate referrals and care for newborns who have disorders or congenital malformations. This block will help you to develop/update your knowledge and skills in providing care to at risk and sick neonate with common medical and surgical problems. This block consists of 4 units as following:

Unit 1 Deals with Management of LBW Babies.
Unit 2 Focusses on Fluid and Electrolyte Therapy in Newborn and Infant
Unit 3 Relates to Common Neonatal Disorders
Unit 4 Details Congenital Malformations

We hope you will enjoy reading these units.
Nursing Care of High Risk Neonate-I
UNIT 1 MANAGEMENT OF LBW BABIES

Structure

1.0 Objectives
1.1 Introduction
1.2 Low Birth Weight (LBW) Baby
   1.2.1 Definition and Types of LBW
   1.2.2 Causes of LBW
   1.2.3 Identification and Characteristics of LBW Babies
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1.4 Care of Low Birth Weight Babies
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1.5 Referral and Transport of Low Birth Weight Babies
1.6 Nursing Care of Low Birth Weight Baby
1.7 Prevention of Birth of Low Birth Weight Baby
1.8 Let Us Sum Up
1.9 Answers to Check Your Progress

1.0 OBJECTIVES

After completing this unit you should be able to:
• Define low birth weight babies;
• List down the types and causes of LBW;
• Identify and assess LBW babies;
• Describe the problems of LBW Babies;
• Explain the nursing care of LBW Babies;
• Outline the referral and transport of LBW babies; and
• Explain prevention of birth of LBW babies.

1.1 INTRODUCTION

About 30% - 40% of all births in India are LBW, out of which 8-10% are preterm and 20-30% are small for date (SFD). These small babies have many physiological handicaps and therefore are ill equipped for normal life. Expert and skilled care by you is required for these babies to lead a normal life. In this unit you will learn about the definition of LBW, types and causes of LBW, Problems, Identification, Assessment, Care, Prevention, Referral and Transport of LBW baby.
1.2 LOW BIRTH WEIGHT BABY

1.2.1 Definition and Types of LBW

A Neonate whose weight is less than 2500 gm at birth irrespective of gestational age is a low birth weight baby.

Types of LBW

The newborn baby can be LBW because of two reasons and hence is of 2 types:

1) **Preterm or Premature baby:** A preterm baby has not yet completed 37 weeks of gestation and the delivery takes place prematurely.

2) **Intrauterine growth retardation:** Here the gestation may be full term or preterm but the baby is underweight, undersized with regard to his/her gestational age. Such a baby is also called small for date neonate. Two third of low birth weight neonates fall under this category. The LBW neonate may be both preterm as well as small for date. (Fig.1.1).

![Intrauterine Growth Curve](image-url)
1.2.2 Causes of LBW

The causes of LBW are as following:

**Prematurity**

- Low maternal weight, teenage pregnancy, multiple pregnancy.
- Previous preterm baby birth, cervical incompetence.
- Antepartum hemorrhage (APH), acute systemic disease.
- Induced premature delivery.
- Unknown Cause.

**Intra Utrine Growth Retardation (IUGR), Small for Date (SFD)**

- Poor nutritional status, underweight mother.
- Short stature < 140 cm.
- Hypertension, toxemia, anemia.
- Multiple pregnancies.
- Chronic malaria, chronic illness.
- Tobacco and drug abuse.

1.2.3 Identification and Characteristics of LBW Babies

You can identify LBW baby by the following:

- Body measurements
- Physical characteristics
- Neurological characteristics

**Body Measurements**

All body parameters are low in LBW baby as compared to normal baby.

- WEIGHT : Less than 2500 gm
- LENGTH : Less than 47 cm
- HEAD CIRCUMFERENCE : Less than 33 cm
- CHEST CIRCUMFERENCE : Less than head circumference by 3 cm
  (it is 2 cm in term new born)

**Physical Characteristics**

It is desirable and of practical relevance to make clinical distinction between the two types of LBW babies. i.e. Premature babies and IUGR babies.

**Preterm Baby**

Preterm Baby is diagnosed on the basis of period of gestation, if the baby is born before 37 completed weeks of gestation, the baby is preterm. Preterm babies have distinct physical features which help in their recognition, as follows:

- The head is large in proportion to the body (Fig. 1.2B).
- Ears are soft and flat as they are devoid of cartilage (Fig. 1.2A)
- Chest is small, have weak thorax muscles.
• Poor development of lung tissue, primarily atelactasis and weak respiratory muscles.
• Cough and gag reflexes may be weak or absent.
• Nasal passages are extremely narrow and are easily injured.
• Retina of eye is immature.
• Female genitalia: Labia minora is not covered by labia majora (Fig. 1.2B). Male genitalia: testicles may be in the abdomen, inguinal canal or scrotum, scrotum non pendulous and not rugaed (Fig. 1.2A).
• Urine scanty and infringement for few days, less ability to concentrate urine, does not excrete drugs well.
• Sole of the feet has one or two transverse creases (Fig. 1.2A).
• Anterior 1/3rd of the sole reveals a deep transverse skin crease.

Fig. 1.2(A) : Features of term and preterm babies
Management of LBW Babies

Fig. 1.2(B) : Features of term and preterm babies

Small for date (SFD) Baby

- Has an emaciated look and loose folds of skin because of lack of subcutaneous tissue, particularly prominent over buttocks and the thighs.
- Look alert, active and seem healthy.
- Seem to have a low weight but often length is not affected and head size may be normal.
- Often have meconium staining of skin, nails and cord.
- When their birth weight is plotted on the intrauterine growth chart, it falls below the 10th percentile.

Neurological Characteristics

LBW baby maintains extended posture, has poor sucking and swallowing reflex. Sucking and swallowing reflex is not coordinated if the baby is born before 34 weeks of gestational age. Since the neurological assessment of the newborn must be done while the neonate is rested and in a quite state, this examination may be carried out at any time from birth when the neonate is alert and awake to the second or third day of life.
Nursing Care of High Risk Neonate

1.2.4 Assessment/Scoring of Low Birth Weight

The accurate assessment of gestational age is important after birth because the plan for care, the problems that will probably be encountered, and the possible outcomes are directly related to it. For instance, a preterm neonate can be

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**Fig 1.3: Assessment of external physical characteristics using Ballard’s newborn maturity classification criteria**
expected to have **immaturity of various body systems**, whereas **placental insufficiency** occurs more often in **post term infants**. Small for gestational age infants may have **hypoglycemia** and **congenital malformations** while **apnea spells** and **hyaline membrane disease** can be expected to occur in **preterm infants**. Neither X-ray examination of the bones of the neonate nor information from the mother concerning the date of her last menstrual period is sufficient to provide an accurate assessment of gestational age. Assessment of gestational age can be done as follows:

**Assessment of certain external physical characteristics**

Dr. Ballard has developed an assessment tool, performed most reliably between 30 and 42 hours of age. In this neonate maturity rating has some physical characteristics and those neurological criteria have been included that can be used even when the neonate is not quiet and rested. It consists of six neurologic and six physical criteria. This system provides an accurate assessment of gestational age whether the newborn is well or ill (Fig. 1.3).

It is of great importance that the assessment of gestational age can be done as soon as possible after birth. It is also important that the published directions for evaluation be followed consciously. Since nurses are assuming increasing responsibility for assessing the gestational age of neonates, an understanding of this technique is of vital importance.

**Fig 1.3** illustrates Ballard’s newborn maturity classification criteria. Physical maturity can be determined by assessing skin, plantar creases, breast, ear and genitals. Neuromuscular maturity is assessed by assessing posture, square window sign, arm recoil, popliteal angle, scarf sign and heel to ear maneuver.

### 1.3 PROBLEMS OF LOW BIRTH WEIGHT BABY

The LBW baby is prone to birth asphyxia, hypothermia, infections, hypoglycemia, respiratory difficulties, feeding problems, intraventricular hemorrhage, retinopathy of prematurity, metabolic problems and jaundice due to immaturity of organs. We shall discuss each one of these problems as follows:

- **Birth Asphyxia**
- **Hypothermia**
- **Feeding Problems**
- **Infections**
- **Neonatal Jaundice**
- **Respiratory Difficulties**
- **Hypoglycemia**
- **Intraventricular Haemorrhage**
- **Retinopathy of Prematurity**

- **Birth Asphyxia**

Inability of a new born to establish regular spontaneous respiration within 30 seconds of birth is called birth asphyxia.
- **Hypothermia**

Although hypothermia may occur at any time when environmental temperature is low and thermal protection is inadequate but in LBW babies immaturity of heat regulating centre in the brain and lack of brown fat predisposes them to hypothermia.

Hypothermia is defined as body temperature below 36.5°C to 37.5°C.

The hypothermia may be mild, moderate or severe:

- **Mild hypothermia**: 36°C to 36.4°C
- **Moderate hypothermia**: less than 36.0°C
- **Severe Hypothermia**: 32.0°C and below (Fig. 1.4)

Change in skin temperature is the initial indicator of cold stress.

The warm and pink feet of the new born indicate **thermal comfort**. But when the feet are cold and abdomen is warm, it indicates **cold stress**, if new born has hypothermia, both feet and abdomen are cold to touch.

![Fig1.4 : Stages of Hypothermia](image)

**Management**

The management of mild, moderate and severe hypothermia is as follows:

**Mild Hypothermia (Cold Stress)**

- Receive the newborn in prewarmed sheet.
- Do not leave the newborn in the pool of blood after birth. Wipe the newborn thoroughly especially the skin folds.
- Thoroughly dry the baby and remove any wet clothing.
- Provide skin to skin contact with the mother immediately after birth (KMC).
- Keep the baby in warm room/bed.
- Dress the newborn appropriately as per climate.
- Maintain the warm chain.
Management of LBW Babies

- Continue Breast feeding.
- Monitor axillary temperature ½ hrly till it reaches 36.5°C, 1 hrly for next 4 hours and 2 hrly for next 12 hours.

Steps of Warm Chain to be followed as:
- warm delivery room
- warm resuscitation
- immediate drying
- skin to skin contact
- breastfeeding
- bathing postponed
- appropriate clothing
- mother and baby together
- professional alertness
- warm transportation

Moderate hypothermia
- In addition to all above measures, additional heat is provided by warm towel, room heater or radiant warmer.
- A rise of 0.5°C/hr is considered adequate.
- Ensure adequate feeding and hydration.

Severe Hypothermia
- Active re-warming using incubator, preheated radiant warmer, or thermostatically controlled heated mattress set at 37-38°C.
- Warm rapidly till 34°C, followed by slow rewarming.
- Supplement oxygen.
- Intravenous fluids, prevent and treat hypoglycemia with 10% dextrose.
- Consider sepsis, start antibiotics if hypothermia persists.
- Monitor temperature, heart rate, blood sugar and blood pressure.

Remember
If newborn does not improve within 30-35 minutes of initial warming. He should be urgently referred for further treatment. The mother must be advised to keep the baby wrapped and close to her body and maintain breast feeding during transport.

- Feeding Difficulties
The coordination of sucking and swallowing reflexes is not well developed in newborn weighing less than 1800 grams and 34 weeks gestational age. This results in aspiration and regurgitation of feed. Breast feeding is not normally possible for the LBW and less mature newborn. Depending upon the weight and gestational age, these newborns are managed at home or hospitals. Therefore, LBW newborns with less maturity are first fed using katori and spoon or paladai. After LBW newborn gains maturity or is more than 34 weeks, then the neonate can be put on direct breast feeding (Fig. 1.5).
Infections are an important cause of neonatal morbidity and mortality in LBW babies. The reasons of susceptibility to infections are:

- Low level of antibodies
- Low immunity
- Humid and warm atmosphere
- Contaminated hands of caregiver
- Excessive handling of the baby
- Unhygienic surroundings during intra-natal and postnatal period.

Therefore, LBW neonates require protection from infection by adopting following practices:

- Washing hands before handling the newborn
- Keeping the surroundings clean
- Early breast feeding
- Avoiding persons with cold, cough and diarrhoea to touch the newborn.

Neonatal Jaundice

Immaturity of liver enzymes result into increased bilirubin levels in the blood. If the newborn has suffered from birth asphyxia and feeding is delayed, then high bilirubin levels can also affect brain in LBW newborns. These newborns should be urgently referred.
• **Respiratory Difficulties**

Respiratory difficulties and later on development of bacterial infection is the major cause of respiratory problems in preterm newborns. In LBW babies, *lung tissue is poorly developed, respiratory muscles are weak* and also their *respiratory centre is poorly developed*. The respiratory difficulty is characterized by increased respiratory rate greater than 60/min and indrawing of chest (recession) and expiratory grunt (sound after expiration). Hence, they develop respiratory distress syndrome. Such preterm newborns require care in the hospital. Because of the immature respiratory control mechanism these babies also have a tendency for apneic spells, wherein the baby stops breathing, develops slow heart rate and turns blue. Such preterm newborns require care in the hospital.

• **Hypoglycemia**

Small for date babies are at significant risk of hypoglycemia, principally because they have less glycogen store in their liver and reduced subcutaneous fat stores which are quickly utilized. In addition, *delayed feeding, birth asphyxia* and *respiratory difficulty* cause hypoglycemia. Immaturity of kidneys results into inability of newborn to conserve water and hence, these newborns tend to get dehydrated. Hypoglycemia is often asymptomatic but jitteriness, lethargy and poor feeding are the most common features associated with it. Untreated hypoglycemia may cause brain damage.

• **Intraventricular Hemorrhage**

Preterm infants have immature vascular bed around brain ventricles. These delicate vessels may rupture and cause intra-ventricular hemorrhage.

• **Retinopathy of Prematurity**

This occurs in newborns when given excess oxygen leading to blindness because of damage to the immature retina.

• **Anemia**

Due to poor iron stores and poor response of bone marrow to erythropoietin.

1.4 **CARE OF LOW BIRTH WEIGHT BABIES**

All LBW babies have special problems, there is a need to identify these LBW babies that can be managed in the community/home or health centres and those who need to be referred.

1.4.1 **At Home**

The first principle is to prevent the baby’s room from being too cold or windy. In the summers, keeping the room warm is not a problem but in winter months, the room needs to be warmed till mother is comfortable. The windows and doors should be kept closed to prevent a windy room. Care must also be taken to prevent fans or coolers blowing directly on to the baby.

The second principle is to prevent the baby from losing body heat. To achieve this, the mother/relatives must be instructed to adequately clothe the baby and keep the baby dry. Keeping the baby in close body contact with the mother will help to retain its body warmth. Practice KMC for LBW babies.
Teach Special Approaches to Keep the Newborn Warm as per following:

- Check the warmth on each visit.
- Advise mother to cover the newborn’s head with a cap to maintain warmth in cool temperature.
- Advise mother to sleep with the newborn and maintain skin-to-skin contact when possible.
- Advise mother to keep the newborn in warm room.
- Advise mother not to put the newborn on any cold surface.

The **third principle** is to provide enough energy for heat production by the baby. LBW babies must therefore, be fed early and frequently (1-2 hrly) by the mother. This will provide sufficient energy for the baby.

Bring the baby to hospital when the following occur:

- Lethargy
- Refusal of feed
- Hypothermia
- Gasping, apnea (pause in between breathing)
- Seizures, vacant sterna, fits, convulsions

### 1.4.2 In the Hospital

The most important factor in the survival of a low birth weight infant is the standard of nursing care provided to meet the basic needs of the infant.

In addition to the above-mentioned principles, additional heat can be provided to meet the basic needs of the infant by any one of the methods listed below:

- Radiant warmer or incubators or thermostatic mattress.
- Heated lamp – a lamp with 100-200 W Bulb placed about 18” from the baby can provide additional warmth to the baby.
- Hot water bags – the sides of a cot can have pockets for placement of hot water bags. The heat from these bags will increase the ambient temperature around the baby. Care should be taken to prevent direct contact between baby and hot water bags (can cause burns) & water in the bags needs to be changed frequently as water cools.

### Feeding

The methods of feeding will depend upon:

a) Gestation and birth weight
b) The clinical well being of infant
c) To be able to feed directly from the breast, the newborn must have a good coordination between sucking and swallowing reflex. This is usually established by 34 weeks of gestation. Thus, babies more than 34 weeks (or birth weight > 1.8 kgs) can usually breast feed.

All babies including LBW babies must be fed only breast milk. No prelacteal feeds should be given as it increases the risk of infection. Early breast-feeding
must be initiated, preferably within half to one hour after birth. LBW babies must be fed frequently because initially most of them suck briefly and also consume small quantities of milk with each feed. Besides delaying feeding increases the risk of hypoglycemia.

Some LBW babies suck poorly at the breast during the first few days, even though they are active. In such instances, the breast milk should be expressed into a clean vessel and fed to the baby with a spoon. There are devices available e.g. paladai for feeding the baby.

Check Your Progress 1

1) List down the problems of LBW babies.

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2) Explain the principles of care of LBW babies at home.

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The same can be used at home since they are culturally acceptable to mothers and their families, it is important that these babies are not bottle fed because:

a) It causes nipple confusion and can delay baby’s ability to suckle from the breast, & Increases the risk of infection, especially diarrhoea.

b) It is important to note that breast milk has enough vitamins and minerals to meet the daily need of these LBW babies who are more than 34 weeks. There is hence, no need to supplement them with any commercial multivitamin preparations.

Monitoring Adequacy of Feeding

If the baby is getting enough milk, how can you assess it?

This is done as under:

a) Firstly, the baby will gain weight. Weight recording performed at least weekly in LBW babies weighing < 1800 grams is a good and sensitive marker of adequate nutrient intake. The baby is expected to gain about 15-20 gm/day or 105 gm/week.

b) In situations where frequent weight record is difficult, adequacy of urination (6-7 times/day), maintenance of temperature (LBW neonate needs energy for heat production) and sleep patterns (satisfied babies sleep for 2-3 hours after each feed) can be useful alternatives for assessment.
Prevention of Infection

LBW babies are prone to increased risk for infection, and thus, utmost care must be taken to prevent infection in all these babies. Following measures should be adopted to prevent infection in LBW newborn:

- Follow clean delivery practices such as (six cleans) i.e. clean room/surface, clean hands, clean cord tie, clean stump, clean blade & clean clothes for mother and baby.
- Ensure hand washing before and after touching a baby.
- Encourage exclusive breast feeding.
- Do not give prelacteal feeds as honey, guti, glucose etc.
- Avoid unnecessary handling of newborn.
- Do not have contact of LBW newborn with a person having infection such as skin infection, respiratory tract infection, diarrhoea etc.
- Encourage personal hygiene of the mother.
- Maintain skin care of the VLBW babies (Fig. 1.6).
- Refer immediately in case of danger signs.
- Advise regarding immunization schedule to mother.

Fig.1.6: Skin care of VLBW babies
1.5 REFERRAL AND TRANSPORT OF LOW BIRTH WEIGHT BABIES

Some LBW babies may need to be referred. In this section you will be made familiar with how to refer LBW babies.

Indications

The cornerstone of care of the LBW infants is **anticipation and early detection of complications**. This is achieved by careful monitoring of the babies, clinical monitoring being the most important and practical method. It involves periodic evaluation for signs of illness. A baby who shows any one or more of the below mentioned signs and symptoms should be immediately referred for hospitalization and prompt management of the specific complications by a specialist pediatrician.

**Indication of Transfer from Community to Special Care Neonatal Unit (SCNU)**

Any neonate who has the following:

- Lethargy
- Refusal to feed
- Hypothermia
- Tachypnea, grunt, gasping, apnea
- Seizures
- Abdominal distension
- Bleeding
- Deep icterus over palms & soles and
- VLBW or premature baby

**Indications of transfer from SCNU to higher facility (Tertiary care centre)**

This includes the following:

- Babies needing mechanical ventilation
- Shock not responding to fluid therapy and vasopressors
- Jaundice needing exchange transfusion
- Major congenital malformations requiring surgery e.g. tracheo-esophageal fistula, diaphragmatic hernia, meningomyelocele etc.
- Refractory seizures
- Abdominal distension with bilious vomiting.

**Prepare well before transport: Follow the guidelines as under:**

1) **Assess**

   Make careful assessment of the baby. Make sure that there is a genuine indication for referral.

2) **Stabilize the neonate**

   Stabilize with respect to temperature, airway, breathing, circulation and blood sugar. Give first dose of antibiotics as injection ampicillin and gentamycin.
3) **Write a note**
Write a precise note for the providers at the referral facility providing details of the baby’s condition, reasons for referral and treatment given to the baby.

4) **Encourage mother to accompany**
Mother should accompany the baby for breast feeding and for providing supportive care to the baby on the way and in the hospital. In case she cannot accompany the baby immediately, she should be encouraged to reach the facility at the earliest.

5) **Arrange a provider to accompany**
A doctor/nurse/health worker should accompany the baby, if feasible, to provide care to the baby during transportation, and to facilitate transfer to the referral facility.

6) **Communicate**
The following should be communicated:

- Explain the condition, the prognosis, and the reasons for transfer of the baby.
- Brief about intranatal and neonatal history.
- Explain where to go and indicate whom to contact.
- Inform the referral facility beforehand.

It is essential to provide **warmth** during transport to prevent **cold injury**. The baby should be clothed and placed in a **pre-warmed basket** (Transport incubator is ideal). Placing the baby next to mother’s body during transportation can provide the necessary warmth to the child during the crucial journey.

Every infant should be stabilized before transport as far as possible. A doctor or nurse should accompany the baby if possible.

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**Common Complications of LBW Babies requiring referral and transport**
The low birth weight infants are susceptible to all disorders of early life, however, certain disorders seems to occur more often in LBW babies than a normal term infant which necessitate referral to a bigger facility. Some of them are:

- Respiratory distress
- Congenital malformations
- Intracranial birth injury
- Neonatal infection
  - Oral thrush
  - Diarrhoea
The nursing management of LBW baby demands expert nursing care to manage the multiple problems.

The objectives of management are as follows:

- Support respiratory effort
- Provide neutral thermal environment
- Provide fluids and nutrition
- Prevent infections
- Provide sensory stimulation
- Keep parents informed of infant’s progress and facilitate mother infant attachment.

The nursing interventions to meet these objectives of care are as following:

1) Support respiratory effort

For optimum air exchange the neonate must be positioned on his back with neck slightly extended. You may take the help of a shoulder roll ¾-1 inch thick to maintain the neck in slight extension. This helps to keep the airway open. The
nosopharynx and trachea should be suctioned as often as necessary to remove the accumulated mucus. The baby should be observed regularly for signs of distress such as apnea, nasal flaring, chest retractions and tachypnea.

You have already learnt earlier in this unit that apnea is a sudden cessation of breathing associated with cyanosis and bradycardia. In many neonatal intensive care Units (NICUs) electronic apnea alarms are used. The electrodes are placed on the infant’s chest with leads attached to the apnea monitor. This gives a continuous reading of respiratory rate. When the rate goes too high or too low or baby fails to breath, a visual and auditory alarm is given. In case of apnea the nurse should at once suction the baby if necessary, then give tactile stimulation by flicking the soles of the baby a couple of times, usually 2-3 flicks. If the breathing is not started give 100 per cent oxygen with bag and mask. The LBW babies may require oxygen to be administered for long periods. You have learnt earlier in this unit that the LBW babies are prone to develop retrolental fibroplasia if they are administered oxygen in concentration higher than 40 per cent. Therefore, as soon as the need is over the concentration of oxygen should be reduced to 40 per cent.

The LBW babies should not be administered oxygen any longer than absolutely necessary. Percussion, vibrations and postural drainage should be carried out frequently to loosen the secretions in the respiratory tract. Infants should be nursed by rotating position regularly from side to side, supine and prone as tolerated. Chest physiotherapy should only be done as tolerated by the infant and stopped immediately if the monitors used indicate baby becoming stressed. Percussion can be done by palm-cup method or with nipple, but it should not done in infants less than 32 weeks. This should be followed by gentle suctioning to remove any secretions and keep the airway patent. Special precautions should be taken during and after feeding to prevent aspiration in the baby.

Remember

The common respiratory complication to occur in LBW babies is Hyaline membrane disease (respiratory distress syndrome) which is characterized by tachypnea, expiratory grunt and inspiratory retractions.

2) Provide Neutral Thermal Environment

The LBW babies are more prone to lose body heat and develop hypothermia. Hypothermia aggravates the intensity of asphyxia, respiratory distress, and sepsis in the baby and makes him prone to hypoglycemia. Therefore, it is essential that these babies should be nursed in a neutral thermal environment. Neutral thermal environment is one in which the set of thermal conditions are such that the baby is able to maintain the skin temperature at normal level with minimum consumption of oxygen and energy. To prevent heat loss and maintain the temperature of the baby at required levels, the following measures should be taken:

- The temperature of the special care nursery should be maintained at 30±2°C. Air conditioners, radiant heaters, hot blowers or heat lamps can be used for this.
- Most of the LBW babies need to be nursed in incubators. The incubators provide isolation, thermal neutral environment and helps in maintenance of desired levels of humidity and oxygen administration.
Most incubators/open care systems are equipped with servo control system for temperature regulation. An electrode is taped to the baby’s abdomen which is connected to a thermostat. Incubator/open care system is set for maintaining the skin temperature of the infant between 36-36.5°C. The thermostat then, automatically regulates the heat output of the unit to maintain the skin temperature at desired level.

Care should be taken to ensure that the electrode does not get dislodged from the skin as this would cause overheating of the body. Frequent recordings of skin temperature with low reading thermometers is useful.

After the need for constant observation is over, the infant should be kept clothed to prevent radiant heat loss even when being nursed in the incubator.

Care should be planned in such a way as to avoid opening of the incubator frequently.

While performing procedures, an open care system or some other means of keeping the infant warm must be used.

In the home environment, a cooking fire and hot plate can be used to transfer heat to the baby by conduction. Use of hot water bottles etc. should be done carefully (rather avoided) to avoid the hazards of burning. The infant should be kept dressed and wrapped in double layers of blankets and nursed close to the mother’s body. Kangaroo mother care should be given to prevent hypothermia.

3) Provide Fluids and Nutrition

Feeding of LBW babies is a very important function and requires skilled nursing. Early feeding is advisable for all LBW babies. Feeding should be started within 4 hours of birth for all preterm babies and within one hour of birth for small for date babies. Early feeding helps prevent acidosis, hypoglycemia and hyperbilirubinemia. Some LBW babies need to be given I.V. fluids for the first few days to meet their requirement of fluid, electrolytes, calories and vitamins. Others are able to suck the nipple and may be given breast feed. Most of them however need gavage feeding.

The fluid and nutritional requirements of low birth weight infant are given in Table 1.1.

Table 1.1: Fluid and Nutritional Requirements of a LBW baby at one week of age

<table>
<thead>
<tr>
<th>Nutrients</th>
<th>Requirements per kg. body weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calories</td>
<td>120-150 Kcal</td>
</tr>
<tr>
<td>Water</td>
<td>100-200 ml</td>
</tr>
<tr>
<td>Proteins</td>
<td>4-6 gm</td>
</tr>
<tr>
<td>Iron</td>
<td>2 mg</td>
</tr>
<tr>
<td>Sodium</td>
<td>30-50 gm</td>
</tr>
<tr>
<td>Potassium</td>
<td>70-90 mg</td>
</tr>
<tr>
<td>Calcium</td>
<td>75-100 mg</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>50 mg</td>
</tr>
</tbody>
</table>
The fluid requirements are higher in infants with lower birth weight. Additional allowances of 20-40 ml/kg/day should be made for infants under phototherapy and increase by 50-90 per cent for those under radiant warmer.

The feeding is started in small amounts of 5-10 ml per feed on the first day and increased by about 5-10 ml per day over a period of one week to 10 days to reach the optimum requirement. Babies weighing below 1500 gm are given feeds 2 hourly and bigger babies are fed 3 hourly.

You have learnt earlier that breast milk is best for the newborns. The same is true for LBW babies also. If the baby is too small to suck, as far as possible expressed breast milk should be given to the baby through cup, spoon and/or paladai feeding and gavage feed. For details of gavage feeding refer to practical-4.

When a gavage fed baby begins to suck at the tube, his hand or fingers he may be ready for breast feeding. The nurse must ensure that the baby is on breast feeding before being discharged from the hospital.

An adequate weight gain in the baby shows that he is getting enough calories. The weight of these babies is usually recorded everyday at the same time with same amount of clothing preferably before feeding.

4) Prevent Infections

The LBW babies are very susceptible to infections which are a major cause of mortality and to protect these babies from infections absolute cleanliness is essential to good nursing practice. In order to prevent spread of infection from one infant to other the most important hygienic practice is hand washing. The nurse and anyone caring for the babies must wash hands before and after handling a baby. The other steps to prevent infection are as follows:

- All personnel entering the unit must wear a sterile gown over their casual clothes/ uniforms, change their shoes into nursery slippers, and wash hands up to elbow after removing watches, rings, bangles etc.
- Persons suffering from cold, respiratory, skin or G.I. infections should not be allowed to enter the nursery.
- Each neonate must be provided with separate articles such as thermometer, stethoscope etc. As far as possible use of disposables should be encouraged. Linen and clothing for the baby must be autoclaved.
- All nursery floors and surfaces should be cleaned thoroughly by wet mopping with detergent solution in every shift. Incubators and cots etc. must be cleaned with soap and water and with antiseptic solution daily and disinfected once a week, between infants and after any infection. All rubber and plastic tubings should be changed and disinfected every day.
- Infants who develop infection should be isolated in a separate area.

Remember

Hand washing is the most important factor in prevention of infection in the NICU.
5) **Provide Sensory Stimulation**

A LBW baby who is nursed in a special care nursery may be deprived of the sensory stimulation that is provided to a normal newborn baby by the mother and others in the family. This task, therefore, has to be taken over by the nurse. She should talk or sing to the baby while feeding or doing any other care activity. The baby should be held, fondled and cuddled in order to provide tactile stimulations. Visual stimulation can be provided by hanging bright coloured toys in the infant’s unit. The position of the baby should be changed periodically from side to side or placed on his back or prone. Care should be taken to ensure that the baby does not aspirate or suffocate. The nurse must encourage parent child contact to help establish normal relationship and bonding.

6) **Monitoring**

The following signs should be monitored:

- Temperature and Respiration
- Sucking
- Sensorium
- Cyanosis
- Convulsions
- Bleeding
- Diarrhoea
- Vomitting
- Abdominal distension.

7) **Communication**

Birth of a LBW baby requiring admission to the special care nursery creates a crisis for the family. Separation, lack of information about baby’s condition and the thought of the baby at the mercy of life support equipment is very threatening for them. The parents, especially the mothers of LBW babies, suffer from heightened anxiety in the postnatal period. You as a nurse must provide opportunity for the parents to express their fears and doubts and help them to cope with the crisis of LBW baby birth and separation. It is important for you to keep the parents fully informed about the baby’s condition.

In most of the NICU, mothers are allowed to visit their babies, though there are scheduled visiting hours for fathers to visit the baby. The mother should be encouraged to come and visit the nursery to **see, touch, handle** the baby and **to participate** in the care activities. This helps to reduce her anxiety and to develop emotional bond between the mother and baby. It also provides an opportunity for the mother to learn the special needs and care of the baby such as feeding, importance of hand washing and prevention of infection in the care of the baby after discharge from the special care unit. The ultimate survival of the baby will depend upon the continued care after discharge from the hospital.
1.7 PREVENTION OF BIRTH OF LOW BIRTH WEIGH BABY

As you have read earlier that mortality and morbidity is also high among LBW babies, therefore, steps should be taken to prevent birth of LBW babies so as to reduce the incidence of overall infant mortality.

Some of the steps that you can take are listed below:

• Educate community about right age of marriage of girls, i.e. 21 years by law.
• Provide care to girl child from early years of life through adolescence.
• Prevent and treat anemia in adolescence.
• Essential maternal care of all expectant women.
• Early identification and management of medical diseases like hypertension and other high risk pregnancies.
• Refer the mother at risk to hospital for institutional delivery or ensure delivery by trained personnel.
• Emphasis on institutional delivery and availability of resuscitation facility at birth.
• Avoid smoking, tobacco chewing during pregnancy.
• Immunization of all pregnant women with at least two doses of tetanus toxoid.
• Giving iron, folic acid supplements to mothers during pregnancy.
• Ensuring extra intake of balanced food by pregnant mother.
• Follow six cleans of intra-natal care.
• Advice on spacing for at least 3 years.
• Train traditional birth attendants (TBAs) working in your area on essential care of newborn, diseases of newborn, Congenital thrombo cytogenic purpura, Hemorrhagic Haemolytic disease of newborn and Anaemia.

1.8 LET US SUM UP

Low birth weight is one of the major causes of morbidity and mortality in newborn. They need special care to survive. In this unit we have discussed about the definition, causes, problems, management and complication of low birth weight in babies. We have also discussed the management of low birth weight baby at home. We have also indicated when to refer these neonates to hospital to prevent the complications.

1.9 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress 1

1) The LBW babies are prone to develop following problems:
• Birth asphyxia
• Hypothermia
• Infections
• Intraventricular hemorrhage
• Metabolic problems
• Hypoglycemia
• Respiratory difficulties
• Feeding problem
• Retinopathy of prematurity
• Jaundice

2) The principles of care of LBW neonate at home are:
• To prevent the baby’s room from being too cold or windy
• To prevent the baby from loosing body heat
• To provide sufficient energy for heat production by baby
• To educate mother to recognize early warming

Check Your Progress 2

1) Indications for referral of LBW babies are:
• Birth weight < 1800 gms
• Gestation < 34 weeks
• Unable to feed
• Sick neonate

2) Points to be kept in mind while transferring LBW babies are:
• Warmth during transport to prevent cold injury
• Stabilize infant as far as possible before transport
• Referral note including the intranatal and neonatal details
• Presence of mother if possible.
UNIT 2 FLUID AND ELECTROLYTE THERAPY IN NEWBORN AND INFANT

Structure

2.0 Objectives
2.1 Introduction
2.2 Body Fluids
   2.2.1 Composition and Distribution of Body Fluids
   2.2.2 Fluid Loss from the Body
   2.2.3 Normal Fluid and Electrolyte Requirement of Newborn
2.3 Fluid Therapy
   2.3.1 Indications of Intravenous Fluid Therapy
   2.3.2 Types of Fluids Used For Replacement
   2.3.3 Total Parenteral Nutrition (TPN)
2.4 Role of Nurse in Fluid Therapy
   2.4.1 Preparation of Fluid
   2.4.2 Calculating Drops/Minute
   2.4.3 Site Selection
   2.4.4 Monitoring Neonate Receiving Intravenous Fluid
2.5 Let Us Sum Up
2.6 Glossary
2.7 Answers to Check Your Progress

2.0 OBJECTIVES

After completing this unit, you should be able to:

- Explain terminologies related to fluid therapy;
- Explain why newborn and infants are vulnerable to fluid loss;
- Calculate normal fluid and electrolyte requirement of newborn and infant;
- List down various conditions requiring fluid therapy; and
- Describe nurses role in managing fluid therapy.

2.1 INTRODUCTION

During transition from fetal to postnatal life, changes occur in total body fluid volume, extra cellular fluid volume and intra cellular fluid volume. The newborn and infants have proportionately higher volume of extra cellular fluid than the adult. The newborn has a higher level of total body sodium and chloride and also higher level of potassium, magnesium and phosphate.

In the previous unit you learnt about management of LBW babies.

In this unit you will learn about fluid and electrolyte therapy in newborn and infant. The unit deals with important terminologies related to fluid and electrolyte.
therapy, fluid compartments, composition of body fluids, physiology of loss of fluids, normal fluid requirements of newborn, indications of intravenous fluid and nurses responsibilities while administering fluids to neonates and infants.

2.2 BODY FLUIDS

In this section we shall discuss about composition and distribution of body fluids, fluid loss from the body, normal fluids and electrolyte requirement of newborn.

2.2.1 Composition and Distribution of Body Fluids

Composition

Body fluid consists of water, electrolytes and proteins in different compartments. At birth 80% of body weight of a term baby is due to water. The main electrolytes and their normal values are given in the Table 2.1.

<table>
<thead>
<tr>
<th>Electrolyte</th>
<th>Normal values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium (Na⁺)</td>
<td>130-150 meq/l</td>
</tr>
<tr>
<td>Potassium (K⁺)</td>
<td>3.9-5.9 meq/l</td>
</tr>
<tr>
<td>Calcium (Ca++)</td>
<td>9-11 mg/dl</td>
</tr>
<tr>
<td>Magnesium (Mg++)</td>
<td>1.2-1.8 meq/l</td>
</tr>
<tr>
<td>Chloride (Cl⁻)</td>
<td>97-110 meq/l</td>
</tr>
<tr>
<td>Bicarbonate (HCO₃⁻)</td>
<td>22-29 meq/l</td>
</tr>
<tr>
<td>Phosphate (HPO₄⁻)</td>
<td>4.3-9.3 mg/l</td>
</tr>
</tbody>
</table>

Remember

Fluids and electrolytes remain fairly constant by different mechanisms like osmosis and diffusion where water and electrolytes are moved across the semipermeable cell membrane of the body cells.

Distribution of Body Fluids

Total body water (TBW) of an individual is distributed into intracellular compartment and extracellular compartment of the body cells (Table 2.2).

<table>
<thead>
<tr>
<th>Age</th>
<th>ECF</th>
<th>ICF</th>
<th>% of Total Body Water (TBW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preterm</td>
<td>55%</td>
<td>30%</td>
<td>85%</td>
</tr>
<tr>
<td>Term</td>
<td>45%</td>
<td>35%</td>
<td>80%</td>
</tr>
<tr>
<td>3 years</td>
<td>25%</td>
<td>40%</td>
<td>65%</td>
</tr>
<tr>
<td>Adult</td>
<td>25%</td>
<td>40%</td>
<td>65%</td>
</tr>
</tbody>
</table>
ECF - Extracellular Fluid  
ICF - Intracellular Fluid  
TBW - Total Body Water

**Remember:**  
Any fluid lost or decreased reduces the extracellular fluid rapidly.

### 2.2.2 Fluid Loss from the Body

Fluid is lost from the body through urine, stool, skin and from lungs through expiration. These losses are referred to as physiologic losses. The fluid lost through skin and lungs is termed as insensible fluid loss (**Table 2.3**). These are stated as:

- **a)** Insensible Water Loss (IWL)
- **b)** Water loss through urine
- **c)** Water loss through stool
- **d)** Sweat loss - negligible in newborns

**Table 2.3: Fluid Loss**

<table>
<thead>
<tr>
<th>Routes</th>
<th>Amount</th>
<th>Water produced (ml/100 k calories)</th>
<th>Net Requirement water lost - water produced (ml/100 k calories)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Insensible loss (lungs and skin)</td>
<td>40 ml</td>
<td>15 ml</td>
<td>125 ml-15 ml= 100ml</td>
</tr>
<tr>
<td>• Urine</td>
<td>80 ml</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Stool</td>
<td>5 ml</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>125 ml</td>
<td>15 ml</td>
<td></td>
</tr>
</tbody>
</table>

- **Insensible Water Loss (IWL):** IWL is loss of water due to evaporation i.e., water that evaporates in an invisible manner via skin (2/3) or respiratory tract (1/3). Various factors which influence IWL include maturity of the newborn, radiant warmer, phototherapy, humidity, plastic heat shield as shown in **Table 2.4**.

**This is the most variable component of fluid calculation.**

**Table 2.4: Factors Affecting IWL**

<table>
<thead>
<tr>
<th>Factors</th>
<th>Effect on IWL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maturity</td>
<td>More with lower gestational age and birth wt</td>
</tr>
<tr>
<td>Radiant warmer</td>
<td>Increased - 50%</td>
</tr>
<tr>
<td>Phototherapy</td>
<td>Increased - 50%</td>
</tr>
<tr>
<td>High humidity</td>
<td>Decreased - 30%</td>
</tr>
<tr>
<td>Plastic heat shield</td>
<td>Decreased - 30%</td>
</tr>
</tbody>
</table>
The heat loss is more in premature babies. The lower the gestational age and birth weight, more is loss of water (IWL) (Table 2.5).

<table>
<thead>
<tr>
<th>Age (in days)</th>
<th>Birth wt (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.75-1.0</td>
<td>1.0-1.5</td>
</tr>
<tr>
<td>0-7</td>
<td>65</td>
</tr>
<tr>
<td>7-14</td>
<td>60</td>
</tr>
</tbody>
</table>

Higher respiratory rate in neonates also contributes to increased IWL. Each ml of water that evaporates from skin is associated with loss of 560 cal. It is difficult to keep a baby warm with high trans-epidermal water loss. Hence it is essential that you should be able to recognize and take into consideration various factors that affect IWL.

b) Water Loss through urine: Another component of maintenance fluid is the amount of water required for the formation of urine. It is dependent on two major factors - status of renal function and renal solute load which is derived from endogenous and exogenous sources. During day 1-2, the exogenous solute load is minimal as infants do not receive proteins or electrolytes. The solute load increases after first week of life (Table 2.6).

<table>
<thead>
<tr>
<th>Age</th>
<th>Solute load mOsm/kg/day</th>
<th>Water req. for excretion ml/kg/d</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1 wk</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>&gt;2 wk</td>
<td>15-20</td>
<td>60-80</td>
</tr>
</tbody>
</table>

c) Water loss through stool: It is only 5-10 ml/kg/day and is considered negated with water of oxidation produced by neonate which is 5-10 ml/kg/day. Hence, while calculating maintenance fluids only IWL and renal water loss is taken into consideration.

d) Loss of water from sweat: It is negligible in newborns. Water turnover (waterloss) of the body is directly proportionate to the basal metabolic rate.

It is estimated that for every 100 k calories metabolized, a newborn baby should receive about 40 ml of water to replenish insensible loss, 80 ml for urine and 5 ml for stool adding up to 125 ml. There is a net production of 15 ml of water produced per 100 k. calories metabolized. Therefore, the newborn should receive 110 ml/100k calories metabolized as his normal maintenance requirement.

2.3.3 Normal Fluid and Electrolyte Requirement of Newborn

Fluid and electrolyte requirements for normal full term newborn are generally calculated on daily basis taking into consideration past losses, projected losses and maintenance requirements. Approximately, a normal full term newborn requires following amount of fluid daily (Table 2.7).
### Table 2.7: Day Wise Fluid Requirements for Newborn

<table>
<thead>
<tr>
<th>Day</th>
<th>Fluid in ml/kg/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>80 ml</td>
</tr>
<tr>
<td>2</td>
<td>100 ml</td>
</tr>
<tr>
<td>3</td>
<td>120 ml</td>
</tr>
<tr>
<td>4</td>
<td>135 ml</td>
</tr>
<tr>
<td>5</td>
<td>150 ml</td>
</tr>
</tbody>
</table>

After day 5, intake of the fluid should be designed to maintain zero balance i.e. 110 ml/kg/24 hours for a neonate, for infant fluid requirements are calculated according to body weight i.e. up to 10 kg it is 100 ml/kg body weight. Normal electrolyte requirements are:

- Na: 2-3 meq/kg/day
- Cl: 1-2 meq/kg/day

### Calculation of Maintenance Fluid Requirements

**Initial Fluid Therapy:** For a term infant under basal conditions, the IWL is 20 ml/kg/day. The urine volume of 50 ml/kg/day is required to excrete solute load of 15 mOsm/kg/day. Thus, maintenance water required is 70 ml/kg/day. Allowing for a negative water balance of 10 ml/kg/day, the true water requirement at birth is 60 ml/kg/day (Refer Table 2.8).

### Table 2.8: Initial Fluid Therapy

<table>
<thead>
<tr>
<th>Birth Wt. (kg)</th>
<th>Dextrose conc.</th>
<th>Fluid (ml/kg/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>&lt;24 hrs</td>
</tr>
<tr>
<td>&lt;1.0</td>
<td>5%</td>
<td>100</td>
</tr>
<tr>
<td>1.0-1.5</td>
<td>10%</td>
<td>80</td>
</tr>
<tr>
<td>&gt;1.5</td>
<td>10%</td>
<td>60</td>
</tr>
</tbody>
</table>

The fluid requirements are required to be calculated as per monitoring data as follows:

- Increase fluids if the baby is under radiant warmer or phototherapy, by 20 ml/kg/day if birth weight <1500 gms and by 10 ml/kg/day if birth weight >1500 gms as IWL increases as prescribed by doctor.
- Make sure that fluid orders are written at least 12 hrly or preferably 8 hrly in preterm or sick neonates.
- Ensure change of fluid to Isolyte P after 48 hrs.

**Fluid requirement by the end of second week: Refer Table 2.9.**

### Table 2.9: Fluid requirement by end of second week

<table>
<thead>
<tr>
<th>Birth weight</th>
<th>Fluid requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;2500 gms</td>
<td>150 ml/kg/d</td>
</tr>
<tr>
<td>1500-2500 gms</td>
<td>170 ml/kg/d</td>
</tr>
<tr>
<td>100-1500 gms</td>
<td>190-200 ml/kg/d</td>
</tr>
<tr>
<td>&lt;1000 gms</td>
<td>200-250 ml/kg/d</td>
</tr>
</tbody>
</table>
Once the phase of initial postnatal adaptation is over, growth is of paramount importance. The amount of fluid required is 20 to 25 ml/kg/day as infant grows at the rate of 25 to 30 g/day and the new tissue contains 70% water. Water for growth is water required for formation of new tissue in growing infant.

Replacement of deficit and replacement of current losses is more important in infant with diarrhoea and dehydration, chest tube drainage, surgical wounds and osmotic diuresis.

As a nurse it is one of your important activities to measure accurately the quantity and composition of abnormal fluid losses to assess appropriate replacement. You need to measure the volume and composition of abnormal fluid loss and replace volume as per volume and mole as per mole basis.

Replace gastric fluid loss by 1/2NS and other body fluids by full strength NS as advised by the doctor.

**Fluid and Electrolyte Imbalance**

Newborn and infants are vulnerable to fluid electrolyte imbalance because they have:

- Higher metabolic rate
- Large surface area
- Higher breathing rate
- Decreased ability of kidney to produce concentrated urine
- Increased proportion of water in the extra-cellular fluid
- Poor temperature controlling ability (non shevering/sweating)
- Exposure under radiant warmer/photo therapy etc.

<table>
<thead>
<tr>
<th>Check Your Progress 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) What are the components of body fluids?</td>
</tr>
<tr>
<td>................................................ ................................................ ................................................</td>
</tr>
<tr>
<td>................................................ ................................................ ................................................</td>
</tr>
<tr>
<td>................................................ ................................................ ................................................</td>
</tr>
</tbody>
</table>

| 2) How are fluids lost from the body? |
| ................................................ ................................................ ................................................ |
| ................................................ ................................................ ................................................ |
| ................................................ ................................................ ................................................ |
| ................................................ ................................................ ................................................ |

| 3) Why newborn is prone to fluid imbalances? |
| ................................................ ................................................ ................................................ |
| ................................................ ................................................ ................................................ |
| ................................................ ................................................ ................................................ |
2.3 FLUID THERAPY

Fluid Therapy is used for meeting the normal requirements, correcting the pre-existing deficits or supplementing additional fluid electrolyte needs. Fluids can be supplied orally, through naso-gastric tube or as parental therapy. Parental therapy includes intravenous fluid therapy and total parental nutrition.

2.3.1 Indications of Intravenous Fluid Therapy

Baby may need fluid therapy in following conditions:

- Birth weight less than 1200gm
- Severe birth asphyxia
- Respiratory distress syndrome
- Apneic attacks
- Hypoglycemia
- Seizures
- Intestinal obstruction
- Severe dehydration.

Remember

Neonates with hyperthermia, diarrhoea, vomiting, tachypnea and low birth weight require increased amount of fluid due to increased fluid loss. Neonates with congestive heart failure, mechanical ventilation, asphyxiated baby, renal failure, high humidity oxygen require decreased amount of fluid due to fluid retention.

2.3.2 Types of Fluids used for Replacement

- Give 10% of glucose for first three days of life.
- On fourth day 10% dextrose with 1/5th saline is started. If urine out put is adequate, 2 meq(1 ml) of potassium is added per 100 ml of fluid.

Remember

Always check fluid prescription by a doctor, usually 2 meq(1 ml) of potassium is added to 100 ml of fluid.

If the neonate requires long term intravenous therapy, total parenteral nutrition is recommended.

2.3.2 Total Parenteral Nutrition (TPN)

It is also known as hyper alimentation therapy. As the name indicates, it gives total nutrition to the newborn. It involves intravenous infusion of highly concentrated solutions of protein, glucose, minerals, vitamins and lipids (fats).

Indications

- Neonates who are not able to feed through gastrointestinal route.
- Severe low birth weight babies who require prolonged intravenous therapy.
- Chronic intractable diarrhoea.
Constituents of TPN

These are as follows:

- Glucose either 10% or higher concentrations.
- Proteins in the form of crystalline amino acids.
- Fat emulsions to increase caloric value.
- Electrolytes, minerals, trace elements and vitamins.

Techniques of administration

These include:

- Peripheral line can be used if glucose concentration is below 10%.
- If concentration of glucose is more than 10%, then it is administered by silicone catheters through central venous line.
- A set with intralipid and another set with protein, carbohydrate, electrolyte and minerals is prepared. Both infusion sets are connected with a Y connector just proximal to the micropore (bacterial) filter, which is connected to the central or peripheral I/V line of the patient.

Points to be kept in mind while giving TPN

These are as follows:

- Strict aseptic technique, preferably under laminar flow.
- Regulate rate of flow.
- Use bacterial filters because protein glucose solution is a very good media for bacteria to multiply.
- Infusion bottles and sets should be changed every day.
- Daily recording of weight, hydration status, urine output and amount of infused fluids should be recorded.

Check Your Progress 2

1) What are the indications of intravenous therapy in newborn?

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2) What are the indications of TPN?

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2.4 ROLE OF NURSE IN FLUID THERAPY

The role of nurse is discussed in following section under various areas:

2.4.1 Preparation of Fluid

Standard intravenous fluids containing a predetermined quantity of sodium (saline) are routinely available in intensive care unit. If it is not available you have to prepare it. Let us see how to prepare D$_{10}$W 1/5 NS 250 ml for a neonate for 24 hrs infusion. You require 10% dextrose (D$_{10}$W) and Normal Saline.

Total amount of fluid to be infused = 250 ml
Type of fluid to be infused D$_{10}$W 1/5 NS
It means that in the total amount of 250 ml fluid 1/5$^{th}$ part will be saline and 4/5$^{th}$ part will be D$_{10}$W.

Therefore amount of saline will be 250x1/5 = 50
amount of D$_{10}$W = 250x4/5 = 200

It means you have to add 50 ml saline and 200 ml 10% dextrose to make D$_{10}$W 1/5 NS 250 ml. Same way you can prepare fluids having different strength of saline as ordered by physician e.g. D$_{5}$NS, D$_{3}$ 1/3 NS etc.

Remember
At one time prepare the amount of fluid required for 24 hours only. Hence, if you have to prepare 250 ml of fluid only, drain out the other 250 ml of fluid from the 500 ml bottle first.

2.4.2 Calculation of Drops/Minute

An infusion set with micro-dropper should be used for infusion. In micro dropper set, 1 ml is equal to 60 micro-drops.

Following formula can be used for calculating drops per minute.

\[
\text{Amount to be infused (in ml)} \times 60 \text{ drops} \\
\text{Time factor prescribed} \times 60 \text{ minutes}
\]

Let us calculate what should be the number of drops per minute for infusing 120 ml fluids over six hours.

Amount to be infused = 120 ml
Time prescribed = 6 hrs

\[
\text{Drops/minute} = \frac{120 \times 60 \text{ drops}}{6 \times 60 \text{ minutes}} = 20 \text{ drops/minute}
\]

2.4.3 Site Selection

The following sites are commonly used for infusions:

- Cephalic vein
- Basilic vein
- Medial cubital vein
• Frontal vein
• Superficial temporal vein
• Posterior auricular vein
• Dorsal venous network
• Great saphenous vein
• Venous network

The site selected for I/V therapy depends upon the accessibility of the site and when selecting a site, care should be taken to meet the mobility needs of newborn. In newborns and small infants a superficial vein of hand, wrist, forearm, foot or ankle is usually most preferable and convenient site and can be easily stabilized. Superficial veins of scalp should only be used when other sites are not accessible.

The precaution that should be taken while starting and for maintaining I/V insertion include:-

1) Practice, good hand washing technique before starting I/V infusion
2) Clean the site with an appropriate antiseptic lotion (alcohol or povidone-iodine before insertion of I/V line catheter).

<table>
<thead>
<tr>
<th>Remember</th>
</tr>
</thead>
<tbody>
<tr>
<td>• While cleaning the site of insertion use a circular motion starting from centre and then moving outward.</td>
</tr>
<tr>
<td>• Allow antiseptic to dry for 30-60 seconds before insertion of catheter.</td>
</tr>
<tr>
<td>• Do not touch or palpate the insertion site after cleaning the site with antiseptic.</td>
</tr>
</tbody>
</table>

3) Teach the family and parents regarding signs and symptoms of infection of insertion site, i.e., inflammation, redness, swelling, pain.
4) When infusion is continued for several days; make sure that you change the tubing and solution at regular intervals as per the policy of your institution. Always discuss about these issues with the physician.
5) Continuously monitor the fluid therapy in relation to type of fluid, time for administration, rate of flow, site and condition of infant.
6) Most oftenly the tubing can be changed every 72 hours. You should put a label on the tubing and fluid indicating the time and date of changing the tubing to ensure that the tubing (equipment) is changed regularly. You should watch for any signs of infection, i.e. redness or pain which require removal of tubing and restarting the fluid at other safer site.
7) You need to watch for infiltration of the fluid from the site. The signs of infiltration include erythema, edema, pain, blanching, streaking of skin along the vein and/or darkened area at the insertion site. Newborn will present pain by irritability and crying.
8) When signs of infiltration are present you should immediately: stop the infusion; elevate the extremity, inform the physician and administer prescribed treatment as early as possible so that further complications do not occur.

| Remember |
| The most common complication of fluid therapy is phlebitis. |
9) When fluid therapy has to be stopped you should gently remove the catheter and the tape from the needle site because the removal of I/V catheter and tape can be severely painful to the infant. Try to remove it manually. If the manual removal is not possible small cut can be made with bandage scissors in the tape to facilitate the removal of tape. While removing you must:

- Ensure that all the digits are visible to avoid any cut.
- Remove the protective covering if it covers the digits.
- Make sure that the scissors do not touch skin of the infant.
- Protect the skin and fingers by sliding your own fingers between the tape and skin of the newborn to avoid touching the scissor with skin of newborn.
- Always place a cut on medial side of extremity (thumb side).
- Remove the catheter by taking it out in opposite direction of the puncture site and put firm pressure on the site to avoid oozing of blood from the site with help of a dressing.

### 2.4.4 Monitoring Neonate Receiving Intravenous Fluid

You have to continuously monitor the newborn undergoing fluid therapy as given below:

<table>
<thead>
<tr>
<th>Nursing intervention</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Explain the purpose of fluid therapy to relatives/family</td>
<td>It reduces fears and anxieties of the relatives/family</td>
</tr>
<tr>
<td>Check the prescription orders of the baby/patient</td>
<td>It enables to check the type, amount of fluid to be given and right fluid therapy</td>
</tr>
<tr>
<td>Collect all the articles required for fluid therapy</td>
<td></td>
</tr>
<tr>
<td>Check the fluid for expiring date, seal of infusion bottle and for any free visible particles</td>
<td>To prevent infection</td>
</tr>
<tr>
<td>Calculate rate of administration and ensure that the micro-dropper delivers the fluid at the required rate</td>
<td>To prevent fluid overloading</td>
</tr>
<tr>
<td>Change I/V infusion set and bag every 24-72 hours as per policy of institution</td>
<td>To prevent infection</td>
</tr>
<tr>
<td>Inspect the infusion site every hour to look for redness and swelling. If swelling or redness, remove immediately and inform</td>
<td>To prevent excavation to the cells</td>
</tr>
<tr>
<td>Check volume of fluid infused and compare with the prescribed volume</td>
<td>To prevent under hydration or over hydration</td>
</tr>
<tr>
<td>Monitor blood glucose every six hours</td>
<td>To maintain normal blood glucose level</td>
</tr>
<tr>
<td>Assess hydration daily</td>
<td>To prevent under hydration or over hydration</td>
</tr>
<tr>
<td>Do accurate urine output charting</td>
<td>To prevent under hydration or over hydration</td>
</tr>
<tr>
<td>Record weight accurately</td>
<td>To prevent under hydration or over hydration</td>
</tr>
</tbody>
</table>
Remember

Signs of dehydration are: Sunken eyes and fontanelles, loss of skin elasticity, dry tongue, and mucous membranes, weight loss more than 5% and oliguria.

Signs of over hydration are: Excessive weight gain, puffy eyes, increasing edema-dependent parts (scrotal in male newborn and labial in female newborn).

Check Your Progress 3

1) What is the role of nurse in fluid therapy?

2) How to prepare D5W 1/4 NS 300 ml for a neonate for 24 hrs?

2.5 LET US SUM UP

In this unit you learnt about fluid and electrolyte therapy for newborn. You also learnt about body fluids, normal fluid requirement of newborn, indications of fluid therapy, total parental nutrition and role of nurse in fluid therapy. Hope you will use the knowledge in your clinical practice.

2.6 GLOSSARY

**Extracellular Fluid (ECF):** is the fluid present outside the cell. Extracellular fluid includes intravascular fluid and interstitial fluid (fluid between the cells) and fluids inside the cavities like pleural fluid, peritoneal fluid etc. As the infant grows, percentage of water in the extracellular fluid reduces. By the age of 3 years it almost reaches adult composition.

**Intracellular fluid (ICF):** is the fluid that is present inside the cells.

**Osmolarity:** number of mols present in a liter of solution. Normal osmolarity of ECF and ICF is same and it is 290 mOsm/kg.
Isotonic solution : a solution having same, solute and water concentration like that of cell, e.g. – Ringer lactate, Normal Saline, 5% Dextrose.

Hypotonic Solution : a solution that contains less solutes than present in cells.

Hypertonic Solution : a solution that contains more solutes than present in cells.

Hypokalemia : serum potassium below 3.5meq/l. It is caused by increased fluid loss as in diarrhoea and is manifested as muscle weakness, hypotonia, changes in ECG and asthma.

Hyperkalemia : serum potassium above 5.9meq/l. It is caused by inadequate excretion of potassium, hemolysis, burns etc. It is manifested as changes in ECG like ventricular fibrillation and heart block.

Respiratory acidosis : low pH caused by increased PCO₂ and compensated by elevated bicarbonate level.

Respiratory alkalosis : increased pH and decreased PCO₂ mainly caused by increased rate of ventilation.

Metabolic acidosis : low pH characterized by reduced HCO₃ and reduced PCO₂.

Metabolic alkalosis : increased pH, increased HCO₃ and elevated PCO₂

Osmosis : movement of water across a semipermeable membrane unless concentration of solutes becomes equal on both sides.

Solute : A substance that gets dissolved in another substance (usually a component of solution).

Solvent : A substance usually a liquid capable of dissolving other substance (e.g. water).

2.7 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress 1
1) Refer Sub-section 2.2.1
2) Refer Sub-section 2.2.2
3) The newborn is prone to lose the fluids because of following reasons:
   - Higher metabolic rate
   - Large surface area
   - Higher breathing rate
   - Decreased ability of kidney to produce concentrated urine
   - Increased proportion of water in the extracellular fluid
   - Poor temperature controlling ability (no shivering/sweating)
   - Exposure under radiant warmer/photo therapy
Check Your Progress 2

These are:
1) • birth weight less than 1200 gm
   • severe birth asphyxia
   • respiratory distress syndrome
   • apneic attacks
   • hypoglycema
   • seizures
   • intestinal obstruction
   • dehydration
2) These include:
   • neonates who are not able to feed through gastro intestinal route.
   • severe low birth weight babies who require prolonged I/v therapy.
   • chronic intractable diarrhoea.

Check Your Progress 3

1) The role of Nurse is as follows:
   a) Preparation of fluid.
   b) Selection of appropriate site for insertion of I/V canula.
   c) Monitoring rate of flow.
   d) Calculating drops/minute.
   e) Continuous monitoring of the neonate.
2) Type of fluid required = 5% dextrose (D₅W) and Normal Saline
   Total amount of fluid to be infused = 300 ml
   Amount of saline = 1/4th part
   Therefore amount of saline = \( \frac{300 \times 1}{4} = 75 \) ml
   Amount of D₅W = 3/4th part
   Therefore, amount of 5% dextrose = 300 ml × 3/4 = 225 ml
   Add 75 ml Saline to 225 ml of 5% dextrose to make D₅W 1/4 NS 300 ml.
3.0 Objectives

3.1 Introduction

3.2 Hypoglycemia
   3.2.1 Definition
   3.2.2 Neonates at Risk
   3.2.3 Signs and Symptoms
   3.2.4 Management of Hypoglycemia

3.3 Respiratory Distress Syndrome (RDS)
   3.3.1 Definition and Types
   3.3.2 Etiopathogenesis
   3.3.3 Common Signs, Symptoms and Diagnosis
   3.3.4 Management of RDS

3.4 Neonatal Sepsis
   3.4.1 Definition and Types
   3.4.2 Etiopathogenesis
   3.4.3 Common Signs and Symptoms and Diagnosis
   3.4.4 Management of Neonatal Sepsis

3.5 Neonatal Shock
   3.5.1 Definition and Types
   3.5.2 Common Signs and Symptoms of Shock
   3.5.3 Management of Shock

3.6 Neonatal Jaundice
   3.6.1 Definition and Types
   3.6.2 Etiopathogenesis
   3.6.3 Common Signs, Symptoms and Diagnosis
   3.6.4 Management

3.7 Neonatal Seizures
   3.7.1 Definition and Types
   3.7.2 Etiopathogenesis
   3.7.3 Common Signs, Symptoms and Diagnosis
   3.7.4 Management of Neonatal Seizures

3.8 Anemia and Bleeding in Neonates
   3.8.1 Definition and Types
   3.8.2 Etiopathogenesis
   3.8.3 Common Signs, Symptoms and Diagnosis
   3.8.4 Management of Anemia and Bleeding in Neonates

3.9 Monitoring of Sick Neonate

3.10 Let Us Sum Up

3.11 Glossary

3.12 Answers to Check Your Progress

3.13 References
3.0 OBJECTIVES

After going through this unit, you should be able to:

- Define common neonatal disorders such as hypoglycemia, shock, RDS, jaundice, neonatal sepsis, neonatal seizures and monitoring of sick neonate;
- List the common causes of these disorders;
- Discuss the pathogenesis, types, signs and symptoms, diagnosis of these disorders; and
- Describe the management of these disorders.

3.1 INTRODUCTION

Majority of newborn babies do not develop any serious disorders and they need routine newborn care which can be provided by the mothers under nurse’s supervision. High risk mothers are likely to give birth to preterm or low birth weight babies who are prone to suffer from a number of disorders. Common causes of morbidity in newborn babies include hypoglycemia, shock, RDS, jaundice, neonatal sepsis, and neonatal seizures. Most neonatal disorders are limited to preterm and low birth weight babies.

In this unit, common neonatal disorders such as hypoglycemia, RDS, shock, jaundice, neonatal sepsis, neonatal seizures and monitoring of sick neonate are being discussed. Hence you will learn about the definition, causes, pathogenesis, types, signs and symptoms, diagnosis and management of these disorders. You will also learn about how to monitor a sick neonate.

3.2 HYPOGLYCEMIA

3.2.1 Definition

Hypoglycemia is defined as a blood glucose level of less than 45 mg/dl in all newborns.

Low birth weight and sick neonates are prone to develop low blood sugar which increases morbidity and mortality. It is important to monitor, diagnose and treat hypoglycemia early for a favorable outcome.

3.2.2 Neonates at Risk

- Premature and LBW neonates especially those weighing less than 2.0 kg.
- Infants of diabetic mother.
- Sick neonate (perinatal asphyxia, hypothermia, poor and/or delayed feeding, sepsis, shock, respiratory distress and polycythemia).

Check Your Progress 1

1) Define hypoglycemia.
2) List down the babies who are at risk for hypoglycemia?

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3.2.3 Signs and Symptoms

The signs and symptoms of hypoglycemia are very nonspecific and can mimic any illness. The common signs and symptoms are:

- Lethargy, weak cry and poor sucking
- Temperature instability
- Poor respiratory effort, apnea or cyanosis
- Excessive jitteriness, convulsions or hypotonia

If the signs are not alleviated by correction of hypoglycemia, consider other diagnostic possibilities for the symptoms.

Check Your Progress 2

1) List down the signs and symptoms of hypoglycemia?

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3.2.4 Management of Hypoglycemia

Management of hypoglycemia includes the following:

- Establish an IV line if one is not already in place. Give a bolus of 2 ml/kg body weight of 10% glucose IV slowly over 5 minutes. Hypoglycemic babies with convulsions may be given 4 – 5 ml/kg of 10% glucose as the initial bolus.
- If an IV line cannot be established quickly, give 2 ml/kg body weight of 10% glucose by gastric tube.
- Start infusion of dextrose at the daily maintenance volume according to the baby’s age so as to provide a Glucose Infusion Rates (GIR) of 6 mg/kg/min (Table 3.1).
- Measure blood glucose 30 minutes after starting the infusion of glucose and then every four to six hours.
- If the blood glucose is less than 25 mg/dl, repeat the bolus of glucose (as given above) and increase concentration of glucose to 8 mg/kg/min in the infusion.
• If the blood glucose is less than 45 mg/dl but is at least 25 mg/dl at any measurement, increase the glucose infusion rate by 2 mg/kg/min and measure blood glucose after 30 min.

• Continue the infusion at this rate until 2 consecutive values 6 hrs apart are above 45 mg/dl.

• Allow the baby to begin breastfeeding. If the baby cannot be breastfed, give expressed breast milk using katori spoon and/or paladai.

• As the baby’s ability to feed improves, slowly decrease (over a two to three-day period) the volume of IV glucose while increasing the volume of oral feeds.

Do not discontinue glucose infusion abruptly to prevent rebound hypoglycemia.

If hypoglycemia is persisting despite above management, give one dose of hydrocortisone: 5 mg/kg and refer to a higher health facility for management of refractory / persistent hypoglycemia.

Table 3.1: Achieving appropriate Glucose Infusion Rates (GIR) using a mixture of D10 & D25.

<table>
<thead>
<tr>
<th>Volume Kg/d (ml/kg/d)</th>
<th>6 mg/kg/min Glucose infusion rate</th>
<th>8 mg/kg/min</th>
<th>10 mg/kg/min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kg/d (ml/6 kg)</td>
<td>D10 (ml/kg/d)</td>
<td>D25 (ml/kg/d)</td>
<td>D10 (ml/kg/d)</td>
</tr>
<tr>
<td>60</td>
<td>42</td>
<td>18</td>
<td>24</td>
</tr>
<tr>
<td>75</td>
<td>68</td>
<td>7</td>
<td>49</td>
</tr>
<tr>
<td>90</td>
<td>86</td>
<td>4 (Dist. Water)</td>
<td>74</td>
</tr>
<tr>
<td>105</td>
<td>85</td>
<td>4 (Dist. Water)</td>
<td>99</td>
</tr>
<tr>
<td>120</td>
<td>86</td>
<td>34 (Dist. Water)</td>
<td>114</td>
</tr>
<tr>
<td>135</td>
<td>86</td>
<td>49 (Dist. Water)</td>
<td>114</td>
</tr>
<tr>
<td>140</td>
<td>86</td>
<td>64 (Dist. Water)</td>
<td>114</td>
</tr>
</tbody>
</table>

Note: Add 20ml/kg of Normal saline beyond 48 hrs of life to provide 3 meq/kg of sodium.

The GIR can also be calculated using this simple equation or the GIR calculated using Table 3.1 can be counter checked by this simple equation as given below:

___ ml/kg/day x ____ % dextrose x 0.007 = ______ mg/kg/min (GIR)

Eg 1: If a baby is on 100mL/kg/day and is being given 10% Dextrose, he is receiving a GIR of 7 mg/kg/min.
Eg 2: If a baby is on 49 mL/kg/day of 10% Dextrose, and 26 ml/kg/day of 25% Dextrose, he is receiving a GIR of 8 mg/kg/min.

On calculation

\[49 \times 10 \times 0.007 = 3.43\]
\[26 \times 25 \times 0.007 = 4.55\]

\[3.43 + 4.55 = 7.98\], the GIR calculated is again 8 mg/kg/min.

**Frequency of blood glucose measurements after blood glucose returns to normal are done as under:**

- If the **baby is receiving IV fluid for any reason**, continue blood glucose measurements every 12 hours for as long as the baby requires IV fluid. If the **blood glucose is less than 45 mg/dl**, treat as described above.

- If the **baby no longer requires or is not receiving IV fluid**, measure blood glucose every 12 hours for 24 hours (two more measurements) and treat as:
  a) If the **blood glucose is less than 45 mg/dl**, treat as described above.
  b) If the **blood glucose remains normal**, discontinue measurements.

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**Check Your Progress 3**

1) What is the treatment of hypoglycemia in a sick newborn?

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2) What is the treatment of hypoglycemia in a sick newborn with seizures?

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3) A 2 day old baby weighing 2.0 kg is brought to SNCU with refusal to feed and hypothermia. His blood sugar by dextrostix is 20 mg/dl. How will you manage this baby?

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4) After 12 hours baby’s blood sugar is above 45 mg/dl, baby is active with normal body temperature. How will you proceed?

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5) How will you monitor this baby whose blood sugars have returned to normal?

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3.3 RESPIRATORY DISTRESS SYNDROME (RDS)

Respiratory distress accounts for significant morbidity and mortality in neonates. It occurs in 4 to 6 percent of neonates. Many of the conditions causing respiratory distress are preventable. Early recognition and prompt management are required.

3.3.1 Definition and Types

Respiratory distress is defined as a condition characterized by the presence of fast breathing with respiratory rate > 60/minute in a quiet resting baby, inspiratory recessions, expiratory grunting, flaring of nostrils with or without cyanosis.

Based on the assessment by using respiratory distress score, it can be categorized into three types i.e. mild, moderate and severe or impending respiratory failure. Refer Table 3.2 for scoring and evaluation of the severity of respiratory distress.

3.3.2 Etio-pathogenesis

A number of causes are responsible for respiratory distress but the most common are obstruction of the baby’s airway by mucus, blood, liquor or meconium, infection etc. The common causes are listed below:

Preterm baby
- Respiratory distress syndrome
- Congenital Pneumonia
- Miscellaneous causes: hypothermia, hypoglycemia

Term baby
- Transient tachypnea of newborn (TTNB)
- Meconium aspiration
Nursing Care of High Risk Neonate-I

- Pneumonia
- Asphyxia

**Surgical causes**
- Diaphragmatic hernia
- Tracheo-esophageal fistula
- Bilateral choanal atresia

**Other causes**
- Cardiac (congenital cardiac defects)
- Metabolic (acidosis, alkalosis, hypoglycemia, hypothermia)

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**Check Your Progress 4**

1) Define Respiratory Distress Syndrome (RDS).

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2) Give four causes of respiratory distress syndrome.

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3) Write down different types of respiratory distress syndrome.

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**3.3.3 Common Signs, Symptoms and Diagnosis**

Whatever may be the cause of respiratory distress, the signs and symptoms will be common besides the signs and symptoms specific to the cause itself. We shall learn about the common signs and symptoms of RDS. We will also learn about the diagnosis.

**Diagnosis is made by history, signs and symptoms and diagnostic tests.**
History: A detailed relevant antenatal and peri-natal history should be taken based on the common causes:

- Gestation
- Onset of distress
- Previous preterm babies with respiratory distress
- Antenatal steroid prophylaxis if preterm delivery
- Rupture of Membranes > 24 hours, Intra-partum fever, chorio-amnionitis
- Meconium stained amniotic fluid
- Asphyxia
- Maternal diabetes mellitus

Signs and symptoms

Common signs and symptoms of respiratory distress syndrome are fast breathing, respiratory rate > 60 per minute, recession of intercostals and subcostal muscles, flaring of nostrils, pallor or cyanosis of skin and mucus membrane.

Assessment of severity of respiratory distress can be done as per Table 3.2 and 3.3.

Table 3.2: Silverman Anderson Score and its interpretation

<table>
<thead>
<tr>
<th>Score</th>
<th>Upper chest retraction</th>
<th>Lower chest retraction</th>
<th>Xiphiod retraction</th>
<th>Nasal flaring</th>
<th>Grunt</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Synchronized</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>1</td>
<td>Lag during inspiration</td>
<td>Just visible</td>
<td>Just visible</td>
<td>Minimal</td>
<td>Audible with stethoscope</td>
</tr>
<tr>
<td>2</td>
<td>See-saw</td>
<td>Marked</td>
<td>Marked</td>
<td>Marked</td>
<td>Audible with unaided ear</td>
</tr>
</tbody>
</table>

Interpretation

Score 0-3 = Mild respiratory distress – O₂ by hood
Score 4-6 = Moderate respiratory distress - CPAP
Score > 6 = Severe/Impending respiratory failure

Table 3.3: Downe’s score and its interpretation

<table>
<thead>
<tr>
<th>Score</th>
<th>Respiratory Rate</th>
<th>Cyanosis</th>
<th>Air entry</th>
<th>Grunt</th>
<th>Retraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>&lt; 60/min</td>
<td>Nil</td>
<td>Normal</td>
<td>None</td>
<td>Nil</td>
</tr>
<tr>
<td>1</td>
<td>60-80/min</td>
<td>In room air</td>
<td>Mild decrease</td>
<td>Audible stethoscope</td>
<td>Mild</td>
</tr>
<tr>
<td>2</td>
<td>&gt;80/min</td>
<td>In &gt; 40% FiO₂</td>
<td>Marked decrease</td>
<td>Audible with unaided ear</td>
<td>Moderate</td>
</tr>
</tbody>
</table>

Interpretation

Score <6 = Respiratory distress (Mild to Moderate)
Score > 6 = Impending respiratory failure (Severe)
**Examination of the baby**

Examination of the baby is done to assess for the following:

- Severity of respiratory distress
- Neurological status
- Blood Pressure, Capillary filling Time (CFT)
- Hepatomegaly
- Cyanosis
- Features of sepsis
- Malformations

**Diagnostic modalities**

The diagnosis is based on the X-ray findings and the sepsis screen. Blood culture is also done.

1) **Chest X-ray**

   To look for
   
   - Respiratory Distress Syndrome (RDS) - Air bronchogram, decreased lung volume and hazy lungs
   - Meconium Aspiration Syndrome (MAS) - Fluffy shadows involving both lungs with hyperinflation
   - Pneumonia - Infiltrates
   - Pulmonary hemorrhage, RDS - White out (Opaque lung)

2) **Sepsis screen**: TLC, DLC, CRP, Micro ESR, IT Ratio, ANC (Antenatal check up)

3) **Blood Culture**: This may give a clue to the infectious etiology of the respiratory distress

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**Check Your Progress 5**

1) List four common signs and symptoms of respiratory distress.

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2) List down the investigations that can help to confirm the RDS.

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   .............................................................................................................
3.3.4 Management of RDS

Management of RDS includes prevention of RDS, general management for mild and moderate to severe RDS and specific management.

Prevention of RDS can be done by the following:

- **Antenatal corticosteroid therapy** is a simple and effective therapy that prevents RDS.
- **Optimal effect of antenatal steroids** is seen if delivery occurs after 24 hrs of starting therapy.
- **Recommended dose** is Inj Betamethasone 12 mg IM every 24 hrs × 2 doses or Inj. Dexamethasone 6 mg IM every 12 hrs × 4 doses, given to mothers with preterm labour or APH before 34 wks of gestation.

Mild respiratory distress is managed as per the following:

- Monitor for respiratory distress and oxygen saturation. Give oxygen if needed.
- Give expressed breast milk by gastric tube.
- When oxygen is no longer needed, allow the baby to begin breastfeeding. If the baby cannot be breastfed, continue giving expressed breast milk using an alternative feeding method.
- If the breathing difficulty worsens at any time during the observation period: treat for moderate breathing difficulty.
- All babies with mild and transient respiratory distress, do not need antibiotics.

However, if the respiratory distress persists for more than 6 hours or there are risk factors, start antibiotics after taking a sepsis screen. Once respiratory distress settles and the sepsis screen is negative – STOP ANTIBIOTICS.

General supportive management for moderate to severe respiratory distress is as follows:

- Give oxygen with oxygen hood or nasal cannula to achieve appropriate oxygen saturation (oxygen administration has been discussed in Block 1, Practical 6).
- Maintain normal body temperature (see section on hypothermia).
- Give IV fluids if the baby does not accept feeds or has severe respiratory distress.
- Maintain blood glucose, if it is low treat hypoglycemia.
- If baby has apnea
  a) Stimulate breathing by rubbing the back or flicking the sole.
  b) If the baby does not begin to breathe immediately provide positive-pressure ventilation with bag and mask.
  c) Aminophylline if baby is preterm
  d) If recurrent apneic spells, treat for sepsis and organize transfer to a specialized centre for assisted ventilation.
Specific management for moderate to severe respiratory distress is as follows:

- Monitor and record the baby’s respiratory rate, presence of chest indrawing or grunting on expiration, and episodes of apnoea every hour until the baby no longer requires oxygen and then for an additional 24 hours.
- Monitor the baby’s response to oxygen by monitoring the level of oxygen saturation.
- Insert an oro-gastric tube to empty the stomach of air and secretions.
- After taking a sepsis screen including blood culture, start antibiotics.
- When the baby begins to show signs of improvement do the following:
  a) Give expressed breast milk by oro-gastric tube.
  b) Allow the baby to begin breastfeeding as the respiratory distress settles. Baby can be put on to breast while on oxygen by nasal cannula with continuous monitoring.
  c) If the baby cannot be breastfed, give expressed breast milk using a cup and spoon or paladai.

Check Your Progress 6

1) List down the prevention of RDS.

2) A 7 day old baby born at term with a birth weight of 2.8 kg is brought with complaints of difficulty in breathing and inability to feed at the breast. The present weight is 2.65 kg, temperature is 36ºC, and respiratory rate is 96/min with moderate retraction with grunting and central cyanosis.

What supportive management would you do for this baby?
3.4 NEONATAL SEPSIS

3.4.1 Definition and Types

Neonatal sepsis is the most important cause of neonatal deaths in the community, accounting for over half of them. It refers to the presence of bacterial bloodstream infection (BSI) in neonate. If diagnosed early and treated with good supportive care and antibiotics, it is possible to save most cases of neonatal sepsis.

3.4.2 Etio-pathogenesis

Most cases of neonatal sepsis in the community are caused by Escherichia coli and Staphylococcus aureus. In hospitals, Klebsiella pneumoniae is also a common organism.

Early-onset (< 72 hrs) neonatal sepsis is caused by organisms prevalent in the maternal genital tract or in the delivery area. The risk factors for early-onset sepsis include the following:

- Low birth weight,
- Prolonged rupture of membranes > 24 hrs;
- Foul smelling liquor,
- Multiple per vaginum examinations,
- Intrapartum maternal fever,
- Difficult or prolonged labour

Early onset sepsis manifests frequently as pneumonia and less commonly as septicemia or meningitis.

**Late-onset** sepsis is caused by the organisms thriving in the external environment of the home or the hospital. The infection is often transmitted through the hands of the care providers.

The onset of symptoms is usually delayed beyond 72 hours after birth and the presentation is that of septicemia, pneumonia or meningitis. The associated factors of late-onset sepsis include the following:

- Low birth weight,
- Lack of breastfeeding,
- Superficial infections (pyoderma, umbilical sepsis),
- Disruption of skin integrity with needle pricks and use of intravenous fluids.

---

**Check Your Progress 7**

1) Define neonatal sepsis.

2) List different types of neonatal sepsis.

3) What are the common pathogens causing sepsis in neonates?
3.4.3 Common Signs, Symptoms and Diagnosis

The most common signs and symptoms are depicted in Table 3.4.

Table 3.4: Clinical manifestations of neonatal sepsis

<table>
<thead>
<tr>
<th>Lethargy</th>
<th>Cyanosis*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refusal to suckle</td>
<td>Tachypnea*</td>
</tr>
<tr>
<td>Poor cry</td>
<td>Chest retractions*</td>
</tr>
<tr>
<td>Not arousable, comatose</td>
<td>Grunt*</td>
</tr>
<tr>
<td>Abdominal distension</td>
<td>Apnea/gasping*</td>
</tr>
<tr>
<td>Diarrhoea</td>
<td>Fever#</td>
</tr>
<tr>
<td>Vomiting</td>
<td>Bulging fontanel#</td>
</tr>
<tr>
<td>Hypothermia</td>
<td>Seizures#</td>
</tr>
<tr>
<td>Poor perfusion</td>
<td>Blank look#</td>
</tr>
<tr>
<td>Sclerema</td>
<td>High pitched cry#</td>
</tr>
<tr>
<td>Poor weight gain</td>
<td>Neck retraction#</td>
</tr>
<tr>
<td>Shock</td>
<td>Excessive crying/irritability#</td>
</tr>
<tr>
<td>Bleeding</td>
<td></td>
</tr>
<tr>
<td>Renal failure</td>
<td></td>
</tr>
</tbody>
</table>

* Particularly suggestive of pneumonia, # Particularly suggestive of meningitis

Meningitis is often silent, the clinical picture being dominated by manifestations of associated septicemia. However, the appearance of excessive or high-pitched crying, fever, seizures, blank look, neck retraction or bulging anterior fontanel are highly suggestive of meningitis.

In sick neonates, the skin may become tight giving a high-bound feel (sclerema) and the perfusion becomes poor (capillary refill time of over 3 seconds). Cyanosis may appear. A critical neonate may develop shock, bleeding and renal failure.

**Diagnosis**

In presence of risk factors, assess the baby’s gestation and presence of symptoms. If the baby’s gestation is > 35 weeks and the neonate is asymptomatic, do a sepsis screen. In case of a positive screen or if the baby develops symptoms start first line antibiotics. The diagnosis is based on the following:

a) **Direct method**

Isolation of microorganisms from blood, CSF, urine, pleural fluid or pus is diagnostic. In clinically suspected cases of sepsis, send blood culture prior to starting antibiotics.

b) **Indirect method**

There are a variety of tests which are helpful for screening of neonates with sepsis as follows:

- **TLC**: A total leucocyte count below 5000/mm$^3$. 


Nursing Care of High Risk Neonate-I

- An **absolute neutrophil count** of < 1800 per cumm is an indicator of infection. Neutropenia is more predictive of neonatal sepsis than neutrophilia.

- **Immature neutrophils** (Band cells + myelocytes + metamyelocytes) **to total neutrophils ratio** (I/T) if > 0.20, it means that immature neutrophils are over 20 percent of the total neutrophils because bone marrow pushes even the premature cells into circulation, to fight infection.

- The **micro-ESR** may be elevated with sepsis and a fall of > 15 mm during first hour indicates infection.

- **C-reactive protein (CRP):** A CRP value of > 10mg/L is taken as positive. A negative CRP is reassuring. The CRP can be affected by asphyxia, shock, meconium aspiration and prolonged rupture of membranes.

There are a variety of other tests which can be used to predict sepsis but it may be difficult to perform them at all places and hence, the clinical acumen remains crucial. A practical positive “sepsis screen” takes into account two or more positive tests out of the five given below:

1) Leukopenia (TLC <5000/cmm)
2) Neutropenia (ANC <1800/cmm)
3) Immature neutrophil to total neutrophil (I/T) ratio (> 0.2)
4) Micro ESR (> 15mm 1st hour)
5) CRP +ve

All neonates with late onset sepsis should be evaluated by doing a lumbar puncture to rule out meningitis. The CSF cytology and the biochemistry values need to be interpreted in the light of the normal range of the values for CSF in the term and preterm neonates (Table 3.5).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Term neonates</th>
<th>Preterm neonates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein</td>
<td>20-150 mg%</td>
<td>65 –180 mg%</td>
</tr>
<tr>
<td>Glucose</td>
<td>44-128 mg%</td>
<td>24-63 mg%</td>
</tr>
<tr>
<td>White cell count</td>
<td>0-22/mm³ (61% polys)</td>
<td>0-26/mm³ (57% polys)</td>
</tr>
</tbody>
</table>

**Check Your Progress 8**

1) Enumerate the common clinical features of neonatal sepsis.

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........................................................................................................................................................................
2) Interpret the following Sepsis screen(s) as positive or negative
   a) TLC -3800/cu mm, CRP Positive, ANC 2020, IT ratio NA, uESR 12 mm
   b) TLC -9900/cu mm, CRP Positive, ANC 2020, IT ratio NA, uESR 12 mm
   c) TLC -9200/cu mm, CRP Negative, ANC 1270, IT ratio NA, uESR 18 mm
   d) TLC -8800/cu mm, CRP Positive, ANC 1920, IT ratio 0.02, uESR 14 mm

3.4.4 Management of Neonatal Sepsis

Early management is crucial. Supportive care and antibiotics are two equally important components of the management. The supportive care makes the difference between life and death early in septicemia.

Supportive care

The purpose of supportive care is to normalize the temperature, stabilize the cardiopulmonary status, correct hypoglycemia and prevent bleeding tendency. Refer Table 3.6 for supportive care.

Table 3.6: Supportive care of a septic neonate

1) Provide warmth, ensure consistently normal temperature.
2) Start intravenous line.
3) Infuse normal saline 10 ml/kg over 20-30 minutes, if perfusion is poor as evidenced by capillary refill time (CRT) of more than 3 seconds. Repeat the same dose 1-2 times over the next 30-45 minutes, if perfusion continues to be poor.
4) Infuse glucose (10 percent) 2 ml/kg stat.
5) Inject Vitamin K 1 mg intramuscularly.
6) Start oxygen by hood or mask, if cyanosed or grunting.
7) Provide gentle physical stimulation, if apneic.
8) Provide bag and mask ventilation with oxygen if breathing is inadequate.
9) Avoid enteral feed if hemodynamically compromised, give maintenance IV fluids.
10) Consider use of dopamine if perfusion is persistently poor.
11) Consider exchange transfusion if there is sclerema.

Antibiotic therapy

Antibiotic therapy should cover the common causative bacteria, namely, Escherichia coli, Staphylococcus aureus and Klebsiella pneumoniae. A combination of ampicillin and gentamicin is recommended for treatment of sepsis and pneumonia. In cases of suspected meningitis, cefotaxime should be used along with an aminoglycoside. Table 3.7 shows detailed guidelines about antibiotic therapy.
Table 3.7: Antibiotic therapy of neonatal sepsis

I) Septicemia or pneumonia

<table>
<thead>
<tr>
<th>Antibiotics</th>
<th>Each dose</th>
<th>Frequency</th>
<th>Route</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt; 7 days age</td>
<td>&gt; 7 days age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inj. Ampicillin or Inj. Cloxacillin</td>
<td>50 mg/kg/day</td>
<td>12 hrly</td>
<td>8 hrly</td>
<td>7-10 days</td>
</tr>
<tr>
<td></td>
<td>50 mg/kg/day</td>
<td>12 hrly</td>
<td>8 hrly</td>
<td>7-10 days</td>
</tr>
<tr>
<td>AND</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inj. Gentamycin or Inj. Amikacin</td>
<td>5 mg/kg/day</td>
<td>24 hrly</td>
<td>24 hrly</td>
<td>7-10 days</td>
</tr>
<tr>
<td></td>
<td>15 mg/kg/day</td>
<td>24 hrly</td>
<td>24 hrly</td>
<td>7-10 days</td>
</tr>
</tbody>
</table>

II) Meningitis

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Each dose</th>
<th>Frequency</th>
<th>Route</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;7 days age</td>
<td>&gt; 7 days age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inj. Ampicillin and Inj. Gentamycin OR</td>
<td>100 mg/kg/day</td>
<td>12 hrly</td>
<td>8 hrly</td>
<td>IV</td>
</tr>
<tr>
<td></td>
<td>2.5 mg/kg/day</td>
<td>12 hrly</td>
<td>8 hrly</td>
<td>IV</td>
</tr>
<tr>
<td>OR</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inj. Cefotaxime and Inj. Gentamycin</td>
<td>50 mg/kg/day</td>
<td>12 hrly</td>
<td>8 hrly</td>
<td>IV</td>
</tr>
<tr>
<td></td>
<td>2.5 mg/kg/day</td>
<td>12 hrly</td>
<td>8 hrly</td>
<td>IV</td>
</tr>
</tbody>
</table>

In late-onset sepsis, to cover nosocomial staphylococcal infection, first line of antibiotics may comprise of cloxacillin 100mg/kg/day and an aminoglycoside (gentamicin or amikacin). In nosocomial sepsis, antibiotic sensitivity pattern of organisms responsible for nursery infection should be known and the antibiotic therapy should be started accordingly. Usually staphylococci and gram negative bacilli (Pseudomonas, Klebsiella) should be covered using aminoglycoside (gentamicin or amikacin) and a third generation cephalosporin (cefotaxime). For resistant staphylococcal infection, vancomycin (30 mg/kg/day) should be used.

On confirmation of sensitivity pattern, appropriate antibiotics are used singly or in combination. In a baby, in whom the antibiotics were started on low suspicion, may be stopped after 3 days, if baby is clinically well and the culture is negative. However, if a baby appears ill even though the cultures are negative, antibiotic therapy should be continued for 7 to 10 days as bacterial infection can occur even with negative cultures.

The duration of antibiotic therapy in sepsis depends upon the pathogen, site of infection and the clinical response of the baby. 7-10 days therapy is required for soft tissue infections or pneumonia. Septicemia should be treated for 10-14 days. Meningitis should be treated for a period of 3 weeks. Deep-seated infections (Septic arthritis, osteomyelitis or ventriculitis) may require therapy for 3-6 weeks and are best managed at a higher centre. Change antibiotics if there is no improvement.
**Prevention of Infections**

A good antenatal care goes a long way in decreasing the incidence, morbidity and mortality from neonatal sepsis. All mothers should be immunized against tetanus. All types of infections should be diagnosed early and treated vigorously in pregnant mothers.

Babies should be fed early and exclusively with expressed breast milk (or breastfed) without any pre-lacteal feeds. Cord should be kept clean and dry. Unnecessary interventions should be avoided.

Along with antenatal care hand washing, infection control practices including disinfection and housekeeping should be observed (Hand washing, disinfection and housekeeping have been discussed in Practical 10, Block 1).

<table>
<thead>
<tr>
<th>Check Your Progress 9</th>
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</thead>
<tbody>
<tr>
<td>1) Write down the antibiotics used for the treatment of pneumonia.</td>
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<tr>
<td>2) Write down the antibiotics used for the treatment of meningitis.</td>
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<tr>
<td>3) Discuss the supportive care of a baby in neonatal sepsis.</td>
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<tr>
<td>4) What are the preventive measures of neonatal sepsis?</td>
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3.5 NEONATAL SHOCK

3.5.1 Definition and Types

The term shock denotes a clinical state of poor perfusion of the body tissues in which the body demands of oxygen and nutrients are not met. This can result in tissue hypoxia and acidosis causing irreversible tissue damage. Shock and hypotension are, by no means synonyms, as hypotension is a late sign of shock. It is the early diagnosis and management which improves neonatal outcome, but often this condition is not identified in neonates in early stages.

Types of shock based on etiology

Types of shock based on etiology may be grouped as:

- Hypovolemic shock secondary to
  - a) Blood loss due to feto-maternal or twin to twin transfusion, birth trauma or disseminated intravascular coagulation.
  - b) Fluid loss due to excessive insensible water loss in extreme preterms, poor fluid intake, vomiting, diarrhoea or pathologic renal losses.

- Cardiogenic shock due to low cardiac output as in birth asphyxia, patent ductus arteriosus, congenital heart disease, arrhythmias, hypoglycemia, acidosis and sepsis.

- Other forms of shock like Distributive, Dissociative and Obstructive shock are less commonly encountered in neonates.

3.5.2 Common Signs and Symptoms of Shock

- Poor peripheral pulses
- Pallor
- Mottling of skin
- Cold extremities
- Increased capillary refill time (>3 seconds)
- Tachycardia
- Low blood pressure is a late sign of shock

Check Your Progress 10

1) Define neonatal shock.

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2) List down the signs and symptoms of shock.

3) Enlist down the types of shock based on etiology.

3.5.3 Management of Shock

Shock is an emergency and outcome depends on early diagnosis and management. Oxygen, airway and breathing are to be maintained. Restoring perfusion is the cornerstone in shock management.

Fluid resuscitation

Infuse fluid bolus of 10 ml/kg of normal saline over 20-30 minutes. e.g. in a baby weighing 3 kg, 30 ml of normal saline should be infused over 20-30 minutes. If no or partial improvement (i.e. tachycardia and CFT still prolonged), repeat a bolus of 10 ml/kg of normal saline.

Improvement parameters seen after successful fluid resuscitation include:

- Improvement in CFT.
- Decrease in heart rate by at least 10 beats per minute.
- An increase in urine output over a period of time.

If the signs of poor perfusion persist despite 2 fluid boluses, start vasopressor support.

Vasopressors

These are the drugs used to enhance myocardial contractility and consequently cardiac output. Some degree of myocardial depression is present in all types of shock. The most commonly used vasopressor in neonatal practice is dopamine.

- **Dopamine** is used as the first line agent.

Dose: Usual starting dose is 5 -10 µg/kg/min and if no improvement occurs, the dose can be increased by increments of 5 µg/kg/min every 20 - 30 minutes to a maximum of 20 µg/kg/min.

How to give Dopamine?

1 ml of commercially available dopamine contains 40 mg of dopamine. For a baby weighing 2.5 kg if we want to start dopamine at a rate of 10 µg/kg/min:
It means that if we add 0.9 ml of dopamine in 24 ml of fluid and give @ rate of 1 ml/hr with syringe pump, we will give dopamine at the desired rate i.e. @ 10 µg/kg/min. If infusion pump is not available, then add 12 mg (0.3 mL) Dopamine to 8 hour maintenance fluid and run at the rate desired for maintenance fluid. After starting dopamine drip, monitor the neonate’s status of perfusion by assessing the CFT and pulse volume. If available, use a non invasive blood pressure monitor to check the improvement in blood pressure.

Assess after 20-30 minutes and if there is inappropriate response, increase the dopamine rate by 5 µg/kg/min by increasing the rate of infusion to 1.5 ml/hr (infusion pump) to provide 15µg/kg/min. Further increments can be done to reach upto 2ml/hr (20 µg/kg/min).

On the other hand with improvement in perfusion, decrease the infusion rate in decrements of 5µg/kg/min. As long as the infant is on dopamine drip, the status of circulation needs to be monitored.

If despite dopamine of 20 µg/kg/min the baby continues to be in shock, Dobutamine is the next vasopressor of choice and has to be used in similar doses along with ongoing dopamine.

- **Hydrocortisone** may be considered in neonates who do not respond to maximal doses of both dopamine and dobutamine. It is given in a dose of 2-5 mg/kg/day. If adequate response is there, give 6 hrly for 24-48 hours.

**Unresponsive shock**

Neonates with shock may not respond to above treatment in presence of severe sepsis, pneumothorax and cardiac tamponade etc.

Look for an underlying cause when response to treatment is inadequate.

**Supportive and specific management of underlying cause**

Management of :

- Hypoxia – Give oxygen to maintain normoxia (Oxygen saturation 90-93%).
- Hypoglycemia – Maintain normal blood sugar (BS >45 mg/dL).
- Hypothermia – Maintain normothermia (Temp 36.5-37.5°C).
- Anemia – Maintain normal hemoglobin (Hb >12 g%).
- Treat sepsis.

**Therapeutic end points**

Treatment should be modified as per assessment and response to achieve capillary refill time <3 seconds, normal pulses, warm extremities and a urine output >1 ml/kg/hour.
Check Your Progress 11

1) What are the signs of improvement of neonatal shock?
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...............................................................................................................
...............................................................................................................

2) A 7 days old baby weighing 2 kg is admitted with refusal of feed, fast breathing, mottling of skin, cold extremities, poor peripheral pulses and a CRT of 5 seconds.
   a) What is your provisional diagnosis?
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   b) What are the steps of initial management of a neonate in shock?
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3.6 NEONATAL JAUNDICE

Jaundice is the sign of disturbance in liver and not the disease. Newborns are prone to get jaundice and hyperbilirubinemia due to immaturity of liver and/or some associated pathological cause.

3.6.1 Definition and Types

Jaundice is defined as yellow discoloration of skin and sclera. About 60% of term and 80% of preterm neonates are clinically jaundiced. However, jaundice
in the newborn might signal a serious, potentially treatable illness and may cause neurological damage, if the bilirubin level is sufficiently elevated.

**Types**

It is of two types:

Physiological and pathological jaundice

**Physiological Jaundice:**

It is characterized by the following:

- Jaundice that first appears between 24-72 hours of age.
- Maximum intensity is seen on 4-5th day in term and 7th day in preterm neonates.
- Total serum bilirubin (TSB) does not exceed 15 mg/dl.
- Clinically undetectable after 14 days.
- No treatment is required but baby should be observed closely for signs of worsening jaundice.

**Pathological Jaundice**

It is characterized by the following:

- Clinical jaundice in first 24 hrs of life.
- Total serum bilirubin (TSB) increasing by > 5mg/dL/day or 0.5 mg/dL/hr.
- TSB >15 mg/dl.
- Conjugated serum bilirubin > 2 mg/dl.
- Clinical jaundice persisting for > 2 week in full term and > 3 weeks in preterm neonates.

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**Check Your Progress 12**

1) Define jaundice.

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2) List the types of jaundice?.

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3) Enumerate the characteristics of physiological jaundice.

4) Enlist the characteristics of pathological jaundice.

3.6.2 Etiopathogenesis

Hyperbilirubinemia in the first week of life is usually of the indirect (unconjugated) variety.

Causes are usually classified based on the time of onset of jaundice as per the following:

1) Appearing within 24 hours of age
   - Hemolytic disease of newborn: Rh, ABO and minor group incompatibility
   - Infections: intrauterine viral, bacterial; malaria
   - G-6PD deficiency

2) Appearing after 24 hours of life
   - All of the above
   - Physiological
   - Polycythemia
   - Concealed hemorrhages: cephalhematoma, subarachnoid bleed, intraventricular hemorrhage.
   - Sepsis
   - Neonatal hepatitis
   - Breast milk jaundice
   - Metabolic disorders.

3.6.3 Common Signs, Symptoms and Diagnosis

As the intensity of jaundice increases, there is cephalocaudal progression of yellow discoloration of skin.

Approach to a jaundiced baby

The following questions need to be answered
Assessment of a jaundiced neonate

In the assessment of jaundiced neonate, the history and examination are directed towards assessing the severity, complications and the etiology of jaundice (Refer subsection 3.6.2).

Severity of jaundice

When a neonate is clinically jaundiced, the Total serum bilirubin (TSB) is usually $> 5 – 7$ mg/dl. Jaundice in newborn progresses in cephalo-caudal direction and thus the extent of yellowness of the skin is useful to assess the level of bilirubin. Kramer’s criteria are used to clinically estimate severity (Figure 3.1).

![Fig. 3.1: Clinical: Visual perception: Kramer 1969](image)

Jaundice restricted to
- Face & Trunk: S.bili $< 12$mg%
- On Hand & Feet: S.bili $> 15$mg%

Once baby is under phototherapy, these assessments may be incorrect.

Diagnostic tests

All babies visibly jaundiced below knees should have a blood sample for Total serum Bilirubin (TSB) estimation. Plot these values on hour specific bilirubin normograms and decide about intervention.
Babies needing phototherapy should have a jaundice workup as follows:

- Haemoglobin, reticulocyte count, Peripheral smear for evidence of hemolysis
- Blood group: Mother and baby
- G6PD

Save baby’s and mother’s blood sample for cross matching.

Check Your Progress 13

1) What is the level of jaundice if the baby has yellow palms and soles?

2) Enumerate the causes of jaundice as per the postnatal age of the baby:
   a) 0-24 hours ....................................................................................
   b) > 24 hours ....................................................................................

3.6.4 Management of Neonatal Jaundice

Management of jaundice is directed towards reducing the level of bilirubin and preventing CNS toxicity. It is done by:

1) Prevention of hyperbilirubinemia by early and frequent feeding.
2) Reduction of bilirubin: This is achieved by phototherapy and/or exchange transfusion.

The decision to treat depends on the severity and the cause of jaundice. Currently, AAP 2004 guidelines are used to treat neonates with hyperbilirubinemia who are 35 weeks of gestation or higher with phototherapy/exchange transfusion. Under these guidelines, jaundiced neonates are divided into 3 groups:

a) Infants at lower risk (> 38 weeks and well)

b) Infants at medium risk (> 38 weeks + risk factors or 35 – 37 weeks and well)

c) Infants at higher risk (35 – 37 weeks + risk factors)

Risk factors include iso-immune hemolytic disease, G6PD deficiency, asphyxia, significant lethargy, temperature instability, sepsis, acidosis, serum albumin < 3.0 gm/dl.

Hour specific bilirubin level treatment guidelines for initiating phototherapy/exchange transfusion are provided in the form of a nomogram (Fig 3.2 and 3.3) for babies above 35 weeks of gestation. Table 3.8 depicts guidelines for Phototherapy and Exchange transfusion for Low birth weight infants.
Fig. 3.2: Nomogram for initiating Phototherapy as per AAP Guidelines 2004

Fig. 3.3: Chart for instituting Exchange Transfusion as per AAP Guidelines 2004
Table 3.8: Guidelines for phototherapy and exchange transfusion in low birth weight Infants according to TSB levels

<table>
<thead>
<tr>
<th>Weight (Gm)</th>
<th>Phototherapy (TSB level mg/dl)</th>
<th>Exchange Transfusion (TSB level mg/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>500-750</td>
<td>5-8</td>
<td>12-15</td>
</tr>
<tr>
<td>750-1000</td>
<td>6-10</td>
<td>&gt;15</td>
</tr>
<tr>
<td>1000-1250</td>
<td>8-10</td>
<td>15-18</td>
</tr>
<tr>
<td>1250-1500</td>
<td>10-12</td>
<td>17-20</td>
</tr>
<tr>
<td>1500-2500</td>
<td>15-18</td>
<td>20-25</td>
</tr>
</tbody>
</table>

Phototherapy (care of baby under phototherapy is given in practical 9 Block 1)

Exchange transfusion

It is an effective and reliable method to reduce serum bilirubin. It should be performed if the Total Serum bilirubin (TSB) remains in exchange transfusion range as per Table 3.8, despite effective phototherapy. If facilities for exchange transfusion at your centre are not available, early referral to a higher centre is indicated. Delay in treatment may result in permanent brain damage. However, if the facilities and skills for performing exchange transfusion are available, the same can be done.

While referring a baby with jaundice, make sure that either the mother is referred or mother’s blood sample is sent. (The detailed procedure of exchange transfusion is given in practical 8, Block 1)

Choice of blood for exchange blood transfusion is as follows:

i) In ABO incompatibility: Use O cells of same Rh type as baby, ideal is to have O cells suspended in AB plasma.

ii) In Rh isoimmunization: In emergency use O-ve blood. Ideal is O -ve cells suspended in AB plasma. One may use baby’s blood group but care must be taken to use Rh negative blood.

iii) Other conditions: Baby’s blood group.

Conjugated hyperbilirubinemia

This is rare in the newborn period and is defined as a direct bilirubin level of > 2 mg/dl. It is important to document cause as it is never physiological.

Approach

The following four questions need to be answered

- Is the baby symmetric Small for Gestational Age (SGA)?
- Is the stool white or clay colored?
- Is the urine high colored?
- Are liver and spleen enlarged?

Never discharge a baby with conjugated hyperbilirubinemia without attempting to find the cause. Rule out or establish the diagnosis of extra hepatic biliary atresia within eight weeks of life when it is still surgically correctable. Exclude metabolic conditions especially galactosemia. These babies are preferably
managed in a Level III neonatal unit. Give Inj. Vitamin K and refer to higher centre.

**Check Your Progress 14**

1) Do the following babies require phototherapy based on AAP guidelines (Answer as Yes/No)
   - 48 hours old, 36 weeks, No risk factors, Serum Bilirubin 12mg/dL ....................................
   - 10 hours old, 39 weeks, Rh –Ve mother, Serum Bilirubin 6mg/dL ..............................
   - 120 hours old, 38 weeks, No risk factors, Serum Bilirubin 20 mg/dL ..............................
   - 28 ours old, 35 weeks, No risk factors, Serum Bilirubin 11 mg/dL ..............................

2) Write down the treatment of pathological jaundice due to Rh isoimmunization.

3.7 NEONATAL SEIZURES

3.7.1 Definition and Types

A seizure in the neonatal period is an emergency. They can occur due to neurological problems like asphyxia, birth injuries or meningitis or due to metabolic problems like hypoglycemia, hypocalcemia and hypo or hypernatermia. Neonatal seizures should be differentiated from spasms of neonatal tetanus.

Features of spasms due to tetanus not seen in Neonatal Seizures are as follows:

- Involuntary contraction of muscles
- Fists often persistently and tightly clenched
- Trismus, Opisthotonus
- Triggered by touch, light, or sound
- Baby is conscious throughout, often crying with pain

Neonatal seizures may sometimes be confused with jitteriness which has following features unlike neonatal seizures as:

- Can be provoked by stimulation, and aborted by gentle restraint
- Are not accompanied by autonomic changes (tachycardia, increased B.P. etc.) or abnormal eye movements
Common types of neonatal seizures depending on type of onset are as follows:

1) **Generalized or Focal, Tonic or Clonic**
   - Repetitive jerking movements of limbs or face.
   - Continuous extension or flexion of arms and legs.

2) **Subtle convulsions**
   - Repetitive blinking, eye deviation, or staring.
   - Repetitive movements of mouth or tongue.
   - Purposeless movement of the limbs, as if bicycling or swimming.

### 3.7.2 Etio-pathogenesis

The causes of seizures are many and varied. The selected causes are given below:

1) Central nervous system like intracranial haemorrhage, intracerebral hemorrhage, hypoxic ischemic encephalopathy, kernicterus and congenital abnormalities.
2) Metabolic like Hypoglycemia, hyperglycemia, hypo or hypercalcemia, hypo and hypernatremia and inborn errors of metabolism.
3) Others like hypoxia, congenital or acquired infections, narcotic withdrawal, hyperthermia.
4) Idiopathic (unknown)

### 3.7.3 Common Signs, Symptoms and Diagnosis

During seizure the baby may have tachycardia, hypertension, raised cerebral blood flow and raised intracranial pressure, all of which can predispose to serious complications.

**Diagnosis**

- A detailed history should be taken and examination should be done after initial acute management of the seizure to determine underlying cause.
- Blood examination for glucose and electrolytes.
- Cerebrospinal fluid for gross blood count, protein, glucose and culture.
- EEG and CT scan.

### 3.7.4 Management

**Treatment is as follows:**

1) **First step** is to resuscitate if needed: Place in thermo-neutral environment and ensure a patent airway, effective breathing and adequate circulation (TABC). Oxygen should be started if required and IV access should be secured and blood samples drawn for complete blood count, blood sugar, serum calcium and electrolytes.

2) **Second step** is to obtain blood sugar by Dextrostix: If less than 45mg/dl, correct hypoglycemia by a bolus of 2 ml/kg 10% dextrose followed by a maintenance infusion of 6-8 mg/kg/min.

3) **Third step** is to give anti convulsant drugs (ACD): ACD should be given if seizures persist even after correction of hypoglycemia.
Pharmacotherapy for neonatal seizures is as follows:

1) **Phenobarbitone:** Drug of choice.
   
   Initial Dose: is 20 mg/kg IV slowly over 20 minutes
   
   Repeat dose: If seizures persist after completion of this loading dose repeat dose of phenobarbitone 10 mg/kg may be used every 20-30 min till a total dose of 40 mg/kg has been given.
   
   Maintenance dose: 3-4 mg/kg/day in 1-2 divided dose, started 12 hrs after the loading dose.

2) **Phenytoin:**
   
   Indication: If maximal dose of phenobarbitone (40 mg/kg) fails to resolve seizures.
   
   Dose is 20 mg/kg IV over 20 – 30 minutes.
   
   Caution: It should only be mixed with saline and not with dextrose as it precipitates in dextrose.
   
   Repeat dose of 10 mg/kg may be tried in refractory seizures. The maintenance dose is 5-8 mg/kg/day in 2 divided doses. Oral administration has very erratic absorption so it should be avoided. Only IV route is preferred and should be discontinued before discharge.

If total serum calcium is low (<7mg%), administer IV 10% calcium gluconate, 2 ml/kg diluted with equal volume of distilled water slowly under cardiac monitoring preferably by an infusion pump. Withhold infusion if HR<100/min.

**Be careful, and watch for potential respiratory depression with higher doses of phenobarbitone.**

**When to discontinue ACD?**

Try to discontinue all medications at discharge if neurological examination is normal.

There is no need to taper the ACD.

**Caution**

Do not use Diazepam or Midazolam for control of convulsions in neonates.

Continue supportive care and treat underlying cause e.g. meningitis.

**Management of neonate with seizures**

Management of neonate with seizures is a systematic approach. It includes the following steps:

- Identify and characterize the seizure.
- Secure airway and optimize breathing, circulation and temperature.
- Start O₂ if seizures continue.
- Secure IV access and take samples for baseline investigations including sugar, hematocrit, sepsis screen and calcium, magnesium, electrolytes where feasible.
- If blood sugar < 45 mg/dl, give 5 ml/kg 10% dextrose.
Common Neonatal Disorders

If seizures continue
- IV phenobarbitone 20 mg/kg over 20 min.

If no control
- Repeat phenobarbitone 10 mg/kg till a total of 40 mg/kg.

If seizures continue
- Give phenytoin 20 mg/kg over 20 min.

After control of seizures initiate maintenance doses.
If seizures are uncontrolled, refer to a higher centre for further management.

3.8 ANEMIA AND BLEEDING IN NEONATES

3.8.1 Definition

In a neonate, anemia is generally defined as venous hemoglobin less than 13 g/dl in the first 2 weeks of life and less than 12 g/dl in a premature baby. However, significance of this value varies according to age and clinical condition of the baby. Physiologically, hemoglobin decreases from higher to lower level with no associated adverse clinical effects.

Maturity Hb Level at Nadir in term and pre term infants:

At Term Hb is 9-11 g/dl at 6-12 week
For Preterm (> 1200 gm) Hb is 8-10 g/dl at 5-10 week
For Preterm (<1200 gm) Hb is 6-9 g/dl at 4-8 week

Check Your Progress 15
1) Define Anemia in neonates.

2) What is the timing and Hb level at nadir in term and preterm infants?
3.8.2 Etio-pathogenesis

A) Obstetric causes – APH, Umbilical cord rupture, Inclusion of placenta during caesarian section.

B) Occult hemorrhage – Feto-placental bleeding, Feto-maternal bleeding, Twin to twin transfusion.

C) Neonatal bleeding – Cephalhematoma, Intracranial bleed, Ruptured liver or spleen, GI bleeding, Bleeding from umbilicus, Adrenal hemorrhage.

D) Hemolysis – Rh or ABO incompatibility, G6PD deficiency, Hereditary spherocytosis, Hemoglobinopathies, Sepsis, Disseminated Intravascular Coagulation (DIC), Malaria.

E) Iatrogenic – Excessive blood sampling.

F) Decreased production – Anemia of prematurity, Infections, Drugs, Congenital leukemia, Diamond Blackfan syndrome.

Check Your Progress 16

1) List down four causes of anemia in neonates.

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3.8.3 Common Signs, Symptoms and Diagnosis

Approach to Anemia includes:

Take a detailed history, do complete physical examination and laboratory investigations.

A) History

Family History (esp. siblings) is taken as follows:

• Anemia and/or Jaundice: Hemolytic causes e.g. blood group incompatibility, hemoglobinopathies, hereditary spherocytosis, G6 PD deficiency

• Splenectomy, Hereditary spherocytosis, hemoglobinopathies

• Gall stones, Hemolytic anemia

Obstetric History is obtained as:

• Traumatic/Instrumental delivery, ICH, Cephalhematoma, ruptured spleen/liver

• APH, Feto-placental / Feto-maternal bleed
Common Neonatal Disorders

- Twins: Twin to twin transfusion
- Drugs: eg. Anticonvulsant
- Caesarean section: Fetoplacental bleed / incision of placenta

**Neonatal History as:**

- Vit K not given, HDN (Hemolytic disease of Newborn)
- Features of sepsis, DIC
- GI bleed, NEC (Necrotizing Enterocolitis)
- Jaundice, Hemolysis
- Excessive sampling, Iatrogenic

2) **Physical examination is performed to find out the following:**

- Shock, mild cyanosis, acute blood loss, poor perfusion
- Pallor, chronic blood loss
- Jaundice, hepatosplenomegaly
- Hemolysis, Pallor is not only due to anemia. It can be associated with hypoxia (severe asphyxia) or shock (poor perfusion)

3) **Laboratory investigations done include:**

- Hb and PCV (Packed cell volume) - May take time to fall after major acute hemorrhage.
- Complete blood count (CBC)- May suggest sepsis or diminished production.
- Peripheral count- Decreased or normal in anemia of prematurity but increased in hemolysis.
- Coomb’s test – Positive in blood group incompatibility.
- Serum bilirubin - Increased in hemolysis.
- Klehauer betke count – Positive in Fetomaternal bleed.
- Ultrasound abdomen / cranium – Shows intraabdominal bleed or intracranial bleed.

**Check Your Progress 17**

1) Name the investigations done for diagnosing anemia in neonates.

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3.8.4 Management of Anemia and Bleeding in Neonates:

Treatment includes:

- For overt bleeding and shock – refer to protocol on shock (3.5.3). Whole blood is to be given when there is acute blood loss.

- Indication of packed RBC transfusion is as follows:
  a) Hematocrit less than 40% if baby has hypotension or is on mechanical ventilation.
  b) Hematocrit less than 30% if baby is sick but hemodynamically stable, has unexplained recurrent apnea or tachycardia (>160/min) for > 48 hrs or wt gain < 10 g/kg/day.
  c) Hematocrit less than 20% if asymptomatic.

The maximum transfusion should be 10-15 ml/kg. Volumes larger than 15 ml/kg are to be divided. The transfusion should be given over a period of 3-4 hrs. Exchange transfusion with packed RBC is preferred when there is severe anemia and large volume is required to correct anemia. This would help to prevent Congestive heart failure (CHF) due to circulatory overload.

Precautions for blood transfusion are as follows:

1) In case of shock due to acute blood loss, compatible whole blood 10-20 ml/kg should be transfused. In emergency situations, where baby’s blood group is not known, O-negative blood may be used.

2) Before transfusion check:
   a) The blood Bag No.
   b) Date of donation
   c) The name and Medical Record / Registration No. of the patient
   d) Blood group of baby and donor.

3) Do not transfuse chilled blood. Warm it till room temperature before transfusion, allow it to gradually come to room temperature in natural environment. Don’t immerse in hot water for rewarming.

4) Routine administration of furosemide with all transfusions is not recommended. Furosemide 0.5 mg/kg IV can be given during transfusion in patients with impending heart failure.

5) Baby’s vitals should be monitored carefully before, during and after blood transfusion (at least for 2 hrs).

6) Check PCV of the baby 4 hrs after blood transfusion.

7) If untoward transfusion reaction like hemodynamic instability such as tachycardia, desaturation, rash, shock is observed, then immediately stop the transfusion and keep IV line on and send bag with blood set, post transfusion sample and duly filled reaction form to the blood bank.
Check Your Progress 18

1) Write down the indications of packed cell transfusion.
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2) List the routine precautions to be taken while transfusion blood.
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3) What shall we do if any untoward reaction occurs during blood transfusion?
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3.9 MONITORING OF SICK NEONATES

3.9.1 Definition
Monitoring of sick neonate refers to both clinical and bio-chemical monitoring. The initial management and stabilization consist of supportive care to maintain
temperature, perfusion, ventilation and a normal metabolic state including glucose, calcium and acid-base balance. Early detection by clinical and biochemical monitoring and prompt management of complications must be done to prevent extension of cerebral injury.

### 3.9.2 Types of Monitoring

**Clinical monitoring**

- All neonates who have suffered asphyxia must be closely monitored clinically as well as by performing certain bedside tests.

- The respiratory status must be monitored by meticulous record of the respiratory score every 2-3 hours.

- The cardio vascular status i.e. CVS assessment should include heart rate (HR), color, CFT, Pulse oximetry and non invasive blood pressure (NIBP).

- The abdominal circumference should be recorded to rule out any ileus due to gut ischemia.

- The urine output should be measured as it is a direct indicator of the state of perfusion. Moreover, this entity is also used as a prognostic sign and the outcome is uniformly poor if the output remains <1ml/kg/hr beyond 36 hrs of life.

**Biochemical monitoring**

- The biochemical monitoring should aim at measuring the blood sugar by Dextrostix, the hematocrit, serum electrolytes (Na, K), serum calcium and blood urea and creatinine.

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**Check Your Progress 19**

1) List the different types of monitoring of sick neonate.

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   2. ........................................................
   3. ........................................................
   4. ........................................................
   5. ........................................................

2) Write the components of clinical monitoring of sick neonates.

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   5. ........................................................

3) What is bio-chemical monitoring of a sick neonate?

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   5. ........................................................
3.10 LET US SUM UP

In this unit you have been introduced to the common neonatal disorders such as hypoglycemia, respiratory distress, neonatal sepsis, neonatal shock, neonatal jaundice, neonatal seizures, anemia and bleeding in neonates and monitoring of sick neonate. You have learnt the definitions, causes, pathogenesis and signs and symptoms of these disorders. Hope you shall utilize this information in prompt recognition and management of these neonatal disorders for avoiding complication and providing comprehensive care to the sick neonates.

3.11 GLOSSARY

**G6PD deficiency**: An X linked recessive hereditary disease characterized by abnormally low levels of glucose-6-phosphate dehydrogenase, a metabolic enzyme involved in the pentose phosphate pathway important in red blood cell metabolism. The individual with the disease may exhibit non-immune hemolytic anemia in response to infection or exposure to certain medications or chemicals.

**Coomb’s Test**: Test used to detect sensitized red blood cells in erythroblastosis fetalis.

**Galactosemia**: An inborn error of galactose metabolism due to deficiency of enzyme 1 phosphate uridyl transferase and characterized by nutrition failure, hematomegaly with cirrhosis, cataract, mental retardation, galactosuria, aminoaciduria, albuminuria.

**Kernicterus**: Encephalopathy caused by deposition of unconjugated bilirubin in the brain cells. It is characterized by lethargy, changes in muscle tone, high pitched cry and later irritability and potential death may follow.

**Opisthotonus**: A titanic spasm in which spine and extremities are bent with convexity forward. The baby rests on head and heels.

**Shake Test**: A test to indicate lung maturity, carried out on gastric aspirate taken at birth. Take 0.5 ml of normal saline and 1.0 ml of 95% ethyl alcohol in a clear test tube. Add 0.5 ml of gastric aspirate. Shake vigorously for 15 seconds and allow to stand for 15 minutes. Observe surface for amount of froth or bubbles. If bubbles cover one third of liquid surface, the risk for developing hyaline membrane disease is more and if form a ring of foam for 15 minutes, the test is positive and chance of respiratory distress syndrome is low in neonate.
3.12 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress 1

1) Hypoglycemia is defined as a blood glucose level of less than 45 mg/dl in all newborns.

2) Babies at risk of hypoglycemia are:
   - Premature and LBW neonates especially those weighing less than 2.0 kg.
   - Infants of diabetic mother.
   - Sick neonate (perinatal asphyxia, hypothermia, poor and/or delayed feeding, sepsis, shock, respiratory distress and polycythemia).

Check Your Progress 2

1) The signs and symptoms of hypoglycemia are very nonspecific and can mimic any illness. The common and signs symptoms are:
   - Lethargy, weak cry and poor sucking
   - Temperature instability
   - Poor respiratory effort, apnea or cyanosis
   - Excessive jitteriness, convulsions or hypotonia.

Check Your Progress 3

Treatment of hypoglycemia in sick newborn is as follows:

1) Establish an IV line if one is not already in place. Give a bolus of 2 ml/kg body weight of 10% glucose IV slowly over 5 minutes.
   - If an IV line cannot be established quickly, give 2 ml/kg body weight of 10% glucose by gastric tube.
   - Start infusion of dextrose at the daily maintenance volume according to the baby’s age so as to provide a GIR of 6 mg/kg/min.
   - Measure blood glucose 30 minutes after starting the infusion of glucose and then every four to six hours.
   - If the blood glucose is less than 25 mg/dl, repeat the bolus of glucose (as given above) and increase concentration of glucose to 8 mg/kg/min in the infusion.
   - If the blood glucose is less than 45 mg/dl but is at least 25 mg/dl at any measurement, increase the glucose infusion rate by 2 mg/kg/min and measure blood glucose after 30 mts. Continue the infusion at this rate until 2 consecutive values 6 hrs apart are above 45 mg/dl.
   - Allow the baby to begin breastfeeding. If the baby cannot be breastfed, give expressed breast milk using katori spoon and/or paladai.
   - As the baby’s ability to feed improves, slowly decrease (over a two to three-day period) the volume of IV glucose while increasing the volume of oral feeds. Do not discontinue the glucose infusion abruptly to prevent rebound hypoglycemia.

2) Treatment remains the same, only hypoglycemic babies with convulsions may be given 4–5 ml/kg of 10% glucose as the initial bolus,
3) Give 4 ml of 10% dextrose I/V slowly over 5 minutes. If I/V line is not there give same amount by gastric tube, Start I/V infusion as daily maintenance of 68 ml/kg/day D 10 and 7 ml/kg/day D 25 to provide GIR of 6mg/kg/min. Measure blood glucose 30 minutes after infusion and then, 4-6 hours. If blood glucose is less than 25 mg/dl repeat the bolus of glucose and increase concentration of glucose to 8 mg/kg/min in infusion.

4) Allow baby to begin breast feeding. If baby cannot be breastfed, give expressed breast milk using katori spoon and/or paladai.

5) If the baby is receiving IV fluid for any reason, continue blood glucose measurements every 12 hours for as long as the baby requires IV fluid. If the blood glucose is less than 45 mg/dl, treat as described in section 3.2.4.

- If the baby no longer requires or is not receiving IV fluid, measure blood glucose every 12 hours for 24 hours (two more measurements) and treat as:
  a) If the blood glucose is less than 45 mg/dl, treat as described in section 3.2.4.
  b) If the blood glucose remains normal, discontinue measurements.

Check Your Progress 4

1) Respiratory distress syndrome is defined as a condition characterized by the presence of fast breathing with respiratory rate > 60/minute in a quiet resting baby, inspiratory recessions, expiratory grunting, flaring of nostrils with or without cyanosis.

2) Four causes of respiratory distress syndrome are

- **Preterm baby**
  - Respiratory distress syndrome
  - Congenital Pneumonia
  - Miscellaneous causes: hypothermia, hypoglycemia

- **Term baby**
  - Transient tachypnea of newborn (TTNB)
  - Meconium aspiration
  - Pneumonia
  - Asphyxia

- **Surgical causes**
  - Diaphragmatic hernia
  - Tracheo-esophageal fistula
  - Bilateral choanal atresia

- **Other causes**
  - Cardiac (congenital cardiac defects)
  - Metabolic (acidosis, alkalosis, hypoglycemia, hypothermia)
3) Based on the assessment by using Silverman Anderson respiratory distress score, it can be categorized into three types i.e. mild, moderate and severe or impending respiratory failure.

Score 0-3 = Mild respiratory distress – O₂ by hood
Score 4-6 = Moderate respiratory distress - CPAP
Score > 6 = Severe Impending respiratory failure

**Check Your Progress 5**

1) Common signs and symptoms of respiratory distress are fast breathing, respiratory rate > 60 per minute, recession of intercostals and subcostal muscles, flaring of nostrils, pallor or cyanosis of skin and mucus membrane.

2) Investigations done are:
   a) **Chest X-ray**
      To look for
      - Respiratory Distress Syndrome (RDS) - Air bronchogram, decreased lung volume and hazy lungs
      - Meconium Aspiration Syndrome (MAS) - Fluffy shadows involving both lungs with hyperinflation
      - Pneumonia - Infiltrates
      - Pulmonary hemorrhage, RDS - White out (Opaque lung)
   b) **Sepsis screen:** TLC, DLC, CRP, Micro ESR, IT Ratio, ANC
   c) **Blood Culture:** This may give a clue to the infectious etiology of the respiratory disorder.

**Check Your Progress 6**

1) **Prevention of RDS**
   - Antenatal corticosteroid therapy is a simple and effective therapy that prevents RDS.
   - Optimal effect of antenatal steroids is seen if delivery occurs after 24 hrs of starting therapy.
   - Recommended Dose is Inj Betamethasone 12 mg IM every 24 hrs X 2 doses or Inj. Dexamethasone 6 mg IM every 12 hrs X 4 doses.
   - Give to mothers with preterm labour or APH before 34 wks of gestation

2) **Supportive management for the baby includes**
   - Give oxygen with oxygen hood or nasal cannula to achieve appropriate oxygenation. (Refer Block 1, Practical 6 for oxygen administration)
   - Maintain normal body temperature (see section on hypothermia).
   - Give IV fluids if the baby does not accept feeds or has severe respiratory distress.
   - Maintain blood glucose, if low treat hypoglycemia.

3) **Respiratory Distress Syndrome (RDS)**

4) **Management of severe breathing difficulty includes**
- Monitor and record the baby’s respiratory rate, presence of chest indrawing or grunting on expiration, and episodes of apnoea every hour until the baby no longer requires oxygen and then for an additional 24 hours.
- Monitor the baby’s response to oxygen by oxygen saturation.
- Insert an oro-gastric tube to empty the stomach of air and secretions.
- After taking a sepsis screen including blood culture, start antibiotics.
- When the baby begins to show signs of improvement do the following:
  - Give expressed breast milk by oro-gastric tube.
  - Allow the baby to begin breastfeeding as the respiratory distress settles. Baby can be put on to breast while on oxygen by nasal cannula with continuous monitoring.
  - If the baby cannot be breastfed, give expressed breast milk using a cup & spoon or paladai.

5) Management of apneic spells includes:
   - a) Stimulate breathing by rubbing the back or flicking the sole.
   - b) If the baby does not begin to breathe immediately provide positive-pressure ventilation with bag and mask.
   - c) Aminophylline if baby is preterm.
   - d) If recurrent apneic spells, treat for sepsis and organize transfer to a specialized centre for assisted ventilation.

Check Your Progress 7
1) Neonatal sepsis refers to the presence of bacterial blood stream infection (BSI) in neonate.
2) Depending upon time of onset neonatal sepsis can be Early onset (<72 hours) Late onset (>72 hours).
3) Common pathogens are Escherichia coli and Staphylococcus aureus in the community. In hospitals, Klebsiella pneumoniae is a common organism.

Check Your Progress 8
1) Lethargy
   - Cyanosis*
   - Tachypnea*
   - Chest retraction*
   - Grunt*
   - Apnea/gasping*
   - Fever#
   - Bulging fontanel#
   - Seizures#
   - Blank look#
   - High pitched cry#
   - Neck retraction#
   - Excessive crying/irritability#
2) a) Positive  
b) Negative  
c) Positive  
d) Negative  

Check Your Progress 9

1) Inj. Ampicillin or Inj. Cloxacillin  
   And Inj. Gentamycin or Inj. amikacin  
2) Inj. Ampicillin and Inj. Gentamicin or Inj. Cefotaxime and Inj. Gentamycin  
3) Supportive care of a septic neonate is as follows:  
   1) Provide warmth, ensure consistently normal temperature.  
   2) Start intravenous line.  
   3) Infuse normal saline 10 ml/kg over 20-30 minutes, if perfusion is poor  
      as evidenced by capillary refill time (CRT) of more than 3 seconds.  
      Repeat the same dose 1-2 times over the next 30-45 minutes, if perfusion  
      continues to be poor.  
   4) Infuse glucose (10 percent) 2 ml/kg stat.  
   5) Inject Vitamin K 1 mg intramuscularly.  
   6) Start oxygen by hood or mask, if cyanosed or grunting.  
   7) Provide gentle physical stimulation, if apneic.  
   8) Provide bag and mask ventilation with oxygen if breathing is inadequate.  
   9) Avoid enteral feed if hemodynamically compromised, give maintenance  
      IV fluids.  
10) Consider use of dopamine if perfusion is persistently poor.  
11) Consider exchange transfusion if there is sclerema.  
4) A good antenatal care goes a long way in decreasing the incidence,  
   morbidity and mortality from neonatal sepsis. All mothers should be  
   immunized against tetanus. All types of infections should be diagnosed  
   early and treated vigorously in pregnant mothers. Babies should be fed early  
   and exclusively with expressed breast milk (or breastfed) without any  
   pre-lacteal feeds. Cord should be kept clean and dry. Unnecessary  
   interventions in baby care other than specified should be avoided.  
   Along with antenatal care hand washing, infection control practices including  
   disinfection and house keeping should be observed.  

Check Your Progress 10

1) A clinical state of poor perfusion of the body tissues in which the body  
   demands of oxygen and nutrients are not met.  
2) Common signs and symptoms of shock  
   • Poor peripheral pulses  
   • Pallor  
   • Mottling of skin  
   • Cold extremities
• Increased capillary refill time (>3 seconds)
• Tachycardia
• Low blood pressure is a late sign of shock.

3) Types of shock based on etiology may be grouped as:

• Hypovolemic shock secondary to
  a) Blood loss due to feto-maternal or twin to twin transfusion, birth trauma or disseminated intravascular coagulation.
  b) Fluid loss due to excessive insensible water loss in extreme preterms, poor fluid intake, vomiting, diarrhoea or pathologic renal losses.
• Cardiogenic shock due to low cardiac output as in birth asphyxia, patent ductus arteriosus, congenital heart disease, arrhythmias, hypoglycemia, acidosis and sepsis.
• Other forms of shock like Distributive, Dissociative and Obstructive shock are less commonly encountered in neonates.

Check Your Progress 11

1) Signs of Improvement of shock are:

• Improvement in CFT.
• Decrease in heart rate by at least 10 beats per minute.
• An increase in urine output.

2) a) Neonatal Shock

b) Infuse fluid bolus of 10 ml/kg of normal saline over 20-30 minutes. e.g. in a baby weighing 3 kg, 30 ml of normal saline should be infused over 20-30 minutes. If no or partial improvement (i.e tachycardia and CFT still prolonged), repeat a bolus of 10 ml/kg of normal saline. If the signs of poor perfusion persist despite 2 fluid boluses, start vasopressor support.

Check Your Progress 12

1) Yellow discoloration of skin and sclera of a newborn.

2) Physiological and Pathological jaundice

3) Physiological Jaundice is characterized by:

• Jaundice that first appears between 24-72 hours of age.
• Maximum intensity is seen on 4-5th day in term and 7th day in preterm neonates.
• Total serum bilirubin does not exceed 15 mg/dl.
• Clinically undetectable after 14 days.
• No treatment is required but baby should be observed closely for signs of worsening jaundice.

4) Pathological Jaundice is characterized by the following:

• Clinical jaundice in first 24 hrs of life.
• Total serum bilirubin (TSB) increasing by > 5mg/dL/day or 0.5 mg/dL/hr.
Nursing Care of High Risk Neonate-I

- TSB >15 mg/dl.
- Conjugated serum bilirubin > 2 mg/dl.
- Clinical jaundice persisting for > 2 week in full term and > 3 weeks in preterm neonates.

Check Your Progress 13

1) S.bilirubin > 15mg%

2) a) 0-24 hours:
   - Hemolytic disease of newborn: Rh, ABO and minor group incompatibility
   - Infections: intrauterine viral, bacterial; malaria
   - G-6PD deficiency
   b) More than 24 hours
   - Physiological
   - Polycythemia
   - Concealed hemorrhages: cephalhematoma, subarachnoid bleed, IVH.
   - Sepsis
   - Neonatal hepatitis
   - Breast milk jaundice
   - Metabolic disorders
   - All the causes of jaundice responsible for less than 24 hours

Check Your Progress 14

1) Yes
   No
   No
   Yes
2) In Rh isoimmunization: In emergency use O-ve blood. Ideal is O -ve cells suspended in AB plasma. One may use baby’s blood group but care must be taken to use Rh negative blood.

Check Your Progress 15

1) Venous hemoglobin less than 13 g/dl in the first 2 weeks of life and less than 12 g / dl in a premature baby.

2) Refer Subsection 3.8.1

Check Your Progress 16

1) A) Obstetric causes – APH, Umbilical cord rupture, Inclusion of placenta during caesarian section.
   B) Occult hemorrhage – Fetoplacental bleeding, Fetomaternal bleeding, Twin to twin transfusion.
   C) Neonatal bleeding – Cephalhematoma, Intracranial bleed, Ruptured liver or spleen, GI bleeding, Bleeding from umbilicus, Adrenal hemorrhage.
D) Hemolysis – Rh or ABO incompatibility, G6PD def, Hereditary spheroeytosis, Hemoglobinopathies, Sepsis, DIC, Malaria

Check Your Progress 17

1) Investigations for diagnosing anemia in neonates
   - Hb and PCV - May take time to fall after major acute hemorrhage.
   - Complete blood count - May suggest sepsis or diminished production
   - Peripheral count - Decreased or normal in anemia of prematurity but increased in hemolysis.
   - Coomb’s test – Positive in blood group incompatibility
   - Serum bilirubin - Increased in hemolysis
   - Klehauer betke count – Positive in Fetomaternal bleed
   - Ultrasound abdomen / cranium – shows intraabdominal bleed or intracranial bleed.

Check Your Progress 18

1) Indications of packed RBC transfusion are:
   - Hematocrit less than 40% if baby has hypotension or on mechanical ventilation
   - Hematocrit less than 30% if baby is sick but hemodynamically stable, has unexplained recurrent apnea or tachycardia (>160/min) for > 48 hrs or wt gain < 10 g/kg/day
   - Hematocrit less than 20% if asymptomatic

2) Routine precautions during blood transfusion
   1) In case of shock due to acute blood loss, compatible whole blood 10-20 ml/kg should be transfused. In emergency situations, where baby's blood group is not known, O-negative blood may be used.
   2) Before transfusion check:
      a) The blood Bag No.
      b) Date of donation
      c) The name and Medical Record / Registration No. of the patient
      d) Blood group of baby and donor.
   3) Do not transfuse chilled blood. Warm it till room temperature before transfusion, allow it to gradually come to room temperature in natural environment. Don’t immerse in hot water for rewarming.
   4) Routine administration of furosemide with all transfusions is not recommended. Furosemide 0.5 mg/kg IV can be given during transfusion in patients with impending heart failure.
   5) Baby’s vitals should be monitored carefully before, during and after blood transfusion (at least for 2 hrs).
   6) Check PCV of the baby 4 hrs after blood transfusion.
   7) If untoward transfusion reaction like hemodynamic instability such as tachycardia, desaturation, rash, shock is observed, then immediately stop the transfusion and keep IV line on and send bag with blood set, post transfusion sample and duly filled reaction form to the blood bank.
Check Your Progress 19

1) Clinical and biochemical monitoring

2) • All neonates who have suffered asphyxia must be closely monitored clinically as well as by performing certain bedside tests.

• The respiratory status must be monitored by meticulous record of the respiratory score every 2-3 hours.

• The CVS status assessment should include HR, color, CFT, Pulse oximetry and Non invasive blood pressure (NIBP).

• The abdominal circumference should be recorded to rule out any ileus due to gut ischemia.

• The urine output should be measured as it is a direct indicator of the state of perfusion. Moreover, this entity is also used as a prognostic sign and the outcome is uniformly poor if the output remains <1ml/kg/hr beyond 36 hrs of life.

3) The biochemical monitoring includes measuring the blood sugar by Dextrostix, the hematocrit, serum electrolytes (Na, K), serum calcium and blood urea and creatinine.

3.13 REFERENCES


UNIT 4  CONGENITAL MALFORMATIONS

4.0 OBJECTIVES

After completing this unit, you should be able to:

• Explain the meaning of congenital malformations;
• List the causes of congenital malformations;
• Outline the measures used for prevention and early detection of congenital malformations;
• Discuss the common congenital malformations; and
• Describe the signs and symptoms, diagnosis, treatment and nursing care of common congenital malformations posing as surgical emergencies.

4.1 INTRODUCTION

The incidence of significant malformations is about 2-5 percent at birth worldwide. However, India reports a lower incidence of 1 in 500 as per the hospital statistics. In this unit the problems related to congenital malformations are being discussed. You will learn about the meaning, causes, prevention and early detection of the congenital malformations. You will also learn about the signs
and symptoms, diagnosis, treatment and nursing care of the common congenital malformations which pose as surgical emergencies.

4.2 MEANING AND CAUSES

Congenital malformation means any abnormality in form, structure or function present at birth. It is also called birth defect, disorder or anomaly. It may be recognizable at birth e.g. spina bifida or may be revealed when signs and symptoms indicate its presence e.g. duodenal atresia. The causes are not fully understood and grouped as follows:

1) Chromosomal or genetic causes
2) Teratogenic causes
3) Multifactorial causes
4) Unknown causes

1) Chromosomal causes

The normal human karotype consists of 22 pairs of autosomes and 1 pair of sex chromosomes XX/XY. The fertilized ovum should have 23 chromosomes (22 autosomes and one sex chromosome) from each parent. If any fault occurs in either the number (e.g. non-disjunction) or structure (e.g. translocation, deletion, inversion, insertion or ring chromosome) of chromosomes at the time of fusion of sperm and ovum or even earlier, in meiotic division phase of gametes (sperm and ovum) a chromosomal abnormality occurs.

2) Genetic Causes

Each chromosome consists of number of genes which are composed of segments of DNA coded for a particular protein. Each gene is concerned with the transmission of one specific hereditary factor. Genetically inherited factors may be dominant or recessive. If any fault occurs in the structure of gene or chromosome as described above, a genetic abnormality occurs.

A dominant gene will produce its effect even if present in only one chromosome of a pair. An autosomal dominant condition can be usually carried through several generations. The examples of autosomal dominant condition are achondroplasia, osteogenesis imperfecta, adult polycystic kidney disease and huntington’s chorea.

A recessive gene will produce its effect only when present in both chromosomes of a pair. The examples of an autosomal recessive condition are cystic fibrosis and phenylketonuria.

3) Teratogenic causes

Teratogen is any agent that increases the risk of congenital abnormality. The effect depends upon gestational age of embryo or fetus at the time of exposure, length of exposure, degree of toxicity and maternal and fetal immune response to teratogen. The teratogens are broadly grouped as under:

a) Drugs/chemicals (Table 4.1)
b) Radiation: exposure to X rays or radiations
c) Infectious agents like rubella, cytomegalovirus, toxoplasma, varicella, parvovirus in mothers during first trimester
d) Others

- Maternal malnutrition, metabolic and endocrinal disorders like uncontrolled diabetes and epilepsy.
- Mechanical compression, deformation, disruption of fetal development due to oligohydraminos, multiple pregnancy, mal-presentsations and others.
- Advancing age increases the incidence of Down’s syndrome at the age of 40. Increasing parity is associated with high incidence of malformations.

Table 4.1: Common Drugs/Chemicals and Possible Adverse Effect on Fetus

<table>
<thead>
<tr>
<th>Drug:</th>
<th>Possible Adverse Effect on Fetus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohol</td>
<td>Cardiac, limb, and facial anomalies</td>
</tr>
<tr>
<td>Phenytoin</td>
<td>Facial, cardiac and limb anomalies</td>
</tr>
<tr>
<td>Trimethadione</td>
<td>Facial, cardiac and visceral anomalies</td>
</tr>
<tr>
<td>Quinine</td>
<td>CNS and limb anomalies, deafness, thrombocytopenia</td>
</tr>
<tr>
<td>Warfarin</td>
<td>Nasal and limb anomalies</td>
</tr>
<tr>
<td>Aminopterin</td>
<td>Skeletal anomalies</td>
</tr>
<tr>
<td>Methotrexate</td>
<td>Multiple anomalies and fetal death</td>
</tr>
<tr>
<td>Oral contraceptives</td>
<td>Cardiac, limb, and visceral anomalies</td>
</tr>
<tr>
<td>Estrogens</td>
<td>Anomalies of mullerian origin</td>
</tr>
<tr>
<td>Steroids</td>
<td>Hare lip and cleft palate</td>
</tr>
<tr>
<td>Streptomycin</td>
<td>Deafness</td>
</tr>
<tr>
<td>Tetracycline</td>
<td>Fetal growth retardation</td>
</tr>
<tr>
<td>Chloroquine</td>
<td>Deafness</td>
</tr>
<tr>
<td>Androgens</td>
<td>Masculinization</td>
</tr>
<tr>
<td>Progestrogens</td>
<td>Enlargement of clitoris</td>
</tr>
<tr>
<td>Tobacco</td>
<td>Intrauterine growth retardation</td>
</tr>
</tbody>
</table>

The developing fetus during 2-8 weeks of embryonic period is more vulnerable to harmful effects of drugs/chemicals.

3) **Multifactorial Causes**

These are due to genetic defects in addition to one or more teratogenic influences.

4) **Unknown Causes**

The specific cause of around 80% malformations remains unspecified.

**Check Your Progress 1**

1) What do you mean by congenital malformation?
2) List four common causes of congenital malformations.

4.3 PREVENTION AND EARLY DETECTION

After knowing about the causes, now we shall learn about the prevention and early detection of congenital malformations.

Prevention

You have learnt that majority of congenital malformations are not associated with any predisposing factors and are not preventable. However, the following measures are used for prevention of those where such factors are suspected or found to be linked:

1) Avoidance of all medicines and irradiations to pregnant mothers during the first trimester.
2) Immunization of all girls to rubella before they get married.
3) Giving folic acid 0.5 mg per day to mother when a couple is planning for a pregnancy or having unprotected sex. This has been found to reduce the risk of neural tube defects.
4) Maternal screening with triple marker test at 16 weeks of gestation.
5) Routine fetal malformation ultrasound scan at 18 weeks.
6) Genetic counseling to mothers with history of hereditary disorders, previous anomaly, abortion or stillbirth.
7) Proper treatment of mothers with diabetes, polyhydraminos, oligohydraminos.
8) Selective MTP for all mothers having major fetal anomalies (e.g. with serious genetic, chromosomal or structural abnormality).
9) Discouraging active reproduction beyond the age of 35 years as the incidence of chromosomal disorders in babies born to elderly mothers is high.
10) Avoidance of consanguineous marriages as the incidence of genetic disorders in babies born to such mother is again very high.

Early Detection

Congenital malformations need to be detected early so that exact treatment can be instituted to reduce perinatal mortality rate. The measures used are as following:

1) History

Ask mother about ingestion of any medicines, irradiation or viral infection during first trimester. Note for any existence of Tracheo-esophageal Fistula/ Oesophageal atresia/ Polyhydraminos in mother indicating possibility of alimentary canal obstruction and/or Oligohydraminos indicating Renal
Congenital Malformations

Agenesis. Also ask for history of baby born with congenital anomalies to anyone in the family.

2) Clinical examination at birth
A quick and complete head to toe examination of newborn is made. The gross congenital malformations are easily evident at birth where as concealed but grave abnormalities are often missed like Tracheoesophageal Fistula i.e. TEF and Imperforate Anus.

3) Radiology
Gross skeletal malformations are diagnosed.

4) Ultrasonography
This helps to detect abnormalities of Gastro-intestinal tract i.e. GIT like oesophageal atresia, duodenal atresia, imperforate anus and their extent. Cardiac and intracranial abnormalities, gross skeletal abnormalities can also be detected.

5) Magnetic Resonance Imaging (MRI)
Information as with ultrasonography could be obtained.

Check Your Progress 2
1) Give any four measures used for prevention of congenital malformations.

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........................................................................................................................................
........................................................................................................................................

2) Name three investigations used for early detection of congenital malformations.

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4.4 COMMON CONGENITAL MALFORMATIONS

So far we have discussed the meaning, causes, prevention and early detection of congenital malformations. Now we shall learn about the common congenital malformations according to the body system.

4.4.1 Gastrointestinal System

- Anorectal Malformation

Ano-rectal anomalies present with spectrum of defects. At one end of the spectrum these include minor malformations that require minimal treatment and which usually render excellent results. At the other end of spectrum one can have a very sick baby with a very complex defect. Classification of ano-rectal anomalies is given in Table 4.2 and Fig. 4.1.
### Table 4.2: Wingspread Classification of ano-rectal malformations

<table>
<thead>
<tr>
<th>Male defects</th>
<th>Female defects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High</strong></td>
<td><strong>High</strong></td>
</tr>
<tr>
<td>- Anorectal Agenesis</td>
<td>- Anorectal Agenesis</td>
</tr>
<tr>
<td>a) With rectoprostatic urethral fistula</td>
<td>c) With rectovaginal fistula</td>
</tr>
<tr>
<td>b) Without fistula</td>
<td>d) Without fistula</td>
</tr>
<tr>
<td>- Rectal Atresia</td>
<td>- Rectal Atresia</td>
</tr>
<tr>
<td>Intermediate</td>
<td>Intermediate</td>
</tr>
<tr>
<td>- Rectourethral fistula</td>
<td>- Rectovestibular fistula</td>
</tr>
<tr>
<td>- Anal agenesis without fistula</td>
<td>- Anal agenesis without fistula</td>
</tr>
<tr>
<td><strong>Low</strong></td>
<td><strong>Low</strong></td>
</tr>
<tr>
<td>- Ano-vestibular fistula</td>
<td>- Ano-vestibular fistula</td>
</tr>
<tr>
<td>- Anal stenosis</td>
<td>- Anocutaneous fistula</td>
</tr>
</tbody>
</table>

**Fig. 4.1: Different types of ano-rectal malformations**
Treatment is mainly surgical usually done in stages. First colostomy is performed followed by definite repair [posterior sagittal anorectoplasty (PSARP)] and finally colostomy closure. After surgery dilatation of anal opening is done to avoid development of anal stenosis.

Cloacal defects require extensive surgery [Posterior Sagittal Vagino-urethro-ano-rectoplasty (PSVUARP)].

- **Congenital oesophageal stenosis**
  It is a rare condition and is found in 1 in 25,000-50,000 live births. Symptoms are vomiting or regurgitation, dysphagia, recurrent respiratory tract infections and growth retardation. The diagnosis is established by esophagogram following barium swallow. The treatment consists of bougienage as conservative treatment and surgical intervention if baby does not respond to medical management.

- **Gastro-oesophageal Reflux (GOR)**
  Gastro-oesophageal reflux is a common disorder in the neonatal period affecting gastro-oesophageal junction. Lower oesophageal sphincter (Fig. 4.2) and intraabdominal oesophagus are the important causes of the Gastro-oesophageal reflux. Diagnosis depends upon radiographic and endoscopic assessment of the oesophagus and stomach. GOR usually runs a benign course. As a result, most babies can be managed conservatively using head up prone position and thickening of feeds which are given more frequently and in smaller volume. Some in addition may require antacids, H₂ receptor antagonists or one of the prokinetic agents such as domperidone to improve gastric emptying. Fundoplication is the surgical procedure performed to treat the disease.

![Fig.4.2: Normal gastro-oesophageal sphincter](image)

- **Gastric Outlet Obstruction**
  Gastric Outlet Obstruction in newborn may be due to hypertrophic pyloric stenosis, pyloric atresia or antral web. The baby may present with persistent
non-bilious vomiting and often with epigastric distention. Due to inadequate fluid and caloric intake, dehydration and weight loss may soon become apparent. Baby is treated surgically by excision of web and/or pyloroplasty.

- **Hare (Cleft) Lip and Cleft Palate (Fig. 4.3)**

Cleft lip may be unilateral or bilateral. Cleft in palate may affect hard palate, soft palate or both. Sometimes alveolar margin or uvula may be included. Deformities of tongue (macroglossia) and jaw (micrognathia) may also be present. These may pose feeding difficulties. So feeding with a spoon with long handle is done. Ventricular septal defect often coexists with soft palate defect. Treatment is surgical repair.

![Fig.4.3: Cleft lip and palate](image)

- **Hirschsprung’s Disease (Fig. 4.4)**

It is a common condition in which parasympathetic ganglion nerve cells are absent in a section of large bowel, usually in the distal end of colon. As a result peristalsis does not occur and bowel therefore, becomes obstructed. There is abdominal distention, failure to pass meconium or delayed passage of meconium and bile stained vomiting. Treatment is resection of aganglionic segment of bowel and anastomosis of more proximal ganglionic bowel to the rectal stump.

![Fig. 4.4: Hirschsprung’s Disease](image)

- **Mal-rotation of Gut (Fig. 4.5)**

It is the incomplete rotation of bowel and as a result caecum lies high and towards the midline and from this peritoneal bands run across the duodenum to the
posterior abdominal wall which may compress the duodenum causing duodenal obstruction. Treatment is dividing the bands, releasing the caecum enlarging the mesentry and replacing the small and large bowel.

Congenital Malformations

Fig. 4.5: Mal-rotation of gut

- **Umbilical Hernia (Fig. 4.6)**

Umbilical Hernia occurs due to the failure of umbilical ring to close. It may not be obvious at birth but becomes more obvious in succeeding weeks. When intra-abdominal pressure e.g. on crying increases the hernia, it becomes larger and bulges at umbilicus. No strangulation of blood vessels occurs and hence, causes no problems at umbilicus. Mother requires emotional support and reassurance as there is 95% chance of spontaneous cure. If this fails, surgical repair is done before the child goes to school.

Fig 4.6: Umbilical hernia

4.4.2 Cardiovascular System

Cyanotic heart disease

- **Fallot’s Tetralogy**

It is the anomaly characterized by four defects i.e. pulmonary stenosis, overriding of aorta, ventricular septal defect with right to left shunt and right ventricular hypertrophy. The newborn develops cyanosis in varying degrees and this is increased by exertion. Treatment is corrective surgery.
Nursing Care of High Risk Neonate-I

- **Transposition of Great Arteries**
  The aorta arises from right ventricle and pulmonary artery from left ventricle. As a result, oxygenated blood is circulated back through the lungs and deoxygenated blood back into the systemic circulation. So, unless there is opportunity for oxygenated blood to access the systemic circulation either by means of a patent ductus arteriosus or accompanying septal defect, baby would die.

- **Total Anomalous Pulmonary Venous Drainage**
  Pulmonary veins instead of draining into the left atrium drain sometimes by devious route into the right atrium. An atrial septal defect is always present which allows sufficient blood to cross the left side of heart to sustain life for short time. Newborn has cyanosis. Treatment involves draining the pulmonary veins into the left atrium and closing the atrial septal defect.

- **Truncus Arteriosus**
  It is a common trunk opening out of both ventricles in early fetal life which later divides into aorta and pulmonary artery by development of septum. If it fails truncus arteriosus develops.

**Acynotic heart disease**

- **Coarctation of Aorta**
  Coarctation of Aorta is narrowing of lumen of aorta which prevents normal flow of blood to the lower part of the body. Treatment is resection of coarctation and anastomosis of aorta.

- **Left Heart Hypoplasia**
  It is a congenital anomaly characterized by small size of the left side of heart. Series of surgical interventions are required to manage this condition.

- **Patent Ductus Arteriosus**
  It is an essential vessel of fetal circulation and closes at birth but sometimes it may not close at birth and continues to allow flow of a large quantity of blood through it. The oxygenated blood flows back from aorta to lungs via pulmonary artery. So strain is put on heart and as a result increased output is necessary causing cardiac failure. The defect may be detected either by a cardiac murmur or the newborn may have recurrent respiratory tract infection and may develop congestive heart failure. Treatment is ligation and division of ductus.

4.4.3 Respiratory System

- **Choanal Atresia**
  It is an obstruction of airway at the junction of nasal cavity and pharynx. Atresia may be unilateral or bilateral causing severe respiratory obstruction. Maintaining clear airway is essential and an oral airway may be used to do so. Treatment is removal of obstructing tissues.

- **Congenital Diaphragmatic Hernia (Fig. 4.7)**
  It is due to the failure of closure of diaphragm or persistence of pleura-peritoneal canal. It is common on the left side. Presence of intestine in the
left hemi-thorax prevents the growth of lung on that side resulting in hypoplasia. Mediastinal shift to the right side stimulates dextrocardia. The defect is corrected surgically. The details of management are given in section 4.5 on surgical emergencies.

Fig. 4.7: Congenital Diaphragmatic Hernia

- **Congenital Lobar Emphysema**
  Congenital lobar emphysema, a relatively common condition is a life threatening respiratory disorder presenting in infancy. It is characterized by over-distention of one or more lobes of the lung caused by trapping of air within the affected lobe. The basic defect in this condition is the inability of the affected lung to deflate normally. In newborn, symptoms consist of wheezing, tachpnoea, grunting, cyanosis usually aggravated by crying and feeding. The diagnosis is made by X-ray chest. Treatment is the surgical lobectomy.

- **Tracheomalacia**
  It is a condition in which tracheal rings fail to become firm enough to maintain a patent airway. This can cause partial or total collapse of trachea with intermittent episodes of acute respiratory obstruction during times of increased airflow like coughing, feeding or crying etc. These sudden apnoeic attacks may be life threatening. Treatment is usually surgical.

- **Vascular Ring**
  When aorta may not form normally and embryological vessels persists forming a vascular ring which encircles the trachea and esophagus, causing obstruction to them. The newborn may have tracheal stridor (high pitched noisy respiration) which is more prominent during feeding. The treatment is division of abnormal vessels to allow expansion of encircled structures.

### 4.4.4 Genito-urinary System

- **Ambiguous Genetalia**
  When any of the following abnormalities is present i.e. hypoplastic penis, chordee, bifid scrotum, undescended testis, and enlarged clitoris, incompletely separated or poorly differentiated labia. Most of these newborns are found to be females.
• **Intersex**

It is a condition in which internal reproductive organs are at variance with external appearance of the genitalia. Hence, here the nature of internal reproductive organs can be identified by ultrasound.

• **Cryptorchidism**

It is a condition in which testes remain undescended, may be found in the inguinal pouch and the scrotum is empty. These can be manipulated to reach scrotal pouch but sometimes it is not possible as testes are too much high in inguinal canal. Treatment is orchidopexy if descent of testes does not occur till school age.

• **Ectopia Vesica**

It is a congenital defect in which urinary bladder mucosa is exposed at and above the pubis due to the defect of lower anterior wall of abdomen and bladder and two ureters opening on the ectopia. A small flattened phallus is present instead of normal penis in males. The ectopia bladder is covered with a layer of paraffin gauze and a nappy is applied around the baby into which urine is continuously discharged. Treatment is surgical correction of bladder between 6-12 months of age.

• **Epispadias (Fig. 4.8)**

In this defect, urethral opening is seen on the upper surface of penis in males. It can be suspected in female who has dribbling incontinence. Examination of perineum will show a double clitoris and separation of pubic bones. Treatment is corrective surgery.

![Fig. 4.8: Epispadias in males and females](image)

• **Hypospadias (Fig. 4.9)**

In this defect urethra opens onto the under surface rather than on tip of glans penis. The hypospadias may be of four varying degrees ranging from the meatus being close to glans or anywhere along the penis to the involvement of perineum with scrotum separated into two halves. Treatment is reconstruction of urethra between 3-4 years of age.
• **Hydronephrosis (Fig. 4.10)**

The commonest urinary tract anomaly detected antenatally. In this condition renal pelvis is dilated more than 7mm in anteroposterior plane on ultrasound examination after 20 weeks of gestation. Pyeloplasty is done in case of renal function deterioration, recurrent urinary tract infection with abdominal pain. Usually large majority (75% approx) of babies require conservative treatment with antibiotics like cotrimoxazole (septran).

• **Polycystic Kidney (Fig. 4.11)**

In this condition kidneys are large due to numerous cysts in them. The babies are usually still born and a few may survive for a period after birth. There is no satisfactory treatment but transplantation offers some hope for future.
• **Posterior Urethral Valve (Fig. 4.12)**

It is a thin fold of mucosa in posterior urethra which prevents normal passage of urine causing back pressure on entire urinary tract. The newborn cannot pass good stream of urine and has overflow incontinence with dribbling. Treatment is resection of valve.

![Fig. 4.12: Posterior urethral valve](image)

• **Renal Agenesis**

In this disease condition kidneys fail to develop. The condition does not have an adverse effect on fetus as the placenta performs the function of excretion. After birth newborn fails to pass urine. There is no effective treatment for this condition.

4.4.5 **Central Nervous System**

• **Anencephaly (Fig. 4.13)**

It is the anomaly in which forebrain and vault of skull in newborn are missing. These babies usually die in uterus and if born alive may die later.
Hydrocephaly (Fig. 4.14)
Due to imbalance between cerebrospinal fluid (CSF) production and its reabsorption, the CSF gets collected in ventricle causing expansion of skull and giving rise to a large vault with sunset eyes. The skull bones do not get fused, fontanelles become large and sutures become quite widely separated. It may be due to meningo-myelocele, intra-ventricular hemorrhage during birth or intrauterine vascular accidents.

Spina Bifida (Fig. 4.15)
In this anomaly posterior portion of laminae of vertebrae fails to close and as a result there is opening in the vertebral column (spinal canal). The defect is called spina bifida occulta. It usually does not involve spinal cord but a tuft of hair or a dimple in the skin over the malformed vertebra may be noted. When the defect is not covered with skin, it is spina bifida aperta.

Meningocele and meningomyelocele (Fig. 4.15)
In meningocele, meninges protrude through spina bifida aperta, which may be flat or appear as a sac filled with or without CSF but it does not contain neural tissues. Meningomyelocele occurs when meninges and neural tissues both protrude out. It usually gives rise to neural damage producing paralysis distal to the defect and impaired function of urinary bladder and bowel. This may appear at any point in the spinal canal but most common site is the lumbosacral. When the defect is present at the base of skull level, it is called encephalocele. It is important to prevent rupture of sac and infection. Treatment is laminectomy and closure of open lesion or removal of sac.
4.4.6 Musculo-skeletal System

- **Achondroplasia (Fig. 4.16)**

  The newborn is generally small with disproportionately large head and short limbed. These babies often develop marked lordosis but cognitive development is not usually impaired. In Amelia, limb or limbs are absent whereas in phocomelia, long bones of upper or lower or both limbs are absent so that the hands and feet are attached close to the body.

- **Developmental Hip Dysplasia (Fig. 4.17)**

  In this condition, dysplastic hip may present in any of three forms i.e. displaced, dislocatable or with subluxation (incomplete dislocation) of joint. The left hip is more often affected than right. It is more common when there is history of oligohydraminos or breech presentation. Treatment is by applying splint or harness to keep the hips in a flexed and abducted position of about 60º. This is not removed while changing napkin or bathing. Teach the mother how to handle and care the baby.
• **Polydactyly**

Extra digit(s) may be fully formed or simply extra tissue attached by a pedicle. Extra digit that does not have a bony attachment is ligated at its base to allow it to necrose. The digit with bony attachment is surgically removed.

• **Talipes (club foot) (Fig. 4.18)**

In talipes equinovarus (TEV), the ankle is bent downwards and front part of foot turned inward. In talipes calcaneovalgus (TCV), the position is opposite. The anomaly is likely to occur when intrauterine space is small e.g. in multiple pregnancy, large fetus or oligohydraminos. If the anomaly is mild, the foot may be easily turned to correct position and mother encouraged to exercise baby’s foot in this way several times a day. More severe anomaly requires manipulation, splinting and or surgical correction.

To overcome these defects different types of prosthesis are available which can be fitted as early as 3 months of age. Innovative surgical techniques such as transferring of toe(s) to hand, to serve as substitute finger(s) is proving very successful for some children.
• Syndactyly
  Body parts fuse together. It more commonly affects the hands. It may appear as an independent anomaly or as a feature of syndrome such as Apert’s syndrome which comprises of premature fusion of hands and feet. Treatment is surgical division depending upon the degree of fusion.

4.4.7 Eye and Ear

• Eye
  Congenital problems of eye include structural defects present at birth. These are usually genetically transmitted including congenital cataract, Dacryostenosis (obstruction of nasolacrimal duct), glaucoma.

• Ear
  Congenital hearing defect can be genetic or non-genetic in etiology. Genetic causes may occur in isolation or be associated with various syndromes such as CHARGE, Klippel-Feil, Down (trisomy 21), Goldenhar and Crouzons syndromes.

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<td>1) Name eight major congenital malformations.</td>
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4.5 SURGICAL EMERGENCIES

Some of the congenital malformations are life threatening and require early surgical attention if amendable to surgical correction, in order to save the life of the neonate. Let us now learn about these surgical emergencies in the following subsections.

4.5.1 Esophageal Atresia with Tracheo-oesophageal Fistula

There is loss of continuity in lumen of oesophagus with or without fistulous communication with trachea. This anomaly occurs in 1 in 2500 to 1 in 4500 in live births and is second only to anorectal malformations. Both the sexes are equally affected.

Types of Esophageal Atresia with Tracheo-oesophageal Fistula

There are five types of this anomaly [see Fig 4.19 (a) to (e)]

Type 1: In this there is esophageal atresia with no tracheal communication or pure esophageal atresia (8-10%)

Type 2: Oesophageal atresia and proximal oesophageal pouch communicating with trachea (0.8%)
Type 3: Oesophageal atresia and distal oesophageal pouch communicating with trachea, which is usually at carina. This is the commonest variety in approximately 87-90% cases.

Type 4: Oesophageal atresia and both proximal and distal oesophagus communicating with trachea (0.7%).

Type 5: No oesophageal atresia but esophagus is communicating with trachea (H type fistula). The incidence is 1-2%.

![Fig. 4.19: Common types of oesophageal atresia and tracheoesophageal fistula](image)

[a. Pure EA (8%), b. EA with proximal TEF (1%), c. EA with distal TEF (86%), EA with both proximal and distal TEF (1%), TEF with no EA (4%)]

Antenatal Diagnosis

Antenatal diagnosis of oesophageal atresia is done during routine maternal ultrasonography, which reveals polyhydraminos associated with inability to detect fetal stomach.

Signs and Symptoms

1) Excessive drooling of saliva.
2) Choking or cyanosis with the first feed, even with a small amount by mouth.
3) Abdominal distension due to air passing from trachea through fistula into the stomach.
4) Overflow of milk/saliva from esophagus and regurgitation through fistulous tract if present; irritates the lung leading to pneumonia.

Diagnosis

1) Observation of single umbilical artery in baby after birth should arouse the suspicion of the defect.
2) Diagnosis is done by passing 6-8 F red rubber catheter orally. If gets arrested at 10 cm from gum margin, it indicates the diagnosis of esophageal atresia. The diagnosis is confirmed by X-ray chest combined with abdomen in an erect posture with catheter in situ. At the time of exposure 5-10 ml of air is injected in the proximal esophageal pouch.

Treatment

If the gap between the ends of esophagus is less than 2.5 cm, immediate surgery is performed which includes ligation of trachea-esophageal fistula and esophageal anastomosis. If gap is more than 2.5 cm, surgery cannot be performed at this time but cervical esophagotomy and gastrostomy is performed.
**Preoperative Nursing Care includes the following:**

1) Provide emotional support and reassurance to parents.

2) Keep newborn in propped up position with 30° or prone position with head turned to one side to avoid aspiration of mucus and secretions and maintain a free airway.

3) Withhold oral feeds and meet fluid and electrolyte balance by intravenous fluids as ordered.

4) Give antibiotics as prescribed to avoid lung infection.

5) Pass wide bore oro-gastric tube in upper oesophageal pouch and aspirate frequently to avoid aspiration of mucus and secretions and maintain a free airway.

6) With hold oral feeds and meet fluid and electrolyte balance by intravenous fluids as ordered.

7) Give antibiotics as prescribed.

**Postoperative Nursing Care**

The care for these babies is essentially the same as the care of any high risk newborn.

**Newborn with Ligation of Tracheo-Oesophageal Fistula and Esophageal Anastomosis**

On return to the ward constant nursing care is given as per following:

1) Check and record vital signs and breath sounds every 30 minutes or as required.

2) Provide respiratory support depending upon the condition of the baby like ventilator or oxygen hood, to provide oxygen and humidity at least for first hour after operation or so.

3) Aspirate mouth or pharynx every 15-30 minutes for first 24 hours and thereafter less frequently. The catheter should not be passed beyond pharynx to avoid damage to anastomosis.

4) Nurse the baby in any position with head slightly raised as it helps in drainage from pleural cavity. Change the newborn’s position hourly to encourage expansion of the lungs and to avoid postoperative atelectasis and hypostatic pneumonia.

5) Perform gentle physiotherapy to chest every 4 hours to clear the secretions from the lungs.

6) Take care of underwater seal drainage system if in place as under:
   a) Be careful while handling the water seal system and check on return from OT.
   b) Never raise water seal bag above the level of newborn to avoid air and fluid being sucked into pleural cavity.
   c) Change the bag daily and while doing so clamp the tube close to chest to avoid air entering the pleural cavity.
   d) Tape all connections to prevent accidental disconnection and inspect the tube regularly to ensure it is not kinked.
e) Note for any continuous bubbling which indicates continuous air leak from lungs and **report immediately.**

f) Check and record any signs of respiratory difficulty, cyanosis and crepitations, presence of fluid oscillation in tube with respiration and amount, colour and consistency of chest drainage.

g) Apply continuous low suction to the chest drains particularly where a persistent drainage of fluid is anticipated.

7) **Give feeds and fluids as per following:**
   a) Give intravenous fluids as prescribed.
   b) Aspirate naso-gastric tube hourly and leave it for free drainage for 24 hours following the operation till the return of peristalsis.
   c) Initially start with 5 ml dextrose and gradually increase amount and interval. If this is tolerated give milk after 24 hours.
   d) Aspirate the tube 2 hourly before feed is given, thereafter increase feeds in amount and interval until newborn is receiving feeds to fulfill its nutritional requirements.
   e) Also give “sham” feeds to retain sucking and swallowing reflexes for feeding which are necessary when alimentary canal is reconstituted. Start oral feeding a week after operation.

8) **Watch for complications and report to the surgeon for immediate management.** The commonest complication is leak at the site of anastomosis indicated by tachypnoea followed by tachycardia and deterioration in general condition of newborn in first week. Anastomotic leak is evident by purulent discharge, increased temperature and increased WBC count.

9) Remove the intercostal drainage tube when lungs expand, drainage and reflux cease and this occurs by 24 hours after operation. To carry this, chip the tube and apply occlusive dressing immediately over the drainage site. Note for any change in respiratory rate for 6 hours (indication of recurrence of pneumothorax) and get check X-ray of chest to know that the lung remains fully expanded.

**Newborn with Cervical Esophagostomy and Gastrostomy**

The care of the neonate is as follows:

1) On return to the ward, immediately suck the pharyngeal secretions by a catheter passed into the esophagostomy and repeat every half hour for 24 hours as by then the esophagostomy usually discharges onto the neck.

2) Clean and dry the skin around esophagostomy regularly. If skin is sored (usually it is due to monilial infection), take swab and send for culture to define the causative organism. If it is candida apply nystatin locally for fast improvement.

3) After one week give “Sham” feeds at the same time as gastrostomy feeds. Sham feeds consist of giving oral feeds which are discharged onto the neck through esophagostomy. Keep a nappy on neck to collect the discharge.

4) Keep the skin around the gastrostomy tube clean and dry. Apply siloderm ointment around the tube to protect the skin from irritation of hydrochloric acid and then apply a non-adherent dressing. Keep the tube fixed in position
with adhesive strapping. This is performed as a sterile procedure until the wound heals.

5) Give feeds by gastrostomy. Feeds can be modified as needed to meet nutritional requirement of baby.

6) Change the gastrostomy tube (malecot catheter) every month. This is done by the surgeon. Check the position of tube by simply pulling it back until its wings can be felt against the abdominal wall. It is done to ensure the tip of tube does not slip beyond the stomach into pylorus or duodenum otherwise profuse diarrhoea may follow feeds leading to rapid dehydration and death.

7) Attend all other general needs of newborn. Instruct the parents in the techniques of suctioning, gastrostomy tube care, feeding and skin care. Instruct the parents to identify behaviours that indicate the needs for suctioning, signs of respiratory distress, constricted oesophagus (poor feeding, dysphagia, drooling or regurgitated ingested food.

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**Check Your Progress 4**

1) List four signs and symptoms of esophageal atresia with tracheoesophageal fistula.

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2) Write down four steps of nursing care of a baby with esophagostomy and gastrostomy.

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4.5.2 Exomphalous (Omphalocele)

The anterior abdominal wall is defective in its entire thickness and the bowel or other viscera protrude through umbilicus but are covered by peritoneum. It differs from gastrochisis in which protruded bowel or other viscera are not covered by peritoneum thus making it very vulnerable to infection and injury. The chromosomal and other congenital anomalies are common and should be excluded (Fig. 4.20).
Congenital Malformations

Fig. 4.20: Omphalocele

Treatment
Surgical closure

Pre-operative Nursing Care
The preoperative care includes the following:

• Provide emotional support and reassurance to parents.
• Establish intravenous line and give only intravenous fluids at maintenance volume according to baby’s age.
• Ensure that the baby does not receive anything by mouth. Handle the newborn carefully to prevent rupture of sac.
• Cover the abdomen with sterile gauze soaked in sterile normal saline and keep gauze moist at all times to prevent drying of abdominal contents. A layer of plastic wrap is placed over the gauze to provide additional protection against heat and moisture loss.
• Insert a nasogastric tube and ensure free drainage.
• Arrange for immediate surgical closure.

Postoperative Nursing Care
The post operative care is as under:

• Carefully observe vital signs especially respiration and if needed give additional oxygen.
• Perform nasogastric aspiration and keep record of amount and colour.
• Give intravenous fluids (nutrition ) and when aspirate decreases, gradually start with milk feeding.
• Attend all other general needs of newborn.

Check Your Progress 5
1) What is exomphalus?

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4.5.3 Imperforate Anus

The term anorectal malformation is used to describe all congenital abnormalities of anorectal origin including imperforate anus. Such incidence is 1 in 4000 to 5000 births with slight male predominance. Detailed classification of anorectal malformation is given in section 4.4.1.

**Signs and symptoms**

Condition is usually detected immediately after birth or within several hours when the following are presented:

- When newborn cries, marked bulging over anal pit is noted if anal membrane is present.
- Absence of anal opening.
- Failure to pass rectal thermometer.
- Misplaced anal opening, may be near vaginal opening in female.
- Absence of meconium passage. Meconium may be seen coming out through opening on perineum or vulva. Meconium may be passed through vagina or urethra which may appear as green tinged urine.
- Progressive abdominal distension.
- Vomiting if newborn is fed.

**Diagnosis**

It is established by the following:

1) Ultrasound scan which locates rectal pouch.

2) X-ray of abdomen detects extent of atresia. It is taken with baby held in inverted position by holding the legs with a coin placed over the pit. Distance between the highest level of intestinal gas and shadow of coin gives extent of atresia.

3) X-ray of lumbosacral spine and urinary tract which excludes any other abnormality in this area.

**Treatment**

1) Imperforate Anus due to anal membrane is treated as:
   a) If membrane is thin: it can break on insertion of rectal thermometer.
   b) If membrane is thick: it is incised followed by digital dilatation of anal canal using a plastic dilator of equivalent 6 to Hegar 13. By three months, the danger of contraction of scar tissue is very low and dilatation can be discontinued.
2) Imperforate anus with low fistula is treated as:
   • Decompression of bowel with catheter irrigation.
   • Local dilatation of fistula for 8-12 months.
   • Rectal cutback anoplasty or Y-V plasty at 1-2 years of age.

3) Imperforate anus with high fistula is treated as:
   • Immediate colostomy usually in right transverse colon for decompression.
   • Pull through operation at 1-2 years of age.

Preoperative Nursing Care

It is as follows:

1) Do not give anything by mouth.
2) Note for any vomiting, its colour and amount. Monitor for presence of stool in the urine and vagina and report immediately.
3) Start IV line and give only IV fluids at maintenance volume (Refer unit 2, Block 3 for fluid and electrolyte therapy) and maintain intake and output record.
4) Insert nasogastric tube and ensure free drainage.
5) Observe minimal handling and give complete care at onetime to encourage rest and sleep.
6) Keep fistula area clean.
7) Provide emotional support and reassurance to mother.

Postoperative Nursing Care

It is as follows:

1) Give I/V fluid for 24 hours and when baby begins to tolerate oral feeds, start with 5 ml of dextrose hourly.
2) Aspirate nasogastric fluid 2 hourly and when aspirate volume decreases, milk feeds are gradually started. When feeds are being tolerated and danger of vomiting is less, tube is removed.
3) Maintain high humidity and give antibiotics to avoid pulmonary complications.
4) Give physiotherapy to chest every 4 hours.
5) Take care of colostomy site, keep stoma skin dry and clean. Apply coconut soaked cloth directly over the stoma to avoid any kind of break in skin.
6) In case of excoriation of skin apply siloderm ointment/adapt cream around the stoma skin.
7) Attend all general needs of newborn as under:
   • Monitor anal area for signs of skin excoriation. Keep the anal surgical incision clear and dry and monitor for redness, swelling or drainage.
   • Keep the baby in side lying position with legs flexed or in a prone position to keep the buttock elevated to reduce edema and pressure on the surgical site.
   • Teach and instruct the parents to perform anal dilation if prescribed by surgeon to achieve and maintain bowel patency.
• Instruct the parents to use only dilators prescribed by the surgeon and a water soluble lubricant (Xylocaine jelly) and to insert the dilator not more than 1-2 cm into the anus to prevent damage to mucosa.

Check Your Progress 6
1) List treatment of imperforate anus (ano-rectal malformation)

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4.5.4 Diaphragmatic Hernia

It is the herniation of intestine into the thorax usually on the left side through the foramen of Bochdalek (70%) in diaphragm. Congenital diaphragmatic hernia is probably the most acute emergency and requires very specialized care (Fig 4.21).

![Diaphragmatic Hernia Diagram](image)

**Fig 4.21: Diaphragmatic Hernia**

**Signs and Symptoms**
1) Respiratory distress with marked cyanosis inspite of vigorous attempts at resuscitation.
2) Unequal movements of thorax.
3) Absence of breath sounds on affected side with flat or scaphoid abdomen.
4) Presence of intestinal sounds in thorax.
5) Newborn may have other anomalies like trisomies (13,18).

**Diagnosis**

It is established by X-ray chest, that reveals gas shadow of small bowel in thorax and mediastinal shift away from the affected side. Ultrasound scan during prenatal period would be of great help.

**Treatment**

Prompt surgical repair of hernia is done through abdominal approach. The abdominal contents are replaced in the abdominal cavity and defect in the diaphragm is closed by a series of interrupted sutures. An intercostals drain is inserted into the left pleural cavity and connected to water seal bag.
**Preoperative Nursing Care**

It is as follows:

1) Insert a large bore open ended nasogastric tube into the stomach, aspirate and leave for free drainage to avoid gaseous distension of bowel.

2) Insert endotracheal tube. Give gentle intermittent positive pressure ventilation of less than 30 mm of Hg with mechanical ventilator.

3) Treat acidosis and monitor blood gas levels.

**Postoperative Nursing Care**

It is as follows:

1) On return to the ward, observe for the dangers such as hypoxia, retention of carbon dioxide and pneumothorax. These are inter-related and are all partly due to the fact that the lungs of newborn are hypoplastic. The hypoplasia of lung on the side of hernia is most marked and the lung may weigh only a quarter of the normal weight. Unequal expansion of hypoplastic lungs with patchy over distention and rupture of some alveoli causes pneumothorax.

2) Counter the danger of hypoxia by intubation with elective intermittent positive pressure ventilation.

3) Perform gentle physiotherapy to chest to clear secretions from lungs as retention of secretions in hypoplastic lung is dangerous.

4) Continue intravenous infusion at the prescribed rate. Oral feeding for the newborn that has not had severe hypoxia, can be given after 24 hours following operation. However, the newborn that has had severe hypoxia is often rather slow in feeding and may need tube feeding for a week or more.

5) Attend all other general needs of the newborn.

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**Check Your Progress 7**

1) Write down diagnosis and treatment of diaphragmatic hernia.

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**4.5.5 Meconium Ileus**

It is characterized by obstruction of the terminal ileum by highly viscid tenacious meconium, which is produced by hyperviscous mucus secreted by abnormal intestinal glands. Proximal ileum is dilated and is full of tenacious meconium. The distal ileum and proximal colon contain inspissated pallets of desiccated meconium. Whole of distal colon appears as microcolon (Fig 4.22).
Signs and Symptoms

- Marked abdominal distention.
- Bile stained vomiting.
- Failure to pass meconium.
- Grossly dilated ileum full of viscid meconium may be palpable.

Diagnosis

It is made by:

1) X-ray of abdomen which shows marked distention of small bowel and solid meconium with granular appearance. This confirms the diagnosis.

2) Sweat test (after the newborn has recovered from operation) shows typically high sodium content of more than 70 mmol/L. This confirms the fibrocystic disease.

3) Examination of duodenal secretions shows low level of pancreatic enzymes such as trypsin. This confirms the fibrocystic disease.

4) Contrast enema (gastrograffin) is given per rectum, which outlines the large bowel and the dye passes back into small bowel, outlining the ileum and showing the classical appearance of meconium ileus. This confirms the diagnosis.

5) Diagnosis can be made during prenatal period by DNA probes from chorionic villi sampling.

Treatment

It is treated as:

1) Gastrograffin when injected in bowel for diagnostic purpose acts as an irritant and with outpouring of fluid, meconium may be passed. If the desired result is not obtained, procedure may be repeated. If these attempts fail, then surgery is needed.

2) Surgery includes resection of grossly dilated segment of ileum, end to side anastomosis and ileostomy.

Preoperative Nursing Care

It is as follows:

1) Give intravenous fluids and electrolytes as ordered.
2) Insert nasogastric tube and aspirate the gastric content.

3) Give antibiotics as ordered to prevent infections.

**Postoperative Nursing Care includes:**

Care of ileostomy is same as care of colostomy described in section 4.5.3.

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**Check Your Progress 8**

1) What is meconium ileus?

2) Describe the preoperative nursing care of baby with meconium ileus.

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### 4.5.6 Duodenal Atresia

The condition is usually common in newborns born to mothers with hydraminos, IUGR, in Down’s syndrome (Fig 4.23).

![Fig. 4.23: Duodenal Atresia](image)

**Signs and Symptoms**

1) Copious and bile stained vomiting.

2) Upper abdominal distention.

3) Following passage of meconium (usually white) no further stools are passed.
Diagnosis

It is made by:

1) Aspiration of more than 10 ml/kg fluid from newborn’s stomach. It is suggestive of duodenal atresia.

2) Straight X-ray of abdomen in upright position which shows typical double appearance of gas in fundus of stomach and vault of proximal half of duodenum.

Treatment

Prompt surgery in which duodenal obstruction is by-passed by anastomosing the dilated proximal duodenum to the jejunum. Gastrostomy may be performed and a fine feeding tube is introduced alongside the gastrostomy tube through the anastomosis and for 10-15cm into jejunum. The operation is named as duodeno-jejanostomy.

Pre-operative Nursing Care includes:

1) Withhold fluids by mouth.

2) Give intravenous fluids and electrolytes.

3) Insert naso-gastric tube and aspirate the gastric content.

Post-operative Nursing Care includes:

1) Aspirate the gastric contents through gastrostomy tube every hour to keep the stomach empty and avoid vomiting.

2) Continue giving intravenous fluids and electrolytes to maintain nutrition. As the dilated proximal duodenum and stomach contract slowly and take some time before starting to pass secretions through the anastomosis into the jejunum, feeding through the fine trans-anastomotic tube is commenced 24 hours after operation. Ensure that administration of feed down this fine tube should not exceed the rate of 1 ml per minute. The amount of milk feed is gradually increased.

3) When gastric aspirate decreases, reduce frequency of aspiration and start feeding into stomach and for 24 hours, give feeds alternately through gastrostomy into stomach and through transanastomotic tube into the jejunum. If the stomach contents are passing on adequately, oral feeding is gradually introduced and the trans-anastomotic tube can be removed. When removing the tube, pull the tube out and after a further 48 hours the gastrostomy tube is removed.

4) If the gastrostomy and trans-anastomotic feeding tubes are not inserted, there is need to give more prolonged IV therapy. A nasogastric tube must then be retained and aspirated regularly until new anastomosis starts functioning.

5) Attend all other general needs of newborn.
Check Your Progress 9

1) List signs and symptoms of duodenal atresia.

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2) Describe the feeding management of baby with duodeno-jejansotomy.

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4.6 LET US SUM UP

In this unit you have been acquainted with the meaning and causes of congenital malformations. You have learnt the measures used to prevent and detect the congenital malformations during early antenatal period.

Then you also learnt about the congenital malformations which pose as surgical emergencies in detail including their explanation, signs and symptoms, diagnosis, treatment and nursing care of each one of them.

4.7 GLOSSARY

“CHARGE” Syndrome : It is an acronym for the set of unusual congenital features seen in a number of newborn children. The letter stands for: coloboma (hole in one of the structures of the eye, such as the iris, retina, choroid or optic disc), heart defects, atresia of nasal choanae, retardation of growth and/or development genitorurinary abnormalities and ear abnormalities and deafness.

Chromosomal/Genetic Malformations : These appear as syndromes and are often associated with multiple anomalies. The babies are mentally retarded and have short half life span. Early detection during pregnancy helps to advise mother for pregnancy termination.

Crouzons Syndrome : A genetic disorder of Chromosome 10. It may be inherited or it may occur spontaneously characterized by particular face and skull
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deformities [Early fusion of the bones of the skull (craniosynostosis)]. The skull problems may push the brain down (tonsillar herniation), and may obstruct the flow of cerebrospinal fluid (hydrocephalus), nose and upper jaw appear sunken in because of poor bone growth in the face (midface hypoplasia), eyes may appear to pop out (exophthalmos or proptosis).

**Down’s (trisomy 21) Syndrome**

It is due to inclusion of additional chromosome or translocation of chromosome. Incidence is 1:600 and rises with advancing age of mother. The baby has small head with flat occiput, widely set and obliquely slanted eyes with epicanthic folds, small nose, thick rough tongue, short upper lip with small mouth, Mongolian face, short broad hands with incurving little finger, single palmer crease (30%) and also generalized hypotonia. Confirmation is done by chromosomal analysis using bone marrow aspiration or leucocytic culture.

**Edwards Syndrome**

It is due to an extra copy of 18th chromosome. Life span is short and majority die during the first year. The baby has small head with flat forehead, receding chin, may have cleft palate, low set ears, mal-developed, short sternum, overlapping of fingers, feet with rocker bottom appearance, usually associated with cardiovascular and gastrointestinal malformations.

**Goldenhar Syndrome**

[Oculo-Auriculo-Vertebral (OAV) syndrome] It is a rare congenital defect characterized by incomplete development of the ear, nose, soft palate, lip, and mandible. It is associated with anomalous development of the first and second brachial arch. Clinical manifestations include limbal dermoids, preauricular skin tags, and strabismus (misaligned eye).

**Klippel-Feil Syndrome**

Congenital fusion of any 2 of the 7 cervical vertebrae. The syndrome occurs in a heterogeneous group of patients unified only by the presence of a congenital defect in the formation or segmentation of the cervical spine.

**Triple marker Test**

A combined biochemical test which includes Maternal serum Alpha feto protein (MSAFP), Human chorionic Gonadotrophin (HCG) and estriol (UE3) and used at 15-18 weeks for detection of Down’s syndrome. It gives a risk ratio and for confirmation amniocentesis is done. If the risk ratio is 1:250 or more, the result is considered to be screen positive.
Check Your Progress 1

1) Congenital malformation means any abnormality in form, structure or function present at birth. It is also called birth defect, disorder or anomaly.

2) a) Chromosomal or genetic causes
    b) Teratogenic causes
    c) Multifactorial causes
    d) Unknown causes

Check Your Progress 2

1) a) Avoidance of all medicines and irradiations to pregnant mothers during the first trimester.
    b) Immunization of all girls to rubella before they get married.
    c) Giving folic acid 0.5 mg per day to mother when a couple is planning for a pregnancy or having unprotected sex. This has been found to reduce the risk of neural tube defects.
    d) Maternal screening with triple marker test at 16 weeks of gestation.

2) a) Radiology
    b) Ultrasonography
    c) Magnetic Resonance Imaging (MRI)

Check Your Progress 3

1) a) Hare (Cleft) lip and cleft palate
    b) Hirschsprung’s Disease
    c) Tracheo-oesophageal fistula
    d) Fallot’s tetralogy
    e) Ectopia Vesica
    f) Talipes
    g) Spina bifida
    h) Developmental Dysplasia

Check Your Progress 4

1) a) Excessive drooling of saliva.
    b) Choking or cyanosis with the first feed, even a small amount by mouth.
    c) Abdominal distension due to air passing from trachea through fistula into the stomach.
    d) Overflow of milk/saliva from esophagus and regurgitation through fistulous tract if present; irritate the lung leading to pneumonia.

2) a) On return to the ward, immediately suck the pharyngeal secretions by a catheter passed into the esophagostomy and repeat every half hour for 24 hours as by then the esophagostomy usually discharges onto the neck.
b) Clean and dry the skin around esophagostomy regularly. If skin is sored (usually it is due to monilial infection), take swab and send for culture to define the causative organism. If it is candida apply nystatin locally for fast improvement.

c) After one week give “Sham” feeds at the same time as gastrostomy feeds. Sham feeds consist of giving oral feeds which are discharged onto the neck through esophagostomy. Keep a nappy on neck to collect the discharge.

d) Keep the skin around the gastrostomy tube clean and dry. Apply siloderm ointment around the tube to protect the skin from irritation of hydrochloric acid and then apply a non-adherent dressing. Keep the tube fixed in position with adhesive strapping. This is performed as a sterile procedure until the wound heals.

Check Your Progress 5

1) The anterior abdominal wall is defective in its entire thickness and the bowel or other viscera protrude through umbilicus but are covered by peritoneum.

2) a) Carefully observe vital signs especially respiration and if needed give additional oxygen.

   b) Perform nasogastric aspiration and keep record of amount and colour.

   c) Give intravenous fluids (nutrition) and when aspirate decreases, gradually start with milk feeding.

   d) Attend all other general needs of newborn.

Check Your Progress 6

1) a) Imperforate Anus due to anal membrane is treated as:
   - If membrane is thin: it can break on insertion of rectal thermometer.
   - If membrane is thick: it is incised followed by digital dilatation of anal canal using a plastic dilator of equivalent 6 to Hegar 13. By three months, the danger of contraction of scar tissue is very low and dilatation can be discontinued.

   b) Imperforate anus with low fistula is treated as:
   - Decompression of bowel with catheter irrigation.
   - Local dilatation of fistula for 8-12 months.
   - Rectal cutback anoplasty or Y-V plasty at 1-2 years of age.

   c) Imperforate anus with high fistula is treated as:
   - Immediate colostomy usually in right transverse colon for decompression
   - Pull through operation at 1-2 years of age.

Check Your Progress 7

1) Diagnosis is established by X-ray chest, that reveals gas shadow of small bowel in thorax and mediastinal shift away from the affected side. Ultrasound scan during prenatal period would be of great help.

Prompt surgical repair of hernia through abdominal approach is done. The abdominal contents are replaced in the abdominal cavity and defect in the
diaphragm is closed by a series of interrupted sutures. An intercostal drain is inserted into the left pleural cavity and connected to a water seal bag.

**Check Your Progress 8**

1) Meconium ileus is the obstruction of the terminal ileum by highly viscid tenacious meconium, which is produced by hyper viscous mucus secreted by abnormal intestinal glands. Proximal ileum is dilated and is full of tenacious meconium.

2) a) Give intravenous fluids and electrolytes as ordered.
   b) Insert nasogastric tube and aspirate the gastric content.
   c) Give antibiotics as ordered to prevent infections.

**Check Your Progress 9**

1) a) Copious and bile stained vomiting.
   b) Upper abdominal distention.
   c) Following passage of meconium (usually white) no further stools are passed.

2) a) Continue giving intravenous fluids and electrolytes to maintain nutrition. As the dilated proximal duodenum and stomach contract slowly and take some time before starting to pass secretions through the anastomosis into the jejunum, feeding through the fine trans-anastomotic tube is commenced 24 hours after operation. Ensure that administration of feed down this fine tube should not exceed the rate of 1 ml per minute. The amount of milk feed is gradually increased.
   b) When gastric aspirate decreases, reduce frequency of aspiration and start feeding into stomach and for 24 hours, give feeds alternately through gastrostomy into stomach and through trans-anastomotic tube into the jejunum. If the stomach contents are passing on adequately, oral feeding is gradually introduced and the trans-anastomotic tube can be removed. When removing the tube, pull the tube out and after a further 48 hours the gastrostomy tube is removed.

### 4.9 REFERENCES

