2014

Neonatal Intensive Care Unit (NICU) Training

Participants' Manual

Federal Ministry of Health of Ethiopia

November 2014
Addis Ababa

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List of Acronyms

AGA	Appropriate for gestational age
ASD	Atrial septal defect
BP	Blood pressure
BPD	Broncho pulmonary dysplasia
BW	Birth weight
CHD	Congenital heart disease
CMV	Cytomegalovirus
CPAP	Continuous positive airway pressure
CVP	Central venous pressure
DDH	Developmental dysplasia of the hips
DIC	Disseminated intravascular coagulation
EBM	Expressed Breast Milk
ECG	Electrocardiogram
EDD	Estimated date of delivery
ELBW	Extremely low birth-weight
FFP	Fresh frozen plasma
FHB	Fetal heart beat
GPH	Gestational proteinuria & hypertension
HIE	Hypoxic ischemic encephalopathy
HMD	Hyaline membrane disease
HR	Heart rate
ICP	Intracranial pressure
IPPV	Intermittent positive pressure ventilation
IUGR	Intrauterine growth restriction
IVH	Intraventricular hemorrhage
KCL	Potassium chloride
LBW	Low birth weight
LFT	Liver function test
LGA	Large for gestational age
LMP	Last menstrual period
LP	Lumbar puncture
MAS	Meconium aspiration syndrome
NEC	Necrotizing enterocolitis
NGT	Naso-gastric tube
NICU	Newborn intensive care unit
OR	Operating room
PaCO2	Partial pressure arterial carbon dioxide
PaO2	Partial pressure arterial oxygen
PDA	Patent ductus arteriosus
PIE	Pulmonary interstitial emphysema
PIP	peak inspiratory pressure
PINSP	Peak inspiratory pressure
PPH	Postpartum hemorrhage

PPHN	Persistent pulmonary hypertension of the newborn
PPROM	Prelabour premature rupture of the membranes
PROM	Prolonged rupture of membranes
PSV	Pressure support ventilation
PVH	Periventricular hemorrhage
RDS	Respiratory distress syndrome
ROP	Retinopathy of prematurity
RV	Residual volume
SpO2	Oxygen saturation
SGA	Small for gestational age
SVD	Spontaneous vaginal delivery
TGA	Transposition of the great arteries
TOF	Tracheal esophageal fistula
TTN	Transient tachypnoea of the newborn
UVC	Umbilical venous catheter
VLBW	Very low birth weight

Acknowledgment

The Federal Ministry of Health of Ethiopia would like to express its sincere appreciation for the National Child Survival Technical Working Group (NCSTWG) for initiating the development of the Neonatal Intensive Care Unit (NICU) training packages that include NICU Participants' Manual, NICU Facilitators' Manual, NICU Management Protocol and NICU Registration Logbook. Our special thanks go to the Newborn TWG that spearheaded the development of the NICU training packages and overall coordination of the process.

The FMOH highly appreciates the team of experts who sit down and work in group to develop the NICU training packages. We would like to recognize the following health professionals for their technical input and for leading the development of the NICU Training Participants' Manual NICU Management Protocol and NICU Registration Logbook.

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We also thank UNICEF for financially assisting us in the development of the training packages. Last but not least we express our deep appreciation for all health professionals, partners and individuals who are tirelessly working to help Ethiopian newborns to have a better opportunity to survive and thrive.

Forward

Globally every year about 4 million children die in the first 4 weeks of life. A similar number of babies are still born. Most neonatal deaths (99 %) occur in low income and middle-income countries and about half of the deaths occur at home. It is tragic that millions of newborn die every year specially when their deaths are so easily preventable. It is estimated that about 75% of neonatal deaths could be avoided with simple, low cost tools that already exist such as antibiotics for pneumonia and sepsis, sterile blades to cut the umbilical cords using knit caps and kangaroo care to keep babies warm.

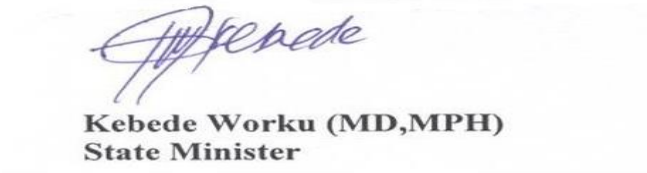
In Ethiopia, about 81,000 babies die every year in the first four weeks of life. This accounts for 42% of all deaths in children younger than five years of age. The risk of death is highest in the first 24 hours of life when more than half of deaths occur and about three- quarters of all neonatal deaths occur within the first week of life. Because a woman health is very closely linked with that of her fetus and newborn many of the cause of maternal death and ill health also have high impact on the health and survival of the neonate.

Generally, real progress in reducing deaths of newborn babies in a country with highest mortality like ours demands a higher coverage of optimally standard neonatal services with special focus to the poorest segment of the population and at the time of greatest risk, which is at birth and in the first few days of life.

Overall, there are indications that some improvements are being made, including access to essential preventive and primary maternal and child health care services. Admittedly, though, neonatal health care services have been remaining less consolidated, systematic efforts have been gaining momentum since relatively recent. Standard of neonatal health care at all events is now almost in process and preparedness and readiness of the formal health care system has been in progress. The massive health sector training of the various cadres, infrastructure and systems strengthening in the recent years are expected to contributing towards the significant newborn health quality improvement.

According to the estimates of the American Academy of Pediatrics, nearly 5% of all the newborns may require the Level III (or Intensive care unit) whilst another 15-20% of all the newborns may require Level II (Specialty) services. At a rate 36 crude births per 1000 live births for Ethiopia, nation-wide, up to approximately 450,000 Level II (specialty) and 115,000 Level III (ICU) services may be required per year. By just considering these figures alone, the neonatal care demand and need (i.e., requirements) are very tremendous; preparedness and readiness are critical.

Interventions that have the greatest effect on neonatal death are less dependent on technology and commodities than on people with skills thus it is my sincere believe that this NICU nurse training materials will help in improving the capacity of health workers involved in the initial care of the newborn at health facility level.



Kebede Worku (MD,MPH)
State Minister

Introduction

Course objectives:

By the end of this introductory session participants are expected to

1. Describe the training objectives and expectations
2. Identify key course training manuals and their use in the training
3. Determine pre-course knowledge on selected key areas that the training covers

Globally an estimated 3.7 million neonates die each year, 99% of them in low-income countries. Since neonatal death rates stagnated in many low-income countries, neonatal deaths now represent an increasing proportion of under-five child deaths, an estimated 41% globally in 2008 compared to 38% in 2000. This proportion is even greater in high mortality settings such as Ethiopia.

As shown in the 2011 DHS report Ethiopia recorded a rapid decrease in infant and under-five mortality during the five years prior to the survey compared to those reported in the 2005 EDHS. However, looking further at the breakdown of the data it becomes evident that the neonatal mortality rate did not show significant decrease. Instead the proportion of under-five child deaths attributed to neonatal deaths increased from 32 percent in 2005 EDHS to 42 percent in the 2011 EDHS.

Background

The government of Ethiopia is committed to achieve the Millennium Development Goals (MDGs) related both to maternal and child health. This is clearly reflected in the Health Sector Development Program (HSDP IV). Alongside scaling up successful practices of HESP implementation and rolling out the Health Development Army (HDA) the FMOH has paid due emphasis to expansion of quality high impact neonatal interventions in health centers and hospitals. This includes establishing basic newborn care units (newborn corners) at health centers and NICUs at hospitals.

As initial activity FMOH with partners has started strengthening and/or eestablishing NICU in selected federal level and university teaching hospitals. The performances of the NICUs in these facilities have been encouraging. Lessons learnt from this exercise was documented that will be fed into the implementation of NICU in the remaining referral and regional hospitals. The FMOH has been working with the Child Survival TWG to define the NICUs and different levels of care expected at the NICUs that the Ethiopian government is planning to strengthen and/or establish.

Neonatal Intensive Care Unit (NICU)

NICU gives care for babies who are born early, who have problems during delivery, or who develop problems while still in the hospital. NICUs are generally classified into three levels.

The functional capabilities of facilities that provide inpatient care for newborn infants should be classified uniformly, as follows:

- **Level I (basic)**: a hospital organized with the personnel and equipment to perform neonatal resuscitation, evaluate and provide postnatal care of healthy newborn infants, stabilize and provide care for infants born at 35 to 37 weeks' gestation who remain physiologically stable, and stabilize newborn infants born at less than 35 weeks' gestational age or ill until transfer to a facility that can provide the appropriate level of neonatal care.

- **Level II (specialty)**: a hospital special care nursery organized with the personnel and equipment to provide care to infants born at more than 32 weeks' gestation and weighing more than 1500 g who have physiologic immaturity such as apnea of prematurity, inability to maintain body temperature, or inability to take oral feedings; who are moderately ill with problems that are expected to resolve rapidly and are not anticipated to need subspecialty services on an urgent basis; or who are convalescing from intensive care.

- **Level III (subspecialty)**: a hospital NICU organized with personnel and equipment to provide continuous life support and comprehensive care for extremely high-risk newborn infants and those with complex and critical illness. Level III is subdivided into 3 levels differentiated by the capability to provide advanced medical and surgical care.

For Hospitals in Ethiopia the level of care expected to be provided by different types of hospitals varies. District hospitals are expected to have minimum of Level I NICU. Regional referral hospitals should at least have Level II NICU. Specialized teaching hospitals must have Level III NICU.

Establishing NICU is very expensive by its nature. Hence, whilst working towards meeting international standards facilities should start providing the most possible care for newborns with the minimum set of equipments and supplies they may have.

Establishing NICU in hospitals and/or strengthening existing one includes providing training and continuous support for newborn health care providers and managers, ensuring the basic equipments and supplies are in place, and strengthening the facility infrastructure and referral system. These training packages were developed to ensure that hospitals are staffed with well trained NICU service providers, equipped with basic and necessary equipment and supplies for provision of NICUs and a strong linkage and referral system among the NICU care providers and facilities are established.

Process of developing the NICU Training Manual

The FMOH through the national child survival TWG and with financial support from UNICEF has developed NICU training manuals, treatment protocols and recoding and reporting formats. The training materials were developed by a team of highly qualified Ethiopian pediatricians and

newborn health experts selected from universities across the country and partners. Three workshops were held in the process of developing the training materials.

First workshop was conducted and participants identified key newborn health problems causing motility and morbidity of newborns in Ethiopia, identified the training areas that should be addressed by the NICU training, listed the topics to be included in the NICU training materials, agreed on the trainees and training modality. Finally, each of the technical people picked a topic or topics according to their expertise and agreed to share draft module on the topic to FMOH before the second workshop.

In the second workshop the team came together to review each of the sections that were separately developed by them. Small groups were formed and the drafts developed on each topic were distributed to the groups according to their expertise and their involvement in drafting the modules. The groups reviewed the draft sections, and in plenary the whole team discussed thoroughly reviewing each of the sections. At the end of the second workshop a draft training NICU manual was developed.

In the third workshop the group again came together to review the NICU training manual and develop NICU Management Protocol and Power Point Presentations on each of the topics that were covered in the training manual. By the conclusion of the third workshop draft NICU Training Manual, Management Protocol and Power Point Presentation on each topic were developed.

Following the third workshop smaller group from the panel of experts further refined the training manual and management protocol and shared with selected partners and Federal Ministry of Health for feedback. Feedback from the partners (including from Save the Children, World Health Organization) and Federal Ministry of Health was incorporated in the documents. Finally NICU Facilitators' manual detailing the training schedule, method and materials was developed by the three colleagues (Prof. Bogale Worku from EPS, Dr. Mulualem Gessesse from Yekatit 12 Hospital Neonatology Department and Abiy Seifu from School of Public Health of Addis Ababa University).

Participants/Trainees

Participants of the NICU training should be newborn care providers with at least BSc degree in nursing, public health or related training. As the training is intensive and requires a huge investment upon return from the training participants of the training must commit to work at NICUs in their respective hospitals. It is highly recommended that the hospital management provide close support and follow up for the strengthening or establishment of the NICUs in their hospitals and ensure that health care providers trained on NICU are assigned and working at the NICUs.

Chapter 1: History and physical examination of neonates and classification of newborns

Learning objectives:

At the end of this lecture, the participants will be able to

- Take history in neonatal age group
- Describe the requirements and steps of newborn clinical examination
- Interpret all the findings
- List counseling points to discuss with mothers after the clinical examination

History and Physical examination of the newborn

1. Neonatal history taking

a. ***Maternal profile*:** age of the mother, occupation, parity, blood group and Rh, chronic maternal illnesses, history of sexually transmitted diseases, Hepatitis B infection
b. ***Current pregnancy***: LNMP (last normal menstrual period), gestational age, ANC, bleeding, hypertension, diabetes, thyroid diseases, eclampsia, acute or chronic infection.
c. ***Previous pregnancy*:** history of abortion, fetal death, early neonatal death, premature birth, history of early neonatal jaundice, history of birth defect.
d. ***Drug history*:** history of alcohol ingestion, cigarette smoking , any medications pregnancy during (anticonvulsants, anti TB, warfarin, HAART, thyroid treatment drugs , antenatal steroid use, contraceptives)
e. ***Family history***: the health worker needs to know the family history to see if there are any inherited diseases like diabetes mellitus, hypertension, bronchial asthma, thyroid disease and others.
f. ***Labor and delivery***: presentation, onset of labor, duration of rapture of membranes, duration of labor, mode of delivery, presence of meconium, breathing condition of at birth, resuscitation, birth weight, place of delivery.
g. ***Presenting compliant***: like failure to suck, fever, breathing difficulty, abnormal body movement, jaundice, etc

2. Physical examination of newborns

The goal of physical assessment of the newborn is to identify neonatal problems and the specific objectives are*:*

- Understand the interpretation of all the findings when examining a newborn
- Describe the requirements and steps of newborn clinical examination
- Know and be able to list counseling points to discuss with mothers after the clinical examination

At initial examination, the health worker has to focus on the following conditions

- Babies response to the transition from fetal life to extra uterine life
- Any congenital anomalies
- Any sign of infection

APGAR scoring

The APGAR score is now used worldwide to quickly assess the health of an infant one minute and five minutes after birth. The 1-minute APGAR score measures how well the newborn tolerated the birthing process. The 5-minute APGAR score assesses how well the newborn is adapting to the environment.

Note: ***The APGAR score is not used to determine the need for resuscitation!***

Figure 1: A newborn with APGAR score of 9 – 10

Table 1: APGAR score

Sign	Score 0	Score 1	Score 2
Activity	Flaccid	Some flexion	Well flexed
Pulse	Absent	<100 per minute	>100 per minute
Grimace	No response	Grimace	Cough or sneeze
Appearance	Pale/Blue	Blue extremities	Completely pink
Respiration	Absent	Weak	Good cry

Three levels of score:

- Low APGAR score 0-3
- Moderate APGAR score 4-6
- Normal APGAR score 7-10

Note: A newborn with an APGAR score of less than 7 needs special attention.

Preparation of examination: The baby should be naked in a thermo-neutral environment to see if there is any birth defect, breathing condition, movement of the baby, cyanosis, pallor and jaundice.

Prepare the following items

- Thermometer
- Measuring rod and tape
- Weighing Scale (for babies)
- Stethoscope
- Watch
- Gloves
- Data collection sheet

Prerequisites

- Review of the obstetrical file and health record.
- Explain to the mother the purpose and process of the examination.
- Wash hands with soap and water.
- Undress and place the baby under a heat source if it is available or prevent heat loss (close shutters and windows, keep baby partially covered, keep examination time short).

Key examination points

- Unlike older children the order of newborn physical examination may not follow the usual cardinal steps, use opportunities as issued.
- ***General examination***: look for movement of the extremities, hypotonia, color, respiratory distress, dysmorphic features, etc…
- Take the ***vital signs***: take the respiratory rate and pulse rate while the baby is calm.
    - Respiratory rate per minute (30 to 60 breathes per min should be counted for a full minute.

    - Pulse oximetry
    - Heart rate per minute (normal rate is between 120 and 160 bpm). Check capillary refill.
    - Axillary temperature (normal is between 36.5 and 37.5)
    - Measure blood pressure using appropriate cuff. The normal range blood pressure of a newborn varies based on birth weight, gestational age and postnatal age. Normal systolic blood pressure should not be less than 60 mmHg. Blood pressure needs frequent measurements.
- Take anthropometric measurement
    - Weigh the baby on a cloth to protect it from temperature loss with a calibrated balance (normal weight range for term babies is 2500g -3999g).
    - Measure the length (normal range is 48-53 cm),
    - Measure head circumference (normal range is 33-38cm),
- ***Color***: normal color is pink, should not be: blue, yellow, pale.
- ***Examination of HEENT***: examine the skull (caput succedaneum subgaleal hemorrhage, cephalohematoma), sutures (craniosynostosis), fontanel, face, nose, ears, mouth, neck, clavicles, eye discharge, icterus, cataracts
- ***Mammary glands***: enlargement of breast tissue and discharge (physiologic)
- ***Respiratory system***:
    - Check for signs of respiratory distress, breathing pattern, respiratory rate, air entry to the lungs , presence of abnormal sounds in the lungs, AP diameter and symmetry of the chest, strider
- ***Cardiovascular***: heart rate, heart murmurs, gallop rhythm, femoral pulses
- ***Abdomen*:** shape (scaphoid, distension), look for any organ enlargement like hepatomegaly, splenomegaly, mass, ascites, kidneys, abdominal wall defect, examination of the umbilical stump (bleeding and discharge), anal patency.
- ***External genitalia***: see if there are any abnormalities of the genitalia both in male and female newborn (size of penis , position of testicles, opening of urethral meatus , ambiguous genitalia), vaginal bleeding or discharge.
- ***Musculoskeletal*:** limb defects (clubfoot, syndactyly, polydactyly), symmetry and movement of extremities to see fractures and birth injuries, spina bifida, joints (hip should be examined to detect developmental dysplasia of the hip, look gluteal fold symmetry), edema.
- ***Skin examination****:* rash, jaundice, pallor, plethora, meconium staining, cyanosis, birthmarks, etc. Acral (extremity) cyanosis is a normal finding in newborns
- ***Neurological examination***: level of alertness, spontaneous movements, muscle tone, reflexes ...
    - Moro reflex, check for completeness and symmetry
    - Rooting reflex, absent or present
    - Grasp reflex (arm and plantar)
    - Sucking reflex, absent, weak or vigorous

After the clinical examination of the newborn:

- Record all the findings in the newborn's registration books or chart prepared for the purpose.

- Inform mothers about the results of the examination, provide explanations if needed and emphasize the importance of regular follow-up.

Classification of the newborn

1. ***Based on the gestational age, a newborn could be classified in to:***

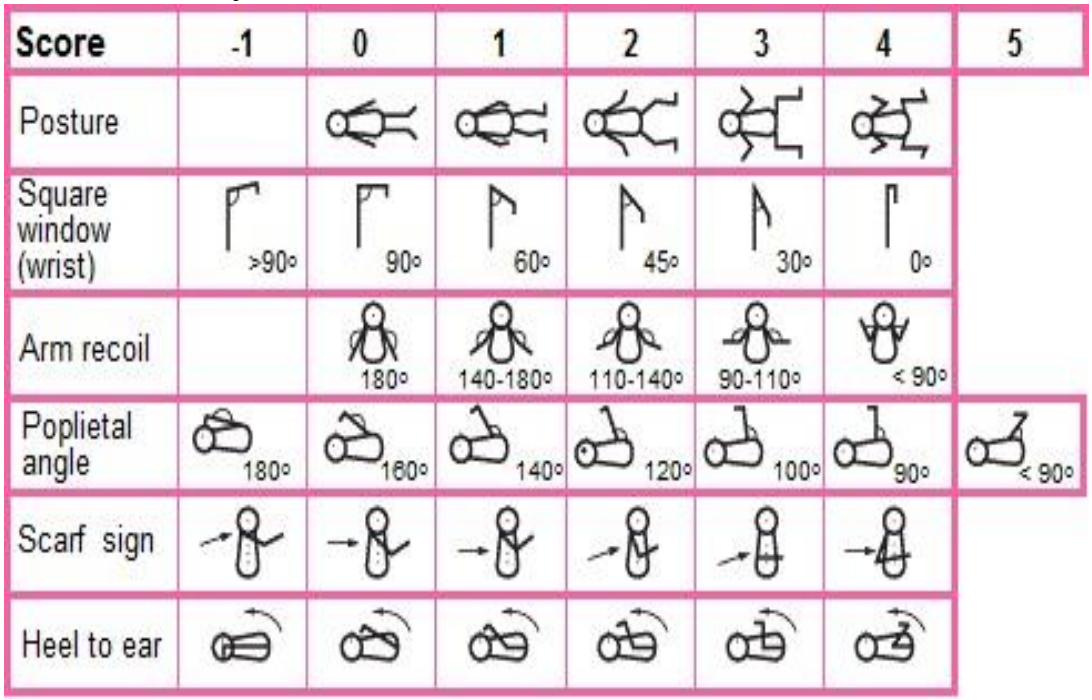
- ***Preterm* :** less than 37 Completed weeks
- ***Term* :** 37- 42 weeks
- ***Post term* :** more than 42 weeks

Gestational age could be estimated by one of the following methods

- On the bases of the first day of the last menstrual period
- Ultrasound estimation: gestational age estimate during the first trimester is ultrasonography can be accurate within +/- 5-7 days.
- Based on Ballard score

The new Ballard has two components, neuromuscular and physical maturity scoring and the accuracy is within a range of +/- two weeks.

Neuromuscular maturity



Physical maturity

SCORE	-1	0	1	2	3	4	5
Skin	Sticky friable, transparent	Gelationous, red, translucent	Smooth, pink; visible veins	Superficial peeling and/or rash few veins	Cracking, pale areas; rare veins	Parchment deep cracking; no vessels	Leathery, cracked, wrinkled
Lanugo	None	Sparse	Abundant	Thinning	Bald areas	Mostly bald	
Plantar surface	Heel -toe 40-50 mm:-1 < 40mm: -2	> 50mm, no crease	Faint red marks	Anterior transverse crease only	Creases anterior 2/3	Creases over entire sole	
Breast	Imperceptible	Barely perceptible	Flat areola, no bud	Stippled areola, 1-2mm bud	Raised areola, 3-4 mm bud	Full areola 5-10 mm bud	
Eye/Ear	Lids fused loosely: -1 tightly: -2	Lids open, pinna flat stays folded	Slightly curved pinna; soft ; slow recoil	Well curved pinna; soft but ready recoil	Formed and firm instant recoil	Thick cartilage, ear stiff	
Genitals (male)	Scrotum flat, smooth	Scrotum empty, faint rugae	Testes in upper canal rare rugae	Testes descending, few rugae	Testes down, good rugae	Testes pendulous, deep rugae	
Genitals (female)	Clitoris prominent, labia flat	Clitoris prominent, small labia minora	Clitoris prominent, enlarging minora	Majora and minora equally prominent	Majora large, minora small	Majora cover clitoris and minora	

Maturity rating	
-10	20
-5	22
0	24
5	28
10	28
15	30
20	32
25	34
30	36
35	38
40	40
45	42
50	44

Figure 2: Maturational assessment of gestational age. Ballard JL et al. New Ballard Score, expanded to include extremely premature infants. J Pediatrics 1991; 119:417

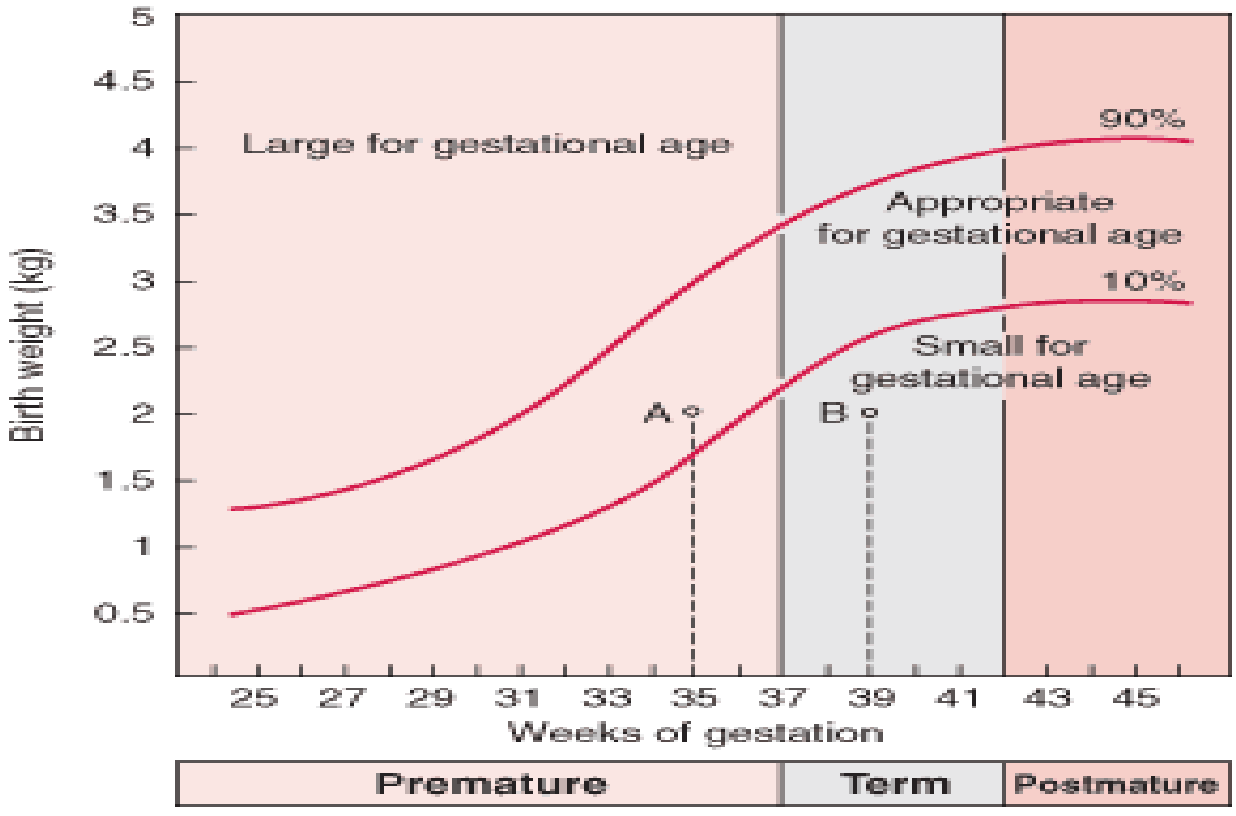
2. ***Classifications of the newborn based on the birth weight:***

- ***Macrosomia*** : birth weight of 4000 gram and above
- ***Normal weight*** : 2500 – 3999 grams
- ***Low birth weight*** : 1500 – 2499 grams
- ***Very low birth weight*** : 1000 – 1499 grams
- ***Extremely low birth weight*** : less than 1000 grams

3. ***A newborn can also be classified with respect to birth weight and gestational age as follows:***

- ***Appropriate for gestational age*** *(AGA)* if the birth weight is between 10-90%
- ***Large for gestational age*** *(LGA)* if birth weight is greater than 90%
- ***Small for gestational age*** *(SGA)* if birth weight is less than 10%

Level of intrauterine growth based on birth weight and gestational age of live born, single, white infants.



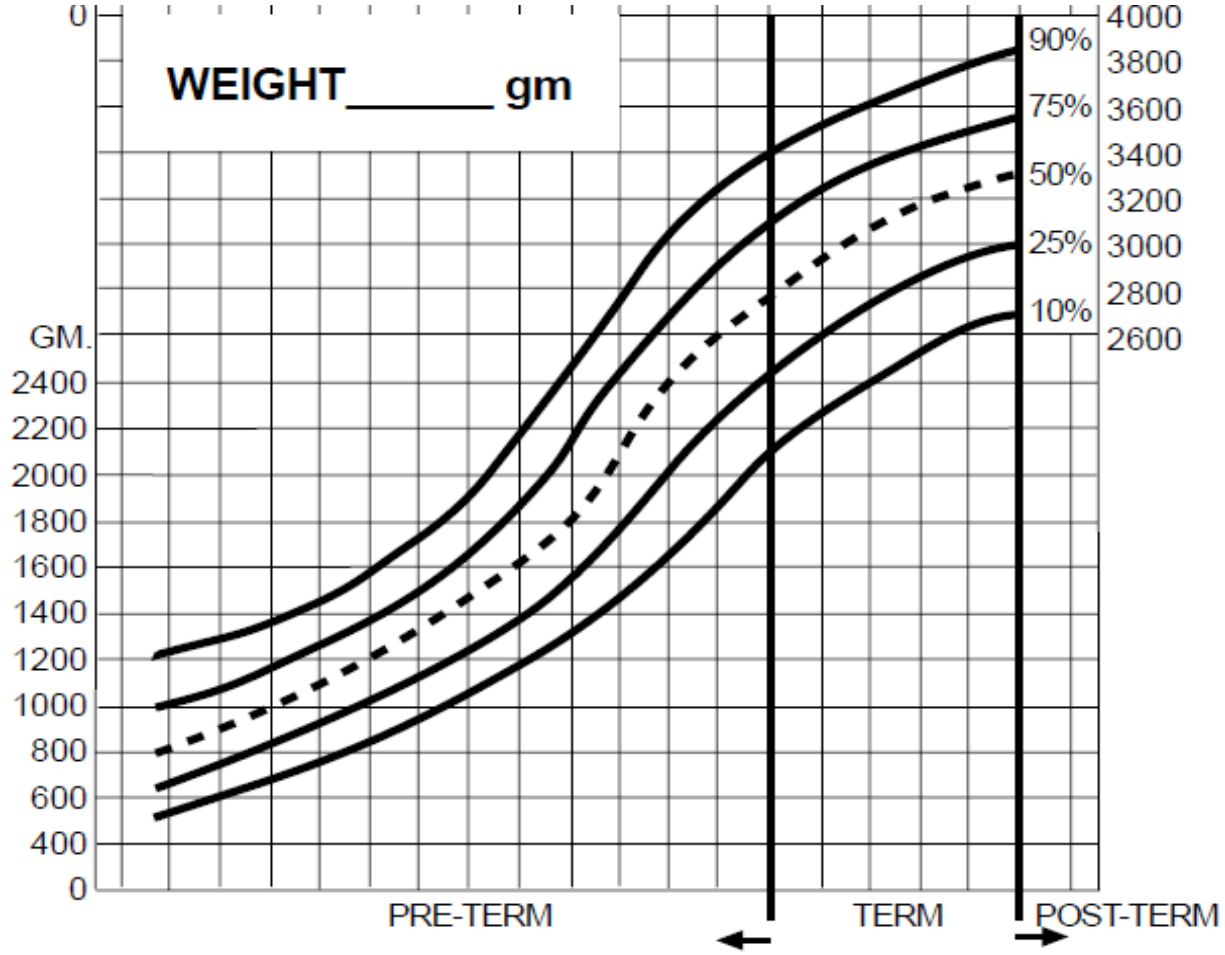


Figure 3: Point A represents a premature infant with appropriate weight for gestational age (AGA). Point B indicates an infant of similar birth weight who is mature but small for gestational age. The growth curves represent the 10th and 90th percentiles for all of the neonates in the sampling. (Adapted from Sweet AY: Classification of the low-birth-weight infant. In *Care of the High-Risk Neonate*, ed. 3, edited by MH Klaus and AA Fanaroff. Philadelphia, WB Saunders Company, 1986;

Definitions

- ***Neonatal period*:** a period from birth to 28 completed days of life.
- ***Early neonatal period*:** this is a period from birth to 7 completed days of life
- ***Late neonatal period*:** A period from 8 to 28 completed days of life
- ***Perinatal period*:** This period includes from 28 completed weeks of gestation to 7 days after birth
- ***Gestational age*:** this is the time counted (in weeks) from the first day of the woman's last menstrual period to the day of delivery (or current date if baby not yet born).
- ***Chronologic age*:** this is the age of the baby counted from the time of birth
- ***Corrected age*:** this is the age of the baby which is counted by reducing the Chronological age from the number of weeks born before 40 weeks of gestation

Chapter 2: Essential newborn care

Learning objectives

At the end of this session, all participants will:

- Identify components of ENC
- Recognize importance of ENC
- Recall steps of the components of ENC and apply them at NICU

Essential newborn care is care given to all newborn infants at birth to optimize their chances of survival.

Standardized procedures in Essential Newborn Care (ENC)

Step 1: Dry and stimulate

- Immediately dry the whole body including the head and limbs.
- Keep the newborn warm by placing on the abdomen of the mother
- Stimulate by rubbing the back or Slapping or flicking the soles of the feet
- Remove the wet towel
- Let the baby stay in skin-to-skin contact on the abdomen and cover the baby quickly, including the head with a clean dry cloth. Don't let the baby remain wet, as this will cool the body and make it hypothermic.

Step 2: Evaluate Breathing

- Check if the baby is crying while drying it.
- If the baby does not cry, see if the baby is breathing properly.
- If the baby is not breathing and/or is gasping: Call for help. The assistant can provide basic care for the mother while you provide the more specialized care for the baby who is not breathing. Cut the cord rapidly and start resuscitation.
- If the baby breathes well, continue routine essential newborn care.
- Do not do suction of the mouth and nose as a routine. Do it only if there is meconium, thick mucus, or blood.

Normal breathing
Normal breathing rate in a newborn baby is 30 to 60 breaths per minute. The baby should not have any chest in-drawing or grunting. Small babies (less than 2.5 kg at birth or born before 37 weeks gestation) may have some mild chest in-drawing and may periodically stop breathing for a few seconds.

Step 3. Cord care

Optimal cord care consists of the following:

- Clamping /tying the cord: If the baby does not need resuscitation, wait for cord pulsations to cease or approximately 1-3 minutes after birth, whichever comes first, and then place one metal clamp /cord tie 2 centimeters from the baby's abdomen and the second clamp / tie another 2 centimeters from the first clamp/tie . Cutting the cord soon after birth can decrease the amount of blood that is transfused to the baby from the placenta and, in preterm babies; it is likely to result in subsequent anemia and increased chances of needing a blood transfusion (1-2)
- Cutting the cord: Cut the cord with sterile scissors or surgical blade, under a piece of gauze in order to avoid splashing of blood. At every delivery, a clean separate pair of scissors or blade should be designated for this purpose. Counseling on cord care:
    - Check for bleeding/oozing and retie if necessary.
    - The cord may be tied by using sterile cotton ties, elastic bands, or pri -sterilized disposable cord tie.
    - Advise the mother not to cover the cord with the diaper
    - Don't use bandages as it may delay healing and introduce infection.
    - Don't use alcohol for cleansing as it may delay healing.
    - Don't apply traditional remedies to the cord as it may cause tetanus and other infections.
    - There is a global evidence that application of chlorhexidine reduces sever cord infection and newborn sepsis and thus recommended to apply 4% chlorhexdine immediately after cutting the cord and continue for 7 days (3-5).

Watch out for

- Pus discharge from the cord stump.
- Redness around the cord especially if there is swelling.
- Fever (temperature more than 38°C) or other signs of infection.

Step 4. Keep the newborn warm (Prevent Hypothermia)

- Keep the baby warm by placing it in skin-to-skin contact on the mother's chest.
- Cover the baby's body and head with clean cloth. If the room is cool (<25 ºC), use a blanket to cover the baby over the mother.

Step 5. Initiate breastfeeding in the first one hour

Skin-to-skin contact and early breastfeeding are the best ways to keep an infant warm and prevent hypoglycaemia. Term and low-birth-weight neonates weighing < 2000g who do not have complications and are clinically stable should be put in skin-to-skin contact with the mother soon after birth after they have been dried thoroughly to prevent hypothermia.

Early breastfeeding means breastfeeding within the first hour, with counseling for correct positioning.

- Early breastfeeding reduces the risk of postpartum hemorrhage for the mother.
- Colostrum (the "first milk") has many benefits for the baby, especially anti-infective properties.
- Skin to skin contact while feeding helps the baby to stay warm.
- Breastfeeding delays the mother's return to fertility because of lactation.
- Breastfeeding provides the best possible nutrition for the baby.
- Feed day and night, at least 8 times in 24 hours, allowing on-demand sucking by the baby.
- If the baby is small (less than 2,500 grams), wake the baby to feed every 3 hours.
- If the baby is not feeding well, seek help.
- Successful breastfeeding requires support for the mother from the family and health institutions.
- There is no need for extra bottle feeds or water for normal babies, even in hot climates
- Avoid the use of the bottles and pacifiers.

Step 6. Administer eye drops/eye ointment

- Wash your hands with soap and water
- Clean eyes immediately after birth with swab soaked in sterile water, using separate swab for each eye.
- Clean from medial to lateral side.
- Give tetracycline eye ointment/drops within 1 hour of birth usually after initiating breast feeding.
- Don’t put anything else in baby's eyes as it can cause infection.
- Watch out for discharge from the eyes, especially with redness and swelling around the eyes.

Step 7. Administer vitamin K Intramuscularly (IM)

- 1 mg for babies with gestational age of 34 weeks or above
- 0.5 mg for premature babies less than 34 weeks gestation

Step 8. Place the newborn’s identification bands on the wrist and ankle

- Putting the identification bands on the hands and ankle will save you from misshaping babies in busy delivery rooms.

Step 9. Weigh the newborn when it is stable and warm

- Place a clean linen or paper on the pan of the weighing scale.
- Adjust the pointer to zero on the scale with the linen/paper on the pan.
- Place the naked baby on the paper/linen. If the linen is large, cover the baby with the cloth.
- Note the weight of the baby when the scale stops moving.
- Never leave the baby unattended on the scale.
- Record the baby ’s weight in partographs/maternal/ newborn charts and delivery room
- Register and inform the mother

Step 10. Record all observations and treatment provided in the registers/appropriate chart/cards

- Note Defer the bath for at least 24 hours.
- Clean the newborn of an HIV-infected mother as recommended
- Organize transport if necessary
- Inform the mother of the newborn's weight

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Chapter 3: Perinatal Asphyxia

Learning objectives:

At the end of this session, the learner is expected to:

- Define perinatal asphyxia
- Recall the basic pathophysiology of asphyxia
- Recognize organ manifestations of asphyxia
- Identify and treat perinatal asphyxia
- State the prognosis of perinatal asphyxia

Important terminologies

- ***Anoxia*** is a term used to indicate the consequences of complete lack of oxygen as a result of a number of primary causes.
- ***Hypoxemia*** refers to decreased arterial concentration of oxygen.
- ***Hypoxia*** refers to a decreased oxygenation to cells or organs.
- ***Ischemia*** refers to blood flow to cells or organs that is insufficient to maintain their normal function

Perinatal Asphyxia

Definitions

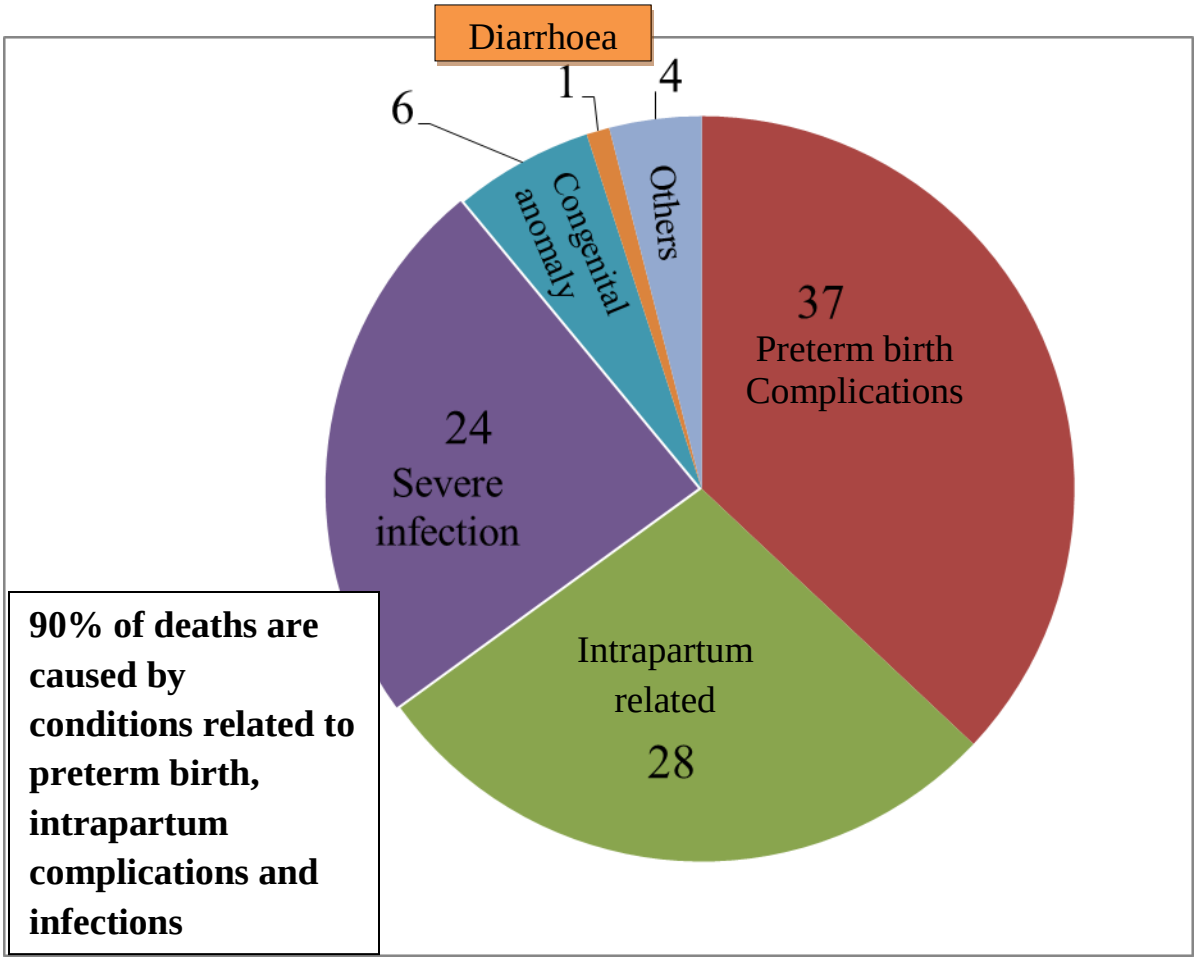
- World Health Organization (WHO) defines birth asphyxia as failure to initiate and sustain breathing at birth
- It can also be defined as placental or pulmonary gas exchange impairment leading to hypoxemia and hypercarbia.

As a result of anaerobic glycolysis lactate is produced and will accumulate in the brain, heart and other tissues with a resultant effect of metabolic acidosis (evidenced by low cord PH< 7). Manifestations of perinatal asphyxia are low APGAR score less than or equal to 6 at 5^{th} minute or less than 3 at 10^{th} minute and abnormal muscle tone.

***Epidemiology*:**

Perinatal asphyxia is the second commonest cause of neonatal mortality only preceded by infection (as in the figure shown below) and the commonest cause of disability in surviving newborns.

Figure 15: Causes of Neonatal Deaths in Ethiopia,



Physiology of Breathing

How does a baby receive oxygen before birth?

Oxygen is essential for survival both before and after birth. Before birth, the placenta provides all of the oxygen used by a fetus. Before birth, only a small amount of fetal blood passes through the fetal lungs. The fetal lungs do not function as a source for oxygen or as a route to excrete carbon dioxide. Therefore, blood flow to the lungs is not important to maintain normal fetal oxygenation and acid-base balance. The fetal lungs are expanded in utero, but the air sacs within the lungs (alveoli) are filled with fluid, rather than air. In addition, the blood vessels that perfuse and drain the fetal lungs are markedly constricted (Figure 16).

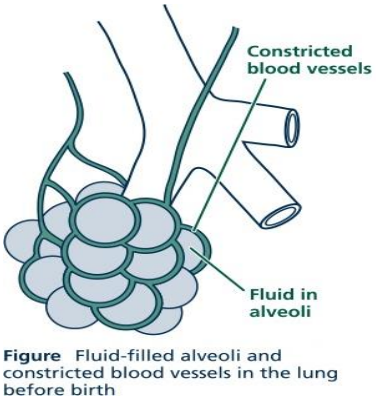


Figure 16: Fluid filled alveoli and constricted blood vessels in the lung before birth

Before birth, most of the blood from the right side of the heart cannot enter the lungs because of the increased resistance to flow in the constricted blood vessels in the fetal lungs. Instead, most of this blood takes the lower resistance path through the ductus arteriosus into the aorta (Figure 17)

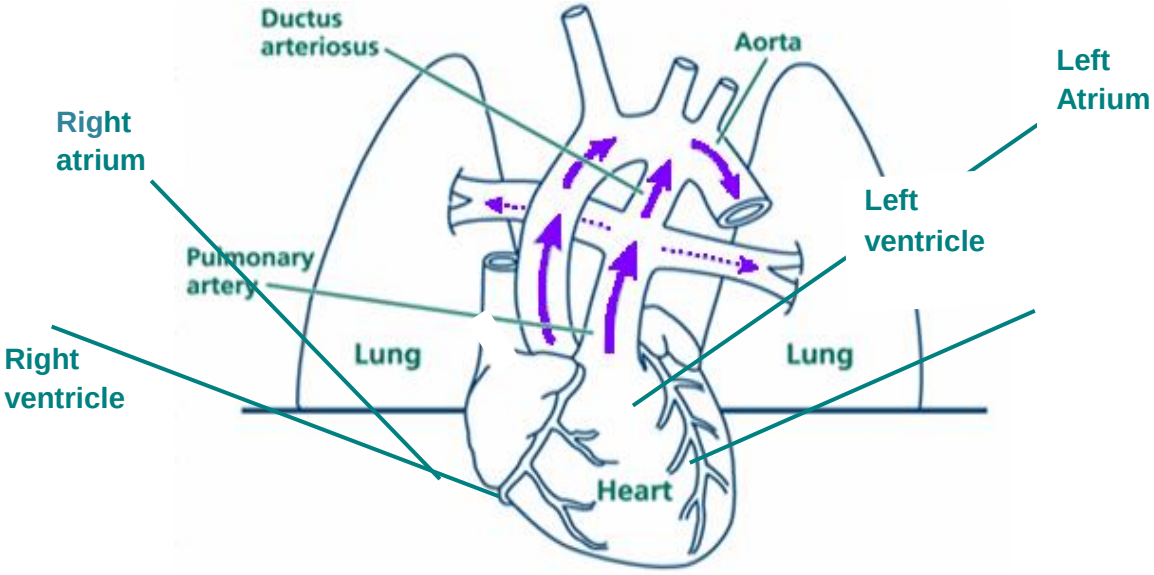


Figure 17: Blood circulation before birth

After birth, the newborn will no longer be connected to the placenta and will depend on the lungs as the only source of oxygen. Therefore, in a matter of seconds, the lung fluid must be absorbed from the alveoli, the lungs must fill with air that contains oxygen, and the blood vessels in the lungs must relax to increase blood flow to the alveoli so that oxygen can be absorbed and carried to the rest of the body.

What happens with normal transition?

Normally, three major changes begin immediately after birth allowing a baby to get oxygen from the lungs.

1. The fluid in the alveoli is absorbed into lung tissue and replaced by air (Figure 18) Because air contains 21% oxygen, filling the alveoli with air provides oxygen that can diffuse into the blood vessels that surround the alveoli.

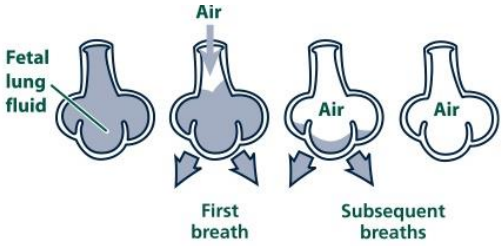


Figure Fluid replaced by air in alveoli

Figure 18: Fluid replaced by air in alveoli

2. The umbilical arteries and vein are clamped. This removes the low-resistance placental circuit and increases systemic blood pressure.

3. As a result of the increased oxygen in the alveoli, the blood vessels in the lung tissue relax (Figure 19). This relaxation, together with the increased systemic blood pressure, creates a dramatic increase in pulmonary blood flow and a decrease in blood flow through the ductus arteriosus (PDA). The oxygen from the alveoli is absorbed by the increased pulmonary blood flow, and the oxygen-enriched blood returns to the left side of the heart where it is pumped to the tissues of the newborn's body.

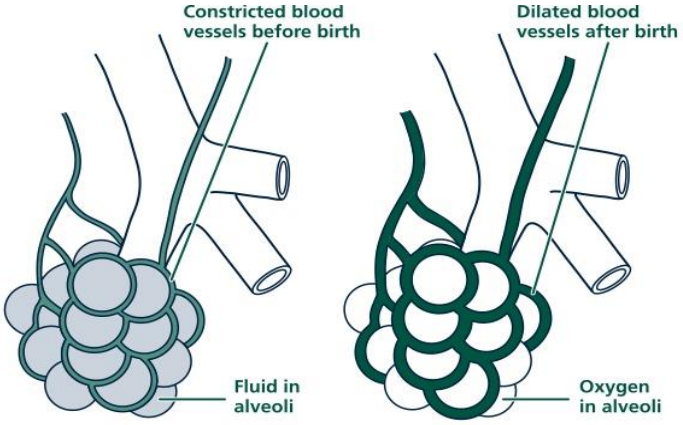


Figure Dilation of pulmonary blood vessels at birth

Figure 19: Dilation of pulmonary blood vessels at birth

In most circumstances, air provides sufficient oxygen (21%) to initiate relaxation of the pulmonary blood vessels. As blood levels of oxygen increase and pulmonary blood vessels relax, the ductus arteriosus begins to close. Blood previously diverted through the ductus arteriosus now flows through the lungs, where it picks up more oxygen to transport to tissues throughout the body (Figure 20).

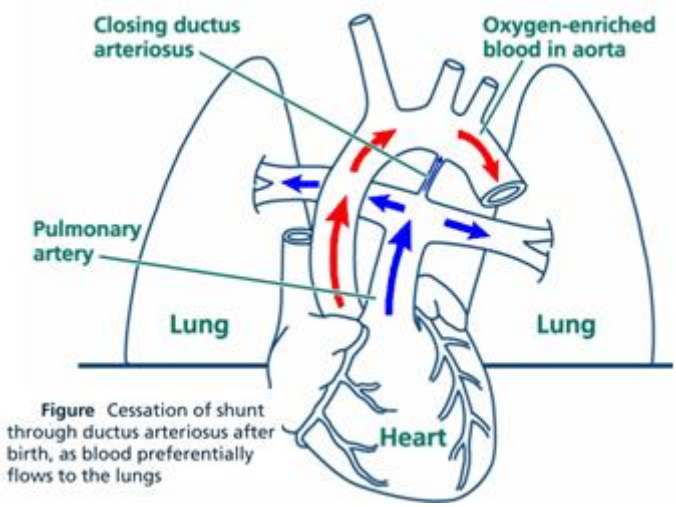


Figure 20: Cessation of shunt through ductus arteriosus after birth, as blood preferentially flows to the lungs

At the completion of this normal transition, the baby is breathing air and using his lungs to get oxygen. His initial crying and deep breaths have been strong enough to help move the fluid from his airways. The oxygen and gaseous distention of the lungs are the main stimuli for the pulmonary blood vessels to relax. As adequate oxygen enters the blood, the baby's skin turns from gray/blue to pink.

A baby who has made a normal transition at birth will be term with no meconium, will be crying or have unlabored breathing, and will have good muscle tone.

Figure 21: Baby who made normal transition

What can go wrong during transition?

A baby may have difficulty before labor, during labor, or after birth. If the difficulty begins in utero, either before or during labor, the problem will usually reflect a compromised blood flow in the placenta or the umbilical cord. The first clinical sign can be a slowing of the fetal heart rate. Problems encountered after birth are more likely to involve the baby's airway. The following are some of the problems that may disrupt normal transition:

- The baby may not breathe sufficiently to force fluid from the alveoli. Foreign material such as meconium may block air from entering the alveoli. As a result, the lungs will not fill with air, preventing oxygen from reaching the blood circulating through the lungs (hypoxemia).

- Excessive blood loss may occur, or there may be poor cardiac function or bradycardia (slow heart rate) from hypoxia (insufficient oxygen to the tissues) and ischemia (inadequate blood to part of the body caused by a blocked artery), so that the expected increase in blood pressure cannot occur (systemic hypotension).

- A lack of oxygen or failure of air to enter the lungs may result in the pulmonary arterioles staying constricted; these arterioles may then remain constricted, thus preventing oxygen from reaching body tissues. (persistent pulmonary hypertension)

- The consequence of inadequate blood perfusion and tissue oxygenation can be brain damage, damage to other organs, or death.

What are the signs of an abnormal transition?

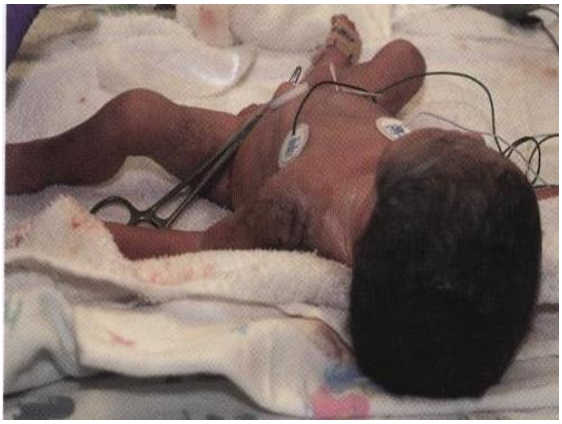


Figure 22: Signs of abnormal transition

The baby that has difficulty making a normal transition may exhibit one or more of the following clinical findings:

- Depression of respiratory drive (slow respiratory rate) from insufficient oxygen delivery to the brain
- Poor muscle tone from insufficient oxygen delivery to the brain and muscles

- Cyanosis (blue discoloration of the skin and mucous membranes) from insufficient oxygen in the blood
- Bradycardia (slow heart rate) from insufficient delivery of oxygen to the heart muscle or brain stem
- Poor perfusion from insufficient oxygen to the heart muscle, blood loss, or insufficient blood return from the placenta before or during birth
- Tachypnea (rapid respirations) from failure to absorb fetal lung fluid

Many of these same symptoms may also occur in other conditions, such as infection or hypoglycemia (low blood sugar), or if the baby's respiratory efforts have been depressed by medications, such as narcotics or general anesthetic agents, given to the mother before birth.

Why premature babies are at higher risk

Premature babies have anatomical and physiological characteristics that are quite different from babies born at term. Some of these characteristics are:

- Their lungs may be deficient in surfactant and, therefore, may be more difficult to ventilate. (Surfactant is a substance that lines the inside of the alveoli and prevents them from collapsing). When babies are born prematurely, prior to 34 weeks, they have decreased amounts or lack surfactant, therefore, they have difficulty breathing
- Their thin, permeable skin, large surface-area-to-body-mass ratio, and lack of subcutaneous fat make them more likely to lose heat and have problems with temperature regulation.
- They are more likely to be born with an infection.
- Their brains have very fragile capillaries that may bleed during periods of stress.
- They often have feeding problems

Caregivers should be aware of these and other unique characteristics of premature babies and the special challenges they may present during resuscitation.

Timing of Insult: Asphyxia can occur during antepartum, intrapartum or postpartum period. The following are ***risk factors*** for asphyxia.

Antepartal events (20%)

- Maternal hypotension
- Severe anemia
- Cardiopulmonary diseases
- Placental abruptio
- Maternal hypertension
- Preeclampsia/eclampsia
- Maternal diabetes

Intrapartum (70%)

- Problems with umbilical circulation (E.g. Cord prolapse)
- Meconium aspiration

- Prolonged labor (maternal/ fetal causes)

Postpartal Asphyxia (10%)

- Prematurity
- Cardiovascular abnormalities
- Pulmonary malformations
- Neurologic abnormalities
- Severe infections
- Bleeding, shock

Generally, risk factors for perinatal asphyxia can be classified as:

a. Impairment of maternal oxygenation
b. Decreased blood flow from mother to placenta
c. Decreased blood flow from placenta to fetus
d. Increased fetal oxygen requirement

Pathophysiology: When there are factors, which result in low oxygen delivery to the newborn, the initial response is increased respiratory rate followed by apnea. This is a critical time that newborns would require drying and stimulation. If asphyxia is prolonged the following two scenarios would happen.

- ***Brief asphyxia****:* There is transient increase followed by a decrease in heart rate, elevation of blood pressure and essentially, there will be redistribution of cardiac output. There will be **gasping respiration.** This is followed by increased blood flow to brain, heart and adrenal glands, which is referred to as **DIVING REFLEX.**

- ***Prolonged asphyxia****:* It leads to decreased blood flow with further compromisation of the heart cascaded by hypotension and increased anaerobic metabolism in the brain. Decreased cerebral flow with anaerobic metabolism later complicates energy failure, increased glucose metabolism and ATP depletion. The final outcome is diffuse cortical and sub cortical injury.

Organ manifestations of perinatal asphyxia

Central Nervous System Manifestations (28%)

Hypoxic Ischemic Encephalopathy**:** It is encephalopathy caused by hypoxic- ischemic mechanism as underlying cause for the encephalopathy.

Table 13: Clinical spectrums of HIE includes mild, moderate or severe according to Saranat stages of HIE

SIGNS	STAGE 1	STAGE 2	STAGE 3
Level of consciousness	Hyper alert	Lethargic	Stuporous, coma
Muscle tone	Normal	Hypotonic	Flaccid
Posture	Normal	Flexion	Decerebrate
Tendon reflexes/clonus	Hyperactive	Hyperactive	Absent
Myoclonus	Present	Present	Absent
Moro reflex	Strong	Weak	Absent
Pupils	Mydriasis	Miosis	Unequal, poor light reflex
Seizures	None	Common	Decerebration
Electroencephalographic findings	Normal	Low voltage changing to seizure activity	Burst suppression to isoelectric
Duration	<24 hr if progresses; otherwise, may remain normal	24 hr-14 days	Days to weeks
Outcome	Good	Variable	Death, severe deficits

Clinical manifestations other than CNS

- Renal failure: Oliguria (< 0.5ml/kg/hr
- Respiratory distress,
- Tachycardia
- Cardiomegaly
- Hepatomegaly
- Shock
- Necrotizing enterocolitis /Bloody stool
- Hypoglycemia
- Hypocalcemia

Laboratory evaluation

- CBC
- RBS
- Urine analysis
- Stool for blood
- Renal function
- Liver function test
- Echocardiography as needed
- Serum electrolytes,
- EEG
- CXR
- Brain imaging

Management of asphyxia in the newborn

I. Perinatal management of high risk pregnancies and early detection of fetal hypoxia
II. Neonatal resuscitation

Neonatal resuscitation means to revive or restore life to a baby.

Basic steps in resuscitation

The diagram below illustrates the relationship between resuscitation procedures and the number of newly born babies who need them. At the top are the procedures needed by all newborns. At the bottom are procedures needed by very few.

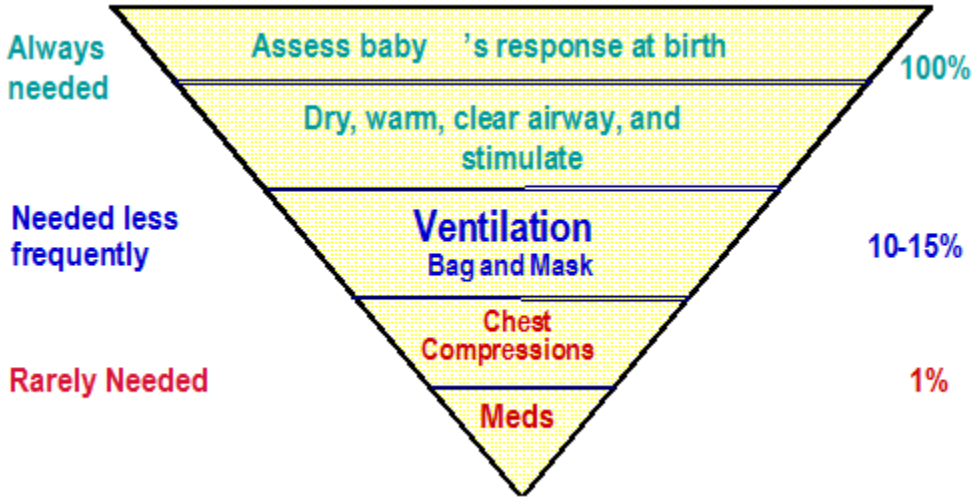


Figure 22: Steps in resuscitation

Risk factors associated with need for resuscitation

Maternal Risk Factors before Labor

Pre-eclampsia and eclampsia
Maternal infection (HIV, STD, Malaria)
Premature rupture of membranes
Post-term gestation
Maternal diabetes
Anemia
previous fetal or neonatal death
Multiple gestation
Diminished fetal activity
bleeding in second or third trimester
Age <16 or >35 years
No prenatal care

Risk Factors during Labor

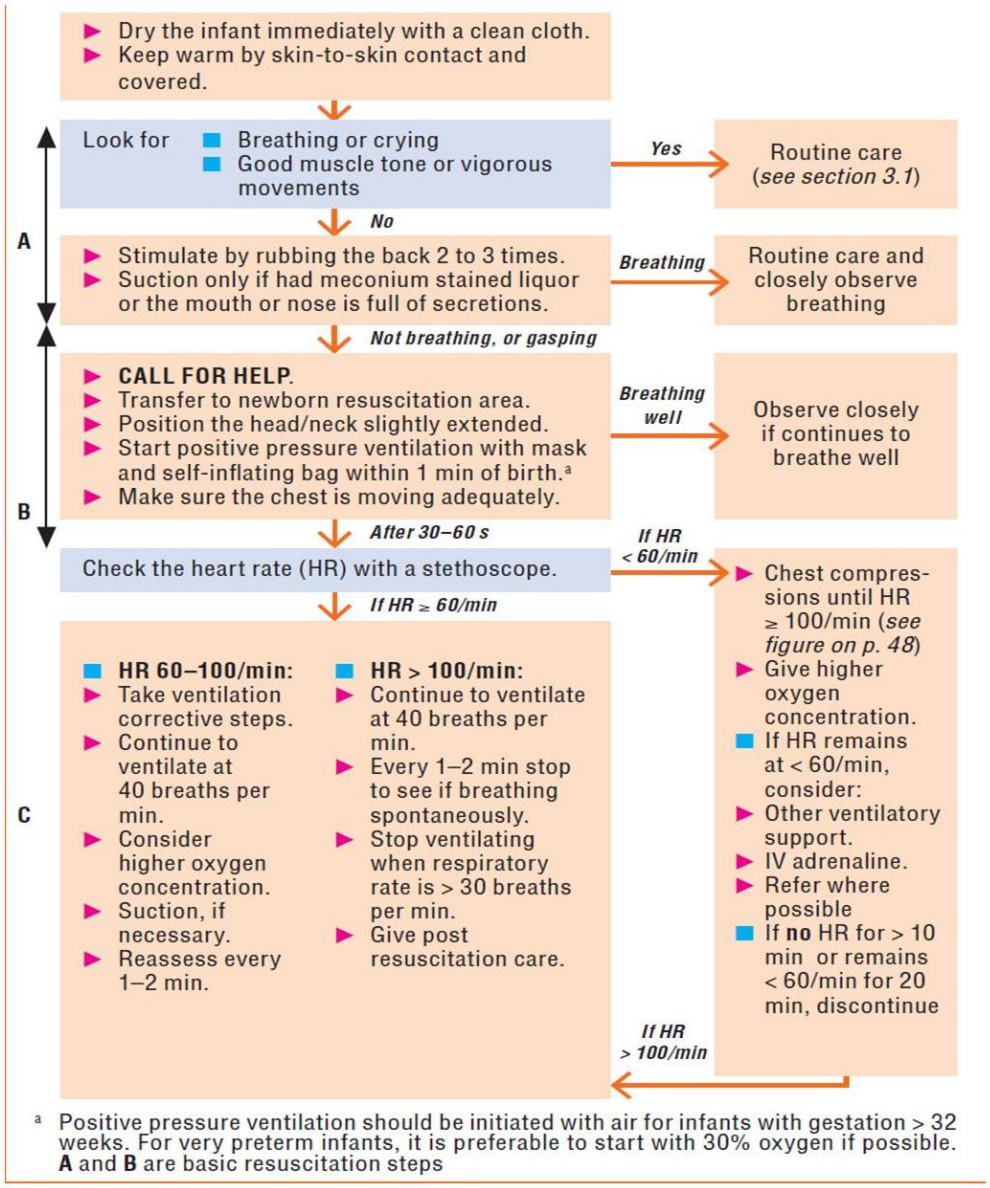
Foul smelling amniotic fluid
Prolonged rupture of membranes (>18 hours before delivery)
Prolonged labor (>24 hours)
Fetal bradycardia (slowing of heart rate)
Meconium
unusual vaginal bleeding before delivery
precipitous labor
Shoulder dystocia
Prolapsed cord
Forceps or vacuum-assisted delivery
Narcotics administered to mother

Maternal complications are often unpredictable, but newborn complications are usually predictable based on these factors. Therefore, it is usually possible to anticipate and prepare for resuscitation.

Neonatal resuscitation action plan

Neonatal resuscitation can be done using the action plan developed by WHO, the action plan is shown in the algorithm below.

Neonatal Resuscitation Flowchart



[a] Positive pressure ventilation should be initiated with air for infants with gestation > 32 weeks. For very preterm infants, it is preferable to start with 30% oxygen if possible.
A and **B** are basic resuscitation steps

Post Resuscitation Care

Infants who require resuscitation are at risk for deterioration after their vital signs have returned to normal. Once adequate ventilation and circulation has been established:

- Stop ventilation.
- Return to mother for skin-to-skin contact as soon as possible.
- Closely monitor breathing difficulties, signs of asphyxia and anticipate need for further care.

Cessation of resuscitation

It is appropriate to consider discontinuing after effective resuscitation efforts if:

- Infant is not breathing and heartbeat is not detectable beyond 10 min, stop resuscitation.
- If no spontaneous breathing and heart rate remains below 60/min after 20 min of effective resuscitation, discontinue active resuscitation.
- Record the event and explain to the mother or parents that the infant has died. Give them the infant to hold if they so wish.

III. Postnatal management of asphyxia

A. *Keep NPO* (because of risk of necrotizing enterocolitis, it can be for 48 hours).
- *Trophic feeding* could be started when the neonate is passing meconium, clear gastric content, normoactive bowel sound

B. *Fluid Management*- two third of the maintenance fluid (avoid both overload and inadequate circulating volume)

C. *Oxygenation* it should be maintained in the normal range(Saturation between 90-95%)

D. *Do not warm asphyxiated babies***.** Cooling therapy is the standard treatment for hypoxic ischemic encephalopathy. However, it is not feasible in Ethiopian setup.

E. *Correction of Metabolic States*-
- Blood glucose has to be kept in the normal range. *Hypoglycemia* is often seen in asphyxiated newborns. It increases energy deficit. It has to be treated with 2ml/kg of 10% dextrose 4ml/kg (in the presence of seizure) followed by maintenance.
- *Hypocalcemia* (can cause seizure and decreased cardiac contractility) administer 1-2ml/kg of 10% calcium gluconate QID

F. Seizure Treatment (refer to the guideline on seizure treatment)

Parent counseling has to be the integral part of management!

Prognosis of HIE

- ***Stage I* (mild HIE)** 98- 100% of newborns will have a normal neurological outcome and < 1% mortality
- ***Stage II* (moderate HIE)** 20-37% of them die or have abnormal neurodevelopmental outcome

- ***Stage III*** **(Severe HIE)** death is more likely survivors would have one or more major neurodevelopmental disability such as Cerebral palsy, intellectual disability, visual impairment or epilepsy.

Perinatal Asphyxia Follow up chart

The very important thing is anticipation of complications and act accordingly.

Perinatal Asphyxia Follow up chart

Parameters	Day1	Day2	Day 3
PR			
RR			
T^o			
SO2			
Wt			
HC			
Input			
Output			
Capillary refill			
RBS			
Urine analysis			
Serum electrolyte			
RFT			
LFT			
Gastric content			
Bowel sound			
Bloody stool			
Mental status			
Neonatal reflexes			
Motor tone			
Seizure			
Progressive patient Assessment			
Treatment plan			

References

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2. Neonatal resuscitation flow chart : Recommendation for Clinical practice of Emergency Obstetric al and neonatal care in Africa , Guide for Health care Provides, WHO, 2013.

Chapter 4: Thermoregulation

Course Objectives:

Neonatal thermoregulation

Newborn survival can be improved by prevention of excessive heat loss, which in turn reduces their bodies' need to perform heat-producing metabolic work.

After birth, newborns must adapt to the new and colder environment by metabolic production of heat since they lack adequate muscular activity (shivering response).

Heat loss can be minimized by keeping newborns in thermoneutral environment, which is defined as the narrow range of environmental temperature at which a given baby can maintain normal body temperature with minimum calorie (oxygen) consumption.

The normal body temperature is between 36.5^0C -37.5 ^{0}C. Hypothermia is defined as skin (axillary) temperature less than 36.5^0C.

In general, newborns are at risk of hypothermia because of their large surface area for small body mass and premature and LBW babies in particular for the following reasons.

- Highly permeable skin which increases epidermal water loss
- Deficient subcutaneous fat with less insulation
- Deficient stores of brown fat
- Immature central thermoregulation
- Poor caloric intake
- Poor oxygen consumption because of associated pulmonary problems

Newborns may lose heat by the following mechanisms

- **Convection** – where heat is lost from the skin to moving air.
- **Radiation** – where heat is dissipated from the baby to a colder object in the surrounding like to the floor, wall or window.
- **Conduction** – where the baby loses heat to the surface on which he or she lies.
- **Evaporation** – major cause of heat loss immediately after birth where water is evaporated from wet infants skin like evaporation from boiling water.

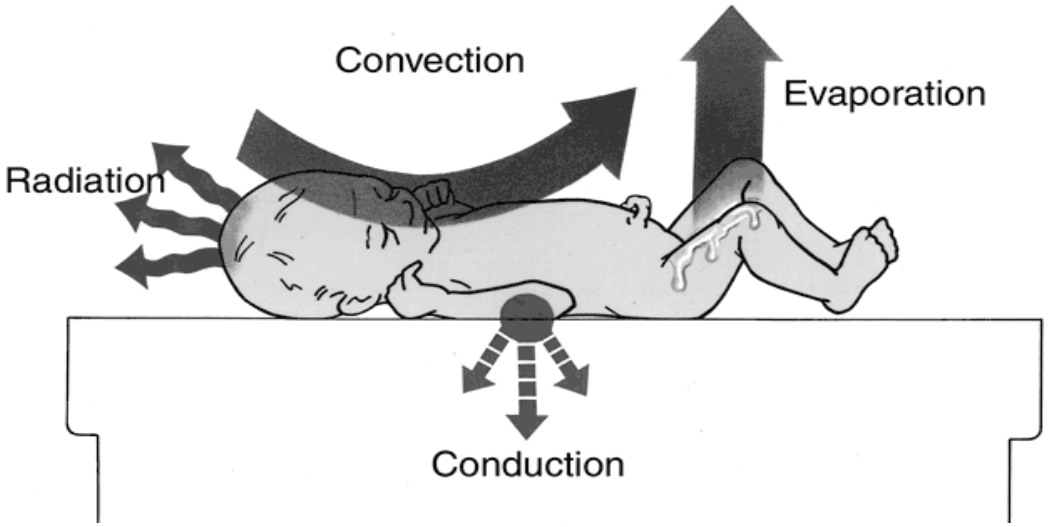


Figure 29: illustrating physical mechanisms of heat loss

Hypothermia

Classification

Based on its severity hypothermia could be:

- Mild (cold stress) = 36^0C -36.4^0C
- Moderate = 32^0C -$35.9\ ^0$C and
- Severe (neonatal cold injury) < 32^0C

Causes of hypothermia

- Cold environment/room
- Wet or naked baby
- Cold linen
- Transportation without proper precaution
- Procedures without thermal protection
- Early bath
- Sepsis
- Prematurity
- Hypoglycemia
- Hypoxia
- Congenital defects (gastroschisis, omphalocele, neural tube defects etc…)

Clinical manifestations

- Bluish discoloration of extremities (acrocyanosis)
- Cold and mottled extremities
- Sluggish and inactive neonate
- Unsatisfactory weight gain and slow increase in head size

Newborns with severe hypothermia may present with

- Hypoglycemia
- Failure to suck
- Bradycardia
- Disseminated intravascular coagulation
- Irregular and slow breathing
- Shock

Prevention

Before delivery

- Warm delivery room
- Organize newborn corner with adequate heat source

At delivery

- Deliver the baby on mother's abdomen
- Dry the baby thoroughly immediately after birth and remove wet clothes.
- Use cap to prevent significant heat loss through the scalp
- Keep the newborn in skin to skin contact with the mother
- Keep the newborn under pre heated radiant warmer – if need for resuscitation
- Cover weighing scales with warm towel
- Initiate early breast feeding

Subsequent care

- Arrange appropriate transportation if needed including KMC
- Postpone bathing (after 24 hours)
- Warm hands and stethoscope before touching the baby
- Do examination/resuscitation of the infant under the radiant warmer
- Practice rooming in wards/post natal rooms
- Keep the newborn away from windows and drafts
- Continue breast feeding

General management

- Identify and treat cause of hypothermia(disease process and environmental conditions)
- Put hypothermic infants on KMC, in incubators or under radiant warmer.
- Warm the new born slowly (*see management of severe hypothermia*)
- Monitor axillary temperature every 30 minutes till newborn temperature becomes stable
- Monitor environmental temperature

Management of newborns with severe hypothermia

- Warm the baby using a pre warmed radiant warmer.
- Remove cold or wet cloths.
- Cover the baby with warm clothes and hat.

- Treat for sepsis ,if present
- Measure blood glucose and treat if hypoglycemic.
- Keep IV line under the radiant warmer to warm the fluid.
- Measure the baby's temperature every hour.
- If the baby's temperature is increasing at least 0.5 °C per hour in the 1st three hours, re warming is successful.
- Then measure the baby's temperature every two hours.
- If the baby's temperature does not rise or is rising more slowly than 0.5 °C per hour, check and reset temperature of the warmer.
- Once the baby's temperature is normal , measure the temperature every three hours for 12 hours and then 12 hourly.
- Monitor for complications and manage accordingly
    - Look for respiratory problems
    - Monitor vital signs
    - Monitor urine output
    - Monitor blood sugars
    - Look for signs multi organ failure

Dangers of warmers

- Hyperthermia
- Dehydration
- Mask serious infections

Kangaroo mother care (KMC)

At the end of this session the learner will be able to:

- Effectively support mothers and caretakers to practice kangaroo mother care (KMC) by being able to
- Define KMC
- Describe KMC.
- Identify babies eligible for KMC.
- Explain and demonstrate steps of KMC.
- Effectively support the feeding of babies and monitor growth of babies during KMC

What is KMC?

Kangaroo mother care consists of skin-to-skin care of babies (usually low birth weight or very low birth weight). KMC also promotes early and exclusive breastfeeding, but may be used even when babies are formula fed.

The cornerstones of KMC

Kangaroo Position

Dress the baby in a nappy and cap and place in an upright position against the mother's bare chest, between her breasts and inside her blouse. One may use a special garment, or one can tuck the mother's blouse under the baby or into her waistband. Cover both mother and baby with a Gabi, blanket or jacket if it is cold. You too can be innovative.

Kangaroo Nutrition

Babies who are unable to suckle should be fed expressed breast milk via a nasogastric tube or cup if they can swallow. Keep babies in the KMC position whilst being tube fed. Allow them to try to suckle during the tube feed.

In the KMC position, babies will declare themselves ready to suckle, as their rooting and suckling reflexes become manifest. Once the baby is able to suckle, allow the baby to breast feed on demand but at least every three hours.

Kangaroo Support
It is very important to explain and demonstrate to the mother until she is motivated and confident to try the kangaroo position. Assist the mother with positioning and feeding, and give emotional support. The concept should be explained to other family members (especially the maternal grandmother), and they can also practice KMC (especially the father).

When to discharge from the hospital
Discharge when the baby has a sustained weight gain of at least 15 grams /kg /day. Bring the baby back for follow up in the next few days to ensure that baby is well and growing. It is advised practice to follow up KMC babies in a designated place.

Types of Kangaroo Mother Care

Intermittent KMC
This type of KMC is not done on a 24-hour basis but only for certain periods of the day. The mother stays at home or within the hospital but comes to the neonatal unit to do KMC at specified times; the newborn is left in an incubator for the remainder of the time. Intermittent KMC is mostly used for very small and sick babies, and/or for mothers who do not want or are not yet ready or able to practice continuous KMC. Examples include very LBW infants or mothers who are recovering from surgery (e. g., C-section). Intermittent KMC can be practiced while the baby is still in neonatal unit or delivery room . It is possible even with babies on oxygen and IV therapy. Frequency is determined by how stable baby is. A common sense approach is best.

Continuous KMC:
This is when KMC is practiced 24 hours every day (except for very short periods when the mother has to bathe or attend to other personal needs) and requires support from family members, including the husband. It is the ideal type of KMC for LBW babies. Continuous KMC can be instituted once the baby is stable, suckling well and needs no additional care. The baby can then be transferred to an adjoining KMC ward. Smaller babies may be able to go onto continuous KMC if they are stable and do not require oxygen.

Where do we do continuous KMC?
The KMC ward should be in close proximity to the Neonatal unit and under the supervision of the Neonatal staff, with 24-hour nursing coverage. The ward should be comfortable, homely and warm but not heated. There should be no crib

Who can provide Kangaroo Mother Care?

- Everyone can provide KMC as long as they understand the method and are motivated to practice it.

- All those who want to assist the mother can practice KMC, such as grandmothers, sisters, aunts, husbands, and even friends.

Duration of KMC

Both **Intermittent KMC and Continuous KMC** are practiced as long as possible until the baby no longer tolerates the method. Babies ,who outgrow KMC, become restless and will usually try to get out of the skin-to-skin position. Local KMC protocols may vary regarding the weight when babies are discharged from KMC follow-up. It is important to note, however, that babies should still be breastfed and kept warm even when KMC is no longer practiced.

How to practice kangaroo mother care

When to start KMC

KMC should be started when the small preterm or LBW baby is stable; otherwise it will have to be delayed. Exactly when KMC can begin depends on the condition and status of the baby and the mother. It is important, however, to encourage the mother to adopt KMC very early on.

Eligibility criteria for KMC

The following criteria should be used to decide whether a mother should begin KMC:

- The willingness of the mother to do KMC
- The baby should be in a stable condition:
  - ✓ No major illness present such as sepsis, pneumonia, meningitis, respiratory distress and convulsions.
  - ✓ Babies who have been started on antibiotics for suspected infection can start KMC as soon as they are stable.
  - ✓ Intermittent KMC can be used until the baby is fully stable.
- Babies under phototherapy may be evaluated to receive intermittent KMC.

Start KMC at your health facility or refer all LBW babies with a weight below 2000 grams to the nearest health facility with KMC services or to a higher level of care.

Positioning of the mother and baby

In KMC the baby, wearing only a nappy, socks and a hat, is held upright between the mother's breasts in continuous contact with her skin (skin-to- skin contact). The position of the baby against the mother's chest underneath the cloth should secure the position of the baby's head and neck.

Figure 31: Mother with baby in kangaroo position.

The mother covers her baby with her own clothes and an additional blanket or shawl to cover the baby. While resting, the mother should be in a comfortable, moderately inclined position at about a 30-degree angle, supported with pillows to keep her comfortable.

When the mother walks around, the baby is still kept upright by a cloth. It is important that the nappy is changed soon after wetting or soiling, not only for the comfort of mother and baby but to reduce the body's heat loss.

Keeping the baby in the KMC position can be demanding for the mother, as continuous KMC practice is a tiring job. To assist the mother when she is tired or is attending to personal needs such as bathing, other family members (such as husbands, grandmothers, mothers-in-law, or older siblings) can be taught how to care for the baby in the kangaroo position so they can give the mother relief when necessary.

Steps in positioning the baby for KMC:

1. Dress the baby in socks, a nappy, and a cap.
2. Place the baby between the mother's breasts.
3. Secure the baby on to the mother's chest with a cloth
4. Put a blanket or a shawl on top for additional warmth.
5. Instruct the mother to put on a front-opened top: a top that opens at the front to allow the face, chest, abdomen, arms and legs of the baby to remain in continuous skin-to-skin contact with the mother's chest and abdomen.
6. Instruct the mother to keep the baby upright when walking or sitting.
7. Advise the mother to have the baby in continuous skin-to-skin contact 24 hours a day (or less in the case of intermittent KMC).
8. Advise the mother to sleep in a half-sitting position in order to maintain the baby in a vertical position.

Figure 32: Position the baby for KMC. (Illustration adapted from *Home Based Life Saving Skills - Baby Information***.** Buffington, Sibley, Beck and Armbruster. 2004. American College of Nurse-Midwives. ISBN 0-914324-09-8.)

Figure 33: Securely wrap the baby with a cloth tied around the mother. (Illustration adapted from *Home Based Life Saving Skills - Baby Information***.** Buffington, Sibley, Beck and Armbruster. 2004. American College of Nurse-Midwives. ISBN 0-914324-09-8.)

Daily routine of a KMC Ward

Babies should be weighed daily, and feeds adjusted according to weight gain. If not yet breastfeeding on demand, they should receive 175ml/kg/day of expressed breast milk, in 8 feeds 3 hourly.

Babies on oxygen should have their oxygen saturation monitored 3 hourly.

Discharge from KMC position

Discharge from the kangaroo positions is usually determined by the babies themselves. When babies are about 40 weeks post menstrual or when their weight is about 2500 grams whichever comes first babies will not be comfortable in kangaroo position and moves a lot to indicate that they no more need the position. Then the health worker or the mother needs to discharge the baby from the kangaroo position by then.

Hyperthermia

It is less frequently seen when compared with hypothermia. It occurs when axillary temperature is above 37.5^{o}C.

Causes

- High environmental temperature
- Dehydration
- Infection
- CNS dysfunction and
- Medications

Signs of hyperthermia

- The newborn will be tachypneic
- Excessive sweating
- Flushed, bright and pink skin

When environmental temperature is the cause of hyperthermia, the trunk, extremities will have the same temperature, and the infant appears pink/vasodilated. But infants with sepsis are often vasoconstricted and the extremities are 2^0C to 3^0C colder than the trunk.

When high environmental temperature is suspected as a cause of fever, adjust room temperature, dress them with suitable clothing, expose them to room temperature or immerse them in tepid water and measure temperature.

Management

- Initiate early and frequent breast feeding
- Keep the baby away from source of excessive heat
- Remove extra cloths
- Look for possible causes including infections and treat accordingly.

N.B

- Do not use antipyretics as initial treatment.
- Do not rash to start antibiotics before ruling out other causes

Chapter 5: Prematurity

Learning Objectives

At the end of this session, the participants should be able to:

- Define prematurity
- Recall the challenges faced after delivery
- Identify risk factors for premature delivery and
- Recognize common problems in preterm newborns

Definition: A newborn delivered before a gestational age of completed 37 weeks (259 days).

Premature newborns have many physiologic challenges when adapting to the extra uterine environment. They additionally have a higher morbidity and mortality when compared to full term (37-42 Gestational Weeks) newborns. Preterm delivery accounts for 75-80% of all neonatal morbidity and mortality.

Causes: prematurity is associated with the following conditions –

- Low socioeconomic status
- Acute or chronic maternal illnesses
- Multiple pregnancy
- Maternal age less than 20 or greater than 35
- Obstetrics factors (hypertensive disorders, Antepartum hemorrhage, cervical incompetence, uterine anomalies)
- Maternal physical stress
- Trauma

Common Problems of Prematurity

Most of the problems of prematurity are related to difficulty in extra uterine adaptation due to immaturity of organ systems. Common problems as follows:

1. Respiratory
    A. Respiratory distress syndrome (RDS)
    B. Apnea of prematurity
2. Neurologic
    A. Respiratory center depression
    B. Intra cranial hemorrhage
3. Cardiovascular
    A. Hypotension (due to hypovolemia, sepsis, cardiac problems)
    B. Patent ductus arteriosus (PDA)
4. Hematologic
    A. Anemia
    B. Hyperbilirubinemia

5. Nutritional and Gastrointestinal
    A. Content, amount and route of feeding problem
    B. Necrotizing enterocolitis (NEC)
6. Metabolic
    A. Hypo or hyperglycemia
    B. Fluid and electrolyte imbalance
7. Renal – low glomerular filtration rate and inability to handle water and solute loads
8. Temperature regulation
9. Immunologic – immature immune defenses
10. Ophthalmologic – retinopathy of prematurity (ROP)

Hyaline membrane disease (RDS type 1)

Primarily, it is caused by immaturity of the lung (lack of adequate surfactant substance, which prevents collapse of alveoli at the end of expiration).

Epidemiology

Most cases of hyaline membrane disease occur in babies born before 37 weeks of gestation. Incidence is inversely related to gestational age and birth weight. It is uncommon in full term babies. The incidence based on gestational age is as follows:

- Less than 28 weeks 60 – 80%,
- 32-36 weeks 15-35% in
- >37 weeks 5%.

Uncomplicated course characterized by peak severity at 1-3 days. Onset of recovery is at 72 hrs.

Risk factors:

- Low gestational age, low birth weight, Male predominance, maternal diabetes, perinatal asphyxia, elective caesarian section

Clinical manifestations

- Respiratory distress (Grunting, flaring, retraction, tachypnea)
- Auscultatory findings – markedly decreased air entry bilaterally
- Cyanosis

Investigation

- CBC, chest X-ray, if possible blood gas analysis, septic work up, oxygen saturation

Prevention

- Antenatal corticosteroids (at least 24-48 hrs before delivery) given to pregnant women < 34 weeks of gestational period

- Prevention of preterm delivery

Management

- Nasal CPAP with continuous monitoring (see Neonatal Procedure)
- Fluid and metabolic management
- Surfactant substance administration

Complication and Prognosis

- Air leaks (pneumothorax, pneumomediastinum)
- Intracranial bleeding, pulmonary hemorrhage
- Bronchopulmonary dysplasia
- Retinopathy of prematurity

APNEA

It is a disorder of respiratory control characterized by absence of air flow for ≥20 seconds or less than that if it is accompanied by bradycardia (heart rate <100/min) or cyanosis. It is classified in to three types:

1. Central – no airflow, no respiratory efforts
2. Obstructive – no airflow, despite respiratory efforts
3. Mixed – often begins as central and later becomes obstructive

It commonly occurs in premature newborns due to immaturity of brain functions and generally begins 1 or 2 days after birth. In term newborns, it occurs in association with serious identifiable causes.

Etiology

- Prematurity, infection, metabolic abnormalities
- Hypoxemia, anemia, hypo or hyperthermia
- Gastroesophageal reflux
- Upper airway malformations (TEF)

Prevention

- Maintain normal hematocrit, electrolytes and PaO2
- Avoid neck flexion and abdominal distension
- Kangaroo Mother Care (KMC)

Management

- Methylxanthines
    - Aminophylline
        - Loading dose 8mg/kg IV infusion over 30 minutes.
        - Maintenance – 1.5 to 3mg/kg IV every 8 to 12 hours.
    - Caffeine – loading dose 20 to 25mg/kg IV Slow Push every 24 hrs
- CPAP
- Kangaroo mother care
- Maintain normal hematocrit, electrolytes and PaO_2
- Avoid neck flexion and abdominal distension
- Treat underlying etiology

Necrotizing Enterocolitis (NEC)

NEC is an acute intestinal necrosis syndrome of unknown etiology. Prematurity is the single greatest risk factor. It is a most common serious surgical disorder among newborns and is a significant cause of neonatal morbidity and mortality. Premature newborns tend to get NEC later compared with full terms. The most commonly affected part is the terminal ileum and proximal colon parts of intestine.

Commonly the onset of NEC is related with gestational age and is as follows:

- In <31 weeks onset is 23rd day
- >31 weeks – 11 days
- Full term – 3rd day

Risk Factors

It has multifactorial associations listed as follows the final result being activation of an inflammatory cascade:

- Feeding (Trophic phase should always be considered)
- Prematurity: immature host defense, immature regulation of circulation
- Formula feeding: 90 to 95% affected neonates had been fed formula, decreased risk with breast milk
- Intestinal ischemia
- Abnormal bacterial colonization: reduced number of bacterial species after antibiotic therapy

Clinical manifestations

- Abdominal distention, feeding intolerance, vomiting, blood in stool, loose stools, abdominal wall erythema, systemic instability

Investigations

- CBC (Leucopenia, thrombocytopenia)
- Serum Electrolytes (Hyponatremia, hypokalemia, metabolic acidosis)
- Disseminated intravascular coagulopathy (DIC)
- Glucose instability
- Plain abdominal X-ray (prone with lateral or decubitus)
    - Pneumatosis intestinalis, dilated loops, thickened bowel wall, ileus, pneumoperitoneum

Management of NEC (Refer table below)

Table 11: Management of NEC

Bell staging criteria	**Diagnosis**	**Management (usual attention to respiratory, cardiovascular and hematologic resuscitation presumed)**
Stage I (suspect)	Clinical signs and symptoms Non-diagnostic radiograph	• NPO with IV fluids • Nasogastric drainage • CBC, electrolytes, Serial Abdominal x-ray • Blood culture • Stool heme test and Clinitest • Ampicillin and gentamicin × 48 hours
Stage II (definite)	Clinical signs and symptoms Pneumatosis intestinalis on radiograph	• NPO with parenteral nutrition (by CVL once sepsis ruled out) • Nasogastric drainage • CBC, electrolytes, Abdominal x-ray, Blood culture • Stool heme test and Clinitest • Ampicillin, gentamicin and clindamycin × 14 days • Surgical consultation
Stage III (Advanced)	Clinical signs and symptoms Critically ill Pneumatosis intestinalis or pneumoperitoneum on radiograph	• NPO with parenteral nutrition (by CVL once sepsis ruled out) • Nasogastric drainage • CBC, electrolytes, Abdominal x-ray Stool heme test and Clinitest • Ampicillin, gentamicin, and clindamycin × 14 days • Surgical consultation with intervention, if indicated: • Resection with enterostomy or primary anastomosis • In selected cases (usually <1,000 g and unstable), bedside drainage under local anesthesia
AP = anteroposterior; CBC = complete blood count, CVL = central venous line; NPO = nothing by mouth.		

N.B. Ampicillin (or penicillin) plus gentamicin plus metronidazole for 10 days is an alternative management (pocket book of hospital care for children; 2nd ed.WHO, 2013)

Complication and prognosis

- Sepsis
- Intestinal strictures,
- Short bowel syndrome,
- Neurodevelopmental delay
- Mortality 30 to 40%
- Recurrence (6%)

Chapter 6: Nutrition: Breastfeeding & Feeding other than breast milk

Introduction: Numerous Socio-economic and cultural factors influence pattern of newborn and infant feeding. Though, Ethiopia is breast feeding nation:

- Only 50% of children born in the past 3 consecutive years were breastfed for 25 months.
- 52% of infants less than 6 months old are exclusively breastfed.
- Complementary feeding is not introduced in timely fashion; only 50% of infants receive complementary feeding at 6-9 months of age.
- 4% of children fed appropriately at 6-59 month based on recommended practice.

Learning objectives:

By the end of this session, participants will be able to:

- Describe benefits of breast feeding
- Give counselling and support about breast feeding and lactation to mothers
- Promote breast feeding practices
- Identify and manage feeding problems
- Initiate preterm feeding and maintain
- Manage mothers with breast problems

Ten steps for successful feeding: "WHO-UNICEF Baby-Friendly Hospital Initiative/*BFHI"*

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

Energy requirement by a newborn

- Energy is needed for Resting metabolic rate, Activity, Thermoregulation, food processing.
- Energy is measured by calorie.
- Recommended daily Calorie for newborn is 100 – 135 kcal/kg/day
- The calorie requirement for preterm, EVLBW and SGA infants is higher (120-150Kcal/kg/day)

- When baby is sick – (fever, sepsis, hypoxia) Calorie requirement increases by 10 – 30Kcal/kg/day

Protein requirement by newborn

- Generally, Newborn needs more protein per unit of weight than adult
- Preterm needs more protein per body weight per day than term newborn.

Table 5: Protein requirement of newborn

Weight (grams)	**g/kg/day**	**g/100kcal**
< 1000	4.0 – 4.5	3.6 – 4.1
1000 – 1800	3.5 – 4.0	3.2 – 3.6
1800 – 2200	3.4	2.6
> 2200 (term)	1.3 – 1.4	1.3 – 1.4

Human milk (Human breast milk)

- Is uniquely adapted to infant's needs
- Is the most appropriate natural milk for infants. It contains carbohydrates, proteins, fat, water, vitamins and minerals.

Table 6: Major constituents of mature human milk

Component	**Value**	**Remarks**
Calorie (kal/dl)	67	-
Protein (g/dl)	1.1 – 1.3	7 – 10 % of Calories
Fat (g/dl)	3.8 - 4.5	~ 50 % of Calories
CHO (g/dl)	6.8	~ 40 % of Calories

Benefits or advantages of breast milk and breast milk feeding

Benefit to newborn

- Provides ideal nutrients for the newborn
- Provides nutrients which are readily digested, absorbed and metabolized
- Promote bonding
- Promote improved behavioural and neurodevelopment including IQ.
- Provides protection against various diseases such as (diarrhea, pneumonia, otitis media, meningitis, urinary tract infection etc) because breast milk consists Immunologic and antibacterial factors such as - (Secretory IgA, complements, Bactericidal enzymes, macrophages, lymphocytes)
- It also promotes growth of Lactobacilli (it protects colonisation by pathogenic bacteria)
- Promotes long term health (protecting from obesity, hypertension, T-I diabetes mellitus, cardiac disease, allergic diseases).

Benefits to the mother

- Most Economical – low cost, no need to prepare it, always clean, available and ready to feed
- Gives her a sense of confidence and feeling of self sufficient to feed her baby
- Protect post-partum haemorrhage (promote contraction and early involution of uterus)
- Family planning (child spacing)
- Protection against breast and cervical cancers

Compositions of Human milk at different stages

Colostrum

- The first and yellow milk after delivery
- May last till 1 week
- Is more immunogenic (1st immunization of the newborn)
- Have higher protein & electrolyte content than mature milk
- It has lower quantity, which is adequate for newborn.

Transitional milk

- Produced after 2nd week.
- Its protein and immunologic content is relatively lower than colostrum but higher than mature milk
- Better quantity when compared with colostrum
- Color become more whiter than colostrum

Mature milk

- Produced after transitional milk usually 2 – 3 weeks after delivery
- The color is whiter, relatively thinner, have higher CHO and fat content but lower protein and immunologic components than transitional milk.
- Nevertheless, it is complete and provides all what newborn needs.

Premature milk

- produced by mother who delivered preterm
- It consists of increased protein and electrolytes (Na, Cl, Mg) than mature milk

NB – All components of milk have Foremilk and Hind milk

- ***Foremilk*** is the 1st milk coming during each feeding; it is richer with CHO & Proteins
- ***Hind milk*** is the milk coming at the end of each feeding; it is richer with Fats

Considerations in feeding*:*

Healthy term and late preterm newborns can be fed directly on breast successfully. Many low-birth-weight infants will be able to suckle at the breast. Infants who can suckle should be breastfed. Those who cannot breastfeed should be given expressed breast milk with a cup and spoon. When the infant is sucking well at the breast and gaining weight, reduce the cup feeds. Infants unable to feed from a cup and spoon should be given intermittent bolus feeds through a gastric tube.

NGT, OGT, CUP is used:
- If baby is in respiratory distress esp. RR > 75/min, NGT is preferable
- If baby is less than 34 weeks of GA (< 1550grams), use cup or NGT/OGT.
- If baby is very sick & unable to suck or swallow, use NGT

Assessing the mother's feeding option: discuss with the mother on the best feeding options

Mother may be well prepared during ANC follow up and already decided what to feed her baby. Before counselling, try to get important ideas about what the mother decided to feed her newborn
- She might decide to feed breast milk. If so encourage and support this decision.
- She might decide to feed other than breast milk.
    - Analyse her reasoning, discuss about the preferred feed and breast-feeding in detail.
    - Compare and contrast and come in to agreement
    - If mother is persisting on her decision, respect her decision

Mother may not come to decision what to feed her newborn
- Assess maternal health status or any contraindications
- Discuss for the best feeding options
- Discuss about breast feeding, its benefit to the baby and to herself
- Encourage her to decide
- Appreciate and support her decision

A. *Feeding term and late preterm infants (gestational age ≥ 34 weeks)*

Start feeding within 1st hour of life
- This period is important period for establishment of bonding
- Is basis for future milk production
- Prevent hypoglycemia

Feeding position
- Mother must be relaxed, emotionally and psychologically ready for breast feeding
- Mother must be in a such way that she is comfortable to breast feed her baby

Proper feeding position of baby *includes* (See pictures below)
- Infant's whole body supported
- Head and body straight
- Infant facing mother
- Infants body touching mother's abdomen

Figure 4: American football position. This type of position avoids maternal belly's preclusion of proper feeding. It is especially used in mothers having, C/S, multiple deliveries

Figure 5: Cradle position (sitting position). This is the usual or classical position, it enable mother to support baby well. To make, both mother and baby remain more comfortable, mother can use special pillows to support the baby. In this way, one hand becomes free so that she can support baby well.

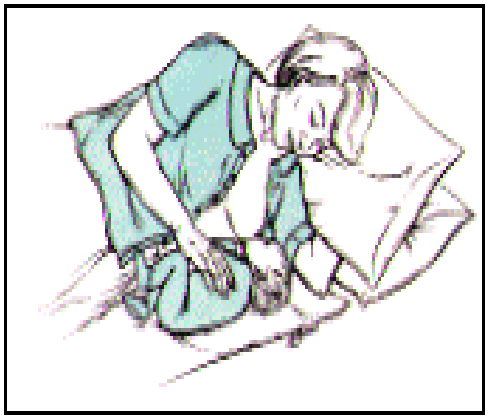


Figure 6: Both mother and baby lying position. This type of position also enable mother to nurse baby confortably while she is resting. Usually uesd by mother who is tyred, sick or had C/S. It needs close observation

Checking for attachment*:* in order for the baby to have effective feeding, good attachments are required. Good attachment means:-

- The baby's mouth should wide open
- Lower lips everted out
- More areola seen on upper part of breast
- Chin of baby should touch the breast

Initiating latching on

- See following pictures
- Mother having good grasp of her breast (avoid grasping areola part) and bringing to touch. Baby's upper lip, stimulates the baby to open mouth.

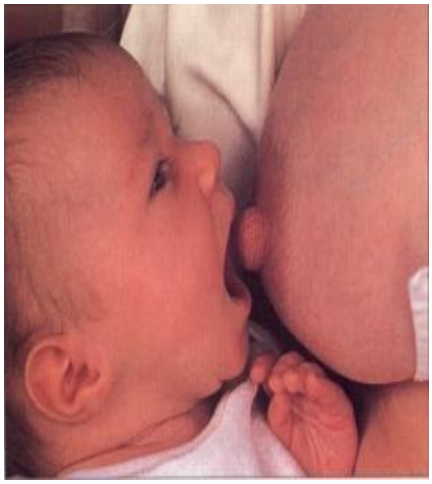


Figure 7: Stimulation of baby for feeding. While baby is opening his/her moth, mother approximating herself and draw the breast into infant's open mouth

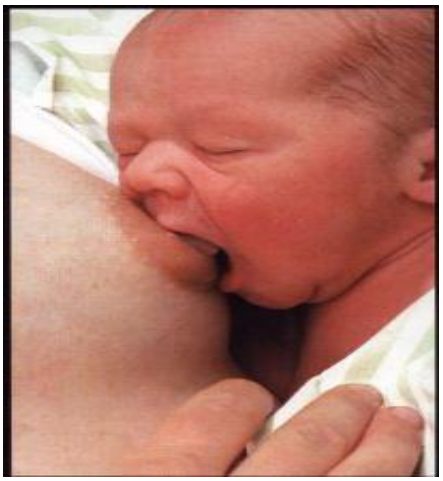


Figure 8. If baby is not stimulated and not opening mouth, it is still possible to stimulate. Tap on the cheek, or corner of mouth so that baby rooting in search of stimulus and opens mouth. Look that baby's mouth deviated towards stimulus.

Figure 9: Baby latching on with good attachment

Optimal Breastfeeding practice

- Newborn is fed 2-3 hourly intervals day and night
- Baby is dry, not too cold or not too warm and is hungry
- Should be fed day and night and fed at any time on demand
- Must be fed exclusively with no water or fluid or any solid is added.
- Nothing else is given per oral except medication ordered by his doctor.
- Avoid pacifiers, dummies, bottle
- Let baby complete one breast before switching to the other breast
- Start next feeding on the breast that was fed on last in the preceding feeding
- This exclusively feeding is continued till 1st 6 months of baby life and is adequate to support growth.
- Explain and encourage her to start semi-solid or solid complementary diet at 6 months with breast feeding continued.

***Clues for* adequate *breast-feeding* include:**

- At least 3-5 strong suckling before pausing for breath or rest
- Dimpling of cheeks may be seen while suckling
- Hearing of swallowing gurgle
- Milk may be seen around the mouth leaking out when it is excess

Well and adequately fed baby will be satisfied and

- Go asleep for 2- 4 hours between each feedings
- Will have frequent wet diapers (at least 6 times) indicating that baby has adequate urine.
- Increase weight daily after 7 postnatal days (20 – 30 gm/kg/day). In the 1st 7 postnatal days baby tend to lose 10% of birth weight. This is normal physiology.

Identify feeding problems or feeding difficulties.

Mother may worry that she is not producing enough milk for her baby. Reassure, encourage, support the mother and **explain** that

- In the first 1-2 weeks after delivery the amount of milk produced is lower
- Volume of milk produced will increase after 2-3 weeks of delivery
- Mothers despite difference in, age, body size, breast size, parity, gestation, mode of delivery (SVD or C/S), size or number of babies, socio-economic condition have potential to produce adequate milk her baby/babies.
- Effective, regular **suckling** of the breast by the baby is important stimulus for milk production
- Letting baby to empty breast during each feeding, allows milk to refill for next feed
- Mother should be relaxed, emotionally and psychologically stable
- Mother must get adequate rest, take more fluids & nutritious feedings and also take micronutrients for herself. Maternal nutrition is important to produce more milk and prevent maternal malnutrition

Mother may be concerned if she is on medication

- Drugs can be passed to the milk to some extent BUT most drugs are safe and will not limit breast feeding
- But only few drugs, which are rarely used in our community are toxic

Table 7: Common breastfeeding problems

Difficulty or Condition	Cause &Prevention	Solutions
a. Problems related to the mother		
Engorgement	- Usually occurs within 3-5days as result of copious milk production - Initiating Breastfeeding immediately after birth and Regular and frequent (2-3hrly) decreases its occurrence	- Apply cold compression on the breasts to reduce swelling; apply warm compression to "get milk flowing." - Decrease by expressing some milk, massage areola - Improve infant positioning and attachment - Breastfeed more frequently and regularly (2-3hrly) - Let baby to finish one breast at a time
Sore or Cracked Nipples	- Mainly results from increased surface tension by act of suckling especially improper position & attachment - Correct positioning, attachment and latching on decreases its occurrence	- Make sure baby is positioned well at the breast - Make sure baby latches on to the breast correctly - Apply drops of breast milk to nipples and allow to air dry in between feeds. - Whenever you want to remove the baby from the breast, break suckling first with your small finger sliding at the corner of the baby's mouth. - Begin to breastfeed on the side that hurts less - Do not use soap or cream on nipples
Plugged Ducts and Mastitis	- Mastitis is acute onset of inflammatory &/or infectious origin, presenting with fatigue, head ache, fever, breast fullness and tenderness - Sore or cracked nipple predispose - Proper technique & skill of feeding minimizes the	- Apply heat & massage before the start of breastfeeding - Increase mother's fluid intake - Advice mother to get adequate rest - Seek medical treatment; analgesics and antibiotics may be necessary for 10-14 days - Continue breastfeeding with proper positioning & attachment.

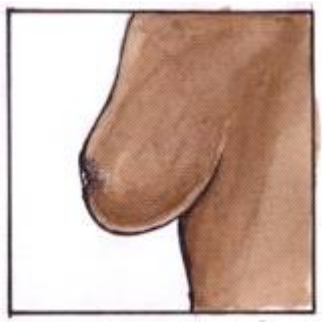
Difficulty or Condition	Cause &Prevention	Solutions
	occurrence - Avoid holding the breast in scissors hold. sleeping on stomach and tight clothing	- If mother is HIV-positive: express milk and heat-treat or discard.
Breast abscess	- If mastitis is not treated lead to abscess - Early recognition and proper treatment of mastitis	- Drainage of abscess - Proper antibiotics - Continue breastfeeding on unaffected breast till improvement
inverted nipple	- Poor antenatal preparation - Proper nipple management during antenatal follow up - Try to pull nipple out and rotate (like turning the knob on a radio). - Make a hole in the nipple area of a bra that the mother is wearing so that the nipple protrudes through the opening.	- Help mother stretching and pulling out of nipple using cut & turned up syringe - Do this repeatedly - See picture-------- (below the table)
b. Problems related to the baby		
Sleepy baby	- Always suspect rule out illness	- Do not allow otherwise healthy baby to sleep for more than 4 hours. - Unwrap, pick and hold upright till fully alert before offering breast
Refusing suckling or crying	- Improper feeding techniques - Mouth ulcers, thrushes, pain in site of birth trauma, wetting or pain at the diaper area	- Always look for secondary reasons why baby is refusing feeding or crying - Check for positioning and attachments, re- correct if any. - Check for mouth ulcers, thrushes, pain site, diaper area correct or sick treatment - Discourage pacifier or bottle
Suckling difficulties	- Tongue tie, craniofacial anomalies like cleft palate, Pierre-Robin sequence or choanal stenosis/atresia, respiratory problems may be results in feeding problems	- If tongue tie is a problem for suckling surgical correction is considered - Cleft palate, Pierre-Robin sequence:- modified positioning, obturator, nipple shield is used. - Breathing problems secondary to choanal stenosis: - consulting ENT specialist is needed

Difficulty or Condition	Cause &Prevention	Solutions
regurgitation and vomiting	- Regurgitation is return of some of ingested milk during or immediately after feeding. Can be reduced by gentle handling or placing baby on his/her right side after each feeding help **eructation** of swallowed gas - Vomiting is emptying out of gastric content and always needs careful evaluation of the baby.	- Explain well on techniques of eructation after each feeding - If vomiting, always sick medical evaluation of the baby.

Table 8: Special considerations

Special Situation	Solutions
Sick baby	- Baby **under 6 months:** If the baby has diarrhoea or fever the mother should breastfeed exclusively and frequently to avoid dehydration or malnutrition. - Breast milk contains water, sugar and salts in adequate quantities, which will help the baby recover quickly from diarrhoea. - If the baby has severe diarrhoea and shows any signs of dehydration, the mother should continue to breastfeed and provide ORS with spoon or cup. - Baby **older than 6 months:** If the baby has diarrhoea or fever, the mother should breastfeed frequently to avoid dehydration or malnutrition. She should also offer the baby bland food (even if the baby is not hungry). - If the baby has severe diarrhoea and shows any signs of dehydration, the mother should continue to breastfeed and add ORS.
Sick mother	- When the mother is suffering from headaches, backaches, colds, diarrhoea, or any other common illness, she SHOULD CONTINUE TO BREASTFEED HER BABY. - The mother needs to rest and drink a large amount of fluids to help her recover. - If mother does not get better, she should consult a doctor and tell the doctor that she is breastfeeding.
Mother who is expressing breast for different	- Refer to the title '**Expressing breast milk'** for details and techniques bellow

Special Situation	Solutions
reason	
HIV-positive mother who chooses to breastfeed	- Mother should practice exclusive breastfeeding for 6 months. At 6 months mother should introduce appropriate complementary foods. - Mother who experiences breast difficulties such as mastitis, cracked nipples, or breast abscess should breastfeed with the unaffected breast, express, and discard milk from the affected breast. - Mother should seek immediate care for a baby with thrush or oral lesions. - Mother who presents with AIDS-related conditions (prolonged fever, severe cough or diarrhoea, or pneumonia) should visit a health centre immediately. **Note: Lactating woman should use condoms to protect herself from exposure to infected semen.**
HIV-positive mother who chooses to replacement feed	- Mother should practice safe and appropriate use of infant formula exclusively for the first 6 months. Encourage to use cup, discourage bottle - Mother should NOT mix-feed – "give only breast milk substitutes, do not breastfeed".



Inverted nipple

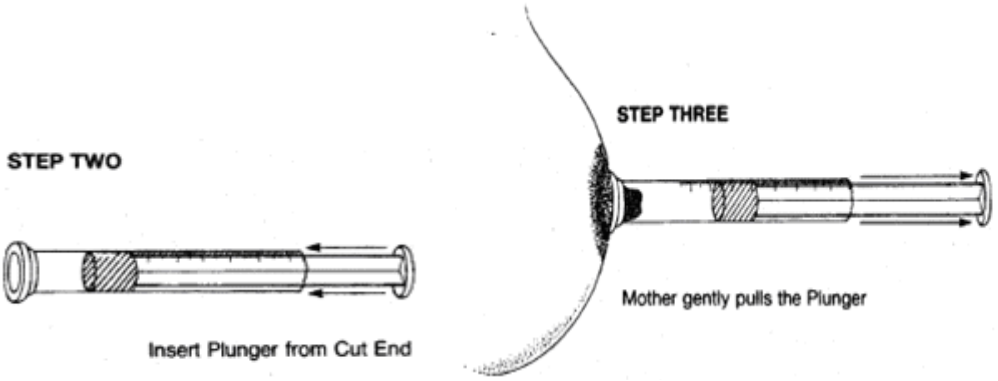


Figure 10: How to manage inverted nipple

B. Feeding preterm newborns (G/A < 34wks)

Nutritional requirement of preterm*:* To attain fast growth and prevent tissue lose, preterm need relatively high nutrients. Table 9 presents protein and energy requirements of premature babies.

Table 9: Protein and energy requirements of premature newborns

Body weight (gm)	Protein (gm/kg/d)	Energy (kcal/kg/d)	Protein/Energy (gm/100kcal)
500 – 700	4.0	105	3.8
700 – 900	4.0	108	3.7
900 – 1200	4.0	119	3.4
1200 – 1500	3.9	125	3.1
1500 – 1800	3.6	128	2.8
1800 – 2200	3.4	131	2.6
Adapted from Ziegler EE, J ped.GI nut 45, 170, 2007			

Source of nutrition for preterm*:*

Human milk (breast milk): Is the primary nutritional source for premature infant

- Premature milk is specially adapted to preterm
- Well tolerated
- Improved gastric emptying
- Reduced NEC and infections
- Possibly better neurocognitive development

For effective Expressing breast milk see below under 'C' with pictures

Feeding schedule of preterm infant*:*

How to feed preterm newborns

- Suckling, swallowing reflexes and coordination with breathing are not well developed
- The newborn might be in respiratory distress or on ventilator
  Therefore → Use NGT, OGT or cup to feed

When to start feeding in preterm newborns

- Feeding should not be delayed once baby is stabilized, usually starting from1st day.
- The 1st feed is called priming or trophic feeding
- It is intended not to provide nutrients to support growth, rather is to facilitate maturation and keep integrity of preterm gut
- Early priming facilitate tolerance and early achievement of full feeding

How to advance daily to full feeding:

The goal is to achieve – Volume: 140 – 150 ml/kg/day & Calorie: 110 – 120 kcal/kg/day

- Infants weighing < 1.5 kg at birth are at the highest risk of feeding problems and necrotizing enterocolitis. The smaller the infant, the higher the risk Initial volume to start is 2ml/kg/feed as trophic.
- Starting on the first day, give 10 ml/kg per day of enteral feeds, preferably expressed breast milk, with the remaining fluid requirement at 50 ml/kg per day met by IV fluids. The frequency of giving per day varies based on birth weight and or baby's tolerance
- The guide to proceed the next feed is baby's tolerance
- Usually is three or four times per day
- Advancement per day shouldn't exceed 20ml/kg/day see Table 10 for detail
- After full volume feeding is achieved, frequency of feeding is every 2 - 3 hourly
- If the infant is well and active and not receiving IV fluids, give 2–4 ml of expressed breast milk every 2 h through a nasogastric tube, depending on the weight of the infant

Table 10: Recommendation for initiation and advancement of preterm feeding

Gestational age (weeks)	**Volume of initial Feed (ml/kg)**	**Rate of feeding**		
		frequency	**Advancement**	
24 – 26	2	6 – 8 hours	Non for 5 – 7 days	10 -15 ml/k/d
26 – 28	2	6 – 8 hours	Non for 3 – 5 days	10 – 20 ml/k/d
28 – 32	2	6 – 8 hours	As tolerated	Aim full feed at 7 postnatal day

NG Tube Feeding

- Use bolus over 20 – 25 minute
- Avoid injecting the milk rapidly. Results gastric distension and intolerance
- Avoid continuous pouring of the milk. Enhances bacterial colonization

Further, follow up of feeding

- Check whether the previously administered milk is emptied before next bolus is given by sucking out gastric content (e.g. If the preterm newborn is getting 10ml every two hours and then if there is retained 5ml, you need to add only 5ml to make a total of 10ml).
- Look for any signs of intolerance
    - Presence of 1/3 or more milk residual during the next feed
    - Vomiting or presence of any gastric content
    - Abdominal distension (decreased or bowel sounds)
    - Blood in stools or diarrheal stools
    - Temperature instability
    - Presence of apnea or respiratory distress
    - Hyperglycemia or metabolic acidosis

If any of signs of intolerance is seen or baby is hypothermic, feeding should be temporarily withheld and serious problems like NEC should be ruled out. Keep baby with IV fluid.

Assessing for adequacy of preterm feeding*:* Remember what we have discussed earlier in the feeding of term & late preterm infant

- Check for adequate urine passage. Usually passage of more than 6 times per day is fair
- Check weight daily. There will be initial about 15% lose of birth weight. In the 1st week.
    - Accepted weight gain in preterm is 15 – 20gm/kg/day until 2kg is reached then in average weight gain is 20 – 30gm/kg/day
    - Once the baby achieved weight of 2 – 2.5 kg, feeding can be switched to full breast milk or preterm formula

Addition of vitamins and minerals

- Preterm is particularly at risk for Iron deficiency anaemia and vitamin D deficiency
- Start Iron drops. Elemental Iron 3mg/kg/day starting from 3rd – 4th weeks of life
- Vitamin D 150 – 400IU. Giving 2 ml/day of cod liver oil (seven seas without vitamin) can provide.

Discharge (refer to guideline on discharge criteria)

C. ***Expressing breast milk***

- Refers to the process by which a woman **expels milk** from her breast manually or using breast pump. The **breast milk** can then be **stored** and **fed** to her baby at a later point in time.
- The best way to establish breast milk production is, to breastfeed, but for various reasons this may not always be possible.
- The alternative way to establish breast milk production is expressing. **Reasons are**:-
    - If baby has difficulty suckling, for example because it was born premature or is unable to attach to the breast
    - If baby is hospitalised and the mother is unable to be in hospital at all the infant's feeding times
    - If mother is hospitalised and it is not possible for the baby to be brought to her for each feed
    - If mother has to go for working and needs to be separated from the baby
    - If mother's breasts feel too full or engorged at times when the infant does not wish to feed.
    - If mother wants to keep a little breast milk stored in the freezer in case there is an emergency which requires her to separate from the infant
    - If mother has mastitis or a blocked duct to ensure her breasts are completely emptied after each breastfeeding session. Also, it may sometimes be necessary to express milk after the baby has finished suckling, to ensure that the breasts are completely empty
    - If nipples are cracked or damaged and need a period free of suckling to heal
    - If mother's milk supply is low, in which case expressing milk can stimulate further production of breast milk

When & how frequent?

- Mother can begin expressing breast milk at any time once breast milk production commences, usually immediately following childbirth.
- The frequency of expressing breast milk depends on the reason why mother has to express breast milk.
    - If baby is premature or sick & not able to suckle, regular expressing every 2-3 hourly or 8-10 times per day or as frequently as every 1.5 hours.
    - Once lactation is established, every 3-4 hours or 6-8 times a day is usually sufficient to maintain sufficient breast milk production.
    - for mother who will be a day away or a night out once in a while need only express breast milk as often as she needs to leave a supply for infant feeding.
    - If mother has to express her breast to relieve breast discomfort, can express milk only at the times when their breasts are feeling too full.
    - If mother had mastitis or blocked ducts, should express as much remaining milk from their breast as possible, each time the baby suckles.
    - If the intention of expressing is to increase the supply of breast milk, expressing should be from each breast until empty, 2-3 times per sitting (in a row), as this will help to establish a larger supply of breast milk over time.

How much milk?

- The correct amount of breast milk to express varies.
- For regular infant feeding, express as much as possible and fully drain both breasts each time. In the 1st day after childbirth, it may be only a few drops or few mls of breast milk. The amount increases daily to be 50-70ml from each breast at 4-5 days to 80-120ml at the end of 1st week. Once regular breast milk production is established women express 440-1,200ml of breast milk each day (90-120ml/session/breast).
- For engorged or uncomfortable breasts, express only as much breast milk as is required to reduce the feeling of engorgement or discomfort.
- For blocked duct or mastitis, express as much breast milk as possible after the infant has finished suckling.
- To store milk for emergency use, express as much milk as is needed for storage.

How is breast milk expressed?

- There are several techniques by which breast milk can be expressed. Regardless of which method is used, there are some basic points, which will make the process easier.
- Women who are attempting to express milk should try to:
    - Find a comfortable place to express breast milk, which is relaxing, warm and free of distractions.
    - Consciously attempt to relax. But if it is not relaxing, try to:
        - Breathe slowly and deeply
        - Have a warm drink just before expressing milk
        - Listen to soft, relaxing music
        - Have a warm shower just before expressing
    - Place a warm towel on the breast for several minutes before trying to express

- Gently massage the breast and nipple to encourage the let-down reflex (the reflex which stimulates the secretion of breast milk, by stimulating the release of oxytocin which causes the cells around milk ducts to expand and push milk from the breast)
- Express milk gently to avoid pain and discomfort
- Express milk frequently as this will help establish breast milk production and result in the production of greater quantities of breast milk compared to less frequent expressing
- Think about the infant and the benefits breast milk will provide as this encourages the let-down reflex which triggers secretion of breast milk. In order to encourage thoughts about their baby woman might wish to:
  - Sit near or in skin contact with the baby if possible
  - Express milk just after separating from the baby (e.g. if the baby is being bottle fed expressed milk in hospital)
  - Look at a photo of the baby
- Have something to eat before commencing expressing milk, as this will ensure adequate energy and nutrients are available for the production of breast milk
- Have a glass of water handy to sip on whilst breastfeeding;
- Maintain a healthy, balanced diet while breastfeeding as breast milk production is dependent on the availability of maternal nutrients. It is important not to skip meals and to drink at least 6 glasses of water per day
- Find a support person to provide encouragement, such as your partner, a friend, relative or a health professional such as a counselor.

Techniques of expressing breast milk

Before starting expressing mother need to know following points:-

- Wash hands thoroughly
- Sterilize the cups and sealed bottles in which expressed milk will be stored and their components (e.g. lids)
- do not touch the inside of containers used for storing breast milk
- Sterilize the breast milk pump and its components if such a device will be used to help express the milk
- Store breast milk in the fridge immediately after expressing or feed right away.

Expressing breast milk by hand

- Ideally, a woman should learn hand-expressing techniques from midwives or other health professionals before being discharged from hospital.
- Begin by massaging the breast and nipple for a couple of minutes to encourage the let-down reflex;

1. Hand expression Position

- First, position the thumb above the nipple and first two fingers below the nipple, about 2.5 to 3.8 cm. from the nipple. The fingers do not have to be at the outer edges of the areola, since breasts and areolas vary in size from one woman to another.
- Be sure the hand forms the letter "C" and the finger pads are at 6 and 12 o'clock in line with the nipple.
- Avoid cupping the breast.

- See Figure 11 below

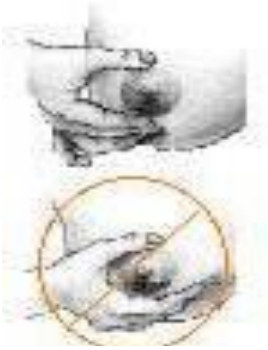


Figure 11: Hand Expression of BM

2. **Express the Breast Milk**
   - Next, push straight in to the chest wall.
   - Avoid spreading the fingers apart.
   - For large breasts, first lift, and then push in to the chest wall.
   - Roll the thumb and fingers forward at the same time. This rolling motion compresses and empties the area where the milk is stored without injuring sensitive breast tissue.
   - Repeat this process rhythmically to completely drain reservoirs.
   - Position, push, roll ----- Position, push, roll. See Figure -12.

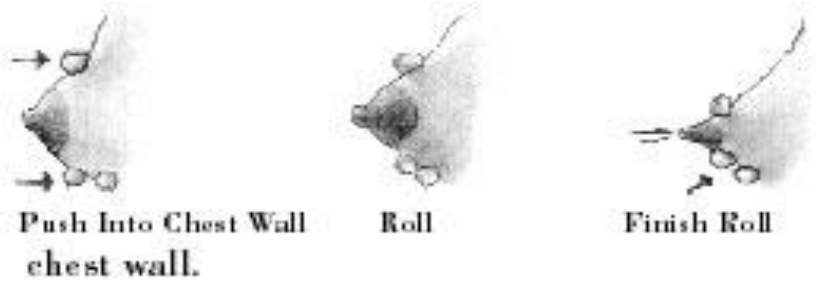


Figure 12: How to manually express BM

3. Then,
   - Rotate the thumb and fingers to milk other reservoirs, using both hands on each breast.
   - If produced milk is not adequate, do same way on the other breast.
   - For right breast use left hand, for left breast use right hand
     See Figure – 13 below.

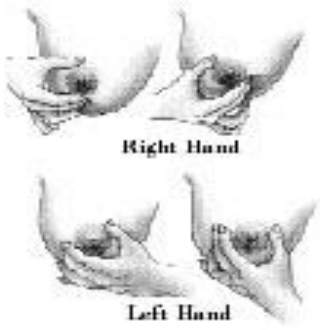


Figure 13: Rotate thumb and fingers to

4. **Avoid**

- Squeezing the breast, as this can cause bruising.
- Sliding hands over the breast, may cause painful skin burns.
- Pulling the nipple, which may result in tissue damage. See picture -13

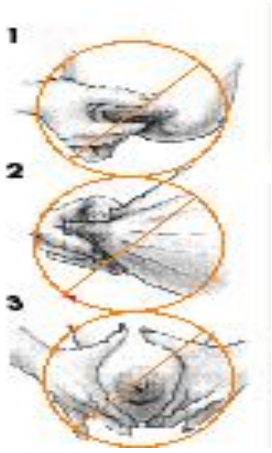


Figure 14: incorrect technique of expressing breast milk

5. Storing the expressed milk

- Label well expressed milk by name of mother or baby, time, date and place
- Freshly expressed breast milk can be stored at room temperature (<26°C) for 6-8 hours
- If it is stored in a refrigerator, (<4°C) breast milk should be placed at the back (not in the door) and will remain fresh for 2-5 days.
- It is also possible to freeze freshly expressed milk in an internal fridge freezer (up to 2 weeks), a fridge freezer with a separate door (3 months) or a deep freeze (6-12 months).

6. **Feeding the expressed milk**

- **Fresh breast milk does not need heating and can be served.** If the infant does not consume all the fresh breast milk, the remainder can be stored in the refrigerator or freezer for later use.
- **Previously refrigerated breast milk** should be heated in a container of warm water prior to infant feeding. It should not be put in a microwave or heated directly, as over-heating kills many of the nutrients in breast milk. The milk should be heated for not more than ten minutes, or until it feels cool-comfortably warm when dripped onto the wrist. Once reheated, any unused breast milk should be discarded. It should not be re-used.
- **Previously frozen breast milk** should be thawed either in a refrigerator (in which case it can be stored in a refrigerator for up to 24 hours) or in warm water (in which case it should be used immediately and any excess discarded). Once thawed, breast milk should be reheated (but only once, after which any remainder should be discarded) in the same fashion as previously refrigerated breast milk.

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Chapter 7: Infection in Neonates

Learning Objectives

At the end of this session, the students will be able to:

- Identify the common infections in neonates
- Recognize the clinical manifestations
- Recall the management of infection in neonates

Newborn babies are at higher risk of infection because of their weak immune systems related to their age. Most infections in newborn babies are caused by bacteria, and some by viruses. A mother's birth canal contains bacteria, especially if she has an active infection. During childbirth, the baby can swallow or breathe in the fluid in the birth canal, and bacteria or viruses can get into his lungs and blood. Infection in newborn babies can progress fast and early diagnosis and treatment is important for improved outcome.

1. Bacterial Sepsis

- Neonatal sepsis is defined as a clinical syndrome of bacteremia with systemic signs and symptoms of infection in the first 4 weeks of life.
- Neonatal infection is one of the major causes of mortality and morbidity. Bacterial sepsis and meningitis often are linked closely in neonates; meningitis is present with Early-onset sepsis (in 30% of cases), late onset sepsis (in 75% of cases). Considering the high mortality rates, there must be a high index of suspicion for neonatal sepsis.

Classification

Early-onset infections are acquired before or during delivery. Late-onset infections are acquired after delivery in the normal newborn nursery, neonatal intensive care unit (NICU), or the community.

1. **Early Sepsis** (Birth to 7 days, usually less than 72 hrs)
2. **Late Onset Sepsis** (7 - 30 days)

***Etiology*:** Commonest organisms causing bacterial neonatal sepsis in developing countries include Klebsiella, Staphylococcus Aureus, and Escherichia coli, were found to be the in Tikur Anbesa hospital.

Clinical features

- Signs and Symptoms of infection in newborn infants could be non-specific or focal signs of infection may be seen. Neonates may show one or more of the following signs.
- Suspect bacterial infection if the infant has one or more of the following danger signs:
    - Abnormal vital signs
    - Fever (temp >38 ºC), hypothermia (temp <36 ºC) or temperature instability
    - Tachycardia (HR > 180) or bradycardia (HR <80)

  - Tachypnea (RR > 60) or bradypnea (RR < 30) including apnea
  - Poor perfusion: capillary refill time > 3 seconds, hypotension
  - Abnormal breathing: gasping, grunting, severe chest indrawing, nasal flaring or apnea
  - Abnormal color: cyanotic, pale, grey, mottled, jaundiced, erythematous including umbilical flare
  - Abnormal activity: tremors, irritability, seizures, floppiness, stiffness or minimal response to stimulation, lethargy
  - Abnormal feeding: poor feeding, abdominal distention, recurrent vomiting, diarrhea, otherwise unexplained hypo- or hyperglycemia
  - History of convulsions
  - Severe Jaundice
  - Bulging fontanel
  - If the infant has signs or risk factors for sepsis, immediately notify the doctor, obtain blood for laboratory testing and start IV antibiotics.
  - Premature or low birth weight <2.0 kg
- *Localizing signs of infection. (*Signs of pneumonia, many or severe skin pustules, bulging fontanel, painful joints, joint swelling, reduced movement…*)*

Maternal risk factors for infection

- Maternal fever (temp >38ºC) during labor or within 24 hours after delivery
- Maternal urinary tract infection in current pregnancy or bacteriura
- Duration of membrane rupture > 18 hours before delivery
- Uterine tenderness or foul smelling amniotic fluid
- Obstetric diagnosis of chorioamnionitis
- Meconium stained amniotic fluid
- Resuscitation at birth
- Invasive procedures
- Home delivery

Septic workup

- Consider blood culture and sensitivity whenever possible and modify that treatment accordingly.
- CBC (Complete Blood Count with differential). Concern for sepsis if:
  - Total WBC is abnormal (<5,000 or >20,000)
  - Differential with granulocytes >70%.
- ESR or CRP. Concern for sepsis if positive.
- Consider urinalysis and gram stain if symptoms of urinary tract infection or more general concerns for sepsis in infant >1 week old

- Consider lumbar puncture if concern for meningitis (lethargy, irritability, convulsions, bulging fontanel, meningismus).
- Consider chest x-ray if respiratory distress or oxygen desaturation

Sepsis with meningitis

- A diagnosis of meningitis should be made based on clinical evidence (abnormal neurological exam: seizures, abnormal tone and full fontanels) and risk of infection for babies less than 72 hours of age , for babies age greater than 72 hours of age diagnosed with sepsis CSF analysis should be done to rule out meningitis despite absence of overt signs of meningitis

CSF analysis suggestive of meningitis:

- Identification of organism on gram stain or culture
- WBC count greater than or equal to 20 cells/mm3
- Low glucose (less than two third of serum value) and
- Protein greater than 150 mg/dl

Treatment: General supportive measures, including respiratory and hemodynamic management, are combined with antibiotic treatment.

For early onset (less than 7 days)
Antibiotic – *Ampicillin and Gentamycin*
Duration: If positive cultures – minimum 7 days.
- If negative cultures, and clinically well, with normal CRP or ESR– stop after 48 hours
- If negative cultures, but not clinically well, abnormal CXR or elevated CRP – treat as confirmed sepsis.
- If no improvement after 48 hours, or worsens, after repeating blood cultures (if possible) and considering further investigations, consider changing to: ***Ceftriaxone and gentamicin***

For late onset (7-30 days)
Antibiotic – *Ampicillin and Gentamicin*
- *In certain cases were patient is critically sick or staphylococcal infection is likely (pustular skin rash, osteomyelitis…) start with triple antibiotics (cloxacillin, ampicillin and gentamycin)*
- If no improvement after 48 hours, or the infant's condition worsens. Consider changing antibiotics to: ***Cloxacillin, ceftriaxone and gentamicin or vancomycine and gentamicin***

Treatment of neonatal sepsis with meningitis
- Antibiotics the same as for sepsis but with higher dose and prolonged duration (Gentamycin for two weeks the rest for three weeks) .

Table 12: Antibiotic Dosing Chart for Newborns

Antibiotic Dosing Chart for Newborns				
Medication	**Dose/Frequency**			**Comments**
	≤ 14 days		***> 14 days***	
	≤ 35 weeks PMA* (if PMA not known use current weight ≤ 2.0 kg)	***> 35 weeks PMA* (if PMA not known use current weight > 2.0 kg)***		
Ampicillin or **Cloxacillin**	150 mg/kg/dose IV every 12 hours If meningitis ruled out: 50 mg/kg/dose IV every 12 hours		50 mg/kg/dose IV every 6 hours Meningitis: 100 mg/kg/dose IV every 6hr.	-
Gentamycin	3 mg/kg IV once a day and once in 48 hrs in very preterm babies.	4 mg/kg IV once a day	> 1 month: 7.5 mg/kg IV once a day	Use newborn dose through first month.
Cefotaxime[1]	50 mg/kg IV every 12 hours	50 mg/kg IV every 8 hours	50 mg/kg every 6 hours	Preferred over Ceftriaxone due to improved safety profile
Ceftriaxone[2]	50 mg/kg IV every 12 hours for sepsis/meningitis: 50 mg/kg x1 IM for pus draining from eye For IM injection, dilute to 350 mg/mL. Max dose ½ mL = 175 mg			Contraindicated in setting of jaundice or within 48 hours of IV calcium administration
Metronidazole	7.5 mg/kg IV every 24 hours	7.5 mg/kg IV every 12 hours	7.5 mg/kg IV every 8 hours	Anaerobic coverage including treatment of necrotizing enterocolitis
Acyclovir	20 mg/kg IV every 12 hrs	20 mg/kg IV every 8 hours		Treatment of herpes simplex infection: 14 days if localized, 21 days if disseminated
	20mg/kg PO every 6 hours if IV acyclovir not available			

Management of healthy appearing infant babies born of women with premature rupture of membrane

PROM Score: A protocol based on accepted high risk factors for immediate postnatal assessment and anticipatory treatment

	High risk factors	Scores
1	Gestational age < 34 weeks	2
2	Gestational age 34-37 weeks	1
3	Maternal clinical amnionitis Maternal temperature >38^{o}C Sustained fetal tachycardia >160bpm Presence of PMN or bacteria in stained Sediment of amniotic fluid or infants' gastric fluid	1
4	5th minutes APGAR score < 6	1
5	Active labor >/= 20 hrs during PROM.	1
	Scores	**Recommended Management**
I	0 – 1	Observation only
II	2	Microbial culture of gastric aspirate, umbilical cord blood, urine followed by observation.
III	>/= 3	As above plus examination and culture of spinal fluid followed by antibiotic therapy.

2. Identifying and treating local infections

2.1. Pustules/ Pyoderma:

- Is superficial skin infection usually caused by Staphylococcus Aureus.
- Develop after the first few days of life; they may be bullous, crusted, or pustular. Although they can develop anywhere on the body, the blisters and pustules commonly occur on the diaper area, axillae, and periumbilical skin.
- When the epidermis is shed in large sheets, staphylococcal scalded skin syndrome should be suspected.
- The diagnosis is made by Gram stain and culture of the blister fluid
- Blood cultures should be obtained before initiating systemic antibiotic therapy, even if the infants are usually otherwise well. Give cloxacillin 50 mg/kg every 12 hours (< 8 days) and every 8 hours (> 8 days). It is usually given intravenously.
- If no improvement/if there is a danger sign, consider treating for sepsis.

2.2. Cellulitis/Abscess:

- If there is a fluctuant swelling, incise and drain the abscess.
- If possible, take a specimen of pus using a sterile cotton swab, and send it to the laboratory for gram stain and/or culture and sensitivity, so that treatment will be modified accordingly.
- Give cloxacillin IV or IM according to the baby's age and weight
- Assess the baby's condition at least once daily for signs of improvement:
- If the cellulitis/abscess is improving after five days of treatment with the antibiotic, continue cloxacillin to complete 10 days of treatment.

2.3. Neonatal conjunctivitis:

Red and swollen eyes or eyes draining pus may be caused by bacteria (e.g. gonococcus, Chlamydia, staphylococcus) that are usually transmitted to the baby at the time of birth. Most causes of newborn eye problems will respond to local treatment, but gonococcal and Chlamydia infections need to be identified, as they require systemic antibiotics.

2.3.1. If there is stickiness of eyelids, swelling and/or redness but no pus discharge,

- Clean the eyelids using sterile normal saline or clean (boiled and cooled) water and a clean swab, cleaning from the inside edge of the eye to the outside edge;
- Have the mother do this whenever possible; repeat four times daily until the eye problems have cleared.
  If the problem persists after 4 days of the above measures treat for Chlamydia:
  - Give erythromycin by mouth for 14 days;
  - Apply 1% tetracycline ointment to the affected eye(s) four times daily until the eye(s) is no longer red, swollen, or sticky.

2.3.2. If *Eyes draining pus (Opthalmia neonatorum)*

a) If the baby is less than 7 days, treat for gonococcal infection.
   - ***If possible,*** take a specimen of pus using a sterile cotton swab, and send it to the laboratory for gram stain and/or culture and sensitivity, so that treatment will be modified accordingly.
   - Give Ceftriaxone 50mg/kg IM stat.
   - Clean the eyelids using sterile normal saline or clean (boiled and cooled) water and a clean swab, cleaning from the inside edge of the eye to the outside edge;
   - Have the mother do this whenever possible and repeat four times daily until the eye problems have cleared.
   - Treat the mother and her partner for gonorrhoea if not already treated give
     - Ceftriaxone 250 mg IM as a single dose to the mother;
     - Ciprofloxacin 500 mg by mouth as a single dose to her partner.

b) If the baby is seven days or older or the problem is not resolved after 48 hours of treatment for gonococcal infection , treat for conjunctivitis due to Chlamydia.

3. Viral lesions

Rarely viral lesions like herpes simplex infection and Primary varicella can occur in neonates, manifested by blistering. Intrauterine herpes simplex infection typically manifests with vesicles at birth or within 24 hours. The vesicular eruption may be widespread or even bullous.

- Neonatal herpes simplex may be limited to the skin, eyes, and mouth or may be disseminated, with multiple organ involvement. Typically, the lesions are 1- to 3-mm vesicles that usually occur on the scalp or face.

- Additional findings include low birth weight, microcephaly, chorioretinitis, and neurologic changes.

***Treatment**:* High-dose, prolonged acyclovir therapy

4. Candidiasis

***Cutaneous lesions*:** Consist of erythematous papules and vesicopustules that become confluent, forming a moist, erosive, scaly dermatitis surrounded by satellite pustules.

Treatment: Topical antifungal agents from the imidazole group are the most effective.

***Oral thrush*:** The lesions of thrush are detectable as creamy white patches of friable material on the buccal mucosa, gums, palate, and tongue .

- Differentiate oral thrush from normal smooth coating of tongue seen in first few days. If in doubt, treat as thrush.
- Apply Nystatin oral solution 4 times daily after feeds, continuing for 2 days after lesions have healed.
- Have the mother apply Nystatin cream on her breasts after breastfeeding.
- Ask the mother to clean her breasts ***once a day*** when bathing, (not repeatedly) with soap and water.
- Topical Miconazole is also effective..

5. Umbilical infection (omphalitis): Stickiness or pus discharge at the base of the cord or inside the umbilicus

- Minor umbilical infection is not associated with swelling or surrounding redness or a foul smell. If any of these or any danger sign is present, treat as a major infection or sepsis.
- Clean the area with 60-90% alcohol or an anti-septic solution 2-3 times a day.
- Take care to lift the cord and apply the antiseptic to the *base* of the cord or, if the cord has fallen off, to the *depth* of the umbilicus.
- Demonstrate the task to the mother and ask the mother to return for follow-up after two days.

6. Congenital syphilis: Syphilis is a sexually transmitted disease caused by the bacteria Treponema Palladum that can result in serious congenital conditions if contracted during prenatal development. Mother-to-child transmission of syphilis is preventable and curable.

Clinical signs

- Often low birth weight
- Palms and soles: red rash, grey patches, blisters or skin peeling
- 'Snuffles': rhinitis with nasal obstruction which is highly infectious
- Abdominal distension due to big liver and spleen
- Jaundice
- Anaemia

- Some VLBW babies with syphilis have signs of severe sepsis with lethargy, respiratory distress, skin petechiae or other bleeding

Diagnosis

- VDRL test
- CSF analysis for VDRL, cell count, and protein
- CBC and platelet count
- Long bone radiography

Treatment

- Asymptomatic neonates born to VDRL positive women should receive
    - Crystalline penicillin G, 100,000–150,000 U/kg/day, administered as 50,000 U/kg/dose IV every 12 hr during the 1st 7 days of life and every 8 hr thereafter for a total of 10 days or
    - Benzathine benzyl penicillin 50,000 units/kg in a single intramuscular dose
- Symptomatic infants require treatment with:
    - Procaine benzyl penicillin 50,000 units/kg as a single dose daily for 10 days or
    - Crystalline penicillin G, 50,000 units/kg every 12 hours IM or IV for the first 7 days of life and then every 8 hours for a further 3 days.
- Treat the mother and partner for syphilis and check for other sexually transmitted infections.

7. Baby of a mother with Active tuberculosis

If the mother has active lung tuberculosis (sputum smear positive TB) and was treated for less than two months before birth or was diagnosed with tuberculosis after birth:

- Reassure the mother that it is safe for her to breastfeed her baby;
- Do not give the tuberculosis vaccine (BCG) at birth;
- Give prophylactic isoniazid 5 mg/kg body weight by mouth once daily

Follow up and management of baby of mother with active TB

- At the age of six weeks, the baby should be re evaluated
    - If there are any findings suggestive of active disease, start full antituberculosis treatment according to national guidelines.
    - If the baby is doing well and tests are negative, continue prophylactic isoniazid to complete six months
- Delay BCG vaccine until two weeks after treatment is completed.
- If BCG was already given, repeat BCG two weeks after the end of the isoniazid treatment.

8. Neonatal Tetanus

Neonatal Tetanus is a generalized tetanus caused by bacterium *Clostridium tetani*, which are universally present in the soil. The disease is caused by the action of a potent neurotoxin produced during the growth of the bacteria in dead tissues, e.g. in dirty wounds or in the

umbilicus following non-sterile delivery. Without good supportive care, case fatality rates can exceed 90%.

***Clinical manifestation*:** diagnosis is clinical as confirming the infection is difficult. The newborn usually exhibits:

- Irritability
- Poor feeding, difficulty in opening the mouth
- Rigidity
- Facial grimacing, and
- Severe spasms with stimulation

Management: Treatment of neonatal tetanus includes administration of tetanus antitoxin and muscle relaxants and parenteral feeding.

- Control of muscle spasms: The patient should be admitted to a quiet, darkened room where all possible auditory, visual, tactile, or other stimuli are minimized.
    - Diazepam controls spasms better and safer than other options listed below (The initial dose of 0.1–0.2mg/kg every 3–6 hr given intravenously is subsequently titrated to control the tetanic spasms);
    - Other drugs which can be used in combination with diazepam include:
        - Phenobarbitone (loading dose 20mg/kg, then 2.5mg/kg/dose q12hr, increased to max 5mg/kg/dose q12hr)
        - Chlorpromazine (1-5mg/kg/dose q8hr)

- Antitoxin therapy: human tetanus immunoglobulin should be given intramuscularly in a single dose (3,000 to 6,000 IU).If human serum immunoglobulin is unavailable, tetanus antitoxin should be given, assuming sensitivity reactions to horse serum are negative. The antitoxin is given intravenously and intramuscularly (half of the dose via each route).
- Antimicrobial therapy: Metronidazole (30 mg/kg/day, given at six hour intervals; maximum 4 g/day) or Parenteral penicillin G (100,000 U/kg/day) is an alternative. Treatment for 10 to 14 days is recommended.
- Wound treatment: After the patient has been sedated and received antitoxin, the
- Wound should be thoroughly cleansed and debrided.
- Supportive treatment: Oxygen should be available. During early stages, oral feeding should be avoided because of the danger of aspiration. A continuous intra- venous infusion can provide fluid (such as water and plasma), electrolytes, glucose, and amino acids.
- Tracheotomy: The combination of heavy sedation, difficulty in swallowing, laryngospasm, and accumulation of secretions may lead to obstruction of the airway . A tracheotomy can be lifesaving if performed when appropriately indicated.

Complications

- Laryngospasm
- Hyperactivity of the autonomic nervous system leading to hypertension, abnormal heart rate, or both;

- Fractures of the spine or long bones as a result of sustained contractions and convulsions;
- Coma
- Aspiration pneumonia: a common late complication of tetanus;
- Death: without good supportive care, case fatality rates can exceed 90%. Most deaths from neonatal tetanus occur during the first week of the disease.

Prevention

- Immunization of women of childbearing age with tetanus toxoid.
- General improvements in delivery and post-delivery practices.

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Chapter 8: Jaundice

Learning objectives

At the end of the training, the trainee will be able to:

- Define jaundice
- Differentiate between physiologic and pathologic jaundice
- Identify the causes of jaundice
- Recall investigation and management of jaundice

Neonatal jaundice

Definition **-** is a yellowish discoloration of the skin and or sclera due to bilirubin deposition. In newborns, jaundice appears when total bilirubin (TB) is more than 7 mg /dl and almost 97 % healthy full term babies have biochemical hyperbilirubinemia. Neonatal jaundice can be classified as either physiologic or pathologic.

Table 15: Features differentiating Physiological jaundice from Pathological Jaundice

No	***Features***	***Physiologic Jaundice***	***Pathological Jaundice***
1	Clinical onset of jaundice (after birth)	>24 hrs	<24 hrs
2	Jaundice still clinically visible (day after birth)	Term < 8 days Preterm < 14 days	Term ≥8 days Preterm > 14 days
3	Peak Total Serum Bilirubin (TSB)	Term < 12 mg/dl Preterm < 15 mg/dl	Term > 12 mg/dl Preterm > 15 mg/dl
4	Rise in TSB	< 5mg/dl/24 hrs	> 5mg/dl/24 hrs
5	Conjugated serum bilirubin level	<2mg/dl	>2mg/dl or 15 % of TB

Causes of Jaundice*:*

- ***Isoimmunization***: RH incompatibility, ABO incompatibility, Other blood group incompatibility
- ***Infection*****:** Bacterial, viral, protozoal
- ***Sequestered blood***: Subgaleal hemorrhage, cephalhematoma, ecchymosis, hemangioma
- ***Erythrocyte biochemical defect***: G6PD deficiency, Hexokinase deficiency
- ***Structural abnormalities of erythrocytes*****:** Hereditary spherocytosis, elliptocytosis
- ***Disorder of hepatic uptake*****:** Gilbert syndrome
- ***Disorder of conjugation*****:** Crigler-Najjar syndrome (absence of UGT activity)
- ***Hypothyroidism*****:** Disorder of enterohepatic circulation (associated with breast feeding practice)

Clinical manifestations

- A newborn presents with yellowish discoloration of sclera, skin, mucus membranes
- Depending on severity and time of presentation a newborn may present with signs of bilirubin encephalopathy.

The following risk factors aggravate bilirubin encephalopathy

- Prematurity
- Metabolic acidosis,
- Hypoglycemia,
- Sepsis,
- Temperature instability,
- Significant lethargy
- Low serum albumin

Complications of hyperbilirubinemia

- ***Acute bilirubin encephalopathy*** is an early bilirubin toxicity, which is **transient and reversible**. If it is not recognized or untreated, it may progress to permanent neurologic impairment-Kernicterus**.**
  Acute bilirubin encephalopathy has three phases
  - **Phase -1 (1st – 2 Days Of Age):** Poor motor reflex, high pitched cry, Decreased tone, lethargy, poor feeding
  - **Phase- 2 (middle of 1st week age):** Hypertonia, seizure and depressed sensorium, fever, opisthotonos posturing, paralysis of upward gazing.
  - **Phase -3 (after 1week of age):** Hypertonia decreases, Hearing and visual abnormality, poor feeding, Athetosis and seizure may also occur
- ***Chronic bilirubin encephalopathy (Kernicterus) seen after 1 year of age and manifests with***
  - Choreoathetoid cerebral palsy
  - Upward gaze palsy
  - Sensorineural hearing loss
  - The intellect may be spared with severe physical handicap

Investigations

- Total bilirubin
- Direct and indirect bilirubin
- Maternal blood group and RH type
- Neonatal blood group and RH type
- Direct/indirect Coombs test
- Hemoglobin (Hgb) or hematocrit (HCT)
- Peripheral RBC morphology

- Reticulocyte production index(RPI)
- Serum albumin level and albumin to bilirubin ratio
- Liver function test (LFT)
- Septic work up.
- Abdominal ultrasound with indication.

Management of Unconjugated Hyperbilirubinemia*:*

The main goal of treatment is to avoid acute and chronic bilirubin encephalopathy by reducing serum bilirubin level.

Note: ***Always categorize babies into low, medium or high risk based on the Bhutani curve as shown below before deciding on the management options.***

Principles of treatment include:

1. *Phototherapy*
2. *Exchange transfusion*
3. *Other medical managements*

1. ***Phototherapy*** – It is the mainstay of treatment

- It is indicated for excessive unconjugated hyperbilirubinemia (see Bhutani curve for phototherapy).
- It acts by photoisomerization, structural isomerization, and photooxidation.
- It is not a substitute for exchange transfusion if exchange transfusion indicated.
- Intensive phototherapy is preferred if available.
- Infant should get adequate feeding.
- Cover the baby's eye and put diaper with maximum body surface area being exposed.
- Make sure that the distance between the light source and the baby should be less than 40 cm.
- The position should be changed every 2 hours from supine to prone.

- Measure weight daily and increase fluid intake by 25 % extra over the usual requirement to compensate the insensible water loss.
- Give a bolus of fluid with Normal saline 20ml/kg if bilirubin remains high

Side effects of phototherapy

- Insensible water loss
- Watery and frequent stool
- Retinal damage
- Erythema and increased blood flow
- Bronze baby syndrome (with increased CB)
- Low calcium level (in preterm)

- Interferes with maternal infant bonding

2. ***Double Volume Exchange transfusion***

- See Bhutani curve for indications of Double volume exchange transfusion.
- The amount of blood volume to be exchanged is equivalent to 2x the blood volume of the baby (85ml/kg)
    - *Example for a newborn weighing 3 kilograms the amount of blood to be exchanged is calculated as follows= 2 x 85ml/kg x3kg =510 ml*
- Do procedure after umbilical catheterization using aseptic technique
- Heparinize the catheter (instill heparin to the tube) before starting the procedure.
- The amount of blood to be removed at a time is 5ml to 20 ml
- Strictly monitor the vital signs during the procedure.
- Determine post transfusion hematocrit 4-6 hours after the procedure.
- Determine bilirubin 4 hourly after the procedure.
- Monitor RBS every 30-60 minutes during the procedure and 2-4 hourly for the first 24 hours after procedure.
- Administer 1ml/kg of Calcium gluconate slowly via a peripheral vein under strict cardiac monitoring after 100ml of blood is exchanged.
- If the cord is infected or there is a breach in the aseptic technique, it is wise to start on prophylactic dose of Cloxacillin 50mg/Kg bid for 2- 3 days and gentamicin 5mg/kg BID for 2-3 days.
- Keep baby NPO for 4 hours before and after procedure because it can predispose the baby to necrotizing enterocolitis..

Selection of blood to be transfused to the newborn

- If there is Rh hemolytic disease – give blood group compatible to the baby and RH to the mother.
- If there is ABO hemolytic disease – give blood group of the mother and Rh compatible to the newborn

Note: - O negative blood is the most preferable type for exchange transfusion.

Complication of exchange transfusion

- Cardiac and respiratory disturbances (arrhythmia, volume overload, perforation of vessels)
- Shock, due to bleeding disorder (clotting factor deficiency) or inadequate replacement of blood.
- Infection (strict infection screening to reduced this risk)
- Clot formation (causing occlusion of catheters, impairment of blood flow to the organs due to thromboembolism)

- Alterations in blood chemistry (high potassium, low calcium, low glucose, decreased in pH)
- Rare but severe complications include air embolism, portal hypertension and necrotizing enterocolitis.

3. Other treatment modalities

- Phenobarbital 5 mg/kg to stimulate liver enzyme in Crigler-Najjar syndrome.
- High dose of IV immunoglobulin.
- In case of Breast milk jaundice, discontinuation of breast milk for 1-3days usually causes a prompt decline, where as in breast-feeding (breast-feeding failure) jaundice increase the amount of feeding.

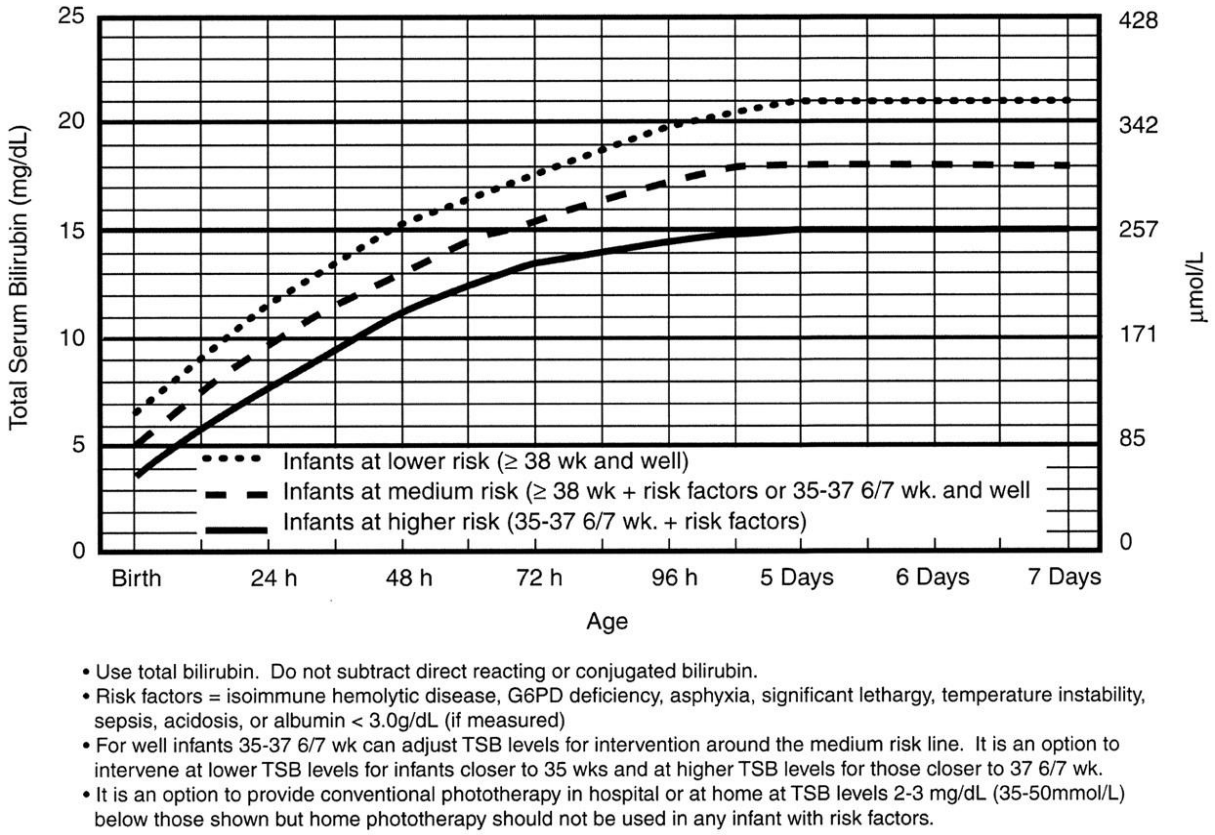
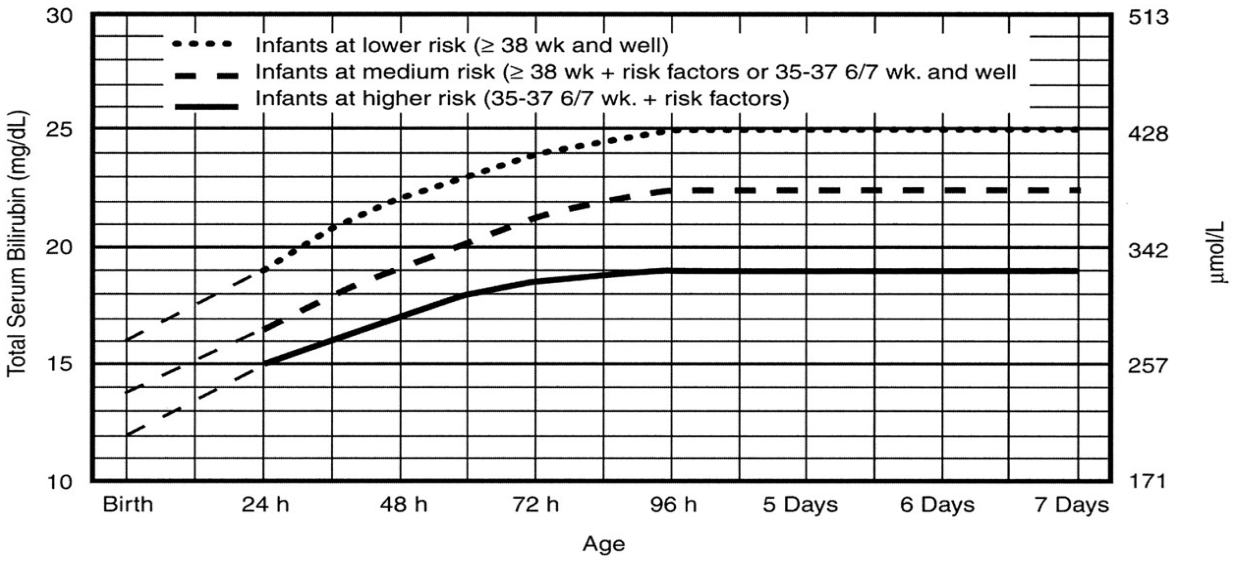


Figure 27: Bhutani curve: phototherapy indication in hospitalized infants of 35 or more weeks' gestation.



- The dashed lines for the first 24 hours indicate uncertainty due to a wide range of clinical circumstances and a range of responses to phototherapy.
- Immediate exchange transfusion is recommended if infant shows signs of acute bilirubin encephalopathy (hypertonia, arching, retrocollis, opisthotonos, fever, high pitched cry) or if TSB is ≥5 mg/dL (85 µmol/L) above these lines.
- Risk factors - isoimmune hemolytic disease, G6PD deficiency, asphyxia, significant lethargy, temperature instability, sepsis, acidosis.
- Measure serum albumin and calculate B/A ratio (See legend)
- Use total bilirubin. Do not subtract direct reacting or conjugated bilirubin
- If infant is well and 35-37 6/7 wk (median risk) can individualize TSB levels for exchange based on actual gestational age.

Figure 28: Bhutani curve: Exchange transfusion in infants of 35 or more weeks' gestation

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Chapter 9: Metabolic disorder

Learning Objectives:
At the end of this session, students will be able to :

- Recognize clinical manifestation and management of common metabolic disorders in neonates

Metabolic Disorders of the Newborn

- *Hypoglycemia*
- *Hyperglycemia*
- *Thermoregulation (See chapter 4)*
- *Hypocalcemia – discussed in fluid and electrolyte section*

Hypoglycemia

Hypoglycemia is common metabolic problem in NICUs. This is because of abrupt cease in glucose supply following clamping of the umbilical cord at birth. Some neonates are symptomatic whereas most are asymptomatic despite very low blood glucose levels. This variability is due to number of factors including:

- Gestational age
- Birth weight
- Post natal age
- Feeding status
- Presence or absence of associated illnesses

The diagnosis of hypoglycemia depends on the clinical setting but not solely on specific blood glucose level. For intervention or further evaluation, hypoglycemia could be defined as blood glucose level less than 40mg/dl.

There are two types of neonatal hypoglycemia, transient and persistent. Most neonates will have transient hypoglycemia, which responds to treatment and is associated with good prognosis.

Causes of hypoglycemia

Transient hypoglycemia could be:

I. Related with changes in maternal metabolism
- Intrapartum glucose administration
- Diabetes in pregnancy-infant of diabetic mother
- Maternal drugs (tocolytics , propranolol ,thiazide diuretics)

II. Related with neonatal problems
- Intrauterine growth retardation
- Prematurity
- Delayed onset of feeding

- Birth asphyxia
- Infection
- Post exchange transfusion
- Hypothermia
- Delayed feeding
- Polycythemia
- Erythroblastosis fetalis

Clinical manifestations

The clinical manifestations of neonatal hypoglycemia are non-specific and they may confuse with other disorders of the newborn.

The newborn may present with:

- Abnormal crying (weak or high-pitched cry).
- Tremors, jitteriness, irritability, hypotonia.
- Seizures ,lethargy or coma
- Poor feeding , vomiting
- Grunting, tachypnea, tachycardia
- Apnea, cyanosis
- Hypothermia

Who should be evaluated?

Healthy term appropriate for gestational age (AGA) neonates without any risk factors for hypoglycemia does not need evaluation of their blood glucose level.

Newborns at risk for hypoglycemia include:

- Preterm infants
- Small for gestational age(SGA)
- Large for gestational age(LGA)
- Infants of diabetic mothers(IDM)
- Sick infants who require intensive care (e.g. sepsis, asphyxia, respiratory distress)
- Post exchange blood transfusion
- Infants on intravenous fluids or parenteral fluids
- Infants whose mothers were treated with beta adrenergic or oral hypoglycemic agents
- Intrapartum dextrose infusions
- Infants with polycythemia
- Hypothermic newborns

Diagnosis is based on

- Supportive perinatal history (risk factors).

- Signs and symptoms of hypoglycemia.
- Whole blood glucose less than 40mg/dl.

Note that

- Glucometers measure whole blood glucose, which is 15% lower than plasma glucose levels.
- Newborns with persistent or recurrent hypoglycemia need additional testing including hormone analysis and imaging studies.

Management of neonatal hypoglycemia

The overall management of neonatal hypoglycemia should include:
1. Anticipation and prevention in those who are at high risk.
2. Correction of hypoglycemia in those who are symptomatic and
3. Investigation and treatment of the cause of hypoglycemia, when it is possible to identify the cause.

a) Treatment of asymptomatic hypoglycemia

Feeding
Feeding is the initial treatment in an asymptomatic term infants,
- Immediately offer breast-feeding.
- Check blood glucose30 minutes after feeding to insure normal glucose level before the next feeding.
- If repeated blood glucose is > 40mg/dl continue to offer feedings at 2-3hours interval.

Indications of **IV infusions** in asymptomatic hypoglycemia (use same infusion as symptomatic hypoglycemia)

- Blood glucose < 25mg/dl.
- Blood glucose remains < 40mg/dl after one attempt of feeding
- If infant becomes symptomatic
- If oral feeding is contraindicated

b) Treatment of symptomatic hypoglycemia

Many neonates have asymptomatic (chemical) hypoglycemia. In contrast to the frequency of chemical hypoglycemia, the incidence of symptomatic hypoglycemia is highest in small for gestational age infants. The exact incidence of symptomatic hypoglycemia has been difficult to establish because many of the symptoms in neonates occur **together** with other conditions

Immediate treatment
- Secure IV line

- Give 2ml/kg of 10% glucose IV bolus over one minute if signs other than seizure
- Give 4 ml/kg of 10% glucose as a bolus over one minute if seizure is present.
- The small bolus minimizes hyperglycemia that can provoke insulin secretion and possibly prolong hypoglycemia.

10% dextrose for IV bolus can be prepared using 40% dextrose, which is available in our country by taking one part of 40% dextrose and three parts of distilled water.

Example; for a symptomatic infant weighing 4kgs ,the total volume of 10% dextrose will be 4 X 2ml = 8ml.To prepare this 8 ml take one part(2ml)from 40% dextrose and three parts (6ml) from distilled water.

Continuous therapy

- Put on 10% glucose infusion at glucose infusion rate (GIR) of 6mg/kg/minutes (~ 90ml/kg/day) as maintenance.
- Recheck blood glucose after 30 minutes and if it remains above 40mg/dl frequency of checking can be decreased to one hourly then every six hourly.
- If blood glucose remains <40mg/dl, increase the GIR by 2mg/kg/minutes every 30 minutes until repeat values are above 40mg/dl.
- Once the blood glucose values stabilize above 40mg/dl for 24 hours, the GIR can be tapered off at 2 ml/kg/min every six hourly with proportional increment of oral feeds.
- If the neonate requires GIR > 12mg/kg/minutes, persistent hypoglycemia should be considered.

Glucose infusion rate (GIR) can be calculated using the following formula

$$\text{GIR in mg/kg/min} = \frac{\text{dextrose \% [ ] X } \frac{\text{ml}}{\text{kg}}\text{/day}}{144}$$

Example: for an infant taking 10% D/W at 100ml/kg/day, the GIR will be $\frac{10 \text{ X } 100}{144}$ = 6.9

mg/kg/min (~ 0.07 ml/kg/min).

See Chapter 4 on fluid and electrolyte management for how to calculate 10% dextrose for maintenance fluid from 5% and 40% dextrose solutions.

Practical points

- Do not use > 12 % dextrose infusion through a peripheral vein due to the risk of thrombophlebitis.
- In addition to glucose infusion and monitoring, reduce energy needs by correcting acidosis, maintaining a thermo neutral environment and treatment of other underlying conditions like sepsis.
- Do not stop an IV infusion of glucose abruptly, severe rebound hypoglycemia may occur.

- If the patient needs repeated boluses, this may be an indication for increasing the rate of continuous glucose infusion, and for considering other causes.

Neonatal hyperglycemia

Hyperglycemia, a high blood glucose concentration is less frequently observed in newborn infants than hypoglycemia.
It is usually defined as whole blood glucose level >125 mg/dl.

Causes

- High rates of parenteral glucose infusion.
- Stress like Asphyxia
- Sepsis
- Drugs (steroids, caffeine, aminophylline…)
- Prematurity
- Neonatal diabetes mellitus(rare cause)

***Diagnosis of hyperglycemia will be made based on*:**

- Perinatal risk factors (asphyxia, sepsis…)
- Clinical manifestations (weight loss, signs of dehydration, polyuria).
- Laboratory (blood glucose >125 mg/dl., ketone & glucose on urine analysis)

Management of neonatal hyperglycemia

- Prevent of hyperglycemia by carefully adjusting GIR and frequent monitoring of blood glucose should be the primary goal.
- If the neonate has signs of dehydration or in shock treat accordingly
- Decrease glucose infusion by 2mg/kg/min (30ml/kg/day) every 6 hrs and stop gradually.
- If the newborn was not on infusion put on 5% glucose with rate of 4mg/kg/min.(~ 60ml/kg/day)
- Look for and treat underlying causes.

Chapter 10: Meconium Aspiration Syndrome

Learning objectives:

At the end of this session, the trainees will be able to:

- Recognize Meconium aspiration syndrome
- List the risk factors for meconium aspiration
- Recall the management of MAS

Meconium aspiration syndrome (MAS)

- Meconium aspiration syndrome (MAS) occurs when a neonate inhales thick, particulate meconium.
- This is usually secondary to fetal hypoxia, which causes increased peristalsis, relaxation of anal sphincters with the release of meconium in to amniotic fluid; and reflex gasping which leads to aspiration of the meconium in to the lungs.
- Meconium is the first stool of the baby, which is odorless, thick, blackish green material, consisting of desquamated cells from GI tract, skin, lanugo, fatty material from the vernix, amniotic fluid and digestive enzymes.
- Prompt Significant aspiration of thick meconium can induce 4 major pulmonary effects:
    - Airway obstruction,
    - Surfactant dysfunction,
    - Chemical pneumonitis and
    - Pulmonary hypertension.

Risk factors

- Prolonged labor
- Post maturity
- Maternal illness, diabetes, hypertension
- Umbilical cord complications
- Intrauterine growth retardation

Clinical Features

- Meconium staining, nails, skin, umbilical cord
- Increased AP diameter of the chest
- Tachypnea, retractions, grunting, and cyanosis
- Pneumothorax, or pneumomediastinum, or both.

Perinatal asphyxia is the single most important risk factor for MAS, and is presumed to relate to the influx of MSAF into the lung during hypoxic fetal gasping. MAS can occur, however, in meconium-stained infants that are in good condition at birth.

Complications

- Persistent pulmonary hypertension
- Air leak — pneumomediastinum, pneumothorax , cystic lung disease
- Pulmonary haemorrhage
- Perinatal asphyxia

Management

- Vigorous infants born through meconium-stained fluid do not need routine intubation to aspirate the lungs.
- Endotracheal intubation and suctioning is indicated for depressed infants (those with hypotonia, bradycardia, or apnea). Those who fail to breathe spontaneously should not be stimulated until the airway is cleared to prevent aspiration during the first breath.
- Oxygen is critically important in infants with MAS
- Antibiotics are indicated, since the clinical picture of MAS and congenital pneumonia are similar
-

Investigation

- CXR
- Septic workup

Prevention

Timely identification of fetal distress and initiating prompt delivery may reduce the risk of acquiring MAS. However, routine intrapartum nasopharyngeal suctioning in pregnancies with meconium-stained amniotic fluid does not reduce the risk for MAS and, may cause nasopharyngeal trauma or cause a cardiac arrhythmia, no more recommended. Immediately after delivery of the baby, suck the oropharynx before drying and stimulation. Identify and treat for any complication.

Chapter 11: Neonatal Seizure

Learning objectives:
At the end of the session the students are expected to:

- Identify the type of seizure in neonate
- Investigate neonates with seizure
- Recall how to manage neonatal seizure

Neonatal seizures

Neonatal seizures are one of the few neonatal neurologic conditions that require immediate medical attention. They are usually brief and subtle in clinical appearance, sometimes comprising behaviors that are difficult to recognize and classify. The commonest causes of neonatal convulsion are PNA, hypoglycemia, CNS infection (sepsis) and so on.

The clinical manifestations of neonatal seizures differ in many ways from those in older patients. These peculiar clinical characteristics of seizures in the newborn infant likely reflect the incomplete Myelination of neonatal brain. They are not generalized seizures like adults or older infants.

Etiology of seizures

Hypoxia and trauma

- Hypoxic encephalopathy
- Intracranial hemorrhage
- IVH

Metabolic

- Hypoglycemia in neonates of IUGR, Prematurity, asphyxia, IDM, E.tc
- Hypocalcaemia in neonates of Prematurity, asphyxia, IDM,.. E.tc
- Hypomagnesaemia
- Hypo-/hypernatremia
- Pyridoxine deficiency/dependency

CNS infection

- Bacterial meningitis- eg-group B strep ,E coli…etc.
- Viral meningoencehalits
- TORCHS

Others: like CNS malformation

Clinical diagnosis of Neonatal seizure

Clinical seizure subtypes

Clinical seizure types in newborn may be categorized broadly into four groups: subtle seizure, clonic seizures, tonic seizures, and myoclonic seizures. In many cases, more than one type seizures occur in a new born over time.

A/ Subtle seizures: are the most common subtype, comprising about 50% of all seizures in term and premature new born. Subtle seizure includes a broad spectrum of behavioral phenomena, occurring in isolation or in combination. Ocular phenomena are common and include tonic eye deviation, nystagmus eye movement, and sudden sustained eye opening with visual fixation. Oro-bucco-lingual movements include chewing, sucking, or lip smacking movements, and are often associated with a sudden increase in drooling. Various types of limb movements including pedaling, boxing, rowing, or swimming movements have been described. Autonomic phenomena, including sudden changes in skin color, tachycardia initially, and bradycardia if sustained and possible apnea have been described.

Subtle seizures are not usually associated with EEG seizure and as well poorly respond to conventional anticonvulsant medications.

B/ Conic seizures: are stereotypic and repetitive biphasic movements with a fast contraction phase and a slower relaxation phase. It can be univocal, multifocal, or generalized. Clonic seizures that remain unifocal are usually not associate with loss of consciousness. The most common cause for clonic seizures that remain unifocal is neonatal stroke.

C/ **Tonic seizures**: have a sustained period (seconds) of muscle contraction without repetitive features. It can be generalized or focal. Over all, the prognosis of tonic seizure is very poor.

D/ **Myoclonic seizures**: are distinguished from colonic seizures by their lightning fast contractions and non-rhythmic characters. It can occur in a multifocal or generalized pattern. Myoclonic seizures are associated with diffuse and usually serious brain dysfunction resulting from etiologies such as PNA, inborn errors of metabolisms, major brain trauma, etc. myoclonic seizures are usually associated with a poor long-term outcome.

Conditions that mimic seizures

In the newborn it may be difficult to distinguish between normal immature behaviors (e.g. non-nutritive sucking), abnormal but no epileptic behaviors (e.g. jitteriness), and true epileptic manifestations. The following clinical features may help distinguish true epileptic seizures from seizure mimics:

- True epileptic seizures are rarely stimulus sensitive
- Epileptic seizures cannot be abolished by passive restraint or repositioning of the infant
- Epileptic seizures are often associated with autonomic changes or ocular phenomena.

Laboratory studies:

- Complete blood count with differential

- Serum electrolyte evaluation
- Blood glucose analysis
- CSF analysis and culture
- Blood culture
- Urine analysis and culture
- EEG

Management of neonatal seizures

Initial management:

- Ensure air way:-place the baby in semi prone position and clean oropharyngeal secretions.
- Ensure satisfactory breathing and circulation.
- Arrest the seizures with the following orders:

a) ***Hypoglycemia***: if glucostix shows hypoglycemia or if there is no facility to test blood sugar, immediately 4 ml/kg of 10% glucose should be given by bolus followed by maintenance.

b) ***Hypocalcaemia***: if hypoglycemia has been treated or excluded as a cause of seizures, the neonate should receive 2 ml/kg of 10% calcium gluconate IV over 10 minutes, under strict cardiac monitoring. If ionized calcium levels are suggestive of hypocalcemia the new born should receive calcium gluconate at 8 ml/ kg/d for 3 days.

c) ***Hypomagnesaemia***: if hypocalcaemia has been treated or excluded and convulsion continues, give magnesium sulphate 50% 0.2 ml/kg. IV.

d) Anticonvulsants

- **Phenobarbitone**: preferred initial drug. Loading dose is 20 mg/kg. Maintenance dose is 2-4 mg/kg. After 2 weeks of age, maintenance dose should increase to at least 5 mg/kg due to increase metabolism/clearance. Advantages of Phenobarbitone include reduction of cerebral metabolic rate and free radical scavenger.
- **Phenytoine**: it is the second agent selected when Phenobarbitone fails. Loading dose is 20 mg/kg; maintenances dose is 4-6 mg/kg daily.
- **Diazepam:** used only when immediate cessation of seizure activity is required. It should be administered after dilution of 0.2 ml of diazepam with 0.8 ml of normal saline. Initial dose is 0.1 -0.3 mg/kg slowly IV until seizures stop.
- **Disadvantage**: It contains sodium benzoate which interferes with binding of billirubin to albumin --- jaundice. It has short anticonvulsant effect but prolonged respiratory suppressant effect
- **Lorazepam**: the current recommended dose is 0.05 mg/kg/dose over 2-5 minute
- **Pyridoxine deficiency /dependency**: is diagnosed by giving pyridoxine 100 mg IV. Seizures will cease within minutes if pyridoxine dependency or deficiency is causing

Maintenance therapy is given for life at 10 to 100 mg daily in case of dependency and 5 mg daily in case of deficiency. Phenobarbitone at a maintenance dose should be continued at discharge.

Follow up anticonvulsant medications
All medications except Phenobarbitone at a maintenance dose of 3.5 mg to 5 mg/kg should be discontinued at discharge.

Indications for discontinuations of antiepileptic drugs
- Normal findings on examinations
- Absence of recurrent seizure
- Non-epileptic EEG

More often, however, anticonvulsants are continued for the first 2 months of life.
Complications:
- Cerebral palsy
- Hydrocephalus
- Epilepsy
- Learning disability, mental retardation

References
1. Avory A. Fanaroff and Martin's Neonatal- Perinatal Medicine 9th edition

Chapter 12: Neonatal Hematologic problems

Learning Objectives

At the end of this session, the trainee will be able to:

- Identify causes of anemia and polycythemia
- Recognize the clinical manifestations of anemia and polycythemia
- Investigate and manage neonatal hematologic problems
- Recall how to do partial exchange transfusion

Approach to a neonate with bleeding disorder

Introduction

- Neonates have decreased activity of clotting factors (II, VII, IX, X), impaired platelet function, and suboptimal defense against clot formation.
- HDN in well babies and disseminated intravascular coagulations (DIC) in sick babies are among the commonest problems.

Hemorrhagic disease of the newborn (HDN)

- ***Definition*:** - HDN occurs in the healthy infant due to Vitamin - K deficiency.

Table 14: Classification, risk factors, prevention, treatment and incidence of HDN according to time of onset

Classification	Early onset	Classic disease	Late onset
Age	0 – 24 hrs	2 – 7 days	>1wk – 12 weeks of age
Site of hemorrhage	Cephalhematoma, Subgaleal hemorrhage, Intracranial hemorrhage (ICH) GI and umbilical bleeding Intra abdominal bleeding	Cephalhematoma Mucosal Intracranial Circumcision Cutaneous Injection site	ICH, GI, Cutaneous ENT – mucosal Ear, nose, through Injection site , thoracic
Etiology/ Risk factors	Maternal drug use (Phenobarbital, Phenytoin, Warfarin, Rifampicin, and INH) Inherited coagulopathy	Vitamin – K deficiency(or not given Vitamin K) Breast feeding	Cholestasis-malabsorption of vitamin K (biliary atresia, hepatitis , cystic fibrosis, Warfarin injection Infant treated with broad-spectrum antibiotics
Prevention	Vitamin- K : 0.5 (Preterm) – 1 mg (term) IM at birth. To the mother , 10 mg IM	Vitamin K: 0.5 (Preterm) – 1 mg (term) IM at birth.	Vitamin K : 0.5 (Preterm) – 1 mg (term) IM at birth.

	24 hrs prior to delivery if she takes the above-mentioned drugs.		
Treatment	Vitamin- K 1mg - 5mg IV Fresh frozen plasma 10 - 20 ml/kg in serious bleeding, prematurity, liver disease Treat shock by blood transfusion	Vitamin- K 1mg - 5mg IV Fresh frozen plasma 10 - 20 ml/kg in serious bleeding, prematurity, liver disease Treat shock by blood	Vitamin- K 1mg at arrival then at 1 wk, 4 wks, and 8 wks
Incidence	Very rare	2 % if not given Vitamin K	Depends on primary disease

Disseminated intravascular coagulation (DIC)

***Definition*:** DIC is a systemic process producing both thrombosis and hemorrhage due to activation and dysregulation of the hemostatic system.

DIC in newborn is due to infection, cold injury, asphyxia or tissue damage and necrosis. The baby usually appears sick and may have petechiae, gastrointestinal bleeding, oozing from vein puncture.

***Laboratory findings** are*

- Decreased platelet count and increased PT and PTT
- Decreased fibrinogen

Management

- Treat the underlying cause
- Vitamin K 1 mg IV.
- Platelet and fresh-frozen plasma 10-20ml/kg may be considered for moderate-to-severe bleeding
- If bleeding persists, do exchange transfusion and continue to transfuse with fresh-frozen plasma and platelet.

Polycythemia

***Definition*:** Polycythemia is defined as a peripheral venous blood of HCT > 65 %. Capillary blood sample is higher by 10 - 15 % than venous blood.

***Causes of Polycythemia* :–**

- Twin to twin transfusion

- Placental insufficiency (SGA infants, maternal HTN, post maturity, maternal chronic hypoxemia)**,**
- Other conditions (IDM, LGA babies, dehydration, congenital hypothyroidism, trisomy 21, 18 and 13).

Clinical finding – most infants are asymptomatic

- ***Central nervous system (CNS)*** – poor feeding, lethargy, hypotonia, apnea, tremors, jitteriness, seizures, cerebral venous thrombosis.
- ***Cardio-respiratory*** – Cyanosis, tachypnea , murmur, congestive heart failure, cardiomegaly, elevated pulmonary vascular resistance, prominent vascular markings on CXR.
- ***Renal*** – decreased glomerular filtration rate, decreased sodium excretion, renal vein thrombosis, proteinuria.
- ***Others*** – thrombosis, thrombocytopenia, poor feeding, increased jaundice, persistent hypoglycemia, hypocalcemia, testicular infarcts, NEC, DIC.

Management

*Management***:** Partial exchange transfusion

The procedure should be done under strict aseptic technique after umbilical catheterization (LOOK NEONATL PROCEDURES for detail)

- Partial exchange transfusion in **symptomatic** patients if venous HCT is > 65%.
- Increase fluid intake and repeat HCT in 4 to 6 hours, in asymptomatic infants with venous HCT between 65% - 70%.
- Partial volume exchange transfusion when the peripheral venous HCT is >70% even in the absence of symptoms.
- Partial volume exchange transfusion is done by withdrawing blood from umbilical vein and replacing it with **Normal saline** using the formula as shown below.
- The amount of blood to be removed at a time is 5ml to 20 ml depending on the gestational age, birth weight and of the infant. The lower range is used for preterm, VLBW, and critically ill infants. The higher amount of aliquot should be utilized in stable newborns that are term with normal birth weight.
- Determine post transfusion hematocrit after 4-6 hours after the procedure
- Monitor RBS every 2-4 hours for the first 24 hours after procedure.
- Keep baby NPO for 4 hours before and after procedure for prevention of NEC and put him on maintaince fluids.

Anemia in newborns

***Definition*:-** Anemia is defined as a hemoglobin (Hgb) or hematocrit (HCT) that is more than 2 standard deviation below for the age or less than normal range for postnatal age and birth weight.(For clinical purpose HCT < 45% in the 1st week of life) .

Causes of neonatal anemia

A. Blood loss

- Hemorrhage
  - Fetal, Placental, traumatic delivery, coagulation defect
  - Bleeding in the neonatal period may be due to:- (Cephalhematoma, subgaleal hemorrhage, retroperitoneal bleeding, adrenal or renal hemorrhage, gastrointestinal bleeding and bleeding from the umbilicus (HDN).
  - Iatrogenic causes (excessive blood loss from frequent blood sampling).
- Early umbilical cord clamping (less than one minute)
- Twin – twin transfusion
- Fetal-maternal transfusion

B. Hemolytic anemia

- Alloimmune (RH, ABO, Minor blood group incompatibility disease)
- Nonimmune (Hemoglobinopathy, Thalassemia, Red blood cell enzymatic deficiency, structural RBC defect, Infection, mechanical destruction, etc)

C. Diminished RBC production

Volume of exchange in ml = blood volume of newborn x $\frac{\text{observed HCT- Desired HCT [55\%]}}{\text{Observed HCT}}$

Example: What is the amount exchanged in a newborn weighing 3kg infant and hematocrit of 75 % the amount of blood to be exchanged is calculated as follows. Volume of blood for term baby is 85ml/kg and for a preterm to bring HCT to 55 %

Volume of exchange in ml = $\frac{85\text{ml} \times 3\text{kg} \times 75-55}{75}$

$= \frac{255 \times 22}{75}$

= 68 ml blood will be exchanged with equal amount of normal saline

- Congenital
- Anemia of prematurity or physiologic anemia of infancy
- Acquired
  - Syphilis, Parvovirus B19, HIV infection, drug induced, disseminated intravascular coagulation (DIC).

Clinical approach to a newborn with anemia

- Detailed obstetric history.
- Physical examination
    - Look for acute blood loss → shock, tachycardia, poor capillary refill time, poor perfusion and acidosis.
    - Chronic blood loss associated with pallor, jaundice, hepatosplenomegaly, cardiac failure.
    - Growing preterm baby may manifest with poor weight gain, apnea, tachypnea or poor feeding.

Investigations

- Complete blood cell count
- Blood group and RH of the newborn and mother.
- Reticulocyte production index (elevates with chronic blood loss and hemolysis, depressed with infection and production defect).
- Blood smear to see the morphology and find evidence for hemolysis (target cells and burr cells).
- Coombs' test and bilirubin level.
- Apt test in case of gastro-intestinal bleeding to differentiate swallowed maternal blood from neonatal bleeding.
- Ultrasound of abdomen and head.
- Screening for infections [(TORCH) toxoplasmosis, rubella, cytomegalovirus infection, herpes simplex infection] and septicemia.
- Bone marrow aspiration (rarely used).

Management

1. **Guideline for packed RBC replacement** in high-risk neonate
    - In severe cardiopulmonary disease: Transfuse if HCT <40%
    - For moderate respiratory distress: Transfuse if HCT < 30%
    - For major surgery: Transfuse if HCT <30%
    - Infant with asymptomatic anemia: Transfuse if HCT <30%
    - If the newborn is in shock, refer to the guideline on management of shock.

Volume of Packed red blood cell to be transfused can be calculated as follows.

$$\textit{Volume of transfusion} = \frac{\textit{Weight in Kg x blood volume / Kg (desired HCT- observed HCT)}}{\textit{HCT of blood to be given}}$$

- Average HCT of packed RBC is in the range 70-80%
- Transfuse over 2-4 hours time

- The average blood volume for term newborn is 85 ml/kg: 95ml/kg in preterm.
- Always transfuse fresh blood (<7 days old) to avoid related complications decreased PH (7.4 Vs 6.5), Elevated potassium level (4.2mM Vs 78.5mM) and decreased 2, 3-diphosphoglyserol.
- Exchange transfusion with packed RBCs may be required for severely anemic infant if direct transfusion result in circulatory overload.
- Consider Frusemide 1mg/kg through the transfusion to minimize volume load

Whole blood transfusion

- If packed RBC is not available give whole blood 15-20 ml/kg over 2-3 hours period
- In case of acute blood loss, use whole blood 15-20ml/kg over 1-2 hours period.
- Give Furosemide 1mg/kg pre and post transfusion.
-

Prophylaxis

- Routinely supplement iron in preterm infants at a dose of 2 – 4 mg/kg/day once full enteral feeding is achieved.

References

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2. Fanaroff and Martin's. Neonatal and Perinatal Medicine, 1309 (9th edition.
3. Hemorrhagic Disease of Newborn Treatment & Management, Updated: Apr 13, 2012 Fanaroff and Mattin 9th edition page 1342
4. Jone P. Cloherty, Eric C., Anne R. Stark Manual of Neonatal Care 6th edition.
5. Uptodate 17.1

Chapter 13: Birth Trauma

Learning objectives:
At the end of this session, the trainee will be able to recognize risk factors and signs of different types of factors of Birth injuries and recall their management

BIRTH injuries
Birth injuries are those sustained during the birth process, which includes labour and delivery. They may be avoidable or unavoidable. It is a common problem with significant neonatal morbidity and mortality.

Risk factors

- Prematurity
- Small maternal stature (CPD)
- Prolonged or precipitated labour
- Mal presentation and malposition
- Instrumental delivery like forceps or vacuum extraction
- Versions and extraction
- Fetal macrosomia or large fetal head.

Evaluation; - a new born at risk for birth injury should have a thorough examination, including a detailed neurologic evaluation. Particular attention should be paid to asymmetry of structure and function, cranial nerves, range of motion of individual joints, and integrity of the scalp and skin.

Types of birth injuries

Injuries to the skull

Caput succedaneum
It is a commonly occurring subcutaneous, extra periosteal fluid collection that is occasionally hemorrhagic. It has poorly defined margins and can extend over the midline and across suture lines. It extends over the presenting portion of the scalp and is usually associated with molding. The lesion usually resolves spontaneously without sequelae over first several days after birth. It rarely causes significant blood loss or jaundice.

Management:

- The lesion usually resolves spontaneously without sequelae over first several days after birth.
- It needs only observation and reassurance.

Cephalohematoma
It is a subperiosteal collection of blood resulting from rupture of the superficial veins between the skull and periosteum. It is always confined by suture lines and cannot cross the suture lines. An Extensive cephalohematoma can result in significant hyperbilirubinemia and rarely serious

enough to necessitate blood transfusion. The risk of infection is very rare. Skull fractures have been associated with 5 – 20% of cases. Picture

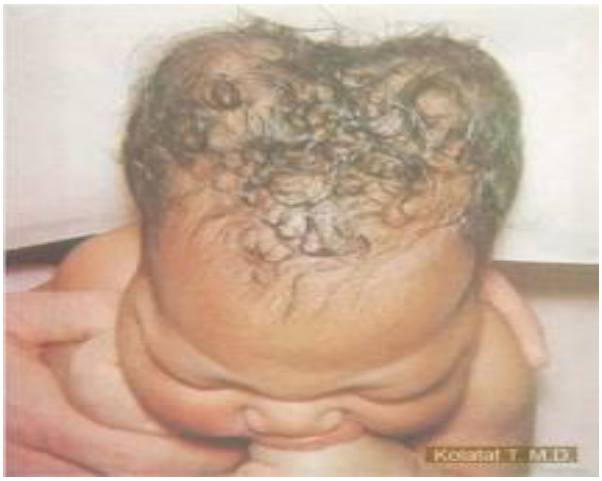

Figure 24: Bicornous cephalohematoma-looks like a horn

Figure 25: Unicornous

Management:-

- Observation in most cases
- Incision and aspiration is contraindicated.
- Anemia and jaundice should be treated as needed

Subgaleal hemorrhage

It is hemorrhage under the aponeurosis of the scalp. Because subaponeurotic space extends from the orbital ridges to the nap of the neck and laterally to the ears, the hemorrhage can spread across the entire calvarium. The initial presentation typically includes pallor, poor tone, and a fluctuant swelling on the scalp, which cross the suture lines. The hematoma may grow slowly or increase rapidly and result in shock. With progressive spread, the ears may be displaced anteriorly and periorbital swelling can occur. Ecchymosis of the scalp may develop and it is very painful on manipulation. The blood is desorbed slowly and swelling resolves gradually.

A Subgaleal hemorrhage associated with skin abrasions may become infected; it should be treated with antibiotics and may need drainage.

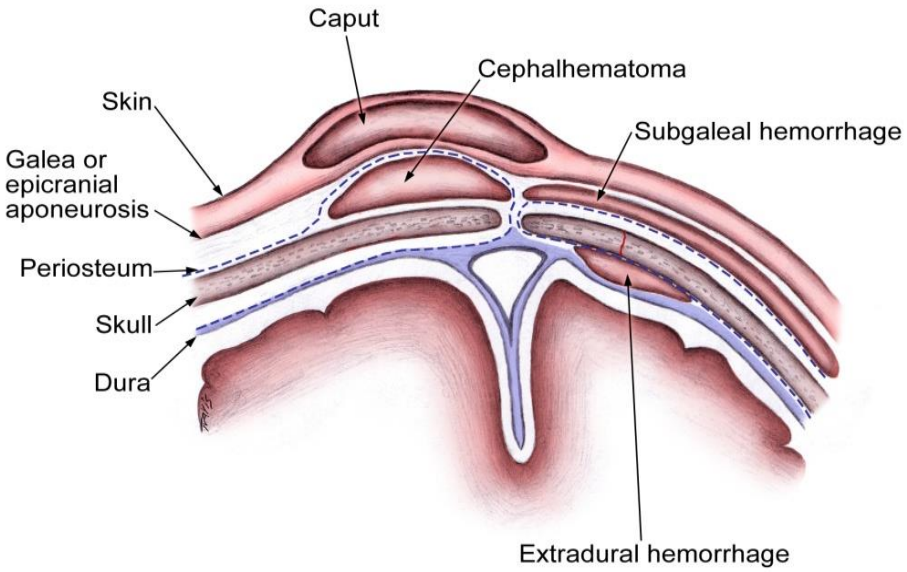

Figure 26:

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Management and follow up;-

1. New born with this lesion should be admitted
2. Assess and treat shock
3. Daily HC measurement and HCT follow-up
4. Minimize manipulation because it is painful
5. Manage anemia and jaundice if needed.

Cervical nerve root injuries

Brachial plexus injury

The cause is excessive traction on the head, neck, and arm during birth. Risk factors include macrosomia, shoulder dystocia, breech presentation. Injury usually involves the nerve root, specially where the roots come together to form the nerve trunk of the plexus .

A. *Duchenne-Erb's palsy*: - involves the upper trunks (C5, C6 and occasionally C7) and is the most common type of brachial plexus injury.

***Clinical presentation*: -** the arm is typically adducted and internally rotated at the shoulder. There is extension and pronation at the elbow and flexion at the wrist and fingers in the characteristic "waiter's tip" posture. Moro is absent on the affected side. The grasp reflex is intact and sensation is variably affected.

B. *Klumpke's palsy*: - involves injury C7/C8 to T1 and is the least common injury. In this case, the grasp reflex is absent and there is sensory impairment on the ulnar side of the forearm and hand.

Management of brachial plexus injury: - physical therapy and passive range of motion exercises prevent contractures. It should be started at 7 -10 days when the post injury neuritis recovered. Splinting should be avoided as contractures in the shoulder girdle may develop. Wrist and digits splints may be useful.

Prognosis:-full recovery varies with the extent of injury. If the nerve roots are intact and not avulsed, the prognosis for full recovery is excellent. Notable clinical improvement in the first two weeks indicates that normal or near normal function will return. Most infants recover fully by three months of age. In case with slow recovery, electromyography and nerve conduction studies are indicated

Phrenic nerve injury (C3, 4 or 5) :

Phrenic nerve injury leading to paralysis of the ipsilateral diaphragm may result from stretch injury due to lateral hyperextension of the neck at birth. Risk factors include breech and difficult forceps deliveries. At least 75%of patients also have brachial plexus injury.

Clinical features

- Respiratory distress and cyanosis
- Some infants present with persistent tachypnea and decreased breath sounds at the lung base.
- There may be decreased movement of the affected hemi thorax
- C-X-ray may show elevation of the affected hemi thorax.

Diagnosis – confirmed by U/S or fluoroscopy that shows paradoxical (upward) movement of the diaphragm with inspiration.

Management: - the initial treatment is supportive. CPAP or mechanical ventilation may be needed. Careful airway care to avoid atelectasis and pneumonia.

Skull fracture

Skull fracture may be either linear or depressed. Depressed skull fractures are usually associated with forceps use. Most infants with linear or depressed skull fractures are asymptomatic unless there is an associated intracranial hemorrhage (e.g., subdural or subarachnoid hemorrhage). The diagnosis is made by skull X-ray. Head CT scan should be obtained if intracranial injury is suspected.

Management:

- An uncomplicated linear fracture does not usually require therapy.
- Depressed fractures require neurological evaluation for possible elevation needed.
- Comminuted or large fractures with neurologic findings need immediate neurologic evaluation.
- If leakage of CSF from the nares or ears is noted, antibiotic therapy should be started and neurosurgical consultation obtained.

Bone injuries

Clavicular fracture: - is the most commonly injured bone during delivery. This fracture is seen in vertex presentations with shoulder dystocia or in breech deliveries when the arms are extended. Macrosomia is a risk factor. A green stick or incomplete fracture may be asymptomatic at birth. The first clinical sign may be a callus at 7 – 10 days of age. Signs of a complete fracture include crepitus, palpable bony irregularity, and spasm of the sternocleidomastoid muscle. The affected arm may have a pseudo paralysis because of pain on movement.

Diagnosis: - is confirmed by chest X-ray.

Management: -

- Should be directed at decreasing pain with analgesics.
- The infant's sleeve should be pinned to the shirt to limit movement until the callus begins to form.
- Complete healing is expected and counsel the family

Long bone injuries:-

A. Humeral fracture: - this fracture usually occurs during a difficult delivery of the arms in the breech presentation and/or of the shoulder in vertex presentation. Direct pressure on the hummers may also result in fracture

***Clinical presentation*:**

Loss of spontaneous arm movement on affected side, followed by swelling and pain on passive motion.

Diagnosis is by X-ray of the affected arm

Management: - the fractured humorous requires splinting for two weeks. Displaced fractures require closed reduction and casting.

***Prognosis*:** - complete healing is expected with the above managements.

B. Femoral fracture: - this fracture follows usually a breech delivery. Infants with congenital hypotonia are at increased risk

Clinical features: - obvious deformity of the thigh and swelling of thigh, decreased movement and paint on palpation or passive motion.

***Diagnosis*: -** confirmed by X-ray

Management - fractures, even if unilateral, should be treated with traction and suspension of both legs with a spica cast. Casting is maintained for about four weeks. Complete healing without limb shortening is expected.

Intra- abdominal injuries

Hepatic injury: - liver is the most commonly injured solid organ during birth. Risk factors include macrosomia, hepatomegaly, and breech presentation. The etiology is thought to be direct pressure on the liver.

Clinical features: - sub capsular hematoma are not symptomatic at birth. Non-specific signs of blood loss such as poor feeding, pallor, tachypnea, tachycardia, and onset of jaundice develop

during first 1 – 3 days of birth. Serial HCT decline may suggest blood loss. Rupture of the hematoma results discoloration of the abdominal wall and circulatory collapse with shock.
Management: - restoration of blood volume, correction of coagulation disturbances, surgical consultation for possible laparatomy. Every diagnosis and correction of volume loss increases survival.

Splenic injury: - Risk factors include macrosomia, breech presentation and splenomegally (eg-congenital syphilis, erythroblastosis fetalis etc).

Clinical features: - similar with hepatic rupture, a mass is sometimes palpable in the Right Upper Quadrant.
Management: - volume replacement and correction of coagulation disorders. Obtain surgical consultation.

Chapter 14: Fluid and electrolytes

Introduction*:* Fluid management to newborn is challenging, especially in those very preterm and VLBW infant. Because

- Transition from fetal to neonatal life is associated with major changes in water & electrolyte homeostasis.
- Weight loss is mainly loss of water. Ten percent birth weight in term and 15% in preterm.
- Renal function is limited, inefficient to modulate changes in fluid & electrolyte
- Total body water for preterm is greater than term newborns
- Insensible water loss is major component in EVLBW infant

Learning objectives

At the end of this session, the students will be able to:

- Recognize newborns fluid and electrolyte requirements
- Demonstrate adequate fluid preparation for neonates
- Identify clinical signs of electrolyte imbalance and adequate management

Fluid composition of newborn differs from that of adult. See table below for comparison

Table 3: Water composition of newborn and adult

Water	**At birth**	**Adult**
Water composition of body	80%	55 – 65%
Extracellular Fluid/ Total Body Water	2/3	1/3
Intracellular Fluid/Total Body Water	1/3	2/3
Water Lose/kg/day	High	Low
Water requirement/kg/day	High	Low

Total body water = ECF + ICF

- Total body water for preterm is > 80% of body weight
- Water is lost through skin & breathing 40 % (Insensible lose), & urine 50-60% (obligatory)
- Water and electrolytes controlled by ADH and Kidneys

A. Fluid and electrolyte requirement

Indications

- Normal healthy term and late preterm newborns usually doesn't need IV infusions
- Fluid usually is started in very preterm (G/A <34 wks) and or sick newborns.

Fluid requirement

- Newborns have high body surface area to body mass and insensible loss of fluid is higher per unit body eight. This is loss of water through skin and breathing
- Passage of water through urine is also higher
- Thus, daily water requirement per unit of body is high
- Daily fluid to be given is calculated based on birth weight and in kilograms
- Caloric expenditure to facilitate loss of fluid from the body is basis for initials and for further modification of fluid

What type and how much fluid are required.

- Type of fluid and amount to be given varies with birth weight and postnatal age of newborn infant. See Table 4
- Main goal of fluid therapy is
    - Weight loss → 1- 2%/k/d in the 1st 7 days
    - Urine output → 1- 2ml/k/hr. (optimal)
    - Sp. Gravity → 1.005 – 1.015
    - Euelectrlytemeia and Euglycemia

Table 4: Fluid requirement of newborn in ml/kg/d

Birth weight in grams.	**Day – 1**	**Day – 2**	**Day - 3**	**Day - 4**
< 1000	100 – 120	120 – 130	130 - 140	140 - 150
1000-1500	80 – 100	100 – 120	120 - 140	140
1501-2000	80 – 90	90 – 110	110 - 130	130 - 140
>2000	60 – 80	80 – 100	100 - 120	120 - 140

NB: This fluid requirement includes total fluid (IV fluid + feeding). *In summary, increase the amount of fluid given over the first 3–5 days (total amount, oral plus IV).Day 1→ 60 ml/kg per day; Day 2→ 90 ml/kg per day; Day 3→ 120 ml/kg per day. Then increase to 150 ml/kg per day when the infant tolerates oral feeds well, the amount of fluid might be increased to 180 ml/kg per day after some days. Be careful in giving parenteral IV fluids, which* can quickly over hydrate a child.

2. Electrolyte

- Electrolyte is given based on body weight
- Important electrolytes needed for normal homeostasis of body are:- Sodium, Potassium, Chloride, Calcium, Phosphorus, Magnesium
    - Sodium (NaCL): 1 – 2meq/kg/d
    - Potassium (KCL) : 1 – 2meq/kg/d
        1meq = 74.6mg; if preparation is 10ml/1.5gm,
        1gm of KCL = 13.4meq. 2meq = 150mg = 1ml
    - Calcium Gluconate 10%: 2 – 3 ml/k/d or 200 – 300mg/k/d; 1ml = 100mg

B. Fluid and electrolyte management

- Always follow strict aseptic technique

- Select proper peripheral site for IV line, Secure well, check functioning well
- Calculate fluid, label and chart properly.

1. Type of fluid to be started and advancement

Day – 1

- Any birth weight. start with 10% DW
- If there is a concern of hyperglycemia; use 7.5%DW, esp. in EVLBW
- If the baby is < 1000gm or asphyxiated, add Maintenance Calcium gluconate 10%, 2ml/k/d (200mg/kg/d) to the maintenance fluid.

Day – 2

- Electrolyte need to be added
- At Any birth, weight the fluid composition of 10% DW and ⅓ of Normal Saline (Suitable alternative IV fluids after the first 2 days are half-normal saline and 5% dextrose.).
- Calcium gluconate if added is continued

Day – 3 and onwards

- The composition of the maintenance fluid is as *Day – 2*.
- Potassium is added based on some conditions, potassium is added from 3rd day of life if renal function is good (urine out - put ≥ 1ml/hr.) &/or serum level of potassium is < 5meq/L
- Calcium is added to the maintenance fluid of any newborn if there is IV infusion.

2. Daily increment of fluid during the first few days of life

- Refer the Table 4 above
- The usual daily increment is 10- 20ml/kg/day
- The maximum daily maintenance fluid shouldn't exceed 1500ml/kg/day ,

3. Special consideration

- An additional volume of fluid (10 – 30ml/kg/d) is considered if neonate is :
    - Febrile
    - Under radiant warmer
    - Under phototherapy
    - Having body defects like Gastroschisis
    - If there is fluid lose in the form of vomiting, NGT drainage then add the same volume.
- Fluid restriction: Fluid restriction to 2/3 daily of maintenance fluid may be required in the following conditions
    - Depressed or Asphyxiated newborn are at risk for development of ATN, and Syndrome of Inappropriate Secretion of Anti-Diuretic Hormone (SIADH), this leads fluid retention.
- Start by 2/3 of maintenance fluid then subsequent adjustment is based on urine output, urine specific gravity or osmolarity, & clinical responses.

- If newborn is on treatment for PDA with **Indomethacine**, which have tendency for fluid retention, restrict maintenance fluid to 2/3.
- ***Features of CHF***: Newborn on protracted treatment for Chronic Lund Disease (CLD) with diuretics needs special attention. Withhold or restrict fluid if
    - There is weight gain in the 1st few days of life when weight lose is expected (1-2%/k/d)
    - Weight gain is excess not explained by normal daily weight gain after 7 days of life
    - Clinical evidence of fluid over load such as edema, increased respiratory rate, tachycardia
    - If urine output is > 3ml/kg/hr, sp. Gravity < 1.005: → and correct accordingly or consult or refer for re-evaluation and treatment

4. IV Fluid management when feeding is started

- The total calculated fluid includes both parenteral infusions and enteral feedings
- If newborn started feeding the fluid to be administered is obtained by subtracting total daily volume of milk from total fluid.
  Example – weight of baby boy is 3kg, total daily fluid is 300ml, he is to be fed with 10ml of milk 3hourly making total 80ml/day - his IV infusion must be 300 – 80 ml = <u>220 ml/day</u>
- In addition, whenever fluid is advanced in daily basis, the amount of milk to be given should be taken in to consideration.
- Deduct volume of any other perfusions like transfusion, fluid used for dilution of medication from the maintenance fluid except trophic feeding.
- Once full feeding is achieved, IV fluid is discontinued. (refer to nutrition section for further guidance on this)

5. Monitoring of fluid & electrolytes

- The maintenance fluid should be perfused continuously over 24 hours (Use a monitoring sheet.).
- Fluid converted into drops per minute. 1ml = 20 drops (use drop factor mentioned in the infusion set)
- Fluid drip is monitored each time to check whether or not running (dripping) – Check the drip rate and volume infused every hour
- Use perfusor pump if it is available. It is important especially if baby is kept NPO.
- Check for infusion site for any leakage, swellings, redness, or infection.
- Change IV site if sign of factors mentioned above
- Monitor baby with :
    - Weight daily
    - Clinical evaluation daily (Watch for facial swelling/fluid overload)
    - Urine output daily
    - Electrolyte & glucose (RBS) determination daily

C. Fluid preparation

- Fluid is available in the form of 5% DW, 40% DW, 9% NS, or RL, but there is no readily prepared fluid for newborn or pediatric age group in the market.
- We have to prepare fluid using what is available. To prepare fluid, use following formula.

We need to prepare x% DW from a% DW and b% DW

General formula is

$$Vb = \frac{(a - x)\,Tv.}{(a - x) + (x - b)} \qquad Va = \frac{(x - b)\,Tv.}{(a - x) + (x - b)}$$

Where

x = conc. of DW wanted
a = highest conc. of DW
b = lowest conc. of DW

Vb = volume of b
Va = volume of a
Tv = total volume needed = (Vb + Va)

Example 1: How to prepare Total volume (Tv) of 10%DW from 40%DW & 5% DW.

Given

x = 10% Vb = Volume of 5%

a = 40 Va = volume of 40%

b = 5% Tv = total volume needed = (Vb + Va)

Using the general formula

$$Vb = \frac{(40 - 10)\,Tv.}{(40 - 10) + (10 - 5)} \qquad Va = \frac{(10 - 5)\,Tv.}{(40 - 10) + (10 - 5)}$$

$$Vb = (30)Tv/35 \qquad Va = (5)Tv/35$$

Total daily fluid volume required by baby girl weighing 3000gm (3kg) is -

3 x 100 = 300 ml/day and type of fluid to be given is 10% DW:

Therefore

Tv = 300ml, Vb = 30 x 300/35 = 57.1ml Va = 5 x 300/35 = 42.85ml

Thus total volume = V of b (257.1) + V of a (42.85) ml.

= 299. 95ml (~ 300 ml) 10% DW

Example 2: To prepare 15%DW of 200 ml (Tv) from 40%DW & 5% DW :

Given

x = 15% Vb = Volume of 5%

a = 40 Va = volume of 40%

b = 5% Tv = total volume needed = (Vb + Va)

Using the general formula

$$Vb = \frac{(40 - 15)\,200.}{(40 - 15) + (15 - 5)} \qquad Va = \frac{(15 - 5)\,200.}{(40 - 15) + (15 - 5)}$$

$$Vb = 5000/35 \qquad Va = 2000/35$$

$$Vb = 142.86ml \qquad Va = 57.14ml$$

Tv= Vb + Va

Tv= 142.86ml + 57.14ml

Tv= ***200ml***

This type of fluid (15%DW) is used when preparing 10%DW with ⅓NS. If ⅓ NS is added to 15%DW, the new fluid combination will have concentration of 10%DW, solute effect of the NS assumed to be negligible.

Example -3: To prepare ⅓ N/S in 10% DW.

Prepare 10% DW in ⅓NS for a baby requiring total fluid volume (Tv) of 300ml from 40%DW & 5%DW

Step – 1: To get proportions of fluid to be combined

a. 1/3 of the fluid is NS : - ⅓NS = Tv/3 = 300/3

Vol. of NS = 100ml

b. 2/3 of the fluid is from 10% DW = ⅔Tv = ⅔300 = 200ml

Step – 2: Preparing x%DW, which when diluted to ⅓NS, gives 10%DW .

Given

x = 15% Vb = Volume of 5%

a = 40 Va = volume of 40%

b = 5% Tv = total volume needed = (Vb + Va)

Using the general formula

$Vb = \frac{(40 - 15)\ 2/3(300).}{(40 - 15) + (15 - 5)}$ $Va = \frac{(15 - 5)2/3(300).}{(40 - 15) + (15 - 5)}$

Vb = 5000/35 Va = 2000/35

Vb = 142.86ml Va = 57.14ml

Step – 3, combine the different type of fluid to get Total volume (TV) required.

= Vol. of NS (1/3Tv) + vol. of ⅔Tv (DW)

= 100ml + 200ml

= 300ml/d of 10% DW in1/3NS.

NB: how x =15% was found?

It is calculated from observation that the total volume of fluid (Tv) will consist the same amount of glucose in the ⅔Tv. i. e. – glucose in Tv = Glucose in 2/3Tv

Example:

In 300ml ⅓NS in 10%DW: glucose is 30gm.this same amount should come from ⅔Tv of fluid.

DW+NS = 300ml → 30gm

⅔ of 300ml → 30gm

200ml → 30gm

100ml → 15gm or 15/100 (15%)

D. Electrolyte imbalance and Management

- If baby is having fluid deficit due to excessive lose because of repeated vomiting, diarrhea, 3rd space lose or if he/she has features of dehydration, or if he/she is in shock, then he/she needs urgent treatment

Electrolyte disorder: The approach to a patient with Electrolyte disorder depends on status of fluid volume i.e. Volume depleted or in excess (edema)

- Common electrolytes imbalances in NICU include hyponatremia, hypernatremia, hyperkalemia, hypokalemia, hypocalcemia.
- There should be high index of suspicion of electrolyte imbalance in sick newborn and should be handled by NICU physician.

Table 4: Electrolyte disorder, clinical presentations and management

Electrolyte disorder	Values	Causes	Clinical presentation/ diagnosis	Treatment/ Management
Sodium (Na)				
Hyponatremia	<135 meq/L		- Asymptomatic - Symptomatic: usually < 120meq/L, seizure, neurological obtundation	- If asymptomatic correct deficit over 48 hours. 1/3NS can correct. - if symptomatic: 3%NS, 12ml/k over 4hours, aiming to raise level to > 125meq/L and 7.5%NaHCo3
Hypernatremia		1. With ECF deficit - Increased Insensible water lose - Extensive skin lesion - ADH deficiency - Acute Gastroenteritis - *Clinical presentation* - Weight lose, tachycardia, hypotension, metabolic acidosis 2. With Excess ECF volume - Excessive Administration of Isotonic or hypertonic solution - Administration of Sodium containing medication like NaHCo3. - Feeding with high solute formula	- Increased weight, edema, Increased FE – Na - BP, Heart rate, urine output, sp. Gravity may be normal	- Reduce Na concentration in the fluid - Reduce rate of Na administration - Threat DHN or shock - Use 2/3 of maintenance as 1/3Na in 5% dextrose, the rate of drop shouldn't exceed by 10meq/L/d
Syndrome of Inappropriate secretion of Ant-Diuretic		- Asphyxia, IVH, Meningitis, Pulmonary diseases like Pneumothorax, Drugs like Opiates, barbiturates, diuretics,	- Clinical: weight gain, edema, Oliguria - Lab. Ix: Increased urine Na, sp. Gravity and	- Fluid restriction for 24 hours then readjust based on clinical response - Furosemide (1-

Hormone (SIADH)		Indomethacin, and Oxytocin.	osmolarity - Decrease in serum Na but BUN, Cr. May be normal	2mg/kg/dose) to increase water lose.
Potassium (K)				
Hypokalemia	< 3.5meq/L	- NGT or Ileostomy drainage, Gastroenteritis, NEC, Diuretics, ATN	- Arrhythmia, paralytic Ilieus, abdominal distension, feeding intolerance, obtundation or altered level of consciousness - ECG changes: prolonged QT interval, ST interval & T-wave depression, U-wave Treatment	- Reduce Gastrointestinal and renal loses and if there is lose replace - Add 2meq/k/d to maintenance fluid
Hyperkalemia	> 6meq/L	- Sever birth asphyxia, metabolic acidosis, and renal failure - Prematurity - Old blood transfusion - Drugs like Indomethacin - Congenital Adrenal Hyperplasia (CAH)	- Arrythymia, Heart failure - ECG changes: Tall T-wave, prolonged PR interval, and QRS; absent P-wave, sine Wave, Ventricular tachycardia or Fibrillation	- Discontinue sources of K especially in the IV fluid, ECG monitor - Cal.gluconate 1-2ml/k over 4 minute with cardiac monitoring - NaHCO3 1-2ml/k - Furosemide 1mg/k - Insulin/glucose drip: bolus I 0.05u/2ml of 10% glucose then Insulin 0.1u/2-4ml of 10% glucose - If no response peritoneal dialysis or exchange transfusion with fresh blood
Calcium (Ca)		-	-	-
Hypocalcaemia		1. Early onset (1st 3 days)	Clinical manifestations	- Prevent by providing

		- Preterm: transplacentally passage occurs towards end of pregnancy - Infant of Diabetic Mother (IDM): multifactorial- increased demand, Impaired Transplacental transfer from mother... - Birth asphyxia: Impaired PTH function, renal injury, metabolic acidosis 2. Late onset (usually after 7th day) - Hypoparathyroidism - Vitamin D deficiency - Miscellaneous factors: Hungry bone syndrome- increased demand for Ca (SGA, - Hypoparathyroidism, Increased vitamin. D activity), hyperphosphatemia, hypoalbuminemia, Alkalosis, lipid infusion, Furosemide, sepsis.	- Increased excitability, jitteriness, increased tone, clonuse hypereflexia, stridor carpopedal spasms. - In early onset (preterm), usually asymptomatic - In late onset may come with seizures Lab Findings - Low serum levels: total < 7mg/dl, ionised < 4mg/dl - Increased phosphate serum level - Thymic shadow may be absent on Chest X ray	prophylactic Ca. To preterm, asphyxiated or sick babies - Calcium Gluconate: 5ml/kg/d q6-8hrs over 20 – 30 minutes (with cardiac monitor) - In emergency situation (seizure, tetany, apnea): 2ml/kg over 5 minute. Repeat this if no response in 10 minute - Monitor till serum level > 7mg/dl, monitor cardiac status each time - Correct underlying problem if possible
Hypercalcemia	>11mg/gl	- Hyperparathyroidism, - Hyperthyroidism, - Hypophosphatemia, - Hypophosphatasia, - Hypervitaminosis D, - Hypervitaminosis A, - Decreased Renal clearance	- May not be symptomatic till >14mg/dl - Hypotonia, lethargy or seizure, hypertension, hypoxia, poor feeding, - Vomiting, constipation, polyuria, in long term hepatosplenomegaly, anemia	- volume expansion with Isotonic solution, if cardiac function is normal 10 – 20ml/kg over 15 – 30 minutes - Furosemide 1mg/kg q6-8hrs - Treatment with Phosphate, Glucocorticoids

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Chapter 15: Shock in the Neonates

Learning Objectives

At the end of this session, the participants will be able to:

- Identify causes of shock
- Diagnose shock in newborns
- Recognize management of shock in neonates

Definition: It is the physiologic state characterized by significant reduction of systemic tissue perfusion, resulting in decreased tissue oxygen and nutrient delivery.

Causes of Neonatal Shock

1. **Hypovolemic shock**: It is the commonest cause of shock in neonates. It follows volume loss due to several reasons, commonly:
   - Hemorrhage (Intracranial/ extracranial)
   - Abruption of placenta
   - Fetomaternal hemorrhage
   - Twin to twin transfusion
   - DIC
   - Neonatal infections (Increased capillary leak/ Gastroenteritis)
   - Excessive volume depletions (Diuresis)

2. **Distributive shock**
   - Sepsis related to increased inflammatory responses
   - Rapid heating
   - Abnormal vasoresponse

3. **Cardiogenic shock**
   - Asphyxia
   - Myocarditis,
   - Arrhythmia

4. **Obstructive shock**: It is due to decreased cardiac output including congenital heart diseases.

Diagnosis*:* It has two broad manifestations

A. Compensated shock –the body will try to adapt the inadequate perfusion with the following physiologic adjustments so that the metabolism will be maintained
   - Tachycardia, BP is maintained normal
   - Increased SVR (systemic vascular resistance) – manifested by cold, pale skin, oliguria and ileus
   - Wide pulse pressure, hypotension are earlier manifestation in septic shock

B. Decompensated shock

- Decreased systolic BP
- Lethargy
- Irreversible organ damage
- Preterms (ICH)

Management*:* Shock in newborns is a medical emergency! Specific therapy depends upon the causes of shock.

Supportive treatment

- **ABC** of life
- Correction of hypoglycemia, hypocalcemia and acidosis
- Intranasal oxygenation
- If large amount of fluid is given 2ml/kg/dose of Calcium gluconate 10% can be administered

Fluid treatment in hypovolemic shock

- Crystalloids (normal saline 20ml/kg within 30min to one hour) can be given three times (60ml/kg) we need to have end goal directed treatment until V/S, urine output, capillary refill and mentation become stable.
- If time permits, fresh frozen plasma can be used.
- The best volume expander, although rarely available, is whole O-negative blood cross-matched against the mother's blood. This provides volume, oxygen-carrying capacity, and colloid
- After stabilization, follow the neonate closely.
-

Acute blood loss

- Whole blood 20ml/kg less than 7 days old over one hour.
- If blood is not available, volume expanders like 0.9% N/S can be used till blood is prepared.

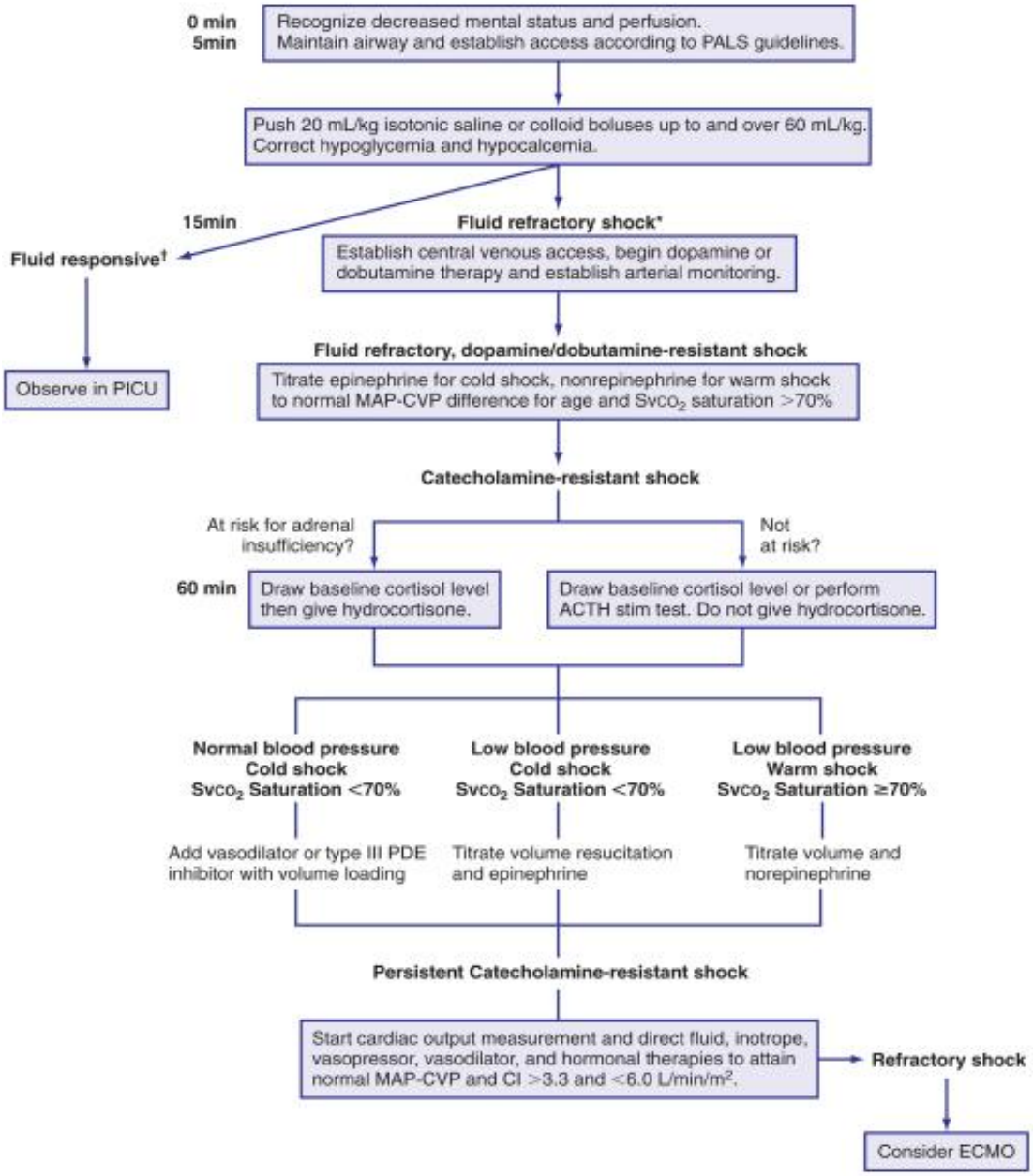
However if the shock is resistant to fluid treatment one should consider septic shock or cardiogenic shock.

Remember that in septic shock you would give as much as 60-80ml/kg of total fluid followed by blood transfusion 20ml/kg of whole blood and Hydrocortisone administration. Give broad spectrum IV antibiotics in suspected septic shock.

Medications

Inotropes

- **Dopamine** – its action is dose dependent. It is the first line of treatment, use dopamine with strict follow up
  - **Low dose 2-5mcg/kg/min** stimulates renal, mesenteric and coronary blood flow but little effect on cardiac output.
  - **Intermediate dose** 5-9mcg/kg/min it has both chronotropic and inotropic effect.
  - **High dose (vasopressor dose) 10-20mcg/kg/minute**
- **Dobutamine** in a dose 5-15mcg/kg/min increases cardiac output with little effect on heart rate.
- **Epinephrine** (1 in 10,000) it has both inotropic and chronotropic effect. The dose is 0.1-0.3ml/kg IV repeat the dose every 3-5 minutes
  - It has a beta1-adrenergic effect, which stimulates the heart, but, of more importance, it also has an alpha adrenergic effect that increases noncerebral peripheral resistance.
- **Milrinone is** a phosphodiasterase inhibitor, used to increase intracellular calcium, increasing cardiac contractility. It improves diastolic myocardial function, decreases pulmonary vascular resistance and SVR.


0 min
5min
Recognize decreased mental status and perfusion.
Maintain airway and establish access according to PALS guidelines.
Push 20 mL/kg isotonic saline or colloid boluses up to and over 60 mL/kg.
Correct hypoglycemia and hypocalcemia.
15min
Fluid responsive†
Observe in PICU
Fluid refractory shock*
Establish central venous access, begin dopamine or dobutamine therapy and establish arterial monitoring.
Fluid refractory, dopamine/dobutamine-resistant shock
Titrate epinephrine for cold shock, nonrepinephrine for warm shock to normal MAP-CVP difference for age and Svco2 saturation >70%
Catecholamine-resistant shock
At risk for adrenal insufficiency?
Not at risk?
60 min
Draw baseline cortisol level then give hydrocortisone.
Draw baseline cortisol level or perform ACTH stim test. Do not give hydrocortisone.
Normal blood pressure
Cold shock
Svco2 Saturation <70%
Low blood pressure
Cold shock
Svco2 Saturation <70%
Low blood pressure
Warm shock
Svco2 Saturation ≥70%
Add vasodilator or type III PDE inhibitor with volume loading
Titrate volume resuscitation and epinephrine
Titrate volume and norepinephrine
Persistent Catecholamine-resistant shock
Start cardiac output measurement and direct fluid, inotrope, vasopressor, vasodilator, and hormonal therapies to attain normal MAP-CVP and CI >3.3 and <6.0 L/min/m2.
Refractory shock
Consider ECMO

Chapter 16: Congenital malformations in neonates

Learning objectives:

At the end of this session, the trainee will be able to recognize common congenital malformations and their management

Congenital Anomalies

- *Neural tube defects and hydrocephalus*
- *Trisomies-Down syndrome*
- *Pierre Robin syndrome*
- *Choanal atresia*
- *Cleft lip and cleft palate*
- *Esophageal atresia & tracheoesophageal fistula*
- *Hypospadias*
- *Undescended testis*

Introduction

Congenital anomalies, whether they are isolated (single) or part of syndromes are causes of long-term illness and death. They are contributing for about 4 % of neonatal mortality in Ethiopia. Health personnel working in NICUs are among the first to identify newborns with congenital anomalies so they need to know basic features of these anomalies and immediate treatment of associated and life threatening illnesses before referral. Subsequent management needs team of experts in well-equipped centers.

Neural tube defects (NTDs)

Neural tube defects (NTDs) are common congenital anomalies of the central nervous system (CNS).

The exact cause is not known but the following risk factors are incriminated: hyperthermia, drugs, malnutrition, chemicals, maternal obesity or diabetes and radiation exposure during pregnancy.

Major NTDs include spina bifida occulta, meningocele, myelomeningocele, encephalocele and anencephaly.

Spina bifida occulta

- Is midline defect of the vertebral bodies without protrusion of the spinal cord or meninges.
- Usually occurs in the lumbar and sacral regions of the spinal cord.
- Most patients are asymptomatic and have no neurologic abnormalities.
- May be covered with patches of hair, lipoma or discoloration of the overlying skin.
- The diagnosis can be confirmed by vertebral x –ray which shows the defect in the lumbosacral column.

Meningocele

- Is the herniation of the meninges through a defect in the posterior vertebral column
- Appears as midline sac filled with cerebrospinal fluid (CSF) mostly covered by skin.
- Those newborns with leaking cerebrospinal fluid or a thin skin covering need urgent referral for immediate surgical treatment to prevent meningitis.

Myelomeningocele

- Most severe form of NTDs , characterized by protrusion of spinal cord and meninges through a defect in the spinal cord.
- Appears as a saclike cystic structure covered by a thin-layered membrane (*see Figure 34)*
- The lumbosacral region accounts for about 75% of the cases.
- May cause bowel and bladder incontinence with loss of pain sensation in the perineal area.
- The covering membrane may rupture easily and results in CSF leak and meningitis.
- The newborn may have flaccid paralysis (weak extremities with diminished tone and deep tendon reflexes) of the lower extremities, lack of response to touch and pain.
- Commonly associated with clubfeet and hydrocephalus.

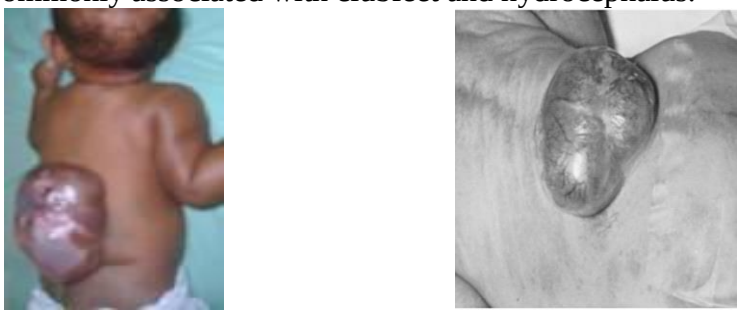


Figure 34: Myelomeningocele covered with thin membrane

Management of myelomeningocele

Immediate management includes

- Covering the defect with a sterile saline-soaked dressing.
- Prevention of hypothermia.
- Placing the newborn in a prone or lateral position to avoid pressure on the lesion.
- Antibiotics for meningitis
- Anticonvulsants if they have seizure (see management of neonatal seizure)

Parents should be informed about the condition of the neonate, available interventions and referral or neurosurgical consultation should be arranged.

The back lesion should be surgically closed as early as possible (within the first 72 hours) after birth to decrease the risk of CNS infection.

Complications

- Meningitis
- Increased intracranial pressure due to hydrocephalus

- Urinary tract infection
- Bed sore
- Early childhood death

Encephalocele

- Is protrusion of meninges with or without brain tissue through a midline defect in the skull (*see Figure* 35).
- Commonly occurs in occipital regions and vary in size from few millimeters to many centimeters.

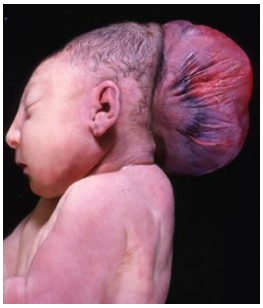


Figure 35: Encephalocele

Anencephaly

- Is a condition where the roof of the skull and the posterior occipital bones are defective or absent exposing remnants of neural tissue (*see Figure 36*)
- This condition is not compatible with survival.

Figure 36: Anencephaly

Prevention of NTDs

- Folic acid supplementation for all women of childbearing age.
- Inform mothers about risk of recurrence and use of folic acid before next pregnancy.

Hydrocephalus

It is a condition associated with excessive production or impaired absorption of CSF.

Causes

- Congenital infections (TORCH)
- Meningitis

- Following intracranial hemorrhage
- Intracranial mass lesions
- Congenital malformations of the nervous system

Clinical features

- Big head –head circumference greater than 90th percentile on standard curves
- Full and tense fontanelles
- Markedly separated cranial sutures.
- Setting sun eye sign and broad forehead.
- Seizure

Diagnosis

- Enlarged head circumference at birth.
- Serial measurements cross percentiles in standard head circumference curves
- Signs and symptoms
- Skull x-rays (widening of sutures, prominent convolutional markings on the inner table of the skull and erosion of the sella turcica).
- Transfontanelle ultrasound (ventricular or subarachnoid space enlargement).

Treatment

Treatment depends on the cause and includes therapy for any associated conditions and measures directed toward the hydrocephalus.

Medical management includes:

- Acetazolamide – to decrease CSF production
- Mannitol – to decrease high intracranial pressure (ICP)
- Furosemide – if mannitol is not available
- Removal of CSF by interval lumbar puncture under strict aseptic condition

The above measures may provide temporary relief by reducing the rate of CSF production, but not recommended for long-term use.

Most cases of hydrocephalus require ventriculoperitoneal shunts or ventriculostomy, so referral or neurosurgical consultation should be considered.

Major complications after ventriculoperitoneal shunt include:

- Shunt occlusion / malfunction- vomiting, mental status changes and
- Shunt infection – persistent fever, neck rigidity

Trisomies

Trisomies are among the major numerical disorders of chromosomes, characterized by the presence of 3 instead of the normal 2 chromosomes. Major trisomies include trisomy 21 (Down syndrome), trisomy 18 (Edwards syndrome) and trisomy 13 (Patau syndrome).

Down syndrome (DS)

Down Syndrome is the most common chromosomal abnormality among live born infants with an incidence of 1 in 750 live births. It is characterized by a variety of dysmorphic features, congenital malformations, and other health problems and medical conditions. The occurrence of DS as it is true for other autosomal trisomies increases with advanced maternal age (≥35 yr).

Neonatal features

The following characteristic features are common in newborns with DS and are usually recognized soon after birth.

- Flat facial profile
- Slanted palpebral fissures
- Low-set ears
- Protruded tongue
- Small chin
- Short neck
- Flat occiput
- Thin & silky hair ,
- Hypotonia
- Poor Moro reflex
- Dysplasia of middle phalanx of fifth finger
- Transverse palmar (Simian) crease
- Excessive skin at nape of the neck
- Hyperflexibility of joints
- Dysplasia of pelvis.

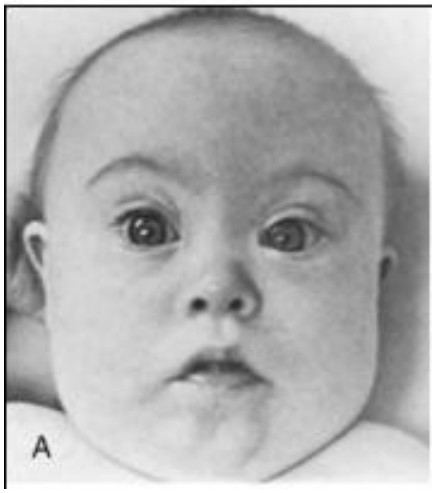


Figure 37: Newborn with features of Down syndrome

DS is also associated with cognitive impairment and congenital heart defects, gastrointestinal anomalies, leukemia, immune dysfunction, hypothyroidism, diabetes mellitus, and problems of hearing and vision.

Newborns with DS will also have hypothermia, jaundice, polycythemia and decreased feeding.

Diagnosis

- Suspected from the characteristic phenotypic/physical features present in the newborn.
- Eight or more of the above dysmorphic features.

- Confirmed with a karyotype, performed on a blood sample.

Laboratory tests

- Determine CBC since they are at risk of polycythemia, transient leukemoid reactions, thrombocytopenia or thrombocytosis.
- Serum bilirubin
- Thyroid function test
- ECG
- Echocardiography

Management

- Inform and counsel parents.
- Treat associated problems (polycythemia, hyperbilirubinemia, hypothyroidism and prevent hypothermia)
- Refer for detailed evaluation and management.

Pierre Robin syndrome

- This syndrome comprises micrognathia, cleft soft palate, and upper airway obstruction caused by the tongue falling back into the hypopharynx.
- The infants present with varying degrees of respiratory difficulty, cyanotic spells, poor feeding, and failure to thrive.
- An airway can be maintained by positioning the infant prone with the head down; this allows the tongue to fall forward and can prevent obstruction of the airway.
- Many infants, however, cannot be successfully maintained this way and continue to have frequent bouts of cyanosis and aspiration.
- Positioning an endotracheal tube through a nostril into the hypopharynx indicated for infants with frequent bouts of cyanosis.
- With time the mandible develops, and the muscles of the jaw become strong enough to keep the tongue forward.

Choanal Atresia

Choanal atresia is the presence of septum between the nose and pharynx resulting obstruction of airflow. Neonates are predominant nose breathers for the first 4 to 6 weeks of life. Bilateral choanal atresia is the most common cause of complete nasal obstruction. Associated anomalies occur in 20% to 50% of infants with choanal atresia.

Clinical feature

Bilateral obstruction always produces symptoms in the neonatal period.

- History of distress when resting that is relieved with agitation and crying.
- Difficulty of feeding, interrupted feeding, worsening of distress while feeding
- Severe asphyxia
- Cyanosis

Diagnosis

- Hold rolled piece of cotton near to nostril and observe whether the cotton is waving while baby is breathing.
- Failure to pass NG tube to each nostril 3-4 cm to the nasopharynx suggests choanal atresia.

Treatment

- Treatment depends on the severity of the obstruction and the clinical presentation of the infant.
- Unilateral atresia rarely requires surgical intervention during infancy and is usually corrected before school begins (4 to 5 years of age).
- For bilateral atresia, put oropharyngeal airway immediately and consult for surgical intervention.
- Start feeding EBM with orogastric tube

N.B.

- Insert NG tube gently and avoid use of excessive force, which may result in trauma.
- Look for and treat associated anomalies.

Cleft Lip (CL) and Cleft Palate (CP)

Orofacial clefts (cleft lip and cleft palate) are common birth defects. Cleft lip may occur either in association with cleft palate or in the absence of cleft palate, and is generally referred to as "cleft lip with or without cleft palate" (CL/P). They may occur as part of a syndrome involving multiple other organs or as an isolated malformation. CL may be unilateral in 80% or bilateral in 20% of cases. When unilateral, it is more common on the left side (70%).

Causes

- Folic acid deficiency
- Use of methotrexate in pregnant mother
- Environmental factors such as cigarette smoking and alcohol use in pregnancy
- Use of anticonvulsants (phenytoin and valproic acid)

Clinical features and diagnosis

- CL may vary from a small notch in the vermilion border to a complete separation involving skin, muscle, mucosa, tooth, and bone.
- Deformed, supernumerary or absent teeth are associated findings.
- CP with CL may involve the midline of the soft palate and extend into the hard palate on one or both sides, exposing one or both of the nasal cavities.
- Sub mucosal cleft of palate may present with a bifid uvula, partial separation of muscle with intact mucosa, or a palpable notch at the posterior of the palate.

Management

- Feeding is the immediate challenge for the health personnel working in NICU.

- Use soft artificial nipples with large openings and a squeezable bottle.
- Instruct parents on difficulties of feeding the risk of aspiration.
- Look for associated anomalies (congenital cardiac defects, vertebral anomalies, limb deformities and renal anomalies).
- Refer for subsequent management (surgery, follow up and speech rehabilitation) by a team of experts.

Esophageal atresia (EA) & Tracheoesophageal Fistula (TEF)

Esophageal atresia (EA) is the most frequent congenital anomaly of the esophagus (≈1/4,000 neonates). More than 90% of newborns with EA have an associated tracheoesophageal fistula (TEF). Infants weighing <1,500 g at birth have the highest risk for mortality. In about half of the cases this condition is associated with anomalies, most often the **VACTERL** (vertebral, anorectal, cardiac, tracheal, esophageal, renal, radial, limb) syndrome.

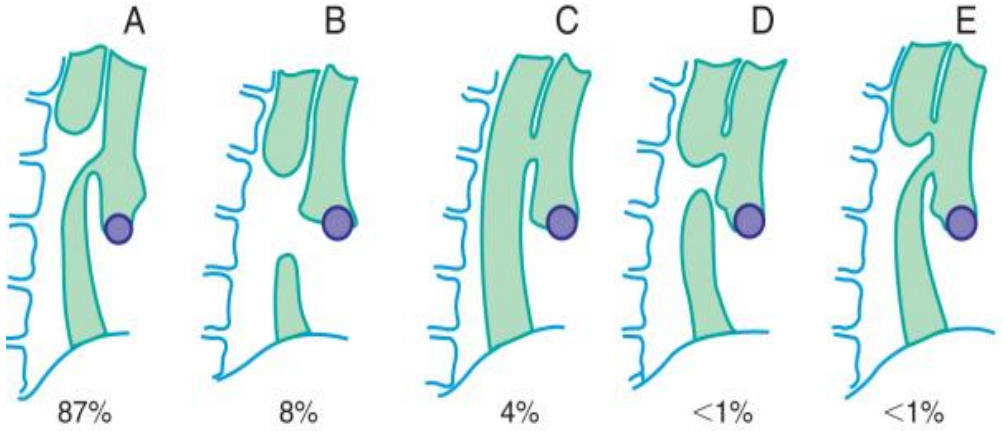


Figure 38: Types EA & TEF with their relative frequencies.

Description of the picture

A- Proximal esophageal atresia with distal TEF.
B- Proximal and distal EA without fistula
C- TEF without atresia
D- Proximal TEF and distal EA
E- Proximal and distal TEF

Clinical features

- Excessive secretion at the mouth and nose after birth
- Episodes of coughing, cyanosis, and respiratory distress exacerbated by feeding
- In the above picture all are neonatal emergencies except picture C

Diagnosis

- History of maternal polyhydramnios
- Failure to pass a nasogastric tube
- Chest x- ray with NG tube in situ (coiled tube in the esophageal pouch)

Management

- Maintain patent airway with frequent suctioning and positioning
- Keep the newborn NPO and put him/her on maintenance fluid.
- Keep the newborn in prone position to minimize aspiration
- Exclude associated anomalies.
- Arrange transportation and referral/consult for surgical management.

N.B

- For suspected cases of EA & TEF avoid feeding before excluding the diagnosis by inserting NG tube.

Hypospadias

Definition and Description

- Hypospadias (*hypo* = below; *spadon* = a fissure or a 'hole') consists of some or all of the following features:
    1. Ventral displacement of the urethral meatus (Hypospadias)
    2. Incomplete formation of the prepuce (dorsal 'hooding')
    3. Ventral curvature (chordee)
- Urethral meatal openings are generally described as being:
    1. Anterior – where the meatus is near the tip of the penis
    2. Middle – where the meatus is along the shaft of the penis
    3. Posterior – where the meatus is near the base of the penis or in the scrotum

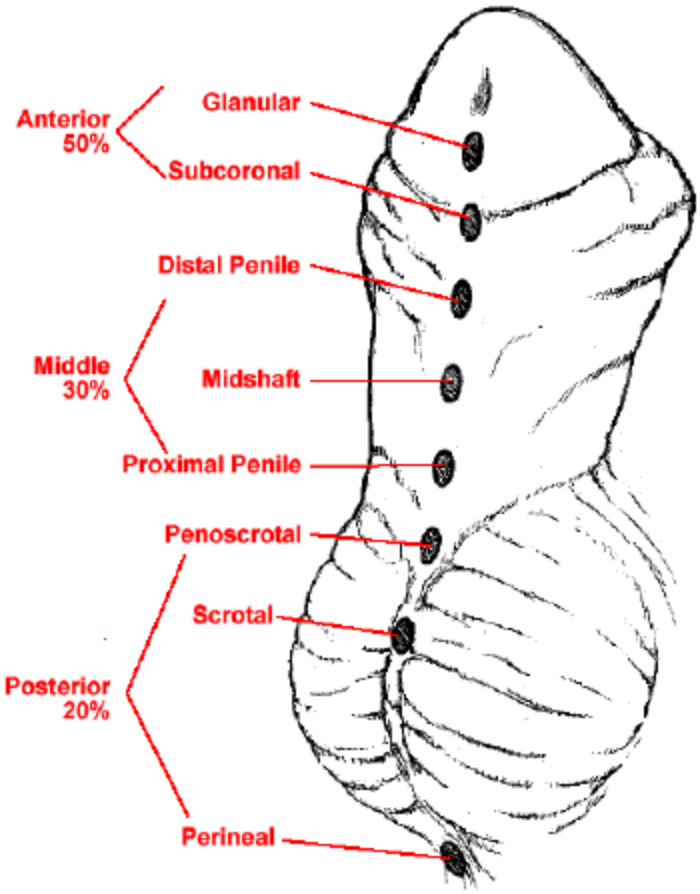


Figure 39: Hypospadias

Early recognition and pediatric urological referral is useful for counseling and planning timing of surgery

Management

- Early recognition and pediatric urological referral is useful for counseling and planning timing of surgery
- Parents should be reassured that hypospadias are common condition which can be corrected with surgery.
- Surgery is usually undertaken between 6 and 18 months.
- It is critical that parents are told that circumcision should not be performed, as the foreskin remnant is required for surgical repair.

Undescended testis

- This condition is suspected when the testis are not found in the scrotum on routine examination. It is also called cryptorchidism.
- Most boys with undescended testis will have their testis descended spontaneously in the first six months.
- The testis could be located in the abdomen (non-palpable) or in the inguinal canal (palpable).

- Problems associated with undescended testis include infertility, testicular cancer, hernia and testicular torsion.
- In these infants, empty scrotum and inguinal mass are common findings.
- If a mass is seen in the inguinal area, it should be assessed carefully for size, shape and mobility.
- Parents should be informed about this condition and subsequent follow up should be arranged.
- Surgical management or referral will be considered within 9-15 months if there is no spontaneous descent on follow up.

Chapter 17: Common congenital heart diseases

Learning objectives:

At the end of this session, the trainees will be able to recognize the clinical manifestations of common congenital heart diseases and their management

Introduction

Globally, CHD affects over one million live births annually and is the leading cause of infant mortality attributable to birth defects. Critical congenital heart disease (CCHD) refers to lesions of the cardiovascular system, present at birth, which if left undiagnosed it will result in infant morbidity and mortality.

Transposed great arteries, hypoplastic left heart, total anomalous pulmonary venous drainage, coarctation of the aorta, and interrupted aortic arch account for more than 70% of cyanotic congenital heart disease. Until recently, clinical examination followed by blood gas analysis (100% oxygen challenge) and echocardiogram have been the mainstays for diagnosis.
At birth, Nada's criteria are used to evaluate a newborn and the presence of one Major or two Minor Criteria indicates Presence of Congenital Heart Disease.

Nada's Major Criteria

Systolic murmur with thrill
- Any diastolic murmur
- Cyanosis (central)
- Congestive cardiac failure

N*ada's Minor Criteria*
- Systolic murmur without thrill
- Abnormal P2 (accentuated P2)
- Abnormal BP (hypo / hypertension)
- Abnormal CXR
- Abnormal ECG

If the Nada's criteria are positive then, send the baby where he can be definitely diagnose with echocardiography and evaluated further. All babies suspected to have CHD should be managed with cautions in IV fluid administration to avoid congestion.

Approach to neonate with cardiovascular disease
- On physical examination look for :-
  - Cyanosis (Central)
  - Murmur (the presence or absence of murmur doesn't rule out or rule in CHD)
  - Abnormal second heart sound
  - Respiratory distress
  - Hepatomegaly (but not specific)

    - Pulse (compare radial and femoral, rate, irregularity, and volume)
- Blood pressure measurement (on upper and lower extremities)
- Pulse oximetry (both preductal/right hand and postductal/lower extremities to see the ductous arteriosus flow pattern at 24 hr of age. In a baby with no lung problem < 90 % on either or < 95 % on both is a positive pulsoxymetry test).
- Hyperoxic test (give 100 % oxygen and measure the saturation)
    - Patient with pulmonary disease has increases oxygen saturation by > 10%
    - Those fixed with Right → Left shunt (Cyanotic lesions) have a small rise < 10%
    - It does not rule out those lesions with Left → Right shunt (acyanotic CHD)
- Radiologic findings
    - Less informative but helps to see the heart size and pulmonary blood flow
- Electrocardiography (ECG)
    - To look for the rate, rhythm and chamber hypertrophy and axis.
    - Sinus tachycardia, Right QRS axis, relatively small voltage, RV hypertrophy.
- Echocardiography
    - It's a definitive diagnostic method to evaluate the heart

Look for associated syndromes

- Down's syndrome (endocardial cushion defect PDA and VSD)
- Turner syndrome (Coarctation of aorta)
- Trisomy – 13 (VSD, ASD, PDA and dextrocardia)
- Trisomy – 18 (VSD)

Table 16: Time of onset of congestive heart failure

Age	**Lesions**
Birth - 72 hrs	Pulmonary, Mitral, and Aortic atresia or critical stenosis
4 days - 01 week	Hypoplastic Lt and Rt heart, Transposition of great arteries
1wk - 4wks	VSD and PDA in premature infant and the lesions mentioned above
4 – 6 wks	Endocardic cushion defect (ECD)
6wk – 6 mo	Large VSD, large PDA

Management

a. Strict cardio respiratory support and monitoring
b. Supportive oxygen therapy
c. Restrict fluid intake to one half to two third of daily maintenance.
d. Treat or correct precipitating factors
e. Treat metabolic derangements (hypoglycemia, hypothermia)
f. After stabilization of the patient refer to a higher center for proper diagnosis and management.

References

1- Avory A. Fanaroff and Martin's Neonatal- Perinatal Medicine 9th edition
2- Perloff the Clinical Recognition of CHD 4th edition.

Chapter 18: Acute/emergency surgical conditions

Learning Objectives

At the end of this session, the trainee will be able to:

- Recognize the most common acute/emergency surgical conditions
- Recall/name their management

Table 20: Common Intestinal Obstruction in the Newborn

Site obstruction	Clinical findings	Radiology findings	Management
Duodenal Atresia	Early vomiting, sometimes bilious 30% of cases are associated with Down syndrome They may have sign of DHN	Double bubble" (dilated stomach and proximal duodenum, no air distal)	Supportive treatment (keep NPO, secure IV line & start IV fluid, insert NGT,) Urgent Consultation for surgical management
Malrotation and volvulus	Bilious vomiting with onset anytime in the first few weeks	Dilated stomach and proximal duodenum; paucity of air distally (may be normal gas pattern)	Supportive treatment (keep NPO, secure IV line & start IV fluid, insert NGT,) Urgent Consultation for surgical management
Jejunoileal atresia, meconium ileus	Bilious gastric contents > 25 mL at birth. Progressive distention and bilious vomiting	Multiple dilated loops of bowel. Intra-abdominal calcifications if in-utero- perforation occurred (meconium peritonitis)	Supportive treatment (keep NPO, secure IV line & start IV fluid, insert NGT,) Urgent Consultation for surgical management

Table 21: Intestinal Obstruction in the Newborn

Intestinal obstruction	Clinical manifestation	Radiology finding	Management
Imperforated anus	Missing or moved opening to the anus Baby does not pass first stool within 24 - 48 hours after birth Stool passes out of the vagina, base of penis, scrotum, or urethra(if	Distended bowel loop. Absence of rectal air	Supportive treatment (keep NPO, secure IV line & start IV fluid, insert NGT,) Urgent Consultation for surgical management

	there is fistula)		
Meconium plug syndrome; Hirsch sprung disease	Abdominal distention. Delayed passing meconium (> 24 h) May have also bilious type of vomiting	Diffuse bowel distention	Supportive treatment (keep NPO, secure IV line & start IV fluid, insert NGT,) Urgent Consultation for surgical management

Abdominal Wall Defects

Omphalocele

Omphalocele is a membrane-covered herniation of abdominal contents into the base of the umbilical cord. There is a high incidence of associated anomalies (cardiac, GI, and chromosomal—e.g., trisomy 13). The sac may contain liver and spleen as well as intestine

Management

Acute management of Omphalocele involves:

- Covering the defect with a sterile dressing soaked with warm saline to prevent fluid loss.
- NGT decompression
- IV fluids and glucose
- Antibiotics
- Keep NPO until the surgical opinion obtained
- Urgent surgical consultation

Figure 41: Omphalocele

Gastroschisis

In gastroschisis, the intestine extrudes through an abdominal wall defect lateral to the umbilical cord. There is no membrane or sac and no liver or spleen outside the abdomen. Gastroschisis usually is not associated with other anomalies

Management

- Covering the defect with a sterile dressing
- Soaked with warm saline to prevent fluid loss
- N GT decompression
- Keep NPO
- IV fluids and glucose
- Antibiotics
- Urgent surgical consultation

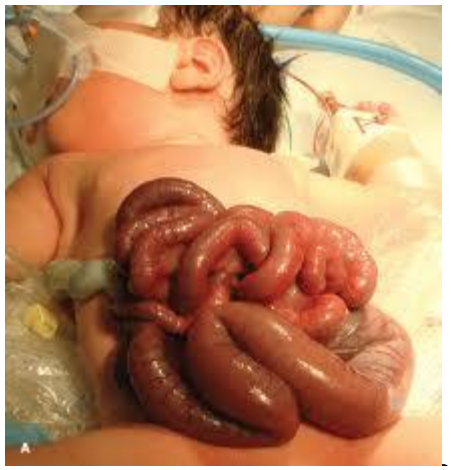


Figure 42: Gastroschisis

Diaphragmatic Hernia

This congenital malformation consists of herniation of abdominal organs into the hemi thorax (usually left) through a postero-lateral defect in the diaphragm

Clinical manifestation

- It presents in the delivery room as severe respiratory distress
- Absence breath sounds and scaphoid abdomen
- Presence of bowel sound in the chest

Management

- Avoid giving bag and mask ventilation
- Prepare for intubation
- Insert NGT for decompression of the GI tract
- Keep NPO
- Start IV infusion of glucose and fluid
- Chest radiograph confirms the diagnosis

Urgent surgical consultation should be made

Chapter 19: Pain management: Post-surgery, post-traumatic, burn pain management

Learning objectives:

At the end of the session, the trainees will be able to:

- Describe pain assessment modalities
- Explain pain prevention and management in neonates

Management of pain in neonates

Introduction

- Preterm and term newborns demonstrate similar or even exaggerated physiological and hormonal responses to pain compared with those observed in older children and adults. "**If it would hurt you, it hurts them!"**
- Neonates have less ability to demonstrate pain symptoms and thus depend on others to recognize, assess, and manage their pain by recognizing the neonate's associated ***behavioral and physiological*** responses to pain.
- Exposure to prolonged or severe pain may increase neonatal mortality and affect long-term neurodevelopmental outcome. A lack of behavioral responses (including crying and movement) does not necessarily indicate a lack of pain especially when the infant is extremely immature, acutely ill or the painful stimulus is severe and /or prolonged.

Pain assessment modalities in term and preterm newborns

1. ***Behavioral indicators of pain***: Facial expression, body movement and crying
2. ***Physiological indicators of pain***
   - Change in heart rate, respiratory rate, blood pressure, Oxygen saturation.
   - Vagal tone, palmar sweating, and plasma cortisol or catecholamine level

Table 17: The Pain Assessment Tool (PAT)

Parameters	Description	Score (0 - 2)
Posture/Tone	Flexed and/or tense	2
	Extended	1
Sleep Pattern	Agitated or withdrawn	2
	Relaxed	0
Expression	Grimace	2
	Frown	1
Cry	Yes	2
	No	0
Colour	Pale/Dusky/Flushed	2
	Pink	0
Respirations	Apnea	2
	Tachypnea	1
Heart rate	Fluctuating	2
	Tachycardia	1
Saturations	Desaturating	2
	Normal	0
Blood Pressure	Hypotensive/ Hypertensive	2
	Normal	0
Nurses Perception:	Yes Pain	2
	No Pain	0
Total Score		

Note: Sedation may mask the neonate's response to painful stimuli and does not provide pain relief!

Advised Interventions Required:

- PAT Score <5: Nursing Comfort Measures (NCM)
- PAT Score >5: Paracetamol and NCM
- PAT Score >10: Paracetamol, NCM and opioid (bolus/ infusion to be commenced) (Note- these interventions are only a guideline and an individual approach should be used for each patient)

Pain prevention and management

Environmental and behavioral approaches during procedure

- Clustering painful interventions prior to a comforting events (e.g. feeding or holding)
- Swaddling (tightly wrapping with cloth) during the procedure
- Non-nutritive sucking: pacifier
- Change diaper

Following the procedure

- Reducing noise and light
- Touch or massage
- Skin to skin contact (KMC)
- Holding the baby using blanket rolls

Physiological interventions (this are sucrose analgesia and competitive stimulation)

Glucose analgesia:-

- 25 % - 30% sucrose (glucose) 1.5 – 3ml PO ~ 2 minutes prior to the procedure for term newborns
- Suckling a nipple used as analgesia for peripheral venous punctures.
- 25 % sucrose (glucose) 0.5 – 1.5 ml PO ~2 minutes prior to the procedure for preterm NB

Competitive stimulation

- Gentile rubbing, taping or vibrating one extremity before and during painful stimulus to another extremity

Table 18: Pharmacologic and physiologic management of pain

Procedures	**Intubated and ventilated infants**	**Non intubated infants**
Arterial puncture Venipuncture	25 %– 30 % sucrose (glucose) 1.5 - 3ml/kg PO	25 %– 30 % sucrose (glucose) 1.5 - 3ml/kg PO
Heel-stick blood draw	25 %– 30 % sucrose (glucose) 1.5 - 3ml/kg PO	25 %– 30 % sucrose (glucose) 1.5 - 3ml/kg PO
Intravenous placement	25 %– 30 % sucrose (glucose) 1.5 - 3ml/kg PO	25 %– 30 % sucrose (glucose) 1.5 - 3ml/kg PO
Lumbar puncture	25 %– 30 % sucrose (glucose) 1.5 - 3ml/kg PO	25 %– 30 % sucrose (glucose) 1.5 - 3ml/kg PO
Dressing change	25 %– 30 % sucrose (glucose) 1.5 - 3ml/kg PO and Morphine sulphate 0.05-0.1 mg/kg IV or Fentanyl 2-3mic gr/kg IV	25 %– 30 % sucrose (glucose) 1.5 - 3ml/kg PO and Morphine sulphate 0.025-0.05 mg/kg IV or Fentanyl 2-3mic gr/kg IV 0.05mg/kg/dose orally.
Endotracheal suctioning (mechanically ventilated)	Morphine sulphate 0.05-0.1 mg/kg IV or Fentanyl 2-3 mic gr/kg IV	
Urinary catheters/Suprapubic bladder tap	-Use pacifier with 24% sucrose 1;5 – 3 ml 2 minutes prior to procedure	-Use pacifier with 24% sucrose 1;5 – 3 ml 2 minutes prior to procedure

Special Considerations

- Morphine is the drug of choice for most situations requiring pain relief
- Wean slowly after prolonged use of morphine, reduce dose by 10-15% of the original dose every 2-3 days as tolerated.

Table 19: Analgesia for invasive procedure

Procedures	None intubated infants	Intubated and ventilated
Palliative Care	-Physical and psychological strategies for pain management -Oral morphine may be used as recommended by the palliative care team	
Chest tube insertion	-Morphine 0.1 mg/kg/dose IV 20 minutes prior to procedure -Use pacifier with 25% Sucrose 0.5-2.0 ml PO 2 minutes prior to procedure. -Buffered lidocaine 1% SQ as local anesthetic. -Start morphine infusion of 5-10mcg/kg/hr following bolus and assess infant as per guidelines for sub acute pain management	-Morphine 0.1 mg/kg/dose IV 20 minutes prior to procedure -Buffered lidocaine 1% SQ as local anesthetic. -Start morphine infusion of 5-10mcg/kg/hr following bolus and assess infant as per guidelines for sub acute pain management
Chest tube removal	-Use pacifier with 25% Sucrose 1.5-3.0 ml PO 2 minutes prior to procedure	Use pacifier with 25% Sucrose 1.5-3.0 ml PO 2 minutes prior to procedure
Circumcision	-30% sucrose1.5-3ml PO and -Acetaminophen 10-15 mg/kg 2 hrs before and every 6hrs after the procedure (x24 hrs) and -Ring block (lidocaine 0.5%)(max 0.5cc/kg)	Not applicable
Laparotomy	Fentanyl 0.25-0.5 micrograms /kg Q 4-6 hrs. or Morphine 0.025-0.05 mg/kg IV or S/C Q 4 hrs or -50 micrograms/kg/dose orally	-Fentanyl 0.25-0.5 micrograms /kg Q 4-6 hrs. or -Morphine 0.025-0.05 mg/kg IV or S/C Q 4 hrs
Thoracotomy	-Acetaminophen 10-15 mg/kg Q 6 hrs or -Fentanyl 0.25-0.5 micrograms/kg Q 4-6 hrs. -Morphine 0.025-0.05 mg/kg IV or S/C Q 4 hrs or -50 micrograms/kg/dose orally	-Fentanyl 0.25-0.5 micrograms /kg Q 4-6 hrs. -Morphine 0.025-0.05 mg/kg IV or S/C Q 4 hrs or
Neurosurgical	-Acetaminophen 10-15 mg/kg Q 6 hrs or -Fentanyl 0.25-0.5 micrograms /kg Q 4-6 hrs. or -Morphine 0.025-0.05 mg/kg IV or S/C Q 4 hrs or -50 micrograms/kg/dose orally	-Fentanyl 0.25-0.5 micrograms /kg Q 4-6 hrs. or -Morphine 0.025-0.05 mg/kg IV or S/C Q 4 hrs or

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2. Newborn cerise drug protocol, Reviewed by Dr Kuchel, Simon Rowley and Brenda February 2001
3. Pediatrics 2000;105;454 Section on Surgery and Canadian Paediatric Society, Fetus and Newborn Committee Committee on Fetus and Newborn, Committee on Drugs, Section on Anesthesiology, Prevention and Management of Pain and Stress in the Neonate

Chapter 20: Infection prevention

Learning objectives:

At the end of this session, participants will able to

- Identify predisposing factors to hospital-acquired infection
- Recognize and apply principle of infection prevention

Infection prevention

- Infection prevention is an important part of every component of care of a Newborn baby.
- Strict infection prevention protocol should be followed in delivery rooms and NICUs as newborn babies are susceptible to infections because their immature immune system.
- Neonatal infection is the leading cause of neonatal mortality in Ethiopia, contributing for 31% of neonatal deaths. Common causes of health care–associated infections are seasonal viruses, staphylococci, and gram-negative bacilli.
- Transmission of infectious agents occurs by various routes, but by far the most common and important route is via the hands.
- Thermometers and other equipment that come into contact with mucous membranes are special risks.
- Common sites of hospital-acquired infection are - respiratory tract, gastrointestinal tract, bloodstream, skin, and urinary tract.

***Predisposing factors to hospital-acquired infection include**:*

- Host factors
    - Damage to skin- Birth injuries
    - Anatomic abnormalities like dermoid sinuses, cleft palate,
    - Organ dysfunction,
    - Intrauterine growth retardation (IUGR)
    - Underlying diseases or co-morbidities
- Prior invasive procedures: intravenous and other catheters bypass host defenses; provide direct access to sterile sites.
- Use of catheters and other devices
- Use of antibiotics: Antibiotics often alter normal bowel flora and encourage colonization by resistant flora.
- Exposure to other patients, visitors, or health care providers with contagious diseases

Principles of Infection Prevention

1. Provide routine care of the newborn baby
    - After the first six hours of life or after the baby's temperature is stable, use cotton cloth soaked in warm water to remove blood and other body fluids (e.g. from the birth) from the baby's skin, and then dry the skin, delay bathing until at least the second day of life

- Use swab to clean the baby if there is excess bleeding & if the baby is meconium stained.
- Clean the buttocks and perinea area of the baby each time the baby's napkin is changed, or as often as required, using cotton soaked in warm, soapy water, and then carefully dry the area.

2. Consider every person (including the baby and staff) as potentially infectious.

- **Do not allow** staff or visitors to enter the newborn care unit if they have an acute infection (e.g. respiratory infection unless he/she puts on mask & gown, skin infections or lesions unless he/she puts on gloves & gown to come into direct contact with babies).
- Limit the number of different individuals handling the baby.

3. ***Hand hygiene****:* Wash hands with soap and water (as shown in the picture below) or disinfect them using an alcohol-based handrub):- before and after caring for a baby and before any procedure; - after removing gloves; - after handling soiled instruments or other items.
    - Instruct the mother and family members to wash their hands before and after handling the baby. Thoroughly wet hands; wash hands for 10 to 15 seconds with plain soap and running or poured water and allow hands to air-dry or dry them with a clean paper or personal towel.
    - An alcohol-based handrub: Mix alcohol and glycerin solution: 2ml of glycerin + 100 ml of alcohol 70-90%; clean hands with 3 to 5 ml of solution. Cover the entire surface of hands and fingers; rub the solution into hands until they are dry.

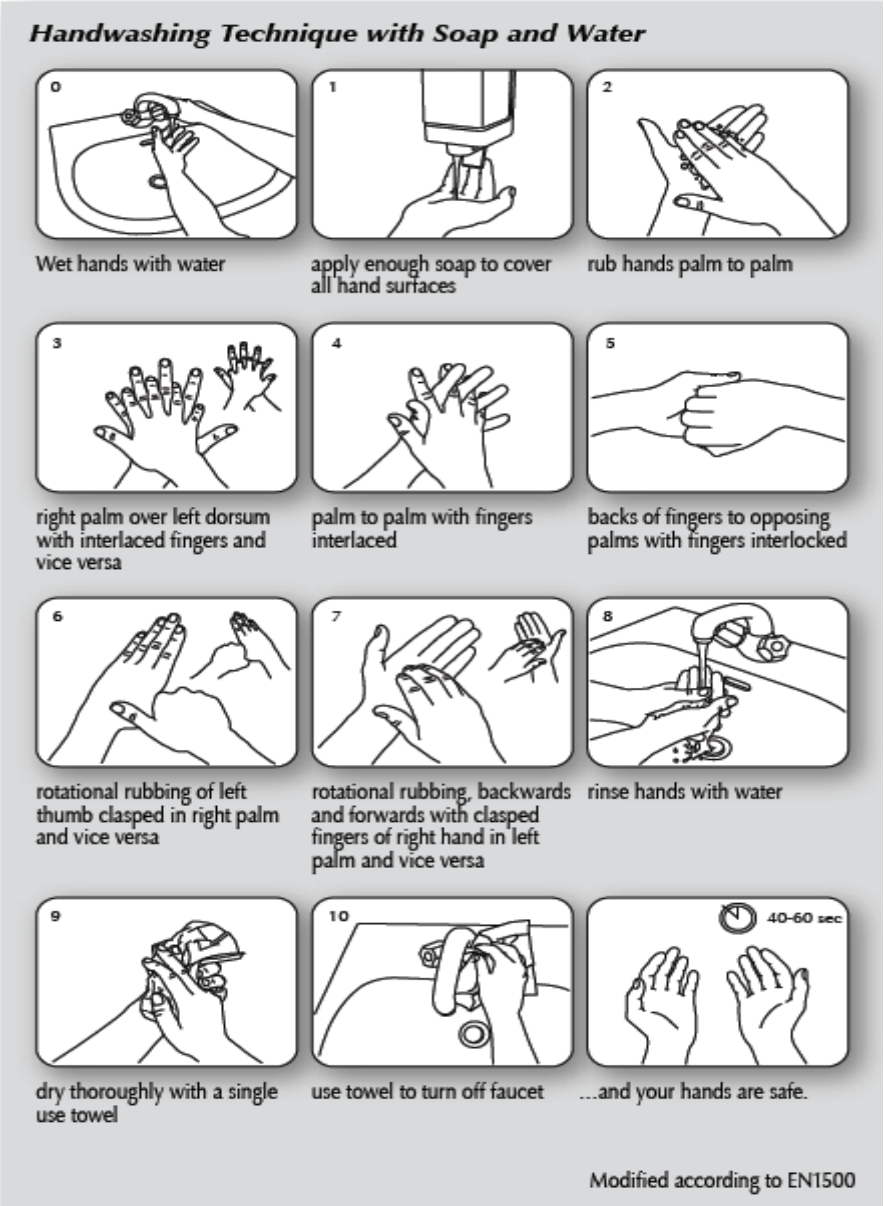

Figure 40: Hand washing Technique with soap and water

4. Protective clothing and gloves

- It is not necessary to wear gowns or masks when providing routine care for newborn babies.
- Wear protective clothing (e.g. aprons, gowns) when contact with blood or body fluids is anticipated.
- Wear closed-toe shoes

Use different gloves for different situations:

- Wear sterile or high-level disinfected gloves for contact with broken skin or for invasive procedures (e.g. lumbar puncture, umbilical vein catheterization);
- Wear clean examination gloves for contact with mucous membranes or body fluids (e.g. taking a blood sample, caring for the umbilicus);
- Wear heavy rubber or latex utility gloves for handling contaminated items, cleaning instruments and equipment, and disposing of waste.

5. Space management in NICU

- One bed for one baby

6. ***Use aseptic technique***.

- Scrub hands for three to five minutes using an antiseptic soap, and rinse with running or poured water
- Allow hands to air dry or dry them with a clean paper or personal towel.
- Put on clean examination gloves.
- Prepare the skin for procedures by washing with a swab or cotton wool ball soaked in an antiseptic solution in an outward spiral motion. Repeat two more times, using a new swab or cotton-wool ball each time, and allow to dry. If polyvidone iodine is used, allow it to dry after applying or wait at least two minutes before continuing with the procedure.
- Remove examination gloves and put on high-level disinfected or sterile gloves.
- Use sterile or high-level disinfected instruments and equipment.
- If there is any question about whether an item is sterile or not, consider it contaminated.

7. Avoid contamination

- If possible, ***Do not*** keep opened glass ampules so that the drug can be used for multiple babies. The drug may not be stable, and taping ampules shut will not prevent contamination.
- Discard diluent solutions (e.g. sterile water or normal saline) after 24 hours.
- Change the IV infusion set and fluid bag every 24 hours; even if the bag still contains IV fluid, (they can be a major source of infection).

Standard antiseptic and disinfectant solutions

Standard antiseptic solutions: for skin preparation or scrub, for taking blood sample or establishment of I. V line

- 2.5%polyviodine
- 4% chlorhexidine gluconate
- 60 to 90%ethyl or isopropyl alcohol

Standard disinfectant solutions

- 0.5% chloride bleach
- 2% glutaraldehyde

8. Instruments and equipment safe handling of sharp instruments

- Immediately dispose sharps by placing them in a puncture-proof container. Do not leave them on the sterile surface were they may cause a needle stick injury.
- ***Do not*** recap, bend, or break the needle or remove it from the syringe.

Instrument Processing Guidelines (after each use)

Thermometers and stethoscopes –

- Wipe with a disinfectant solution after each use.
- Dedicate a single thermometer and stethoscope for each bed.

Resuscitation bag and mask –

- Wipe exposed surfaces with gauze pad soaked in disinfectant solution
- Wash with soap and water

Weighing machine-

- Shouldn't be shared with other pediatric wards
- Should be cleaned after every use.

Incubator or radiant warmer-

- Wipe with a disinfectant solution daily
- Wash radiant warmer with soap and water before using for a new baby
- Wash incubator weekly, if the same baby is still in the incubator, and before using for a new baby

Suction apparatus and catheter, gastric tube, nasal prongs, nasal Catheter

- Soak in disinfectant solution for 10 minutes,
- Wash with soap, high-level disinfect or sterilize.
- Oxygen head box (if available) –
- Wash with soap and water

Ensure that a fresh container containing disinfectant solution is available at all times

- Immediately clean up spills of blood or body fluids using disinfectant solution.
- After each use, wipe off beds, tables, and procedure trolleys using disinfectant solution.
- Clean and dry the bottle containing water for humidification of oxygen daily.

9. *Routinely clean the newborn special care unit.*

- Have a housekeeping schedule and post the cleaning schedule in a visible area. Clean the floor twice a day and more if needed and clean the room once a week.

10. Care of Health Care Workers

- ***Exposure to human immunodeficiency:*** The risk of a health care worker acquiring HIV after a needle stick or other "sharps" injury is less than 0.5%. Risk reduction must be undertaken for all blood borne pathogens, including: adherence to standard precautions using personal protective equipment and appropriate use of safety devices and a needle disposal system to limit sharps exposure.

- ***Sharp injuries:*** Needle stick injuries are the most common of sharps injuries, although other contaminated sharp instruments may also cause injuries. All health care workers with potential exposure should be vaccinated. For other personnel, the risk of hepatitis B, hepatitis C and HIV infection should be assessed and appropriate immunization or chemoprophylactic steps taken. Immediate treatment of such injuries should encourage washing thoroughly with running water and an antiseptic solution. An incident reporting system should be in place. It should not be seen as penalizing. Post exposure prophylaxis should be given as per the national guideline.

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Chapter 21: Common neonatal procedures

Learning objectives:

At the end of this session, the trainees will be able to:

- Explain principles behind common neonatal procedures
- Practice common neonatal procedure

GENERAL PRINCIPLES OF INFECTION PREVENTION

Observing the infection prevention practices below will protect the baby, mother, and health care provider from infections. They also will help prevent the spread of infections.

- Provide routine care of the newborn baby.
- Consider every person (including the baby and staff) as potentially infectious.
- Wash hands or use an alcohol-based handrub.
- Wear protective clothing and gloves.
- Use aseptic technique.
- Handle sharp instruments carefully, and clean and, if necessary, sterilize or disinfect instruments and equipment.
- Routinely clean the newborn special care unit, and dispose of waste.
- Isolate babies with infections to prevent nosocomial infections.

ADMINISTERING OXYGEN

- Ensure that the baby does not receive too little or too much oxygen:
    - Giving too little oxygen may cause organ damage and eventual death;
    - Giving too much oxygen may damage the baby's lungs and retinas. This damage, however, occurs after days (rather than minutes or hours) of excess oxygen therapy and is unlikely to occur in babies more than 35 weeks gestation.

Table 22: Methods for administering oxygen

Method	Flow and Concentration	Advantages	Disadvantages
Nasal Prongs	- Low = 0.5 L per minute - Moderate = 0.5 to 1 L per minute - High = more than 1 L per minute	- Low flow of oxygen required - Constant concentration of oxygen if applied correctly	- Requires special prongs for use on newborn babies - Requires flow control device that allows low flow - Directs cold oxygen into baby's lungs
Nasal Catheter	- Low = 0.5 L per minute - Moderate = 0.5 to 1 L per minute - High = more than 1 L per minute	- Low flow of oxygen required - Constant concentration of oxygen if applied correctly	- Requires flow control device that allows low flow - Directs cold oxygen into baby's lungs
Head box	- Low = 3 L per minute - Moderate = 3 to 5 L per minute - High = more than 5 L per minute	- Warms the oxygen - Can give a high Concentration	- High flow of oxygen required to achieve desired concentration
Face mask	- Low = 1 L per - minute - Moderate = 1 to 2 L per minute - High = more than 2 L per minute	- Oxygen can be administered quickly - Convenient for administering oxygen for short periods of time	- Carbon dioxide can accumulate if flow rate is low or mask is small - Difficult to feed baby while mask is in place - Difficult to keep mask in place
Incubator	- If using a head box inside the incubator, see above - If connecting oxygen directly to the incubator, follow the manufacturer's instructions	- Warms the oxygen	- Disadvantages of giving oxygen directly into the incubator: - High flow of oxygen required to achieve desired concentration - Difficult to maintain oxygen concentration when incubator portholes are open for care and procedures

Nasal Prongs

- Use 1-mm prongs for a small baby (less than 2.5 kg at birth or born before 37 weeks gestation) and use 2-mm prongs for a term baby.
- Place the prongs just within the baby's nostrils.
- Secure the prongs in place using elastic or a piece of adhesive tape.
- Adjust the flow of oxygen to achieve the desired concentration.
- Change the nasal prongs twice daily. Give oxygen using a face mask while cleaning and disinfecting the prongs, if necessary.

Nasal Catheter

- Use an 8-F catheter. If the **8-F catheter is too large**, use a 6-F catheter.
- Determine the distance the tube should be passed by measuring the distance from the nostril to the inner margin of the eyebrow.
- Gently insert the catheter into the nostril. If a **gastric tube is already in place in one nostril**, insert the catheter into the same nostril that the gastric tube is in, if possible.
- Ensure that the catheter is correctly positioned:
    - Look into the baby's mouth;
    - The catheter should not be visible at the back of the mouth;
    - If the **catheter is visible at the back of the mouth**, pull the catheter out slowly until it is no longer visible.
- Adjust the flow of oxygen to achieve the desired concentration.
- Change the nasal catheter twice daily. Give oxygen using a face mask while cleaning and disinfecting the catheter, if necessary.

Head Box

- Place a head box over the baby's head.
- Ensure that the baby's head stays within the head box, even when the baby moves.
- Adjust the flow of oxygen to achieve the desired concentration.

FIGURE 43 - Baby receiving oxygen via a head box

Face Mask
- Place the mask over the baby's mouth and nose.
- Secure the mask in place using elastic or a piece of adhesive tape.
- Adjust the flow of oxygen to achieve the desired concentration.

Incubator
- Use a head box, following the instructions for a head box, or connect the oxygen directly to the incubator according to the manufacturer's instructions.
- Adjust the flow of oxygen to achieve the desired concentration.

Sources of Oxygen

Ensure that a source of oxygen is available at all times. Oxygen is expensive, so use it only in situations where it is necessary, and discontinue as soon as possible. There are three main sources of oxygen, which are described below. The oxygen is carried from the source to the baby by means of non-crush, plastic oxygen delivery tubing. A face mask, which can give a high concentration of oxygen, should always be available in case of rapid deterioration of the baby's condition.

Table 23 – Source of Oxygen

Source	Special Considerations	Advantages	Disadvantages
Oxygen cylinder (cylinder filled with oxygen under high pressure)	- Ensure that a backup cylinder is available in case the first cylinder becomes empty	- Does not require electricity	- Requires a special regulator to control the flow of oxygen

Oxygen concentrator (machine that extracts oxygen from air)	- Ensure that a backup oxygen cylinder is available in case of electrical or Mechanical failure	- May be less expensive to operate than buying oxygen cylinders (in the long term) - Built-in flow control Device	- Requires a reliable source of electricity
Piped oxygen from central storage area to a wall outlet			- Expensive - Usually available only in larger health care facilities - Requires a separate flow control device at each outlet

Monitoring the Baby's response to Oxygen

- Use an oximeter according to the manufacturer's instructions to ensure that the baby receives an adequate concentration of oxygen.
- If an **oximeter is not available**, monitor the baby for signs of oxygenation by assessing whether the baby has signs of breathing difficulty or central cyanosis (blue tongue and lips) (note that these observations cannot differentiate between normal and excessive concentrations of oxygen in the blood):

Central cyanosis is a late sign that the baby is not receiving enough oxygen. If the baby shows signs of central cyanosis, increase the concentration of oxygen immediately and continue until cyanosis is eliminated.

- If the **breathing difficulty is moderate to severe**, give oxygen at a moderate flow rate;
- When the baby's breathing begins to improve (e.g. respiratory rate begins to move towards the normal range, grunting or chest indrawing decreases), decrease the oxygen flow;
- When the baby's respiratory rate is within the normal range and there are no other signs of breathing difficulty (e.g. chest indrawing or grunting on expiration), remove oxygen and observe the baby for 15 minutes:
- If the **baby's tongue and lips remain pink**, do not give any more oxygen. Observe for central cyanosis every 15 minutes for the next hour;
- If **central cyanosis reappears at any time**, give oxygen again at the last rate given;
- Continue to observe the baby for 24 hours after oxygen is discontinued.

Taking Blood Samples

- Determine how much blood will be needed to perform all necessary laboratory investigations
- Take enough blood at one time for all the tests, if possible
- Use venipuncture when more than 1 ml of blood is needed for several laboratory investigations or for blood culture and sensitivity
- Use a capillary blood sample (heel prick) If only a small volume of blood is needed

Venipuncture

- Use veins in the hands and feet first.
- Do not use jugular or femoral veins for routine sampling.
- when a sterile blood sample for bacterial culture and sensitivity is needed, use a closed system using a butterfly set and syringe

Procedure

- Identify the vein to be used
- Prepare the skin over the vein using a swab or cotton-wool ball soaked in antiseptic solution, and allow to dry
- Have an assistant use her/his forefinger and thumb to gently encircle the limb above the site selected for puncture.

Needle with a syringe or butterfly set

- Attach the syringe to the needle or butterfly set tubing.
- Insert the needle through the skin at an angle of about 15 degrees, with the bevel of the needle facing upward.
- Pull gently on the syringe plunger as the needle is advanced. Once blood flows easily into the syringe or the tubing of the butterfly set, do not advance the needle any further.
- After blood is collected:
    - Have the assistant remove her/his finger and thumb from around the baby's limb;
    - Withdraw the needle from the vein, and have the assistant apply gentle pressure to the puncture site with a dry cotton-wool ball for several minutes to prevent bruising.
- If an **open collection tube is used**, carefully recap the needle and remove it from the syringe before transferring the blood into the tube.

Needle without syringe

- This can be messy and is unsterile, making this method unsuitable for culture and sensitivity.
- Insert the needle through the skin at an angle of about 15 degrees, with the bevel of the needle facing upward, until blood flows out quickly:
- If the **blood comes out very slowly**, gently adjust the needle slightly by pulling it back or pushing it in;

- Hold the collection tubes under the needle to collect the blood, being careful not to touch the tubes or the end of the needle.

Capillary Blood Sample (Heel Prick)

- Use sterile lancet (if a lancet is not available, use a 24-gauge needle) to prick

Procedure

- Flex the foot up towards the leg and hold it in this position with one hand.
- Squeeze the heel firmly enough to make it flush red (but not so much that it turns white).
- Puncture the skin (about 1 to 2 mm deep) firmly with a lancet:
- Aim towards the lateral or medial side of the heel;
- Avoid the heel pad because of the risk of infection;
- Avoid using previously used sites, if possible.

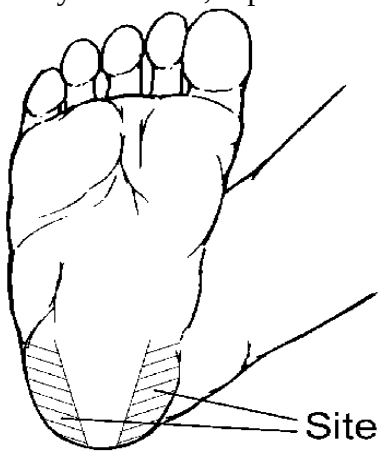


FIGURE 44 - Site for heel prick

- Squeeze the heel gently and intermittently to enhance blood flow.
- Avoid excessive squeezing and rubbing of the heel, as this will cause bruising and dilution of blood with tissue fluid, giving an inaccurate result.
- After blood is collected, have an assistant apply gentle pressure to the puncture site with a dry cotton-wool ball for several minutes to prevent bruising.

Giving Injections

A. Intramuscular injections:

General Principles:

The sites for IM injections include the:

- Quadriceps muscle group of the upper, outer thigh. This site is preferred because of the small risk of giving the injection intravenously, hitting the femur with the needle, or injuring the sciatic nerve;
- Gluteus muscle group in the buttock - use only the upper, outer quadrant of the muscle, and always aspirate before injecting to avoid injury to the Sciatic nerve and major blood vessels
- Deltoid muscle group. This site can be used for giving immunizations but should not be used for giving other injections.
- Minimize pain with injection by using a sharp needle of the smallest diameter that will allow fluid to flow freely (e.g. 22- to 24-gauge);
- Avoiding rapid injection of material;

Potential complications of IM injections include:

- Inadvertent intra-arterial or intravenous injection;
- Infection from contaminated injection material;
- Neural injury (typically the sciatic nerve after injections in the buttock);
- Local tissue damage due to injection of irritants

Procedure

- Grasp the centre of the target muscle between the thumb and forefinger, if possible.
- Insert the needle at a 90-degree angle through the skin with a single quick motion

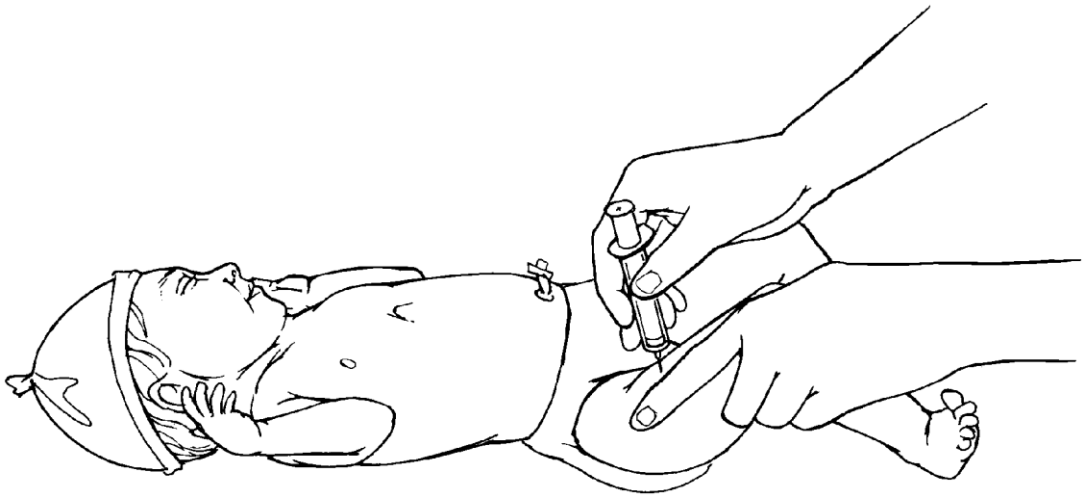


FIGURE 45 – IM injection into quadriceps muscle group

- Withdraw the plunger of the syringe slightly to ensure that the tip of the needle is not in a vein (i.e. no blood should enter the needle):
- If the **needle is in a vein** - Withdraw the needle without injecting the material; and apply gentle pressure to the site with a dry cotton-wool ball to prevent bruising; Place a new, sterile needle on the syringe; Choose a new site for injection;
- If the **needle is in the muscle**, inject the material with steady pressure for three to five seconds.
- Upon completion of the injection, withdraw the needle and apply gentle pressure with a dry cotton-wool ball.

- Record the site of the injection, and rotate the site of subsequent injections.

B. Intravenous (IV) Injections

The directions in this section are for giving an IV push injection to a baby with an IV line in place; these directions do not apply if the drug is mixed with IV fluid in a bag and then infused.

Procedure

- Choose the place in the IV line where an IV injection can be given closest to the insertion site of the cannula (e.g. a valve or a soft rubber connector)
- Clean the port with the swab or cotton-wool ball soaked in antiseptic solution, and allow to dry
- Draw the material for injection into the syringe
- Ensure that the drug and dose are correct
- If the **IV fluid was infusing without problem -** Stop the IV infusion;
- Insert the needle into the IV line, and inject the material slowly over two minutes, carefully observing the area around the cannula for swelling

If **there is any question as to whether the cannula is properly positioned in the vein**:

- Stop the IV infusion;
- Flush the IV line first with 2 ml of IV fluid, observing the area around the cannula carefully for swelling that indicates that the cannula has come out of the vein;
- If the **cannula is still in the vein**, inject the material slowly over two minutes, carefully observing the area around the cannula for swelling.
- Upon completion of the injection, withdraw the needle and restart the IV infusion.

C. Intradermal Injections

Only use intradermal injection for the BCG vaccine and when first administering local anesthetic for draining an abscess

Procedure

- Sterile 25- or 27-gauge, 5/8-inch needle
- Sterile 21-gauge, 1-inch needle
- Sterile tuberculin syringe (1-ml)
- Draw the material for injection into the syringe using the 21-gauge needle.
- Replace the 21-gauge needle with a 25- or 27-gauge needle.
- Hold the syringe and needle almost parallel with the skin, with the bevel of the needle facing up.
- Pull the skin taut with one hand, and insert the tip of the needle barely under the skin. Advance the needle slowly until the bevel of the needle has fully entered the skin.
- Gently point the needle upward, without re-piercing the skin.
- Inject the material with steady pressure for three to five seconds (there will be significant resistance) and look for a blanching of the skin. The baby will probably cry during the

injection; a true intradermal injection often burns slightly and should raise a small "bleb" under the skin that causes the skin to pucker like the skin of an orange (peau d'orange).
- Upon completion of the injection, withdraw the needle and apply gentle pressure with a dry cotton-wool ball.

Establishing an Intravenous Line

Common sites used for a baby are:
- Peripheral veins on the back of the hand or top of the foot (the most common and preferred sites);
- Veins on the forearm, the front of the elbow, or around the ankle or knee (minimize use of the veins around the knee because there is a greater risk of the needle coming in contact with the bone);
- Scalp veins.

If a **peripheral IV line cannot be established quickly in an emergency situation** , use an umbilical vein catheter or intraosseous line

A. Peripheral IV Line

Procedure
- Prepare the solution to be infused, ensuring that the entire infusion set is filled with fluid and that there is no air in the infusion set. If a **butterfly set is used**, ensure that the set is filled with IV fluid.

Air embolism can occur easily in babies. It is essential to ensure that all components of the IV infusion set are filled with fluid and that there are no air bubbles in the set before beginning the infusion.

- Have an assistant press on the skin near the vein to act as a tourniquet: If **using a vein on the hand, foot, arm, or leg**, have the assistant use her/his forefinger and thumb to gently encircle the limb above the chosen site of insertion; If **using a scalp vein**, have an assistant press over the vein below the chosen site of insertion, or place a rubber band (as a tourniquet) around the baby's head

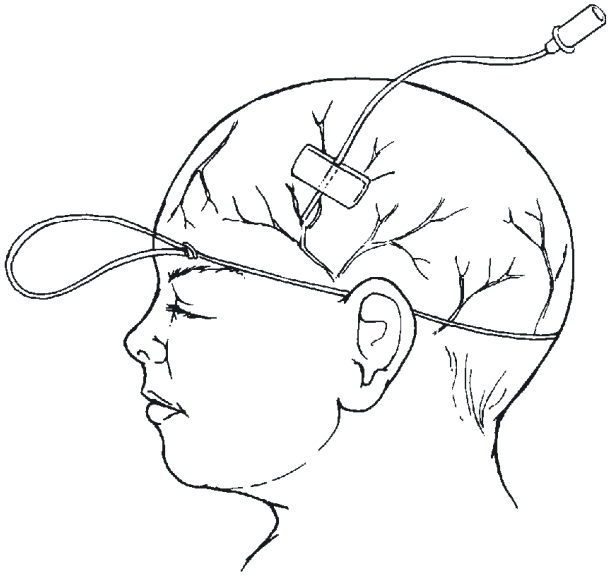


FIGURE 46- Using a rubber band as a tourniquet for scalp vein

- Insert the needle at a 15-degree angle through the skin, with the bevel of the needle facing upward:
- If **using a butterfly set**, a small amount of blood will flush back into the tubing when the vein is punctured. Do not push the needle in any further;
- If **using a cannula**: Once blood fills the hub of the cannula, withdraw the needle partially while continuing to push the cannula in;
- When the hub of the cannula reaches the skin at the puncture site, withdraw the needle completely;
- Have the assistant remove her/his finger and thumb from around the baby's limb (or remove the rubber band if a scalp vein was used).
- Connect the infusion set to the cannula or butterfly set:
- Ensure that there are no air bubbles in the infusion set;
- Infuse fluid into the vein for a few seconds to make sure that the vein has been successfully cannulated. The fluid should run freely, and there should be no swelling around the site of the cannula;
- If **swelling develops around the site of infusion**, withdraw the needle from the vein and repeat the procedure using a different vein.
- If **using a vein in the hand, arm, foot, or leg**, immobilize the limb (e.g. using an arm board [or splint] and adhesive strapping or thin paper tape) to minimize movement

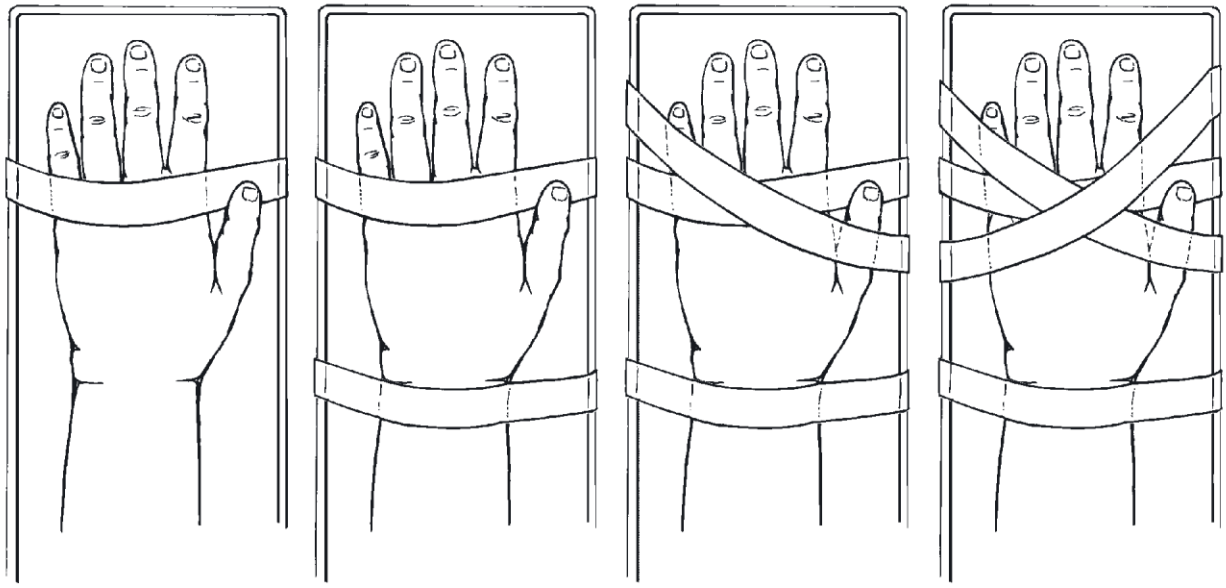


Figure 47: Immobilizing the hand

- Secure the cannula or butterfly set in position using strips of adhesive strapping or thin paper tape (e.g. **Fig. 47**). If **tincture of benzoin is available**, apply this to the skin before applying the adhesive strapping.

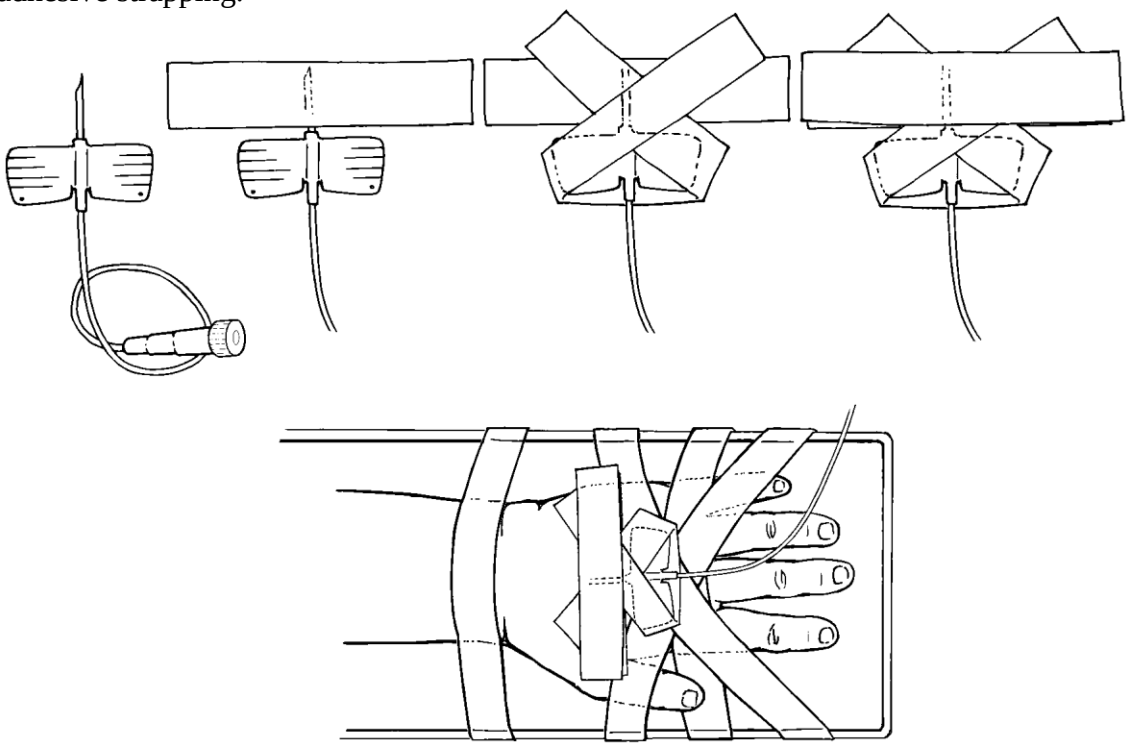


FIGURE 48 - Securing butterfly set in place

- Inspect the infusion site every hour:

- Look for redness and swelling around the insertion site of the cannula, which indicate that the cannula is not in the vein and fluid is leaking into the subcutaneous tissue. If **redness or swelling is seen at any time**, stop the infusion, remove the needle, and establish a new IV line in a different vein
- Check the volume of fluid infused and compare to the prescribed volume;

Solutions containing glucose can cause tissue to die and should not be allowed to leak into subcutaneous tissue.

- Change the IV infusion set and fluid bag every 24 hours; even if the bag still contains IV fluid, (they can be a major source of infection).

B. Umbilical Vein Catheter

An umbilical vein catheter is indicated only when the need for IV access is urgent but a peripheral IV line cannot be established quickly.

Equipment and supplies

- High-level disinfected or sterile umbilical catheter or ordinary gastric tube:
- If the baby weighs less than 1.5 kg, use a 3.5-F catheter
- If the baby weighs 1.5 kg or more, use a 5-F catheter
- Sterile infusion set with IV fluid (use a microdropper if one is available)
- Sterile 5- or 10-ml syringe
- Sterile drapes
- Sterile blade
- Cord tie or suture (to control bleeding)
- Sterile forceps
- Sterile suture, adhesive strapping, or thin paper tape (to secure catheter)

Procedure

- Prepare the solution to be infused.
- Prepare the umbilicus and surrounding skin by washing in an outward spiral motion with a swab or cotton-wool ball soaked in antiseptic solution. Repeat two more times, using a new swab or cotton-wool ball each time, and allow to dry.
- Remove examination gloves and put on high-level disinfected or sterile gloves.
- Fill the umbilical catheter with IV fluid using a closed syringe (i.e. with the plunger completely inside the barrel of the syringe) attached to the end of the catheter.

Ensure that air is not in the catheter and that a closed syringe is attached to the end of the catheter; a sudden deep breath by the baby just after the catheter has been inserted may result in an air embolus if air is inside the catheter.

- Place sterile drapes over the baby's body so that only the umbilical area is exposed.
- Place a cord tie or suture around the base of the umbilicus to control bleeding, and using a sterile blade, cut the cord to a length of 1 to 2 cm

- Identify the two umbilical arteries, which are thicker-walled and usually contracted, and the single umbilical vein, which usually has a wider opening and is found above the arteries (closer to the baby's head

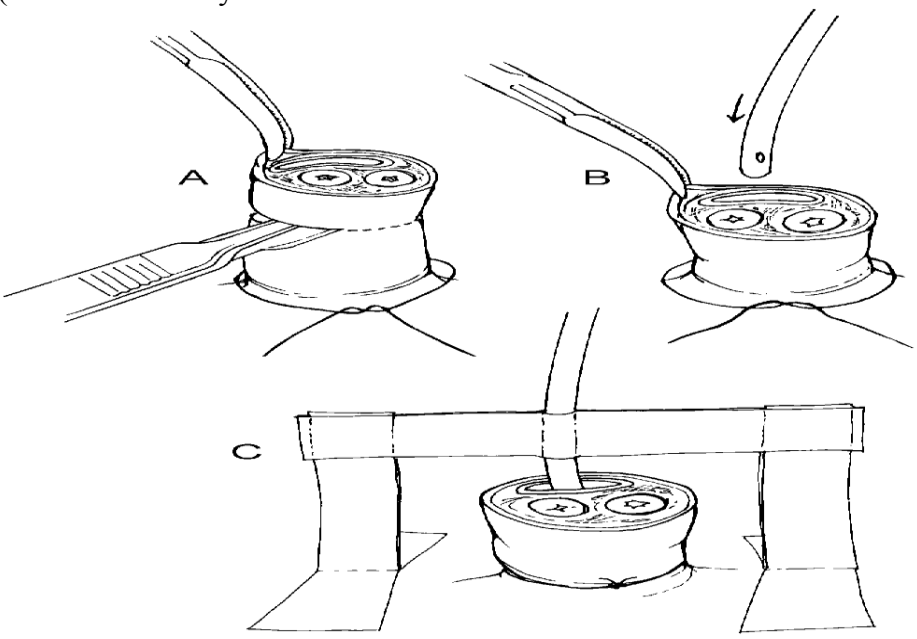


FIGURE 49 - Inserting an umbilical vein catheter

- Hold the catheter in one hand (applying gentle traction to the cord with forceps in the other hand, if necessary) and insert the catheter into the umbilical vein, guiding the catheter towards the head of the baby and to the baby's right side
- As the catheter is advanced, periodically apply gentle suction with the syringe until blood flows back. Once blood flows back freely through the catheter (usually after the catheter is inserted 5 to 7 cm), do not advance the catheter any further.
- If **resistance is encountered while advancing the catheter**, especially in the first 2 to 3 cm, do not continue. Remove the catheter and try again.

Never force the umbilical catheter if resistance is encountered.

- Tie the cord tie or suture around the stump of the umbilicus to hold the catheter in place and prevent bleeding around the catheter or from one of the arteries.
- Remove the syringe and connect the infusion set to the catheter, ensuring that there are no air bubbles in the set.
- Secure the catheter with suture material or adhesive tape to prevent it from being dislodged.
- Inspect the infusion every hour:
- Look for redness and swelling around the umbilicus, which may indicate infection. If **redness or swelling is seen at any time**, stop the infusion and remove the umbilical vein catheter. Attempt to establish a peripheral IV line again, and treat for infection of the umbilicus
- Check the volume of fluid infused and compare to the prescribed volume;

Intraosseous Infusion

Establishing intravenous access in a newborn baby can be difficult. In an emergency, a good temporary alternative is the intraosseous route using the bone marrow cavity. Fluid and drugs can be given by this route.

Remove the intraosseous line as soon as other IV access is established (within eight hours, if possible). Do not place an intraosseous line if there is infection at the intended insertion site or if the bone is fractured. Because this procedure is only performed in an emergency, no anaesthetic is required.

Supplies

- Sterile intraosseous needle, bone marrow needle, or 22-gauge needle
- Sterile infusion set with IV fluid (use a microdropper if one is available)
- Adhesive strapping or thin paper tape
- Sterile 5-ml syringe
- Elastic bandage
- Padded splint

Procedure

- Prepare the solution to be infused, ensuring that the entire infusion set is filled with fluid and that there is no air in the infusion set.
- If **using a regular hypodermic needle**, attach a 5-ml syringe filled with 3 ml of IV fluid, and flush the fluid through the needle.
- Identify the insertion site (proximal end of tibia or distal end of femur): The site at the proximal end of the tibia is 1 cm below and 1 cm medial to the tibial tuberosity; the site at the distal end of the femur is 2 cm above the lateral condyle.
- Prepare the skin over the insertion site using a swab or cotton-wool ball soaked in antiseptic solution, and allow to dry.
- Position the baby's leg with the knee bent about 30 degrees and the heel resting on the table.
- Support the upper tibia with one hand, placed so that the hand is not directly behind the site of insertion.
- Hold the needle (with the attached syringe if using a hypodermic needle) in the other hand at a 90-degree angle to the selected insertion site, angled slightly towards the foot.
- Advance the needle using a firm, twisting motion and moderate, controlled force. Stop immediately when there is a sudden decrease in resistance to the needle, which indicates that the needle has entered the marrow cavity.
- Once the needle is properly positioned, remove the stylet (if a bone marrow or intraosseous needle was used) and attach the syringe.
- Aspirate using the syringe to confirm that the needle is correctly positioned. The aspirate should look like blood.
- Slowly inject 3 ml of IV fluid to check for proper placement of needle
- Look for swelling (indicating leaking of fluid under the skin) at the front of the leg or in the calf muscle at the back of the leg. If swelling is seen, remove the needle and try again;

- If it is **difficult to infuse the fluid but there is no swelling in the calf muscle**, the needle may have entered the posterior bone cortex. Withdraw the needle approximately 0.5 cm and cautiously inject IV fluid again.
- If **no problems are detected**, attach the infusion set to the needle

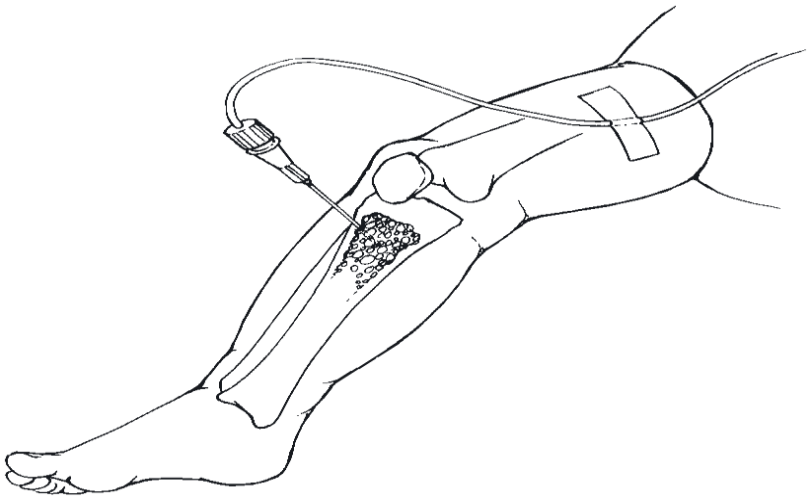


FIGURE 50- Intraosseous infusion

- Secure the needle in place using tape, and splint the leg as for a fractured femur, ensuring that the elastic bandage does not interfere with the needle or infusion set.
- Inspect the infusion site every hour:
- Look for redness and swelling around the insertion site of the cannula and in the baby's calf muscle, which indicate that the cannula is not in the vein and fluid is leaking into the subcutaneous tissue. If redness or swelling is seen at any time, stop the infusion, remove the needle, and attempt to establish a peripheral IV line again or establish a new intraosseous line at a different site;
- Check the volume of fluid infused and compare to the prescribed volume; flow rates may alter dramatically with changes in the position of the leg;
- Remove the intraosseous needle as soon as alternative IV access is available, and within eight hours, if possible.

Inserting Nasogastric Tube

A gastric tube may be inserted via one nostril or the mouth. Insert the tube via the nostril if the baby is breathing regularly, using the smallest (narrowest) tube available. Insert the tube via the mouth if the tube is needed for drainage of the stomach, for feeding a baby with breathing difficulty, or if only a relatively large tube is available.

Supplies

- Clean plastic tube or catheter appropriate for baby's weight:
    - If the baby weighs less than 2 kg, use a 5-F tube
    - If the baby weighs 2 kg or more, use an 8-F tube

- Writing pen or flexible tape measure
- 3- to 5-ml syringe (for aspiration)

Procedure

- Estimate the required length of tube:
    - Hold the tube so that it mimics the route that it will follow once inserted (i.e. from the mouth or the tip of the nostril to the lower tip of the ear lobe and then to the stomach, just below the rib margin; and place a mark on the tube with a pen or a piece of strapping;
    - Alternatively, estimate the distance using a flexible tape measure, and mark the distance on the tube with a pen or a piece of strapping.

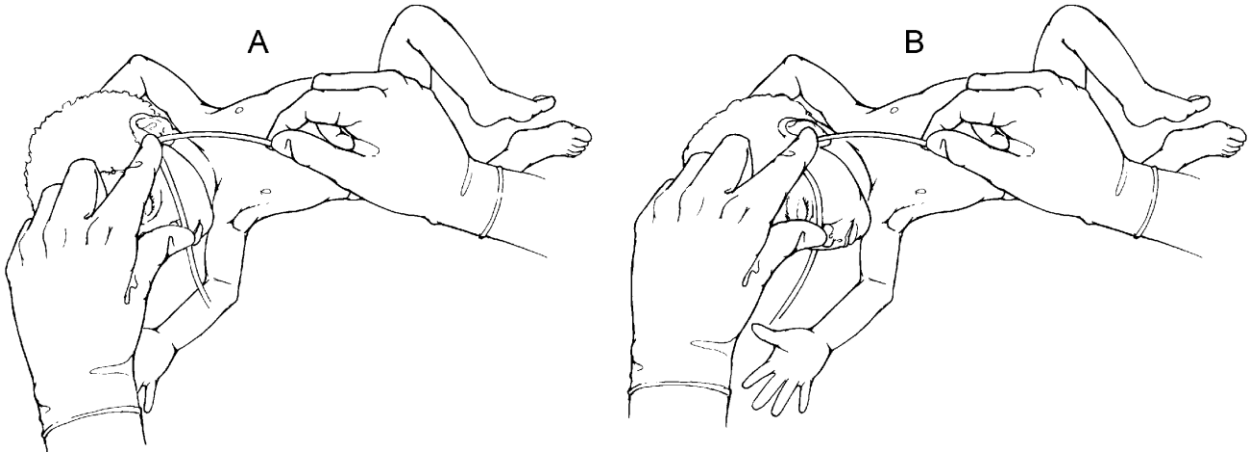


FIGURE 51- Measuring gastric tube for oral (A) and nasal (B) routes

- Flex the baby's neck slightly and gently pass the tube through the mouth or through one nostril to the required distance. If **using the nasal route**:
    - If a **nasal catheter is in place for administration of oxygen**, insert the gastric tube through the same nostril, if possible;
    - If the tube does not slide easily into the nostril, try the other nostril;
    - If the **tube still does not slide easily into the nostril**, use the oral route.

Never force the gastric tube into the nostril if resistance is encountered.

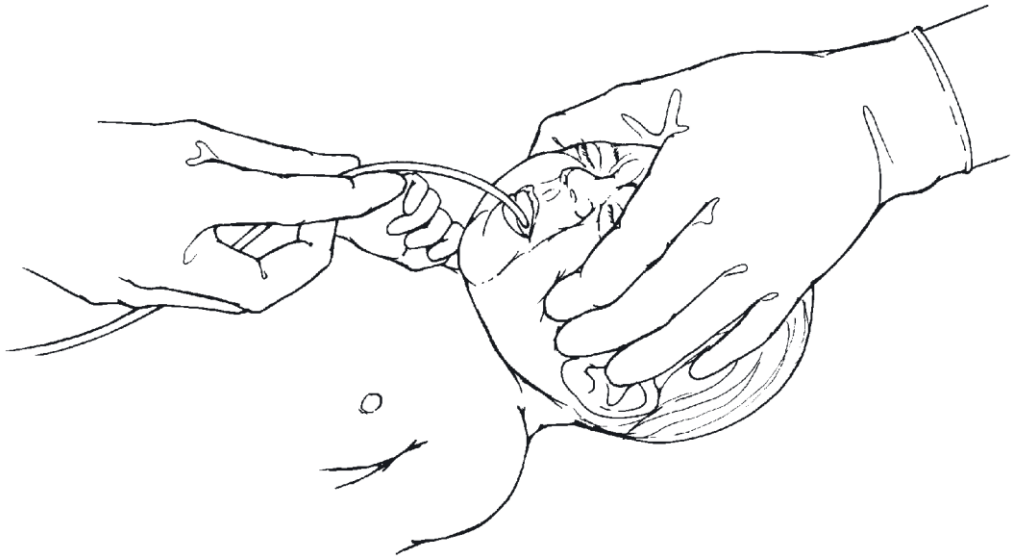


FIGURE 52- Inserting oral gastric tube

- Secure the tube in position with adhesive strapping:
    - If **tincture of benzoin is available**, apply this to the skin first before applying the adhesive strapping;
    - If a **nasogastric tube is used**, avoid pulling the tube taut against the nostril, as this may injure the skin.

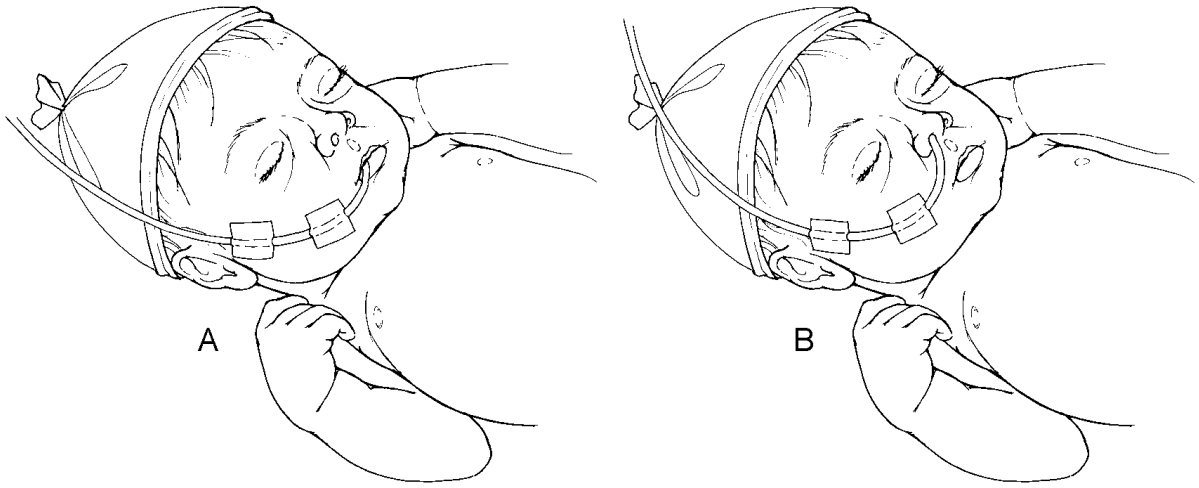


FIGURE 53- Securing oral (A) and nasal (B) gastric tube in place

Confirm proper placement of the tube:

- Fill a syringe with 1 to 2 ml of air and connect it to the end of the tube. Use a stethoscope to listen over the stomach as air is quickly injected into the tube:
    - If a **whistling sound is heard through the stethoscope as the air is injected**, the end of the tube is correctly positioned in the stomach;

    - If a **whistling sound is not heard**, the tube is not properly positioned. Remove the tube and repeat the procedure.
- Alternatively, test the acidity of the aspirate:
    - Note that this method is only suitable for babies more than 24 hours old or small babies (less than 2.5 kg at birth or born before 37 weeks gestation) who are more than 48 hours old;
    - Use a syringe to aspirate some fluid, and place a drop of fluid onto a strip of blue litmus paper:
- Replace the tube with another clean gastric tube after three days, or earlier if it is pulled out or becomes blocked

Using A Gastric Tube For Feeding Or Drainage

- If the **gastric tube is inserted for the purpose of giving expressed breast milk**, see instructions for feeding
- If the **gastric tube is inserted for drainage**, leave the tube uncapped and wrap clean gauze around the end, fastened with tape, to keep the tube clean and to absorb the drainage from the stomach.

Performing a Lumbar Puncture

Lumbar puncture is used to confirm the diagnosis when the baby has signs suggestive of meningitis. Do not perform a lumbar puncture if the baby has spina bifida/meningomylocele

Supplies

- Spinal needle or intravenous needle (22- to 24-gauge)
- Appropriate collection tubes

Procedure

- Be prepared to resuscitate the baby using a bag and mask, if necessary.
- Place the baby under a radiant warmer, if possible, and undress the baby only when ready to perform the procedure.
- Position the baby:
- Have an assistant hold the baby in a sitting position:
    - Position the baby so that the baby's legs are straight and the back is arched
    - Ensure that the baby's neck is partially extended and not flexed towards the chest, which could obstruct the baby's airway.

FIGURE 54 - Sitting position for lumbar puncture

- Alternatively, place the baby on her/his side facing the assistant (most right-handed health care providers find it easiest if the baby is on her/his left side;
    - Position the baby so that the baby's back is closest to the side of the table from which the lumbar puncture will be performed;
    - Have the assistant place one hand behind the baby's head and neck, and place the other hand behind the baby's thighs to hold the spine in a flexed position;
    - Ensure that the baby's neck is partially extended and not flexed towards the chest, which could obstruct the baby's airway.

FIGURE 55- Lying position for lumbar puncture

- Prepare the skin over the area of the lumbar spine and then the remainder of the back by washing in an outward spiral motion with a swab or cotton-wool ball soaked in antiseptic

solution. Repeat two more times, using a new swab or cotton-wool ball each time, and allow to dry.

- Identify the site of the puncture between the third and fourth lumbar processes (i.e. on a line joining the iliac crests;

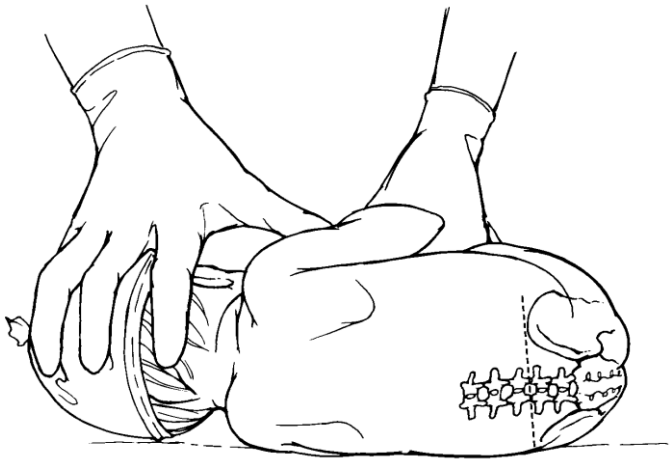


FIGURE 56 - Site of lumbar puncture

- Remove examination gloves and put on high-level disinfected or sterile gloves.
- Place sterile drapes over the baby's body so that only the puncture site is exposed.
- Insert the needle in the midline of the vertebrae, angled towards the baby's umbilicus.
- Slowly advance the needle to a depth of about 1 cm (or less if the baby is small [less than 2.5 kg at birth or born before 37 weeks gestation]). A slight "pop" may be felt as the needle enters the subarachnoid space.
- If **using a spinal needle**, remove the stylet
- If **bone is encountered**, the needle cannot be redirected. Pull the needle back to just beneath the skin and reinsert the needle, directing it slightly upward while aiming for the baby's umbilicus.
- Collect the cerebrospinal fluid (CSF):
    - Collect about 0.5 to 1 ml (about 6 to 10 drops) of CSF in each collection tube;
    - If **CSF does not come out**, rotate the needle slightly;
    - If **CSF still does not come out**, remove the needle and reinsert it between the fourth and fifth lumbar processes;
    - If **blood is seen in the CSF**, the needle probably went through the spinal canal and caused bleeding. If the **CSF does not clear**, collect enough CSF for culture and sensitivity only.
- After the CSF is collected, remove the needle.
- Have an assistant apply gentle pressure to the puncture site with a cotton wool ball until bleeding or leakage of fluid stops.
- Apply an adhesive bandage to the site.

Nasal Continuous Positive Airway Pressure Ventilation (nCPAP)

Indications

1. Mild to moderate respiratory distress as a result of:
    - Respiratory distress syndrome (Hyaline Membrane Disease)
    - Wet lung syndrome (Transient Tachypnea of the newborn)
    - Meconium Aspiration Syndrome
2. Apnea of prematurity
3. Atelectasis (and also small lung volume)

Contraindications

1. Upper airway abnormalities
2. Severe cardio-respiratory instability
3. Essential intubation and mechanical ventilation

Dangers (complications)

1. Nasal obstruction as a result of secretions or displaced nasal prongs
2. Nasal prongs displacement
3. Nasal decannulation
4. Water accumulate in circuit and nose
5. Pneumothorax
6. CO2 retention, impaired pulmonary blood flow
7. Abdominal distension

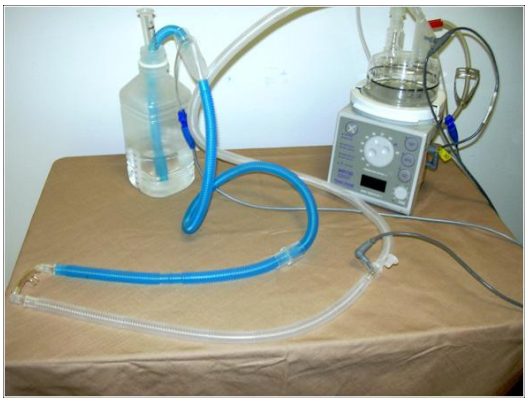
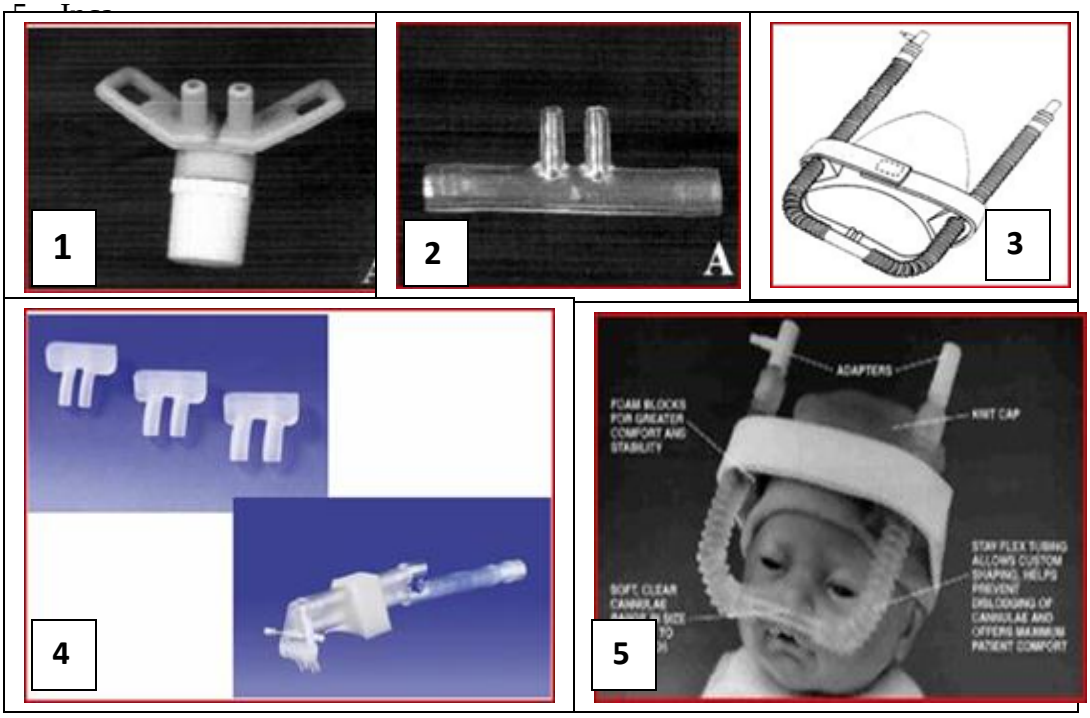


Figure 57: Setting up the nCPAP Apparatus

Types of Prongs (4 Types)

There are four types of nasal prongs that we can possibly use as shown in the figures below.

1. Argyle
2. Hudson
3. Inca
4. Fisher and paykel
5. Inca



Commence nCPAP as quickly as possible

1. Palace baby supine in overhead radiant heater bed with small rolled up nappy under the shoulders
2. Keep baby NPO initially with orogastric tube on open drainage
3. Begin intravenous infusion
4. Put snug-fitting woolen cap on baby's head
5. Choose correct size of nasal prongs so as to fit comfortably into nostrils. insert without pressing on nasal septum.
6. Connect correct size of nasal prongs to the nosepiece and place in baby's nostrils. The prongs should fit smugly without pressing on the nasal septum.
7. Tie the tapes of the nosepiece to the woolen cap with sticking plaster
8. Check that there is sterile water in the humidifier
9. Commence initial oxygen flow of 6-8litres/minute or 4-5cm H2O pressure
10. Adapt oxygen concentration (FiO2) according to saturation.
11. Observe baby and document saturation

Chapter 22: Admission, Discharge, Re-admission and Follow-up after discharge

This chapter discusses key criteria that should be followed when sick neonates are admitted, re-admitted or discharged and those who require follow up at high-risk infant clinics.

At the end of this session, all participants will:

- State admission and discharge criteria
- Recall discharge recommendations
- Identify follow up needed for newborns

Admission Criteria

- Birth weight less than 1500g
- Gestational age less than 34 wks
- Hematologic problems: Hyperbilirubinemia, Blood group and RH incompatibility, anemia, polycythemia, bleeding disorders
- ***Infection*** - suspected or confirmed serious infection.
- ***Respiratory problems***
  (a) Apnea or cyanotic episodes
  (b) Any respiratory distress.
  (c) Requirement for ventilation
- ***Gastrointestinal problems***
  (a) Feeding problems severe enough to cause clinical concern
  (b) Bile stained vomiting, or other signs suggesting bowel obstruction
- ***Metabolic problems*****:**
  a) Hypo/hyperglycemia
  b) Hypocalcaemia/hypercalcemia
  c) Hypo/hypernatremia
- ***CNS problems***
  (a) Convulsion
  (b) Birth asphyxia
  (c) Altered mentation
- ***Malformations*****:** Congenital anomalies that may require immediate intervention
- ***Cardiovascular*****:** Problems requiring monitoring or intervention
- Birth trauma: Subgaleal hemorrhage, cephalohematoma, bone fracture, etc.
- ***Miscellaneous*****:** Any baby that is causing concern to such a degree that the attending doctor or nurse feels that the baby requires **observation or treatment**.
- ***Social issues/terminal care*****:** Such babies ideally should be nursed in the ward. On occasions (after multidisciplinary consultation), circumstances dictate that these babies require a period of care.

Criteria for isolation

- All infants with neonatal tetanus, diarrhea, and infectious skin lesion.

Discharge Criteria

- They have no **danger** signs or signs of serious infection
- **Low birth weight infants** has to be **gaining weight (average weight gain of 15-20gm/kg/d)**
- Ability to take all feeding by cup or breast without respiratory compromise
- Baby should complete inpatient treatment
- The baby must be able to maintain his or her **temperature in the normal range (36 – 37^0C) in an open cot.**
- The mother is confident and able to care for the infant
- **Parents must be willing and comfortable** to take the baby home and to have demonstrated that they have adequate skills to provide care at home
- Some basic information should be known about the **home environment**, if they are living in a remote area

Recommendations at discharge

- Hearing screening at discharge from the ward
- Eye examinations at 34 -37 weeks of gestational age.
- If possible, cranial ultrasonography (look for intraventricular hemorrhage for those <32 wk GA and <1500 g at 7-14 wks then repeat at 36-40 wks of postnatal age).
- Make sure the baby got the first immunization and subsequent vaccinations.
- Arrange an infant follow-up program and give a short appointment.
- Counsel parents before discharge about basic care, nutrition/exclusive breastfeeding, keeping the infant warm, sunlight exposure, recurrence rate of congenital anomalies, avoidance of malpractices and any danger sign for care seeking.

Neonatal Follow-up for neonates discharged from the NICU

The objective of neonatal follow-up program is to provide continuum of specialized medical management for neonates admitted, treated, and discharged from NICU. These includes-

- Very low birth weight babies
- Gastro esophageal Reflux disease
- Asphyxia (Hypoxic ischemic insult stage II and III)
- NEC – look for nutritional status, short bowel syndrome and intestinal stricture.
- Bronchopulmonary Dysplasia (BPD) [Oxygen required at 28 postnatal age].
- Neurologic abnormalities (Hydrocephalus, Hyperbilirubinemia, bilirubin encephalopathy, Microcephaly, Neonatal seizure, Meningitis, Intraventricular hemorrhage)
- Infant requiring special equipments (Oxygen, NG- tube feeding).
- Patient who had surgical intervention needs follow up by NICU team too.

Table 2: Follow-up schedule for neonates discharged from the NICU

Age	Type of evaluation
1st visit 7 – 10 days after discharge	To see how the child is adopting to the home environment
4 - 6 month of corrected age	Look for adequate catch-up growth and sever neurologic abnormalities
8 – 9 months of corrected age	Is the earliest and good time to confirm CP or other neurologic abnormalities
18 – 24 months	Most transient neurologic findings will resolve If not, refer them to specialty clinic Catch-up growth for head circumference is 12 months Catch-up growth for weight is 24 months

***During follow up, evaluate the following*:-**

- Growth and Nutrition need
- Neurologic assessment
- Evaluation of normal and atypical developmental pattern

Babies should be on exclusive breastfeeding for 6 months. When mother goes to work, she can express her breast milk and keep it in room temperature for 6 – 8 hrs, in refrigerator for 48 hrs but encourage the mother to keep the baby with her as much as possible.

Follow up for Preterm Newborns

- Measure growth rate for corrected age
    - Weight, Head Circumference according to growth monitoring chart
- Consider cranial ultrasonography if possible for those less than 32 Wk of GA at 7 – 14 days of postnatal age. Repeat at 36 – 40 weeks of Post Menstrual Age (PMA) to see IVH.
- Start Iron, Vitamin and other micronutrients supplementation when full enteral feeds are established and follow hematocrit as indicated (for the dosage refer to the guideline on nutrition)
    - 2 - 4 mg/kg if infant is feeding human milk.
    - 2 mg /kg if infant feeding on formula milk
- Bronchopulmonary Dysplasia (BPD) Infant requiring supplemental oxygen at 28 days of life
- Retinopathy of prematurity
    - Ophthalmologic examination to all infants < 1500gr or < 32 Wk GA
    - Low-birth-weight infants should be followed up weekly for weighing and assessment of feeding and general health, until they have reached 3 kg

Look for Major Neurologic Sequelae

- CP (Spastic diplegia, quadriplegia, and Hemiplegia)

- Blindness, visual impairment or other oculomotor problems
- Deafness or hearing impairment
- Neonatal Seizure , Hydrocephalus, Craniosynostosis

Frequency of Follow up as follows unless there is an exceptional case

- Every two weeks for the 1st 4 weeks of life
- Every one month for the 1st 3 months of life
- Every two month for 3-6months
- Every 3 month till 12 months of age

References

1- Betty R. Voher Neonatal Follow up program in the new Millennium. American Academy of Pediatrics. September 29 2009.
2- Avory A. Fanaroff , Richard J. Martin . Neonatal Perinatal Medicine. 9th edition

Chapter 23: Parental counseling in neonatal intensive care unit

At the end of this session, the participants will:

- Demonstrate how to counsel parents of neonates in the ICU

Introduction

In neonatology, the patient is the infant, but the parent is the recipient of information. Most parents desire as much information as possible about their children's diseases and the concept of patient-centered care. Unfortunately, the NICU is a complex clinical setting in which information and predictions vary and change rapidly: decisions are complex, and parents find the uncertainty difficult to cope with.

It is a good practice for parents to be present at the bedside during NICU rounds. This allows them to be updated daily and to become familiar with all team members. Ideally, delivery of 'bad-news' or discussion of complicated diagnoses and treatment options should be done in a quiet, private setting with suitable social support for the parents.

Providing family-centered end-of-life care to infants and their families in the NICU should be a component of optimal neonatal palliative care. If a child dies the family needs intense and long-term psychosocial support as well as cultural and spiritual comfort.

When communicating with the family, remember the following

1- Be respectful and understanding
2- Listen to the family's concern and reply their questions and express their emotions
3- Use simple and clear language when giving them information about the baby's condition, progress, and treatment.
4- Respect the family's right to privacy and confidentiality during delivery of 'bad-news' or discussion of complicated diagnoses and treatment options with suitable social support for the parents.
5- Respect their cultural beliefs and customs and accommodate the family's needs as far as possible.
6- Ensure the family understands any instructions, and give written information to family members if possible. Some situations may require repeated discussion for a better understanding.
7- Obtain informed consent before performing procedures if possible.
8- Remember that health care providers may feel anger, guilt, sorrow, pain and frustration. Showing emotion is not a weakness.

Parents of a baby who is dying or died

1- Allow the mother and the family to be with the baby even during the procedure, explain what is being done to the baby and why.
2- If the baby's death is an inevitable, focus on providing emotional support to the family. Provide compassionate and family-centered end-of-life care to infants and their families.

3- Encourage the mother and family to see and hold the baby after death and for as long as they desire, and ask the family how they will bury the baby.
4- It is also crucial that complete documentation be taken during end-of-life care.
5- Arrange to see the family after the death.
6- Counsel on autopsy when it is required

References

1- Helena Moura ,I Vera Costa, II Manuela Rodrigues, II Filipe Almeida, III Teresa Maia, II Hercı´lia Guimara˜es End of life in the neonatal intensive care unit, CLINICS 2011;66(9):1569-1572
2- Wendy Yee, MD FRCPC and Sue Ross, PhD Communicating with parents of high-risk infants in neonatal intensive care Paediatr Child Health. 2006 May; 11(5): 291–294. PMCID: PMC2518680
3- WHO, Managing Newborn Problems: a guide for doctors, nurses, and midwives.

Chapter 24: Other patient monitoring formats and checklists

Normal values chart

When managing a neonate with a problem in the NICU you are expected to use the normal value charts annexed with this manual. It is critical that you stick to the figures and the recommended values to closely follow the prognosis of the sick neonate and avoid unwanted outcomes of the treatment and management applied on the newborn under care. There may be slightly different values presented in other documents and guideline. For use in Ethiopian facilities we advise you to stick to the annexed values.

For your quick reference you are advised that you print the normal value charts and posted them on the visible area on the wall in the NICU.

Patient care follow-up card

It is critical that sick neonates are closely followed up 24 hours a day, seven days a week and throughout their stay in the health facilities. Based on the specific diagnosis they have and their general conditions the level of follow up they may need may vary. Annexed with this manual there are some cards and checklists that you need to use for the daily and hourly monitoring of the sick neonates. The charts and checklists require that you regularly fill in patient information to ensure that the progress of the problem and the condition of the sick neonate at each point of contact is well recorded and there is complete information for the NICU care providers when they switch patients under care. It is important to understand that the next care provided to the sick neonate under care, and hence the outcome of the management is largely based on the recorded information on the card and checklists and all checklists and monitoring card should be completed and completed with accurate information.

Chapter 25: NICU Information Management System

The NICU service information will be collected and used to improve the quality of care provided and monitor program performance. At the initial phase NICU registration book will be provided to each health facility with NICU and service providers will be orientated on appropriate use of the registration book to ensure the service data are captured. Effort will be made to include selected critical NICU indicators in the national HMIS to ensure that NICU performance and quality are continuously tracked in the health facilities around the country.

NICU service and program data will be collected through routine supportive supervision of the health facilities with NICU and review meetings with NICU facilities and program managers. In addition, quality of the in-service training provided to NICU service providers will be tracked through pre-post training knowledge and skills texts. In the long run NICU indicators will be included in the national HMIS and routine reported by the health facilities.

List of NICU quality and performance indicators will be identified and database will be developed to continuously track the status of the indicators and provide feedback to the health facilities to improve quality and coverage of the NICU services. Service data will be collected during supportive supervision and through other mechanisms.

Evaluation of the NICU program performance, using qualitative and quantitative methods, in selected health facilities may be done by independent evaluators. The evaluation may focus on quality and effectiveness of the NICUs in terms of improving the survival and health of neonates in the NICU implementing health facilities.

The FMOH is committed to scale up NICU services in all hospitals in the country (Level I, II or III depending on the status of the hospital). There is also growing interest from health development partners to support health interventions that aim at improving the survival of newborns. It is critical that the initial phase of NICU implementation generate sound evidence on the program quality and effectiveness and capture real-life implementation challenges and measures taken to address them. The primary beneficiary of these evidences will be NICU facilities, FMOH/RHBs and NICU program partners. The evidence can also be shared with health development partners who have interest to improve the health and survival of newborns. Furthermore, from the evidence messages can be developed to communicate to mothers and caretakers/communities to ensure that newborns with problems are brought to the health facilities and receive appropriate care.

Chapter 26: Linkage of NICUs

NICU implementing hospitals in the country are at different status. Some of them are teaching hospitals with relatively better infrastructure, management and expertise. Others are less organized and may need intensive support to be able to provide standard care for neonates with problems. Creating a learning forum which enables poorly performing NICU facilities to share experiences from best performing facilities is one of the mechanisms that will be used to improve the quality of NICU services provided in health facilities. To realize this linkage will be created among NICU facilities with different capacities.

Some of the purposes of linking NICUs across the country include:

- Create experience sharing forum for the weakly performing NICU facilities to learn from the best performing NICUs
- Ensure senior pediatricians and neonatologists provide clinical mentorship and on the job training for NICU facilities with technical assistance and support need
- Ensure that best performing NICU providers are recognized and motivated

The strategies that will be followed to realize strong linkage among the NICU facilities will be through organizing regular review meetings, conducting regular need based clinical mentoring visit to NICU facilities and establishing NICU providers' association.

NICU facilities will meet at least once every quarter to review their performance, discuss the challenges they faced and the measures they have taken to address them. In the review meetings, in addition to the experiences shared among the NICU facilities in Ethiopia, new evidences and experiences form other countries with better NICU implementation experiences will be communicated.

Annexes

APPENDIX 1. Normal Hematologic Values: First Two Weeks of Life in the Term Infant.

Value	Cord Blood	Day 1	Day 3	Day 7	Day 14
Hb (gm/100ml)	16.8	18.4	17.8	17.0	16.8
Hematocrit (%)	53.0	58.0	55.0	54.0	52.0
Red cells (cu.mm. x 10^6)	5.25	5.8	5.6	5.2	5.1
MCV (m^3)	107	108	99.0	98.0	96.0
MCH (*yy*)	34	35	33	32.5	31.5
MCHC (%)	31.7	32.5	33	33	33
Reticulocytes (%)	3-7	3-7	1-3	0-1	0-1
RBC (cu.mm)	500	200	0-5	0	0
Platelets (1000's/cu.mm)	290	192	213	248	252

APPENDIX 2. The White Blood Cell and the Differential Count: First Two Weeks of Life

Age	Leukocytes	Neutrophil			Eosinophils	Basophiles	Lymphocytes	Monocytes
		Total	*Seg*	*Band*				
Birth								
Mean	18.100	11,000	9,400	1,600	400	100	5,500	1,050
Range	9.0-30.0	6.0-26			20-850	0-640	2.0-11.0	0.4-3.1
Mean %	-	61	52	9	2.2	0.6	31	5.8
7 Days								
Mean	12,200	5,500	4,700	830	500	50	5,000	1,100
Range	5.0-21.0	1.5-10.0			70-1100	0-250	2.0-17.0	0.3-2.7
Mean %	-	45	39	6	4.1	0.4	41	9.1
14 Days								
Mean	11,400	4,500	3,900	630	350	50	5,500	1,000
Range	5.0-20.0	1.0-0.5			70-1000	0-230	2.0-17.0	0.2-2.4
Mean %	-	40	34	5.5	3.1	0.4	48	8.8

APPENDIX 3. Hematologic Values in Low Birth weight Neonates

Determination	1-3 Days	4-7 Days	2 Weeks	4 Weeks	6 Weeks	8 Weeks
Birth weight less than 1200g						
Hemoglobin	15.6	16.4	15.5	11.3	8.5	7.8
Reticulocytes as % of RBC	8.4	3.9	1.9	4.1	5.4	6.1
Platelets	148,000 ± 61,000	163,000 ± 69,000	162,000	158,000	210,000	212,000
Leukocytes	14,800 ± 10,200	12,200 ± 7,000	15,800	13,200	10,800	9,900

Segmented Neutrophils	46	32	41	28	23	23
Band Neutrophils	10.7	9.7	8.0	5.9	5.8	4.4
Juvenile Neutrophils	2.0	3.9	5.3	3.6	2.6	2.0
Lymphocytes	32	43	39	55	61	65
Monocytes	5	7	5	4	6	3
Eosinophils	0.4	6.2	1.0	3.7	2.0	3.8
Nucleated RBC as % of total RBC	16.7	1.1	0.1	1.0	2.7	2.0
Birth weight 1200-1500g						
Hemoglobin	20.0	18.0	17.1	12.0	9.1	8.3
Reticulocytes as % of RBC	2.7	1.2	0.9	1.0	2.2	2.7
Platelets	151,000 ± 35,000	134,000 ± 49,000	153,000	189,000	212,000	244,000
Leukocytes	10,800 ± 4,000	8,900 ± 2,900	14,300	11,000	10,500	9,100
Segmented Neutrophils	47	31	33	26	20	25
Band Neutrophils	11.9	10.5	5.9	3.0	1.4	2.1
Juvenile Neutrophils	5.1	2.4	2.7	1.8	1.7	1.6
Lymphocytes	34	48	52	59	69	64
Monocytes	3	6	3	4	5	5
Eosinophils	1.3	2.2	2.5	5.1	2.6	2.3
Nucleated RBC as % of total RBC	19.8	0.8	0	0.4	1.4	1.0
Hemoglobin	20.0	18.0	17.1	12.0	9.1	8.3
Reticulocytes as % of RBC	2.7	1.2	0.9	1.0	2.2	2.7

APPENDIX 4. SILVERMAN ANDERSON ASSESSMENT OF RESPIRATORY DISTRESS

Signs	**0**	**1**	**2**
Thoraco-abdominal movement	Rhythmic and regular	Immobile thorax movement in abdomen	Thorax and abdomen in up and down
Intercostals retraction	Absent	Discrete	Accentuated and constant
Xiphoid retraction	Absent	Discrete	Very marked
Flaring of alanasi	Absent	With closed mouth	Very marked with open mouth
Grunting	Absent	Mild and inconstant	Constant and accentuated

Scoring:

- **0 – 3 ------ Mild , 4 – 6 ------Moderate , >6 ---------Sever**

APPENDIX 5. PARKIN METHOD OF CLINICAL ASSESSMENT OF GA

External sign	**0**	**1**	**2**	**3**	**4**
Skin color	Dark red	Uniform red	Pink pale variable over the body	Pale only pink over the ear palms and sole	
Skin texture	Very fine gelatinous	Fine and smooth	Smooth medium thickness skin rash pealing	Mild thickness skin with pealing hand and feet	Thick like parchment

Breast	No breast tissue	Breast tissue in one or both sides <0.5 cm of the diameter	Breast tissue in one or both sides 0.5-1cm of the diameter	Breast tissue in one or both sides >1 cm of the diameter	
ear	Smooth early folded doesn't turn back	Smooth easily folded returns back slowly	Cartilage over the top smooth returns fast	Firm ear returns very fast	

Point	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
GA	**30.6**	**31.7**	**32.8**	**33.9**	**35.1**	**36.2**	**37.3**	**38.4**	**39.4**	**40.6**	**41.7**	**42.8**

APPENDIX 6. BLOOD PRESSURE MEASUREMENT TABLE

Weight in Kg	**Gestational Age**				
	28	**30**	**32**	**34**	**36**
1	35-45	36-46	37-47	38-48	39-49
1-2	37-47	38-48	39-49	40-50	41-51
1-4	39-49	40-50	41-51	42-52	43-53
1-6	41-50	41-51	42-52	43-53	44-54
1-8	42-52	43-53	44-54	45-55	46-56
2	43-53	44-54	46-56	47-57	48-58
2-2	45-55	46-56	47-57	48-58	49-59
2-4	47-57	48-58	49-59	50-60	51-61
2-6	48-58	49-59	50-60	51-65	52-62
2-8	50-60	51-61	52-62	53-63	54-64
	8-18hs	**19-32hs**	**33-54hs**	**55-96hs**	**97-124hs**
	+2	**+4**	**+6**	**+8**	**+10**

APPENDIX 7. APGAR SCORE ASSESSMENT

Apgar score	**If at 1st minute <6 assess at 5th minute**			**1st minute**	**5th minute**	**10th minute**	**20th minute**
	0	**1**	**2**				
Heart rate	Absent	<100/min	>100/min				
Respiratory effort	Absent	Slow, irregular	Good, crying				
Muscle tone	flaccid	some flexion of extremities	active motion				
Reflex irritability	no response	Grimace (slight response)	vigorous cry, cough, sneezing etc				
Color	Blue, pale	Pink body, extremities blue	Completely pink				
Score:			Total				

• **0-3: Severely depressed (URGENT RESUSCITATION)** • **4-6 : Moderately depressed** • **-10: Good condition**					

APPENDIX 8. COMPOSITION OF BREAST MILK AND DAILY REQUIREMENT

Status at delivery	Composition	Post delivery days				
		3	7	14	21	28
Pre term	Calorie	0.51**kcal/ml**	0.67	0.72	0.65	0.70
	Protein	0.032**gm/ml**	0.024	0.021	0.018	0.018
Term	Calorie	0.48	0.60	0.64	0.68	0.69
	Protein	0.022	0.18	0.015	0.015	0.014

PROTEIN requirement /24 hrs

- In the first week→1-3 gm/dl/24hrs
- After 7 days →up to 6 gm/dl/24hrs preterm every 2 hrs- Time of feeding

CALORIES requirement/24 hrs

- In the first week →120kcal/24hrs
- After 7 days →up to 160kcal/24hrs

Time of feeding

- Preterm every 2 hrs
- Term every 3 hrs

Example of daily requirement for 28 days old and 4.2Kg

- CALORIE =TBM X 0.7 X 8 x 4.2 kg
  60ml x 0.7 x 8 x4.2 =80kcal/day; which is low. So we have to increase it by10 to 20ml/day/kg according to their GA and post natal age
- PROTEIN =TBM X 0.018 X 8 x4.2kgm.
  60ml x 0.018 x 8x4.2 =2gms /dl/day. This is also low and we have to increase the amount.

APPENDIX 9. NORMAL ECG PARAMETERS

Age in days		**Rate**	**QRS axis**	**PR (ms)**	**PII (mV)**	**R V1 (mV)**	**R V5 (mV)**	**R V6 (mV)**	**S V1 (mV)**
	95%	150	+185	140	0.25	2.35	1.8	1.0	1.8
0-1	50%	120	+135	105	0.16	1.3	1.0	0.4	0.8
	5%	100	+90	82	0.07	0.7	0.3	0.1	0.1
	95%	150	+185	132	0.25	2.4	1.9	1.0	1.8
1-3	50%	120	+135	105	0.16	1.5	1.1	0.4	0.8
	5%	100	+90	85	0.05	0.7	0.4	0.1	0.1
	95%	160	+180	130	0.27	2.1	1.9	1.1	1.5
3-7	50%	125	+135	103	0.17	1.25	1.3	0.5	0.7
	5%	100	+90	80	0.08	0.5	0.5	0.15	0.1
	95%	175	+150	128	0.28	1.7	2.1	1.3	1.0
7-30	50%	145	+110	100	0.18	1.0	1.4	0.5	0..4
	5%	110	+75	75	0.08	0.4	0.6	0.25	0.1

- Values relate to term neonates.
- At a paper speed of 25 mm/sec, 1 mm=0.04 sec (one small square)

5 mm=0.2 sec (one large square)

- Rate ----Divide 300 by the number of big squares between 2 R-R complexes

APPENDIX 10. GUIDELINE TO START ORAL FEEDING

Weight (gm)	**INTERVAL**	**STARTING (ml/kg/d)**	**INCREMENT (ml/kg/d)**	**MAXIMUM (ml/kg/d)**
<750	Every 2 hrs	10	15	150
750 - 1000	Every 2 hrs	10	15 - 20	150
1001 - 1250	Every 2 hrs	10	20	150
1251 - 1500	Every 3 hrs	30	20	150
1501 - 1800	Every 3 hrs	30	30	150
1801 - 2500	Every 3 hrs	40	40	165
>2500	Every 3 hrs	50	50	180

Neonatal daily Progress Monitoring Sheet

Name of the Neonate______________________________ Age in Weeks_________
Diagnosis______________________ Card Number ____________________ Date _____________

D	V/Sign					Condition		I/V Therapy					Feeding					Output			Air Way		Lab		Remark
	T					Imp.		F					NPO					Urine			N		BGF		
	RR					N/imp.		AB					EBF					stool			DO2		HCT		
	AHB					D/charge		B/P					FF					G/con			CPAP		RBS		
	Kg					Dead		O					O					O			O		BIL		
D	**V/Sign**					**Condition**		**I/V Therapy**					**Feeding**					**Output**			**Air Way**		**Lab**		**Remark**
	T					Imp.		F					NPO					Urine			N		BGF		
	RR					N/imp.		AB					EBF					stool			DO2		HCT		
	AHB					D/charge		B/P					FF					G/con			CPAP		RBS		
	Kg					Dead		O					O					O			O		BIL		
D	**V/Sign**					**Condition**		**I/V Therapy**					**Feeding**					**Output**			**Air Way**		**Lab**		**Remark**
	T					Imp.		F					NPO					Urine			N		BGF		
	RR					N/imp.		AB					EBF					stool			DO2		HCT		
	AHB					D/charge		B/P					FF					G/con			CPAP		RBS		
	Kg					Dead		O					O					O			O		BIL		
D	**V/Sign**					**Condition**		**I/V Therapy**					**Feeding**					**Output**			**Air Way**		**Lab**		**Remark**
	T					Imp.		F					NPO					Urine			N		BGF		
	RR					N/imp.		AB					EBF					stool			DO2		HCT		
	AHB					D/charge		B/P					FF					G/con			CPAP		RBS		
	Kg					Dead		O					O					O			O		BIL		
D	**V/Sign**					**Condition**		**I/V Therapy**					**Feeding**					**Output**			**Air Way**		**Lab**		**Remark**
	T					Imp.		F					NPO					Urine			N		BGF		
	RR					N/imp.		AB					EBF					stool			DO2		HCT		
	AHB					D/charge		B/P					FF					G/con			CPAP		RBS		
	Kg					Dead		O					O					O			O		BIL		
D	**V/Sign**					**Condition**		**I/V Therapy**					**Feeding**					**Output**			**Air Way**		**Lab**		**Remark**
	T					Imp.		F					NPO					Urine			N		BGF		
	RR					N/imp.		AB					EBF					stool			DO2		HCT		
	AHB					D/charge		B/P					FF					G/con			CPAP		RBS		
	Kg					Dead		O					O					O			O		BIL		
D	**V/Sign**					**Condition**		**I/V Therapy**					**Feeding**					**Output**			**Air Way**		**Lab**		**Remark**

	T				Imp.		F					NPO					Urine			N		BGF		
	RR				N/imp.		AB					EBF					stool			DO2		HCT		
	AHB				D/charge		B/P					FF					G/con			CPAP		RBS		
	Kg				Dead		O					O					O			O		BIL		

University of Gondar INFANT FEEDING CHART													
Patient Name:		Hospital No:			Age:		Gestation / age (cga)						
Total Fluids mls/kg/day:		Of which:	ORAL		Kcal/day:		Weight (+date)						
			IV										
Freq of feeds:		Volume per feed			Any changes to above:	(with date)							

Date	Time	Type of feed (✔)			Method of feeding (✔)			Amount offered (mls) / duration of feed (mins) if breast	Amount taken (mls)	Vomiting + posset ++ medium +++ large	Abdomen **S**oft/**F**irm/ **D**istended/ **L**oopy	BO? PU?	Total Feed Vol/24h
		Breast	EBM	Formula	Breast	NG	Cup						

NEONATOLOGY UNIT PRETERM BABY FEEDING CHART
Name of the Neonate_____ Age in Weeks_____
Diagnosis_____ Card Number _____ Date _____

Date		**Daily weight**	**Mode & Quantity of feeding**	**Feeding every 2/hrs/24hrs**												**Remark**
				Morning			Afternoon			Evening			Night			
				6am	***8am***	***10am***	***12m***	***2pm***	***4pm***	***6pm***	***8pm***	***10pm***	***12md***	***2am***	***4am***	
1																
2																
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