NEONATOLOGY

By dr. Adnan Al-Rikabi

Definition of terms :

1. The normal human gestational period is 280 days or 40 weeks , calculated from the first day of the mother last menstrual cycle .
   a- **Preterm** gestation refers to delivery at less than 37 wks gestation .
   b- **Term** gestation refers to delivery at 38 to less than 42 wks gestation .
   c- **Post term** gestation refers to delivery at or after 42 wks gestation .
2. The neonatal period is defined as the first 28 days (4 wks) of life for term infant , although , from a practical standpoint it is extended in the case of prematurely delivered infant.
3. Fetal and neonatal growth :
   a- Fetal growth, the fetal growth rate is 5 g /day at 14-15 wks gestation, 10 g/day at 20 wks and 30 g/day at 32-34 wks. The growth rate slows after 36 wks gestation.
   b- Neonatal growth :
   (1)- after birth , there is a loss of weight due to a loss of extracellular water and suboptimal caloric intake . term infant lose 5% of their birth weight , preterm infants lose up to 15% of their birth weight .
   (2)- term infant regain their birth weight by the end of the first week of life and thereafter gain 20-30 g/ day .

Delivery room management of the newborn

A- **Goals .the goals of delivery room management** are to assess and promptly attend the immediate needs (e.g oxygenations, ventilations) and potential problems (e.g serious anomalies) of the newborn .

B- **Physical layout and equipment** . the newborn resuscitation are should be in immediate proximity to the delivery room . it should have adequate lighting and space for personal and equipment for resuscitation, including a bed with a radiant warmer .

C- Preparation for delivery .

1- Obtaining perinatal information .the pediatrician must have specific information concerning the mother and the fetus to prepare for routine care of the mother and newborn as well as treatment of specific problems related to a particular delivery ,
   a- Obstetric history should include all information that may be pertinent to the immediate fetal conditions .the information is best obtained from the obstetrician and the medical chart and by direct communication

with parents .important issues are (maternal age , medical and previous obstetric history , length of gestations , blood group incompatibilities , maternal infections , maternal drug use , ultrasound evaluations of fetal growth and amniotic fluid volume or congenital anomalies , signs of chorioamnionitis including prolonged rupture of fetal membrane ,maternal fever , and leukocytosis .

b- Labor history should include (fetal heart tracing , duration of fetal membrane rupture , evaluation of amniotic fluid (color and quantity), progress of labor and fetal blood PH.

2- Composition of the resuscitation team .personnel and their tasks vary with type of delivery that is anticipated .high risk deliveries include (maternal diabetic , RH and ABO incompatibility , preterm delivery at less than 38 wks ,post term delivery at more than 42 wks , multiple gestations ,maternal bleeding , severe pre eclampsia ,IUGR, fetal anomalies , breech presentations , cesarean delivery , fetal distress .So high –risk team include
   a- Team leader to direct resuscitation and direct and institute airway management .
   b- One to assess heart rate and to initiate cardiac compression if needed .
   c- One to assess with drying , suctioning , ventilation ,and prepare drugs for injection .
   d- One to gain intravenous access and to administer drugs .

3- Equipment for resuscitation include :
   a- Airway management (suction pump with regulator ,DeLee suction catheter , oral airway with deferent sizes ,endotracheal tubes , laryngoscope , suction catheter .
   b- Ventilations and oxygenations (oxygen source , mask of deferent sizes , bag with oxygen reservoir) .
   c- Intravenous access (umbilical catheter 3.5 F and 5 F ,instruments for umbilical cut down , saline solution 0.9% .
   d- Drugs like (epinephrine , plasma volume expander , sodium bicarbonate or naloxone) .

D- **Assessment of the newborn and the APGAR score .** The goal of the initial assessment is to determined the newborn state of oxygenation and ventilation. this is usually done by performing an abbreviated APGAR evaluation.

TABLE . **APGAR** evaluation of the newborn

Sign	Score		
	0	1	2
Heart rate	Absent	<100 beats/min	>100 beats/min
Respiratory effort	Absent	weak, irregular	strong , regular
Muscle tone	Flaccid	some flexion	well flexed
Response to catheter in nostril	No response	grimace	cough or sneeze
Skin color	Blue ,pale	body pink Extremities blue	entire body pink

1- The degree score was devised as a means of assessing the oxygenation , ventilation, and degree of asphyxia in a uniform manner that quickly communicates information to all people involved in the resuscitation of the newborn .

The **APGAR** evaluation is performed at one and five minutes after birth . Five signs – heart rate ,respiratory effort ,muscle tone ,reflex irritability and skin color __are examined and assigned a score of 0, 1, 2. The APGAR score is obtained by adding all individual scores .

a- A score of 8-10 reflect good oxygenation and ventilation and indicates no need for vigorous resuscitation .
b- A score 5-7 indicate a need for stimulation and supplemental oxygen .
c- A score lees than 5 indicates a need for assisted ventilation and possible cardiac support .

1- The **apgar** score is a useful method of communicating the well-being of the newborn .however urgently needed resuscitation should not be delayed while a full examination Is performed . bradycardia or poor respiratory effort alone indicate a need for immediate resuscitation .

2- The **apgar** score at five minute reflects the adequacy of resuscitation and the degree of perinatal asphyxia .

E- **Resuscitation** . the purpose of resuscitation is to re-oxygenate the CNS of the newborn by providing oxygen , establishing ventilation , and ensuring an adequate cardiac output . although it may be difficult to differentiate primary apnea from secondary apnea , a quick assessment of the newborn skin color , respiratory activity , and heart rate should allow prompt institution of appropriate resuscitation .

1-Routine procedures .the evaluation and procedures that constitute the resuscitation of the newborn are listed in the order in which they should be initiated .

a- Maintenance of body heat . the infant should be dried and provided with radiant heat to maintain body temperature . it is important to avoid hypothermia , which will increase the newborn oxygen consumption .

b- Establishment of an airway . immediately after delivery , the infant head should be placed in a neutral or slightly extended position and an airway established by clearing the mouth , nose and pharynx of thick secretion or meconium . deep and frequent oropharyngeal suctioning should be avoided because it will increase the vagal output causing apnea and bradycardia .

c- Ventilation . the adequacy of air exchange in the newborn must be assessed . in the most cases , drying off, suctioning and tactile stimulation (e. g. gentle flicking of the feet or rubbing of the back) are adequate to induce effective spontaneous ventilation .

(1) If ventilation is adequate , supplemental oxygen may be given to improve heart rate or skin color .

(2) If supplemental oxygen does not improve heart rate or skin color , or if ventilation is inadequate , mechanical ventilation should be initiated , using mask and bag ventilation .

(a) If spontaneous ventilation improves ,mechanical ventilation should be stopped and supplemental oxygen resumed .

(b) If the response is poor or if airway obstruction occurs ,an endotracheal tube should be inserted and mechanical ventilation continued .

d- Circulation . If mechanical ventilation does not improve the heart rate or skin color one of the following steps taken .

(1)- If heart rate is less than 60beats b/min or between 60 and 80 beats / min and not improving cardiac compression is initiated over the lower third of the sternum at a rate of 90 compression /min , the ratio of compression to ventilation is 3:1(90 compression , 30 breath) if heart rate not improve , epinephrine is administered via an umbilical venous catheter or endotracheal tube .

(2)- If heart rate is 80 beats /min or greater but there is poor perfusion or weak pulse , a plasma volume –expanding agent is administered at a dose of 15 ml / kg .

d- Drug support . the following drugs may be useful during resuscitation .
(1) **Sodium bicarbonate** (2 mEq/kg) should be reserved until it is clear that a metabolic acidosis exists .
(2) **Naloxone** (0.1mg/kg) may be helpful for poor spontaneous respiratory effort secondary to maternal narcotic use during labor . Naloxone is contraindicated in an infant born to mother who is addicted to narcotics .
(3) **Dopamine** (5-20 ug/kg/min) improve myocardial function .

2-Special proplems requiring resuscitation:

a- **Meconium aspiration syndrome** . thick meconium is a serious concern because it may be aspirated and result in aspiration pneumonia , it imperative that the meconium be removed from the airway before any attempt is made to ventilate the infant .
b- **Choanal atresia** is a membrane or bony obstruction of the posterior nasal passage .
c- **Progressive respiratory distress or cyanosis** that occur in an infant despite appropriate resuscitation usually suggests an underlying disorder of the cardiopulmonary system , which require immediate investigation (cyanotic heart disease , congenital or acquired disorders of the lung like diaphragmatic hernia or pneumothorax) .

Neonatal examination

Goals of neonatal examination :

1- Assess wellness of the newborn , screening for general abnormalities , birth trauma or acquired medical problems .
2- Assess the newborn for gestational age and appropriateness of size for gestational age .
3- When appropriate confirm infants normality to parents .
4- When appropriate demystify and reassure parents about common , benign variation in newborn physical examination or behavior .
5- Foster early infants –parent bonding and parental self-confidence .

Physical examination :

1- **general appearance** .important observation include body proportion , activity , quality of cry ,skin color , gross abnormalities ,unusual features and signs of respiratory distress , weight , length and head circumference measurement are obtained and recorded .
2- **skin color** may suggest cyanosis , pallor or jaundice .
   - **a- normal peripheral vascular instability** presentation include skin mottling . peri-oral cyanosis and cyanosis of the hand sand feet , with lips , mucous membrane , nail beds and tongue remaining pink .
   - **b- cracking or desquamation** of the skin is normal in the term and postmature infants . in the term infant fine downy hair known as lanugo covers the skin , particularly the shoulder and upper back .
   - **c- jaundice** in the neonate is first visible on the face and as the serum bilirubin level rises it progress caudally to include the rest of the body and the sclera .natural sunlight should be used to inspect the skin for the extent of jaundice .
   - **d- birth marks** are common and visible at birth include flat vascular nevi (e.g.salmon patch nevus and port wine stains) and Mongolian spots .raised vascular nevi usually become apparent several wks after birth (e.g. capillary or strawberry hemangioma , cavernous hemangioma) .
   - **e- benign rashes** are common :
     - **1- comerythema toxi** has a flea-bite appearance with scattered erythematous macules that may contain papulopustular centers filled with eosinophils . this rash typically changes distribution from day to day .
     - **2- milia** are transient fin , pinpoint, yellow-white papules caused by retain sebum that typically cover the bridge of the nose, chin,and cheeks .

3- **<u>neonatal pustular melanosis</u>** consists of small vesiculopustules that are present at birth and rupture within a few days , leaving transient pigmented macules with scaly borders .

3-<u>head and neck</u> .the head and face frequently exhibit sequelae of the birth process including bruises and asymmetries . most resolve spontaneously .facial features should be carefully inspected for size , placement and symmetry .

a- .palpation of **skull** determines contour , extent of separation or over riding of sutures and the size of the fontanelles .
   1- **molding** of the head shape into elongated or asymmetric contour occurs secondary to intrauterine pressure or forces during labor .
   2- **cephalhematoma** and **caput succedaneum .**

b- eyes : dimming the room light cradling the occiput in the examiner hand to left the baby head off the mattress may stimulate the baby to open her or his eyes .
   1- conjunctival or **sclera hemorrhage** resolve with time and usually benign .
   2- the presence of a **red reflex** exclude the presence of lens opacities .
   3- up to 3 months the eyes normally may appear to cross intermittently.

c- Ears patency of the canal should be determined . malformed or low set ears may be associated with auditory or renal abnormalities .

d- Nose newborns are nose breathers obstruction of the nasal passage reslt in respiratory distress .

e- Mouth . should be examined by inspection and palpation . common minor abnormalities include small, white **epithelial pearls** along the gum margins . small white cyst termed **epistein pearls** along the median raphe of the hard palate . palpation may reveal a submucosal bony **cleft** of palate **.**

f- Neck must be hyperextended to inspect adequately for masses . congenital masses include **goiter ,cystic hgroma , brachial cleft cysts** and **thyroglossal cysts .** a webbing of the neck is seen in turner syndrome .

4-<u>chest :</u>

a- Clavicles are palpated for signs of fractures

b- Respiratory rate and pattern and the presence of **chest asymmetry , retraction granting** and **nasal flaring** must be determined in some healthy infants , transient crackles may be auscultated during the first few hrs after birth , unaccompanied by signs of respiratory distress . a normal pattern of periodic breathing with pauses up to 10-15 seconds unaccompanied by bradycardia or change in the color and tone may be observed .

c- Cardiac location is screened by determined that the heart sound s are loudest in the left chest . soft systolic murmurs are commonly heard in the first 24 hours of life , probably because of closing ductus arteriosus or normal changes in the pulmonary vascular resistance . these murmur usually disappear within 48 hrs after birth.

5-abdomen is convex and moves prominently with respiration .

a- A normal **liver edge** may be palpated 1-2 cm below the right costal margin , and the tip of the normal spleen may be palpated ate the left costal margin .

b- Because the most common **abdominal masses** in the newborn involve the genitourinary tract , palpation of the kidneys is important . the kidney may be palpated in the fingertips pressing deeply onto the lower lateral aspect of the abdomen with opposite hand rested under the baby back at a level just superior th the iliac crest .

6 - inguinal region and genitalia :

a- Femoral pulses must always be palpated because diminished pulse suggest coaractation of aorta .

b- Male genitalia examination should include location of the urethral meatus , palpation of the testes and a for bulge in the groin or scrotum suggesting hernia or hydrocele .

c- Female genitalia examination should a certain the presence of urethral and vaginal opening as well as a normal sized clitoris to exclude ambiguous genitalia , imperforated hymen and vaginal atresia . in normal infants a transient swelling of the labia minora or a vaginal discharge that is mucoid or bloody results from the influence of maternal hormones .

d- Anus is inspected for patency and placement .

7- Extremities temporary flexion contractures at the elbow , hips and knees are seen in the term newborn as a result of intrauterine pressure effects .approximately 5% of all newborn have more significant limb deformities either deformities caused by positional abnormalities and intrauterine posture or true malformation .

a- Developmental dysplasia of the hip (DDH) .occurs in 1 in 1000 live birth and is much more common in girls and breech delivery .. asymmetry in lower limb length , placement of the medial thigh and gluteal folds or degree of hip flexion should raise suspicion for unilateral hip dislocation . when the hips are flexed to 90 degrees the legs normally can be abducted fully to touch the examining table " telescoping " of the femoral head with subluxation (barlow) maneuver or a palpable " thump " with ortalani maneuver suggest dislocation .

b- Erbs and klumpke palsy as a result of trauma to the brachial plexus result in asymmetric or diminished arm movements .

8- Back .the spine is inspected and palpated for sinus tract or overlying lesions such as lipomas , hairy tufts , or hemangiomas ,any of which may be signs of a covert neural tube defect .

9- Neurological examination . overall state of consciousness and the ease with which the infant makes transition from waking to sleeping or fussing to calming as well as strength of cry should be noted .primitive primary reflexes , cranial nerves .

10- <u>Gestational age</u> . and appropriateness of **size** for gestational age .

a- Gestational age may be determined by assessing certain physical and neurological characteristic that evolve in a predictable and progressive fashion during the later part of gestation . finding are assigned numerical values when compared to standard rating scales and summed totals are correlated to specific gestational ages .

b- After determining gestational age , **weight ,length ,** and **head circumference** values are plotted on graphs that classified newborns according to appropriateness of size for gestational age .

CARE OF THE NEWBORN .

A- **<u>Fluid and electrolyte requirements</u>** .

Water represents 94% of the fetal weight at three months of gestation. At term ,water content has decline to 80% of the birth weight of the newborn.

1- <u>Fluid loss and replacement</u> :

a- Fluid loss.

(1) During the first week of life , the extracellular fluid space contracts ,resulting in large reduction in body water . This water loos is responsible for 5% of the weight loss observed in term infants .the preterm infant may loss up to 10-15% of his birth weight .

(2) Water loss through evaporation from the skin and from expired air is referred to as insensible water loss. Water loss through the urine and stool is referred as sensible water loss .stool accounts for a very small amount of sensible water loss .

b- Fluid replacement , is based on fluid loss and calculated as the sum of insensible and sensible water loss. Initial parenteral fluid replacement should be accomplished with a 10% of dextrose solution .
Fluid intake in term infants is usually begun at 60-70 ml/kg on day one and increased to 100-120 ml/kg by days 2-3.smaller , more premature infants may need to start with 70-80 ml /kg on day one and advance gradually to 150 ml/kg .day .

c- Fluid balance is monitored by examining :

(1)- urine output .

(2)- change in body weight .

(3)- serum sodium concentration .

(4)- urine specific gravity .

2- Electrolyte loss and replacement :

a- **Sodium , potassium and chloride** , are the principle salts that are lost through the urine and should be replaced accordingly .assuming an adequate urine output , replacement is begun 24 hrs after birth at the following rates:

(1)- sodium 1-3 mEq/kg/day .

(2)- potassium 1-2 mEq /kg/day .

(3)- chloride 1-3 mEq /kg /day .

b- **Calcium** .a decrease in serum calcium concentration frequently occurs during the first week of life . serum calcium concentration below 7 mg/dl or below 3-3.5 mg/dl(ionized)bare considered hypocalcemia .

(1)- early neonatal hypocalemia . nearly all infants experience small decline in tatal serum calcium during the first few days of life owing to intrauterine parathyroid hormone suppression . early neonatal hypocalcemia rarely requires treatment except in preterm , infant of diabetic mother and asphyxiated infants .

(2)- late neonatal hypocalcemia (non physiological)is seen at the end of the first week of life , may be due to :

(a)- increased phosphate ingestion , as occur in infant whon are fed cows milk .

(b)- hypomagnesemia .

(c)- hypoparathyroidisim .

(3)- therapy usually consists of calcium replacement with calcium gluconate and treatment of underling cause of hypocalcemia .

(c)- other required mineral as phosphorus , magnesium , iron and trace Metals .

b- Nutritional consideration . the composition of the nutritional solution and the route of delivery depend on the gestational age , general medical condition and possible special nutritional need of the newborn

a- Enteric nutrition .

(1)- Route of feeding :

(a)-the term infant can be breast- fed or bottle fed on demand as long as attention is paid to intake and fluid balance .

(b)- the otherwise healthy preterm infant who is between 34-38-wks should be fed every 3 hrs by breast bottle or gavage depend on the infant strength and alertness .

(c)- the preterm infant who is less than34 wks does not have a well coordinated suck and swallow reflex , and therefore should be fed via a feeding tube . the feeding may be gastric bolus every 2-3 hrs except in infant weighting less than 1000 g .

(d)- continuous gastric or transpyloric feeding is employed in the infant who weight less than 1000 g , because this infant has a limited gastric volume and may experience intermittent hypoglycemia and hypoxia when given bolus feedings .so trophic feeding can be given at 10-20 ml/kg/day and the volume increased accordingly .intravenous fluid are needed until feeding provide approximately 120/kg/day .

(e)- continuous transpyloric feeding should be considered for the infant who require an endotracheal tube and mechanical ventilation to prevent gastric reflex and aspiration .

(2)- feeding solution .

The composition of the feeding solution depends on the presence or absence of special protein , carbohydrate , or fat requirements or intolerance which in turn depend on gestational age , gastrointestinal motility status , and the possibility of intestinal enzyme deficiencies or other metabolic disorders .

(a)- term infant who do not have complicating metabolic problem :

All of the water calorie , protein , and vitamin requirement of the normal term infant are met by human milk or 20 kcal/oz cows milk based formula .

The specific nutritional need of these infant for normal growth are as follow:

(!) the normal term infant needs 100- 120 kcal/kg /day to meet basal and growth requirement .

(!!) the infant also needs 2-3g/kg/day of protein for cellular growth which represent approximately 10% of total daily calorie intake .

(!!!) in addition ,40% of the daily calorie requirement should be derived from carbohydrates with remainder provided by dietary fat.

(b)- preterm infant :have decreased gastric motility and intestinal lactase activity as well as increased calcium and phosphorus requirement ,among other nutritional problems. The initial feeding solution should be a dilute whey –based formula or human milk as positive nitrogen balance is achieved , the infant may be advanced to a formula that is high in calcium ,phosphorus and protein , or to supplemented human milk .a 24kcal/oz formula is reserved for infants whose water intake must be restricted and infants who can not tolerate adequate feeding volumes .

(c)- infant with special metabolic needs . special formula solutions are available for infant with selected intestinal enzyme deficiencies (sucrase – isomaltase deficiencies) or metabolic diseases (PKU) .

(3)- Vitamins and mineral . commercially available formula now are fortified with vitamins ,minerals, and trace elements .therefore formula fed term infants do not routinely require vitamins or mineral addition .

(a)- special vitamins need .

(i) infants who are fed human milk may receive a multiple – vitamins supplement containing vit. A,D and C .

(ii) Owing to small body store and inadequate feeding volumes , preterm infants should routinely receive a multiple –vitamin supplement containing a the fat soluble vitamins (A and D) and the water –soluble vitamins (B and C). In addition , the preterm infant who is less than 36 wks and should receive vitamin E to prevent hemolytic anemia .

(b)- special mineral and trace element needs :

(i) Iron .all infant require iron supplementation ,which may be obtained via iron –fortified formula or through a separate supplement . iron supplement may be delayed in the preterm infant until enteric feeding are tolerated . because of the increased bioavailability of iron in human milk ,iron supplementation in term breast –fed infants may wait the introduction of iron –fortified cereal at 4-6 months of age . Folic acid also needed to be added for DNA and produce new cells .

(ii) fluoride .supplementation probably should not be given to infant younger than 6 months of age , even when otherwise indicated , because the danger of fluorosis .

(iii) calcium and phosphorus . the needs of the growing term infant are met by either commercial formula or human milk . owing to rapid bone growth , the calcium and of phosphorus requirements of the preterm infants are greater and necessitate special fortified formula or supplementation if fed human milk .

b. Total parenteral nutrition .

preterm and other sick infants may required total parenteral nutrition because of gastrointestinal disorders (e.g. neonatal necrotizing enterocolitis) as well as nongastrointestinal disorders (e.g.respiratory diseases , sepsis) an intravenous solution of dextrose , aminoacid , fat , vitamins ,and mineral can be administered by either peripheral or central venous access . appropriately used ,total parentral nutrition can provide adequate calories and protein to support the basal need and growth of the sick infants .

C - **Principles of drug therapy in neonate .**

The administration and dosing of drug a are different in neonates .disregarding this fact may result in toxicity or nontherapeutic use of drugs .after administration of a drug , the effect and disposition depend on a number of the following factors :

1- Route of administration, determines the peak drug level , how quickly the peak level is reached ,and how long the peak drug level is sustained .
2- Solubility and PH determine the compatibility of drugs, tissue penetration and excretion rate .
3- Protein binding .the plasma total protein and albumin level of the new born are lower than the adult levels .
   a- At similar total drug concentration , there will be , a larger unbound drugs fraction for drugs with strong protein binding in the newborn compared to the adult .because unbound fractionis the active ftaction in the blood , lower total drug concentrations are needed to achieve a therapeutic effect in the newborn .
   b- Drug competition for albumin binding sites in the infant with hyperbilirubinemia also poses a problem . if all the albumin binding sites are occupied with bilirubin , there will be a larger free fraction of drug in the blood . conversely , if the drug displaces bilirubin or is already occupying the binding site, the increase in free bilirubin may increase the risk of kernicterus .
4- Metabolism of the drugs by the liver : often is suboptimal because of low levels of glucuronyl transferase . this often result in increase in plasma drug level and excretion of unchanged drug compared to the adult.
5- Excretion of drugs by the kidney : often is impaired owing to low renal blood flow , low glomerular filtiration rate ,and immature tubular function

Gestational age assessment :

Estimation of gestational age can be based on :

- Menstrual period .
- Date of conception .
- Fetal ultrasonography .
- Physical and neuromuscular criteria after birth (ballard score). The ballard score is based on the neonate physical and neuromuscular maturity and can be used up to 4 days after birth .the neuromuscular component are more consistent over time because the physical component mature quickly after birth . however , the neuromuscular component can be affected by illness and drugs.

The physical and neuromuscular score are added to calculate gestational age .
Physical criteria include (increasing firmness of the pina of the ear ,size of the breast tissue , lanugo hair , creases of planter surface and genitalia) .
Neurological criteria include (posture , squire window , arm recoil ,popliteal angle , scarf signs and heal to ear) .

Birth trauma

Birth injury refers to avoidable and unavoidable injury to the fetus during the birth .

Caput succedaneum is a diffuse edematous often dark swelling of the soft tissue of the scalp that extended across the midline and suture line ,and seen after prolong labor in fullterm and premature infants .

Cephalhematoma is a subperiosteal hemorrhage that does not cross the suture lines and may associated with skull fractures . with time may organized and calcified , also may cause jaundice , both caput and cephalhematoma not need treatment .

Retinal and subconjuctiveal hemorrhage are common and not need treatment .

Brachial plexus may result from excessive traction on the neck producing paresis or complete paralysis .the simplest one Erb- duchenne paralysis involve the fifth and sixth cervical nerves .the usual picture is is painless adduction , internal rotation of the arm and moro reflex absent on affected side and the hand grasp is intact . Klumpke paralysis is caused by injury to the seventh and eight cervical nerve and the first thoracic nerve , if the sympathetic nerve are injured an epsilateral Horner syndrome (ptosis ,miosis) treatment of brachial injury is supportive and include positioning to avoid contracture , active and passive exercise may be needed and nerve graft in persist defect .

Facial nerve injury may be the result of compression of the seventh between the facial bone and the mother pelvic bone or the physician forceps .this peripheral injury is characterized by asymmetric crying face and the affected side is flaccid , the eye does not close , the nasolabial fold is absent and the side of the mouth is dropped at rest . if there is a central injury to the facial nerve , only the lower two third of the face (not the forehead) are involved .

skull fractures are rare are usually linear and require no treatment other than observation for very rare delayed complications like leptomeningeal cyst .depressed fractures may need elevation .

clavicle fracture is the most common fractures and usually is unilateral of course in macrosomic infants after shoulder dystocia .decreased the movement and moro reflex

on the affected side . the prognosis is excellent and many infants require no treatment.

Extremity fractures are less commonly than clavicle and involve humerus more than the femur .the treatment involve immobilization and triangular splint pandage for the humerus and traction suspension for the legs for femoral fractures .

Visceral trauma to the liver and spleen or adrenal gland occurs in macrosomoc infants and in extremely premature infants with or without breech or vaginal delivery.rupture of the liver with subcapsular hematoma formation may lead to anemia and shock and DIC . *infants with anemia and shock who are suspected to have intraventricular hemorrhage but with normal head ultrasound examination should be evaluated for hepatic or splenic rupture* **.**infants with severe adrenal gland hemorrhage may exhibit a flank mass , jaundice and hematuria with or without shock .

Certain procedures that can be done to the newborn :

1- Metabolic screen . before discharge a blood sample should be obtained from every neonate for presence of congenital hypothyroidismand phenylketonuria. In certain states screening also performed for other inborn error of metabolism like (**galactosemia , cystic fibrosis . sickle cell anemia , maple syrup urine disease homocystinuria , histidinemia) .**
2- Every newborn should receive a single dose of 0.5 -1 mg of natural vitamin K within one hour of birth .
3- Prophylaxis of **gonococcal ophthalmia** either a 1% silver nitrate or 0,5 erythromycin .
4- **Newborn circumcision** has potential medical benefits and advantage with disadvantage . benefit and risk should be carefully explained to the parents
   a- Benefits :
      - ✓ Prevent inflammation of glans and prepuce .
      - ✓ Decrease the incidence of penile cancer at adult .
      - ✓ Reduce urinary tract infection .
   b- Risk :
      - ✓ Local infection .
      - ✓ Bleeding .
      - ✓ Pain .
5- All newborn should be vaccinated with first dose of hepatitis vaccine .and if the mother is hepatitis B surface antigen –positive should also receive a dose of hepatitis B immunoglobulin as soon as possible after birth .

Problems in bonding between the sick infant and his parents :

Bonding :the process of psychological attachment of the parents to the newborn .the following procedures are recommended to minimized the physical separation of the infant from the parents and to encourage the formation of a strong bond .

1- Whenever possible , the mother should be transported to a tertiary care center before delivery .
2- When the infant is transported to another hospital , the father should travel immediately to the referral center so that he may keep close contact with the infant and bring photographs and information back to the mother .
3- Visitation should be available 24 hrs a day .
4- A strong line of communication be established between the medical staff (i.e .physician, nurse , social workers) and the parents .
5- The parents should encourage to keep in contact by telephone when visitation is difficult .
6- The parents suold be prepared regarding what to expect during their first visit to the nursery ,and they should be made aware of any sudden change in the infant condition .
7- Information should conveyed in a positive and truthful manner .
8- Psychological evaluation and support should be made available to parents who are having a particularly difficult time coping with their sick infant or the intensive care unit setting . parents groups often are helpful .
9- Plans for discharge should be made in advance and should include the parents .having the parent stay overnight in the hospital before discharge can significantly help them adapt to new roles that they will perform after they leave the hospital . any current or future medical problems and follow-up plans should be explained to the parents .

Prematurity :

Live infants delivered before 37 wks from the last day of the last menstrual period .

Low birth weight (weight 2.5 kg or less) due to prematurity or to poor intrauterine growth or both .

Prematurity and IUGR are associated with increased neonatal morbidity and mortality

Very low birth weight infants weigh less than 1.5 kg .and predominantly premature .

Causes of prematurity

- Fetal like (multiple gestation , fetal distress ,).
- Placental (placenta previa , placental dysfunction).
- Uterine (bicornuate uterus) .
- Maternal (heart diseases , D .M . ,renal disease , maternal infection).
- Others like premature rupture of membrane ,trauma , polyhydramios .
  A premature infant may show these signs soon after birth :
  - Trouble breathing .
  - Low weight .
  - Low body fat .
  - Inability to maintain a constant body temperature .
  - Less activity than normal .
  - Movement and coordination problems .

Complication of prematurity :

- Brain hemorrhage .
- Pulmonary hemorrhage .
- Hypoglycemia .
- Infection .
- Anemia .
- Patent ductus arteriosus .
- Respiratory distress syndrome .
  Long term outlook for premature infants include :
  - ✓ Hearing and speech problems .
  - ✓ Vision loss or blindness .
  - ✓ Learning disability .
  - ✓ Physical disability .
  - ✓ Delayed growth and poor coordination .

that interfere with the circulation and efficiency of the placenta , with the development or growth of the fetus or with the general health and nutrition of the mother .

Intrauterine growth restriction and small for gestational age :

IUGR represent a deviation from expected growth pattern . the decreased fetal growth associated withIUGR is adaptation to unfavorable intrauterine conditions that result in permanent alteration in metabolism , growth and development .

SGA describes an infant who birth weight is statistically less than 10^{th} percentile or two standard deviation below the mean birth weight for gestational age .

Causes of IUGR and SGA :

1- Maternal causes (genetic short stature, infections , young age , smoking , poor nutrition black race , chronic diseases like diabetes)
2- Fetal congenital infection , defect in metabolism , multiple gestation , chromosomal abnormalities) .
3- Maternal medication (antimetabollites , lead mercury , narcotics steroid , warfarin).
4- Placental and uterine (abruption placentae , abnormal implantation

At birth infants who are mildly to moderately SGA appear smaller than normal with decreased subcutaneous fat .

More severely affected may present with a wasted appearance with asymmetrical findings including larger head for size of the body (central nervous system sparing) widened anterior fontanelles , small abdomen thin arms and legs decreased subcutaneous fat dry skin and meconium stained umbilical cord .

Physical examination should detail the presence of dysmorphic features like abnormal extremities and hepatosplenomegaly . jaundice , skin rash and cataract that may suggest the presence of congenital infection or metabolic defect .

Infants with severe IUGR or SGA may have problems at birth include respiratory acidosis ,metabolic acidosis , asphyxia , hypotension , hypoglycemia , polycythemia , meconium aspiration syndrome .

Management of IUGR and SGA infants is usually symptomatic and supportive . the diagnosis evaluation at birth should be directed the cause if possible . the mortality rate are 5-20 times those of infants who are appropriate for gestational age . postnatal growth and development depend on part on the etiology , the postnatal nutritional intake and the social environment .infants who have IUGR and SGA secondary to congenital infection , chromosomal abnormalities or constitutional syndromes remain small throughout life . infants who have growth inhibited late in gestation because of uterine constraints , placental insufficiency , or poor nutrition have cutch up growth and approach their inherited growth and development potential under optimal environmental conditions .

Post –term infants :

Post term infants are those born after 42 completed weeks of gestation regardless the birth weight .

Clinical features may involve skin desquamation , long nail abundant hair ,pale skin alert face , and loose skin meconium stained nails and umbilical cord .

Complication include (perinatal depression . meconium aspiration . persistent pulmonary hypertension , hypoglycemia , hypocalcemia , and polycythemia .

Large –for- gestational – age infants:

Infants with birth weight >the 90^{th} percentile for gestational age are called large for gestational age . neonatal mortality rate decrease with increasing birth weight until approximately 4kg after which they increased . maternal diabetes , obesity and large parental size are predisposing factors .infant have a higher incidence of birth trauma like (brachial plexus injuries, fractured clavicle cephalhematoma)

Increased risk of hypoglycemia and polycythemia , congenital anomalies ,

Multiple gestation :

Multiple gestation always should be seen as a high risk event owing to its increased association with intra uterine accidents , growth abnormalities , prematurity and problems at the time of delivery like abnormal position and asphyxia .

1-**Incidence** . approximately 1-1.3% of all live birth are the result of twin gestation . the true incidence of twin gestation is probably is slightly higher . the monozygotic twining rate is 3.5-4 in live births or 35-40 %of all twin who are born .

1- **Etiology :**
a-monozygotic twin : maybe viewed as a teratogenic event because it occurs more frequently with increasing maternal age .isassociated with more congenital malformation and can be caused by teratogen . a problem of a symmetry in the developing embryo

may result in conjoined twins .the incidence of monozygotic twins is unaffected by racial and familial factors .

b-dizygotic twinning :is caused by double ovulation , which may be related to elevated gonadotropin .twin not of the same sex are dizygotic . in twin of the same sex , zygosity should be determined and recorded at birth through carefull examination of placenta .

c. incidence increase due to treatment of infertility with overian stimulant and in vitro fertilization .

2- **Prenatal problems** :

a- Death : may be occur because of cord accidents and twin to twin transfusion , which may lead to the death of one fetus , with thromboplastin release and subsequent DIC in the second twin .

b- Growth disturbances are the rule :

(1)- IUGR there is a decrease potential for growth in twin fetus compared to a single fetus ., probably owing to the limitation of placental area for nutrient transfer .

(2)- twin to twin transfusion , resulting in a large polycythemic twin and a small anemic twin .

c- the incidence of congenital malformation is doubled .

c- Increased spontaneous apportion .

d- Preterm delivery is the most common complication of multiple gestation it occurs in up to 50% of twin pregnancies , the incidence is even higher in triplet and quadruplet pregnancy .

e- Maternal complications include

- Pregnancy induced hypertension .
- Polyhydramnios .
- Hyperemesis and nausea .
- Anemia .

3- Postnatal problems include :

1. Prematurity and its complications.
2. Growth retardation.
3. Perinatal asphyxia .especially of the second twin because the placenta may be separated after birthof the first twin . and in instances of malpresentation or vasa previa may result in long term morbidity and mortality .

4- Management is aimed at :

a- Identifying multiple gestation as early as possible .

b- Managing other medical problems .

c- Controlling preterm labor .

d- Identifying ideal route of delivery .

e- Avoiding asphyxia in the second twin

Maternal diseases affecting the newborn

1- **Idiopathic thrombocytopenia ITP** : ITP is immune process in which antibodies are directed against platelets that cross the placenta and cause thrombocytopenia in the fetus and newborn , that increase the risk of intracranial hemorrhage .close maternal and fetal management is vital . infants with hemorrhage may need platelets transfusion or intravenous immunoglobulin .the condition usually resolve within 4-6 wks .

2- **Systemic lupus erythematosus SLE** : immune abnormalities in SLE can lead to the production of antibodies that can cross the placenta and injure fetal tissues and the most serious problems in fetus is damage to the cardiac conducting system which result in congenital heart block . neonatal lupus may occur and is characterized by skin lesion thrombocyropenia , autoimmune hemolysis and hepatic involvement . the mortality rate is about 2o% and most surviving infants require pacing .

3- **Neonatal hyperthyroidism** : is due to the transplacental passage of thyroid – stimulating antibodies , hyperthyroidism can appear rapidly within the 12 to 48 hrs . symptoms may include IUGR prematurity , goiter exophthalmos , stare , craniosynostosis . flushing, congestive heart failure tachycardia ,arrhythmia , hypertension , hypoglycemia , thrombocytopenia and hepatosplenomegaly .treatment include propylthiouracil , iodine drops and propranolol .the condition usually resolve in 2-4 months .

4- **Antiphospholipid syndrome**: is associated with throbophilia and recurrent pregnancy loss . antiphspholipid antibodies are found in 2-5% of the general healthy population . obstetric complications arise from the prothrombotic effects of theantiphospholipid antibodies on the placental function . vasculopathy ,infarction, and thrombosis have been identified in the mothers with antiphospholipid syndrome that manifested by fetal growth impairment , placental insufficiency , maternal preeclampsia and premature birth .

5- **Diabetes mellitus** :

RESPIRATORY TRACT DISORDERS

Respiratory disorders are the most frequent cause of admission for neonatal intensive care in both term and preterm infants . signs and symptoms of respiratory distress include cyanosis , grunting , nasal flaring retraction, tachypnea , decreased breath sounds with or without rales and pallor .

The first breath :

Initiation of the first breath is caused by a decline in Pao2 and PH and a rise in Paco2 as a result of interruption of the placental circulation , a redistribution of cardiac output , a decrease in body temperature and various tactile and sensory inputs .

Hyaline membrane disease (respiratory distress syndrome of newborn)

Is a respiratory disorder that primarily affects preterm infants who are born before the biochemical maturation of their lungs .

Biochemical development : the most important prenatalevent is the production of surfactant by type II alveolar cells .

The major function of **surfactant** is to decrease alveolar surface tension and increasing lung compliance . surfactant prevent alveolar collapse at the end of expiration and allows for opening of the alveoli at a low intra-thoracic pressure . the ratio of lecithin to sphingomyelin in the aminiotic fluid is areflection of the amount of intrapulmonary surfactant and lung maturity .an L/S ratio of 2:1 or greater usually indicates biochemical lung maturity .

Surfactant increase by (steroid administration , prolonged membrane rupture ,preeclampsia , placental insufficiency , thyroide hormone , theophyline).

Surfactant decreased by (maternal diabetes , acute asphyxia) .

1- **Pathophysiology** . the lungs are poorly compliant owing to deficiency of surfactant resulting in classic complex of progressive atelectasis , intrapulmonary shunting , hypoxemia ,and cyanosis .the hyaline membrane that forms and lines the alevioli is composed of protein and sloughed

epithelium – the result of oxygen exposure , alveolar capillary leakage and the forces generated by the mechanical ventilation of these infants .

2- **Clinical features:** affected infants characteristically present with tachypnea , grunting , nasal flaring , chest retraction ,and cyanosis , in first three hours of life . there is decrease air entry on auscultation .apnea and irregular respiration are ominous sign requiring immediate action .respiratory failure may occur in severe course

3- **Clinical course :** the natural course is a progressive worsening over the first 48- 72 hrs of life .
   (a) After the initial insult to the airway lining , the epithelium is repopulated with type II alveolar cells .
   (b) Subsequently , there is increase production and release of surfactant , so that there are sufficient quantities in the air spaces by 72 hrs of life .this result in improvement in lung compliance and resolution of the respiratory distress .

4- **Diagnosis** :is confirmed by a chest radiograph that reveals a uniform ground-glass pattern and an air bronchogram that is consistent with a deffuse atelectasis , clinical manifestation and gas analysis .
   RDS should be differentiated from (early onset sepsis , pneumonia , cyanotic heart diseases , aspiration syndromes , spontaneous pneumothorax , transient tachypenia of newborn .) .

5- Therapy and prognosis :
   a- Conventional therapy for the affected premature infant include supportive care as well as the administration of oxygen . it also necessary to increase the main airway pressure by use of continuous positive airway pressure , intermittent assisted ventilation , or a high frequency oscillation . outcome with conventional therapy is good .
   b- Exogenous surfactant replacement therapy with artificial or bovine surfactant has become an important intervention for those infants with severe surfactant deficiency . alveolar opening and improvement in oxygenation and ventilation occur almost immediately .

6- **Prevention .** when amniotic fluid assessment reveals fetal lung immaturity and preterm delivery can not be prevented , administration of corticosteroid to the mother 48 hrs before delivery can induce or accelerate the production of fetal lung surfactant .

7- **Complications :**common complications and associated findings include pneumothorax , patent ductus arteriosus , intraventricular hemorrhage , necrotizing enterocolitis , bronchopulmonary dysplasia and retinopathy of prematurity .

Transient tachypnea of newborn :

Is thought to result from decreased lymphatic absorption of fetal lung fluid It most commonly occurs in the infant born near term by cesarean section ,without preceding labor (the catecholamine surge associated with labor and delivery which is thought to enhance pulmonary lymphatic drainage does not occur in this setting)

(1)- clinical features . the tachypnea is quiet or mild and usually not associated with retraction . the infant appears comfortable and rarely cyanotic .

(2)- diagnosis : is based on the delivery and chest radiograph ,which characterized by fluid in the major fissure , prominent vascular marking , increased interstitial markings and hyperinflation . auscultation may reveal rales .

(3)- therapy is supportive . the tachypnea resolves in a few days .low doses of supplemental oxygen may be required .

persistent of the fetal circulation(persistent pulmonary hypertension).

Usually a disease of term infants who are experience acute or chronic in utero hypoxia .it is seen frequently in infant with meconium aspiration syndrome .

(1) **Pathophysiology** . the primary abnormality is a failure of the pulmonary vascular resistance to fall with postnatal lung expansion and oxygenation .
   (a) Normally at birth the systemic vascular resistance rises as a result of cessation of blood flow through the placenta , and pulmonary vascular resistance falls with the first breath .
   (b) With persistence of the fetal circulation , the pulmonary vascular resistant continues to be high and may in fact be higher than the systemic resistance .this result in shunting of the deoxygenated blood which is returning to the right side of the heart away from the lungs. The right to left shunt can occur at both the atrial level(foramen of ovale) and through the ductus arteriosus .because the lung are bypassed the blood is not oxygenated and hypoxemia ensues.

(2) **Clinical features** . these infants have rapidly progressive cyanosis associated with mild to severe respiratory distress . there is a varied response to oxygen administration depending on the size of the shunt .

(3) Diagnosis :
   (a) The diagnosis is suggested by a history of perinatal asphyxia and clinical cyanosis at birth combined with a negative cardiovascular examination and negative chest radiograph , although parenchymal disease may coexist (MAS,RDS) .
   (b) Echocardiography should be used to establish the diagnosis and should demonstrate :
      (!) the absence of cyanotic heart disease .
      (!!) an increased pulmonary vascular resistance .

(!!!) the presence of right to left shunt at the foramen of ovale ductus arteriosus , or both .

(4) **Therapy :** include supplemental oxygen , mechanical ventilation , hyperventilation ,support of systemic blood pressure and administration of sodium bicarbonate and pulmonary vasodilators .

(5) **Prognosis :** the overall mortality rate associated with this disease is high .extra-corporeal membrane oxygenation may improve the outcome .

Apnea

Apnea is cessation of breathing for longer than 20 seconds . apnea often occurs in preterm infants (apnea of prematurity) and reflect immaturity of the respiratory control mechanism in the brain stem .

(1)- **clinical features** ,bradycardia (HR less than 80beats/min) often associated with apnea .apnea of prematurity is characterized by periodic breathing and intermittent hypoxia , which further diminish respiratory derive .

(2)- **diagnosis** . of apnea of prematurity is made after excluding other reason for the apnea like :

- Respiratory (pneumonia , airway obstruction, hypoxia , pneumothorax).
- CNS (intracranial hemorrhage , seizure , drugs ,hypoxic injury).
- Infections (sepsis , meningitis).
- Metabolic (hypoglycemia , hypocalcemia , decrease or increase sodium , hypothermia).
- Cardiovascular (heart failure , hypotension ,).
- Gasrtointestinal (necrotizing enterocolitis ,).

(3)- **therapy** : therapy of apnea of prematurity include one of ht efollowing :

a- tactile stimulation

b--maintain body temperature .

c- supplemental oxygen .
d- administration of respiratory stimulant (theophyline , caffeine)
e- use continuous positive air way or intermittent assisted ventilation) .
f- treatment of underling cause .

prognosis : apnea of prematurity dose not alter prognosis unlees it severe , recurrent and refractory to therapy).

Choanal atresia : is a unilateral or bilateral obstructionof the posterior nasal airway by a membrane or bony septum .this life threatening anomaly result from failure of the bucconasal mucosa to rupture .

Clinical features : because most newborn are obligate nose breathers , bilateral atresia usually presents in the delivery room as airway obstruction , apnea and cyanosis .distressed neonate then cry which relieve the cyanosis . unilateral obstruction may be asymptomatic .

Diagnosis : is confirmed either by inability to pass a suction catheter through the nostril into the oropharynx or by radiography using radioopaque dye to show the area of nasal obstruction .

Therapy : emergency management consists of establishing an airway either with an oral airway or by endotracheal intubation . definitive therapy is surgical reconstruction performing in neonatal period .

Diaphragmatic hernia :

Diaphragmatic hernia is a displacement of the abdominal content into the thoracic cavity through a defect in the diaphragm .

Types :

(a) hernias through the **foramen of bochdalek** are by far the most commonly seen diaphragmatic hernia . the defect , which almost always is on the left occurs in the posteriolateral portion of the diaphragm . it results from failure of the pleuroperitoneal canal to close , which normally occurs between 6-8 wks gestation.

(b) Herians through the **foramen of morgagni** are somewhat rare , the hernia usually on the right .frequently the hernia contain only omentum and the affected newborn is asymptomatic .

Pathophysiology : ipsilateral pulmonary hypoplasia results from compression of the affected lung by the displaced gastrointestinal organs a shift of the mediastinal structures resulting in compression of the contralateral lung may cause hypoplasia of the lung to a lesser degree .

Diagnosis : is confirmed by a chest radiograph demonstrating air-filled bowel in the hemithorax .

Therapy : includes intubation , vigorous oxygenation and mechanical ventilation , decompression of the intestinal tract with a nasogastric tube ,

correction of metabolic acidosis , and surgical removal of the abdominal contents from the thorax with repair of the hernia .

(a) Mask and bag ventilation should be avoided or minimized because it results in distension of the bowel and further compromises the pulmonary function of the affected newborn .
(b) Pulmonary hypertension frequently complicates the preoperative and postoperative course .
(c) Extracorporeal membrane oxygenation may be helpful in selected infants .

Prognosis : survival rates depend on the degree of the lung hypoplasia and the presence of other anomalies ,symptoms before 24 hrs of age , herniation to the contralateral lung and need for ECMO . with conventional therapy , survival rates are approximately 67% , however the use of extracorporeal membrane oxygenation may improve survival .

Meconium aspiration syndrome (MAS)

MAS is a multiorgan disorder with perinatal asphyxia as the underlying cause . it is most commonly occurs in post term infants and in infants who are small for gestational age due to intrauterine growth retardation . both have placental insufficiency as a common for fetal hypoxia .

(1) **Pathophysiology** . the fetal hypoxia triggers via a vagal reflex , the passage of thick meconium into the amniotic fluid .the contaminated amniotic fluid is swallowed into the oropharynx and aspirated at birth with the initiation of breathing . with severe fetal asphyxia and acidosis , the meconium may be aspirated prenatally because of fetal gasping .other organ affected by the perinatal hypoxia include the brain ,heart gastrointestinal tract and kidneys .
(2) **Diagnosis :** is established by the presence of mecomium in the tracheal or amniotic fluid combined with symptoms of respiratory distress and a chest radiograph that reveals a pattern of diffuse infiltrate with hyperinflation .
(3) **Therapy :** because most episodes of aspiration occur with the initiation of respiration , the most effective therapy is prevention . this consist of removal of the meconium before the initiation of ventilation . the meconium is removed from the infant airway as follows:
    - The oropharynx is suctioned before both delivery of the thorax and initiation of breathing ,and again when the infant is on the warmer bed .

- The vocal cords are visualized using a laryngoscope , and a large endotracheal tube or DeLee catheter is inserted .
- Direct wall-unit suction is applied to the tube or catheter as it is removed . this procedure is repeated if significant meconium is removed . *only after the trachea is cleared of any meconium should spontaneous or artificial ventilation be initiated* .
- If aspiration has occurred and the infant is in distress , therapy consists of administration of oxygen and mechanical ventilation .
- Persistent pulmonary hypertension also may coexist and should be vigorously treated .

Pneumothorax :

Pneumothorax is presence of free air in the pleural space . the air often is under pressure and in this setting is referred to as tension pneumothorax .

(1) **Incidence and etiology .** asymptomatic , spontaneous pneumothorax occurs in 1-2% of otherwise healthy newborn at birth . symptomatic pneumothorax more commonly occurs in the infant who is receiving mechanical ventilation or who has underling lung disease (RDS, MAS) .

(2) **Clinical manifestations** . symptoms and signs include cyanosis , tachypnea ,and elevation of the affected hemithorax . auscultation reveals diminished breath sounds on the affected side .

(3) Diagnosis :

(a) The diagnosis made by a chest radiograph that demonstrate a dense partially collapsed lung surrounded by a large area of radiolucent air within the hemithotax . depending on the degree of tension and lung compliance , the mediastinal structures are shifted toward the opposite side of the chest .

(b) Transillumination of the thorax may aid in the diagnosis of the pneumothrax in the emergencies , positive evidence is the transmission of light through the affected side .

(4) **Therapy :**varies with the severity of the symptoms .

(a) If no other lung disease exists and there is minimal respiratory distress , supplemental 100% oxygen (nitrogen wash out technique) for several hours usually is sufficient .

(b) If a significant degree of tension , respiratory distress ,or some other lung disease exist the air should be evacuated by aspiration with a syringe and needle or by a chest tube if a continuous air leak exists .

Digestive system disorders

Neonatal necrotizing enterocolitis (NEC) : refers to a spectrum of varying degrees of acute intestinal necrosis usually following injury of the bowel with secondary invasion and devitalization of the bowel wall .

1- **Incidence .** this is a serious and common problem affecting 1-5% of all newborn admitted to the intensive care units . affected infants most commonly are premature near 90% , asphyxiated and suffering from other medical problems . necrotizing enterocolitis rarely observed in a healthy term infants and less common in in infants fed human milk .
2- **Etiology and pathogenesis** :
   (a) Bowel ischemia secondary to preceding perinatal asphyxia generally is regarded as the cause of bowel wall injury . the introduction of formula or human milk then provides the substrate for bacterial overgrowth . bacterial invasion of thr bowel wall often with gas production (pneumatosis intestinalis), leads to tissues necrosis and perforation .
   (b) Other predisposing factors includes :
      (1) Systemic hypotension .
      (2) Patent ductus arteriosus .
      (3) Placement of au umbilical artery catheter .
      (4) Exchange transfusion .
      (5) Previous treatment with systemic antibiotics .
      (6) Use of hyperosmolar formula .
      (7) Rapid advancement of the feeding volume .
3- **Clinical features and diagnosis** : signs and symptoms are usually are noted during the first 2 wks of life , shortly after enteric feeding has begun :
   - Gastric residuum which often is bile stain .
   - Abdominal distension .
   - Blood in stool .
   - Lethargy and apnea .
   - Poor perfusion with hypotension or shock .
   - Abdominal wall discoloration .
   - Unstable temperature and metabolic acidosis .
4- **Laboratory findings** :
   (1) Suggestive on blood film leukocytosis , neutropenia or thrombocytopenia.
   (2) Suggestive findings on abdominal radiography include :
      (a) Dilated thickened bowel loops .
      (b) Pneumatosis intestinalis which usually starts in the right lower part .
      (c) Perforation , with free abdominal air and portal vein air .

5--Clinical course :two distinct clinical patters are noted :

a- Most infants follow a course characterized by feeding intolerance , abdominal distension occult blood in the stool , and dilated bpwel loops on radiography . these finding improve rapidly with therapy .
b- The other group of infants has severe progressive symptoms including groos blood in the stool , extreme abdominal tenderness , hypotension disseminated intravascular coagulation and sepsis . peumatosis intestinalis and perforation frequently occur in this setting .

6- **Therapy :**
   a- Treatment should begin with discontinuation of enteric feeding , gastric drainage and administration of intravenous fluid .
   b- Once culture have been taken ,systemic antibiotics (e.g. ampicillin ,gentamicin) shloud be given .also any accompanying disorders (e.g. DIC) should be treated .
   c- Surgical resection of the necrotic bowel segment is indicated for infants who have a progressive downhill course and for those in whom intestinal perforation has occurred .
7- **Prognosis :** the mortality rate associated with necrotizing enterocolitis which is highest in the most premature infants is approximately 30% .later complications may include intestinal strictures and short bowel syndrome ..

Anemia of the newborn

Neonatal hemoglobin concentration at birth about 16.5-18 g/dl. After birth hemoglobin decline to 11-12 g/dl at 3-6 months at term . premature infant has a lower hemoglobin concentration to achieves a nadir at 1-2 months after birth .fetal hemoglobin represent 60- 90 %of hemoglobin at term birth and the level decline to adult level by 4 months of age . for term infant blood volume is 70-90 ml/kg and a preterm infant ,blood volume is 90-100 ml/kg .

The physiological anemia noted at 2-3 months of age in term infant and at 1-2 months of age in preterm infants , is a normal process that does not result in signs of illness and does not require any treatment . it is a physiological condition believed to be related to several factors including increased tissue oxygenation experience at birth , shortened RBC life span and low erythropoietin levels .

Etiology : symptomatic anemia in the newborn period may be caused by decreased RBC production ,increased RBC destruction or blood loss ..

Hemolytic disease of the newborn (erythroblastosis fetalis) .

Result from blood group incompatibility between the mother and the fetus . hemolysis occurs when maternal antibodies to a particular blood group antigen cross the placenta and bind to fetal red blood cells , which are then destroyed in the spleen .

ABO blood group incompatibility : with neonatal hemolysis develops only if the mother has IgG antibodies from a previous exposure to A or B antigens .these IgG antibodies cross the placenta by active transport and affect the fetus or newborn . sensitization of the mother to fetal antigens may have occurred by previous transfusion or by condition of pregnancy that result in transfer of fetal erythrocyte into maternal circulation such as first trimester abortion , ectobic pregnancy amniocentesis , or normal pregnancy .

ABO incompatibility with sensitization usually does not cause fetal disease other than mild anemia . it may produce hemolytic disease of newborn , however which is manifested as significant anemia and jaundice . because many mother who have blood group O have antibodies to A and B before pregnancy , the first born infant of A or B type may be affected . in contrast to RH disease , ABO hemolytic disease dose not become mre severe with subsequent pregnancies .hemolysis with ABO incompatibility is a less severe than hemolysis in RH-sensitized pregnancy , either because the anti A or anti B antibody may bind to non erythrocytic cells that contain A or B antigen or because fetal erythrocyte have a fewer A or B antigenic determinants than they have RH sites . with declining incidence of RH hemolytic disease , ABO incompatibility has become the most common cause of neonatal jaundice requiring therapy .

Erythroblastosis fetalis :

Erythroblastosis fetalis classically is caused by Rh blood groip incompatibility . most RH negative mother have no anti-Rh antibodies at the time of their first pregnancy . in most Rh-sensitized cases ,the D antigen of the fetus sensitized the Rh negative mother resulting in IgG antibody production during the first pregnancy . because most mothers are not sensitized to Rh antigen at the start of pregnancy . Rh erythroblastosis fetalis is uaually a disease of second and subsequent pregnancies .the first affected pregnancy results in an antibody response in the mother which may be detected during antenatal screening with coombs test and determined to be ant-D antibody . The first affected newborn may show no serious fetal disease and may manifest hemolytic disease of the newborn only by development of anemia and jaundice . subsequent pregnancies result in an increasing severity of response because of an earlier onset of hemolysis in utero . fetal anemia , heart failure elevated venous pressure , portal vein obstruction and

hypoalbuminemia result in fetal hydrops, which is characterized by ascites , pleural and pericardial effusion and anasarca .the risk of fetal death is high . If the fetus near term can be delivered and treated in neonatal intensive care unit . if the fetus less than 33 wks and immature lung intrauterine transfusion O-negative blood into the umbilical vein is indicated and may have to be repeated until pulmonary maturity is reached

Prevention : of sensitization of the mother carrying an Rh –positive fetus is possible by treating the mother during gestation (more than 28 wks gestational age and within 72 hrs after birth with anti-Rh-positive immune globulin . the dose (300ug) is base on the ability of this amount ao antiRh-positive antibody to bind all the possible fetal Rh positive erythrocytes entering the maternal circulation during the fetal –to-maternal transfusion at birth (approximately 30 ml).

Diagnosis and management :

Hemolysis in utero result in hydrops with (ansarca ,heart failure,and pulmonary odema that result in asphyxia , hepatosplenomegaly ,pallor and become jaundice within 24 hrs after birth . patients with ABO incompatibility often are asymptomatic and show no physical signs at birth , mild anemia with jaundice develops during the first 24-72 hrs of life .

Newborn with acute blood loss due to(feto-maternal hemorrhage , placenta previa ,or internal hemorrhage) is characterized by pallor , diminished peripheral pulses ,and shock but no hepatosplenomegaly .

Newborn with chronic blood loss caused by (chronic fetal-maternal hemorrhage , twin to twin transfusion) present with marked pallor , heart failure hepatosplenomegaly with or without hydrops with low HB at birth and decreased serum iron store . shock is more typical in patient with internal hemorrhage whereas in hemolytic diseases heart failure may br seen with severe anemia .

Laboratory evaluation :

A complete blood count , blood smear , reticulocyte count , blood type and direct coombs test (to determined the presence of antibody coated RBCs) should be performed in the initial evaluation of all infants with hemolysis . RBC enzymes , hemoglobin electrophoresis and RBC membrane tests .

The diagnosis of fetal- maternal hemorrhage is confirmed by the Kleihauer – Betke acid elusion test .

Internal hemorrhage or when nonimmune hemolysis is suspected ,ultrasound of liver brain spleen or adrenal gland may be indicated .

The treatment of symptomatic neonatal anemia is transfusion of cross matched packed RBCs .if immune hemolysis is present ,the cells to be transfused must be cross matched against maternal and neonatal plasma . Acute volume loss may need non blood products such as saline if blood not available .

To correct anemia 10-15 ml/kg of packed RBCs can be given

Neonatal hyperbilirubinemia

Neonatal hyperbilirubinemia is a condition characterized by an excessive concentration of bilirubin in the blood .there are two types of neonatal hyperbilirubinemia (unconjugated) which can be physiological or pathologic in origin and (conjugated) which always stems from pathologic cause . both types may lead to jaundice . neurotoxic concentration of unconjugated bilirubin can cause kernicterus .

1- Normal bilirubin metabolism : bilirubin is a bile pigment formed from the degradation of heme that is mainly derived from red blood cell destruction 75% but also from ineffective red blood cell production 25% .

Bilirubin is poroduced by the catabolism of hemoglobin in the reticuloendotheelial system . the tetrapyrole ring of the heme is cleaved by heme oxygenase to form equivalent quantities of biliverdin and carbine monoxide . biliverdin is converted to bilirubin by bilivedin reductase . one gram of hemoglobin produce 35 mg of bilirubin compared with adult newborn have two to three fold greater rate of bilirubin production (6-10 mg/kg/day vs.3mg/kg/day) this increased production is caused in part by increased RBC mass and short half life of erythrocyte 70-90 days compared to 120 days in adult .Bilirubin produced after hemoglobin catabolism is lipid soluble and unconjugated and react as un indirect reagent in the van den bergh test .indirect – reacting unconjugated bilirubin is toxic to the central nervous system and is insoluble in water ,limiting its excretion . unconjugated bilirubin binds to albumin on specific bilirubin binding sites , one gram of albumin binds 8.5 mg of bilirubin in the newborn .if the binding sites become saturated or if a competitive compound binds at the site displacing bound protein , free bilirubin becomes available to enter the central nervous system .organic acids and and drugs like sulfisoxazole can displace bilirubin from its binding sites on albumin .Bilirubin dissociates from albumin at the hepatocyte and become bound to a cytoplamic liver protein Y ligandin . hepatic conjugation result in the production of bilirubin diglucuronide , which is water suloble and capable of biliary and renal excretion . the enzyme glucuronosyl transferase represents the rate – limiting step off bilirubin conjugation . the concentration of ligandin and glucuronosyl transferase are lower in newborn particularly in premature than in older children .Conjugated bilirubin gives a direct reaction in the van den bergh test . most conjugated bilirubin is excreted through the bile into the small bowel and eliminated in the stool .some bilirubin may undergo hydrolysis back to the unconjugated fraction by intestinal glucuronidase , however and may be reabsorbed (enterohepatic recirculation) . in addition , bacteria in the neonatal intestine covert bilirubin to urobilinogen and stercobilinogen which are excreted in urine and stool and usually limit bilirubin reabsorbtion . delayed passage of meconium which contain bilirubin , also may contribute to the enterohepatic recirculation of bilirubin .maternal indirect hyperbiliruninemia also may increase fetal bilirubin level .

Physiological jaundice :

Physiological jaundice is a common cause of hyperbilirubinemia among newborn it is a diagnosis of exclusion made after careful evaluation has ruled out more serious causes of jaundice such as hemolysis , infection and metabolic diseases .

Physiological jaundice as opposed to pathological jaundice is characterized by :

(1) Clinical jaundice appearing after first day .
(2) An increase in the total serum bilirubin concentration of less than 5mg/dl/day
(3) A total serm bilirubin concentration of less than 13 mg/dl in term and less than 15mg/dl in preterm and direct bilirubin of less than 1.5-2 mg/dl .
(4) Persistence of clinical jaundice for less than one week .

Pathological jaundice :

Jaundice and underling hyperbilirubinemia are considered pathological if the time of appearance ,duration ,or pattern varies rom that of physiological jaundice .the greatest risk associated with indirect hyperbilirubinemia is the development of bilirubin induced neurological toxicity which typically occurs with high indirect bilirubin levels , the development of kernicterus depends on :

1- Level of indirect bilirubin .
2- Duration of exposure to bilirubin elevation .
3- The cause of jaundice .

The infants well-being .

specific causes of nonphysiological indirect hyperbilirubinemia include :

(i) – hemolytic diseases of immune etiology .(fetomaternal blood group incompatibilities RH and ABO as well as non immune like spherocytosis , hemoglobenopathies red blood cell enzyme deficiency .

(ii)- extravascular blood loss and accumulation (cephalhematoma) .

(iii)- increased enterohepatic circulation due to intestinal obstruction .

(iv)- breast feeding associated with poor intake .

(v)- disorder of bilirubin metabolism like Gilpert syndrome and Crigler-Najjar syndrome.

(vi) – metabolic disorder like hypothyroidism .

Jaundice associated with breast –feeding :

Significant elevation in indirect bilirubin (*breast milk jaundice)* develops in term infants after the seven day with maximum concentration as high as 10-30 mg/dl reached during the 2^{nd} -3^{rd} wk .and may persist for 3-10 wk at a lower level if the breast feeding discontinued for one or two days the serum level fall rapidly. although uncommon kernicterus can occur .the cause of breast milk jaundice is unclear but may be due to glucuronidase in some breast milk .

The late jaundice associated with breast feeding should be distinguished from early onset known as breast feeding jaundice which occur in the 1^{st} wk and may be a result of decreased milk intake or dehydration .

Crigler –najjar syndrome :

Is a serious rare autosomal recessive , permanent deficiency of glucuronosyltransferase that result in severe indirect jaundice . type ll respond to enzyme induction by Phenobarbital producing elevted enzyme and reduce bilirubin .type l does not respond to Phenobarbital and manifest as persist indirect jaundice often leeding to kirnicterus in absence of hemolysis .

Gilbert disease : is caused by a mutation of the promoter region of glucuronosyltransferase and result in mild indirect jaundice and usually occur after puberty and not need treatment .

Causes of jaundice in the first wks (physiological jaundice , ABO and Rh –incompatibility , concealed hemorrhage , congenital infection , sepsis ,breast feeding jaundice , Crigler –Najjar syndrome ,urinary tract infection , polycythemia) .

Causes of jaundice after first wks (beast milk jaundice , septicemia , bile duct atresia , hepatitis , galactosemia , hypothyroidisim , CF ,inborn error of metabolism) .

Kernicterus ;

Kernicterus is a severe neurological condition associated with very high levels of unconjucated bilirubin in the blood . kernicterus is characterized by yellow staining of the basal ganglia and hippocampus ,which is accompanied by wide spread of cerebral dysfunction .

(a) **Causes .** kernicterus occurs when free bilirubin crosses the blood brain barrier and enter the brain cell .
(i)- normally unconjugated bilirubin is bound tightly to albumin which prevent bilirubin from crossing the blood brain barrier .*free bilirubin exists when ths amount of unconjugated bilirubin exeeds the binding capacity of albumin.*
(ii)- bilirubin also may enter the brain at a low concentration owing toe displacement from the albumin binding site by another compound (e.g. sulfa drugs). Which lead to increased free bilirubin concentration or because of disruption of the blood brain barrier by sepsis , asphyxia , acidosis , or infusion of hyperosmolar solutions .

(b) Kernicterus causes a complex of neurologic symptoms including the earliest clinical manifestation as lethargy ,hypotonia , irritability poor moro response and poor feeding . later signs include bulging fontanelle , opisthotonic posturing , pulmonary hemorrhage ,fever and seizure .
Infants with severe cases of kernicterus die in the neonatal period , survived infants may developed nerve deafness . choreosthetoid cerebral palsy , mental retardation and discoloration of the teeth .
Kernicterus can be prevented by avoiding high indirect bilirubin levels and avoiding condition and drugs that may displace bilirubin from albumin .
Early signs occasionally may be reversed by immediately exchange transfusion .

Treatment of jaundice :

Regardless the cause the goal of therapy is to prevent neurotoxicity related to indirect –reacting bilirubin .

(1)--**Phototherapy** : is an effective and safe method for reducing indirect bilirubin particularly when initiated before serum bilirubin increased to levels associated with kernicterus . in term infants phototherapy is begun when indirect levels are between 16- 18 mg/dl . in premature infants when bilirubin is at lower levels . blue and white lights are effective in reducing bilirubin levels .

Phototherapy causes a photochemical reaction producing the reversible , more water soluble isomers of indirect bilirubin this isomr can be excreted bypassing the liver conjugation system or excreted in urine .

Because phototherapy may require 6-12 hrs to have a measurable effect it must be started at bilirubin level below those indicated for exchange transfusion . the therapeutic effect of phototherapy depend on :

- Light energy and effective wavelength 425-to475 nm wavelength .
- The distance between the light and infant 15-20 cm .
- The surface area of exposed skin .
- Rate of hemolysis and metabolisim and excretion of bilirubin .

Complications of phototherapy include :

- Increased insensible water loss and dehydration .
- Macular –papular skin rash .
- Lethargy and masking of cyanosis .
- Nasal obstruction by eye pads and potential retinal damage .
- Loose stool .
- Bronze baby syndrome in infants with direct jaundice .

(2)- intravenous immunoglobulin in jaundice caused by isoimmune hemolyric disease and can be used if phototherapy not effective and bilirubin approaching exchange level .

(3)- metalloporphyrins a single i.m dose on the first day of life may reduce the need for subsequent phototherapy . the proposed mechanism is competitive enzymatic inhibition of the rate – limiting conversion of heme protein to biliverdin .

(4)- **exchange transfusion** : is used principally in hemolytic disease or when the bilirubin concentration is very high . this procedure directly remove the bilirubin from the intravascular space . unbound antibodies that initiate the hemolytic process and affected red blood cell also are removed beside correction of anemia .

Exchange transfusion usually is performed when the serum bilirubin concentration is 20 mg/dl or more . the specific bilirubin concentration that requires treatment varies with gestational age , the cause of jaundice and the presence of medical complications (e.g. sepsis , acidosis).

As the rule of thumb alevel of 20 mg/dl for bilirubinnis te exchange number for infantwith hemolysis who weigh more than 2000g .asymptomatic infant with physiological or breast milk jaundice may not require exchange transfusion unless indirect bilirubin level exceed 25 mg/dl .the exchangeable level of bilirubin for other infants may be estimated by calculating 10% of birth weight in grams , so the level in an infants weighing 1500g would be 15mgdl .

The exchange transfusion is usually performed umbilical catheter in vein to a distance no greater than 7 cm in a full term .the exchange should be carried out over 45-60 min.with aspiration of 20 ml of infant blood alternating with infusion of 20 ml of donor blood , 5-10 ml may be indicated in sick or premature infants .

1- Rh hemolytic disease of the newborn need O Rh negative RBCs do not have major blood group antigen so they are not memolysed by maternal antibodies that may still be present in the infants circulation .if RBC are made available before delivery of the sensitized infant the RBCs must be O Rh negative and cross matched against the mother . if the RBCs are sourced after delivery the RBCs must be cross matched against infant .
2- ABO incompatibility : use group O , Rh specific RBCs . these RBCs contained low levels of antibodies and lack antigens that could trigger any circulating maternal antibodies in th newborn .
   Estimated double volume to be exchange :
   Term/preterm=85ml x 2 x weight(kg)= 170 ml x weight (kg) .

The infants stomach should be emptied before transfusion to prevent aspiration and body temperature should be maintained and vital signs monitored .

After exchange transfusion the bilirubin level must be determined at frequent intervals every 4-8 hrs because bilirubin may rebound within hrs as a result of continued hemolysis and redistribution of bilirubin from tissue store .

Acute complications include (transient bradicardia , cyanosis ., transient vasospasim , thrombosis , apnea , infections necrotizing enterocolitis , vessel perforation or hemorrhage , metabolic instability).

Late complications (late anemia GVH reaction , inspissated bile syndrome , portal vein thrombosis) .

Conjugated or direct hyperbilirubinemia

Direct jaundice defined as direct bilirubin level > 2mgdl or > 20% of the total bilirubin is never physiological . direct bilirubin is not neurotoxic to the infant but signifies a serious underling disorder involving cholestasis or hepatocellular injury .

Causes of direct jaundice :

1- TORCH infection (toxoplasmosis ,rubella,cytomegalovirus ,herpes simplex)
2- Metabolic disorders (e.g. galactosemia).
3- Bacterial sepsis .
4- Obstructive jaundice (e.g. biliary atresia) .
5- Prolonged administration of intravenous protein solution .
6- Neonatal hepatitis , alpha one antitrypsin deficiency , cystic fibrosis .
7- Inspissated bile from prolonged hemolysis .

diagnosis : is based on conjugated fraction of the bilirubin level and (liver enzymes ,bacterial and viral culture , metabolic screen , hepatic ultrasound sweet chloride and possible liver biopsy) .
therapy : is directed to the underlying cause of direct jaundice .

Hydrops fetalis :

I s a condition that develops I utero , usually as a result of chronic anemia due to hemolytic disease ,although many etiologies exist and its chief features include anemia or anasarca and hypoptoteinemia with heart failure .

1- Etiology :
a- Severe chronic anemia due to (isoimmunizationdue to Rh and ABO incompatibility) ,homozygous alph thalasemia , twin to twin transfusion .
b- Cardiac (structural defect , paroxysmal aterial tachycardia) .
c- Hypoproteinnemia .
d- Intrauterine infection including syphilis , toxoplasmosis and CMV) .
e- Chromosomal disorders (e.g. turner syndrome) .

2- Pathophysiology :
The exact pathophysiology is unknown , but the central factor in the development of the hydrops fetalis appears to be severe chronic anemia with loss of oxygen-carrying capacity , leading to hypoxia and acidosis . a controlling factor is hypoproteinemia , which together with anemia causes the development of congestive heart failure , edema , pleural effusion and ascites .all of these problems contribute to the respiratory distress seen at birth .

3- Clinical features :
a- Signs and symptoms include (congestive heart failre,pallor, pleural effusion.periphral edema and hepatosplenomegaly).
b- Laboratory findings include (anemia,hypoprotenemia,hypoxia.acodosis) .

4- **Therapy** : is aimed at correcting the anemia and treating the cogntive heart failure and respiratory distress .in addition appropriate treatment should be provided for associated etiologies .idiopathic causes of hydrops are associated with a high mortality rate .

Polycythemia :

Polycythemia occurs in 2-5% of all newborn and is defined as a hematocrit of 65% or greater when a freely following blood sample is taken from a large vein . hyperviscosity of the blood almost always exists in associated with polycythemia .

a- **Etiology**. Polycythemia has been associated with the following conditions :
   1- Fetoplacental transfusion associated with birth asphyxia or delayed cord clamping .
   2- Twin to twin transfusion .
   3- Chronic intrauterine hypoxia secondary to placental insufficiency (e.g. pregnancy induced hypertension with fetal growth retardation or increased fetal metabolism (e.g. with maternal diabetes) .
   4- Endocrine disorder (e.g. hyperthyroidism) .
   5- Genetic disorder (e.g. down syndrome , Beckwith –Wiedeman syn.) .

b- Pathophysiology :
   1- Many of the problems associated with polycythemia were originally thought to be caused by organ ischemia and hypoxia secondary to an increase in blood viscosity . it is now known that most of the blood flow reduction is the result of an increased oxygen content in the arterial blood .this reciprocal relationship of decreased blood flow and increased arterial oxygen content result in a normal or increased delivery of oxygen to most organs .
   2- Therefore , most of the problems associated with polycythemia are more likely the result of the perinatal events (i.e. acute or chronic hypoxia) that also are responsible for the development of the polycythemia , rather than any flow disturbance attributable to the polycythemia itself .

c- Clinical features :
   1- Symptoms and signs include :
      a- Tachypnea and cyanosis and feeding intolerance .
      b- Jitterness and seizure .
      c- Renal dysfunction .
      d- Hypoglycemia ,thrombocythemia .
      e- Necrotizing enterocolitis .
   2- Complications .polycythemia is associated with an abnormal long term neurologic outcome .

d- **Therapy** : generally is supportive .reduction of the hematocrit by partial exchange transfusion may be helpful in alleviating distress , renal dysfunction and hypoglycemia , but may increase the risk of necrotizing enterocolitis .

The equation used in partial exchange is :

Volume of exchange (ml) = blood volume x (observed – desired hematocrit) /observed hematocrit .

The desired hematocrit is 50% and the blood .

Hemorrhagic disease of the newborn

Have the most profound deficiency of vitamin K-dependent factors (VII,X,V and II) and these factors decline further after birth , because breast milk is a poor source of vit. K , breastfed infants are at increased risk for hemorrhage that usually occurs between day three and seven of life . bleeding usually ensues from the umbilical cord , circumcision site ,intestine , scalp , mucosa , and skin but internal hemorrhage places the infant at risk for fatal complications such as intracranial hemorrhage .

Hemorrhage on the first day of life resulting from the deficiency of the vitamin K dependent factors often is associated with administration to the mother of drugs that affect vitamin K metabolism in the infant . this early pattern of hemorrhage has been seen withmaternal warfarin and antibiotics (e.g.isoniazid or rifampicin) therapy and in infants of mothers receiving Phenobarbital and phenytoin . bleeding also may occur 1to 3 months after birth particularly among breastfed infant .vitaminK deficiency in breastfed infant also should raise suspicion about the possibility of vitamin K malabsorption resulting from cystic fibrosis , biliary atresia , hepatitis or antibiotics suppression of the colonic bacteria that produce vitamin K .

Levels of PIVKA (protein induced by vitamin K absence) increased in vitamin K deficiency and are helpful diagnostic marker, vitamin K administration rapidly correct the coagulation defects (normalizes prothrombin time which is depend on vitamin K) and reducing PIVKA to undetectable levels .the bleeding time which reflect platelet function and number is a normal during newborn period .

Prevention and treatment :

Bleeding associated with vitamin K deficiency may be prevented by administration of vitamin K to all infants at birth . before routine administration of vtamin K 1-2% of all newborn have hemorrhagic disease of newborn .

One intramuscular dose (1 mg) of vitamin K prevents bleeding .

Treatment of bleeding resulting from vitamin K deficiency involves intravenous administration of 1-5 mg of vitamin K . if severe life threatening hemorrhage is present fresh frozen plasma also should be given . unusually high doses of vitamin K may be needed for hepatic disease and for maternal warfarin or anticovulsant therapy .

Neurological disorders

Hypoxic –ischemic encephalopathy (HIE) :

Condition known to reduced uteroplacental blood flow or to interfere with spontaneous active respiration after complete birth lead to perinatal hypoxia , to lactic acidosis and if severe enough to reduce cardiac output or cause cardiac arrest to ischemia . the combination of the reduced availability of oxygen for the brain resulting from hypoxia and the diminished or absent blood flow to the brain resulting from ischemia leads to reduced glucose for metabolism and to accumulation of lactate that produces local tissue acidosis . after reperfusion hypoxic-ischemic injury also may be complicated by cell necrosis and vascular endothelial edema , reducing blood flow distal to the involved vessels .typically hypoxic –ischemic encephalopathy in the term infant is characterized by cerebral edema , cortical necrosis , and involvement of basal ganglia , whereas in the preterm it characterized by periventricular leukomalacia . both lesions may result in cortical atrophy , mental retardation and spastic quadriplegia or diplegia .

Perinatal risk factors and conditions associated with birth asphyxia : (extremes in maternal age i.e.<20 yrs or > 35 yrs , placental abruption or previa , preeclampsia , preterm gestation , meconium stain ameniotic fluid feat bradycardia , malpresentation , multiple gestation and maternal diabetes).

Postnatal symptoms of asphyxia :

a- Brain :
   1- Mild asphyxia .the infants initially well be depressed . this followed by a period of hyperalertness which resolves within 1 or 2 days . there are no focal signs and the prognosis is excellent for a normal outcome .
   2- Moderate asphyxia . the infants will be very depressed . this is followed by a prolonged period of hyperalertness and hyperreflexia . generalized seizure often occur hours after the episode of asphyxia but are controlled easily , resolving in a few days regardless the therapy . the prognosis is variable , negative result on EEG are predictive of normal outcome .
   3- Severe asphyxia .is associated with coma , intractable seizure , cerebral edema and intracranial hemorrhage . the infant becomes progressively more depressed over the first 1-3 days , as rhe cerebral edema develops and death may occurs during this period . survival usually is associated with a poor long term outcome .also the prognosis depend on other organ injury and low apgar score especially if the score remains low by 20 min .

b- Heart . severe or prolonged episodes of asphyxia may result in hypoxic – cardiomyopathy . signs and symptoms include hypotension, poor myocardial contractility , cardiomegaly and congestive heart failure .

c- Lung . respiratory distress and a need for oxygen can occur owing to a delay fall in pulmonary vascular resistance .
d- Kidney . depressed renal blood flow during the aspyxial events causes acute tubular necrosis . this is usually self limiting .
e- GIT is associated with poor GIT motility or ileus . the hypoxia also predispose to secondary bacterial invasion and to the development NEC .
f- Blood . hypoxia depressed bone marrow function and initiates intravascular coagulopathy which result in thrombocytopenia prolonged PT and PTT and clinical evidence of bleeding .

Diagnosis : MRI is the preferred imaging modality in neonates with HIE . CT scan are helpful in identified focal hemorrhage lesion ,diffuse cortical injury later on and damage to basal ganglia .ultrasonography it is the initial preferred modality in preterm infant not in term .EEG may help to determined which infants are at highest risk for long term brain injury .

Therapy :

1- General principles . the primary objective in treating perinatal asphyxia is to restore oxygen supply to the body tissues , especially the brain . this require ventilation with oxygen and ensuring adequate cardiac output . the secondary objective is to evaluate the degree of hypoxic injury and to plan treatment . whole body hypothermia or selective reduce mortality or major neurodevelopmental impairment in term infants with HIE .phenobarbital is the drug of choice for seizure . phenytoin and lorazepam may be needed for refractory seizures . monitoring of blood pressure, hemodynamic status , acid –base balance , hypoglycemia and possible infection is vital .
2- Specific therapy . specific delivery room resuscitation procedures .
And anticipate the conditions associated with asphyxia and treat if present.

Intracranial hemorrhage :

1- Subarachnoid hemorrhage: may occur after a normal or traumatic delivery . bleeding is self limited and symptoms like irritability and seizure resolves in a few days .the infant may be asymptomatic .
2- Subdural hemorrhage: also is seen with birth trauma . a significant amount of blood can accumulate and cause focal neurological deficits owing to pressure exerted on the brain . however drainage is necessary only if symptoms are severe or do not resolve .
3- Intraventricular hemorrhage : is seen almost exclusively in preterm infant and is the result of bleeding of the germinal matrix , frequently after asphyxial insult .the hemorrhage occur in the first three days of life . the clinical manifestation of IVH include seizures, apnea , bradycardia , lethargy ,coma , hypotension , metabolic acidosis , anemia not corrected by blood transfusion , bulging fontanelle and cutaneous mottling .

   Infants with small hemorrhage (grade 1 or 2) are asymptomatic , infants with larger hemorrhage (grade 4) often have catastrophic event that rapidly progress to shock and coma .

   The diagnosis of IVH is confirmed and the severity graded by ultrasound or CT examination through the anterior fontanelle :

   - Grade 1 IVH is confined to the germinal matrix .
   - Grade 2 blood noted in ventricle without ventricular dilation .
   - Grade 3 extension of grade 2 with ventricular dilation .
   - Grade 4 blood in dilated ventricle and in cerebral cortex .

Grade 4 hemorrhage has a poor prognosis as does the development of periventricular , small echolucent cystic lesion with or without porencephalic cysts and posthemorrahgic hydrocephalus . the cysts may correspond to the development of periventricular leukomalacia which may be a precursor to cerebral palsy .

Treatment : treatment of acute hemorrhage involves standard supportive care including ventilation for apnea and blood transfusion for shock . post hemorrhagic hydrocephalus may be managed with serial daily lumber puncture ,external ventrculostomy tube or a permanent ventricular –peritoneal shunt .implantation of the shunt often is delayed because of the high protein content of the hemorrhagic ventricular fluid .

Neonatal seizures :

Are not uncommon in the neonatal period subtle seizures which manifest as rhythmic eye deviation or blinking lip smacking tongue thrusting , fluctuation of vital signs or apnea are the most common form followed by generalized tonic , multifocal clonic , focal clonic and myoclonic seizures .

Seizures may be difficult to differentiate from benign jitteriness or from tremulousness in infants of diabetes mother , in infants with narcotic withdrawal .in contrast to seizures , jitteriness and tremors are sensory dependent elicited by stimuli and interrupted by holding the extremity . seizure activity becomes manifested as coarse , fast and slow clonic activity , whereas jitteriness is characterized by fine rapid movement . seizures may be associated with abnormal eye movement .

Etiology :

1- Asphyxia .
2- Brain anomalies .
3- Intracranial hemorrhage
4- Systemic metabolic disorders (hypoglycemia , hyponatremia ,hypernatremia , hypocalcemia ,hyperammonemia) and inborn error of amino acid and organic acid metabolism .
5- Meningitis and encephalitis .
6- Pyridoxine deficiency .

Diagnosis : the following evaluation should be made in effort to pin point the cause of the seizure activity :

1- Neurological examination .
2- EEG .
3- Ultrasound and CT scanning
4- Screening for metabolic disorders involving (glucose , calcium , or sodium) for inborn error of metabolism (amino acid s or organic acid .
5- Lumbar puncture and evaluation of the SCF for sepsis .

Treatment :

The treatment of neonatal seizures may be specific such as treatment of meningitis or the correction of hypoglycemia , hypocalcemia , hypomagnesemia , hyponatremia or vitamin B6 deficiency or dependency . in the absence of identifiable cause , therapy shloud involve anticonvulsant agent such as (20-40 mg/kg of phenobarbital) (10-20 mg/kg of phenytion) or (0.1-0.3 mg/kg of diazepam) followed by one of the two longer acting drugs . the long term outcome for neonatal seizure usually is related to the underlying cause and to the primary pathology such as hypoxic- ischemic encephalopathy , meningitis , drug withdrawal , stroke or hemorrhage .

Neonatal hypoglycemia :

Neonatal hypoglycemia is defined as a plasma glucose concentration less than 35 mg/dl during the first 24 hrs and lees than 45 mg/dl thereafter . hypoglycemia is very common in infants of diabetes mother as well as in infants who are born after various perinatal complication , including prematurity , IUGR , and asphyxia .

1- **Pathogenesis** . the pathogenesis varies depending on the clinical setting and the associated conditions affecting the infants .
   a- Maternal diabetes , the hypoglycemia in infants of diabetes is the result of a hyperinsulinemia state that persist after the umbilical cord is cut and the maternal supply of glucose is interrupted .
   b- Prematurity . preterm infants become hypoglycemia owing to diminished glycogen store and to immaturity of gluconeogenic enzymes .
   c- Growth retardation . growth retarded infants frequently are depleted of hepatic glycogen and quickly become hypoglycemic .
   d- Perinatal asphyxia . forces the fetus to use anaerobic metabolism , which quickly depletes stored glycogen and result in hypoglycemia.
   e- Cold stress . increased oxygen consumption as well as glucose consumption . it also may increase free acids and result in hypoglycemia .
   f- Sepsis. May cause hypoglycemia , although hyperglycemia also is observed which presumably is caused by insulin insensitivity .
   g- Beckwith-Wiedmann syndrome . is characterized by hypoglycemia , visceromegaly , macroglossia and omphalocele . hyperinsulinemia secondary to pancreatic islet cell hyperplasia is responsible for hypoglycemia .
   h- Nesidioblastosis and pancreatic islet cell adenoma are associated with hyperinsulinemia and hypoglycemia .
   i- Metabolic disorder such as galactosemia and panhypopituitarism .

Clinical features :

Infants with hypoglycemia are not always symptomatic . however the following symptoms may occur (hypotonia or jitteriness , apnea or tachypnea, cyanosis ,hypothermia , poor feeding and seizures .

Therapy :

a- Primary therapy is intravenous glucose . the glucose infusion may be required for several days until the basal insulin secretion rate decreases , glycogen stores are replenished or gluconeogenesis improves . bolus infusion of hypertonic glucose should be avoided because they may result in a rebound hypoglycemia .intravenous glucose should be administered as a constant

infusion begun at a rate of 6-8mg/kg/min .this may be increased to a rate of up to 20mg/kg/min (a central venous access should be used for infusion given at a rate above 15 mg/kg/min .
A small (0.5-1.0 g/kg) bolus may be used for extreme hypoglycemia or if severe symptoms related to hypoglycemia . this shloud always be followed by a constant infusion .

b- Hypoglycemia that is secondary to hyperinsulinemia and resistant to intravenous glucose should be treated with corticosteroid or diazoxide . if drug treatment fails partial pancreatectomy should be performed . these more aggressive forms of therapy rarely are necessary except for hypoglycemia that associated with Beckwith-Wiedmann syndrome , nesidioblastosis , or islet cell adenoma .

Infant of diabetic mother

Women with diabetes in pregnancy are at increased risk for adverse pregnancy outcome . adequate glycemic control before and during pregnancy is crucial to improving outcome .

The effect of diabetes on the fetus depend in part on severity of the diabetes state , age of onset of diabetes , duration of treatment with insulin and presence of vascular disease .poorly control maternal diabetes leads to maternal and fetal hyperglycemia that stimulates the fetal pancreas , resulting in hyperplasia of the islets of Langehans .fetal hyperinsulinemia results in increased fat and protein synthesis and fetal macrosomia except brain and ossification centers .

Hypoglycemia develops in about 25-50% of of infants of diabetic mother and 15-25% of infants of mothers with gestational diabetes . infants should initiate feeding within 1 hour after birth and a screen glucose test should be performed within 30 mint. Of the first fed. In asymptomatic infants treatment indicated if plasma glucose less than 30mg/dl . in symptomatic infants the treatment indicated if plasma glucose less than 40% . treatment of hypoglycemia as mention above .

Neonatal problems of diabetic mother :

1- Birth asphyxia and birth trauma due to macrosomia .
2- Hypoglycemia , hypocalcemia , hypomagnecia .
3- Polycythemia and indirect jaundice .
4- Congenital anomalies is increased 3-folds like congenital heart disease .
5- Neurological disorders like neural tube defect and holoprosencephaly .
6- Renal disorders likes renal agenesis ,double ureter , renal vein thrombosis .

7- Respiratory likes RDS due low surfactant synthesis and TTN .
8- Preterm labor is common and the result of fetal distress or a planed early delivery .

Prognosis :

The neonatal mortality rate is > 5 times that of infants of non diabetic mother .the subsequent incidence of diabetes mellitus in infants of diabetic mother is a higher than that in general population .
The key to optimal outcome is consistent euglycemia in the mother .

Neonatal hypocalcemia :

Hypocalcemia is a common in sick and premature newborn . total serum calcium levels less than 6 mg/dl and ionized calcium levels of lees than 3 to 3.5 mg/dl are considered hypocalcemia .
Early onset neonatal hypocalcemia occurs in the first 3 days of life and is often asymptomatic and can result from transient hypoparathyroidism or congenital absence of the parathyroid gland and DiGeorge syndrome .
Hypomagnesemia (< 1.5 mg/dl) may be seen with hypocacemia that may need to treat both conditions .
Late onset neonatal hypocalcemia or neonatal tetany often is the result of high phosphate containing milk or the inability to excrete the usual phosphorus in commercial infant formula . vitamin D deficiency and malabsorption also can be associated with late onset hypocalcemia .
The clinical manifestations of hypocalcemia include (apnea , muscle twitching seizures , laryngospasm .
Chevostek sign and Trousseau sign can be see more with late onset hypocalcemia .
Neonatal hypocalcemia may be prevented by administration of IV or oral supplement at a rate of 25 to 75 mg /kg /day .
Early asymptomatic hypocalcemai of preterm infants and infants of diabetic mother often resolved spontaneously .
Symptomatic hypocalcemia should be treated with 2- 4 ml /kg of 10% calcium gluconate given intravenously and slowely over 10 to 15 minutes followed by a continous infusion of 75 mg/kg/day of elemental calcium .
If hypomagnesemia is associated with hypocalcemia , 50% magnesium sulfate 0.1 ml/kg should be given by IM and repeated every 8 to 12 hrs .
The treatment of late hypocalcemia include immediate management as in early hypocalcemia plus the initiation of feeding with low phosphate formula .

Infection

Infection continues to be a major cause of neonatal mortality and morbidity despite advance in therapy . although perinatally acquired bacterial infections are the most common infections that are acquired in utero remain important source of long term disability .

General consideration :

a- Predisposing factors . the newborn is particularly susceptible to infection owing to immaturity of immune system mechanism including
   - ❖ Neutrophil chemotaxis .
   - ❖ Neurtophil phagocytosis .
   - ❖ Bacterial activity .
   - ❖ Humeral components.

b- Timing and route of infection . the causative organism and abnormalities associated with neonatal infection vary with time and route of infection .
   1- *Organisim* responsible for transplacental infections before birth are (CMV , HIV , Rubella virus , toxoplasma gondi , echovirus and listeria monocytogenes) .and can cause abnormalities associated with infection acquired in the first trimester (congenital malformation , IUGR , microcephaly , hydrocephalus and still birth) and also can cause abnormalities with infection acquired later in pregnancy (microcephaly , hydropes fetalis , DIC , anemia , IVH , hepatosplenomegaly , jaundice , skin and eye lesions beside still birth) .
   2- *Perinatal infection* include infections acquired through the fetal membrane ascending infections acquired after rupture of membrane and infection acquired via the birth canal . common causative organisims are (Group B Beta-hemolytic streptococcus , E-coli . Klebsiella species , streptococcus pneumoniae Herpes simplex virus, Chlamydia trochomatis , neisseria gonorrhoeae , neisseria meningitidis) .and can cause the following abnormalities (respiratory distress , temperature instability , septic shock , neuropenia , thrombocytopenia , meningitis) .
   3- *Postnatal infections* most often are required as a result of nosocomial or community exposure . hospitalized newborns who are premature or require instrumentation are particularly susceptible . common causative organisms are (staphylococcus aureus , staphylococcus epidermidis , pseudomonas aeruginosa , candida albicans , E –coli , klebsiella,clostridia, enterococcus)and associated abnormalities are (respiratory distress , feeding intolerance , apnea, anemia shock , DIC , hypoglycemia and temperature instability)

2- ***Bacterial infection and neonatal sepsis*** . bacterial infection most frequently are acquired via the birth canal or nosocomialy . the infection almost always is bacteremic and associated with systemic symptoms – a condition referred to as neonatal infection .

a- **Incidence** . neonatal sepsis is common in premature infants . about 1-4% of these infants have at least one episode of sepsis during their hospitalization . sepsis in term infants are rare , occurring in less than 1% .

b- **Risk factors** for early neonatal sepsis include :

1- Premature labor .
2- Low birth weight .
3- Prolonged rupture of the fetal membrane .
4- Chorioamnionitis .
5- Maternal fever .

c- **Etiology** . . the most common causative organisims include :

1- Gram-positive cocci especially group B Beta –hemolytic streptococci , but also staphylococcus aureus and staphylococcus epidermidis .
2- Gram- negative rods especially E-coli and klebsiella pneumoniae .
3- Gram-positive rods like listeria monocytogenes .

d- features :

1- Signs and symptoms of bacterial infections include :

- ✓ Unexplained respiratory distress .
- ✓ Unexplained feeding intolerance .
- ✓ Temperature instability .
- ✓ Hypoglycemia and hyperglycemia .
- ✓ Apnea , lethargy or irritability .

2- Laboratory findings include :

a- Abnormal white blood cell count ,including neutropenia or un elevated ratio of immature to total neutrophil suggest sepsis .
b- Prolonged of PT and PTT .
c- Tracheal aspirate , gastric aspirate for neutrophil count , gram stain and culture .
d- Blood culture .
e- A lumber puncture .
f- Urine for general exam and culture .
g- Chest radiograph ,
h- Arterial blood gas analysis .

Therapy :

1-Empiric antibiotics therapy should begin after the diagnostic work up and consist of a broad –spectrum penicillin (usually ampicillin) and un aminoglycoside (usually gentamicin) . once culture data available . therapy should be tailored to the specific organism .

2-The initial choice of antibiotics for nosocomial infection depend on nursery . community and individual patient exposure information.

3-The duration of therapy usually is 7-10 days except for invasive infections (e.g. meningitis , osteomyelitis) which require longer course of antibiotics therapy

4-Other complication can be treated accordingly for example treatment of shock with fluid and vasopressor .

1- Monitoring serum drug level .
   Persistent signs of infections despite antibacterial treatment suggest candidal or viral sepsis .

Best regard