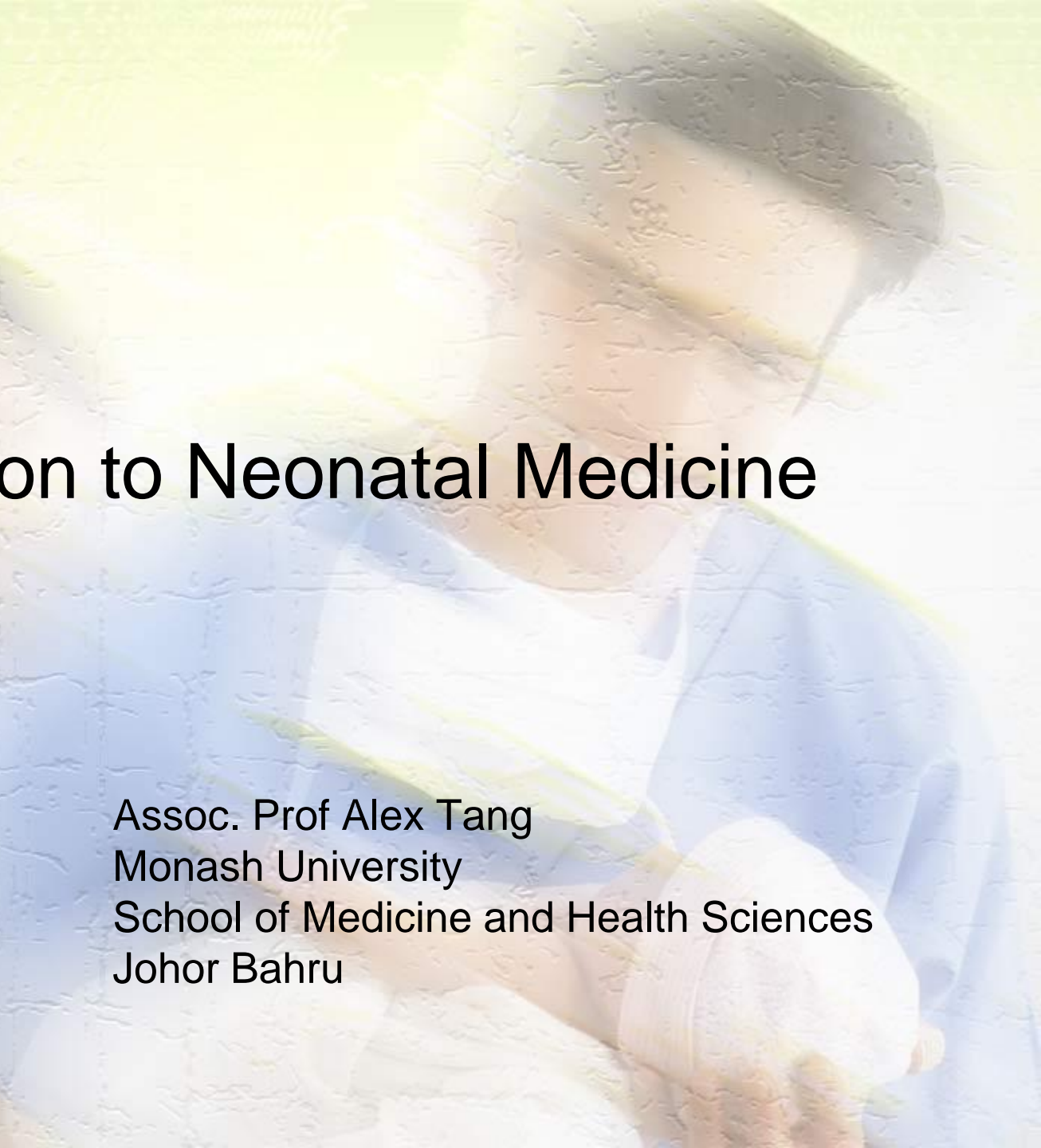




Introduction to Neonatal Medicine

Assoc. Prof Alex Tang
Monash University
School of Medicine and Health Sciences
Johor Bahru



Objective

- Describe an overview of neonatal medicine
- Define possible problems faced by preterm, term and post-term babies
- Discuss the complications and management of these problems



The newborn examination

All newborn babies are carefully examined in the first 24 h of life to check that they are healthy and to detect congenital abnormalities, some of which may not be obvious to the parents. The baby should be fully undressed in a warm room and examined from head to toe. Ask the mother if she has any concerns and whether there is any family history of note, for example of deafness or congenital dislocation of the hips

General observation

- Weight, length and head circumference
- Maturity
- Muscle tone
- Reflexes: Moro, grasp, suck and rooting
- Is this a healthy baby who is feeding well?

Face—dysmorphic features?

- Low set or simple ears
- Inner epicanthic folds
- Mongolian or anti-Mongolian slant of eyes
- Symmetry of face and mouth
- Accessory auricles and pre-auricular pits
- Micrognathia (small chin)

Heart

- Cyanosis
- Heart failure (tachypnoea, hepatomegaly)
- Heart murmur
- Femoral pulses (coarctation)
- Apex beat (dextrocardia)

Back and spine

- Spina bifida or posterior encephalocele
- Midline naevus, lipoma or deep sacral pit can suggest an underlying spinal abnormality

Hips

- Barlow and Ortolani tests for congenital dislocation of the hips (CDH)
- Ask about risk factors (breech, family history of CDH)

Genitalia and anus

- Hypospadias (urinary meatus on underside of penis)
- Cryptorchidism (undescended testes)
- Ambiguous genitalia: if both testes are impalpable, consider whether the baby could be a virilized female, due to congenital adrenal hypoplasia
- Imperforate anus (may have fistula to bladder or vagina)

Skin

- Pallor
- Jaundice
- Cyanosis
- Rashes (erythema toxicum is normal)
- Birthmarks (see p. 88)



Head

- Anterior fontanelle
- Cephalhaematoma (parietal swelling that does not cross suture lines)
- Chignon from Ventouse suction cup

Eyes

- Red reflex (to exclude cataract)
- Jaundiced sclera
- Colobomata (defect in the pupil)

Mouth

- Cleft lip/palate
- Central cyanosis
- Neonatal teeth

Chest

- Respiratory rate
- Respiratory distress
- Symmetry of chest movement (pneumothorax, diaphragmatic hernia)

Abdomen

- Abdominal distension or bile-stained vomiting suggest bowel obstruction (e.g. atresia)
- Palpable kidneys (hydronephrosis)
- Anterior abdominal wall defects (gastroschisis or exomphalos)
- Three vessels in umbilical cord? (normal)

Common syndromes to be aware of:

- Trisomy 21 (Down syndrome)
- Trisomy 13 (Patau syndrome)
- Trisomy 18 (Edward syndrome)
- Turner syndrome (45 XO)
- Noonan syndrome (lymphoedema)
- VATER and VACTERL association
- Pierre-Robin sequence

Limbs

- Talipes equinovarus (club foot)
- Polydactyly (extra digits or toes)
- Syndactyly (fused digits or toes)
- Single palmar crease and 'sandal gap' between toes (Down syndrome)
- Contractures (oligohydramnios or congenital muscular disorder)
- Absent radii (VACTERL association)

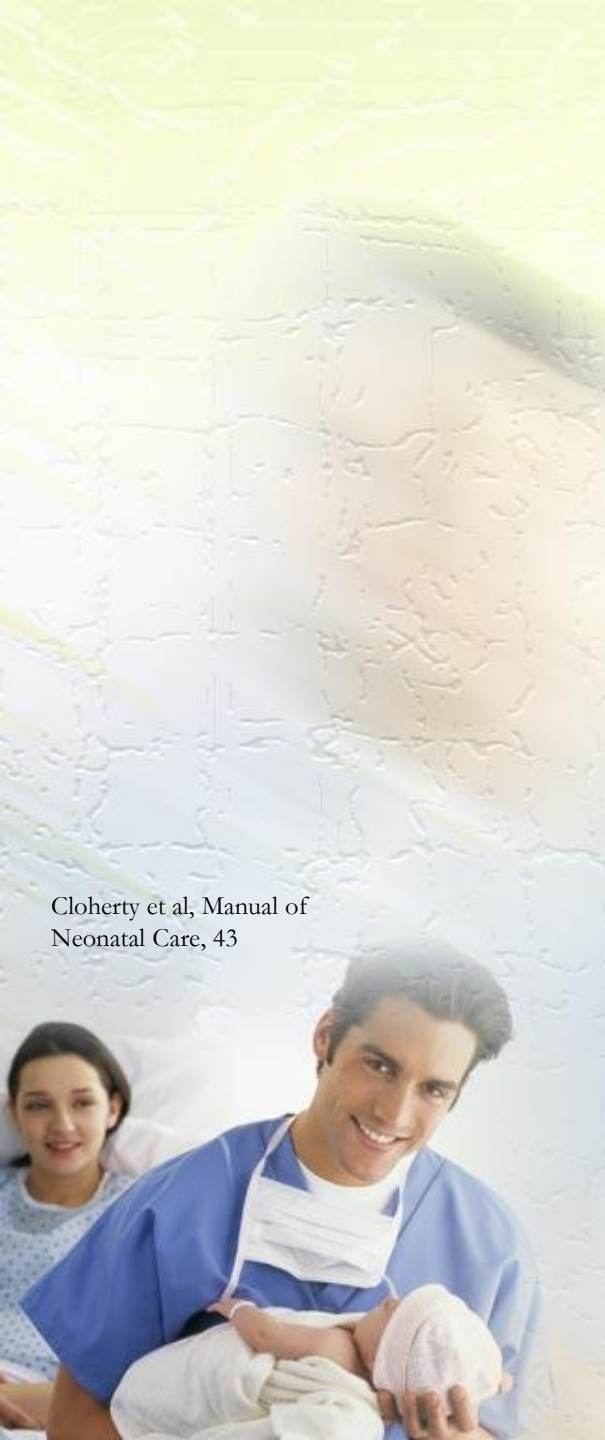
Assessment of gestational age



Assessment of Gestational Age

- EDD
- Ultrasound
 - Crown-rump
 - Biparietal diameter (BPD)
 - Fetal femur length
- Clinical
 - Ballard score





Cloherly et al, Manual of Neonatal Care, 43

Neuromuscular Maturity

	-1	0	1	2	3	4	5
Posture							
Square Window (Wrist)	>90°	90°	60°	45°	30°	0°	
Arm Recoil		180°	140°-180°	110°-140°	90°-110°	<90°	
Popliteal Angle	180°	160°	140°	120°	100°	90°	<90°
Scarl Sign							
Heel to Ear							

Physical Maturity

Skin	Sticky Friable, Transparent	Gelatinous, Red, Translucent	Smooth Pink, Visible Veins	Superficial Peeling and/or Rash, Few Veins	Cracking, Pale Areas, Rare Veins	Parchment, Deep Cracking, No Vessels	Leathery, Cracked, Wrinkled
Lanugo	None	Sparse	Abundant	Thinning	Bald Areas	Mostly Bald	
Plantar Surface	Heel-Toe 40-50 mm:-1 <40 mm:-2	>50mm No Crease	Faint Red Marks	Anterior Transverse Crease Only	Creases Anterior 2/3	Creases Over Entire Sole	
Breast	Imperceptible	Barely Perceptible	Flat Areola No Bud	Stippled Areola 1-2 mm Bud	Raised Areola 3-4 mm Bud	Full Areola 5-10 mm Bud	
Eye/Ear	Lids fused Loosely:-1 Tightly:-2	Lids Open Prima Flat Stays Folded	Sl. curved pinna; soft; slow recoil	Well-Curved Pinna; Soft but Ready Recoil	Formed and Firm Instant Recoil	Thick Cartilage Car Stiff	
Genitals (Male)	Scrotum Flat, Smooth	Scrotum Empty Faint Rugae	Testes in Upper Canal Rare Rugae	Testes in Descending Lew Rugae	Testes Down, Good Rugae	Testes Pendulous, Deep Rugae	
Genitals (Female)	Clitoris Prominent, Labia Flat	Prominent Clitoris, Small Labia Minora	Prominent Clitoris, Enlarging Minora	Majora and Minora Equally Prominent	Majora Large, Minora Small	Majora Cover Clitoris and Minora	

Maturity Rating

Score	Weeks
-10	20
-5	22
0	24
5	26
10	28
15	30
20	32
25	34
30	36
35	38
40	40
45	42
50	44

Expanded NBS Includes Extremely Premature Infants and Has Been Refined to Improve Accuracy in More Mature Infant.

Figure 3B.1. New Ballard score. (From Ballard JL, Khoury JC, Wedig K, et al. New Ballard Score, expanded to include extremely premature infants. *J Pediatr* 1991;119:417.)

Gestational Age

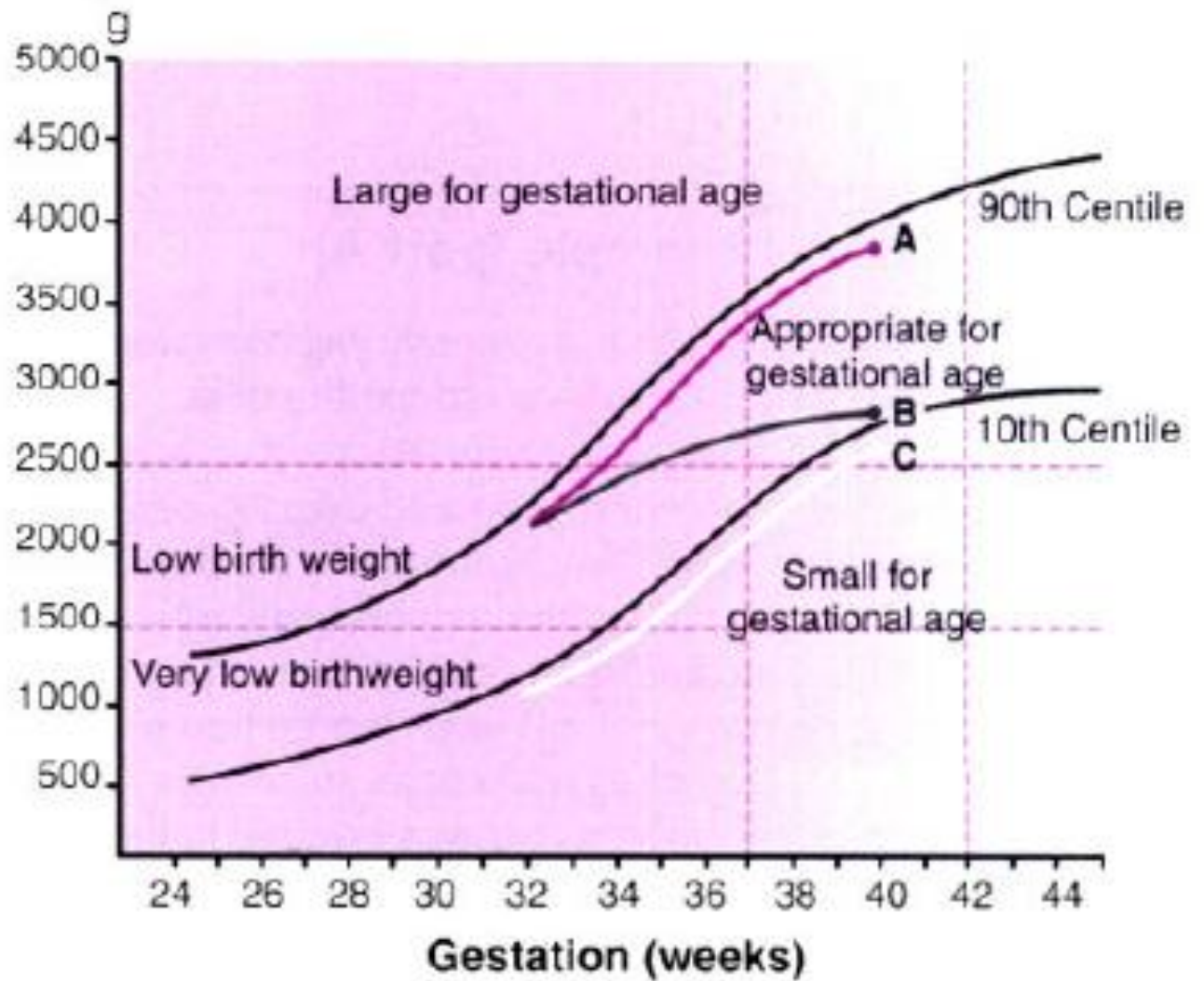
- Preterm
- Term
- Post-term



Problems in the Neonatal Period

- Growth Factors





Preterm	Term	Post-term
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Problems of Intra Uterine Growth Retardation

Fetal nutrient limitation	Consequences for the fetus	Possible clinical consequences for the newborn	Long term consequences
Reduced supply of glucose	Reduced body fat Reduced glycogen stores	Hypothermia Hypoglycaemia	Increased mortality Neurological damage
Reduced supply of oxygen	Stillbirth Asphyxia Increased haematopoiesis Redistributed cardiac output Cardiac failure	Meconium aspiration Hypoxic ischaemic encephalopathy Coagulopathy Polycythaemia Jaundice Relatively big head (head sparing) Pulmonary haemorrhage	Neurological damage
Reduced supply of amino acids	Impaired immune function Delayed bone maturation Reduced muscle mass	Infection Hypocalcaemia Insulin resistance	Poor growth



Problems in the Neonatal Period

- Growth Factors
- Prematurity
 - Risk factors



Risk Factors for Prematurity

Maternal

- Extremes of maternal age
- High gravidity
- Low prepregnant weight
- Acute abdomen
- Pyelonephritis
- Uterine anomalies
- Cervical incompetence
- Pre-eclampsia/ eclampsia
- Prior termination of pregnancy
- History of infertility
- Genital infection

Fetal

- Multiple gestation
- Fetal anomalies
- Polyhydramnios
- Fetal demise
- First trimester threatened abortion

Placenta and membranes

- Placenta previa
- Abruptio placentae
- Premature rupture of membranes
- Chorioamnionitis

Social

- Low socioeconomic status
- Smoking
- Alcohol abuse
- Illicit drug abuse
- Fatigue and psychological stress

Idiopathic

- Previous preterm delivery



Problems in the Neonatal Period

- Growth Factors
- Prematurity
 - Risk factors
 - Complications



Complications of Prematurity

	Common	Rare except in VLBW
Early		
Respiratory	Respiratory distress syndrome Apnoea	
Cardiac		Patent ductus arteriosus
Neurological		Periventricular haemorrhage Periventricular leucomalacia
Hepatic	Hypoglycaemia Hyperbilirubinaemia	Hyperglycaemia
Renal	Hyponatraemia	Hyperkalaemia Metabolic acidosis
Gastrointestinal	Feeding problems	Necrotising enterocolitis
Other	Anaemia Infection Poor thermo-regulation	
Late		
	Delayed growth	Retinopathy of prematurity Chronic lung disease Neurodevelopmental delay



Complications of prematurity

Eyes

- Retinopathy of prematurity due to abnormal vascularization of the developing retina
- Requires laser treatment to prevent retinal detachment and blindness

Brain

- Intraventricular haemorrhage
- Post haemorrhagic hydrocephalus
- Periventricular leucomalacia
- Increased risk of cerebral palsy

Temperature control

- Increased surface area to volume ratio leads to loss of heat
- Immature skin cannot retain heat and fluid efficiently
- Reduced subcutaneous fat reduces insulation

Respiratory

- Respiratory distress syndrome (surfactant deficiency)
- Apnoea and bradycardia
- Pneumothorax
- Chronic lung disease

Cardiovascular (see Chapter 51)

- Hypotension
- Patent ductus arteriosus

Nutrition

- May require parenteral nutrition
- Nasogastric feeds until sucking reflex develops at 32–34 weeks
- Difficult to achieve *in-utero* growth rates

Metabolic

- Hypoglycaemia is common. Symptomatic hypoglycaemia must be treated promptly. Blood glucose should be maintained above 2.6 mmol/L to prevent neurological damage
- Hypocalcaemia
- Electrolyte imbalance
- Osteopenia of prematurity (with risk of fractures)

Gastrointestinal

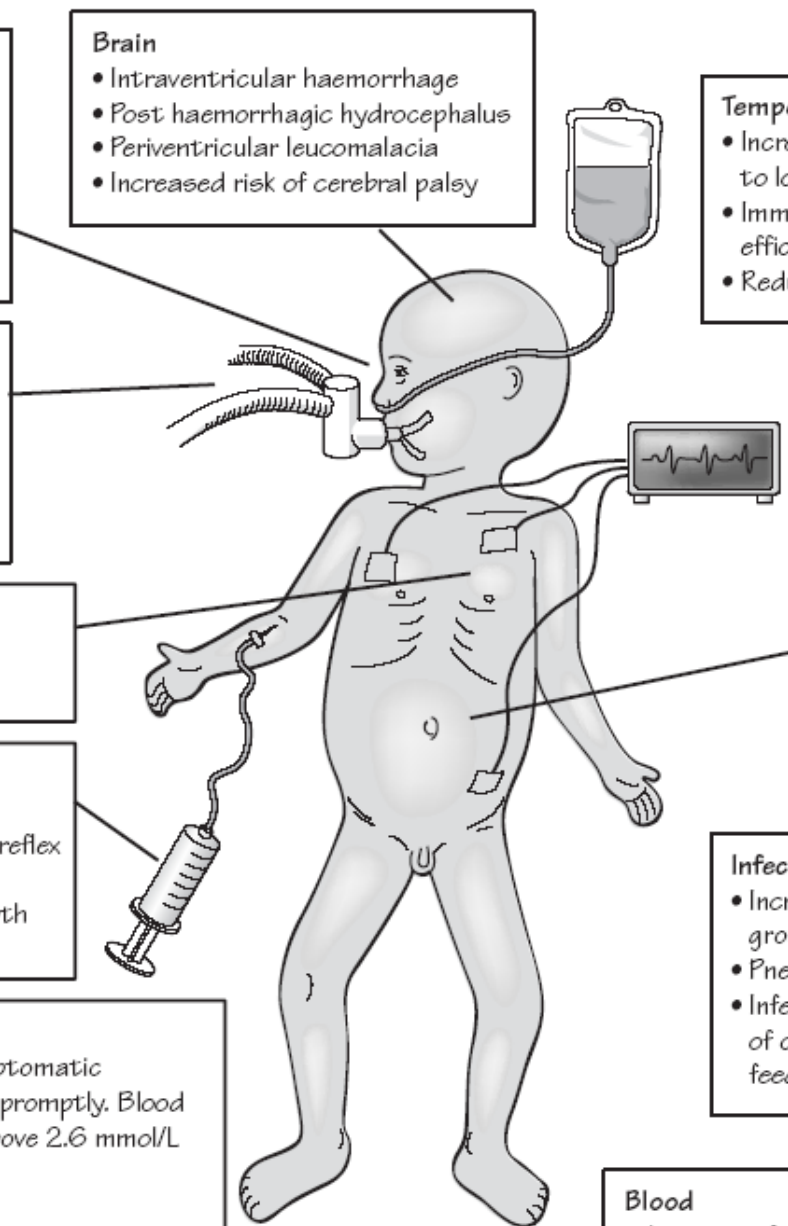
- Necrotizing enterocolitis: a life-threatening inflammation of the bowel wall due to ischaemia and infection and which can lead to bowel perforation
- Gastro-oesophageal reflux
- Inguinal hernias (with high risk of strangulation)

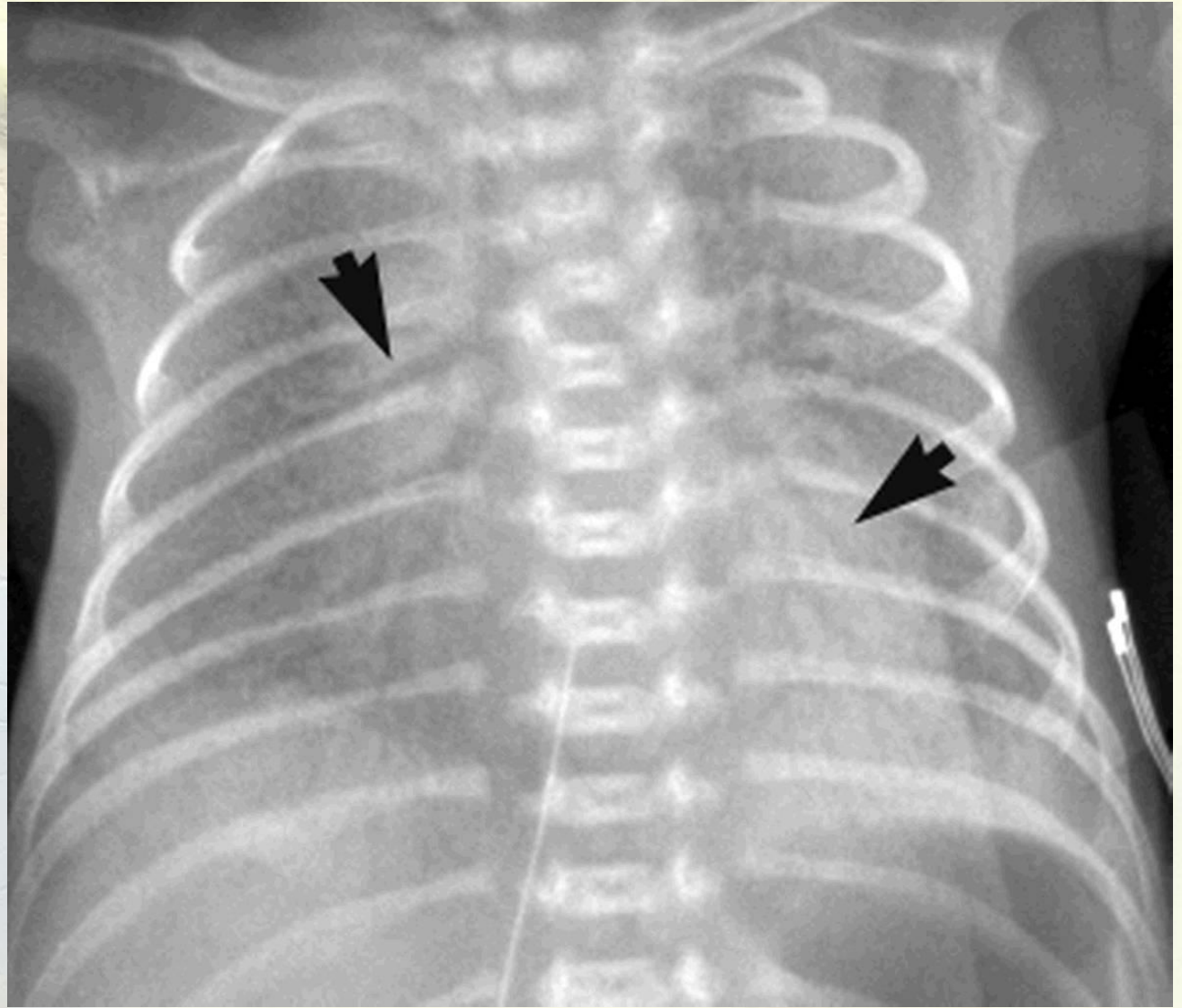
Infection

- Increased risk of sepsis, especially group B streptococcus and coliforms
- Pneumonia is common
- Infection is a common complication of central venous lines required for feeding

Blood

- Anaemia of prematurity
- Neonatal jaundice (see Chapter 50)



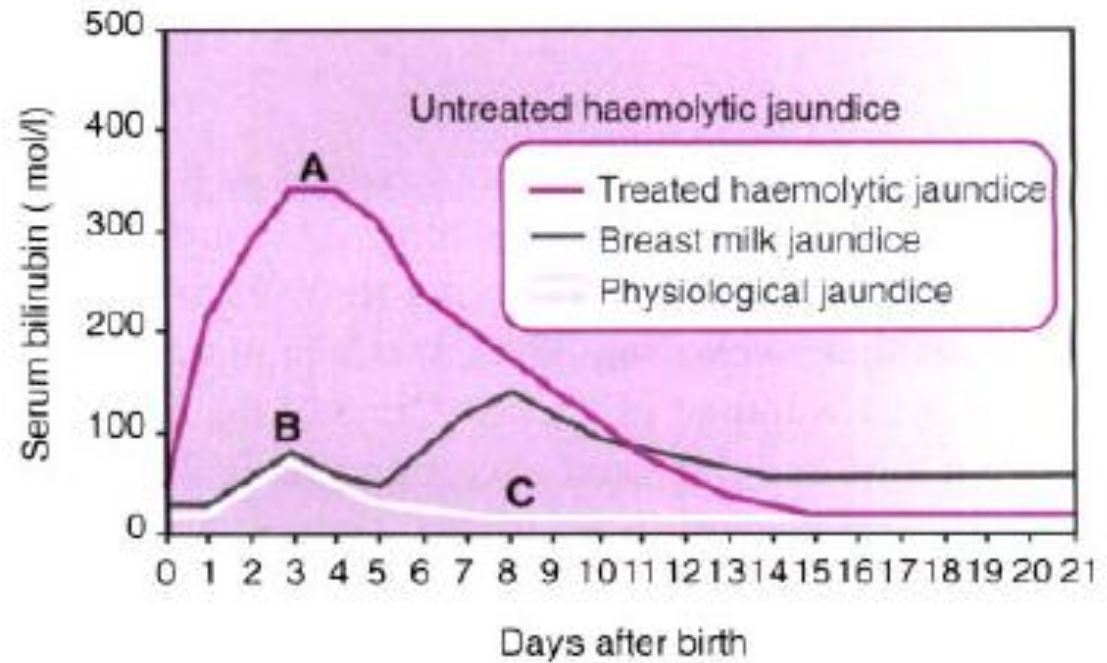


Problems in the Neonatal Period

- Growth Factors
- Prematurity
- Jaundice



Common Types of Neonatal Jaundice



Causes of Hemolytic Jaundice

Immune mediated

ABO incompatibility

Rhesus disease

Minor blood group incompatibilities

Drug induced

Maternal autoimmune haemolysis

Acquired, non immune

Congenital intrauterine infection

Bacterial sepsis

Hereditary

Membrane defects: hereditary spherocytosis, elliptocytosis, and others

Enzyme abnormalities: G6PD deficiency, pyruvate kinase deficiency

Haemoglobinopathies



Causes of Physiological Jaundice

Increased bilirubin load

- Increased red blood cell volume
- Decreased red blood cell survival
- Increased enterohepatic circulation

Defective hepatic uptake

- Low levels of protein Y, protein Z
- Relative hepatic uptake deficiency

Defective bilirubin conjugation

- Decreased synthesis and activity of glucuronyl transferase

Defective bilirubin excretion

- Higher concentration of β -glucuronidase in intestinal mucosa increasing bilirubin breakdown
- More alkaline pH in proximal small intestine causing breakdown of conjugated bilirubin
- Lack of intestinal flora



Causes of jaundice in the neonatal period

Unconjugated hyperbilirubinaemia

Prematurity

- Immature liver enzymes

Rhesus incompatibility

- If mother is Rh negative and baby Rh positive, then maternal IgG can cause haemolysis
- Sensitization occurs in earlier pregnancies
- If severe can cause hydrops in utero
- Coomb's test positive

ABO incompatibility

- Usually milder than Rhesus

Infection

- Bacterial infection

Bruising

- Skin or scalp bruising from traumatic delivery is broken down into bilirubin

Hypothyroidism

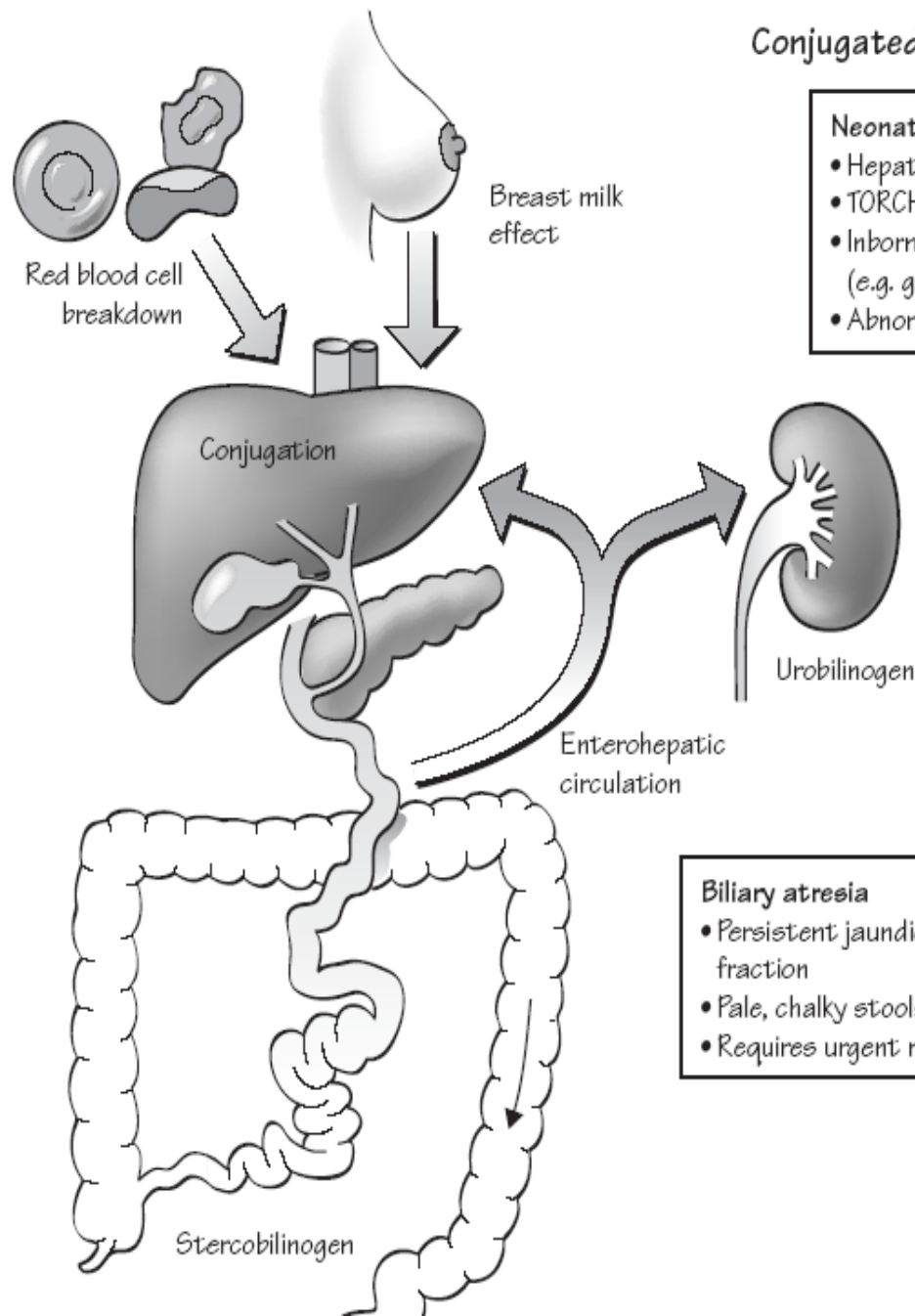
- May be associated with pituitary disease

Breast milk jaundice

- Well baby who is breast-fed
- Jaundice develops in second week

Physiological

- Low liver enzyme activity
- Breakdown of fetal haemoglobin



Conjugated hyperbilirubinaemia

Neonatal hepatitis

- Hepatitis A,B
- TORCH infection
- Inborn errors of metabolism (e.g. galactosaemia)
- Abnormal liver function tests

Cystic fibrosis

- Cholestasis

Choledocal cyst

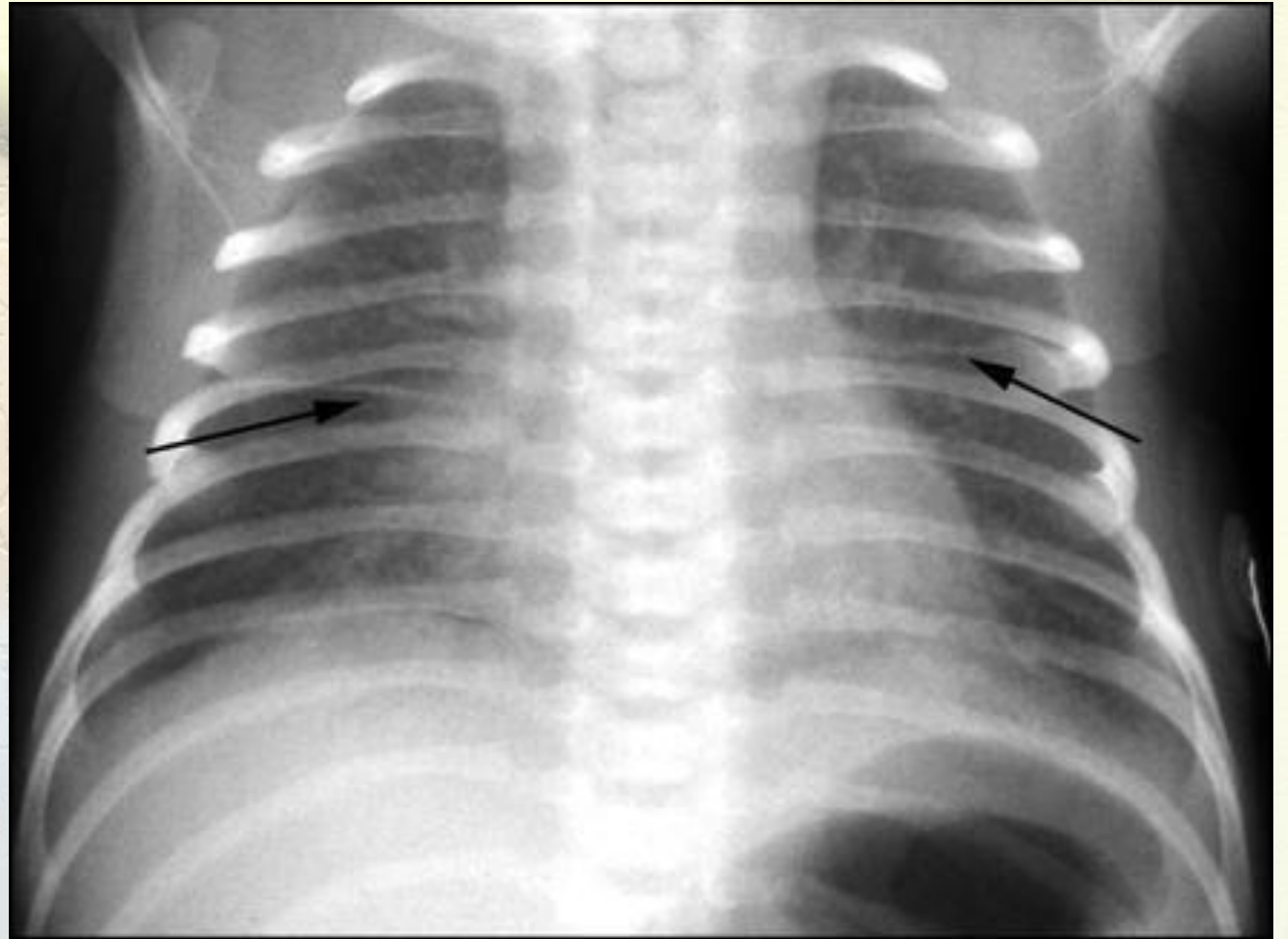
Biliary atresia

- Persistent jaundice with rising conjugated fraction
- Pale, chalky stools
- Requires urgent referral

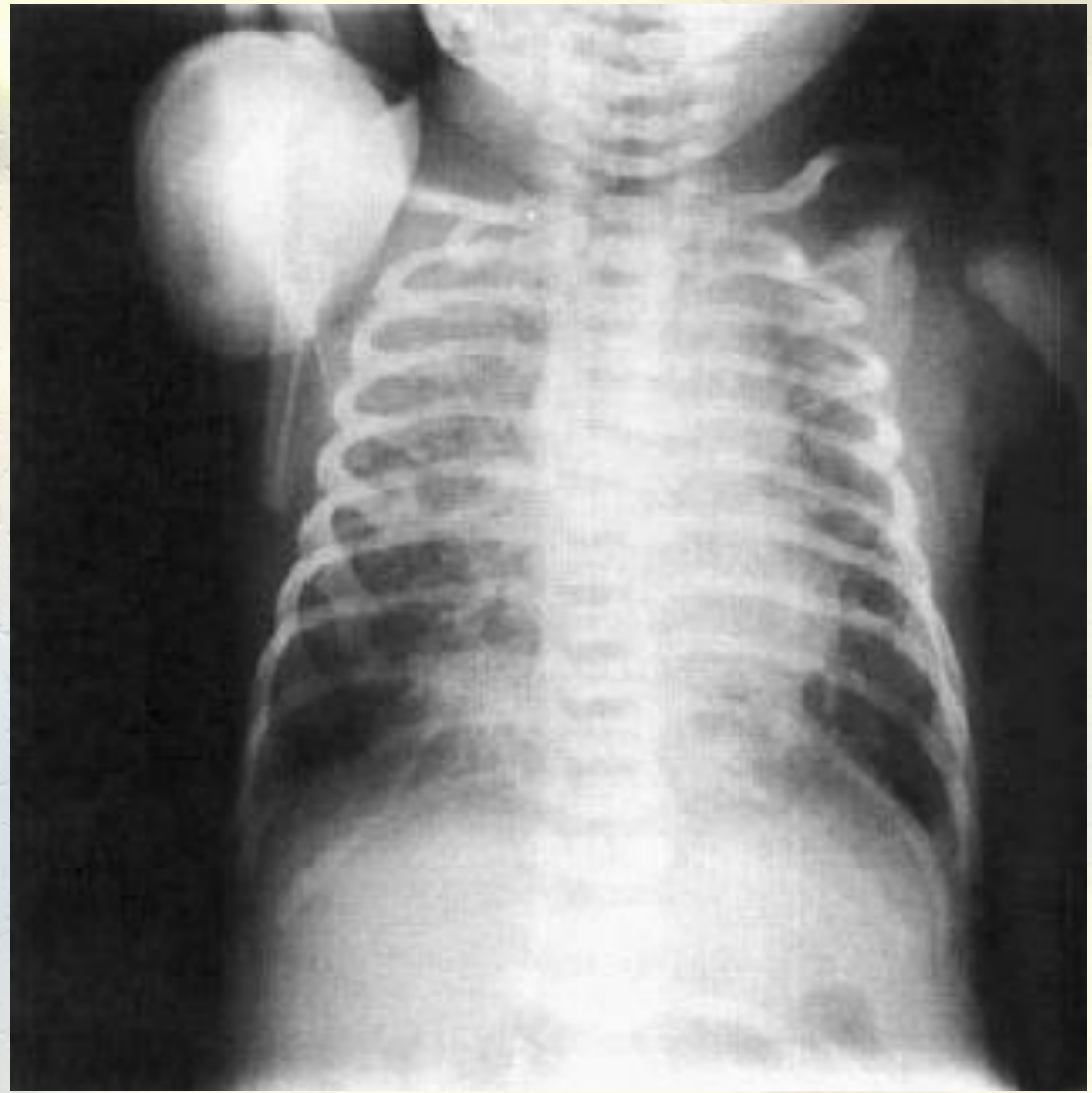
Problems in the Neonatal Period

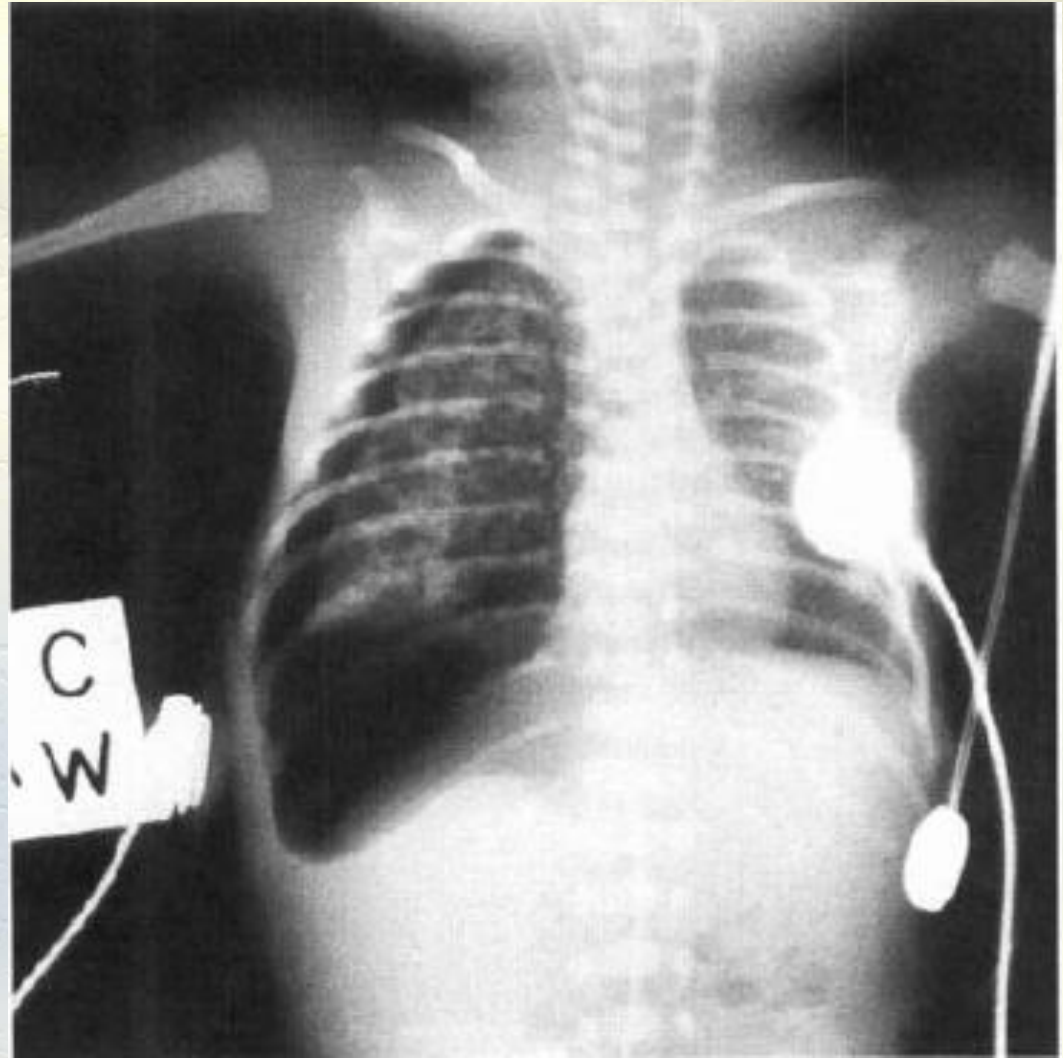
- Growth Factors
- Prematurity
- Jaundice
- Respiratory Problems

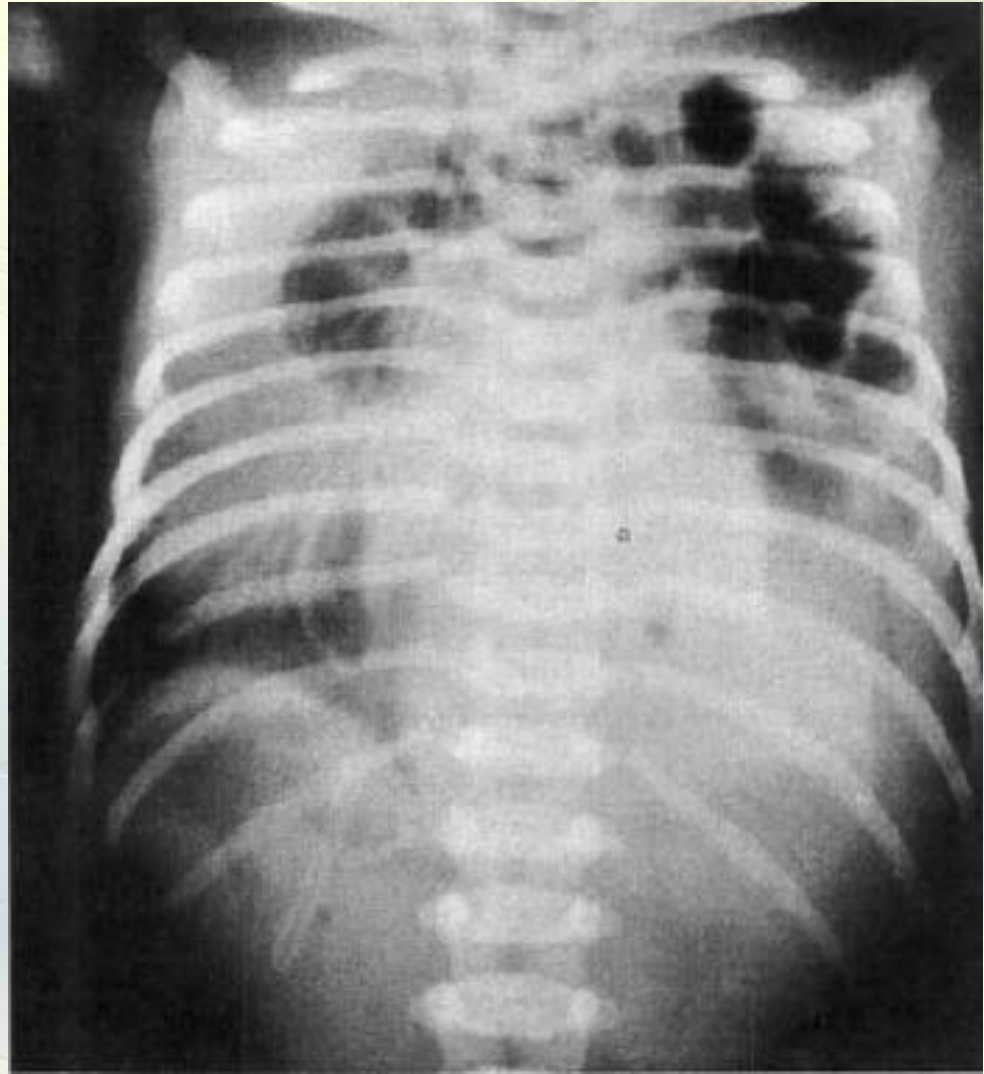




Picture source: Pediatrics in Review



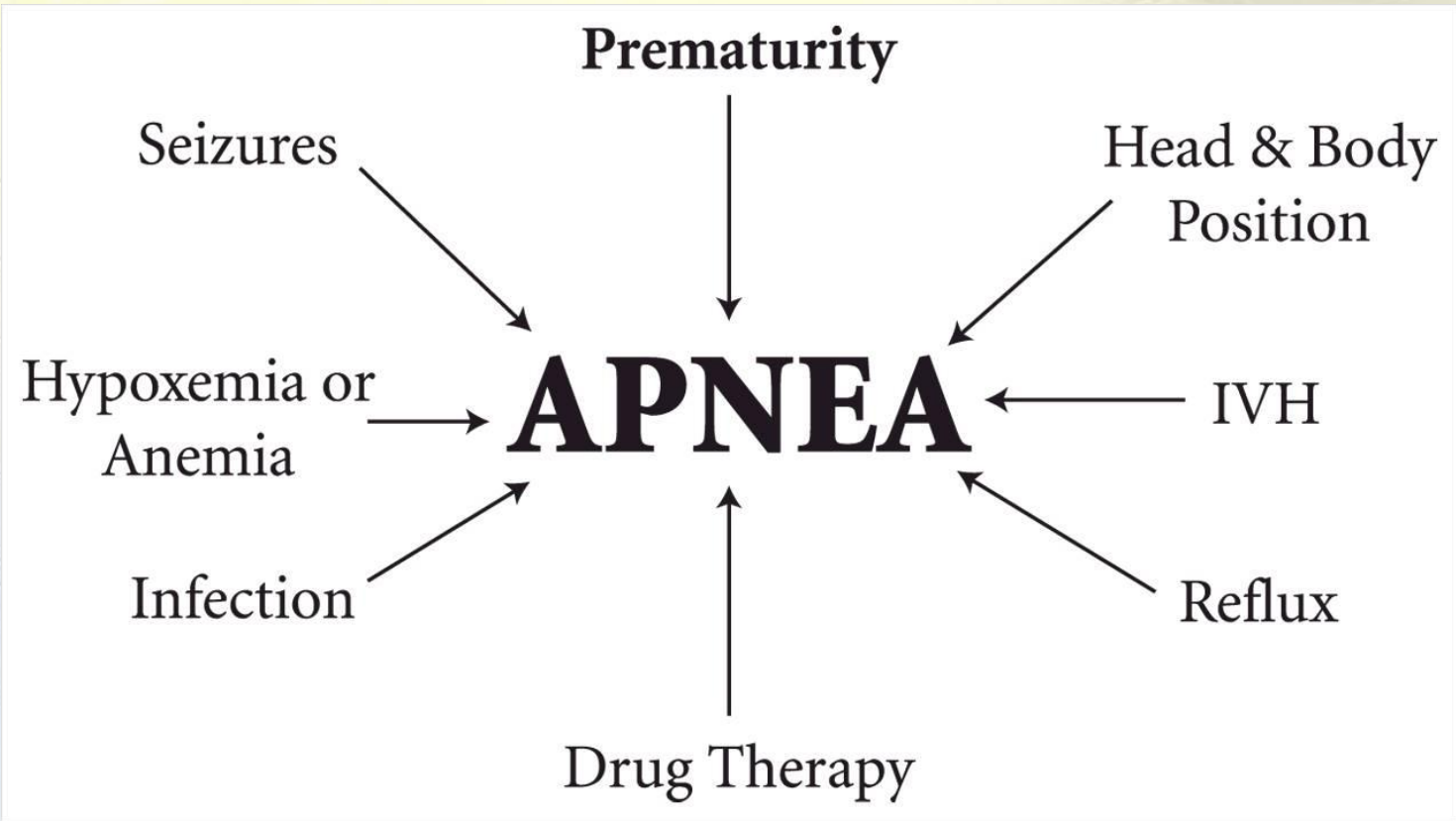




Respiratory Disorder in Newborns

- Respiratory distress
 - Transient Tachypnea of Newborn (TTN)
 - Respiratory Distress Syndrome (RDS)
 - Pneumonia
 - Meconium Aspiration Syndrome (MAS)
 - Pneumothorax
 - Diaphragmatic hernia
- Upper respiratory obstruction
- Apnea, bradycardia



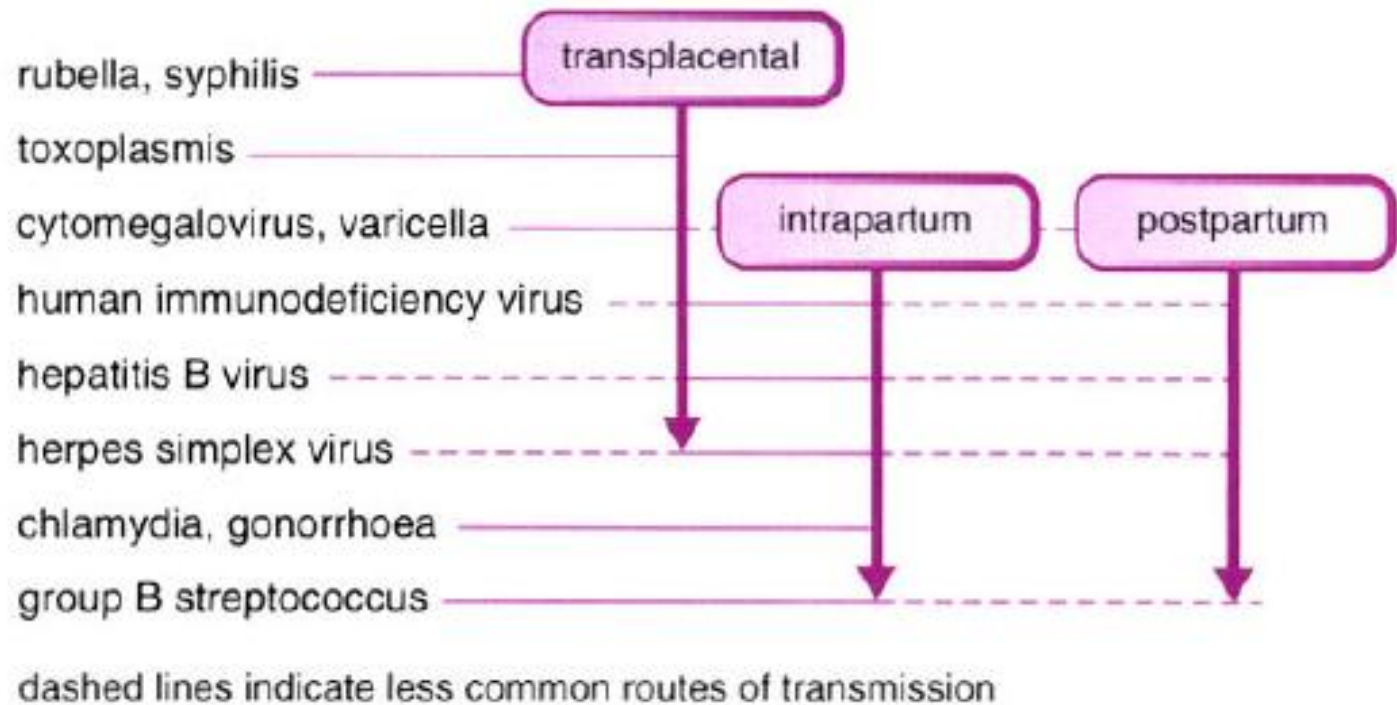


Problems in the Neonatal Period

- Growth Factors
- Prematurity
- Jaundice
- Respiratory Problems
- Infections
 - Intrauterine



Congenital and Perinatal Infections





Picture source: Pediatrics in Review



Picture source:Pediatrics in Review

Problems in the Neonatal Period

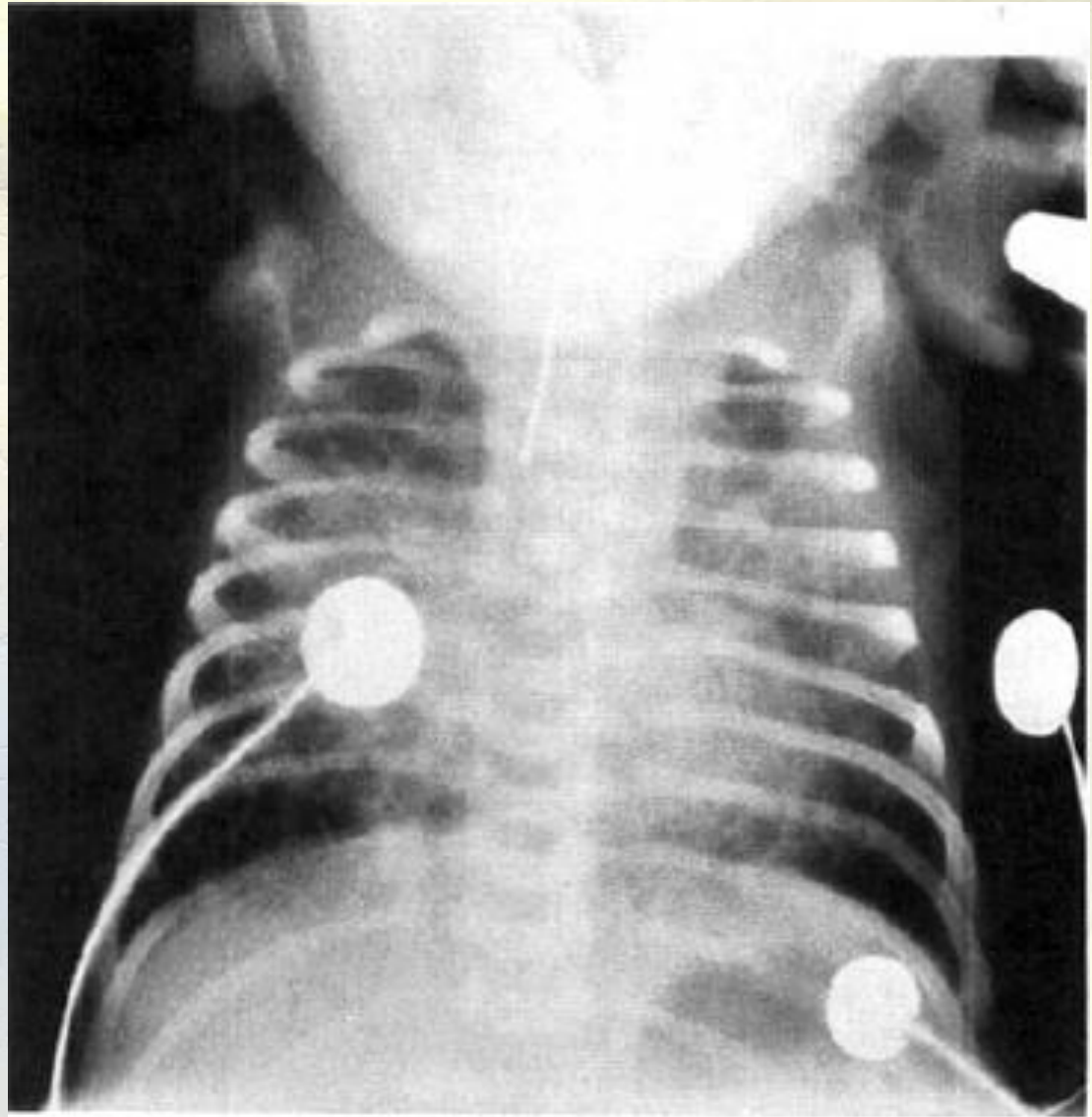
- Growth Factors
- Prematurity
- Jaundice
- Respiratory Problems
- Infections
 - Intrauterine
 - Neonatal sepsis



Neonatal Sepsis

- respiratory distress, tachypnoea, apnoea
- temperature instability, irritability
- feeding difficulty, vomiting, diarrhoea
- neutrophilia or neutropenia
- increased proportion of immature neutrophils
- thrombocytopenia
- coagulopathy.





Problems in the Neonatal Period

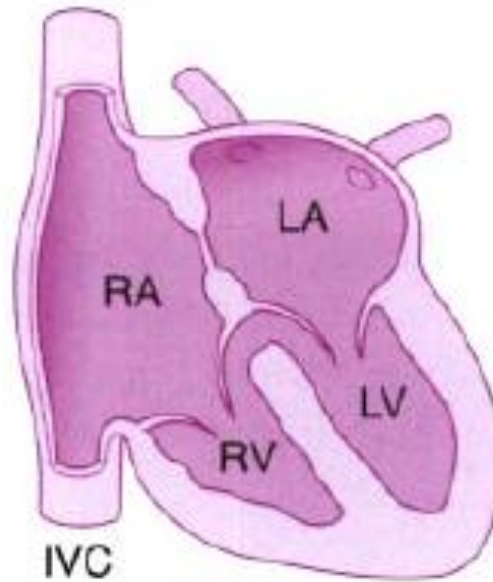
- Growth Factors
- Prematurity
- Jaundice
- Respiratory Problems
- Infections
- Cardiac Problems



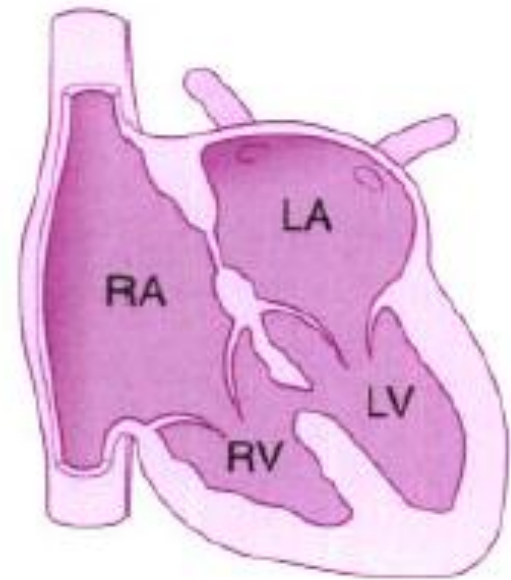
Ventricular Septal Defect (VSD)

Perimembranous VSD

SVC

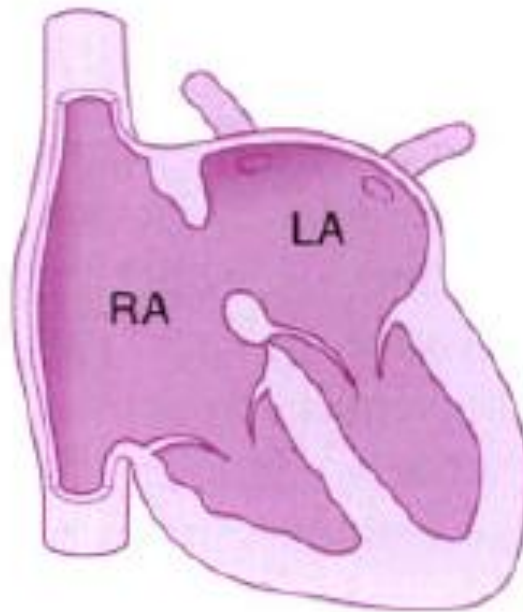


Muscular VSD

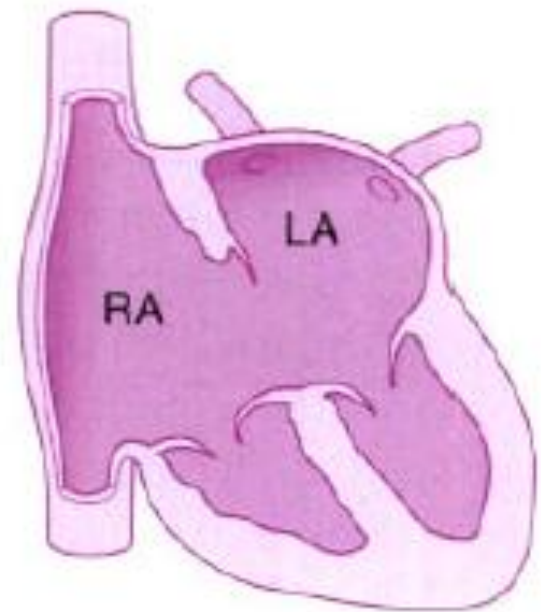


Atrial Septal Defect (ASD)

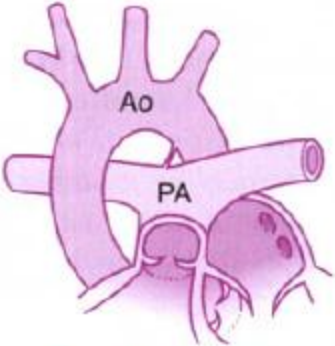
ASD secundum



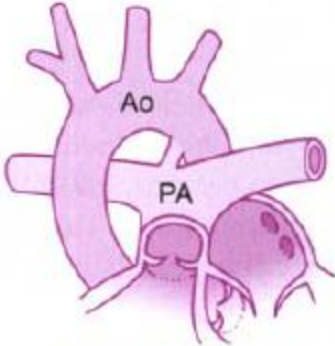
ASD primum
(partial AV septal defect)



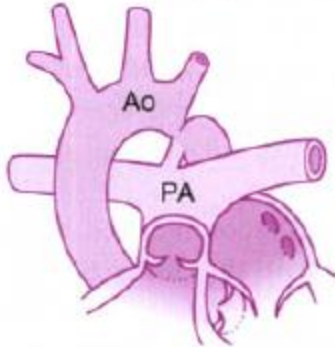
Coarctation of Aorta



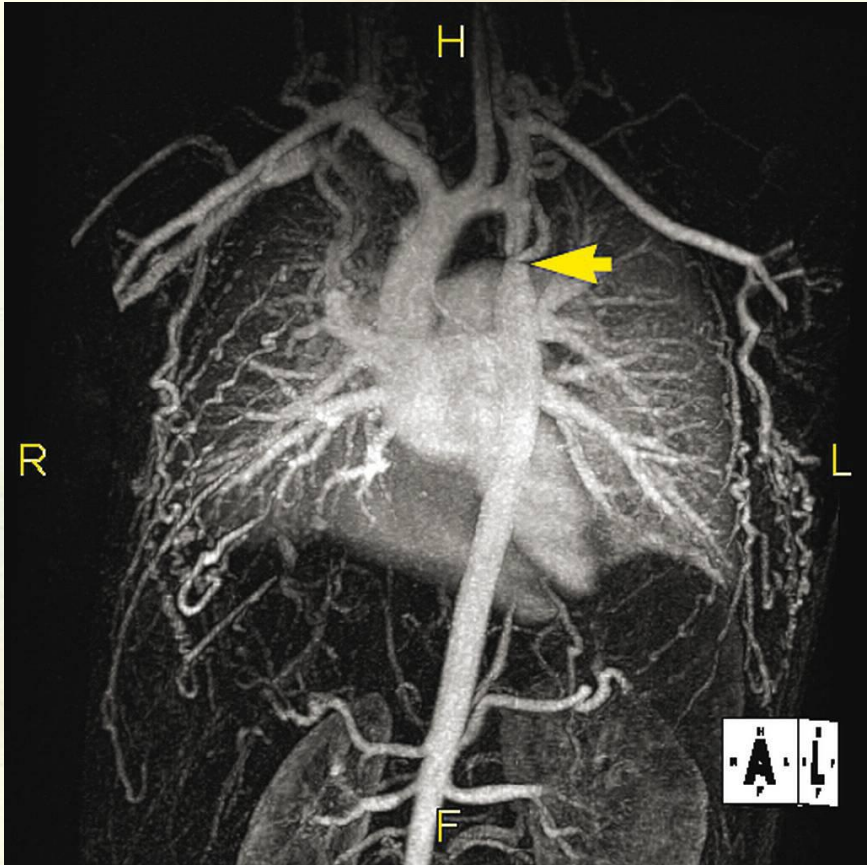
Normal with 'ligamentum'



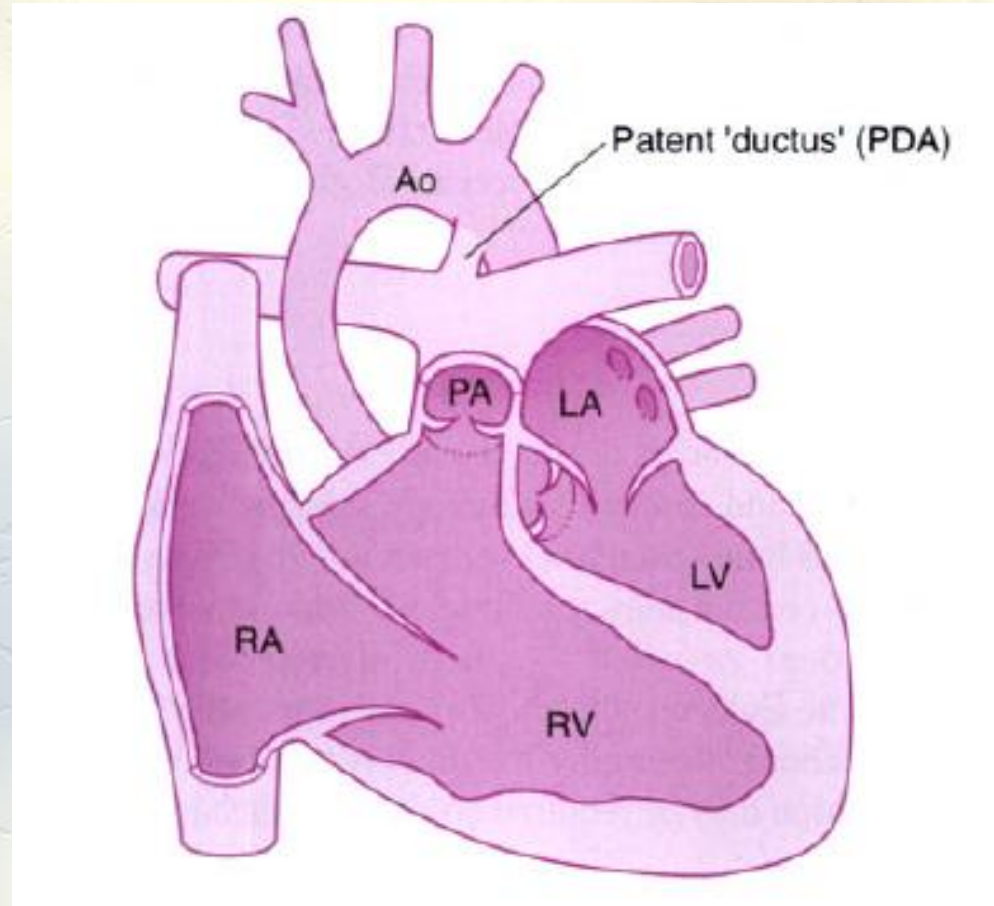
Isolated small PDA



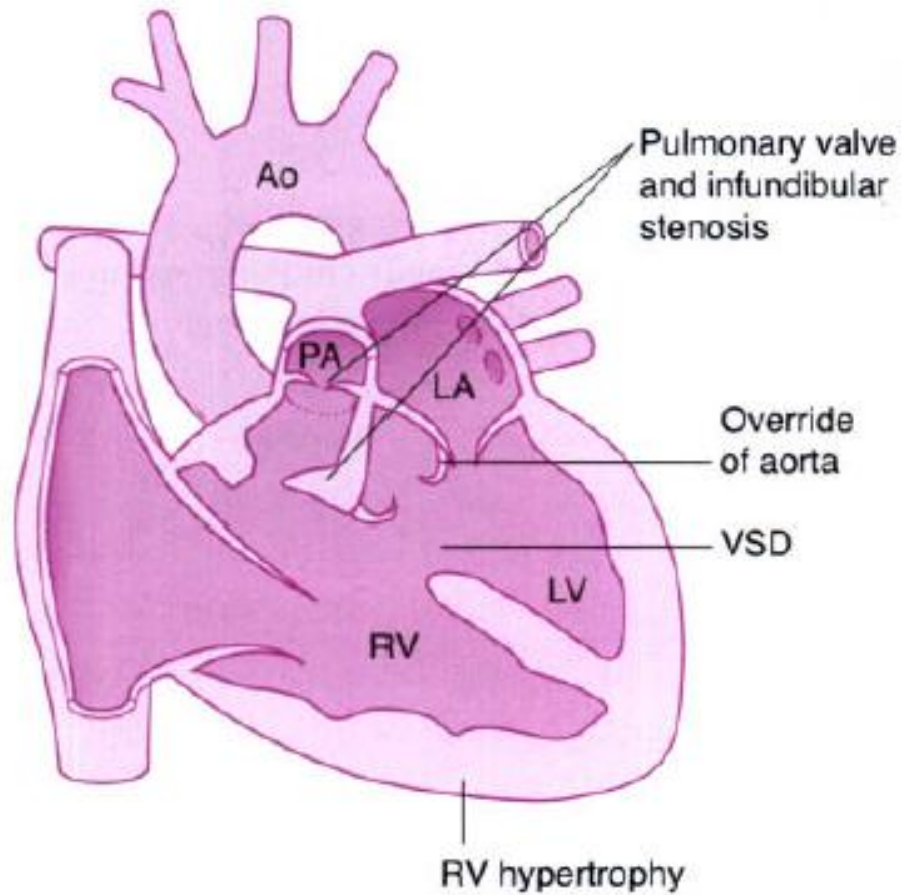
Coarctation of the aorta (+small PDA)



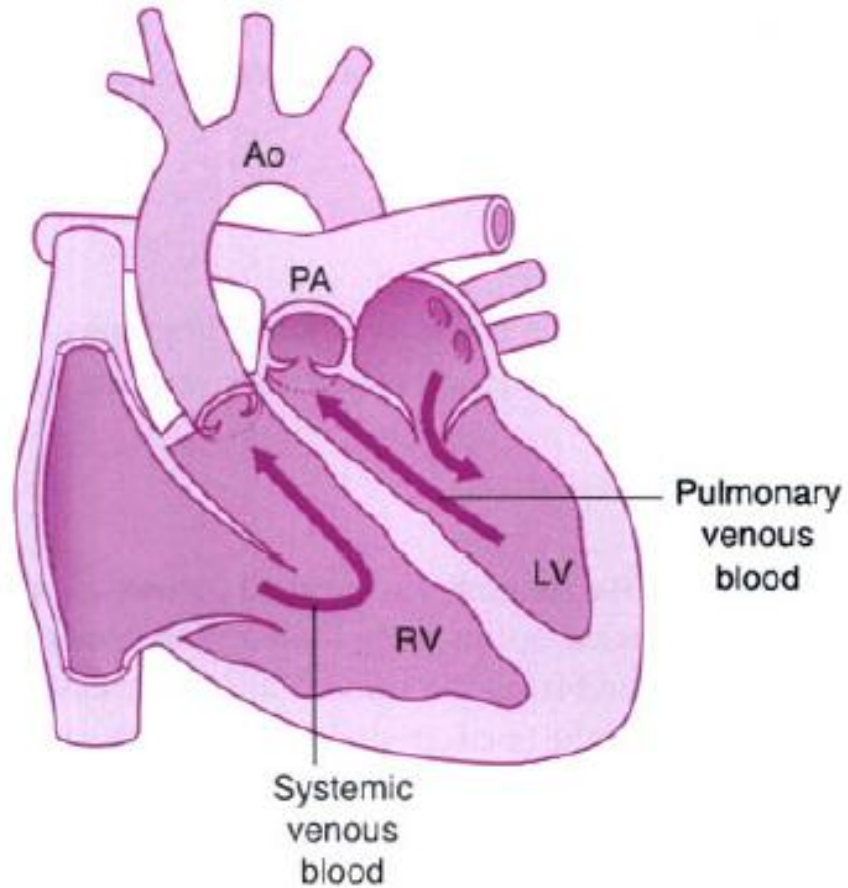
Hypoplastic Left Heart Syndrome



Fallot's Tetralogy



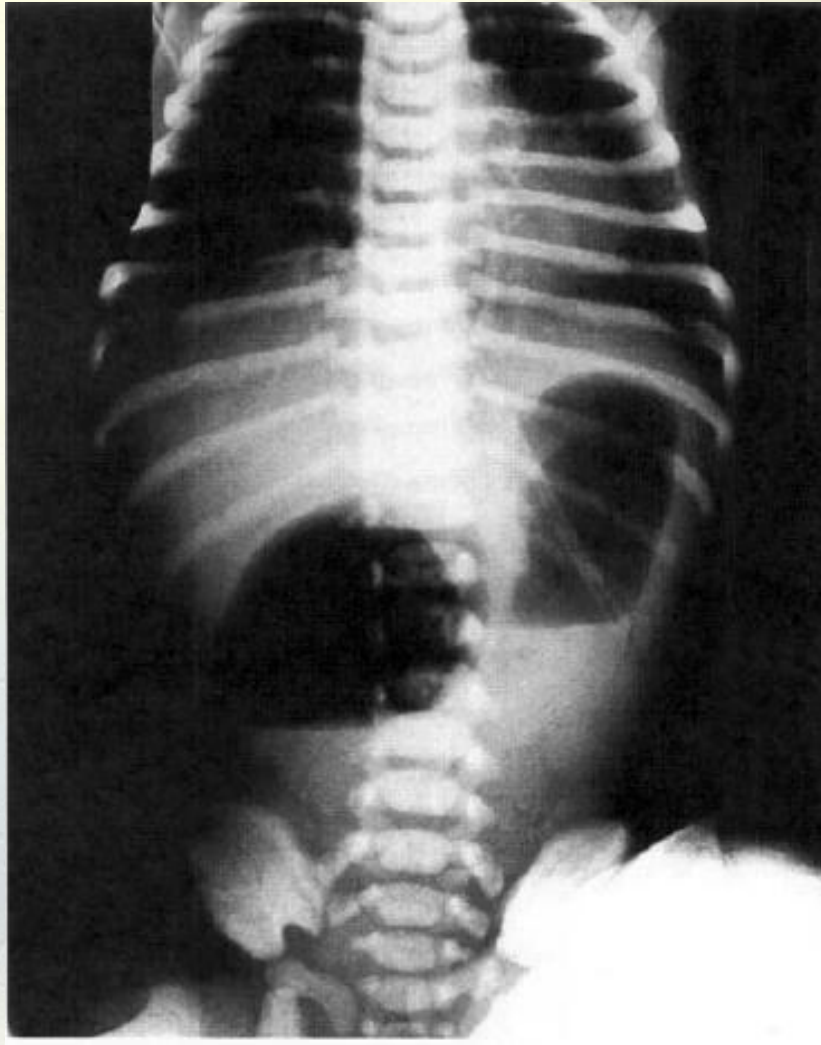
Transposition of the Great Arteries (TGA)

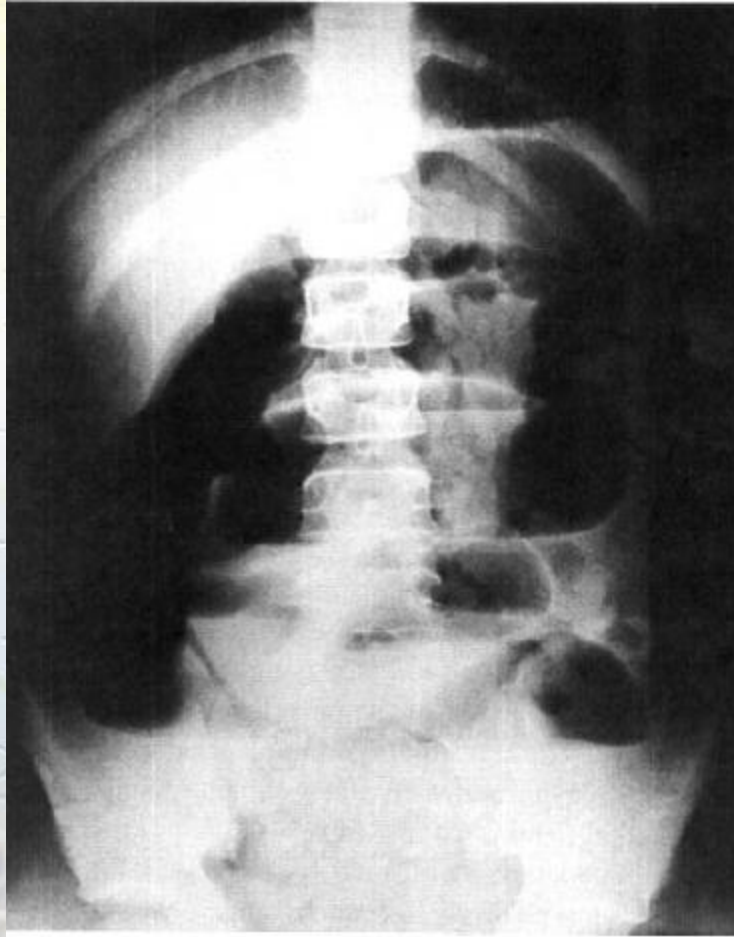


Problems in the Neonatal Period

- Growth factors
- Prematurity
- Jaundice
- Respiratory problems
- Infections
- Cardiac problems
- GIT problems

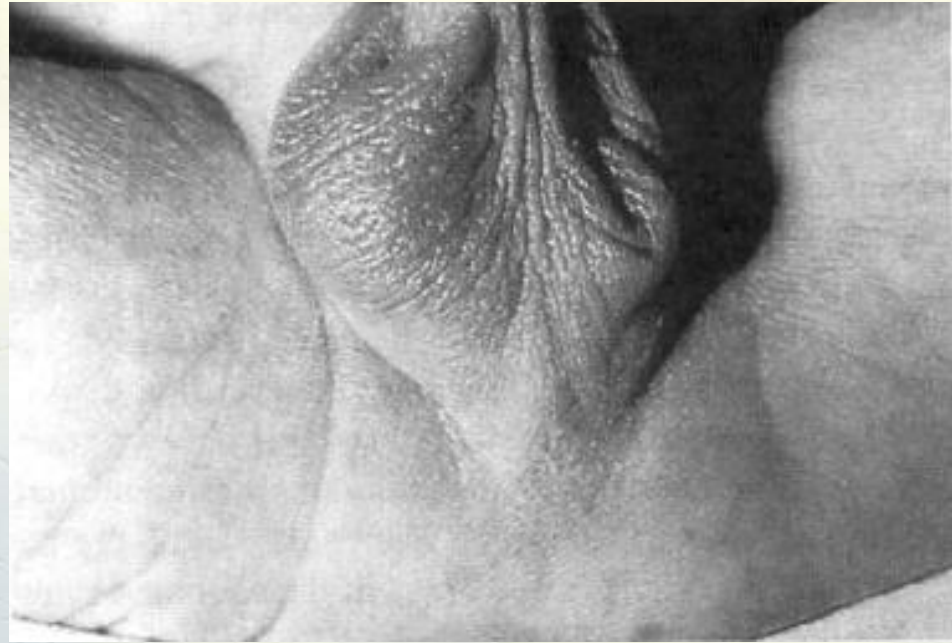








Picture source: Pediatrics in Review





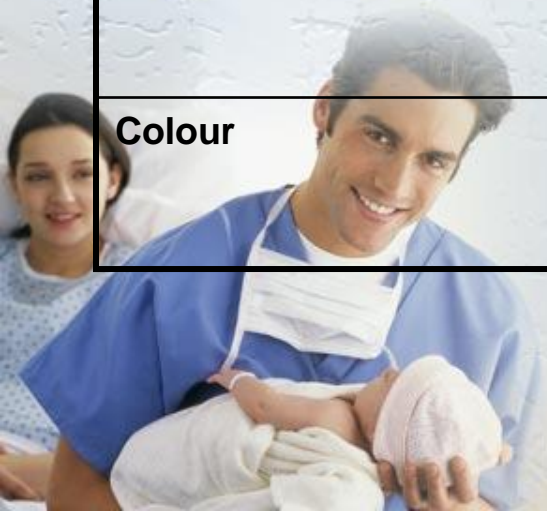
Problems in the Neonatal Period

- Growth factors
- Prematurity
- Jaundice
- Respiratory problems
- Infections
- Cardiac problems
- GIT problems
- Birth problems



Apgar Score

Heart rate	0 no heart rate 1 < 100 beats/min 2 > 100 beats/min
Respiratory effort	0 no resp. effort 1 irregular, poor effort 2 regular, crying
Reflex irritability	0 no response 1 weak grimace 2 grimace or withdrawal
Muscular tone	0 floppy 1 partial flexion 2 active
Colour	0 cyanosed 1 central pink, peripheral cyanosed 2 pink



Perinatal Asphyxia

- Neonatal Depression
- Neonatal encephalopathy
- Hypoxic-ischemic encephalopathy (HIE)
- Hypoxic-ischemic brain injury
 - Biochemical (CK-BB)
 - EEG
 - U/S head (HUS)
 - MRI or CT
 - Post mortem



Problems in the Neonatal Period

- Growth factors
- Prematurity
- Jaundice
- Respiratory problems
- Infections
- Cardiac problems
- GIT problems
- Birth problems
- Congenital Abnormalities





Picture source: Pediatrics in Review



Picture source :Pediatrics in Review



Picture source: Pediatrics in Review

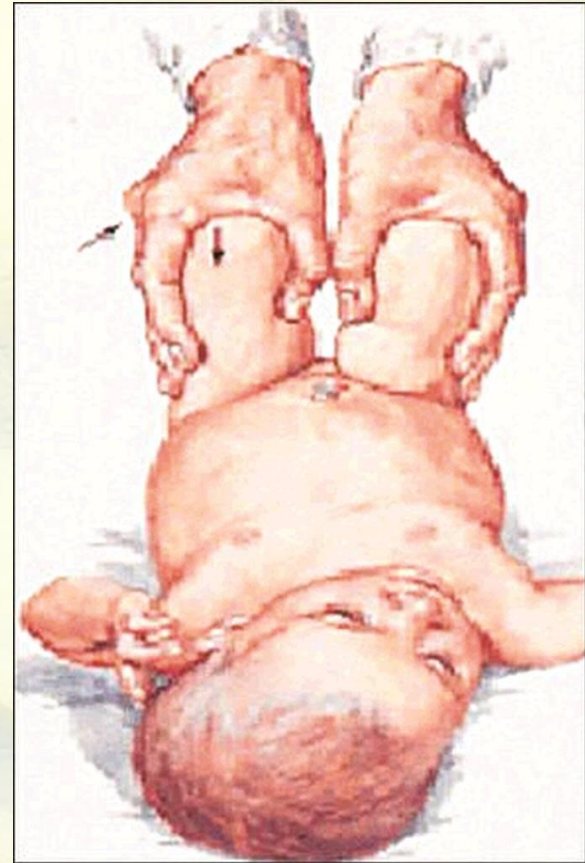
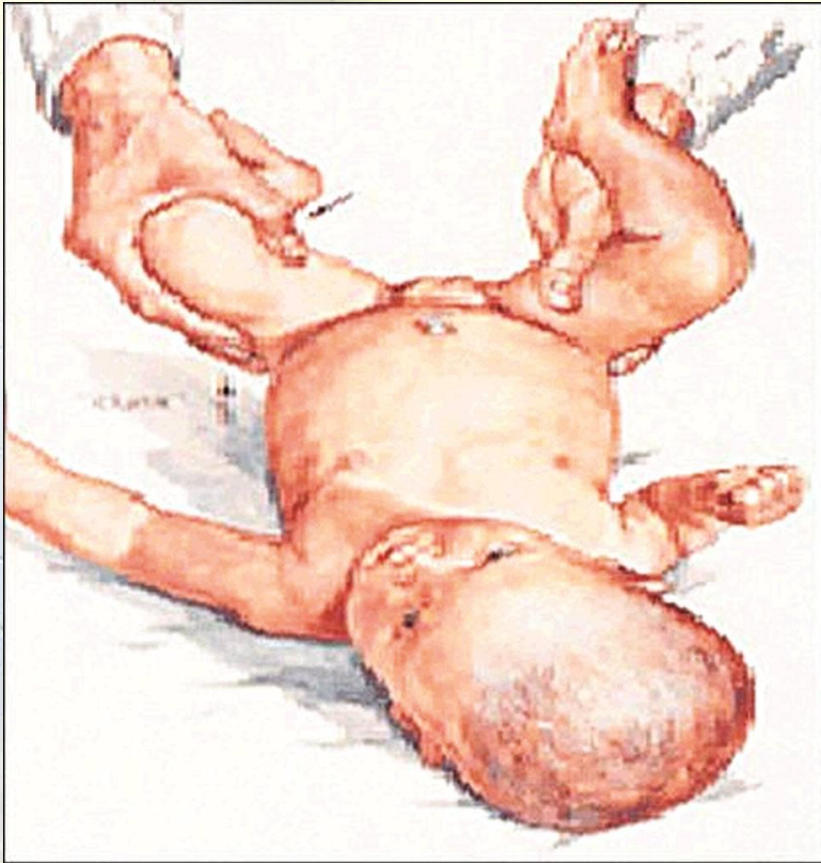




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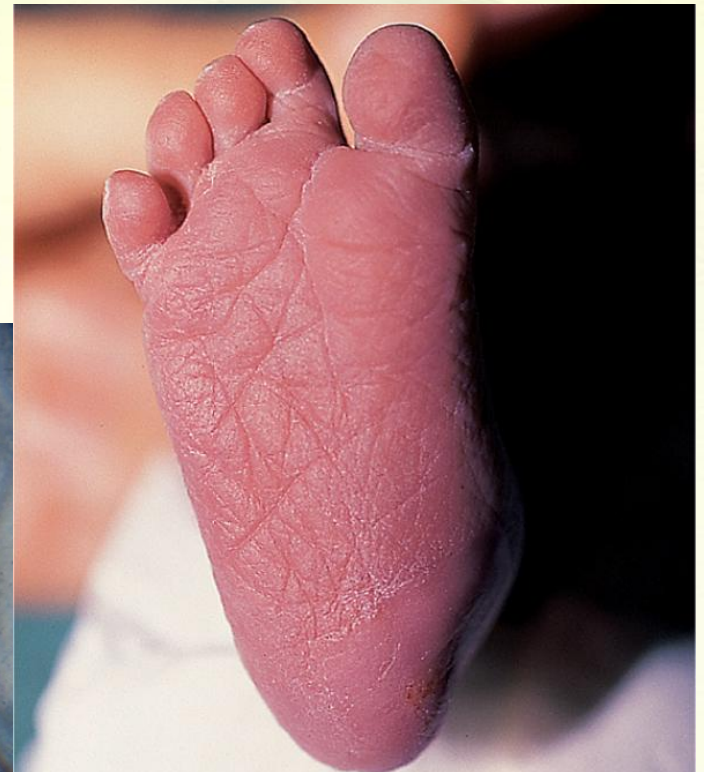
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Contact me

- My email : draltang@yahoo.com
tang.tuck.hon@monash.edu
- My website: www.kairos2.com/medical_notes.html
- My blog: www.draltang01.blogspot.com
- Mobile: 012 7880812

