Introduction to Neonatal Medicine

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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 hip.

**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?

**Skin**
- Palor
- 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

**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 (breach, family history of CDH)

**Genitalia and anus**
- Hypoplasia (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)

**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)

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

**Abdomen**
- Abdominal distension or bile-stained vomiting suggest bowel obstruction (e.g. stressis)
- Palpable kidneys (hydronephrosis)
- Anterior abdominal wall defects (gastrochisis 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 X0)
- Noonan syndrome (lymphoedema)
- VATER and VACTERL associations
- Pierre-Robin sequence
Assessment of gestational age
Assessment of Gestational Age

- EDD
- Ultrasound
  - Crown-rump
  - Biparietal diameter (BPD)
  - Fetal femur length
- Clinical
  - Ballard score
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
Problems of Intra Uterine Growth Retardation

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

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

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

Idiopathic
- Previous preterm delivery
Problems in the Neonatal Period

- Growth Factors
- Prematurity
  - Risk factors
  - Complications
## Complications of Prematurity

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

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 leukomalacia
- Increased risk of cerebral palsy

**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
- Naso gastric 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)

**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

**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
- Rh 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 Rh incompatibility
- 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
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
APNEA

Prematurity
Seizures
Head & Body Position
Hypoxemia or Anemia
IVH
Infection
Reflux
Drug Therapy
Problems in the Neonatal Period

- Growth Factors
- Prematurity
- Jaundice
- Respiratory Problems
- Infections
  - Intrauterine
Congenital and Perinatal Infections

- Transplacental infections:
  - rubella, syphilis
  - toxoplasmosis
  - cytomegalovirus, varicella
  - human immunodeficiency virus
  - hepatitis B virus
  - herpes simplex virus
  - chlamydia, gonorrhoea
  - group B streptococcus

- Intrapartum infections:

- Postpartum infections:

Dashed lines indicate less common routes of transmission.
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)
Atrial Septal Defect (ASD)
Coarctation of Aorta
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
Problems in the Neonatal Period

• Growth factors
• Prematurity
• Jaundice
• Respiratory problems
• Infections
• Cardiac problems
• GIT problems
• Birth problems
## Apgar Score

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Heart rate</strong></td>
<td>no heart rate</td>
<td>&lt; 100 beats/min</td>
<td>&gt; 100 beats/min</td>
</tr>
<tr>
<td><strong>Respiratory effort</strong></td>
<td>no resp. effort</td>
<td>irregular, poor effort</td>
<td>regular, crying</td>
</tr>
<tr>
<td><strong>Reflex irritability</strong></td>
<td>no response</td>
<td>weak grimace</td>
<td>grimace or withdrawal</td>
</tr>
<tr>
<td><strong>Muscular tone</strong></td>
<td>floppy</td>
<td>partial flexion</td>
<td>active</td>
</tr>
<tr>
<td><strong>Colour</strong></td>
<td>cyanosed</td>
<td>central pink, peripheral cyanosed</td>
<td>pink</td>
</tr>
</tbody>
</table>
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
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