The very preterm infant – prehospital and emergency care
Learning Objectives

• Understand incidence of preterm birth
• Understand risks preterm babies face
• Understand what can be done in to help and to prevent harm
What is preterm birth?

• Birth less than 36 completed weeks of pregnancy (<36 weeks +6 days)
  – Low birth weight = birth <2500 grams
  – Very low birth weight = birth <1500 grams
  – Extremely low birth weight = birth <1000 grams
What’s different about being very preterm?

- Small size
- Immature organs
- Large surface area to body-weight ratio
- Less reserve (energy, organ function)
- Less reliable transition to postnatal life
Heat loss

• Evaporation
• Conduction (to cold surfaces, bedding)
• Radiation (to environment, nearby cold surfaces)
• Convection (drafts)
Fetal Skin

26 weeks

40 weeks
Transepidermal water loss

Hammarlund et al. 1983
Why are preterm babies more prone to heat loss?

• Immature skin ➞ markedly increased evaporation

• Reduced subcutaneous fat ➞ reduced insulation

• Reduced energy reserves
  Immature autonomic responses ➞ Less thermogenesis
  Immature hormonal responses

• Large surface area:body weight ratio ➞ increased evaporation, radiation

• **Iatrogenesis**
  • Exposed skin
  • Cold dry gas
Impacts of heat loss

• Increased metabolic demands as baby struggles to rewarm – may make borderline oxygenation or blood glucose more critical
• Worse lung function – surfactant inactivation
• Apnoea
• *Increased mortality* – estimated at 18% increase in mortality for each 1.0°C below 36.5°C at admission to NICU
Evidence-based temperature management

For well babies
- Dry
- Skin to skin with mother
- Avoid drafts

For very preterm babies
- Ambient temp of at least 26°C
- Polyethylene bag or wrap, *without* drying or unwrapping
- Avoid drafts (note resuscitation gases)
- Cap
- Warm towels / bedding
- Radiant warmer or skin to skin with mother

For all babies
- Prevention of hyperthermia
Other hints for temperature management

• If using plastic bag/wrap – avoid opening and closing until a humidified incubator is available
• Things you can do without removing bag/plastic wrap:
  – Weigh
  – Insert IV, umbilical line (cut a small hole in bag)
  – Auscultate
  – Saturation monitoring (avoid uncovering to apply)
  – Provide warm blanket or towel over the top
  – “Plastic to skin” with mother
• If need to apply skin antiseptic – use sparingly only to minimum area needed
Transitional circulation

FETUS

- To and from head
- To and from arm
- Aorta
- Superior vena cava
- Foramen ovale is open between atria
- Superior vena cava
- Descending aorta
- Ductus venosus
- Umbilical arteries
- Umbilical vein
- Placenta
- Pulmonary artery
- Pulmonary vein

NEWBORN

- Aorta
- Ductus arteriosus closes
- Pulmonary artery
- Pulmonary vein
- Superior vena cava
- Foramen ovale closes
- Inferior vena cava
- Lung
Timing of cord clamping

Uncomplicated term birth
• delay clamping for minimum of 1 min or until cessation of cord pulsation
  – improved iron status through infancy, increased likelihood of jaundice requiring phototherapy (McDonald, Cochrane Database 2008)

Uncomplicated preterm > 30 weeks
• delay clamping 30 sec - 3 min
  – increases BP during stabilisation, reduces risk of intraventricular haemorrhage & need for blood transfusion (Rabe et al, Neonatology 2008)
Timing of cord clamping in compromised infants?

Compromised infant
– optimal timing unknown & resuscitation measures may need to take priority
– In pre-hospital setting, if the best place to resuscitate the baby is on the bed or ambulance stretcher between mother’s legs anyway, there is probably no rush to clamp the cord

Preterm infant < 30 weeks?
– await.....
Airway Management

- Suctioning of the nose, mouth or pharynx after birth
- Suctioning can delay the normal rise in oxygenation

**Positioning is critical**
- Big head/prominent occiput/skull deformation during vaginal birth
- Weak neck muscles
- Small upper airways
- Immature airway-protective reflexes

**Avoid iatrogenesis**
- Careful not to compress soft tissues of neck with your fingers during mask hold
Ventilation

Initiating ventilation;

• aim is initially to establish functional residual capacity (FRC)
• optimal strategy - not established
• studies suggest sustained initial breaths and PEEP helpful especially for preterm infants
LARYNGEAL MASK

Size 0 mask - can be used down to about 1.5 kg
Ventilation

- TLC: Total Lung Capacity
- Volume vs. Pressure Graph
- Points:
  - A: Low FRC (atelectasis)
  - B: Normal FRC
  - C: High FRC (overexpansion)

Legend:
- Normal FRC
- Low FRC (atelectasis)
- High FRC (overexpansion)
Ventilation

- Pressures adjusted according to response

*For most infants, ventilation can be accomplished with progressively lower pressures and rates as resuscitation proceeds*
The conducting airways develop by 16 weeks.

Gas exchange regions follow.
24 week lung
• simple airspaces
• thick interstitium
• high water content
• long diffusion distance for $O_2$, $CO_2$

32 week lung
• more elaborate acini
• thinner but stronger interstitium
• reduced water content
• shorter diffusion distance
Challenges ventilating very preterm lung

Low levels of collagen, elastin ➔ reduced tensile strength and elasticity

VERY difficult airway

Damage to lungs, brain from too-liberal use of oxygen

• Be gentle
• Judicious use of pressure, oxygen
• Expert help as soon as possible
The use of oxygen in newborn resuscitation will be remembered as one of the most dangerous therapies inflicted on newborns.

Ola Saugstad

In-hospital: Air, oxygen, blender, oximeter need to be considered as standard neonatal resuscitation equipment.

Pre-hospital – as far as possible – judicious use of oxygen.
Recommendations for oxygen

Term babies commence resuscitation in room air

Preterm commence in room air or blended air & O2 (30-50%)

In all cases, the first priority is to ensure adequate inflation of the lungs, followed by increasing the concentration of inspired oxygen only if needed

Adjust oxygen using pulse oximetry to meet targeted saturations

<table>
<thead>
<tr>
<th>Time from birth</th>
<th>Target saturations for newborn infants during resuscitation</th>
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<tbody>
<tr>
<td>1 min</td>
<td>60-70</td>
</tr>
<tr>
<td>2 min</td>
<td>65-85</td>
</tr>
<tr>
<td>3 min</td>
<td>70-90</td>
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<tr>
<td>4 min</td>
<td>75-90</td>
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<tr>
<td>5 min</td>
<td>80-90</td>
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<tr>
<td>10 min</td>
<td>85-90</td>
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</tbody>
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**Oxygen Saturations – normal & targets**

![Graph showing oxygen saturations over time](image)

**FIGURE 2**
Third, 10th, 25th, 50th, 75th, 90th, and 97th \( \text{SpO}_2 \) percentiles for term infants at \( \geq 37 \) weeks of gestation with no medical intervention after birth.

**Source:** Dawson et al., Paediatrics 2010
Gentle handling – Preterm infants

• Avoid abrasion of skin
• Use alcohol-containing antiseptics VERY gingerly – avoid if possible (can cause severe skin burns)
• Great caution with adhesives (can cause nasty delamination of skin)
• Avoid head-down position/rapid changes in posture (premies can’t autoregulate cerebral circulation well → risk of intraventricular haemorrhage)
• Leave 4-5 cm between cord clamp and baby (to enable later umbilical catheterisation, reducing need for other lines)
• Caution in use of fluid boluses
  – chloride load → metabolic acidosis
  – limited capacity to excrete excess water or sodium
  – positive fluid balance in first days increases risk of chronic lung disease)
• Cleanliness/hygiene – meticulous handwashing, consider gloves