Respiratory distress and CPAP

Clinical Guideline

45 minutes
Towards CPD Hours
References:
Queensland Clinical Guideline: Respiratory distress and CPAP is the primary reference for this package.

Recommended citation:

Disclaimer:
This presentation is an implementation tool and should be used in conjunction with the published guideline. This information does not supersede or replace the guideline. Consult the guideline for further information and references.

Feedback and contact details:
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Objectives

• Identify babies at risk for respiratory distress

• Identify babies with respiratory distress at birth
  ◦ Diagnosis and management

• Consider the management and care of a baby requiring continuous positive airway pressure (CPAP)

• Identify complications of CPAP
## Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
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<tbody>
<tr>
<td>BGL</td>
<td>Blood glucose level</td>
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<tr>
<td>BPD</td>
<td>Bronchopulmonary dysplasia</td>
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<tr>
<td>CPAP</td>
<td>Continuous positive airway pressure</td>
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<tr>
<td>CXR</td>
<td>Chest X-ray</td>
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<tr>
<td>IV</td>
<td>Intravenous</td>
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<tr>
<td>OGT</td>
<td>Orogastric tube</td>
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<tr>
<td>pCO₂</td>
<td>Partial pressure of carbon dioxide</td>
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<tr>
<td>PPHN</td>
<td>Persistent pulmonary hypertension</td>
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<tr>
<td>RDS</td>
<td>Respiratory distress syndrome</td>
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<tr>
<td>SpO₂</td>
<td>Peripheral capillary oxygen saturation</td>
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<tr>
<td>TTN</td>
<td>Transient tachypnoea of the newborn</td>
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Lung development and physiology

• Bronchioles and alveolar ducts develop from 16–25 weeks gestation—potentially viable lungs
• Surfactant is produced after 20 weeks gestation
• Chest wall compliance and decreased lung function increase risk of respiratory distress with decreased gestation
Pulmonary surfactant

- Reduces alveolar surface tension
- Facilitates alveolar expansion
- Reduces risk of atelectasis from alveolar collapse

Surfactant is present during normal expiration

Surfactant is absent resulting in abnormal respiration
Surfactant deficiency

- Excessive negative intrathoracic pressure and poorly compliant lungs → Chest recession
- High surface tension → Lungs—low volume and decreased compliance
- Lung inflammation and epithelial injury → Pulmonary oedema and increased airway resistance
Surfactant deficiency

- Primary cause of RDS
- Requires increased pressure to open the alveoli
- Alveolar instability at low lung volumes leads to collapse and diffuse atelectasis

Normal alveoli

Underinflated alveoli
Hypoxaemia

Caused by:
• Ventilation-perfusion mismatch
• Extra-pulmonary shunting

Poor ventilation identified from:
• Elevated pCO$_2$ (respiratory acidosis)
• Lactic acid production from hypoxaemia and poor perfusion (metabolic acidosis)
Ventilation-perfusion mismatch

- Atelectasis—portions of lung collapse
- Intra- and extrapulmonary shunts
- Abnormal fluid absorption from inefficient clearing in damaged lung—pulmonary oedema impedes gas exchange
Causes of respiratory distress

- RDS
- TTN
- Infection
- PPHN
- Pulmonary air leak
- Aspiration
  - Meconium, liquor, water, milk
- Congenital anomalies
- Interstitial lung disease
Signs of respiratory distress

- Tachypnoea > 60 breaths per minute
- Increased work of breathing
  - Expiratory grunt
  - Recession–sternal, lower costal, intercostal
  - Nasal flaring
- Cyanosis
RDS

Respiratory signs
- Tachypnoea > 60/minute
- Increased respiratory effort
  - Expiratory grunt
  - Chest recession
  - Nasal flaring
- Decreased breath sounds
- Chest x-ray appearance

Colour
- Pale or
- Cyanosed

SpO₂:
- Targets not met:
  - Term baby: 92–98%
  - Preterm baby: 90–95%

Blood gas
- pCO₂ increased

Cardiovascular
- Diminished peripheral pulses
- May have:
  - Tachycardia, bradycardia +/- apnoea

Urine output
- May be reduced in first 24 hours
Babies at risk of RDS

- Preterm birth
- Maternal diabetes in pregnancy (poorly controlled)
- Elective caesarean section
Normal chest X-ray

- Symmetrically aerated lung fields
- Diaphragm at 6th ribs anteriorly and 8th rib posteriorly
Abnormal chest x-ray

RDS

- Low lung volume
- Diffuse reticulogranular ‘ground glass’
- Air bronchograms
- Confluent alveolar shadowing
Abnormal chest X-ray

**TTN**
- Normal or slightly over-inflated lung fields
- Increased streaky shadowing and perihilar densities
- Fluid in horizontal fissure

**Meconium aspiration syndrome**
- Asymmetrical opacification
- Streaky linear densities
- Hyperinflation of lungs
- Flattening of diaphragm
Management and supportive care

- Oxygenation
- Fluids–IV glucose
- Thermoregulation
- Developmental care
- Infection screening
- Antibiotics
- Monitoring
- Blood glucose
CPAP

- Maintains expansion of alveoli by providing a constant pressure to the lungs
- Prevents atelectasis
- Allows gas exchange
Benefits of CPAP

• Improves lung compliance
• Stabilises the compliant chest wall
• Improves thoraco-abdominal synchrony
• Reduces work of breathing
• Reduces apnoea:
  ◦ Obstructive—by upper airway splinting
  ◦ Central—due to regular breathing pattern
• Reduces oxygen requirements
• Reduces risk of bronchopulmonary BPD
Indications for CPAP

• To correct respiratory failure
  ◦ Signs of respiratory distress
  ◦ Oxygen requirement ≥ 30% or
  ◦ < 30% and other significant signs of respiratory distress

• To treat airway obstruction

• To prevent respiratory failure
  ◦ Apnoea of prematurity
Contraindications to CPAP

- Bi-lateral choanal atresia
- Tracheo-oesophageal atresia
- Congenital diaphragmatic hernia
- Gastroschisis or omphalocele
- Necrotising enterocolitis
- Cleft palate
Commencing CPAP

• Pressure: start at 7–8 cm H₂O
• Flow: 6–8 L per minute
• FiO₂: to maintain oxygen saturations
• Humidification temperature:
  ◦ 37 °C at baby interface and
  ◦ 40 °C at humidifier
Care of baby on CPAP

• Observe baby in incubator (nappy only)
• Supportive care
• Oxygen to incubator during cares
  ◦ If fragile baby, two people to perform cares
• Only disturb baby when necessary
• Pain management
• Encourage family involvement
Care of baby on CPAP

• Assessment and monitoring
  ◦ Vital signs and work of breathing
  ◦ Oxygen saturations (preductal)
  ◦ Blood glucose levels
  ◦ Blood gas as clinically indicated

• Fluids and feeding
  ◦ IV glucose
  ◦ OGT on free drainage; aspirate 4–6 hourly
  ◦ Non-nutritive sucking
  ◦ If baby stable, consider small gavage feeds
Care of baby on CPAP

• Suctioning
  ◦ Keep airways clear
  ◦ Avoid deep suctioning

• Circuit
  ◦ Avoid traction
  ◦ Remove condensation

• Record CPAP settings
  ◦ Pressure, gas flow, FiO₂ and humidifier temperature
Complications of CPAP

- Pulmonary air leaks
- Pain/discomfort
- Abdominal insufflation
- Hyperinflation of lungs
- Pressure injury
Prevention of pressure injury from prongs

- Measure and size the interface for each baby
- Fit prongs correctly to avoid pressure on high risk areas and prevent excess rubbing and movement
- Position binasal prongs 2 mm from nares
- Avoid contact with septal columella
Prevention of pressure areas from mask

- Measure and size the interface for each baby
- Cover entire nose
- Do not fit mask tightly
- Avoid indentations and pressure on nasal bridge
- Avoid tight fitting hat
Pressure area care

• Vigilant skin assessment and skin resting time
  ◦ Erythema is first sign of pressure injury

• Risk factors
  ◦ Nasal CPAP
  ◦ Length of therapy
  ◦ Age and size of baby
  ◦ Environmental temperature and humidity
Skin care

• Assess for:
  ◦ Nasal—redness, skin breakdown, bruising, indentation, bleeding, altered shape
  ◦ Ears—creases, folds, pressure areas
  ◦ Forehead—pressure areas (if midline device)
  ◦ Nasal bridge—midfacial indentation
  ◦ Head—pressure areas
Developmental care

• Aim to avoid skin breakdown and plagiocephaly
• Release bonnet for few minutes with cares
• Change skin barrier at least 12th hourly
• Developmental positioning
• Cycled lighting
• Reduce environmental stimuli
• Family bonding time
Positioning

• Avoid:
  ◦ Inadvertent tension to interface
  ◦ Condensate accumulation at nares
• Use chin strap/pacifier to keep baby’s mouth closed
• Position prone or prone quarter turn
• Avoid left lateral positioning
Weaning CPAP

• Reduce FiO₂ before pressure

• Commence when:
  ◦ FiO₂ < 25%
  ◦ Respiratory rate < 60 breaths/minute
  ◦ Chest recession absent
  ◦ Apnoeas < 20 seconds and self-reverting
  ◦ Bradycardias not < 100 beats/minute
  ◦ Average SpO₂ > 95% for previous 6 hours

• Cease if stable in air and CPAP 5 cmH₂O