Respiratory distress and CPAP

Clinical Guideline Presentation v4.0

45 minutes

Towards CPD Hours

Clinical Excellence Queensland

Queensland Government

References:

Queensland Clinical Guideline: Respiratory distress and CPAP is the primary reference for this package.

Recommended citation:

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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.

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Objectives

- Early recognition of babies with respiratory distress
- Assessment of the underlying cause
- Investigation and diagnosis
- Management and care considerations of a baby requiring continuous positive airway pressure (CPAP)
- Identification of complications of CPAP
- Integration of family centred care for the baby with respiratory distress

Abbreviations

CLD	Chronic Lung Disease
CPAP	Continuous positive airway pressure
CXR	Chest X-ray
FiO_2	Fractional inspired oxygen
FRC	Functional residual capacity
IV	Intravenous
MAS	Meconium aspiration syndrome
OGT	Orogastric tube
$PaCO_2$	Partial pressure of arterial carbon dioxide
PaO_2	Partial pressure of arterial oxygen
pCO_2	Partial pressure of carbon dioxide
pO_2	Partial pressure of oxygen (unreliable on venous or capillary samples)
PEEP	Positive end expiratory pressure
PPHN	Persistent pulmonary hypertension of the newborn
RDS	Respiratory distress syndrome
SpO2	Peripheral capillary oxygen saturation
TTN	Transient tachypnoea of the newborn

Causes of respiratory distress

- Respiratory distress syndrome (RDS)
- Meconium aspiration syndrome (MAS)
- Transient tachypnoea of the newborn (TTN)
- Persistent pulmonary hypertension of the newborn (PPHN)
- Congenital anomalies
- Non-pulmonary causes
- Pulmonary air leaks
- Infection
- Other aspiration

Risk factors for RDS

Maternal

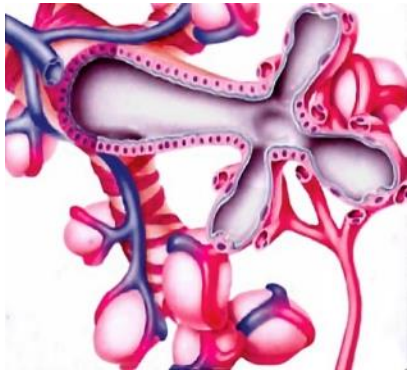
- Antenatal
  - Diabetes
  - Obesity
  - Asthma
  - Smoking
- Medications
  - Antenatal
  - Intrapartum

Neonatal

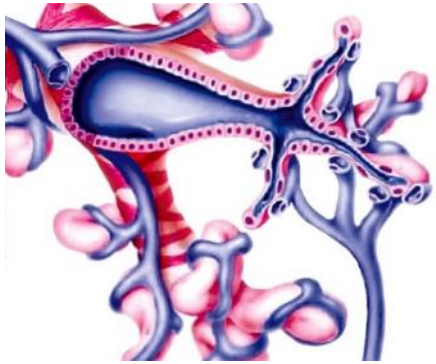
- Gestational age
- Mode of birth
  - Caesarean no labour
  - Precipitous
- Resuscitation
- Diagnosed abnormalities

Pulmonary surfactant

- Surfactant is produced after 20 weeks gestation
- 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

Lung physiology at birth

- Alveolar fluid clearance
- Lung expansion
- Decrease in pulmonary vascular resistance with corresponding increase in pulmonary blood flow
- Increase in systemic blood pressure
- Closure of the right–to–left shunts (foramen ovale and ductus arteriosus)

Respiratory distress

- 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*

Physiology of respiratory distress

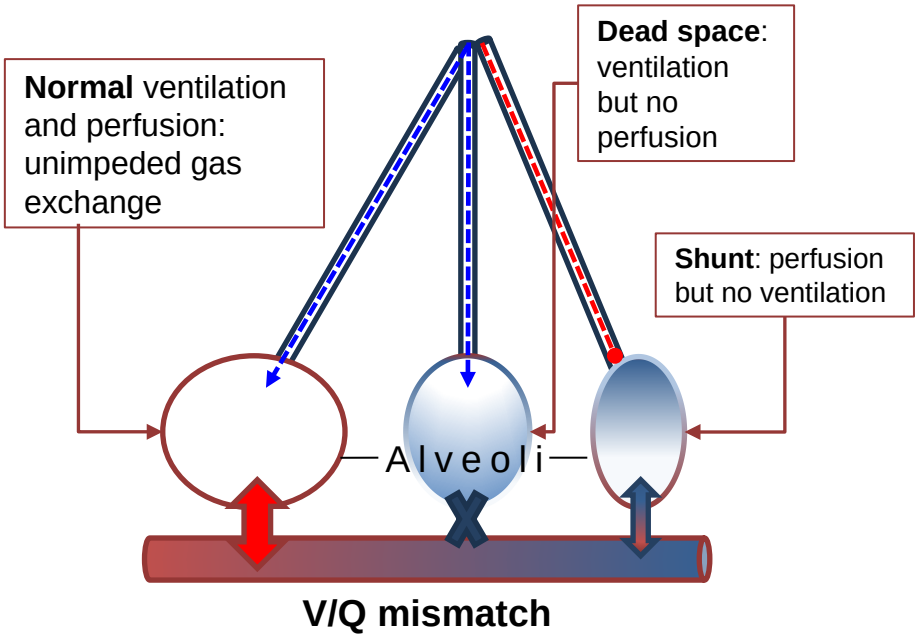
- Surfactant deficiency
  - → *Primary cause of RDS*
- Requires increased pressure to open alveoli
- Alveolar instability at low lung volumes
  - → *Collapse and diffuse atelectasis*

Normal alveoli

Underinflated alveoli

Ventilation-perfusion mismatch

- The presence of a *shunt* and a degree of *dead space* in the same lung
- When either the ventilation (V) or perfusion (Q) in the lungs is impaired; preventing lungs from delivering oxygen to the blood



V/Q mismatch

Signs of respiratory distress

Respiratory signs

- Tachypnoea > 60/minute
- Increased respiratory effort
  - Expiratory grunt
  - Chest recession
  - Nasal flaring
- Decreased breath sounds

SpO_2

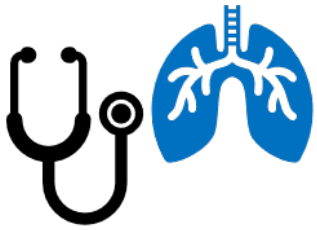
- Targets not met:
  - Term baby: 92–98%
  - Preterm baby: 90–95%

Cardiovascular

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

Colour

- Pale
- Cyanosed



Urine output

- May be reduced in first 24hrs

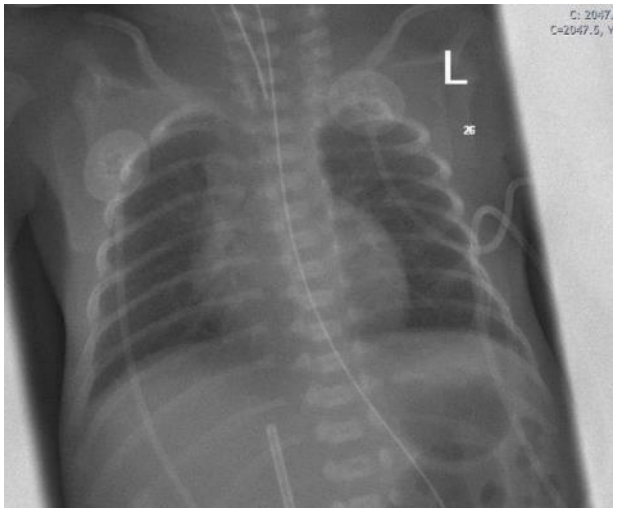
Chest X-ray

- Anteroposterior (AP) chest X-ray
  - Appropriate for diagnosis
- Confirms position of tubes and lines
  - Including OGT
- Assists assessment of pulmonary inflation
- Excludes undiagnosed congenital abnormality
- Excludes pulmonary air leaks

Normal vs Abnormal chest X-ray

Normal

- Symmetrically aerated lung fields
- Diaphragm at
  - 8th rib anteriorly
  - 10th rib posteriorly



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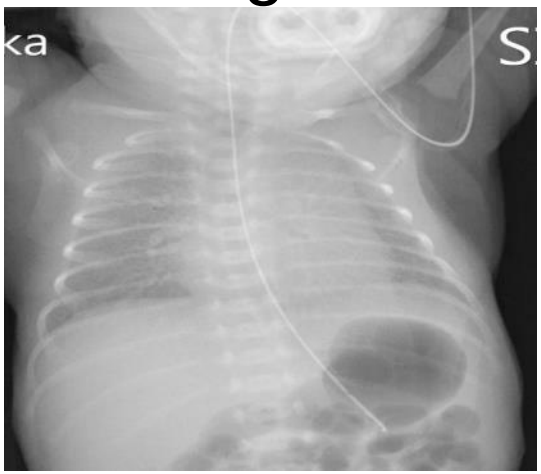
RDS

- Low lung volume
- Diffuse reticulogranular ‘ground glass’
- Air bronchograms
- Confluent alveolar shadowing



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Abnormal chest X-ray

TTN

- Normal or slightly over-inflated lung fields
- Streaky shadowing
- Fluid in horizontal fissure

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MAS

- Asymmetrical opacification
- Streaky linear densities
- Hyperinflation of lungs
- Air trapping

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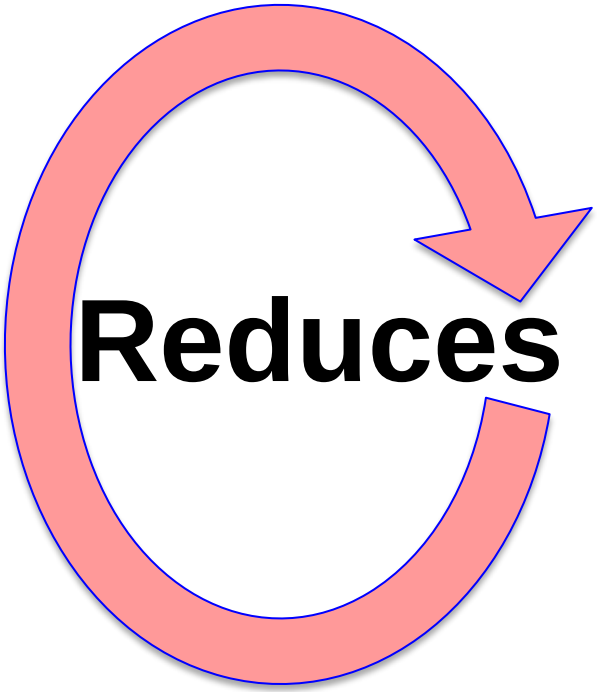
Management and supportive care

Oxygenation	Infection screening
Fluids–IV glucose	Antibiotics
Thermoregulation	Monitoring
Developmental care	Blood glucose
Blood gas	Feeding–when able
Pain management	Pressure area care

CPAP

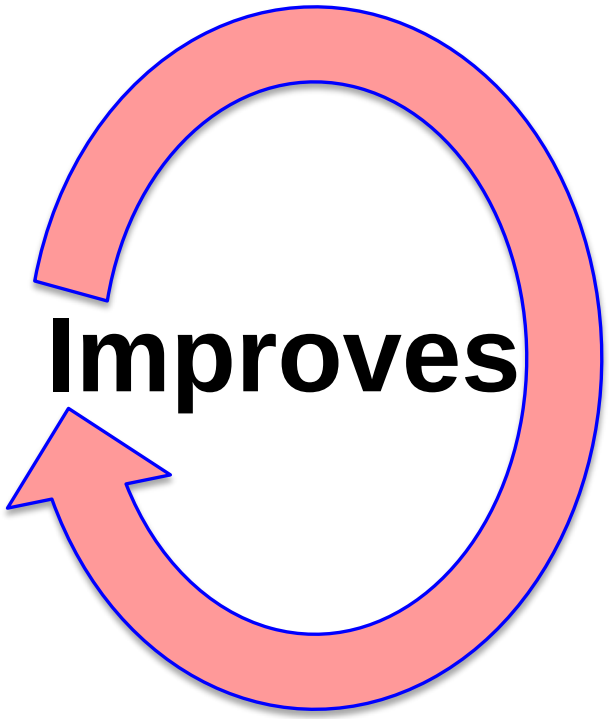
- Prevents atelectasis
- Allows gas exchange
- Maintains expansion of alveoli by providing a constant pressure to the lungs

Benefits of CPAP



- Oxygen requirement
- Work of breathing
- Atelectasis and airway closure
- Utilisation of endogenous surfactant
- Intrapulmonary shunting
- Central apnoea
- Obstructive apnoea
- Risk of chronic lung disease

Benefits of CPAP



- Thoracoabdominal synchrony
- Lung fluid clearance
- Oxygenation and maintains lung volume
- FRC by decreasing the work of breathing
- Lung compliance and stabilises compliant chest wall

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

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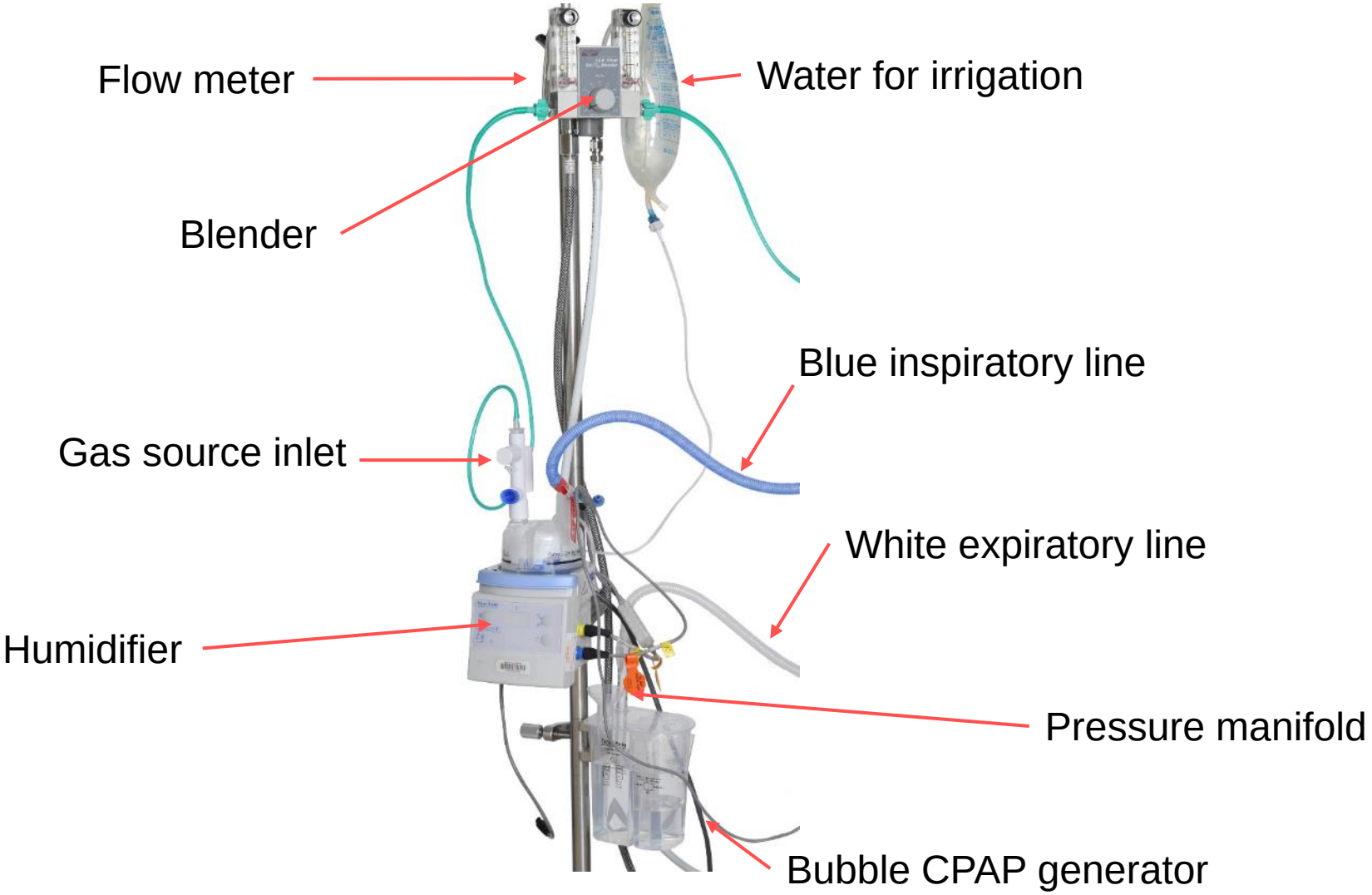
Contraindications to CPAP

• Bi-lateral choanal atresia	• Post-abdominal surgery
• Tracheooesophageal fistula	• Significant skin or septal damage from CPAP
• Gastroschisis or omphalocele	• Congenital diaphragmatic hernia
• Cleft palate	• Oesophageal atresia
• Necrotising enterocolitis	• Congenital lung/airway lesions

Bubble CPAP


Flow meter
Water for irrigation
Blender
Blue inspiratory line
Gas source inlet
White expiratory line
Humidifier
Pressure manifold
Bubble CPAP generator

Commencing CPAP

- Pressure: start at 7–8 cm H_2O
- Flow: 6–8 L per minute
- FiO_2: titrate to maintain oxygen saturations
  - Term: >95%
  - Preterm: 90-95%
- Humidification temperature
  - 37 ^oC at baby interface
  - 40 ^oC at humidifier

Care of baby on CPAP

- Observe unclothed (nappy only)
- Supportive care
- If fragile baby:
  - Two people to perform cares
- Only disturb baby when necessary
- Pain management
- Encourage family involvement
- Maintain normothermia

Care of baby with respiratory distress

- 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 10%
  - 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 • Not always required • Avoid deep suctioning • Provide comfort measures
Circuit	• Avoid traction, twisting or tension • Remove condensation
Positioning	• Reduces incidences of: ◦ Nasal trauma and other pressure injuries • Position to avoid: ◦ Tension to the interface ◦ Accumulation of condensation

Positioning

Prone	•Improves oxygenation •Ribcage–abdominal synchrony •Consistency of breathing pattern
¼ Prone	•Stabilises respiratory rate •Increases oxygen saturations
Lateral	•Avoid for acute lung disease •May reduce bilateral lung expansion •Increases the risk of atelectasis
Supine	•Encourage flexion of the arms and legs

Complications of CPAP

	Pulmonary air leaks
	Pain/discomfort
	Abdominal insufflation
	Hyperinflation of lungs
	Pressure injury
	Condensation, leading to aspiration

Prevention of pressure injury from prongs

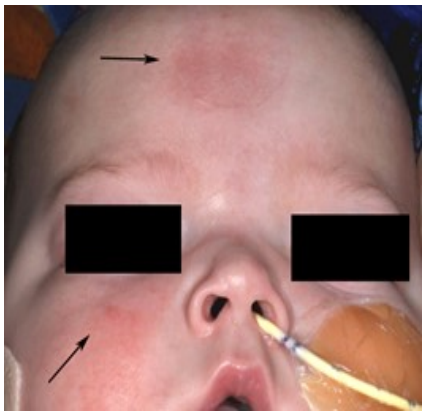
- Measure and size the interface for each baby
- Fit prongs correctly to avoid pressure on *high-risk* areas
- Avoid contact with septal columella
- Position binasal prongs 2 mm from septum
- Hourly observations

High-risk areas of the nose

- Septal columella
- Nares
- Philtrum
- Nasal tip

Prevention of pressure areas from mask

- Measure and size:
  - Individually
  - According to manufacturer's guidelines
- Cover entire nose
- Do not fit mask tightly
- Avoid indentations and pressure on nasal bridge



Hydrocolloid dressings

What are they used for?

- Helps create a seal to maintain CPAP pressure

When not to use

- First 15 minutes of first application of nasal prongs
- If evidence of nasal trauma present
- With application of mask CPAP
- When trialling off CPAP

Hydrocolloid dressings

Not a fix for everything

- Increases pressure injury risk - blanching not able to be visualised
- Will not prevent pressure being applied to the septal columella
- Inhibits observation of nasal flaring
- Inhibits visualisation of nares and septal columella

Assessment of hydrocolloid dressing

- Assess regularly for moisture
- Change at least every 12 hours or more frequently if:
  - Seal not created
  - Visualisation of the nasal skin is required
  - Moisture present

NB: Use an adhesive dissolving wipe when removing

Family-centred care

- Assists with:
  - Early social development
  - Relationship-forming
  - Emotional and behavioural development
- Good relationships and open communication
- Actively involved in care and planning for their baby

Family-centred care

Nappy changes/ assist with cares

Reading

Modified skin-to-skin

Voice and touch

Hand hugs

When baby is unstable