

# 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:

Queensland Clinical Guidelines. Respiratory distress and CPAP clinical guideline education presentation E20.3-V7-R25. Queensland Health. 2020

## 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:

**M:** GPO Box 48 Brisbane QLD 4001 | **E:** [guidelines@health.qld.gov.au](mailto:guidelines@health.qld.gov.au) | **URL:** [www.health.qld.gov.au/qcg](http://www.health.qld.gov.au/qcg)

**Funding:** Queensland Clinical Guidelines is supported by the Queensland Health, Healthcare Improvement Unit.

## Copyright:

© State of Queensland (Queensland Health) 2020



icensed under a Creative Commons Attribution-NonCommercial-NoDerivatives V4.0 International licence. In essence, you are free to copy and communicate the work in its current form for non-commercial purposes, as long as you attribute Queensland Clinical Guidelines, Queensland Health and abide by the licence terms. You may not alter or adapt the work in any way. To view a copy of this licence, visit <https://creativecommons.org/licenses/by-nc-nd/4.0/deed.en>

For further information, contact Queensland Clinical Guidelines, RBWH Post Office, Herston Qld 4029, email [Guidelines@health.qld.gov.au](mailto:Guidelines@health.qld.gov.au), phone (07) . For permissions beyond the scope of this licence, contact: Intellectual Property Officer, Queensland Health, GPO Box 48, Brisbane Qld 4001, email [ip\\_officer@health.qld.gov.au](mailto:ip_officer@health.qld.gov.au), phone (07) 3234 1479.

Images are property of State of Queensland (Queensland Health) unless otherwise cited.



# 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

BGL	Blood glucose level
BPD	Bronchopulmonary dysplasia
CPAP	Continuous positive airway pressure
CXR	Chest X-ray
IV	Intravenous
OGT	Orogastric tube
pCO <sub>2</sub>	Partial pressure of carbon dioxide
PPHN	Persistent pulmonary hypertension
RDS	Respiratory distress syndrome
SpO <sub>2</sub>	Peripheral capillary oxygen saturation
TTN	Transient tachypnoea of the newborn



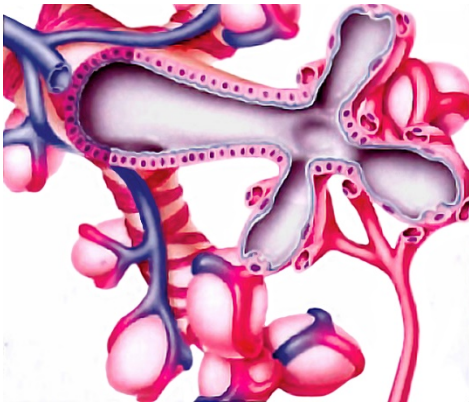
# Lung development and physiology

- 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

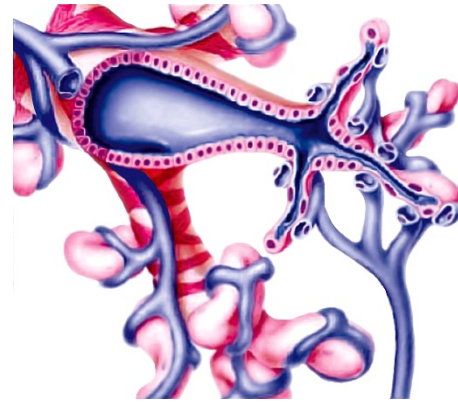


# Pulmonary surfactant

- 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



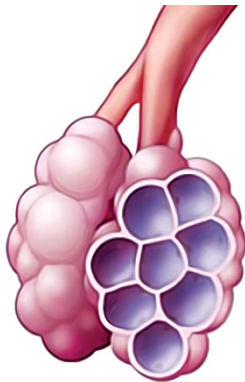
# Surfactant deficiency

- 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*

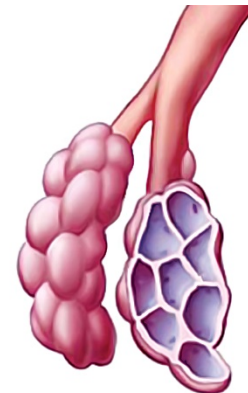


# Surfactant deficiency

- 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  $p\text{CO}_2$  (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



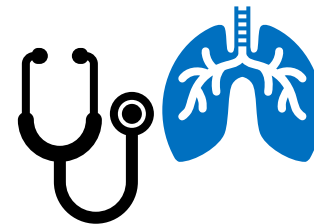
# Causes of respiratory distress

- 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

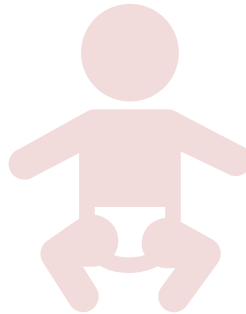
- Pale or
- Cyanosed

## SpO<sub>2</sub>:

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

## Blood gas

- pCO<sub>2</sub> 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 6<sup>th</sup> ribs anteriorly and 8<sup>th</sup> rib posteriorly

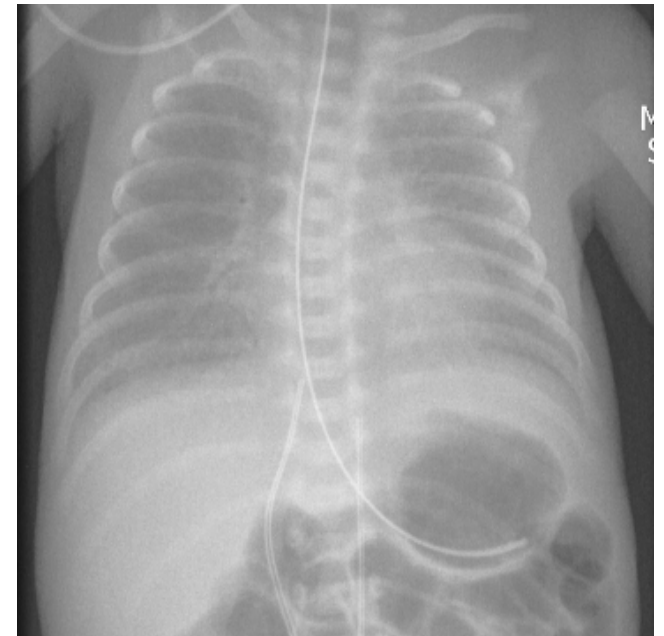




# Abnormal chest x-ray

## 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



Infection screening



Fluids—IV glucose



Antibiotics



Thermoregulation



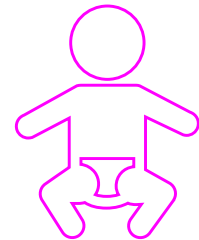
Monitoring



Developmental care



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  $\geq 30\%$  or
  - $< 30\%$  and other significant signs of respiratory distress
- To treat airway obstruction
- To prevent respiratory failure
  - Apnoea of prematurity



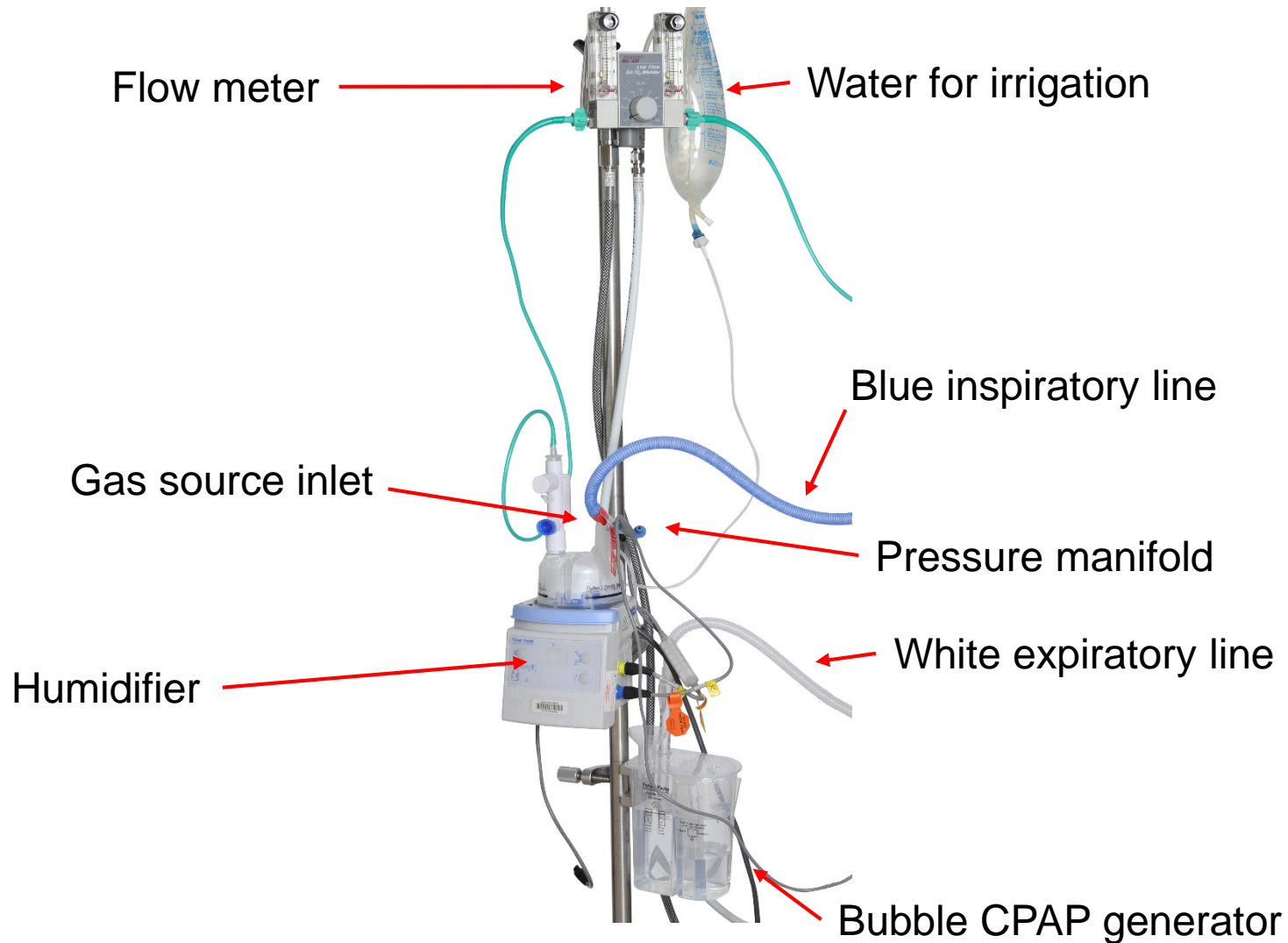
# Contraindications to CPAP



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



# Bubble CPAP





# Commencing CPAP

- Pressure: start at 7–8 cm H<sub>2</sub>O
- Flow: 6–8 L per minute
- FiO<sub>2</sub>: 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





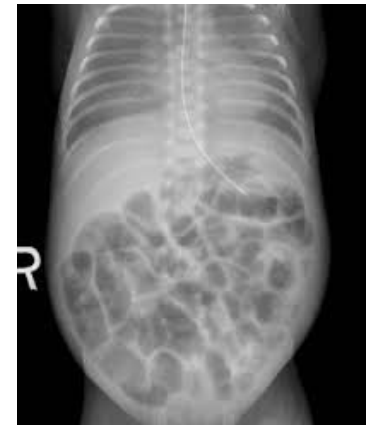
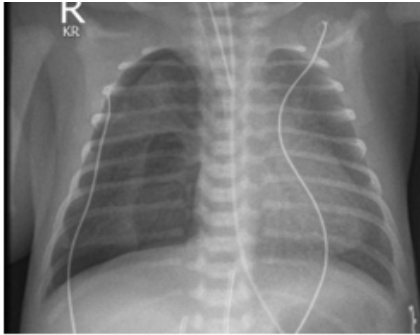
# Care of baby on CPAP

- Suctioning
  - Keep airways clear
  - Avoid deep suctioning
- Circuit
  - Avoid traction
  - Remove condensation
- Record CPAP settings
  - Pressure, gas flow,  $\text{FiO}_2$  and humidifier temperature



# Complications of CPAP

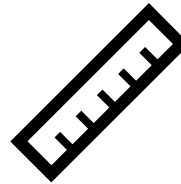
- Pulmonary air leaks
- Pain/discomfort
- Abdominal insufflation
- Hyperinflation of lungs
- Pressure injury





# Prevention of pressure injury from prongs

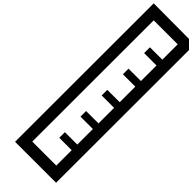
- Measure and size the interface for each baby
- Fit prongs correctly to avoid pressure on high risk areas and prevent excess rubbing and movement
- Position binasal prongs 2 mm from nares
- Avoid contact with septal columella





# 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 12<sup>th</sup> 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  $\text{FiO}_2$  before pressure
- Commence when:
  - $\text{FiO}_2 < 25\%$
  - Respiratory rate  $< 60$  breaths/minute
  - Chest recession absent
  - Apnoeas  $< 20$  seconds and self-reverting
  - Bradycardias not  $< 100$  beats/minute
  - Average  $\text{SpO}_2 > 95\%$  for previous 6 hours
- Cease if stable in air and CPAP 5  $\text{cmH}_2\text{O}$