Non-Invasive Ventilation (NIV)

Ventilatory support without using an invasive artificial airway

Types

**CPAP = continuous positive airway pressure**
- Tight fitting mask which delivers fixed positive air pressure to keep the airways open
- Indications: sleep apnoea; type 1 respiratory failure (e.g. acute pulmonary oedema)

**BiPAP = bi-level positive airway pressure**
- Similar to CPAP, but the air pressure increases during the patient’s inspirations
  - **ePAP =** pressure during expiration
  - **iPAP =** pressure during inspiration
- **Pressure support** = difference in pressure between ePAP and iPAP (i.e. the amount of ‘help’ given on inspiration)
- Indication: type 2 respiratory failure (e.g. COPD exacerbation) with acidosis (pH<7.35) or exhaustion despite optimal medical therapy

NB. The oxygen concentration in the air can be adjusted because tubing from an oxygen supply can plug directly into the machine

Background physiology

**Hypercapnia**

\[
p_{CO_2} \propto \text{minute volume}
\]

minute volume = respiratory rate \times tidal volume

Can’t be affected by NIV

Can be increased by a higher NIV pressure support. Therefore to reduce hypercapnia, iPAP can be increased (relative to ePAP).

**Hypoxia**

\[
p_{O_2} \propto \text{FiO}_2 \& PEEP
\]

Can be increased by increasing oxygen flow rate

PEEP = positive end expiratory pressure

PEEP = CPAP = ePAP

PEEP maintains alveolar recruitment which proportionally affects oxygenation of the alveoli. Hence, to reduce hypoxia, CPAP/ePAP can be increased.

Settings

**CPAP**
- Start at 4cmH₂O and gradually increase to reduce hypoxia
- Maximum of 12cmH₂O

**BiPAP**
- Start at 12/4cmH₂O (i.e. iPAP of 12cmH₂O, ePAP of 4cmH₂O) and gradually increase iPAP to 20cmH₂O or maximum tolerated
- Maximum of 20/12cmH₂O
  - Increase iPAP to reduce hypercapnia
  - Increase ePAP to reduce hypoxia (but remember iPAP should also be increased proportionately to maintain the same pressure support which is what affects CO₂)
**Oxygen**

- **Titrate up to maximum of 15L** to aim for sats of 94-98% in non-COPD patients and 88-92% in COPD patients
  - For COPD patients on BiPAP, start at 2L oxygen and titrate up
  - For heart failure patients of CPAP, start using high flow oxygen and titrate down

**Complications**

- Too high CPAP or ePAP: reduced venous return which can cause hypotension
- Too high iPAP: mask leak; stomach inflation leading which can cause aspiration (oesophageal opening pressure is 25cmH₂O)
- Both: patient discomfort; claustrophobia; pressure sores; dryness; pneumothorax

**Contraindications**

- Undrained pneumothorax
- Severe epistaxis
- Vomiting
- Apnoea
- Severe agitation
- Unable to tolerate or fit mask
- Low GCS
- NIV should **not** be used for asthma (just delays inevitable intubation) or pneumonia (unless patient is not for intubation)

**Monitoring required**

- Oxygen saturation monitoring (aim 88-92% in COPD patients, 94-98% in non-COPD patients)
- Regular arterial blood gases (~30mins after each change to monitor pCO₂ and subsequent pH)
  - In COPD, aim PaO₂~8mmHg and improving pH
- Blood pressure (check not becoming hypotensive)
- Respiratory rate

**Weaning off NIV**

- Once the medications have had time to work, NIV can be gradually weaned
- Options:
  - Give patient time off NIV and gradually extend time off (but not overnight as respiratory drive naturally decreases)
  - Gradually reduce pressures

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