

Options

Adults/Children:

- Continuous Positive Airways Pressure (CPAP) - positive pressure throughout resp cycle.
- Bilevel Positive Airways Pressure (BIPAP) - 2 levels of pressure insp & exp (IPAP > EPAP)

Neonates: Nasal CPAP (NCPAP)

Infants: High Flow Nasal Cannulae (HFNC) - humidified high flow rates generate some NCPAP.

Benefits

- ↓Intubation, ↓Cx of intubation (airway trauma, sedation, nosocomial infection), ↓LOS
- ↑lung vol, ↑FRC, ↑TV/minute volume
- ↓WOB, splints airways open, ↓V/Q mismatch, and ↑CO by ↓pre-/afterload

Indications

- Best if reducing the work of breathing will likely address an acute & reversible cause.
- Acute or chronic ventilatory failure ($\text{PaCO}_2 > 50 \text{ mmHg}$) or hypoxaemia ($\text{PaO}_2 / \text{FiO}_2 < 200$).
- Requires a patent airway and intact respiratory drive.

Contraindications

- Cardiac/respiratory arrest
- Hypotensive shock, acute MI
- ↓LOC or unprotected airway
- Facial trauma/burns or upper airway obstruction
- Vomiting/upper GI bleed or recent upper GI Sx

Recommended Indications

Primary:

- COPD
 - BIPAP & CPAP useful
 - Failure more likely if $\text{GCS} < 11$, $\text{pH} < 7.5$ or $\text{RR} > 30$
- APO/CCF
 - CPAP or BiPAP (but no evidence BiPAP is better)
 - Improves symptoms and ↓mortality
 - PEEP may worsen CO in cardiogenic shock

Other (less evidence):

- Immunosuppressed
- Palliative/elderly
- Post-op/post-extubation
- Asthma
- Neuromuscular disease
- Partial upper airways obs
- Thoracic trauma
- Obesity hypoventilation

Settings

CPAP: Start at $5 \text{ cmH}_2\text{O}$ and ↑ in $2 \text{ cmH}_2\text{O}$ increments

BIPAP: Start 8-10/3-4

- In hypoxaemia: ↑EPAP in $2 \text{ cmH}_2\text{O}$ increments and ↑IPAP to maintain 1:2.5 ratio
- In hypercarbia: ↑IPAP in $1-3 \text{ cmH}_2\text{O}$ increments

NB: Humidify if used $\geq 6 \text{ h}$. Beware pressures $> 15 \text{ cmH}_2\text{O}$ as ↑Cx.

Complications

- Poor tolerance/agitation in some patients
- ↓venous return/pre-/afterload, may → ↓BP
- Abdominal compartment syndrome
- Air trapping
- Respiratory alkalosis
- Mask: keeping seal, pressure areas

Control (aka cycle or limit)

Pressure-controlled: Breath determined by achieving a set peak inspiratory pressure (PIP)

- Pro: limits risk of barotrauma
- Con: if compliance of lung changes then hypo- or hyper ventilation may occur

Volume-controlled: Breath determined by delivering a set tidal volume

- Pro: better control of tidal volume
- Con: if compliance of lung is high then PIP may be high, risking barotrauma

Volume-Control Modes

Controlled Mechanical Ventilation:

- Ventilator delivers breaths at set rate, patient unable to breathe spontaneously
- For apnoeic, deeply sedated, muscle relaxed patients

Intermittent Mechanical Ventilation (IMV):

- Ventilator delivers breaths at set rate, but patient able to make unassisted breaths too

Assist/Control (A/C) Ventilation or Continuous Mechanical Ventilation (CMV):

- Ventilator has a back-up rate set, and delivers a breath if no patient-initiated breath in time period. Patients may breathe above the set rate, each breath will be assisted.
- Often used in ED patients

Synchronized Intermittent Mechanical Ventilation (SIMV):

- Similar to A/C mode, the ventilator has a back-up rate set, and delivers a breath if no patient initiated breath in time period. Patients may breathe above the set rate.
- However only the set rate of ventilator- or patient-initiated breaths are assisted to the full TV or PIP. Additional patient-initiated breaths above the set rate are not assisted.
- Often used in ED patients

Pressure-Control Modes

Positive End Expiratory Pressure (PEEP) & CPAP:

- Functionally similar
- PEEP is the term used in mechanical ventilation and CPAP during spontaneously breathing
- \uparrow FRC, maintains alveolar patency, \uparrow PO₂, but may \downarrow CO at higher pressures

Pressure Support Ventilation (PSV):

- Spontaneous breathing by patient supported by attaining a set PIP on each breath
- PEEP may be added too, as well as a mandatory back up rate (usually via SIMV)

Indications

- Intubation - Failure of ventilation, oxygenation, loss of airway patency or protection.
- Failed NIV

Common Initial Settings

Depends on underlying issues - Lung protection (most situations) or Obstructive lung dz

Lung protection: Vol A/C or SIMV - V_T 6-8ml/kg, Insp Flow 60-80ml/min, RR 12-20, I:E 1:2, FiO₂ 1.0 & PEEP 5cmH₂O, Plateau Pressure < 30cmH₂O

Obstructive lung dz: PSV mode - PIP < 40cmH₂O OR Vol A/C or SIMV - V_T 8ml/Kg, Insp Flow 60-80ml/min. For both: RR 8-10, I:E 1:4-5, FiO₂ 1.0, PEEP 0-5cmH₂O, Plateau pressure < 30cmH₂O

Complications

- Intubation trauma
- Barotrauma
- Air-trapping/intrinsic PEEP
- Nosocomial infections
- \uparrow WOB if asynchrony of breaths or poor trigger