

CONTINUOUS POSITIVE AIRWAY PRESSURE (CPAP)
BI-LEVEL POSITIVE AIRWAY PRESSURE (BI-PAP)

Introduction

Continuous Positive Airway Pressure (CPAP) has demonstrated efficacy in enhancing vital signs, gas exchange, reducing the work of breathing, alleviating dyspnea, and lowering the requirement for endotracheal intubation in individuals experiencing shortness of breath due to conditions such as congestive heart failure (CHF), acute pulmonary edema (APE), and COPD.

Bi-level Positive Airway Pressure (Bi-PAP) contributes to both oxygenation and ventilation support. It is referred to in various terms, with CPAP with Pressure Support being the most prevalent. The advantages of Bi-PAP include enabling patients to attain adequate tidal volumes with reduced respiratory system strain.

Mechanism of Action

CPAP operates by delivering continuous gas pressure to the lower airway structures, thereby enhancing gas exchange in the alveoli. In CHF patients, CPAP enhances hemodynamics by reducing preload and afterload.

Bi-PAP functions by furnishing a dual level of respiratory support. Similar to CPAP, Bi-PAP enhances patient oxygenation. Moreover, it aids ventilation by providing assistance to patients during inhalation, thereby enabling those with high end-tidal CO₂ levels (>50) to achieve higher tidal volumes and effectively expel CO₂.

Indications

CPAP or Bi-PAP should be considered for patients experiencing moderate to severe respiratory distress secondary to conditions like asthma/reactive airway disease, near drowning, COPD, CHF, APE (both cardiogenic and non-cardiogenic), or pneumonia, particularly if presenting with:

- a) Utilization of accessory muscles or retractions
- b) Respiratory rate surpassing 25 (Bi-PAP should be considered if indicated)
- c) Pulse oximetry readings persisting below 90% despite standard treatments
- d) End-tidal CO₂ levels exceeding 50 mmHg (Bi-PAP should be considered)
- e) Persistent wheezes, rales, or rhonchi unresponsive to medication therapy

Contraindications

- a) Inability to protect the airway
- b) Inability to assume an upright position
- c) Respiratory arrest or agonal respirations (consider intubation or bag-valve-mask positive pressure ventilation)

SAEMS PREHOSPITAL PROTOCOLS

- d) Persistent nausea/vomiting
- e) Inability to establish a proper mask seal
- f) Penetrating chest trauma
- g) Active upper GI bleed or recent history of gastric surgery

Considerations

- a) Depressed level of consciousness
- b) Systolic BP below 90 mmHg not due to heart failure and unresponsive to fluid bolus or pressors.
- c) Suspected pneumothorax
- d) Shock associated with cardiac insufficiency
- e) Facial abnormalities/trauma

Procedure

- a) If switching patient from hospital machine, ensure you are utilizing the proper mask type for your equipment (closed vs open vented mask).
- b) Ensure that you have adequate oxygen supply, considering the oxygen concentration required for the patient (O_2 consumption calculation).
- c) Implement treatment protocols/standing orders for underlying condition as appropriate. Administration of bronchodilators should take priority over use of CPAP or BI-PAP in asthmatic patients; if the CPAP or BI-PAP device allows inline bronchodilator therapy both should be initiated if indicated.
- d) Position the patient in a sitting or comfortable position.
- e) Apply monitors (EKG, SpO₂, NIBP) and continue to assess every 5 minutes for patient deterioration and/or complications.
 - a) Consider contacting medical control if the blood pressure remains below 90 mmHg and is unresponsive to fluid therapy or pressors before initiating CPAP or BI-PAP.
 - b) Assess lung sounds before and after applying CPAP or BI-PAP, and as feasible during transport.
- f) Explain the procedure to the patient, anticipate and alleviate anxiety through verbal coaching.
- g) Assemble and initiate CPAP at 5 cmH₂O.
 - a) Securely apply the mask, check for air leaks, and consider having the patient hold the mask before applying head straps to reduce anxiety.
 - b) Gradually increase pressure by 1-2 cmH₂O increments as tolerated by the patient to achieve desired oxygenation
 - a) Maximum CPAP pressure is 10 cmH₂O
 - c) Continuously coach the patient
- h) Assemble Bi-PAP with IPAP (Inspiratory Positive Airway Pressure) of 10 cmH₂O and EPAP (Expiratory Positive Airway Pressure, equivalent to CPAP) of 5 cmH₂O.
 - a) Securely apply the mask, check for air leaks, and consider having the patient hold the mask before applying head straps to reduce anxiety.

SAEMS PREHOSPITAL PROTOCOLS

- b) Gradually increase IPAP by 1-2 cmH₂O increments as tolerated by the patient to achieve desired response.
 - a) Maximum IPAP pressure is 15 cmH₂O
- c) Gradually increase EPAP by 1-2 cmH₂O increments as tolerated by the patient to achieve desired oxygenation, maintaining a minimum gradient of 5 cmH₂O between EPAP and IPAP.
 - a) Maximum EPAP pressure is 7 cmH₂O
- d) Continue to coach the patient
- i) Decrease or discontinue PEEP for CPAP or IPAP and EPAP for BI-PAP when systolic BP < 90 mm Hg.
- j) Contact medical control for patient exceeding these upper limits.

Special Notes:

- Notify receiving facility of CPAP or BI-PAP application
- Do not remove the mask until hospital therapy is ready to be administered.
- Success depends heavily on patient tolerance and the ability to coach the patient.
- Instruct the patient to breathe through the nose and exhale through the mouth for as long as possible.
- Monitor closely for signs of nausea/vomiting and gastric distension.
- Most patients respond to treatment within 5-10 minutes; if there is no improvement within this timeframe, reassess for other clinical causes or issues. Re-evaluate mask seal and settings.
- Removal of CPAP/Bi-PAP should only occur if the patient cannot tolerate the mask, requires suction or airway intervention, experiences continued or worsening respiratory failure, or if pneumothorax is suspected. Consider intermittent positive pressure ventilation (BVM) or intubation if the patient is removed from CPAP therapy.