Prehospital Noninvasive Ventilation

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Non-Invasive Positive Pressure Ventilation (NPPV):

- **Mask only**—no ETT
- **Continuous Positive Airway Pressure**:
  constant level throughout respiratory cycle
- **Bilevel PAP**: separate settings for inspiration and expiration

Other forms:

- + pressure ventilation via B-V-M: inspiration only; highly variable pressures
- PEEP: Positive end-expiratory pressure only
- PSV: Pressure support ventilation (insp. only)
- PAV: Proportional assist vent. (effort-related)
Normal vs. Supported Ventilation

- Our usual breathing is NEGATIVE inspiratory pressure, pulling air and blood flow into chest.

- **POSITIVE pressure ventilation:**
  - pushes air into chest
  - overcomes airway resistance
  - ↑ pulmonary gas exchange
  - keeps alveoli open
  - decreases blood return to heart
  - lowers BP
CPAP/BiPAP Benefits

Mostly hospital studies—CHF and COPD:

- ↑ Alveolar ventilation / oxygenation
- ↓ Work of breathing
- ↓ Mortality
- ↓ Morbidity
- ↓ Length of hospital stay
- ↓ Need for ETT/mechanical ventilation
- ↓ RR, ↑ TV, ↑ $V_E$, ↔ V/Q match, ↑ FRC
Prehospital CPAP

Hubble, et al (PEC, 2006):
- 2 similar EMS systems/protocols
- “Pulmonary edema” patients (24% missed Dx)

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<thead>
<tr>
<th></th>
<th>CPAP</th>
<th>No CPAP</th>
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<tr>
<td>ETT:</td>
<td>8.9%</td>
<td>25.3%</td>
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<tr>
<td>Mortality:</td>
<td>5.4%</td>
<td>23.2%</td>
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<tr>
<td>RR and P:</td>
<td>better</td>
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<td>Dyspnea:</td>
<td>better</td>
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Use in Respiratory Failure (hypercarbic*, hypoxic)

- Acute cardiac pulmonary edema*
- COPD exacerbation*
- Asthma
- “Do Not Intubate” patients in resp distress
- Noncardiac PE/ARDS/drowning/smoke
- Pneumonia
- Obstructive sleep apnea
- Hypoventilation with morbid obesity
- Immunocompromised patient
- Trauma (no PTX)
- Cystic fibrosis

*best evidence
Use in Respiratory Failure +

**Subjective:**
- Clinical judgment
- “Looks bad”/“heading for a tube”

**Objective:**
- Accessory muscle use
- O2 sat <90% (or < 92%)
- RR > 24
- Unable to speak full sentences
- Abdominal/paradoxic breathing
- Altered mentation
Contraindications

- **Obvious need for ETT**: apnea, arrest
- **Hypotension** (< 90 systolic)
- **Severe AMS (GCS < 11)**—judgment call with hypercarbic AMS
- **Inability to cooperate**
- **Pneumothorax**
- **Facial deformity / trauma / unable to seal**
- **Recent (<1 wk) facial, neurologic, gastric surgery**
- **High risk of aspiration**
- **Unstable cardiac arrhythmia**
- **Caution**: **Upper airway obstruction / FB**
CPAP devices

- **CPAP generator**
- **Circuit (tubing)**
- **Interface:**
  - Face mask—acute Sx’s, mouth breathing
  - Nasal mask—better tolerated, can talk, low risk of aspiration—not for EMS
  - Helmet—better tolerated, can talk, read, drink thru straw, less complications with long use, but can accumulate CO2, noisy
- **Oxygen source**
- **Bells and whistles (hospital devices)**
Use

- Prep the patient while setting up CPAP
- Give necessary meds
  - Asthma, COPD—nebulizers, etc.
  - Cardiac PE—NTG, furosemide, etc.
- Apply mask—may have pt hold it at first
- Adjust straps for good seal
- Reassure patient
- Monitor patient status
- Alert the receiving hospital
- Continue CPAP during transfer of care
Potential Complications

EMS Concerns:

- Air leak
- Inability to tolerate mask
- Hypotension—rare
- Aspiration if vomiting

Longer use:

- Local skin damage, eye irritation, sinus pain
- Gastric distension—mild, uncommon
- Barotrauma / pneumothorax—rare
CPAP Devices for EMS

- Small, portable, air/O2 driven
- Fixed or variable pressure, FiO₂
- May drain O₂ tanks fast
- Available for EMS use:
  - Boussignac CPAP
  - PORTO₂ VENT CPAP Os
  - Whisperflow Fixed, Variable, Low Flow
  - EzPAP
  - + more
Implementation

- Protocols
- Training
- Encouragement of first use on patient
- Prep the hospitals—ED needs to have CPAP or BiPAP device
- QM
References