Thoughts on the Use of Continuous Positive Airway Pressure in the Field for Ventilatory Assistance

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Presented with thanks to the State of Wisconsin Department of Health and Family Services EMS Systems Section and to Dr. George Boussignac
History:

CPAP has been in use for over 50 years, mainly for weaning patients from mechanical ventilation.

For this purpose it was applied by way of an endotracheal tube or full face mask.
History of CPAP

1912 - Maintenance of lung expansion during thoracic surgery (S. Brunnel)

1937 - High altitude flying to prevent hypoxemia. (Barach et al)

1967 - CPPB + IPPV to treat ARDS (Ashbaugh et al)

1971 - Term CPAP introduced, used to treat HMD in neonates (Gregory et al)

1972 - CPAP used to treat ARF (Respiratory Failure) (Civetta et al)

1973 - CPAP used to treat COPD (Barach et al)

1981 - Downs generator (Fried et al)

1982 - Modern definition of CPAP (Kielty et al)
History:

In 1981, Sullivan and associates described the use of a nasal mask so that CPAP could be applied more conveniently and comfortably. They first used nasal CPAP to treat obstructive sleep apnea, whereby the air pressure acts as a pneumatic splint to prevent pharyngeal collapse during sleep. Nasal CPAP is now widely used at home for this indication.
Continuous positive airway pressure by face mask in acute cardiogenic pulmonary edema.

Rasanen J, Heikkila J, Dewns J, Nikki P, Vaasanen J, Ylitalen A.

The therapeutic efficacy of continuous positive airway pressure (CPAP) administered by face mask was studied in 40 patients with acute cardiogenic pulmonary edema and respiratory failure. Arterial blood gas values and pH, systemic arterial pressure, heart rate and respiratory rate were measured during administration of 30% oxygen with a high-flow face mask apparatus at ambient airway pressure. Twenty patients were then randomly chosen to continue ambient airway pressure breathing and 20 received 10 cm H2O of CPAP. The measurements were repeated 10, 60 and 180 minutes after therapy was initiated. During the first 10 minutes of CPAP treatment, arterial blood oxygen partial pressure increased 8 +/- 9 mm Hg (mean +/- 1 standard deviation, p less than 0.01) and respiratory rate decreased 3 to 5 breaths/min (p less than 0.001). Systolic arterial pressure decreased 12 +/- 21 mm Hg (p less than 0.05), and heart rate by 10 +/- 11 beats/min (p less than 0.001). A decrease in respiratory rate by 2 to 5 breaths/min (p less than 0.05) was the only change that occurred in the control group. The improvement in arterial blood oxygenation persisted throughout the investigation period (p less than 0.05). Thirteen patients (65%) in the control group and 7 patients (35%) in the CPAP group met our criteria for treatment failure during the study (p = 0.063). Thus, CPAP administered by face mask improves gas exchange, decreases respiratory work, unloads circulatory stress, and may reduce the need for ventilator treatment in acute cardiogenic pulmonary edema.

PMID: 3881920 [PubMed - indexed for MEDLINE]
EMS transports for difficulty breathing: is there a potential role for CPAP in the prehospital setting?

Kosowsky JM, Gasaway MD, Stephanides SL, Ottaway M, Sayre MR.

University of Cincinnati, Cincinnati, OH.

Mask-applied continuous positive airway pressure (CPAP) has been shown to reduce morbidity among patients with acute respiratory distress in the setting of cardiogenic pulmonary edema. OBJECTIVE: To determine a minimum percentage of patients transported by ALS for difficulty breathing who could potentially benefit from a pre-hospital trial of CPAP. METHODS: Paramedic run sheets were collected from consecutive, adult, ALS transports for a chief complaint of difficulty breathing over a 6 week period in a large urban EMS system. Demographic information, medical history, vital signs, clinical assessments, and transport times were abstracted into a database by trained reviewers. Strict criteria for CPAP were defined in advance as "acute respiratory distress," meaning (1) respiratory rate > 25 and (2) labored or shallow breathing, and "presumed cardiogenic pulmonary edema," meaning (3) a prior history of heart disease and (4) presence of bilateral rales on exam. RESULTS: Data from 240 consecutive run sheets were compiled. Median patient age was 66 years old, with females outnumbering males 168 to 81. A total of 15 spontaneously breathing patients met all 4 criteria for CPAP. Four of these patients were either hypotensive (SBP < 90) or had potential for airway compromise (i.e., obtundation), making CPAP inadvisable. Among the 11 remaining patients (4.4% of all transports for difficult breathing), median transport time was 20 minutes (range 14-31 minutes). CONCLUSIONS: Using very strict criteria, a small but not significant percentage of patients are optimal candidates for a prehospital trial of CPAP. Transport times would appear to justify this type of intervention. A prospective study is currently under way to test the feasibility of administering CPAP to such patients in the prehospital setting.

PMID: 11015253 [PubMed - as supplied by publisher]
The use of prehospital continuous positive airway pressure treatment in presumed acute severe pulmonary edema.

Kallio T, Kuisma M, Alaspaa A, Rosenberg PH.
Department of Anesthesiology and Intensive Care, Helsinki University Hospital, Helsinki, Finland.

OBJECTIVE: To describe the prehospital use of a continuous positive airway pressure (CPAP) system for the treatment of presumed acute severe pulmonary edema (ASPE). METHODS: The efficacy of prehospital CPAP treatment was analyzed in terms of changes in oxygen saturation, need for intubation or ventilatory support, and possible morbidity associated with the CPAP therapy. This was a retrospective cohort study conducted in the mobile intensive care unit of a university hospital. Participants included all consecutive patients with a clinical picture of ASPE treated by a mobile intensive care unit between January 1, 1998, and December 31, 1999. RESULTS: 121 patients were included in this study. 116 patients received prehospital CPAP therapy. Two patients (1.7%) from the CPAP-treated patients were intubated in the field. A total of six patients required endotracheal intubation before hospital, and six other patients after that. After the beginning of CPAP treatment, there was statistically significant elevation in blood oxygen saturation (mean and standard deviation [SD] before CPAP 77% +/- 11% and after CPAP 90% +/- 7%) (p < 0.0001) as well as reductions in the respiratory rate (mean and SD before CPAP 34 +/- 8 breaths/min and after CPAP 28 +/- 8 breaths/min) (p < 0.0001), systolic blood pressure (mean and SD before CPAP 173 +/- 39 mm Hg and after CPAP 166 +/- 37 mm Hg) (p = 0.0002), and heart rate (mean and SD before CPAP 108 +/- 25 beats/min and after CPAP 100 +/- 20 beats/min) (p = 0.0017). The main reason for in-hospital death (8%) was myocardial infarction. No technical problems or complications occurred during CPAP treatment. CONCLUSIONS: Prehospital CPAP treatment in patients with ASPE improved oxygenation significantly and lowered respiratory rate, heart rate, and systolic blood pressure. Because of the retrospective nature of this study, the hemodynamic effects of nitroglycerine and morphine cannot be excluded. The mortality rate was low, which needs to be confirmed in a controlled, prospective study.

PMID: 12710780 [PubMed - indexed for MEDLINE]
Prehospital use of continuous positive airway pressure (CPAP) for presumed pulmonary edema: a preliminary case series.

Kosowsky JM, Stephanides SL, Branson RD, Sayre MR.

Department of Emergency Medicine, Brigham and Women's Hospital, Boston, Massachusetts 02115, USA.

OBJECTIVE: To describe the prehospital use of a continuous positive airway pressure (CPAP) system for the treatment of acute respiratory failure presumed to be due to cardiogenic pulmonary edema. METHODS: Prospective case-series analysis. Paramedics administered CPAP via face mask at 10 cm H2O to patients believed to be in cardiogenic pulmonary edema and in imminent need of endotracheal intubation (ETI). Data from run sheets and hospital records were analyzed for treatment intervals, vital signs, complications, admitting diagnoses, need for ETI, and mortality. RESULTS: Nineteen patients received prehospital CPAP therapy. Mean duration of therapy was 15.5 minutes. Pre- and post-therapy pulse oximetry was available for 13 patients and demonstrated an increase from a mean of 83.3% to a mean of 95.4%. None of the patients were intubated in the field. Two patients who did not tolerate the CPAP mask required ETI upon arrival in the emergency department (ED); an additional five patients required ETI within 24 hours. There was one death in the series and two additional adverse events (one aspiration pneumonia, one pneumothorax); none of these were attributable to the use of CPAP. The diagnosis of cardiogenic pulmonary edema was corroborated by the ED or in-hospital physician in 13 patients (68%). Paramedics reported no technical difficulties with the CPAP system. CONCLUSION: For patients with acute respiratory failure and presumed pulmonary edema, the prehospital use of CPAP is feasible and may avert the need for ETI. Future controlled studies are needed to assess the utility and cost-effectiveness of prehospital CPAP systems.

PMID: 11339731 [PubMed - indexed for MEDLINE]
The use of prehospital continuous positive airway pressure treatment in presumed acute severe pulmonary edema.

Kallela T, Kuisma M, Alaspaa A, Rosenberg PH.

Department of Anesthesiology and Intensive Care, Helsinki University Hospital, Helsinki, Finland.

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METHODS: The efficacy of prehospital CPAP treatment was analyzed in terms of changes in oxygen saturation, need for intubation or ventilatory support, and possible morbidity associated with the CPAP therapy. This was a retrospective cohort study conducted in the mobile intensive care unit of a university hospital. Participants included all consecutive patients with a clinical picture of ASPE treated by a mobile intensive care unit between January 1, 1998, and December 31, 1999. RESULTS: 116 patients were included in this study. 116 patients received prehospital CPAP therapy. Two patients (1.7%) from the CPAP-treated patients were intubated in the field. A total of six patients required endotracheal intubation before hospital, and six other patients after that. After the beginning of CPAP treatment, there was statistically significant elevation in blood oxygen saturation (mean and standard deviation [SD] before CPAP 77% +/- 11% and after CPAP 90% +/- 7% (p < 0.0001) as well as reductions in the respiratory rate (mean and SD before CPAP 31 +/- 8 breaths/min and after CPAP 28 +/- 8 breaths/min) (p < 0.0001), systolic blood pressure (mean and SD before CPAP 173 +/- 39 mm Hg and after CPAP 166 +/- 37 mm Hg) (p = 0.0002), and heart rate (mean and SD before CPAP 108 +/- 25 beats/min and after CPAP 100 +/- 20 beats/min) (p = 0.0017). The main reason for in-hospital death (8%) was myocardial infarction. No technical problems or complications occurred during CPAP treatment. CONCLUSIONS: Prehospital CPAP treatment in patients with ASPE improved oxygenation significantly and lowered respiratory rate, heart rate, and systolic blood pressure. Because of the retrospective nature of this study, the hemodynamic effects of nitroglycerine and morphine cannot be excluded. The mortality rate was low, which needs to be confirmed in a controlled, prospective study.

PMID: 12710780 [PubMed - indexed for MEDLINE]
CPAP is oxygen therapy in its most efficient form.

- Simple Masks
- Venturi Masks
- Humidifiers
- CPAP
CPAP and Patient Airway Pressure

The application of positive airway pressure throughout the whole respiratory cycle to spontaneously breathing patients.
Respiratory Distress and Failure

BIPAP

(BiLevel Positive Airway Pressure)

Two Steps forward in Ventilation
IPPV - BIPAP

SIMV - BIPAP

"genuine" BIPAP

CPAP

Mechanical ventilation

Spontaneous breathing
CPAP and Partial Pressure

The pressure of a gas mixture is equal to the sum of the partial pressures of its constituents.

This allows oxygen into the blood during inspiration and Carbon Dioxide out during expiration.

Example: Air at sea level has a pressure of 760mm Hg. Air is 21% oxygen and 79% nitrogen.

\[ \text{Partial pressure of oxygen} = 760 \times 21\% = 159\text{mm Hg} \]
So why does oxygen pass into the blood?

**Pressure Gradient**

Deoxygenated blood has a lower partial pressure of oxygen than alveolar air so oxygen transfers from the air into the blood.
CPAP alters the pressure gradient!

**7.5cm H\textsubscript{2}O CPAP**

1cm H\textsubscript{2}O is equal to 0.735mm Hg.

7.5cm H\textsubscript{2}O CPAP increases the partial pressure of the alveolar air by approximately 1%.

This increase in partial pressure ‘forces’ more oxygen into the blood.

Even this comparatively small change is enough to make a clinical difference.
The Requirements Of CPAP

- The real requirement is for Continuous CONSTANT Positive Airway Pressure
- A stable airway pressure as prescribed in order to reduce work of breathing (WOB)
Important Aim Of CPAP Is To Increase Functional Residual Capacity (FRC)

- Volume of gas remaining in lungs at end-expiration
- CPAP distends alveoli preventing collapse on expiration
- Greater surface area improves gas exchange
Physiological Effects Of CPAP

- Increases $P_{so_2}$ (Surface oxygen)
- Increases FRC
- Reduces work of breathing
Fig. 2: Effect of CPAP on left ventricular ejection fraction (LVEF) in patients with congestive heart failure and central sleep apnea. Values shown are means and standard errors of the mean. After 3 months, LVEF was significantly greater in treatment group (Δ) than in control group (▽) (*p = 0.019). Reproduced from Naughton et al.³ with permission. © American Lung Association
Current Uses of CPAP

1. Ambulance/Emergency Room
2. Pre-Operative (Anesthesia)
3. Intensive Care
4. Recovery Room
5. General Ward
# Clinical Applications of CPAP

<table>
<thead>
<tr>
<th>Condition</th>
<th>Area for Treatment</th>
</tr>
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<tbody>
<tr>
<td>ARDS</td>
<td>Emergency</td>
</tr>
<tr>
<td>Pulmonary edema</td>
<td>Emergency</td>
</tr>
<tr>
<td>Acute Respiratory Failure</td>
<td>Emergency</td>
</tr>
<tr>
<td>CHF/COPD</td>
<td>Emergency</td>
</tr>
<tr>
<td>Anesthesia</td>
<td>Pre Operative</td>
</tr>
<tr>
<td>Atelectasis</td>
<td>ICU/General Ward</td>
</tr>
<tr>
<td>Alternative to Mechanical Ventilation</td>
<td>ICU/General Ward</td>
</tr>
<tr>
<td>Weaning from Mechanical Ventilation</td>
<td>ICU/General Ward</td>
</tr>
</tbody>
</table>

Also:
- Left Ventricular Failure
- Renal Failure
- Sleep Apnea
Adult Respiratory Distress Syndrome (ARDS)

- Characteristics
  - Hypoxemia
  - Reduced compliance
  - Large intrapulmonary shunt

- CPAP in early stages may
  - Correct hypoxemia
  - Improve compliance
  - Reduce intrapulmonary shunt

(Schmidt 1975)
CPAP And Pulmonary Edema

- Severe pulmonary edema is a frequent cause of respiratory failure
- CPAP increases functional residual capacity
- CPAP increases transpulmonary pressure
- CPAP improves lung compliance
- CPAP improves arterial blood oxygenation
- CPAP redistributes extravascular lung water

(Rasanen 1985)
Redistribution Of Extravascular Lung Water With CPAP
CPAP And Acute Respiratory Failure

- CPAP overcomes inspiratory work imposed by auto-peep
- CPAP prevents airway collapse during exhalation
- CPAP improves arterial blood gas values
- CPAP may avoid intubation and mechanical ventilation

(Miro 1993)
When Not To Use Mask CPAP

- Hypercapnia
- Pneumothorax
- Hypovolemia
- Severe facial injuries
- Patients at risk of vomiting
Common Complications With CPAP

- Pressure sores
- Gastric distension
- Pulmonary barotrauma
- Reduced cardiac output
- Hypoventilation
- Fluid retention
Essential Components Of A CPAP System

1. Flow generator
2. CPAP valve
Whisperflow Flow Generators
PortOVent
Emergent Technologies

CPAP05 Oxygen Delivery System
Caradyne Isobaric CPAP Valve
Boussignac CPAP works the same way as the turbines of a jet engine.

**Oxygen Supply**
- Oxygen molecules enter the chamber

**Oxygen Acceleration**
- The molecules of oxygen are accelerated at the speed of sound as they pass through micro channels

**Oxygen Braking**
- The molecules of oxygen strike a deflector which sends them back to the central zone (mixing zone)

**Establishment of a Virtual Valve**
- The collision of the molecules generates a turbulence which transforms the speed into pressure
Boussignac continuous positive airway pressure device in the emergency care of acute cardiogenic pulmonary edema: a randomized pilot study. European Journal of Emergency Medicine. 10(3):204-208, September 2003. Moritz, Fabienne a; Benichou, Jacques c; Vanheste, Marc a; Richard, Jean-Christophe b; Line, Sebastien a; Heliot, Marie-France c; Bonmarchand, Guy b;

2003 EJEM
Boussignac vs. Standard Oxygen
30 patients randomly assigned
9.3 cm H₂O
? Resp. Rate after 30 minutes
? Work of Breathing

Compared with baseline, Boussignac-CPAP was easily implemented and no side effects were reported. Continuous positive pressure delivered using the Boussignac-CPAP device is feasible in an emergency care setting. It can quickly improve respiratory distress in acute cardiogenic pulmonary edema patients. A larger trial should be initiated in such an emergency care setting to demonstrate the effectiveness of the Boussignac-CPAP device.
2003 EJEM
Prehospital Study, Pulmonary Edema
9 cm H$_2$O
Sl. Resp. Rate
57 patients, 7 “excluded”
10 intubated within an hour

including flexibility and pressure monitoring, lower oxygen consumption, and ease of use. These should allow this technique to be used more widely by prehospital teams.
Operation of the device is straightforward:

Attach the hose to a regular oxygen port capable of 10–25 L/minute (LPM) of flow and place the device into a well-fitting face mask that has an inflatable cuff.
A standard medication nebulizer can also be placed in-line with the Boussignac device to help deliver meds to the lungs faster. When set to a low level (2.0–4.0 cm H2 O) of CPAP, users can achieve a 30% increase in drug delivery and deeper lung penetration of the medication. The usual steaming exhalation of wasted medication is nearly eliminated.
A second oxygen source is required to simultaneously power both the nebulizer and CPAP.
The open end of the Boussignac CPAP device provides several advantages over a closed system.

A soft suction catheter can be passed through the opening to remove any fluids from the patient's mouth without interrupting the CPAP treatment.
Application of CPAP
CPAP System
CPAP Training Flow Sheet

No Exclusion Criteria Present

- Respiratory/Cardiac Arrest
- Pt. unable to follow commands
- Unable to maintain patent airway independently
- Major Trauma
- Suspicion of a Pneumothorax
- Vomiting or Active GI Bleed
- Obvious signs/Symptoms of Pulmonary infection

2 or more of the following Respiratory Distress Inclusion Criteria

- Retractions of accessory muscles
- Bronchospasm or Rales on Exam
- Respiratory Rate > 25/min
- O2 Sat. < 92% on high flow O2

Administer CPAP using Max F102

Stable or Improving

- Continue CPAP
- Continue COPD/Asthma/Pulmonary Edema Protocol
- Contact Medical Control with a Report

Reassess Patient

Deteriorating

- Contact Medical Control with report
- Discontinue CPAP unless advised by Medical Control
- Continue Asthma/COPD/Pulmonary Edema Protocols
Determine the required level of CPAP, and select the desired flow rate.

With the Boussignac, Cm H₂O of CPAP provided with oxygen flow at:

- 10 LPM = 2.5–3.0
- 15 LPM = 4.5–5.0
- 20 LPM = 7.0–8.0
- 25 LPM = 8.5–10.0
At a 25 LPM flow rate, an EMS crew can anticipate a full (2,200 psi) "D" cylinder of oxygen to last 14 minutes and a full "E" cylinder to last 23 minutes.

**Minutes of Oxygen by Cylinder Size**

All based on full 2200 PSI Cylinders

<table>
<thead>
<tr>
<th>Flow (LPM)</th>
<th>D Cylinder (EMS Portable)</th>
<th>E Cylinder (EMS Portable)</th>
<th>M Cylinder (EMS Ambulances)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>70</td>
<td>123</td>
<td>703</td>
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<tr>
<td>6</td>
<td>58</td>
<td>102</td>
<td>598</td>
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<td>8</td>
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<tr>
<td>25</td>
<td>14</td>
<td>23</td>
<td>140</td>
</tr>
</tbody>
</table>
Several features about the Boussignac set it apart:

- Portable and can be kept in a respiratory kit and taken into a patient’s home (so is the Whisperflow)

- Disposable

- Can be left at the hospital

- Can use nebulizers with it

- Can suction through it
To: Ambulance Service Providers  
Ambulance Service Medical Directors  
EMS Training Centers  
EMS Coordinators

From: Dan Williams, Chief  
Wisconsin Emergency Medical Services Systems Section  
Bureau of Local Health Support and EMS

Re: Continuous Positive Airway Pressure (CPAP) Device

Continuous Positive Airway Pressure (CPAP) use is now available to all EMT-Basic and EMT-Intermediate Technician providers in Wisconsin. This makes CPAP an optional skill in Wisconsin at all EMT levels.

The use of CPAP by Wisconsin EMTs for the treatment of respiratory distress resulting from congestive heart failure (CHF), pulmonary edema, chronic obstructive pulmonary disease (COPD), asthma, and pneumonia has been shown to be both as safe and effective. CPAP has been shown to rapidly improve vital signs, gas exchange, reduce the work of breathing, decrease the sense of dyspnea, and decrease the need for endotracheal intubations in patients who suffer from shortness of breath from asthma, COPD, pulmonary edema, CHF, and pneumonia.
Comparative Cost of Boussignac vs. Emergent by Usage
(Yellow = Emergent, Pink = Boussignac)
Respiratory Distress

Assess and support ABCs. Place the patient in a position of comfort, minimize patient exertion. Apply $\text{SpO}_2$, ETCO$_2$ monitors. Administer as much oxygen as necessary to alleviate symptoms. Maintain $\text{SpO}_2$ values of 96% or better. Apply ECG monitor and establish IV access.

**CHF Suspected:** Crackles or rales with evidence of respiratory distress

Nitroglycerin 0.4mg SL
- May be administered without an IV if SBP > 110mmHg
- May repeat twice (at 2-min intervals) if SBP remains > 110mmHg

If no significant improvement on NTG, Administer CPAP at 5 cm pressure

Obtain 12-Lead ECG and transmit to BioTel

If no improvement, BioTel may authorize
- Nitroglycerin 0.4mg SL (IF SBP > 110mmHg)
- Albuterol 2.5mg via nebulizer
- Lasix®40mg iVP or twice the patient’s usual single, daily PO dose (max of 100mg) ONLY after patient has received nitroglycerin

**CPAP Contraindications:**
- Children under 13 years of age;
- Facial deformities or patient to small for mask to seal.
- (If the mask doesn’t fit, you can’t use CPAP);
- Agonal respirations or respiratory arrest;
- Pneumothorax;
- Tracheotomy;
- Unconsciousness

For COPD with chronic hypoxia (home $\text{O}_2$), titrate oxygen flow to maintain $\text{SpO}_2$ of 98%-92%

Observe for possible depressed ventilation

If ETCO$_2$ rises in response to $\text{O}_2$ therapy, the concentration of supplemental oxygen may need to be decreased

**Assess breath sounds**

**Wheezing**

If Anaphylaxis, proceed to Allergic Reaction Protocol

Albuterol 2.5 mg via nebulizer

If wheezing persists but NOT improving

- Combine 2nd and 3rd Albuterol doses with Atrovent 0.5 mg
- Repeat Albuterol nebulizer X 2, if needed

If no response:
- Administer CPAP at 5 cm pressure
- Epinephrine 1:1,000 0.3mg SC, unless contraindicated

If no improvement, BioTel may authorize
- Albuterol with or without Atrovent®
- Epinephrine 1:1,000 0.3mg SC
- Magnesium Sulfate (10%) 2 grams IV piggyback over 5 - 10 minutes

**CPAP should be discontinued and intubation performed if the patient:**
- Develops respiratory or cardiac arrest
- Becomes unresponsive to verbal stimuli (GCS <5)
Continuous Positive Airway Pressure Ventilation

**Indications:**
Any patient who is complaining of shortness of breath for reasons other than pneumothorax and:
- Is awake and oriented and able to cooperate;
- Has the ability to maintain an open airway (GCS>10);
- Has a respiratory rate greater than 25 breaths per minute;
- Has a systolic blood pressure above 90 mmHg;
- Uses accessory muscles during respirations;

**Precautions:**
Exercise extreme caution when administering CPAP if the patient has:
- Impaired mental status and is not able to fully cooperate with the procedure;
- Failed at past attempts at noninvasive ventilation;
- Active upper GI bleeding or history of recent gastric surgery;
- Complaints of nausea or is vomiting;
- Inadequate respiratory effort;
- Excessive secretions;

**Procedure:**
1. Explain the procedure to the patient.
2. Place the patient on continuous pulse oximetry and waveform capnography.
3. Ensure adequate oxygen supply to ventilation device (100% when starting and until SpO₂ is >96%).
4. Place the delivery device over the mouth and nose.
5. Secure the mask with provided straps or the other provided devices.
6. Use 5 cm H₂O of PEEP.
7. Check for air leaks.
9. Continue to coach patient to keep mask in place and reapply as needed.
10. If respiratory status deteriorates, remove device and provide BVM ventilation with or without endotracheal intubation.

**Removal Procedure:**
- CPAP therapy should not be removed unless the patient cannot tolerate the mask or experiences continued or worsening respiratory failure.
- BVM ventilation and/or intubation should be considered if the patient is removed from CPAP therapy.

**Special Notes:**
- Contact BioTel as soon as you know you are going to use CPAP so the receiving hospital can be prepared for patient.
- Upon arrival at the hospital, do not remove CPAP until hospital therapy is ready to be placed on patient.
- Most patients will improve in 5-10 minutes. If no improvement within this time, consider ventilation with a BVM.
- Monitor patient for gastric distention.
- Use nitroglycerine tablets to avoid nitroglycerine spray from being dispersed on medics.
CPAP is quite a bit about treatment, but it is ALL ABOUT being a temporizing device.
Patients on CPAP are generally so sick that they must be monitored constantly.
Monitoring includes:

- LOC
- Airway
- RR & L
- Circulation (Pulse, BP)
- General improvement or worsening
- Pulse Oximetry
- Capnography (if available???)
- Possible need for slight sedation
Efficacy of Continuous Insufflation of Oxygen Combined with Active Cardiac Compression—Decompression during Out-of-hospital Cardiorespiratory Arrest

Jean-Marie Saissy, M.D.,* Georges Boussignac,† M.D., Eric Cheptel, M.D.,‡ Bruno Rouvin, M.D.,§ David Fontaine, M.D.,† Laurent Barques, M.D.,§ Jean-Paul Levacque, M.D.,§ Alain Michel, M.D.,† Laurent Brochard, M.D.‖

**Background:** During experimental cardiac arrest, continuous insufflation of air or oxygen (CIO) through microcannulas inserted into the inner wall of a modified intubation tube and generating a permanent positive intrathoracic pressure, combined with external cardiac massage, has previously been shown to be as effective as intermittent positive pressure ventilation (IPPV).

**Methods:** After basic cardiorespiratory resuscitation, the adult patients who experienced nontraumatic, out-of-hospital cardiac arrest with asystole, were randomized to two groups: an IPPV group tracheally intubated with a standard tube and ventilated with standard IPPV and a CIO group for whom a modified tube was inserted, and in which CIO at a flow rate of 15 l/min replaced IPPV (the tube was left open to atmosphere). Both groups underwent active cardiac compression—decompression with a device. Resuscitation was continued for a maximum of 30 min. Blood gas analysis was performed as soon as stable spontaneous cardiac activity was restored, and a second blood gas analysis was performed at admission to the hospital.

**Results:** The two groups of patients (47 in the IPPV and 48 in the CIO group) were comparable. The percentages of patients who underwent successful resuscitation (stable cardiac activity; 21.3 in the IPPV group and 27.1% in the CIO group) and the time necessary for successful resuscitation (11.8 ± 1.8 and 12.8 ± 1.9 min) were also comparable. The blood gas analysis performed after resuscitation (8 patients in the IPPV and 10 in the CIO group) did not show significant differences. The arterial blood gases performed after admission to the hospital and ventilation...
Summary thoughts...
Field ventilatory assistance with CPAP is now accepted and essential.
Cost effective devices have now made it essential for EMS Medical Directors to place these devices in their ambulances.
It is critical that standard quality control assessment be conducted following its use.
www.rayfowler.com
Thank you for your kind attention...