

Old Dogs and New Tricks



**The “3E’s” of Pre-hospital CPAP –
“Efficiency, Efficacy and Economy”**

Continuous Positive Airway Pressure



History of CPAP

- 1912 - Maintenance of Lung Expansion during Thoracic Surgery (S. Brunel)
- 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 (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)

The theory has been around a long time!

Aims Of CPAP

Increase Functional Residual Capacity (FRC) by:

- Having a volume of gas remaining in lungs at end-expiration
- Expand the alveoli preventing collapse on expiration
- Provide a greater surface area for improving gas exchange

CPAP Provides:

“An effective way to treat respiratory distress from COPD, Asthma, CHF, and pneumonia without having to resort to intubation and positive pressure ventilation of the patient”!



Continuous Positive Airway Pressure

How it Works

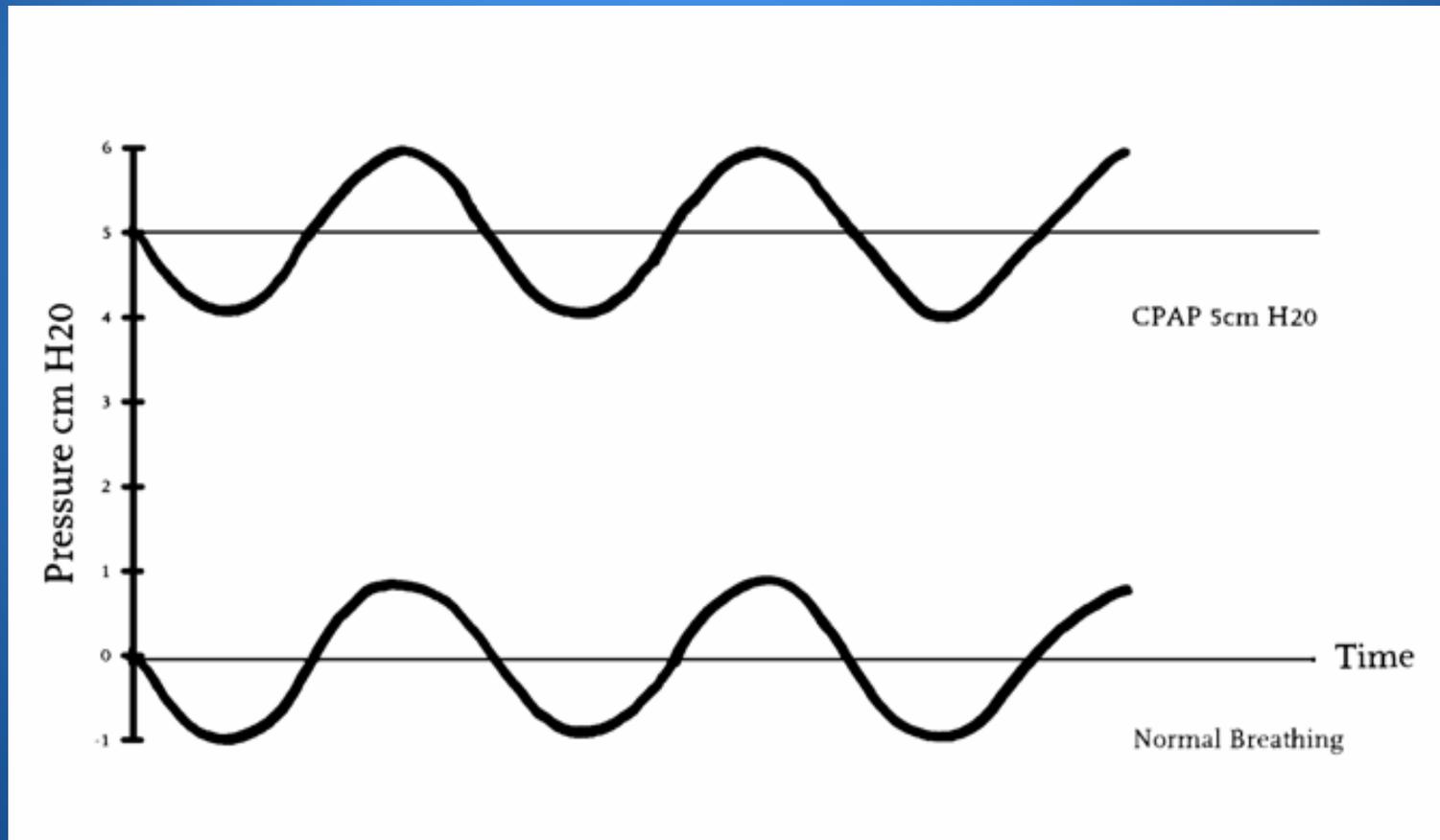
With each breath, oxygen-enriched air is forced into the lungs and maintained at a constant pressure in the patient's airway

This has the effect of:

recruiting lung space, opening the airways and forcing fluid out of the alveolar spaces into the interstitium to improve gas exchange and decreasing the work of breathing

CPAP and Patient Airway Pressure

‘The application of positive airway pressure throughout the whole respiratory cycle to spontaneously breathing patients’



BiPAP versus CPAP

BiPAP:

Provides a biphasic pressure by decreasing the pressure during exhalation

CPAP:

Provides continuous pressure throughout respiratory cycle

BiPAP results in lower work of breathing.

NOTE: Some studies have shown that BiPAP may have a negative effect on some patient groups

Physiological Effects Of CPAP

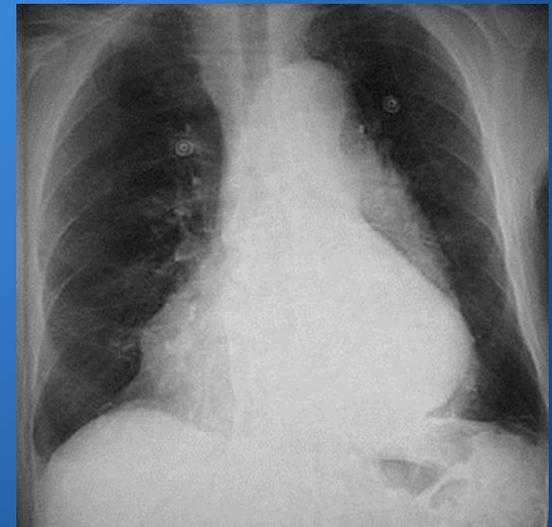
- **Increases oxygenation**
- **Increases FRC**
- **Reduces Work of Breathing**



CLINICAL APPLICATION OF CPAP

Diseases Treatable with CPAP

- **Pulmonary Edema**
- **Congestive Heart Failure**
- **COPD**
 - Asthma
 - Chronic bronchitis
 - Empysema
- **Pneumonia**



How does CPAP work for these conditions?

Common factors:

- **Increased work of breathing**
- **Inability to remove carbon dioxide**

- **As condition worsens, minute ventilation decreases.**
- **Less air movement results in carbon dioxide levels rising.**
- **Fatigue and rising carbon dioxide lowers ventilation rate**
- **Patient suffers a respiratory arrest.**

This leads to the need for ventilation, intubation and Intensive care admission.

The use of CPAP in the pre-hospital environment can help to avoid this downward spiral

Who is CPAP For?



CPAP is NOT for every patient.....

- **who is simply short of breath**
- **who is wheezing**
- **who has pneumonia**
- **who uses inhalers**
- **with heart disease**

CPAP is for.....

- The patient in severe respiratory distress who:
 - Has the signs and symptoms of the diseases indentified
 - Meets the criteria in the protocol
 - Someone who would otherwise require bag-valve-mask ventilation or intubation if they did not respond quickly to other therapies

CPAP DECISION ALGORHYTHM



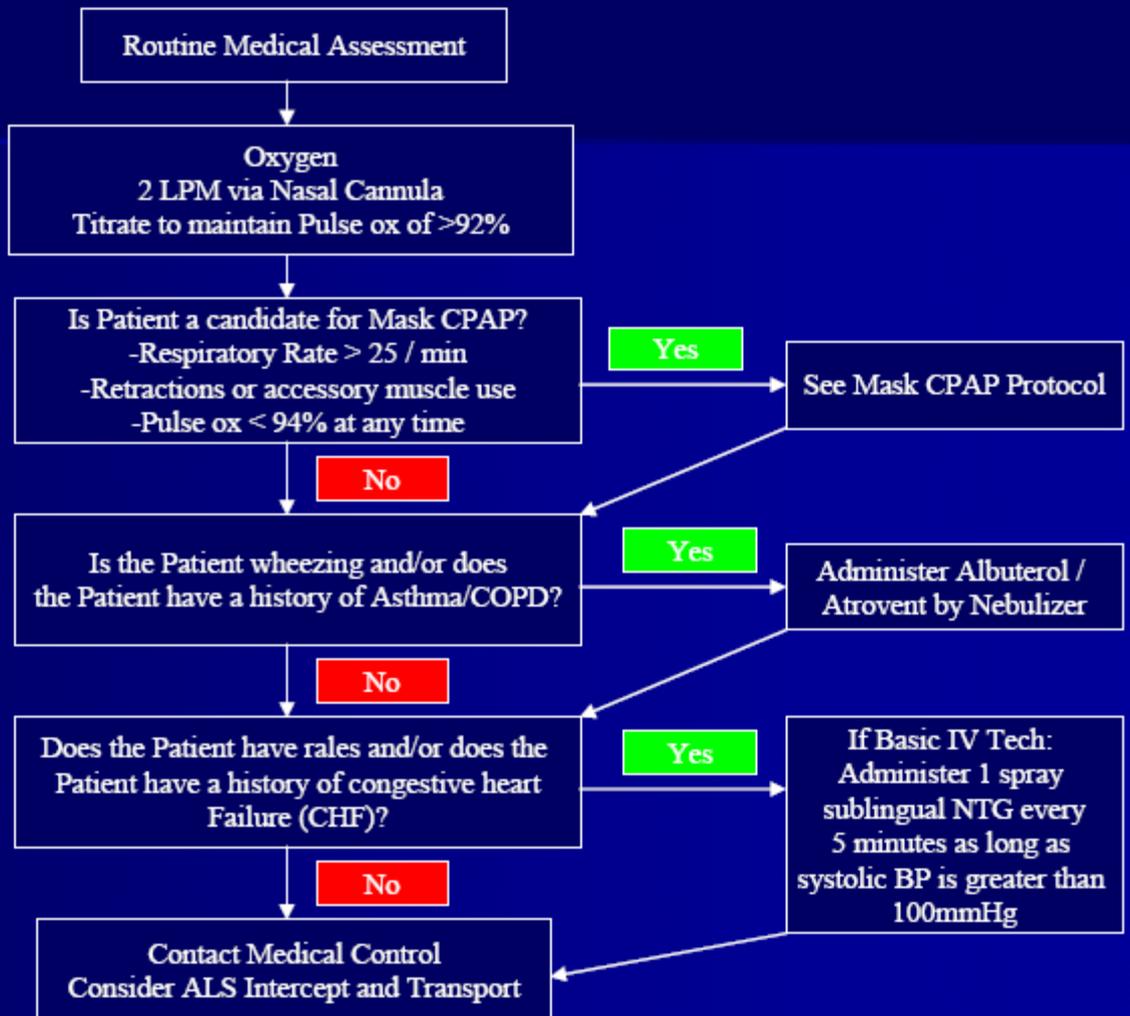
Adult Respiratory Distress Protocol (Age greater than 12)

References:

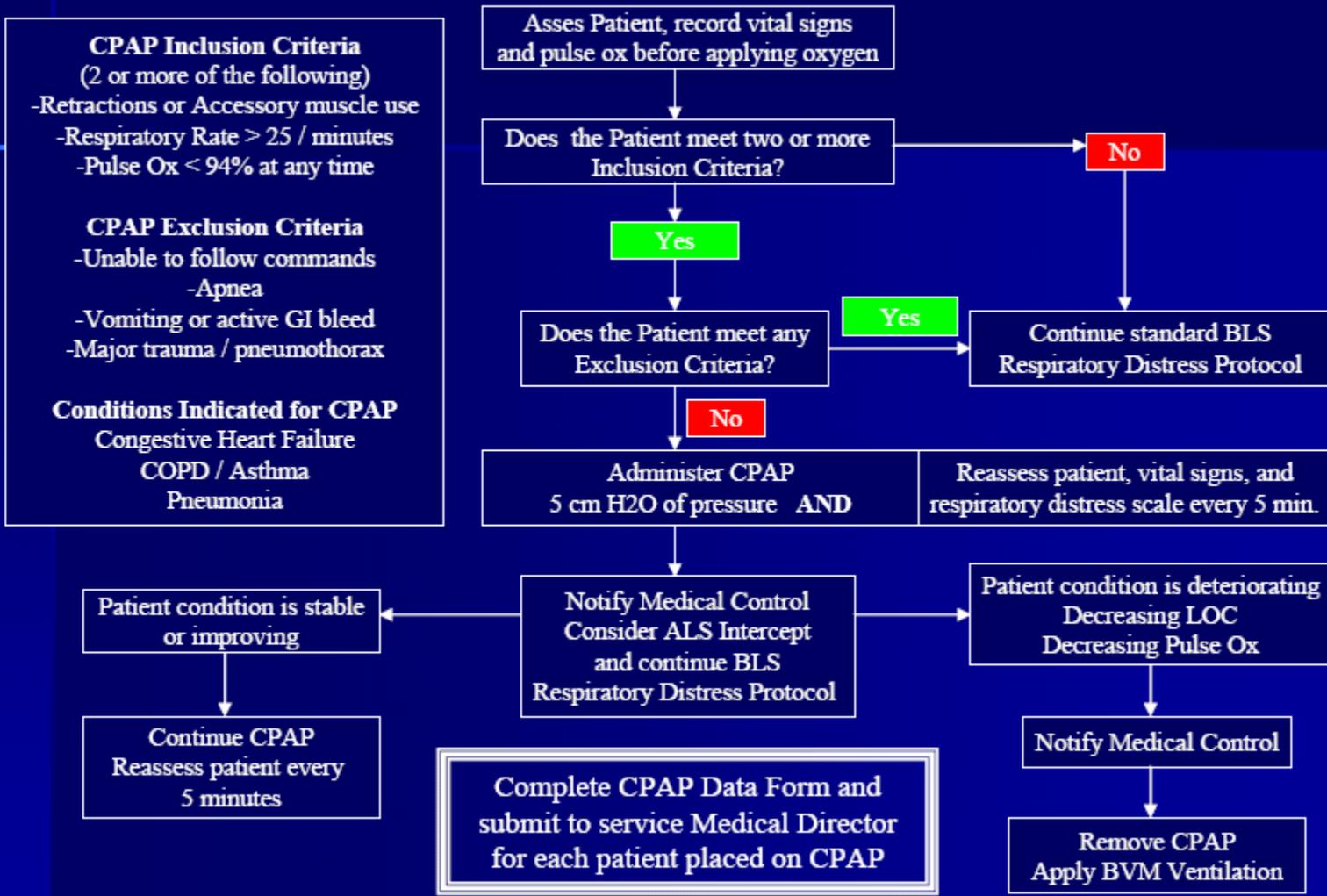
Kosowsky JM, Stephanides SL, Branson RD, Sayre MR. Prehospital use of continuous positive airway pressure (CPAP) for presumed pulmonary edema: a preliminary case series. *Prehosp Emerg Care* 2001 Apr-Jun;5(2):190-6

Kosowsky JM, Gasaway MD, Stephanides SL, Ottaway M, Sayre MR. EMS transports for difficulty breathing: is there a potential role for CPAP in the prehospital setting? *Acad Emerg Med* 2000 Oct;7(10):1165

Reissmann HK, Ranieri VM, Goldberg P, Gottfried SB. Continuous positive airway pressure facilitates spontaneous breathing in weaning chronic obstructive pulmonary disease patients by improving breathing pattern and gas exchange. *Intensive Care Med* 2000 Dec;26(12):1764-72



Mask CPAP for EMT-Basic

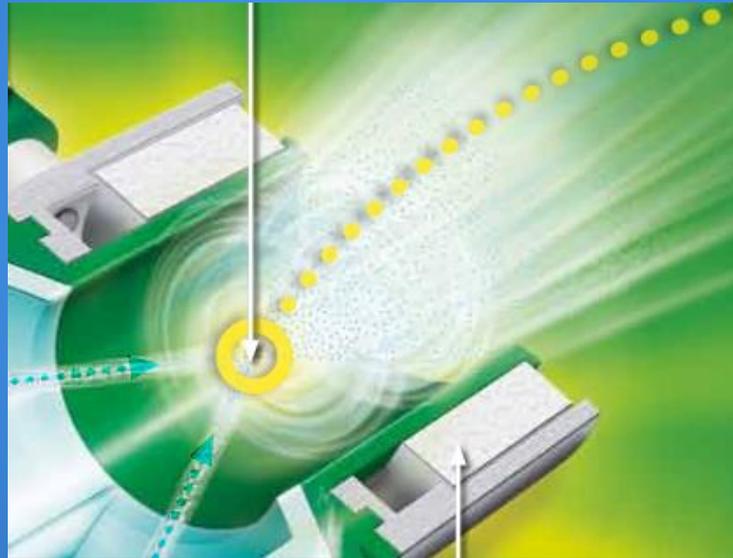


Disposable CPAP Devices

**The first disposable
CPAP device was the
Boussignac Valve.**



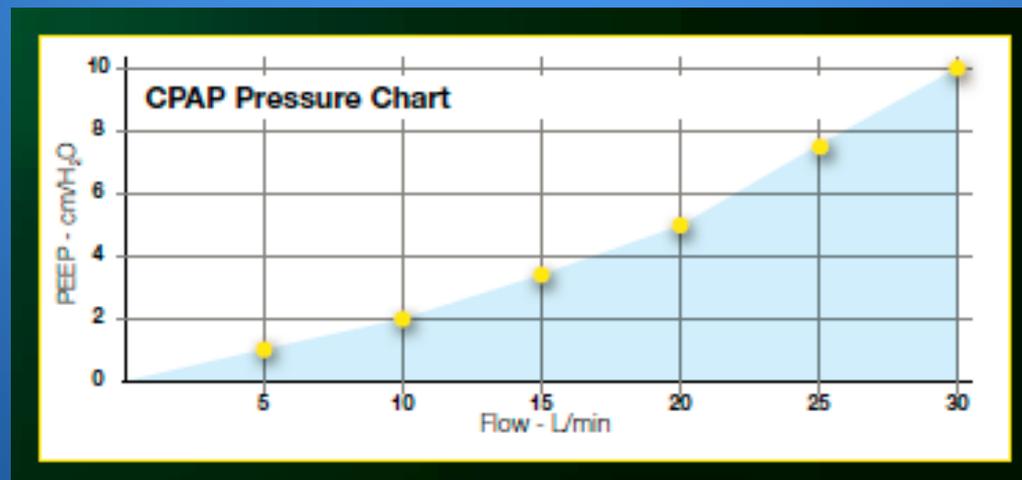
Boussignac “Virtual valve” concept.



?Only creating PEEP

Negative Attributes

- High flow rates – up to 30 L/min!
- Excessive gas consumption –
at 10 cm H₂O a “D” size cylinder (416 litres of O₂) will only last 14 minutes
- Limited CPAP levels -
Maximum 10 cm H₂O!



Downs Flow Generators use high flow rates and PEEP Valves

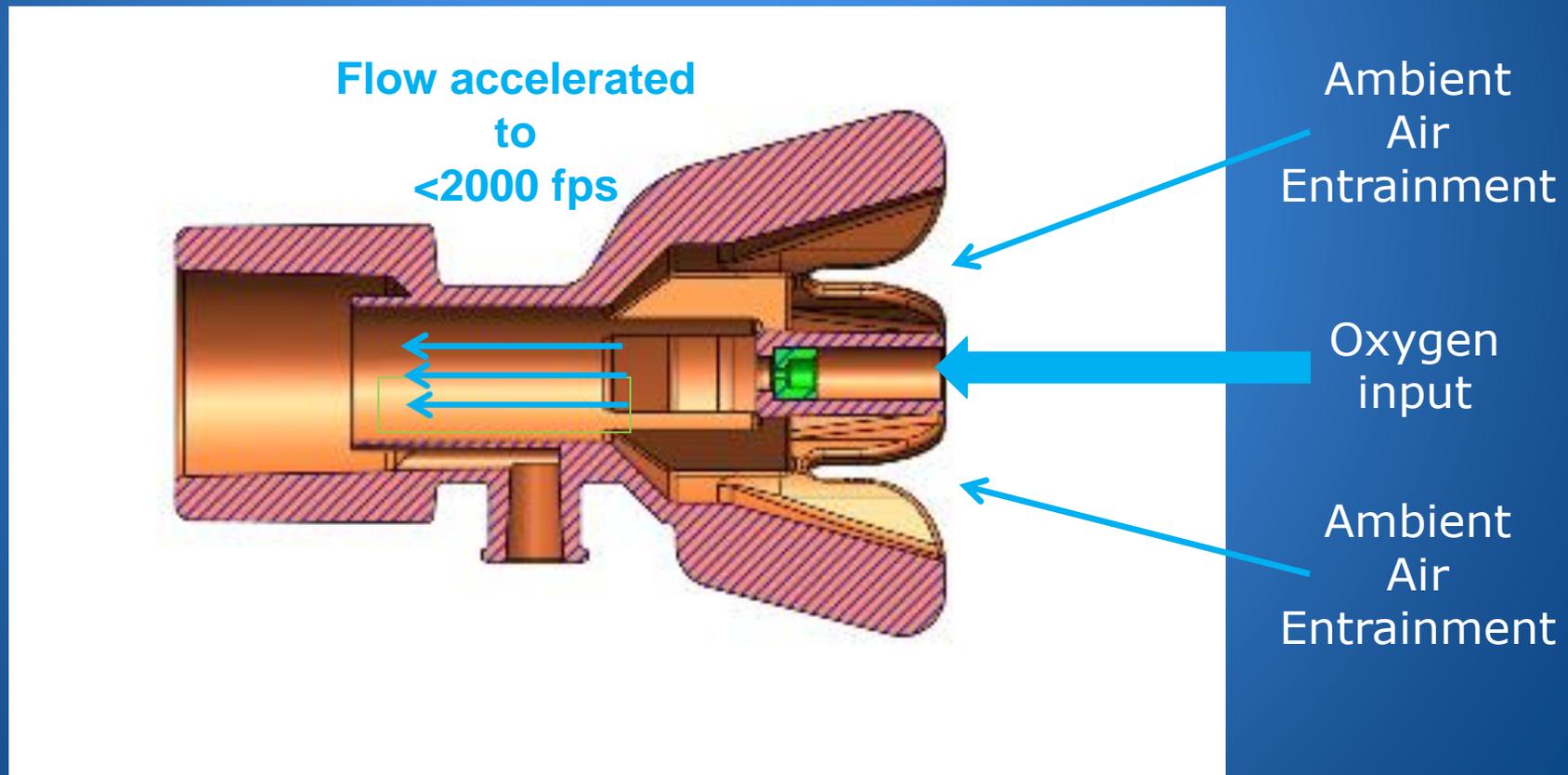


Negative Attributes

- High flow rates – up to 120 L/min!
- Excessive gas consumption –
“D” size cylinder will only
last 3.5 minutes
- May require multiple PEEP valves



New velocity and flow vectoring technology to generate CPAP



Negative attributes

NONE!

Positive attributes

- **Low flow – max. 25 L/min**
- **High Pressure – 25cm H₂O at 25 L/min**
- **Low gas consumption – 34 minutes at 10 cm H₂O on a “D” size cylinder**

CPAP Procedure



CPAP - Procedure

Discuss the procedure with the patient, including each of the following:

- **Effects of positive pressure ventilation**
- **Possibilities of discomfort**
- **Need for cooperation**



CPAP - Procedure

- **Calm the patient as much as possible during the procedure.**
- **Inform the patient prior to application of the CPAP device**



CPAP - Procedure

Have ready and check all ancillary equipment before proceeding

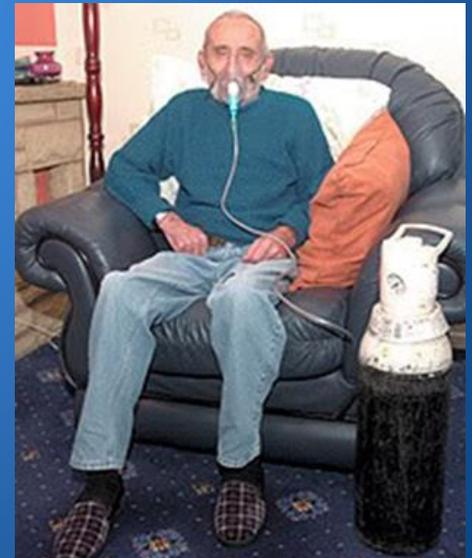
- a. Oxygen source (M cylinder or portable D cylinder) with appropriate quick-connect adaptors**
- b. BVM**
- c. Intubation equipment**



CPAP - Procedure

Ensure that the device is properly connected to the oxygen supply and that the mask and hoof ring are securely in place.

Place patient in the most comfortable position, usually sitting upright



CPAP - Procedure

**Open the main valve on the oxygen cylinder
– DO NOT TURN ON THE THERAPY FLOW.**

Initially ask the patient to hold the mask in place on their face until the patient is comfortable with the mask

Open the therapy flow and gradually increase the flow until the desired level is reached in accordance with local protocols, Until and an affect is felt by the patient

Continue to discuss the procedure with the patient and provide reassurance

CPAP - Procedure

When tolerated, place the head harness on the patient and make necessary adjustments in the straps to ensure a tight fitting mask



Secure the mask in place by attaching the 4 straps on the harness to the hook ring on the mask

CPAP - Procedure

Continue to monitor for patient comfort and air leaks due to mask position.



Conclusions

The pre-hospital provision of mask CPAP can result in:

- **Early physiologic improvement**
- **Less potential for the need for intubation**
- **Reduced incidence of intensive care admissions.**

