

**AN INTRODUCTION TO
CONTINUOUS POSITIVE
AIRWAY PRESSURE (CPAP)**

LEARNING PACKAGE

1. INTRODUCTION

This package is aimed at increasing your knowledge in the use of wisperflow CPAP. It is essential that you have completed the respiratory physiology learning package or have a good understanding of it before you start this package.



Activity: Before you start reading, write your own definitions for:

- Work of breathing
- Respiratory resistance
- Respiratory compliance
- Functional residual capacity

2. CONTINUOUS POSITIVE AIRWAY PRESSURE (CPAP)

Continuous positive airway pressure (CPAP) refers to the addition of a fixed amount of positive airway pressure to spontaneous respirations, in the presence or absence of an endotracheal tube. CPAP is not a mode of ventilation, as it does not provide ventilation. Rather it is used during spontaneous breathing to improve oxygenation, recruit alveoli, and or decrease the work of breathing.^{1,2,3}

The major benefit of CPAP is achieved through its ability to increase functional residual capacity (FRC) and keep FRC above Closing Capacity. The increase in FRC is accomplished by increasing alveolar volume and through the recruitment of alveoli that would not otherwise contribute to gas exchange. Thus increasing oxygenation and lung compliance.^{1, 2, 3}

The potential ability of PEEP and CPAP to open closed lung units, increases lung compliance and tends to make regional impedances to ventilation more homogenous.

3. PHYSIOLOGICAL RESPONSES TO CPAP / PEEP

CPAP may decrease cardiac output and mean arterial blood pressure through a decrease in venous return and hence ventricular filling, as illustrated in the following diagram. In patients with poor left ventricular function and pulmonary oedema the addition of CPAP however may improve cardiac output through an improvement of stroke volume.^{1, 2, 3}

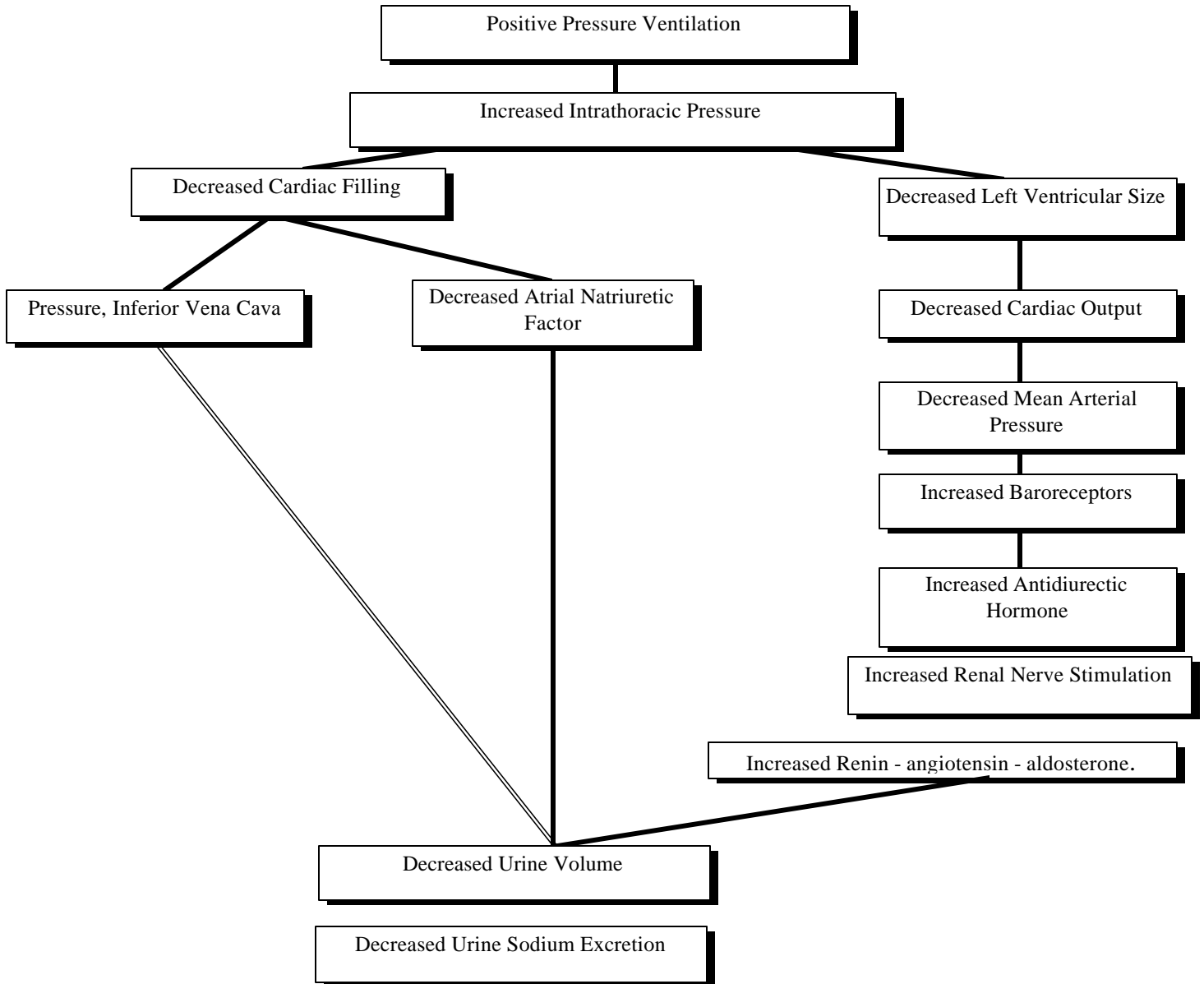


Provide an explanation of how stroke volume is improved with application of CPAP/PEEP in the patient with heart failure.

Fluid retention and diminished urinary output are commonly observed in patients receiving CPAP for extended periods. CPAP can increase the production of antidiuretic hormone, decrease mean renal artery perfusion pressure, redistribute perfusion from the cortex, reduce urine flow, reduce creatinine clearance and diminish fractional excretion of sodium.

Effects of CPAP

CPAP results in	-	increased CVP
	-	decreased Right ventricular end diastolic volume (preload)
	-	increased pulmonary vascular resistance (RV afterload)
	-	decreased Left ventricular end diastolic volume (preload)
	-	decreased Left Ventricular afterload



Schematic Representation Of The Multiple Effects Of Positive Pressure Ventilation On Renal Function (adapted from Perel & Stock 1992 P 69)₄

4. WHY USE CPAP

CPAP can be used in the short term to avoid intubation and mechanical ventilation by preventing further alveolar and bronchiolar collapse, re-expand collapsed alveoli and assist in the resolution of atelectasis.

4.1 Indications for CPAP

- Acute respiratory failure
- Atelectasis
- Post-operative respiratory support
- Pulmonary oedema - to prevent flooding of alveoli
- Pneumonia
- Adult Respiratory Distress Syndrome - will usually require ventilation
- Asthma - to 'splint' airways open
- Flail chest/pulmonary contusion
- Inhalation burn injury
- Obstructive sleep apnoea - to overcome upper airways collapse

4.2 Contraindications

- Pre-existing barotrauma
- Severe respiratory fatigue where CPAP will increase the work of breathing
- Depressed level of consciousness
- Patient unable to protect own airway
- Unstable haemodynamics
- Hypovolaemia
- Extensive facial lacerations or unstable facial fractures
- Tracheal, laryngeal, bronchial or oesophageal trauma
- Raised intracranial pressure
- .Base of skull fracture

4.3 Possible Complications

- Pneumothorax
- Gastric distention and aspiration (insert NG if >10cm of CPAP used)
- Hypoventilation with high levels of CPAP
- CO₂ retention
- Decreased cardiac output
- Fluid retention
- Facial pressure sores
- Patient discomfort
- Pneumocephalus (with base of skull fractures)
- Raised intracranial pressure.
- Sputum retention

5. PATIENT CARE

- Explain the therapy to the patient. Inform the patient of the possible discomfort from the tightness of the mask. Remember, the patient can reject CPAP if it is applied too quickly, so, hold the mask on for a few breaths at a low CPAP setting - 5cm. When the patient appears comfortable, then attach the mask and gradually increase the level of CPAP to the desired amount if needed
- Record hourly settings (CPAP and % O₂), patient respiratory rate and oxygen saturation.
- Initially maintain therapy as long as patient can tolerate. For the best results, CPAP should be kept on for at least two hours. Check for signs of redness underneath the mask and straps. Remove any moisture from the patient's face and the mask. Readjust the straps or pad the skin as required.

- If the CPAP level is greater than 10, a nasogastric tube must be inserted to prevent gastric distension and aspiration. **This is hospital policy.**
- If CPAP is required for greater than four hours or with CPAP levels greater than 10cm H₂O, then JHH must be contacted in relation to ongoing management or retrieval



Why is it necessary to insert a nasogastric tube if the CPAP level exceeds 10cm H₂O?

5.1 Weaning

Weaning of the patient off CPAP should be done by gradually with the aim being to gradually

- reduce the FIO₂ to less than 40%
- reduce the CPAP level to 5
- reduce the time per hour on CPAP

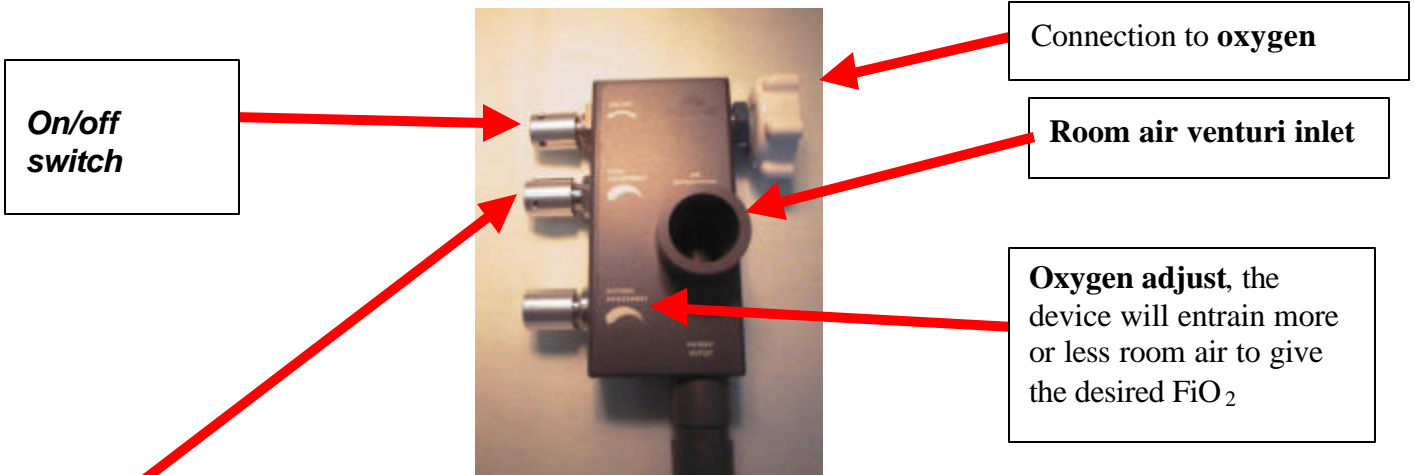
while constantly monitoring the patient to ascertain success.



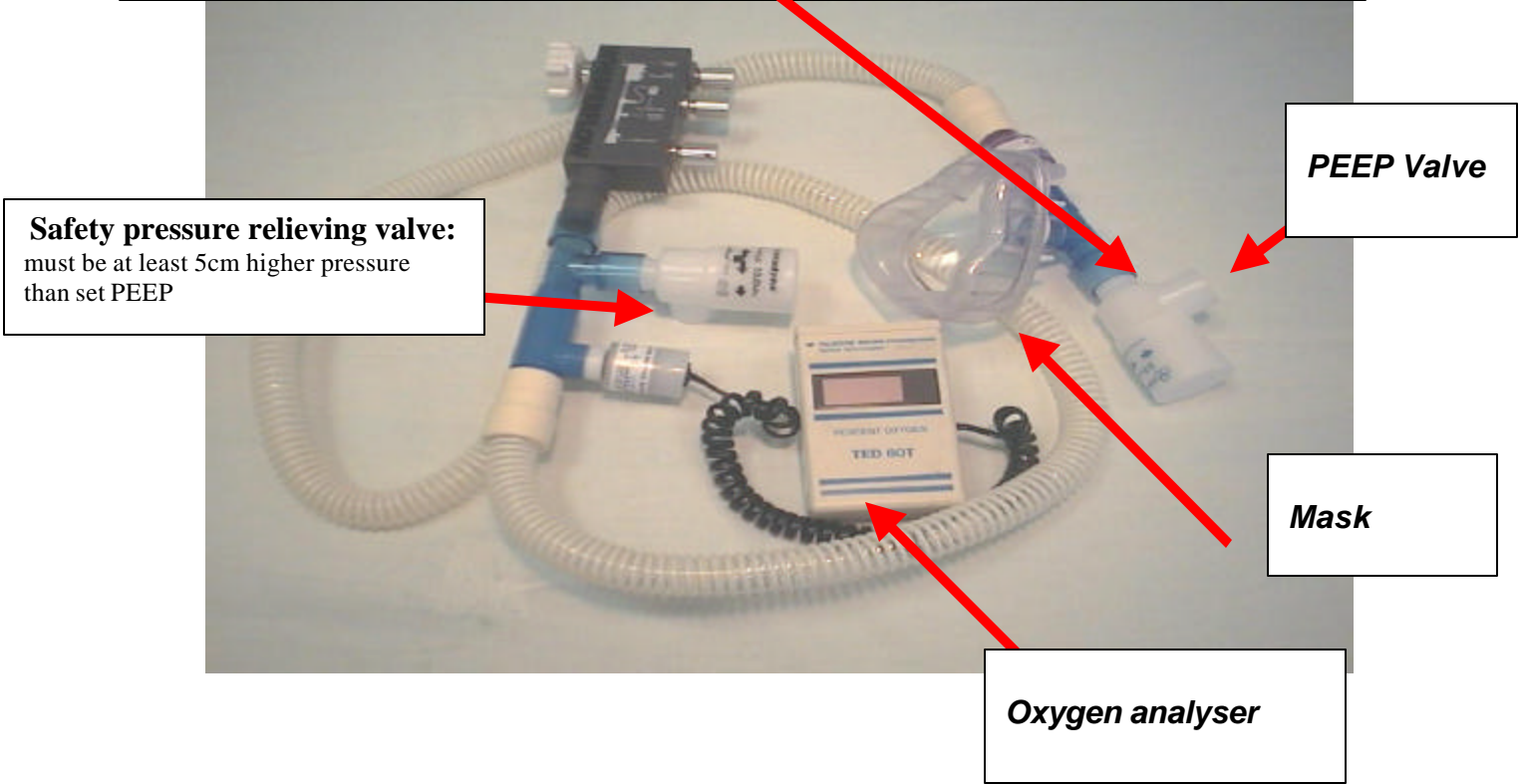
You are caring for a patient whose has presented with acute pulmonary oedema. Treatment consisted of IV lasix, nitrates and commencement of CPAP. OA the patients observations where RR 25 SaO₂ 88% in obvious respiratory difficulty and moist cough. CPAP was ordered at Oxygen 70% and CPAP 10 cm/H₂O,, it is now 1 hour later and the patients RR is 15 and sats are 97%, the MO asks you to wean the patient off CPAP.

Write a weaning plan for the patient including the observations that you would take to ensure weaning is being accomplished successfully.

6. WISPERFLOW CPAP AS USED IN THE RURAL SECTOR OF HUNTER HEALTH



Flow adjustment. Must be adjusted meet flow demand of patient, this is ascertained by watching the valve in the patients PEEP valve. Adequate flow is indicated by the observation that the valve remains slightly open during both inspiration and expiration



REFERENCES AND RESOURCES

1. Rossi, A. Ranieri, 1994, "Positive end-expiratory pressure" in Principles and Practice of Mechanical Ventilation, M. Tobin, ed, McGraw Hill, New York.
2. Hall, J. Schmidt, G. & Wood, L. 1992, Principles of Critical Care, ed, McGraw Hill Inc, New York
3. Smith, R. 1992, "Positive end-expiratory pressure (PEEP) and continuous positive airway pressure (CPAP)" in Handbook of Mechanical Ventilatory Support, A. Perel and Stock, M. eds, Williams & Williams, Baltimore.
4. Perel A., & Stock MC. 1992, Handbook of Mechanical Ventilatory Support. Williams & Williams, Baltimore.