London Health Sciences Centre

Southwest Ontario Regional Base Hospital Program

SWORBHP

CPAP Certification

www.lhsc.on.ca/bhp

Overview

- Learner Package Review
  - Scenario Review
  - Anatomy & Physiology
  - CPAP
  - Pathophysiology
  - Medical Directive
  - Scenario Review
  - Skill Review
- Skill Station
- Post Course Test

Objectives

Given a review of the learner package, skill stations and the Provincial Medical Directives, the paramedic will;

- Describe the anatomy and physiology of the adult respiratory system,
- Relate the pathophysiology of the common causes of respiratory distress in the adult (Pulmonary Edema, COPD, Asthma and Pneumonia),
- Explain the applications, benefits and potential complications of CPAP,
- Identify patients who qualify for application of CPAP as per the current Medical Directive,
- Demonstrate the appropriate application of CPAP to patients presenting with shortness of breath as per the current CPAP medical directive,

As evaluated by the learner, peers and facilitator

Scenario 1

29 year old female patient who started coughing a couple hours ago and thought she was getting a cold. While walking, she became short of breath and still is, even after sitting down. She is able to talk only in three and four word sentences and her nose is flaring. Lung sounds are absent in the bases with expiratory wheezing in the upper fields; skin is pink, warm and dry. Vital signs: HR 120, RR 36, BP 138/88, SpO_2 95%.

- Which respiratory emergency is this patient experiencing?
- Based on your assessment, are there any contraindications for the use of CPAP?
- What is your treatment plan for this patient?

Scenario 2

70 year old female patient complaining of shortness of breath. She is sitting in a kitchen chair, leaning forward with her hands on her knees. Skin is pale and diaphoretic; lung sounds are diminished in the bases with crackles present in all fields. The patient has a history of an MI, angina and HTN. She has pain in her back but denies any other pain. Vital signs: HR 96, RR 40, BP 182/104, SpO_2 93%.

- Which respiratory emergency is this patient experiencing?
- How does CPAP affect left ventricular function?
- How is venous return affected by the use of CPAP?
- Based on your assessment, are there any contraindications for the use of CPAP?
- What is your treatment plan for this patient?

Scenario 3

60 year old male patient complaining of shortness of breath. He is sitting at the end of his bed, leaning forward with his hands on his knees. He is on home O_2 at 2L/min. Skin is pink, warm and dry; lung sounds are diminished in the bases with wheezes in all fields; his chest has equal expansion and appears barrel-shaped. He smokes a pack of cigarettes a day for 35 years. Vital signs: HR 88, RR 36, BP 142/88, SpO_2 94%.

- Which respiratory emergency is this patient experiencing?
- What effect does CPAP have on the alveoli of this patient?
- Based on your assessment, are there any contraindications for the use of CPAP?
- What is your treatment plan for this patient?

Scenario 4

20 year old male with a history of severe asthma. He is a tall, thin track and field athlete who was exercising when he suddenly became short of breath. He is complaining of pain on his right side, and using his rescue inhaler has not improved his breathing. Skin is pink, warm and dry; lung sounds are absent on the right and clear in the left upper and lower fields. Vital signs: HR 112, RR 32, BP 128/64, SpO_2 94%.

- Which respiratory emergency is this patient experiencing?
- Based on your assessment, are there any contraindications for the use of CPAP?
- What is your treatment plan for this patient?

Scenario 5

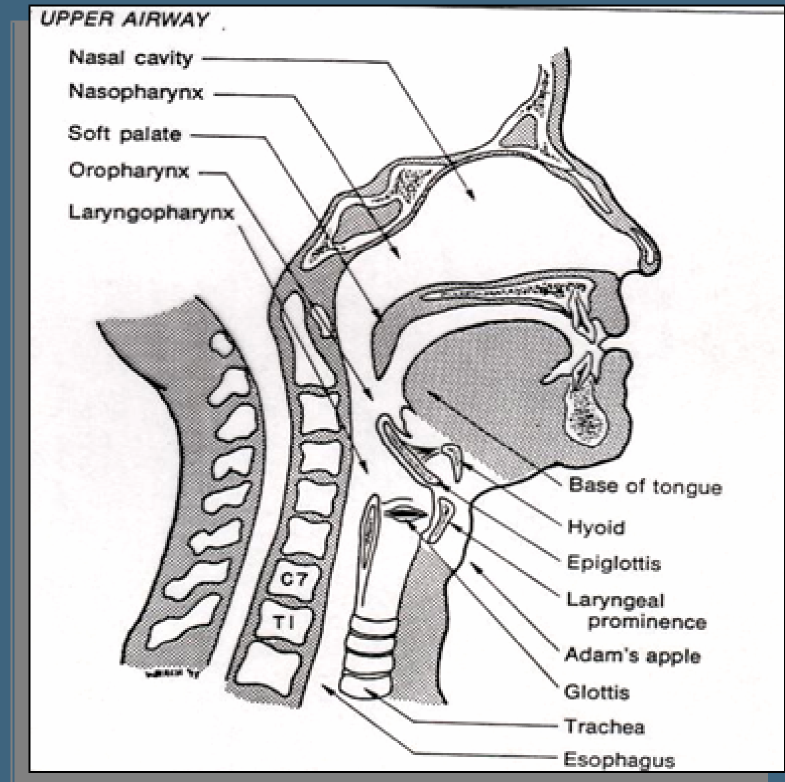
62 year old female with a history of CHF, COPD, hyperlipidemia and HTN complaining of SOB. She is sitting hunched over (tripod), is pale, diaphoretic and auscultation reveals crackles in the upper fields and decreased air entry in the bases. She is using accessory muscles and VS reveal: HR 100, RR 40, BP 208/110, SpO_2 92%. As you load this patient, she deteriorates into respiratory arrest.

- Which respiratory emergency is this patient experiencing?
- Are there any contraindications for CPAP?
- What is your treatment plan for this patient?

Anatomy & Physiology Review

- Upper Airway
  - Nose/Mouth
  - Pharynx
  - Larynx
  - Trachea (to the carina)

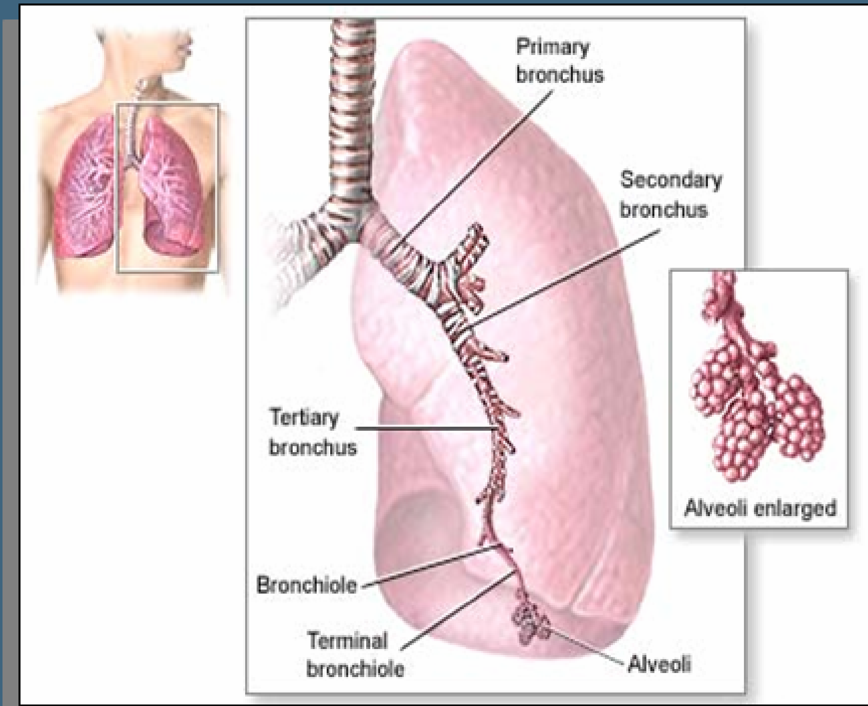
- Functions
  - Warms
  - Humidifies
  - Filters



Anatomy & Physiology Review

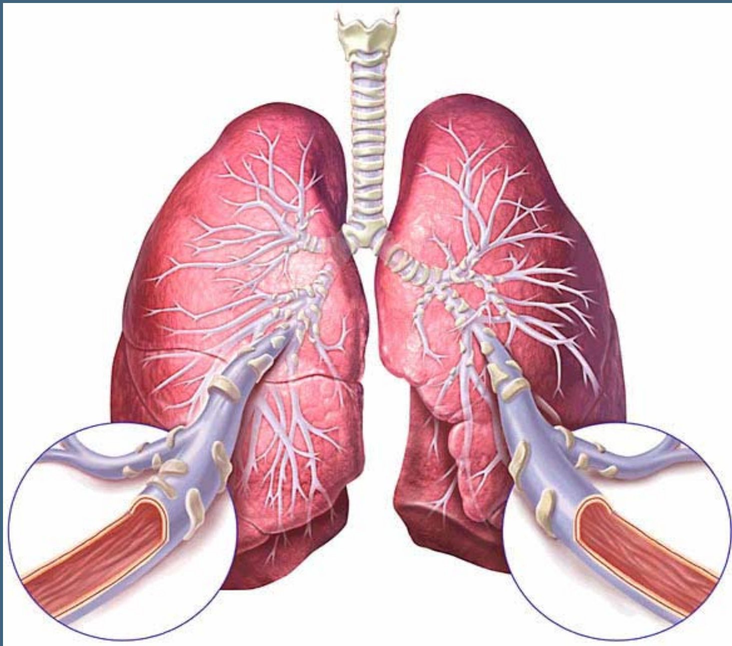
- Lower Airway
  - Trachea
  - Bronchi
  - Bronchioles
  - Alveoli

- Function
  - Gas exchange



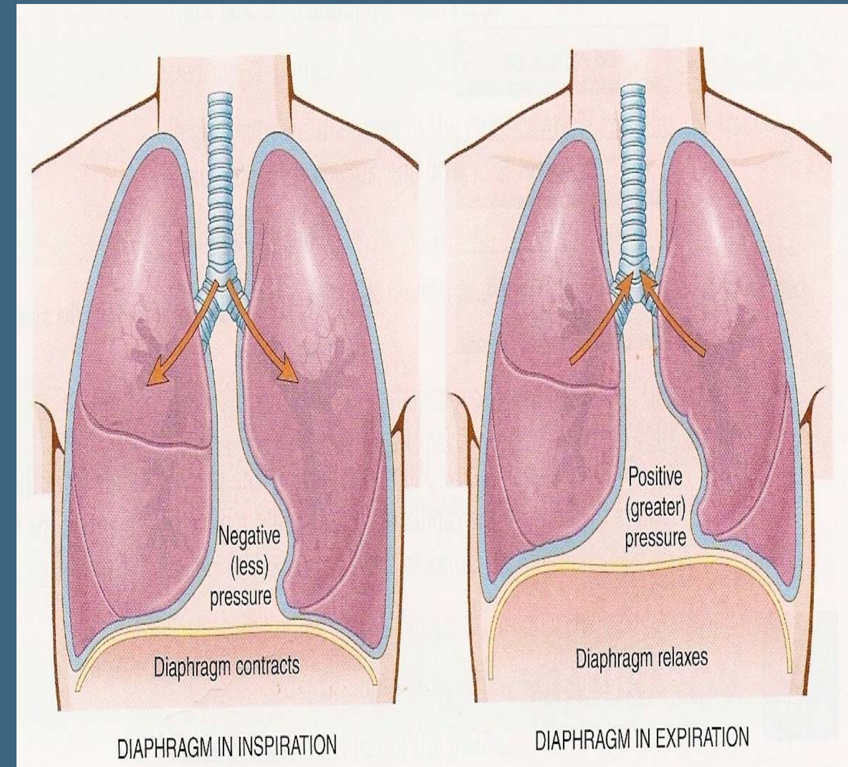
Anatomy & Physiology Review

- Gas Exchange
  - Between alveoli and capillary membrane
  - Alveoli walls must not be damaged or filled with fluid
  - Perfusion must be sufficient



Anatomy & Physiology Review

- The Act of Breathing
  - Inhalation
    - Diaphragm contracts
    - Negative pressure draws air in
  - Exhalation
    - Diaphragm relaxes
    - Positive pressure pushes air out



Anatomy & Physiology Review

- Oxygen Saturation
  - Measured via Pulse Oximeter
  - Measures amount of light absorbed while passing through the capillary bed based on Hg occupancy
  - Only assessment tool for Oxygen saturation?
  - Affected by:
    - Poor circulation
    - Hypothermia
    - Shock
    - Anemia
    - Nail polish

CPAP

- Continuous Positive Airway Pressure
  - Similar to PEEP (used in hospital setting)
  - Non-Invasive ventilatory support (via mask) as opposed to ETI
  - Maintains pressure during inhalation and exhalation
  - Decreases the need for intubation (and related complications)

CPAP

- CPAP vs. ETI vs. BVM

CPAP	Endotracheal Intubation	BVM
Non-Invasive	Invasive	Non-Invasive
Easily Discontinued	Potential for Infection	Easily Discontinued
Easily Adjusted	High level of training required	Difficult to Monitor
No Sedation	May require Sedation	No Sedation
Comfortable	Traumatic	Comfortable

CPAP

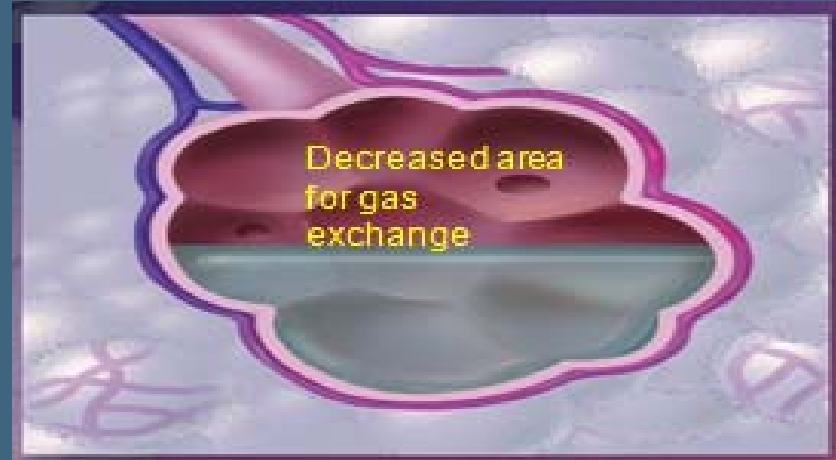
- How does it work?
  - Tight fitting mask controlled by a regulator designed to provide high flow O_2
  - Flow restriction device on exhalation port provides Positive End Expiratory Pressure (PEEP)
  - Airways are kept under constant pressure causing fluid to be ‘pushed back’ and airways to be kept open

CPAP

- Used to treat patients presenting with S/S of COPD or Pulmonary Edema due to CHF
  - Increases Functional Residual Capacity (volume of gas in the lungs at the end of expiration)
  - Prevents alveolar collapse – increases surface area for gas exchange
  - Decreases the workload of the heart by increasing oxygenation
  - ↓Venous return = ↓Preload, ↓Afterload
  - ↑Intrathoracic pressure + ↓Transpulmonary pressure = Enhanced left ventricular function

CPAP

- Fluid Filled Alveoli



- Alveoli after treatment with CPAP

CPAP

- What will you see?
  - ↓RR
  - ↓HR
  - ↓BP
  - ↑SpO_2
  - ↓ Work of Breathing
  - Relief of anxiety

Pathophysiology

- COPD – Treat with CPAP!
  - Combination of Chronic Bronchitis and/or Emphysema
  - Exacerbation triggered by common respiratory infection

  - Chronic Bronchitis
    - Chronic exposure to an irritant causes inflammation and scarring of the bronchi as well as excess mucous production
    - Blue Bloaters – Productive cough, low SpO_2, crackles
  - Emphysema
    - Increased size of alveoli due to destruction of alveolar walls resulting in decreased surface area for gas exchange
    - Pink Puffers – Thin, barrel chest, distant lung sounds

Pathophysiology

- COPD & CPAP
  - During an exacerbation, bronchioles collapse leading to air trapping in the alveoli
  - CPAP will force collapsed bronchioles open enabling gas exchange to resume

Pathophysiology

- CHF & Acute Pulmonary Edema – Treat with CPAP!
  - Left ventricle fails to keep up with demand leading to back flow of blood into the alveoli
  - Results in decreased gas exchange – hypoxia
  - $SpO_2 < 90\%$, crackles, positional respiration

Pathophysiology

- Acute Pulmonary Edema & CPAP
  - Constant pressure from CPAP causes fluid to be ‘pushed back’ into systemic circulation allowing for more surface area in the alveoli for gas exchange

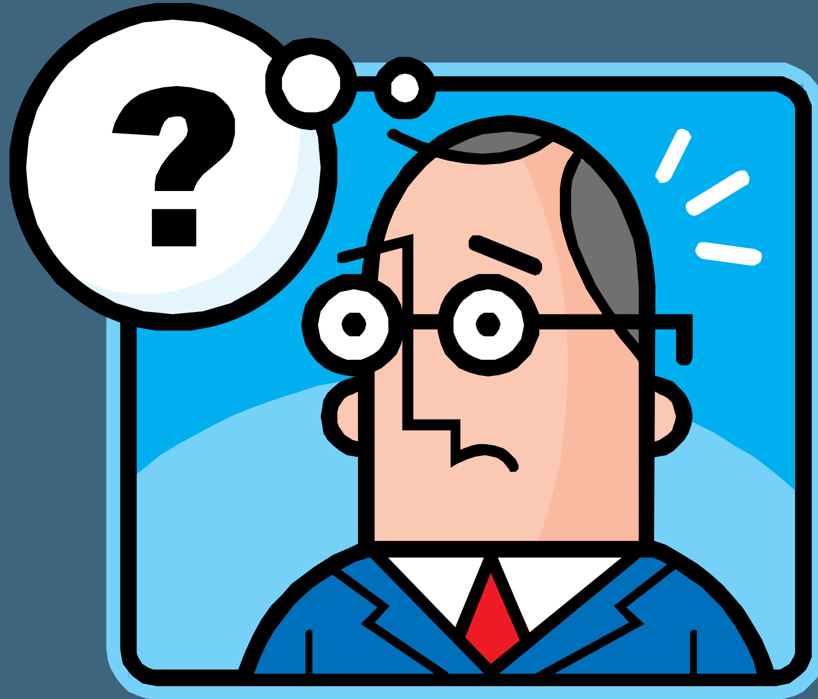
Pathophysiology

- Pneumonia – DO NOT Treat with CPAP!
  - Infection in the lungs due to bacteria, virus, fungus
  - Affected alveoli are pus filled and inflamed
  - Localized chest pain, fever, tachypnea, productive cough
  - CPAP is not used for patients with Pneumonia
  - WHY?

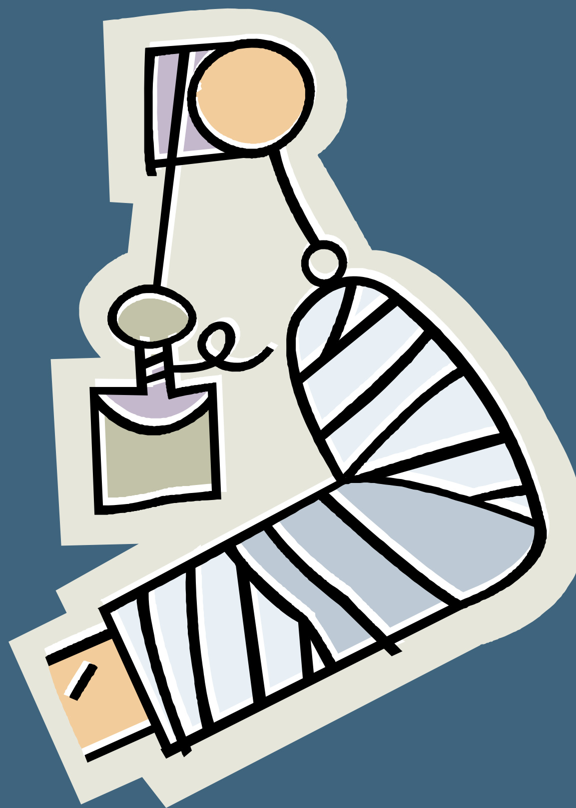
Pathophysiology

- Asthma & CPAP – DO NOT Treat with CPAP!
  - Adverse reaction to stimulus causing contraction of smooth muscle and mucous production in the bronchioles
  - Wheezing on expiration, tachycardia, tachypnea, positional respiration, cyanosis
  - CPAP is not used for patients having an Asthma attack
  - WHY?

Questions??



Break – 10min



Medical Directive – Indications

Patient is awake, able to follow commands and is in severe respiratory distress as evidenced by at least 2 of the following:

- RR $\geq$ 24 bpm
- SpO_2 < 90%
- Accessory muscle use

AND with signs & symptoms consistent with:

- COPD Exacerbation OR
- Acute Pulmonary Edema

Medical Directive – Conditions

- Age $\geq$ 12 years **OR**
- Weight $\geq$ 40kg

Medical Directive – Contraindications

- Asthma exacerbation
- Unable to cooperate
- Suspected pneumothrax
- Intubation
- Inability to maintain airway (FBO, Vomiting, GI Bleed)
- Decreased LOA
- RR < 8 bpm
- SBP < 90 mmHg
- Cardiac Arrest
- Major Trauma /Burn to face, neck, chest, abdomen
- Facial anomalies
- Inability to sit upright
- Tracheostomy

Medical Directive – Procedure

1. Treat appropriately while equipment is set up
2. Position patient sitting upright
3. Explain procedure
4. Connect O_2 supply to flow generator
5. Assemble mask
6. Connect circuit to O_2 supply
7. Monitor patient as per BLS standards
8. Attach $EtCO_2$ if available

Medical Directive – Procedure

9. Turn on O_2 and attach mask to patient
10. Increase pressure from 5 cmH_2O to max 15 cm H_2O as required
11. Confirm CPAP deliver via manometer if available
12. Monitor Vital Signs and SpO_2 q5min
13. Mask may be removed briefly for medication administration as indicated
14. If respiratory status deteriorates, remove CPAP and consider PPV/Intubation

Medical Directive – Removal

- Do not remove unless:
  - Any contraindications are present
  - Patient cannot tolerate
  - Medication administration
  - Respiratory Arrest
  - Vomiting

- If you've removed CPAP:
  - BVM
  - Supraglottic Airway
  - Intubation

Medical Directive – Titration of CPAP

- If no initial clinical improvement:
  - Increase by 2.5 cmH_2O q5min to maximum 15 cmH_2O

  - 15 LPM – 5 cmH_2O
  - 20 LPM – 7.5 cmH_2O
  - 25 LPM – 10 cmH_2O

Flow Rate	Pressure	Full D Tank	Full M Tank
15 LPM	5 cmH_2O	23 min	199 min
20 LPM	7.5 cmH_2O	16 min	175 min
25 LPM	10 cmH_2O	14 min	140 min

Medical Directive – Documentation

Time	Code	Procedure	Results
1318	339	CPAP 5cmH2O (15LPM O2 Flow Rate)	Patient Tolerated, Decreased Respiratory Effort, Manometer: cmH2O
1321	336	Respiratory Assessment	SpO2: 97% Decreased Work of Breathing

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Scenario 5

62 year old female with a history of CHF, COPD, hyperlipidemia and HTN complaining of SOB. She is sitting hunched over (tripod), is pale, diaphoretic and auscultation reveals crackles in the upper and middle fields and decreased air entry in the bases. She is using accessory muscles and VS reveal: HR 100, RR 40, BP 208/110, SpO_2 92%. As you load this patient, she deteriorates into respiratory arrest.

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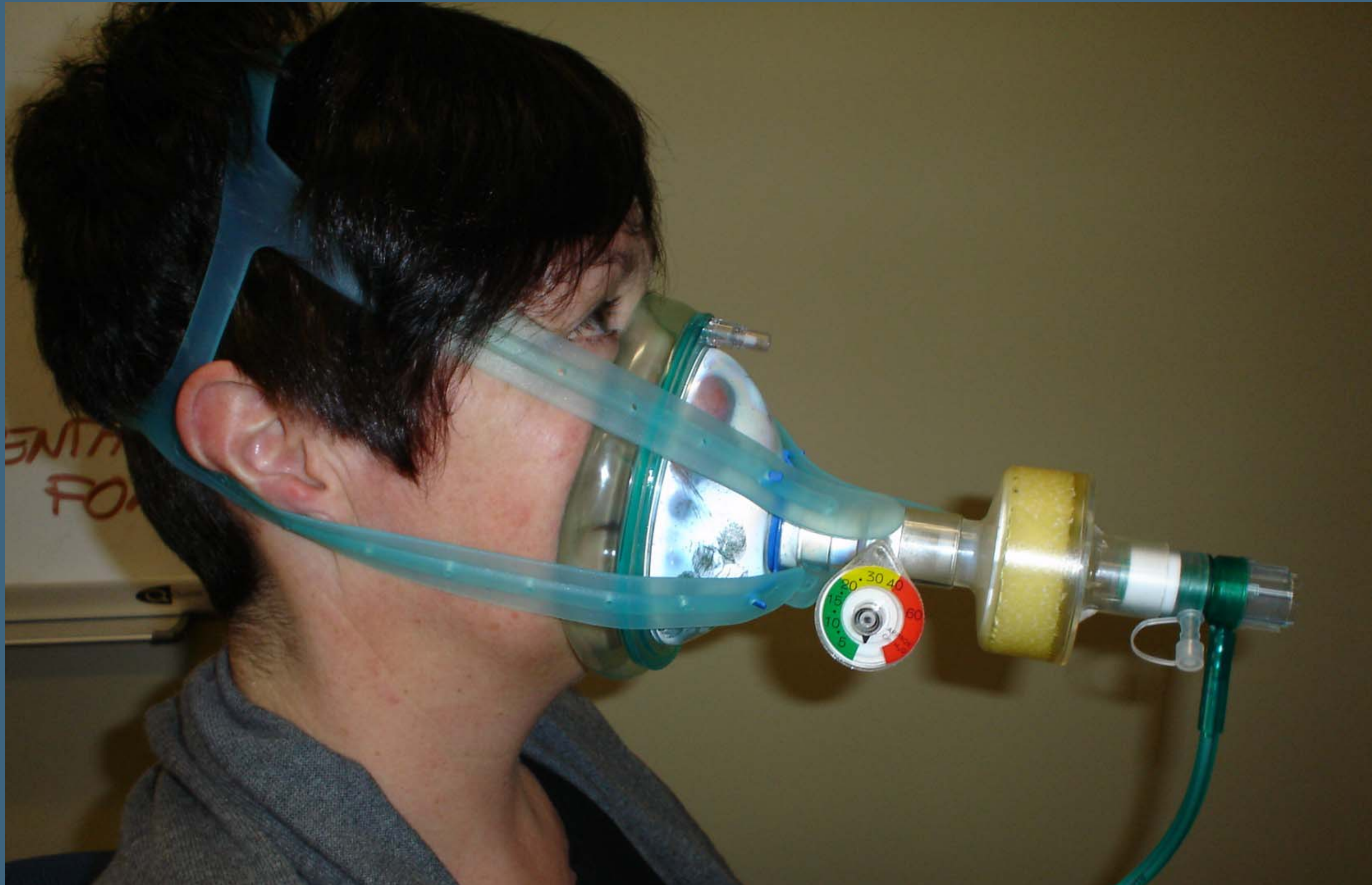
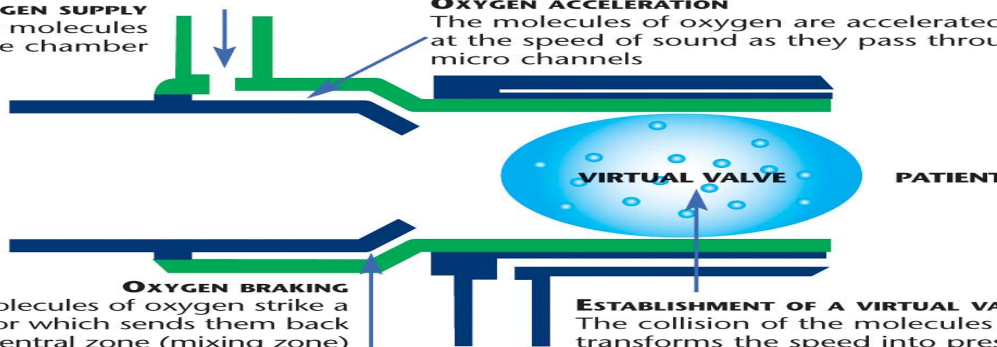
CPAP Device – Boussignac



Boussignac – How it Works

- Oxygen entering the chamber is accelerated – causing an increase in pressure as it reaches the patient.
- Turbulence generated by the increased pressure creates a 'virtual valve' ensuring oxygen travels in the direction of the patient.



Boussignac – Sizing

- Medium (Size 5)
  - Fits 60% of the population
- Large (Size 6)

Boussignac – Application

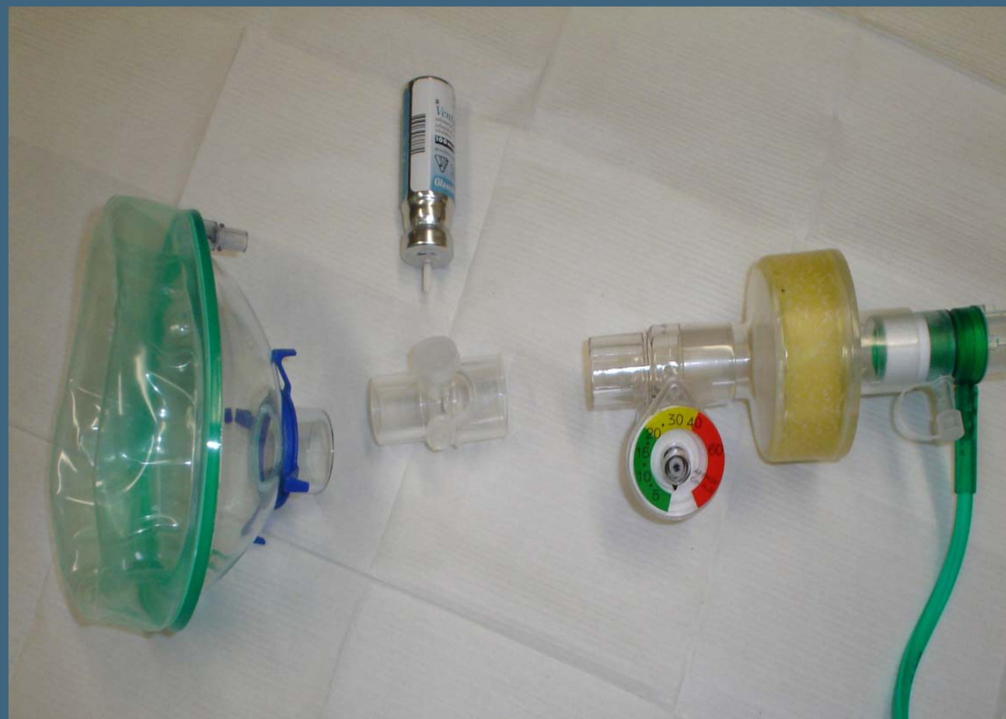
1. Explain procedure to the patient
2. Size the mask
3. Hold the assembled mask in place while coaching the patient
4. Secure head straps
5. Connect O2

Boussignac – Considerations

- Facial Hair
  - Ensure seal by tightening
- Dentures
  - Leave dentures in
- Air Leak
  - Adjust mask cuff

Boussignac – Med Admin

- CPAP & Nitro
  - Remove mask temporarily for NTG admin
- CPAP & Salbutamol
  - Use MDI adapter or nebulizer



Boussignac & Safety

- Device is an open safety – PPE is a MUST!
  - Filter
  - N95 for anyone within 3m
  - Goggles
  - Exhaust Fan
  - Partition window

* CPAP is continuous – when moving from D Tank to M Tank, or vice versa, move quickly!

Questions??

References

- Ontario Base Hospital Group, Education Subcommittee, 2008 (power point)
- Provincial Medical Directives, 2009