London Health Sciences Centre
Southwest Ontario Regional Base Hospital Program

Paramedic Rounds

Pre-Hospital Continuous Positive Airway Pressure (CPAP)

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www.lhsc.on.ca/bhp

Objectives

- Outline evidence for pre-hospital CPAP
- Describe normal pulmonary anatomy and physiology
- Describe abnormal pulmonary A&P leading to acute respiratory emergencies
- Describe the mechanism of action of CPAP
- Describe the indications, conditions and contraindications for pre-hospital CPAP
- Describe approach to monitoring a patient receiving CPAP and possible complications

Why CPAP in EMS?

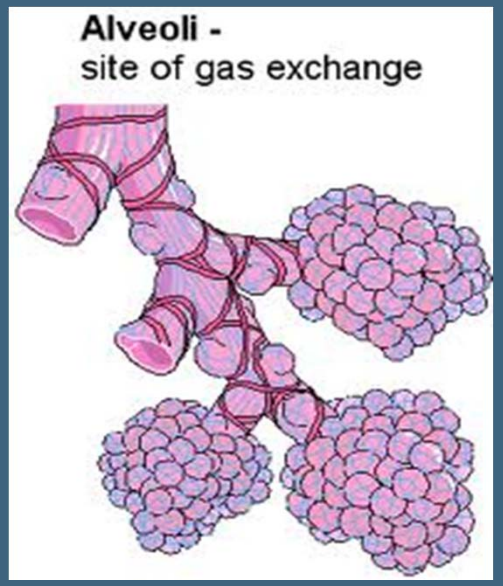
- Hubble MW et all (2006)
  - Compared to similar EMS systems
  - System with CPAP protocol showed
    - Decreased intubation rate
    - Decreased mortality
    - Decreased hospital length of stay

Why CPAP in EMS?

- Thompson J et al (2008)
  - Randomized controlled trial
  - Patients randomized to CPAP treatment group:
    - Decreased intubations
    - Decreased mortality
- No studies have shown evidence of harm

The Respiratory System

- Architecture of the lung
  - similar to an inverted tree-like structure with progressively smaller airways
  - Leads to terminal bronchi and
  - alveoli



The Respiratory System

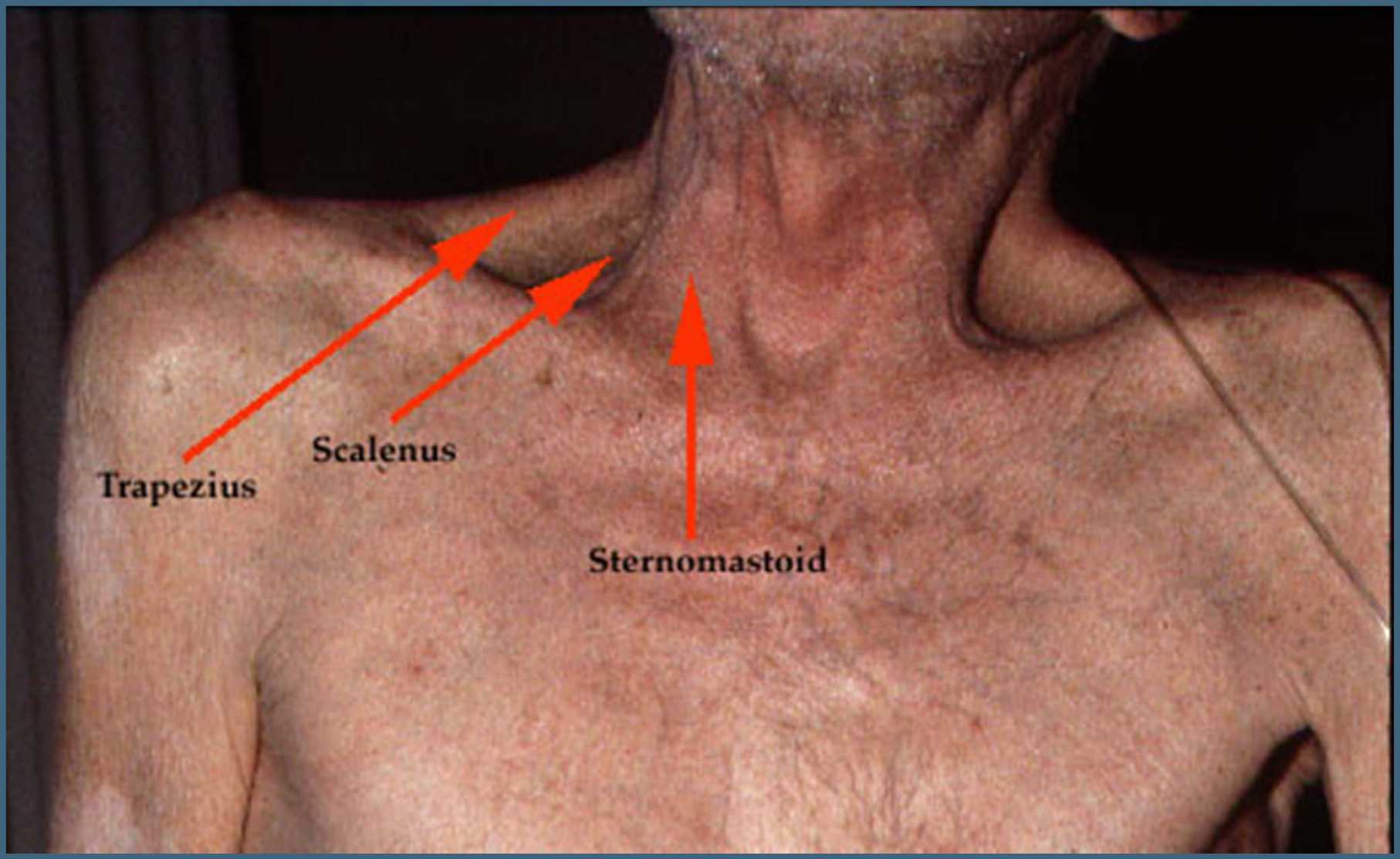
- Alveoli
  - The Functional units of respiration
  - Contain surfactant
    - Liquid which decreases surface tension
    - Prevents alveoli from “sticking together”
  - Alveolar collapse leads to decreased lung volume
    - Decreased blood oxygen (hypoxemia)
    - Increased blood CO2 (Hypercarbia)

The Respiratory System

- Muscles of Respiration
  - Diaphragm exerts negative pressure on Lungs
  - Intercostal muscles cause chest excursion
  - Exhalation is a passive process (elastic recoil)

The Respiratory System

- Respiratory Distress:
  - Accessory muscles such as sternocleidomastoids and scalenes increase chest excursion
  - At rest, healthy person uses ~4% of oxygen to fuel respiratory muscles
  - During acute respiratory emergency, may use up to 20% of oxygen to fuel respiratory effort
  - Increased oxygen demand with work of breathing


Trapezius
Scalenus
Sternomastoid

Pathophysiology

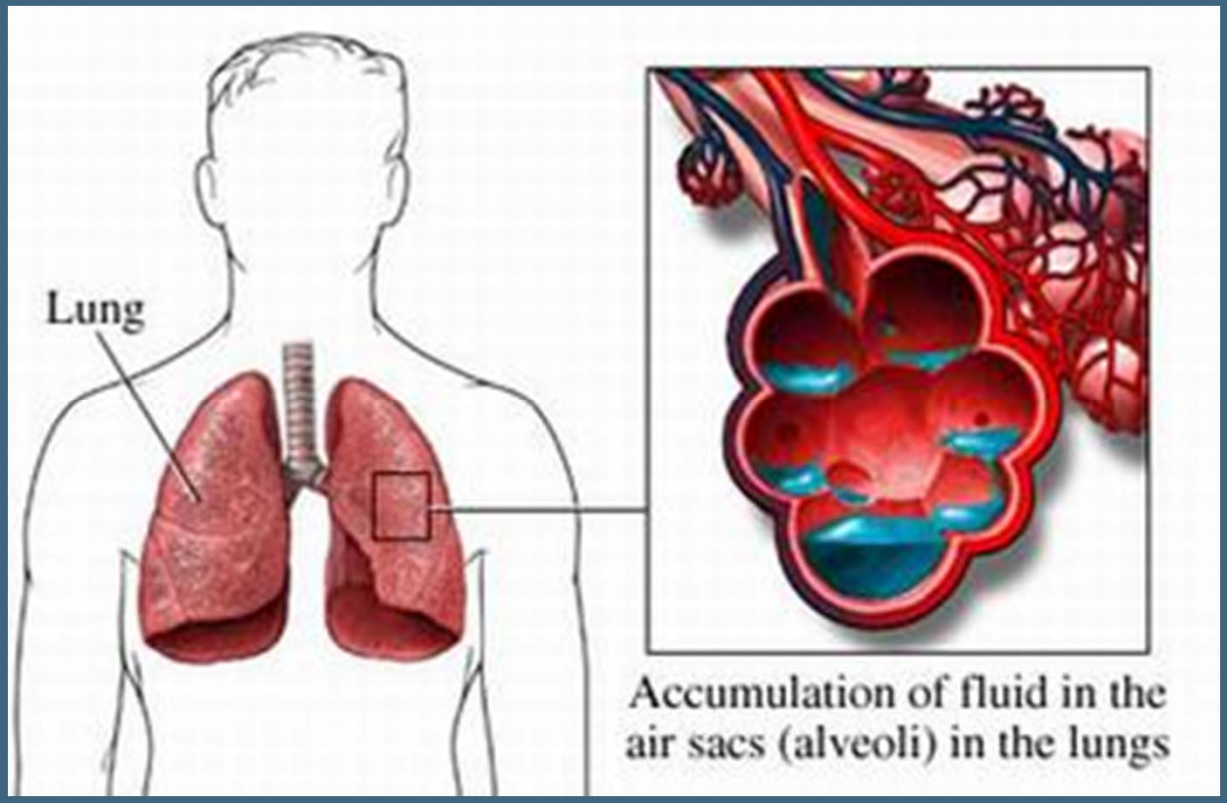
- Common conditions leading to resp distress:
  - Cardiogenic Pulmonary Edema
  - Chronic Obstructive Pulmonary Disease
  - Asthma
  - Pneumonia

Cardiogenic Pulmonary Edema

- Secondary to congestive heart failure (CHF)
- Left ventricular failure leads to backward pressure and vascular congestion in lungs
- Increased hydrostatic pressure causes leakage of fluid into alveoli
- Reduces gas exchange leading to hypoxia
- “washes out” surfactant leading to alveolar collapse (atelectasis)

Pulmonary Edema

Decreased gas exchange due to fluid build up and alveolar collapse



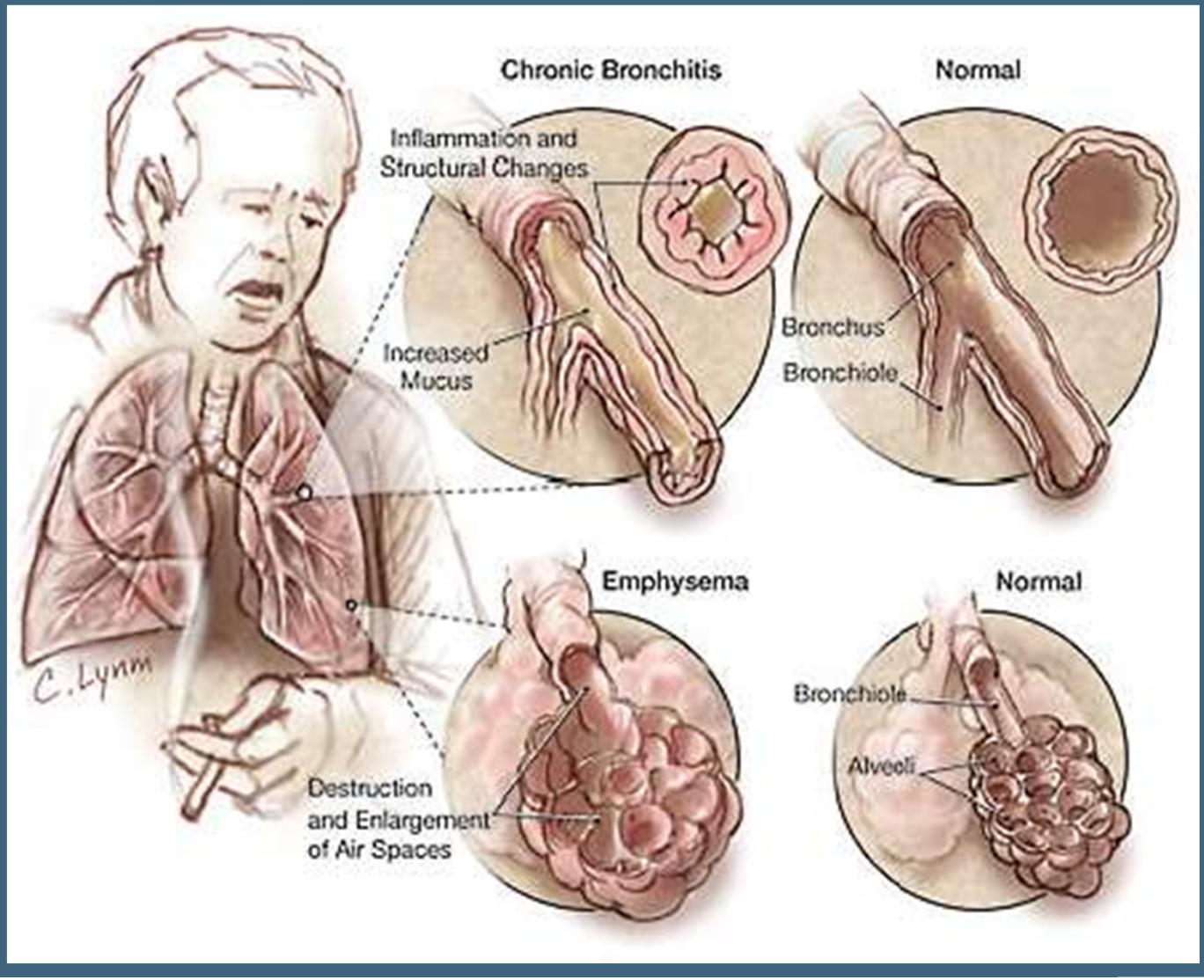
Acute Pulmonary Edema

- Patient short of breath with increased work of breathing and diffuse inspiratory crackles in all lung fields
- Potentially decreased air entry at bases due to alveolar collapse (atelectasis)
- Patient often has history of coronary artery disease and or cardiac risk factors such as HTN, DM, Hyperlipidemia and family cardiac history

Chronic Obstructive Pulmonary Disease

- Pt has chronic airway disease elicited on history usually with a history of long-term cigarette exposure
- **Bronchitis** – chronic inflammation characterized by scarring of airways and increased mucous production
- **Emphysema** – characterized by loss of elasticity of lung parenchyma with destruction of alveoli

COPD


Chronic Bronchitis
Normal
Inflammation and
Structural Changes
Increased
Mucus
Bronchus
Bronchiole
Emphysema
Normal
C. Lynn
Destruction
and Enlargement
of Air Spaces
Bronchiole
Alveoli

COPD Exacerbation

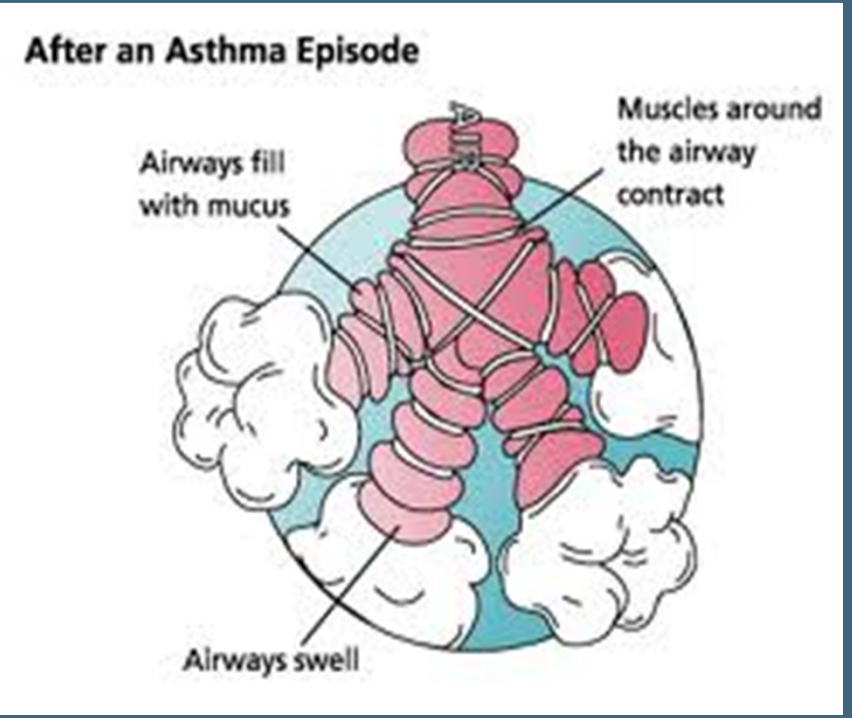
- Usually precipitated by respiratory infection
  - Acute SOB
  - Increased work of breathing
  - Excess secretions (CLEAR productive cough)
  - Potentially leads to respiratory failure

Asthma

- Bronchospasm secondary to irritant or allergic stimulus
- Patient presents with
  - Expiratory wheeze
  - May progress to insp/expiratory wheeze
  - Eventually silent chest with no appreciable ventilation to affected area of lungs

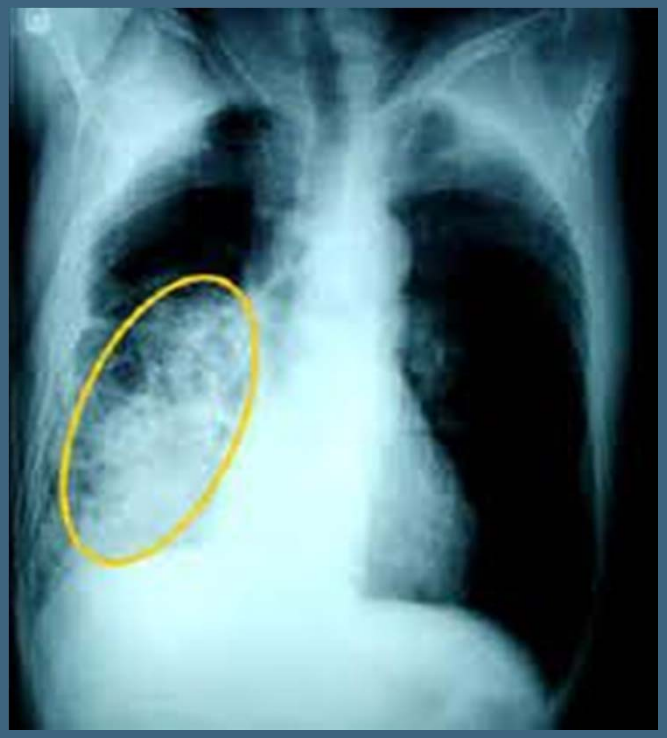
Asthma

- Patient has history of asthma and often a recognized inciting event ("trigger")
- Treated with bronchodilators and 100% oxygen via NRB mask



Pneumonia

- Bacterial, viral or fungal infection of the lung
- Generally a focal area of infection
- Patient presents with
  - Fever
  - productive cough
  - localized chest pain
  - focal inspiratory crackles



Non-Invasive Positive Pressure Ventilation (NIPPV)

- Continuous Positive Airway Pressure (CPAP)
- Bi-level Positive Airway Pressure (BIPAP)

How does CPAP work?

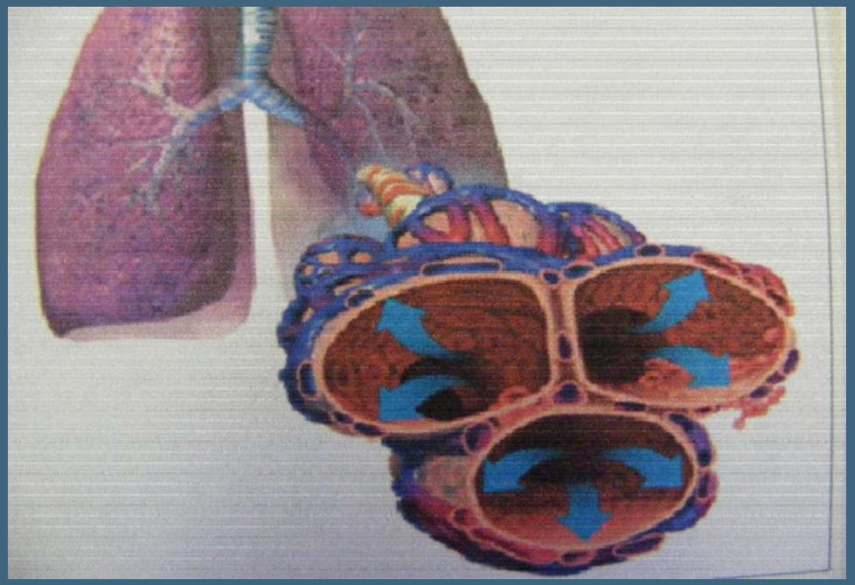
- Tight fitting mask controlled by a regulator with high-flow oxygen
- Flow restriction device on exhalation port exerts continuous positive pressure on airways

Main Effects

- Splints airways open
- Positive pressure decreases leakage of fluid into alveoli
- Positive pressure decreases work of breathing and oxygen requirements
- Improves cardiac function by decreasing preload and afterload on the heart

Cardiogenic Pulmonary Edema

- CPAP:
  - Decreased leakage of fluid into lungs
  - Splints airways
  - Decreases work of breathing/O2 Requirments
  - Decreases atelectasis



COPD

- CPAP:
  - Splints airways
  - Decreases atelectasis
  - Decreases work of breathing and oxygen requirements

Asthma

- CPAP Contraindicated!

- Air-trapping/hyperinflation
- Potential to do harm
- Focus on bronchodilators and 100% oxygen

Pneumonia

- CPAP Contraindicated!

CPAP Indications

- Patient awake and able to follow commands
- Meets at least two of the following:
  - Resp rate 24 or greater
  - SpO2 less than 90%
  - Accessory muscle use
- AND with signs and symptoms consistent with
  - Exacerbation of chronic obstructive pulmonary disease OR
  - Acute pulmonary edema

CPAP Conditions

- Age 12 years or greater

OR

- Weight 40Kg or greater

CPAP Contraindications

- Resp distress due to other medical condition
  - Asthma
  - Pneumonia
- Condition that may be worsened by CPAP
  - Pneumothorax
  - Systolic BP <90
  - Major trauma or burns (face, neck, chest, abdo)

CPAP Contraindications

- Other intervention required
  - Unable to cooperate, decreased mentation, inability to sit upright
  - Unable to maintain airway, intubated patient, facial abnormality, tracheostomy
  - Resp rate < 8
  - Cardiac arrest

Patient Monitoring

- Assess for:
  - Decreased Respiratory Rate
  - Increased SpO2
  - Subjective improvement in dyspnea
  - Decreased anxiety

  - Vitals q5min with particular attention to:
    - Blood pressure
    - Adequacy of ventilation

Complications

- Hypotension
- Conversion of pneumo to tension pneumo
- Airway obstruction
- Requires continuous oxygen supply
- Relies on patients respiratory rate
- Intolerance of mask
- Vitals q5min and constant patient monitoring!

Questions???