Paramedic Rounds

Pre-Hospital Continuous Positive Airway Pressure (CPAP)

Morgan Hillier MD Class of 2011
Dr. Mike Peddle Assistant Medical Director
SWORBHP

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 al. (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
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
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 Requirements
  • 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
  - 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 patient's respiratory rate
- Intolerance of mask
- Vitals q5min and constant patient monitoring!
Questions???