Learning Objectives

Upon the completion of this program participants will be able to:

• Identify common causes of Shortness of Breath and general principles of management
• Describe the appropriate use of supplemental Oxygen
• Discuss the prehospital identification and treatment of COPD and Asthma
• Describe the recognition and management of Pneumothorax

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Learning Objectives

Upon the completion of this program participants will be able to:

• Describe the pathophysiology of CHF
• Describe the history and physical in suspected CHF
• Identify the challenges of this diagnosis by EMS
• Describe the treatment of CHF including:
  – Role of nitrates
  – Role of NIPPV
  – Alternative therapies
Introduction: Shortness of Breath (SOB)

- 2nd Most common complaint
- 13% of EMS call volume
- Evidence based benefit of ALS care
- Treatment of SOB must balance disease severity, diagnostic uncertainty, likelihood of harm
- Differentiating COPD from CHF in the field is very difficult

OPALS study indicated improved survival with ALS care in patients with SOB
Given the recognized difficulty in discriminating between COPD exacerbation and CHF, medical directors should anticipate that there will be misdiagnosis and therefore a common pathway for treatment of both should be considered, i.e. the dyspneic patient

Indications for Supplemental Oxygen

- Ventilation/perfusion mismatch or shunting
- Decreased oxygen carrying capacity
- Tissue hypoxia
- Diffusion problems
Use of Supplemental Oxygen

- Historical EMS use of O2 on anyone with potential for hypoxia
- Greater emphasis on titration based on clinical need
  - Titration with pulse oximetry (93-96%)
  - Superoxia may be detrimental in some conditions
- COPD is no longer absolute contraindication to O2 administration (SpO2 goals of 88-92%)

Pathophysiology

- Upper Airway Obstruction- Foreign Body, Anaphylaxis, or Angioedema
- Small Airways Obstruction- COPD, Asthma
- Cardiogenic- Pulmonary Edema
- Infectious conditions- Pneumonia, Abscess
- Mechanical- pneumothorax, mucous plug
Assessment: History

- **Upper Airway Obstruction**: Sore throat, neck stiffness, fever, exposure to insect stings, medications, or other allergens
- **Small Airways Obstruction**: History of COPD or Asthma. Exposure to allergens, smoking.
- **Cardiogenic**: HTN, MI, Diuretic use, Weight gain
- **Infectious conditions**: Fever, productive cough, aspiration

Assessment: Physical Exam

- Evaluate VS, Mental Status, Oxygenation and Ventilation
- **Upper Airway Obstruction**: Stridor
- **Small Airways Obstruction**: Diminished Breath Sounds, Wheezing, Prolonged expiration
- **Cardiogenic**: Bilateral crackles, wheezing
- **Infectious conditions**: Unilateral decrease, focal crackles or wheezing

Other disease presenting as SOB

- MI: Chest pain obtain and ECG
- Dysrhythmia: palpitations monitor
- Sepsis: Presence of fever, elevated lactate
- Pulmonary Embolism: pleuritic chest pain, tachycardia
- Toxic Exposure: ASA, CO, CN
- Metabolic acidosis: DKA, AKA
Obstructive Pulmonary Diseases

Treatment of SOB in Asthma/COPD
- Monitor VS
- Obtain IV Access
- Place on O₂ to maintain SpO₂ (92-94%)
- Bronchodilators
- Adjunctive Medications
- Non Invasive Positive Pressure Ventilation
- Endotracheal Intubation

Treatment of Asthma
- Oxygen
- Short Acting Beta Agonists- mainstay of therapy
- Corticosteroids- may decrease admissions
- Epinephrine (when inhaled Beta agonists are not effective)
- Heliox- improves laminar flow to the distal airways
- NIPPV
- Ketamine- induction agent that bronchodilates
Chronic Obstructive Pulmonary Disease

• Chronic lung disease precipitated by an inflammatory response to noxious particles
• Results in destruction of alveoli and is only partially reversible
• Presents with:
  – Cough
  – Increased mucous production
  – Dyspnea
  – Wheezing

Treatment of COPD

• O₂ to maintain SpO₂ (92-94%)
• Administration of Beta agonists and Anticholinergics
• Corticosteroids
• Antibiotics reduce mortality
• NIPPV- may prevent intubation
• Intubation only as a last resort

Despite concerns over impairing respiratory drive, O₂ should be administered to all hypoxic COPD patients

Mechanical ventilation should be done at volumes of 8cc/kg or less to reduce the risk of barotrauma

Short Acting Beta Agonists are first line and are synergistic with anticholinergics
Bronchodilators

- Beta Agonists - rapid onset of smooth muscle relaxation in bronchioles
- Some absorption into systemic circulation
  - Rarely precipitate MI
  - May drive potassium intracellular = hypokalemia
- May result in hypoxemia due to shunting and V/Q mismatch

Adjunctive Medications

- Anticholinergics - smooth muscle relaxation, synergistic with Beta agonists, no systemic absorption.
- Magnesium - smooth muscle relaxation, may be beneficial in severe bronchospasm
- Steroids - reduces inflammation in the airways, peak effect may take hours

Use of Non Invasive Devices for Ventilation

- Continuous Positive Airway Pressure (CPAP)
  - Reduces the work of breathing
  - Improves oxygenation through the recruitment of alveoli
  - Displaces fluid in the airway
- BiLevel Positive Airway Pressure (BiPAP) - further reduces the work of breathing
- Beneficial in both COPD and CHF
- Contraindicated in patients with immediate need for intubation
Typical setting for CPAP are a pressure of 5 or 10 cm H2O (can be thought of as PEEP)

BiPAP Inspiratory Pressure of 10 over an expiratory pressure of 5 (can be though of as Pressure Support (IPAP) and PEEP (EPAP))

Contraindications: Immediate need for Intubation  
Airway closure (burns, anaphylaxis, angioedema)  
Inability to cooperate or tolerate the mask  
Inability to protect the airway from secretions or vomitus

Use of NIPPV
• Improves cardiopulmonary mechanics:  
  – Redistributions extravascular pulmonary fluid  
  – Increases FRC and recruitment  
  – Improves oxygenation  
  – Decreased work of breathing  
  – Increases intrathoracic pressure  
  – Reduces venous return

Indications for NIPPV
• Use in CHF in conjunction with traditional therapies  
• Reported success in:  
  – Pneumonia  
  – Asthma/COPD  
• Requires patient cooperation and:  
  – Intact resp drive and airway reflexes  
  – Intact mental status
Asthma

- Chronic inflammatory lung disorder characterized by airway hyper reactivity and reversible obstruction
  - Inflammation
  - Mucous Production
  - Bronchospasm
- May be precipitated by allergens and pollution
- Presents with: Dyspnea, Cough, Wheezing, Chest Tightness

CHF Pathophysiology

- Volume overload
  - Due to neurohumoral activation
  - Increased afterload
  - Volume overload (Bucket theory)
  - Hypertensive state
- Inadequate cardiac output
  - Hypotensive state
  - Discussed in shock
- Capillary Leak

History and Physical

- Difficult to diagnose in prehospital setting
- Poor sensitivity/specificity to each finding
- Must use combination of history and exam
- Cumulative picture to create suspicion
- ETCO2 waveform analysis may be beneficial
  - Distinguishes from obstructive process
Findings

<table>
<thead>
<tr>
<th>History</th>
<th>Physical</th>
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<tbody>
<tr>
<td>• HPI:</td>
<td>• Crackles</td>
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<tr>
<td>• Cough (character/volume)</td>
<td>• Peripheral edema</td>
</tr>
<tr>
<td>• Orthopnea/PND</td>
<td>• JVD*</td>
</tr>
<tr>
<td>• DOE</td>
<td>• Hepatofugal reflux</td>
</tr>
<tr>
<td>• Prior history of same</td>
<td>• S3 /S4</td>
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<tr>
<td></td>
<td>• Specific</td>
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<td>• Difficult to assess</td>
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CHF Primary Management

• Supplemental oxygen
• Essential Preload/Afterload reduction
  – Nitrates (SL vs IV)
  – Used as tolerated by BP
• Positioning

If patient is in volume overload category and in need of intervention treatment is directed at reduced pre-load and after-load. Blue book notes that because treatments are associated with potential risk patients that are stable should be transported to the ED for more definitive dx.

The blue book recommends the very traditional use of ntg, positioning and Lasix. The use of NIPPV is mentioned as a promising modality. More recent management has shifted to aggressive use of ntg without use of diuretics because of frequent misdiagnosis both by EMS and in the ED.

The need for an IV is discussed and is not required.
Primary Management

- Non-invasive Positive Pressure Ventilation
  - Reduces preload
  - Increases alveolar recruitment
  - Redistributes pulmonary fluid
- Reduced need for ETI and ICU admission
- Low cost and increasingly common
- Must be tolerated by patient

The text indicates NIPPV, either CPAP or BiPAP as a “promising” modality because of increased alveolar recruitment, decreased work of breathing and forcing fluid from alveoli. Cites small EMS case series that suggests decreased intubation rates and length of ICU stay but no impact on mortality. The benefits of NIPPV are more clearly understood since the writing of the text.

More has been learned about CPAP and there is no evidence that fluid is forced from the lung. CPAP does redistribute pulmonary fluids away from the capillary alveolar interface which is thought to improve the ability to oxygenate. Ability to oxygenate is also increased by alveolar recruitment and reducing the v/q mismatch. Increased intrathoracic pressure reduces venous return and preload.

Supplemental Management

- ACE Inhibitors
  - Proven ED therapy but little in EMS
  - May be used as SL or IV
  - Caution in patients with Renal Injury
- Diuretics
  - Onset of action is at least 30 min
  - Has limited value in the EMS environment
- Morphine
  - No longer recommended
ED use of ACE inhibitors supports their use in CHF though little is known about their use in the field. Use of SL captopril resulted in lower intubation and ICU admission rates. Recommendation is careful consideration of their use in CHF. Diuretics are cited as initial treatment after NTG. Recommended dose is 20mg if furosemide naïve or iv dose the same as patients oral dose if already taking furosemide. Limited effect of diuretic on cardiac output is noted in the text and in particular the erroneous conclusion that furosemide causes immediate reduction in preload via venodilation. Given the limited benefit relative to NTG its use may have little value in the setting of short transport times and/or unclear diagnosis. The information on increased mortality is not included in the blue book or Tintinalli. The text does review the literature that indicates increased mortality with use of morphine.

Pneumothorax

- Air present between the lung and the pleural cavity
- Spontaneous Pneumothorax- leakage of air from the lung into the pleural space. Usually in tall slim men
- Open Pneumothorax- Wound between the skin and the pleural space allowing air to communicate
- Tension Pneumothorax- Air in the pleural space under positive pressure forcing collapse of the lung and compression of the thoracic structures

Field Identification of Pneumothorax

- **Simple Pneumothorax**- acute onset of dyspnea or decreased exercise tolerance.
- **Open Pneumothorax**- Thoracic wound, dyspnea, decreased breath sounds, subcutaneous emphysema
- **Tension Pneumothorax**- Tracheal deviation, Dyspnea, Absent unilateral breath sounds, Jugular venous distension, tachycardia, and tachypnea
Management of Pneumothorax

- **Spontaneous Pneumothorax** - w/o tension physiology. Oxygen and monitoring
- **Open Pneumothorax** - 3 sided occlusive dressing to allow escape of gas from the pleural space
- **Tension Pneumothorax** - Needle decompression. A Heimlich valve should be placed on the catheter to allow gas to escape.

Management of PTX with Occlusive Dressings or other devices

- **Occlusive Dressing** - can be fashioned from plastic placed over an open PTX and taped on three sides to allow gas to escape.
- **Needle Decompression** - A large bore (12-16g) catheter should be inserted in the second intercostal space midclavicular line.
- **Heimlich Valve** - devices are plastic tubes with rubber sleeves that connect to the catheter and allow escape of gas. An improvised device can be constructed with a glove finger.

Use of Capnometry for Diagnosis

- Shark fin appearance of capnographic waveform denotes impaired exhalation and is associated with obstructive or bronchospastic (COPD and Asthma) disease
Use of Capnometry for Diagnosis

- Becoming standard for intubated patients
- Increasing use for non-intubated patients
- Abrupt loss of capnometric waveform indicates dislodgement of the endotracheal tube or cardiovascular collapse

Take-Home Points

- Brief review of indications/methods of oxygen delivery
  - Clinical aspects of EMS medicine (40%)
- Oxygen therapy should be used based on clinical presentation and titrated as needed
- Be familiar with delivery devices and estimated range of oxygen delivery

Take-Home Points

- Clinical Aspects of EMS = 40% of tests items
- Take home points:
  - Changes in NIPPV delivery devices have made them more affordable and more common
  - NIPPV augment cardiopulmonary function and improve oxygenation
  - Use is no longer limited to CHF
  - Proper patient selection is required
Take-Home Points

• Treat all SOB with oxygen to maintain normoxia
• Bronchodilators are generally safe for patients with SOB.
• NIPPV will prevent intubation in many patients presenting with severe SOB
• Needle decompression of tension pneumothorax is live saving but may not be necessary in simple pneumothorax.