EMS Subspecialty Certification Review Course

Respiratory
1.3.1 Respiratory
1.3.1.1 Shortness of Breath
1.3.1.1.1 Determination of Causes
1.3.1.1.2 Use of Capnography and Capnometry Waveforms in Diagnosis
1.3.1.1.3 Medical Management of Resp Distress/Shortness of Breath
1.3.1.2 Pneumothorax
1.3.1.2.1 Identifying Pneumothorax without ancillary testing
1.3.1.2.2 Management of Pneumothorax with occlusive dressing and alternative devices

2025

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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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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

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Indications for Supplemental Oxygen

- Ventilation/perfusion mismatch or shunting
- Decreased oxygen carrying capacity
- Tissue hypoxia
- Diffusion problems

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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%)
  - Hyperoxia may be detrimental in some conditions
- COPD is no longer absolute contraindication to O2 administration (SpO_2 goals of 88-92%)

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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

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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

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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

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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

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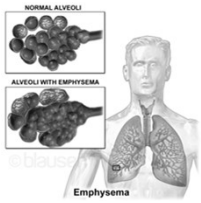
Obstructive Pulmonary Diseases



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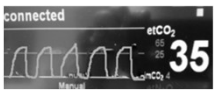
Use of Capnometry for Diagnosis

- Standard of Care (Airway management vs SOB complaint)
- Abrupt loss of Capnometric waveform indicates dislodgement of the endotracheal tube or cardiovascular collapse
- Shark fin appearance of capnographic waveform denotes impaired exhalation and is associated with obstructive or bronchospastic (COPD and Asthma) disease



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Treatment of SOB in Asthma/COPD

- Monitor VS
- Obtain IV Access
- Place on O_2 to maintain SpO_2 (92-94%)
- Bronchodilators
- Adjunctive Medications
- Non Invasive Positive Pressure Ventilation
- Endotracheal Intubation

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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

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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 mucus production
  - Dyspnea
  - Wheezing

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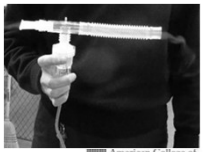
Treatment of COPD

- O_2 to maintain SpO_2 (92-94%)
- Administration of Beta agonists and Anticholinergics
- Corticosteroids
- Antibiotics reduce mortality
- NIPPV- may prevent intubation
- Intubation only as a last resort



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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

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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

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Use of Non-Invasive Devices for Ventila

- 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

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Use of NIPPV

- Improves cardiopulmonary mechanics:
  - Redistributes extravascular pulmonary fluid
  - Increases FRC and recruitment
  - Improves oxygenation
  - Decreased work of breathing
  - Increases intrathoracic pressure
  - Reduces venous return

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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

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Asthma

- Chronic inflammatory lung disorder characterized by airway hyperreactivity and reversible obstruction
- May be precipitated by allergens and pollution
- Presents with:
  - Dyspnea
  - Cough
  - Wheezing
  - Chest Tightness

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CHF Pathophysiology

- Volume overload
  - Due to neurohumoral activation
  - Increased afterload
  - Acute volume overload
  - Hypertensive state
- Inadequate cardiac output
  - Hypotensive state
  - Discussed in shock
- Capillary Leak

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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

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Findings

History
- HPI:
- Cough (character/volume)
- Orthopnea/PND
- DOE
- Prior history of same

Physical
- Crackles
- Peripheral edema
- JVD*
- Hepatojugular reflux
- S3 /S4
  - Specific
  - Difficult to asses

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CHF Primary Management

- Supplemental oxygen
- Essential Preload/Afterload reduction
  - Aggressive use of SL nitrates
  - IV NOT required prior to administration
  - Used as tolerated by BP
  - Remember ED drugs
- Positioning

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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

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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

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Pneumothorax

- Air present between the lung and the pleural cavity
- Spontaneous Pneumothorax- leakage of air from the lung into the pleural space. Prototypically in tall slim males
- 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

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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

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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.

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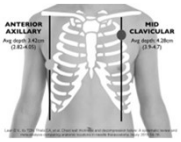
Management of PTX with Occlusive Dressings or other devices

- **Occlusive Dressing**- can be fashioned from plastic placed over an open PTX and taped on three sides to allow gas to escape.
- **Needle Decompression**- Current recommendation (ACS) favors anterior axial approach (ICS 4 or 5) > midclavicular (2nd ICS) due to potential for vascular injury and failure to enter intrathoracic space.
- **Finger Thoracostomy** is also an option
- **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.



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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

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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

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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 life saving but may not be necessary in simple pneumothorax.

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