February EMS Training: Pulmonary Emergencies

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Goals

- Review airway anatomy and physiology for adults and pediatrics
- Review issues and techniques in airway management
- Review prehospital management of: COPD, Asthma, Croup, and Pneumonia
- Review smoke inhalation injury patterns
- Review of oxygen delivery devices for prehospital providers
Anatomy Review

Anatomy of Pulmonary Circulation

- Right pulmonary artery
- Three lobar arteries to right lung
- Right pulmonary veins
- Right atrium
- Right ventricle
- Aortic arch
- Left pulmonary artery
- Two lobar arteries to left lung
- Pulmonary trunk
- Left pulmonary veins
- Left atrium
- Left ventricle
Anatomy of the Upper Airway

- Frontal sinus
- Nasal conchae
- Nasal vestibule
- External nares
- Hard palate
- Oral cavity
- Tongue
- Mandible
- Hyoid bone
- Thyroid cartilage
- Cricoid cartilage
- Esophagus
- Trachea
- Internal nares
- Nasopharynx
- Pharyngeal tonsil
- Entrance to auditory tube
- Soft palate
- Palatine tonsil
- Oropharynx
- Laryngopharynx
- Epiglottis
- Glottis
- Vocal chord
- Vallecula
Internal Anatomy of the Upper Airway

- Epiglottis
- Lesser cornu
- Hyoid bone
- Extrinsic ligament
- Ventricular fold
- Vocal cords
- Thyroid cartilage
- Intrinsic ligament
- Cricoid cartilage
- Arytenoid cartilage
- Pyriform fossae
- Tracheal cartilages

Cricothyroid membrane
Anatomy of the Lower Airway

Lung Sound Flyby...
You hear “rhonchi” in the bronchi
Anatomy of the Pediatric Airway

- Relatively greater proportion of soft tissue
- Larynx more superior and anterior
- Epiglottis rounder and floppier
- Smaller jaw
- Cricoid cartilage – narrowest part of the pediatric airway
- Loosely attached mucous membranes
In the supine position, an infant’s or child’s larger head tips forward, causing airway obstruction.
Placing padding under the patient’s back and shoulders will bring the airway to a neutral alignment.
Airway Assessment

- Abnormal upper airway sounds
  - Snoring
  - Crowing
  - Gurgling
  - Stridor
What is the most common airway obstruction?

The tongue!
OXYGEN DELIVERY DEVICES
NASAL CANNULA

Ambient air containing 21% oxygen

100% oxygen

24% to 44% oxygen concentration delivered
NON-REBREATHER MASK

Delivered concentration approximately 90% oxygen

Ambient air sealed out

100% oxygen
HAND-HELD NEBULIZER (HHN)
IN-LINE NEBULIZER

• Depending on your agency or restock availability, In-Line Nebulizer set-ups can vary dramatically.

• Become familiar with your equipment

• Separate oxygen supplies are required for the BVM and the nebulizer
Bag-Valve Mask Devices
Pediatric bag-valve-mask device.
BVM Devices

- Self inflating and non-rebreathing valve
- Used with BLS or ALS airway maintenance device
- Use with apenic patient or diminished respiratory effort
- Provides blood/body fluid barrier
- Room air (21%) to 100% concentration
- Sense of lung compliance
- Difficult to master – tidal volume dependent on mask seal
- Complications
  - Inadequate tidal volume from poor technique, poor mask seal, and gastric distention
BVM Devices

• Method
  – Rescuer at patient’s head
  – Clear airway
  – Head tilt- chin lift
  – BLS or ALS airway
  – Tight seal on mouth with C-E positioning
  – One and two rescuer options
“C – E” Technique
Two-Person Technique
Side-by-Side Comparison
BVM Devices

• Method/Technique
  – Observe for gastric distension, changes in bag compliance, color changes, improvement in level of consciousness, air leak around mask
  – Trauma patients require in-line BVM
Pertrach

• More expensive than needle crichs, but really easy to use!
Pertrach Procedure

- Patient supine with head slightly extended if no cervical spine trauma suspected
- Locate the cricothyroid membrane
- Cleanse the overlying skin
Pertrach Use

ADULT PERTRACH®
DIRECTIONS FOR USE
Directions for Pertrach Disposable Emergency Cricothyrotomy or Emergency / Elective Tracheostomy Device

1. Remove dilator from the package and protective sheath and advance it into tracheostomy tube.
2. Landmark cricothyroid membrane. Either make an incision in the skin or simply insert Splitting Needle through skin directly over cricothyroid membrane, depending on local medical protocol.
3. While advancing Splitting Needle perpendicular to the skin, lightly pull back on the plunger of syringe. When air bubbles occur or you feel a break in resistance, cease advancement of Splitting Needle.
4. Incline needle more than 45 degrees toward carina and complete insertion. Always maintain the tip of the needle in the midline of the airway. Remove syringe.

5. Insert tip of dilator into the hub of Splitting Needle. Squeeze wings of needle together, then open them out completely to split the needle. Remove needle, continuing to pull it apart in opposite directions, while leaving dilator in trachea.

6. Place thumb on dilator knob while first and second fingers are curved under flange of trachea tube. By exerting pressure, advance dilator and tracheostomy tube into position until flange is against skin.

7. Remove dilator. Inflate cuff until you have control of the airway. Attach resuscitator or ventilator to tracheostomy tube. Secure tracheostomy tube around patient’s neck with twill tape.
Pertrach Insertion
CPAP

- Continuous positive airway pressure
- A form of noninvasive positive pressure ventilation
- Used in awake, spontaneously breathing patients who need ventilatory support
CPAP

- Positive pressure is measured in cmH$_2$O.
- Positive pressure helps inflate collapsed alveoli and improve oxygenation.
- Helps displace fluid in alveoli in left ventricular failure
CPAP

• Indications
  – Congestive heart failure
  – Pulmonary edema
  – COPD
  – Asthma
  – Pneumonia
CPAP Contraindications

- Apnea or agonal respirations
- Inability to follow commands
- Inability to maintain an airway
- Unresponsive
- Shock with cardiac insufficiency
- Cardiac arrest
- Vomiting
- Pneumothorax or chest trauma
- Tracheotomy
- Facial trauma
CPAP

• Procedure
  – Inform and coach the patient.
  – Minimize the patient's anxiety.
  – Obtain vital signs and $\text{SpO}_2$.
  – Have an adequate oxygen supply.
  – Place the patient in seated or semi-Fowler's position.
CPAP

• Procedure
  – Assemble and check the device.
  – Secure the mask with straps.
  – Provide pressure up to 10 cmH\textsubscript{2}O.
  – Continue to coach the patient.
CPAP

• Procedure
  – Do not discontinue CPAP unless contraindications arise or you are advised by medical direction.
  – Notify the receiving facility so they can prepare to transfer CPAP.
CPAP

• Assess effectiveness with these measures:
  – Respiratory rate
  – Heart rate
  – Systolic blood pressure
  – Oxygen saturation
  – End-tidal CO₂
  – Complaint of dyspnea

• Monitor for:
  – Pneumothorax
  – Gastric distention
  – Vomiting
  – Worsening of respiratory distress or failure
  – Decreased mental status
  – Intolerance of the device
Hazards of Overinflation

- Overinflation leads to serious complications.
  - In cardiac arrest, perfusion is decreased.
  - In spontaneously breathing patients, return to the left ventricle can be reduced.
COPD

• Obstructive pulmonary diseases
  – Emphysema
  – Chronic bronchitis
  – Asthma
Emphysema

- Destruction of alveolar walls and distention of alveoli
- Increased resistance to air flow
- Severe reduction in gas exchange
- Caused primarily by smoking
Emphysema Signs & Symptoms

- Anxious
- Dyspneic
- Accessory muscle use
- Thin, barrel-chested appearance
- Coughing
- Prolonged exhalation

- Diminished breath sounds
- Wheezing and rhonchi
- Pursed-lip breathing
- Difficulty breathing with exertion
Emphysema

• Clinical findings
  – Tachypnea
  – Tachycardia
  – Diaphoresis
  – Normal low pulse oximetry
    • 90-94% could be normal
  – On home oxygen
CODE 30
Acute Asthma/COPD With Wheezing

Don’t get lured by the Oxygen Demon...

COPD patients don’t typically require high amounts of oxygen. In fact, two published studies concluded that prehospital administration of high flow oxygen may lead to increase mortality rates and poor clinical outcomes.
CODE 30
Acute Asthma/COPD With Wheezing

Don’t get lured by the Oxygen Demon...

COPD patients are believed to breathe through a process called hypoxic drive. This means that they are adjusted to low oxygen levels in the blood. They typically retain a higher level of CO2 than non-COPD patients.
Hypoxic Drive Theory:

Hypoxia:
Hypoxia is a condition of insufficient oxygen anywhere in the body, from the inspired gas to the tissues.

Hypoxic Drive Theory:
Hypoxic Drive Theory is a form of respiratory drive in which the body uses oxygen chemo-receptors instead of carbon dioxide receptors to regulate the respiratory cycle.

It is believed when a patient has chronically elevated CO2, that CO2 levels stop being the drive to breath, and that low oxygen levels becomes the main drive to breath.
Treatment for COPD patients

- Per CODE 30
  - Initial Medical Care
    - Oxygen at 2-6L/min
    - If severe distress or cyanosis, 15L NRB
  - DO NOT DELAY TRANSPORT
    - These patients decompensate rapidly
    - Delay may lead to respiratory failure, require intubation
  - Treat wheezes with Albuterol
    - May administer in-line if patient is intubated
  - CPAP may be applied at the discretion of Medical Control
ASTHMA

• Symptoms present in a similar way as those of COPD
  – Anxious
  – Dyspneic
  – Accessory muscle use
  – Diminished breath sounds
  – **Wheezing and rhonchi**
  – Pursed-lip breathing
  – Difficulty breathing with exertion

Dominantly heard in the middle lungs
Asthma

• Pathophysiology
  – Bronchial walls are normally thicker and contain some mucous in an asthma patient
  – Asthma “attacks” have triggers
    • Temperature
    • Humidity
    • Allergens/Exposure to toxins in the air
    • Acute respiratory infections
  – During an asthma “attack”
    • Bronchial walls thicken even further
    • Increase in bronchial mucous secretions
    • Air goes in easy but cannot be exhaled very well
    • Alveolar sacs trap air, cannot push through bronchial swelling and mucous to exit the lungs
This is a normal asthmatic airway

This is what happens during an asthma attack
Asthmatic Bronchioles

- Oxygen
- Carbon dioxide
- Tightened muscle bands
- Bronchioles
- Alveoli
- Excess mucus
Treating Acute Asthma Attacks

• Initial Medical Care
  – Do not delay transport
    • These patients decompensate rapidly when not responding to therapies
• Start oxygen delivery low and titrate upward to relief
• Quickly administer bronchodilators (Albuterol)
• If bronchodilators are not working, contact Medical Control for discretionary orders
  • Epinephrine 1:1000, 0.01mg/kg (up to 0.3mg) SQ
CROUP
Croup

- Viral disease
- Affects children 6 months to 7 years old
- Most often caused by the parainfluenza virus
- Swollen tissue that narrows airway in the larynx (voicebox)
Signs and Symptoms

• The most common and obvious symptom of Croup is the “seal bark cough”
• Onset is usually in the evening to overnight hours
• Patient may appear short of breathe
  – Pay attention to
  – work of breathing
  – Accessory muscle use
  – Patient positioning
  – SKIN PARAMETERS ARE A TELLTALE SIGN OF RESPIRATORY DISTRESS
• Inhalation often results in a high-pitched wheezing
• These patients do not typically present with a fever, drooling, or lethargy (this would represent Epiglottitis)
Treatment

• CODE 55 – Pediatric Respiratory Distress
• Croup is rarely life threatening – but very unnerving for parents!
  – You may need to keep parent calm
• Reactive (Lower) Airway Disease
• Consider “Blow-By” treatments for agitated patients
Code 55
Pediatric Respiratory Distress

- Position of comfort
- Nebulized Albuterol (Ventolin) 2.5mg
- Pulse oximetry
- Cardiac monitor

- Support ABC’s
- Observe
- Keep warm
- TRANSPORT
Albuterol and Croup...Just saying...

• A great majority of croup patients respond just as well to humidified oxygen, or nebulized 0.9% Normal Saline
  – Ask any parent with a croupy child and they will tell you to bring them into a steamed up bathroom or even take them outside on a cold evening (cold temp will cause quick bronchoconstriction)

• Albuterol works GREAT on the bronchial tree but is hit-or-miss when it comes to dilation of the trachea

• For agitated children whose heart rate is already elevated, consider other options after discussion with Medical Control. LEAD THE CONVERSATION AND STATE YOUR CASE!!!
  – A rationale explanation from a critically thinking paramedic goes a LONG way in advocating for your patient!!!
What is it?

• Pneumonia is a common lung infection caused by bacteria, a virus or fungi.
• Treatment depends on the cause of your pneumonia, how severe your symptoms are, and your age and overall health.
• Most healthy people recover from pneumonia in one to three weeks, but pneumonia can be life-threatening.
• Pneumonia can be prevented—by getting an annual flu shot (as flu often leads to pneumonia), frequently washing your hands, and for people at high risk, getting a vaccine for pneumococcal pneumonia.
Signs & Symptoms

- Cough (with some pneumonias you may cough up greenish or yellow mucus, or even bloody mucus)
- Fever, which may be mild or high
- Shaking chills
- Shortness of breath, which may only occur when you climb stairs
- Sharp or stabbing chest pain that gets worse when you breathe deeply or cough
- Headache
- Excessive sweating and clammy skin
- Loss of appetite, low energy, and fatigue
- Confusion, especially in older people
Diagnosis

• It is impossible to narrow down a pneumonia in the prehospital setting.
• We CAN get half way there though....
• Physicians use two tools to diagnose a pneumonia:
  – Physical exam: In pneumonia, lungs may make crackling, bubbling, and rumbling sounds on inhalation. There may also be wheezing, and it may be hard to hear sounds of breathing in some areas of your chest.
  – Chest x-ray
What can EMS do?

- Administer fluids for fever and dehydration
- Treat shortness of breathe
- The primary treatment of shortness of breath due to pneumonia in the prehospital setting is preventing hypoxia with the application of supplemental oxygen.
  - These patients need early treatment with antibiotics for improvement of symptoms and disease resolution.
  - Often, pneumonia can exacerbate COPD; thus, Albuterol may be helpful in decreasing wheezing and dyspnea.
SMOKE INHALATION INJURIES

Fire Deaths Due to Smoke Inhalation Outnumber Fire Deaths Due to Burns

SMOKE INHALATION INJURIES

• During fires, smoke inhalation victims are unable to efficiently breathe through the nose, thereby decreasing inspiratory air filtration and enabling a greater amount of particle distribution in the airway. This subsequently leads to severe lung injury.

• Inhalation injury from smoke in fires may account for as many as 60-80% of fire-related deaths in the United States, many of which are preventable.
Smoke Inhalation Resulting in Loss of Consciousness

Reduced Gas Exchange and Build-up of Carbon Monoxide

- Eventual loss of consciousness
- Brain hypoxia from absence of O₂
- CO to the brain
- Formation of carboxyhemoglobin in bloodstream
- Alveolar sacs
- Pulmonary vein (deoxygenated blood to heart)
- Alveolus
- Capillary
- Pulmonary arteriole (deoxygenated blood from heart)
- CO₂
- CO

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Smoke Inhalation Injuries

• Smoke inhalation may produce injury through several mechanisms.
  – Heated air from a fire can cause significant thermal injury to the upper airway.
  – Particulate matter produced during combustion (soot) can mechanically obstruct and irritate the airways, causing reflex bronchoconstriction.
  – Noxious gases released from burning materials include carbon monoxide (CO) and hydrogen cyanide.
Smoke Inhalation Treatment

• DO NOT DELAY TRANSFER
• Secure the airway as needed, deliver high-flow oxygen by mask, and obtain IV access. Cardiac monitoring also is important for any patient with respiratory distress.
• Albuterol may be given as a treatment for wheezing
• If respiratory failure is present, the patient should have assisted ventilation and/or endotracheal intubation.
• Perform cricothyrotomy if airway obstruction is present or impending and an airway cannot be secured orally.
• Obtain a CO level at the scene if possible.