

**UNIT TERMINAL OBJECTIVE**

- 5-1 At the end of this unit, the EMT-Critical Care Technician student will be able to utilize the assessment findings to formulate a field impression and implement the treatment plan for the patient with respiratory emergencies.

**COGNITIVE OBJECTIVES**

At the completion of this unit, the EMT-Critical Care Technician will be able to:

- 5-1.1 Identify and describe the function of the structures located in the upper and lower airway. (C-1)
- 5-1.2 Discuss the physiology of ventilation and respiration. (C-1)
- 5-1.3 Identify common pathological events that affect the pulmonary system. (C-1)
- 5-1.4 Discuss abnormal assessment findings associated with pulmonary diseases and conditions. (C-1)
- 5-1.5 Compare various airway and ventilation techniques used in the management of pulmonary diseases. (C-3)
- 5-1.6 Review the pharmacological preparations that EMT-Critical Care Technicians use for management of respiratory diseases and conditions. (C-1)
- 5-1.7 Review the use of equipment used during the physical examination of patients with complaints associated with respiratory diseases and conditions. (C-1)
- 5-1.8 Describe the epidemiology, pathophysiology, assessment findings, and management for the following respiratory diseases and conditions: (C-1)
  - a. Bronchial asthma
  - b. Chronic bronchitis
  - c. Emphysema
  - d. Pneumonia
  - e. Pulmonary edema
  - f. Spontaneous pneumothorax
  - g. Hyperventilation syndrome
  - h. Pulmonary thromboembolism

**AFFECTIVE OBJECTIVES**

At the completion of this unit, the EMT-Critical Care Technician will be able to:

- 5-1.9 Recognize and value the assessment and treatment of patients with respiratory diseases. (A-2)
- 5-1.10 Indicate appreciation for the critical nature of accurate field impressions of patients with respiratory diseases and conditions. (A-2)

**PSYCHOMOTOR OBJECTIVES**

At the completion of this unit, the EMT-Critical Care Technician will be able to:

- 5-1.11 Demonstrate and record pertinent assessment findings associated with pulmonary diseases and conditions. (P-1)
- 5-1.12 Review proper use of airway and ventilation devices. (P-1)
- 5-1.13 Conduct a simulated history and patient assessment, record the findings, and report appropriate management of patients with pulmonary diseases and conditions. (P-3)

**DECLARATIVE**

- I. Introduction
- II. Anatomy and physiology review
  - A. Anatomy review
    - 1. Upper airway
    - 2. Lower airway
  - B. Global physiology of the pulmonary system
    - 1. Function
      - a. The respiratory system functions as a gas exchange system
      - b. 10,000 liters of air are filtered, warmed, humidified, and exchanged daily in adults
      - c. Oxygen is diffused into the bloodstream for use in cellular metabolism by the body's 100 trillion cells
      - d. Wastes, including carbon dioxide, are excreted from the body via the respiratory system
    - 2. Physiology
      - a. Ventilation
      - b. Diffusion
      - c. Perfusion
- III. General system pathophysiology, assessment, and management
  - A. Pathophysiology
    - 1. A variety of problems can impact the pulmonary system's ability to achieve its goal of gas exchange to provide for cellular needs and excretion of wastes
    - 2. Understanding these problems globally can enable the EMT-Critical Care Technician to quickly and effectively pinpoint probable causes and necessary interventions
    - 3. Specific pathophysiologies
      - a. Ventilation
        - (1) Upper airway obstruction
          - (a) Trauma
          - (b) Epiglottitis
          - (c) Foreign body obstruction
          - (d) Inflammation of the tonsils
        - (2) Lower airway obstruction
          - (a) Trauma
          - (b) Obstructive lung disease
          - (c) Mucous accumulation
          - (d) Smooth muscle spasm
          - (e) Airway edema
        - (3) Chest wall impairment
          - (a) Trauma
          - (b) Hemothorax
          - (c) Pneumothorax
          - (d) Empyema
          - (e) Pleural inflammation
          - (f) Neuromuscular diseases (such as multiple sclerosis or muscular dystrophy)
        - (4) Problems in neurologic control
          - (a) Brainstem malfunction
            - i) CNS depressant drugs
            - ii) CVA or other medical neurologic condition

- iii) Trauma
    - (b) Phrenic/ spinal nerve dysfunction
      - i) Trauma
      - ii) Neuromuscular diseases
  - b. Diffusion
    - (1) Inadequate oxygen concentration in ambient air
    - (2) Alveolar pathology
      - (a) Asbestosis, other environmental lung diseases
      - (b) Blebs/ bullae associated with chronic obstructive lung disease
      - (c) Inhalation injuries
    - (3) Interstitial space pathology
      - (a) Pulmonary edema
        - i) High pressure (also known as cardiogenic)
          - a) Left heart failure
          - b) Idiopathic pulmonary hypertension
        - ii) High permeability (also known as non-cardiogenic)
          - a) Acute Respiratory Distress Syndrome (ARDS)
          - b) Environmental lung diseases i.e. asbestosis,
          - c) Near-drowning
          - d) Post-hypoxia
          - e) Inhalation injuries
  - c. Perfusion
    - (1) Inadequate blood volume/ hemoglobin levels
      - (a) Hypovolemia
      - (b) Anemia
    - (2) Impaired circulatory blood flow
      - (a) Pulmonary embolus
    - (3) Capillary wall pathology
      - (a) Trauma
- B. Assessment Findings
  - 1. Scene size up
    - a. Pulmonary complaints may be associated with exposure to a wide variety of toxins, including carbon monoxide, toxic products of combustion, or environments which have deficient ambient oxygen (e.g., silos, enclosed storage spaces)
    - b. It is critical to assure a safe environment for all EMS personnel before initiating patient contact
    - c. If necessary, individuals with specialized training and equipment should be utilized to remove the patient from a hazardous environment
  - 2. Initial assessment
    - a. A major focus of the initial assessment is the recognition of life-threat; there are a variety of pulmonary conditions which may offer a very real risk for patient death
    - b. Recognition of life-threat and the initiation of resuscitation takes priority over detailed assessment
    - c. Signs of life-threatening respiratory distress in adults, listed from most ominous to least severe
      - (1) Alterations in mental status
      - (2) Severe cyanosis
      - (3) Absent breath sounds
      - (4) Audible stridor
      - (5) 1-2 word dyspnea

- (6) Tachycardia > 130 beats/ minute
- (7) Pallor and diaphoresis
- (8) The presence of retractions/ use of the accessory muscles
- 3. Focused history and physical examination
  - a. Chief complaint
    - (1) Dyspnea
    - (2) Chest pain
    - (3) Cough
      - (a) Productive
      - (b) Non-productive
      - (c) Hemoptysis
    - (4) Wheezing
    - (5) Signs of infection
      - (a) Fever/ chills
      - (b) Increased sputum production
  - b. History
    - (1) Previous experiences with similar/ identical symptoms
      - (a) The patient's subjective description of acuity is an accurate indicator of the acuity of this episode if the pathology is chronic
      - (b) Asking the patient "what happened the last time you had an attack this bad" is an extremely useful predictor of this episode's course
    - (2) Known pulmonary diagnosis
      - (a) If the diagnosis is not known to the EMT-Critical Care Technician, an effort should be made to learn whether it is primarily related to ventilation, diffusion, perfusion, or a combination
    - (3) History of previous intubation is an accurate indicator of severe pulmonary disease, and suggests that intubation may be required again
    - (4) Medication history
      - (a) Current medications
      - (b) Medication allergies
      - (c) Pulmonary medications
        - i) Sympathomimetic
          - a) Inhaled
          - b) Oral
          - c) Parenteral
        - ii) Corticosteroid
          - a) The presence of corticosteroid in the patient's home regimen strongly suggests severe, chronic disease
          - b) Inhaled
          - c) Oral (daily versus during exacerbations only)
          - d) Chromolyn sodium
          - e) Methylxanthines (theophylline preparations)
          - f) Antibiotics
      - (d) Cardiac-related drugs
    - (5) History of the present episode
    - (6) Exposure/ smoking history
  - c. Physical exam
    - (1) General impression
      - (a) Position

- i) Sitting
    - ii) "Tripod" position
    - iii) Feet dangling
  - (b) Mentation
    - i) Confusion is a sign of hypoxemia or hypercarbia
    - ii) Restlessness and irritability may be signs of fear and hypoxemia
    - iii) Severe lethargy or coma is a sign of hypercarbia
  - (c) Ability to speak
    - i) 1-2 word dyspnea versus ability to speak freely
    - ii) Rapid, rambling speech is a sign of anxiety and fear
  - (d) Respiratory effort
    - i) Hard work indicates obstruction
    - ii) Retractions
    - iii) Use of accessory muscles
  - (e) Color
    - i) Pallor
    - ii) Diaphoresis
    - iii) Cyanosis
      - a) Central
      - b) Peripheral
- (2) Vital signs
  - (a) Pulse
    - i) Tachycardia is a sign of hypoxemia and the use of sympathomimetic medications
    - ii) In the face of a pulmonary etiology, bradycardia is an ominous sign of severe hypoxemia and imminent cardiac arrest
  - (b) Blood pressure
    - i) Hypertension may be associated with sympathomimetic medication use
  - (c) Respiratory rate
    - i) The respiratory rate is not a very accurate indicator of respiratory status unless it is very slow
    - ii) Trends are essential in evaluating the chronic patient.
      - a) Slowing rate in the face of an unimproved condition suggests exhaustion and impending respiratory insufficiency
  - (d) Respiratory patterns
    - i) Eupnea
    - ii) Tachypnea
    - iii) Cheyne-Stokes
    - iv) Central neurogenic hyperventilation
    - v) Kussmaul
    - vi) Ataxic (Biot's)
    - vii) Apneustic
    - viii) Apnea
- (3) Head/ neck
  - (a) Pursed lip breathing
  - (b) Use of accessory muscles

- (c) Sputum
  - i) Increasing amounts suggest infection
  - ii) Thick, green, or brown sputum suggests infection and/ or pneumonia
  - iii) Yellow or pale gray sputum may be related to allergic or inflammatory etiologies
  - iv) Frank hemoptysis often accompanies severe tuberculosis or carcinoma
  - v) Pink, frothy sputum is associated with severe, late stages of pulmonary edema
- (d) Jugular venous distention may accompany right-sided heart failure, which may be caused by severe pulmonary obstruction
- (4) Chest
  - (a) Signs of trauma
  - (b) Barrel chest demonstrates the presence of long-standing chronic obstructive lung disease
  - (c) Retractions
  - (d) Symmetry
  - (e) Breath sounds
    - i) Normal
    - ii) Abnormal
      - a) Stridor
      - b) Wheezing
      - c) Rhonchi (low wheezes)
      - d) Rales (crackles)
- (5) Extremities
  - (a) Peripheral cyanosis
  - (b) Carpopedal spasm may be associated with hypocapnia resulting from periods of rapid, deep respiration
- d. Diagnostic testing
  - (1) Pulse oximetry
    - (a) Used to evaluate or confirm the adequacy of oxygen saturation
    - (b) May be inaccurate in the presence of conditions which abnormally bind hemoglobin, including carbon monoxide poisoning or methemoglobinemia
  - (2) Peak flow
    - (a) Provides a baseline assessment of airflow for patients with obstructive lung disease
  - (3) Capnometry
    - (a) Provides ongoing assessment of endotracheal tube position; end-tidal CO<sub>2</sub> drops immediately when the tube is displaced from the trachea
    - (b) Quantitative versus qualitative
- C. Management
  - 1. Airway and ventilatory support
    - a. Manual airway opening maneuvers
    - b. Oropharyngeal airway
    - c. Nasopharyngeal airway
    - d. Nasal cannula
    - e. Simple oxygen mask

- f. Non-rebreather mask
        - g. Multi-lumen airway
        - h. Bag-valve-mask
        - i. Suctioning
        - j. Endotracheal tube
        - k. Oxygen powered manually triggered ventilators
        - l. Automatic transport ventilator
      - 2. Circulatory support
      - 3. Pharmacological interventions
        - a. Oxygen
        - b. Sympathomimetic
          - (1) Beta 2 agonists (e.g., albuterol - Proventil, Ventolin, metaproterenol sulfate - Alupent)
          - (2) Epinephrine
      - 4. Non-pharmacological interventions
        - a. Positioning - sitting up
        - b. Back blows
      - 5. Monitoring and devices
        - a. Pulse oximetry
        - b. Peak flow
        - c. Capnometry
      - 6. Transport considerations
        - a. Appropriate mode
        - b. Appropriate facility
      - 7. Psychological support/ communication strategies
- IV. Specific illness
  - A. Obstructive airway disease
    - 1. A spectrum of diseases which affect a substantial number of individuals worldwide
    - 2. Diseases include asthma, COPD (which includes emphysema and chronic bronchitis)
    - 3. Epidemiology
      - a. Morbidity/ mortality
        - (1) Overall
        - (2) Asthma - 4-5% of US population
        - (3) 20% of adult males have chronic bronchitis
      - b. Causative factors
        - (1) Cigarette smoking
        - (2) Exposure to environmental toxins
        - (3) Genetic predisposition
      - c. Factors which may exacerbate underlying conditions
        - (1) Intrinsic
          - (a) Stress is a significant exacerbating factor, particularly in adults
          - (b) Upper respiratory infection
          - (c) Exercise
        - (2) Extrinsic
          - (a) Tobacco smoke
          - (b) Allergens (including foods, animal danders, dusts, molds, pollens)
          - (c) Drugs
          - (d) Occupational hazards
    - 4. Pathophysiology overview
      - a. Obstruction occurs in the bronchioles, and may be the result of

- (1) Smooth muscle spasm
  - (a) Beta receptors
- (2) Mucous
  - (a) Goblet cells
  - (b) Cilia
- (3) Inflammation
- b. Obstruction may be reversible or irreversible
- c. Obstruction causes air trapping through the following mechanism
  - (1) Bronchioles dilate naturally on inspiration
  - (2) Dilation enables air to enter the alveoli despite the presence of obstruction
  - (3) Bronchioles naturally constrict on expiration
  - (4) Air becomes trapped distal to obstruction on exhalation
- 5. Specific pathophysiology
  - a. Asthma
    - (1) Reversible obstruction
    - (2) Obstruction caused by a combination of smooth muscle spasm, mucous, and edema
    - (3) Exacerbating factors tend to be extrinsic in children, intrinsic in adults
    - (4) Status asthmaticus - prolonged exacerbation which does not respond to therapy
  - b. Chronic bronchitis
    - (1) Reversible and irreversible obstruction
    - (2) Characterized by hyperplasia and hypertrophy of mucous-producing glands
    - (3) Clinical definition - productive cough for at least 3 months per year for 2 or more consecutive years
    - (4) Typically associated with cigarette smoking, but may also occur in non-smokers
  - c. Emphysema
    - (1) Irreversible airway obstruction
    - (2) Diffusion defect also exists because of the presence of blebs
    - (3) Because blebs have extremely thin walls, they are prone to collapse
    - (4) To prevent collapse, the patient often exhales through pursed lips, effectively maintaining a positive airway pressure
    - (5) Almost always associated with cigarette smoking or significant exposure to environmental toxins
- 6. Assessment findings
  - a. Signs of severe respiratory impairment
    - (1) Altered mentation
    - (2) 1-2 word dyspnea
    - (3) Absent breath sounds
  - b. Chief complaint
    - (1) Dyspnea
    - (2) Cough
    - (3) Nocturnal awakening with dyspnea and wheezing
  - c. History
    - (1) Personal or family history of asthma and/ or allergies
    - (2) History of acute exposure to pulmonary irritant
    - (3) History of prior similar episodes
  - d. Physical findings
    - (1) Wheezing may be present in ALL types of obstructive lung disease



- (2) Retractions and/ or use of accessory muscles
    - e. Diagnostic testing
      - (1) Pulse oximeter to document degree of hypoxemia and response to therapy
      - (2) Peak flow to establish baseline airflow
  - 7. Management
    - a. Airway and ventilatory support
      - (1) Intubation as required
      - (2) Assisted ventilation may be necessary
      - (3) High flow oxygen
    - b. Circulatory support
      - (1) Intravenous therapy may be necessary to
        - (a) Improve hydration
        - (b) Thin and loosen mucous
    - c. Pharmacological interventions
      - (1) Beta 2 agonists
    - d. Transport considerations
      - (1) Appropriate mode
      - (2) Appropriate facility
      - (3) Continue monitoring
      - (4) Contact medical direction
    - e. Psychological support/ communication strategies
- B. Pneumonia
  - 1. Epidemiology
    - a. Incidence
      - (1) Fifth leading cause of death in the US
      - (2) Not a single disease, but a group of specific infections
    - b. Risk factors
      - (1) Cigarette smoking
      - (2) Alcoholism
      - (3) Exposure to cold
      - (4) Extremes of age (old or young)
  - 2. Anatomy and physiology review
    - a. Cilia
    - b. Causes and process of mucous production
  - 3. Pathophysiology
    - a. Ventilation disorder
    - b. Infection of lung parenchyma
      - (1) Most commonly bacterial
      - (2) May also be viral or fungal
    - c. May cause alveolar collapse (atelectasis)
    - d. Localized inflammation/ infection may become systemic, leading to sepsis and septic shock
    - e. Community acquired versus hospital acquired
  - 4. Assessment findings
    - a. Typical pneumonia
      - (1) Acute onset of fever and chills
      - (2) Cough productive of purulent sputum
      - (3) Pleuritic chest pain (in some cases)
      - (4) Pulmonary consolidation on auscultation
      - (5) Location of bronchial breath sounds

- (6) Rales
- b. Atypical pneumonia
  - (1) Non-productive cough
  - (2) Extra- pulmonary symptoms
  - (3) Headache
  - (4) Myalgias
  - (5) Fatigue
  - (6) Sore throat
  - (7) Nausea, vomiting, diarrhea
  - (8) Fever and chills
- 5. Management
  - a. Airway and ventilatory support
    - (1) Intubation may be required
    - (2) Assisted ventilation as necessary
    - (3) High flow oxygen
  - b. Circulatory support
    - (1) Intravenous access
    - (2) Administration of IV fluids
      - (a) Improve hydration
      - (b) Thin and mobilize mucous
  - c. Pharmacological interventions
    - (1) Beta 2 agonists may be required if airway obstruction is severe or if the patient has accompanying obstructive lung disease
  - d. Non-pharmacological interventions
    - (1) Cool if high fever
  - e. Transport considerations
    - (1) Appropriate mode
    - (2) Appropriate facility
  - f. Psychological support/ communication strategies
- C. Pulmonary edema
  - 1. Not a disease, but a pathophysiological condition
    - a. High pressure (cardiogenic)
    - b. High permeability (non-cardiogenic)
  - 2. Epidemiology
    - a. Risk factors vary based on type
      - (1) High pressure (cardiogenic)
        - (a) Acute myocardial infarction
        - (b) Chronic hypertension
        - (c) Myocarditis
      - (2) High permeability (non-cardiogenic)
        - (a) Acute hypoxemia
        - (b) Near-drowning
        - (c) Post cardiac arrest
        - (d) Post shock
        - (e) High altitude exposure
        - (f) Inhalation of pulmonary irritants
        - (g) Adult Respiratory Distress Syndrome (ARDS)
  - 3. Anatomy and physiology review
  - 4. Pathophysiology
    - a. Diffusion disorder

- b. High pressure (cardiogenic)
    - (1) Left-sided heart failure
    - (2) Increase pulmonary venous pressure
    - (3) Increase in hydrostatic pressure
    - (4) Engorgement of pulmonary vasculature
    - (5) Failure of cough and lymphatics to drain fluids
    - (6) Excessive accumulation of fluid in the interstitial space
    - (7) Widening interstitial space impairs diffusion
    - (8) In severe cases, fluid may accumulate in the alveoli
  - c. High permeability (non-cardiogenic)
    - (1) Disruption of the alveolar-capillary membranes caused by
      - (a) Severe hypotension
      - (b) Severe hypoxemia (post drowning, post cardiac arrest, severe seizure, prolonged hypoventilation)
      - (c) High altitude
      - (d) Environmental toxins
      - (e) Septic shock
    - (2) Disrupted membranes leak fluid into the interstitial space
    - (3) Widened interstitial space impairs diffusion
5. Assessment findings
- a. High pressure (cardiogenic)
    - (1) Refer to Cardiac Emergencies unit
  - b. High permeability (non-cardiogenic)
    - (1) History of associated factors
      - (a) Hypoxic episode
      - (b) Shock (hypovolemic, septic, or neurogenic)
      - (c) Chest trauma
      - (d) Recent acute inhalation of toxic gases or particles
      - (e) Recent ascent to high altitude without acclimatizing
    - (2) Dyspnea
    - (3) Orthopnea
    - (4) Fatigue
    - (5) Reduced exercise capacity
    - (6) Pulmonary rales, particularly in severe cases
  - c. Diagnostic testing
6. Management
- a. High pressure (cardiogenic)
    - (1) Airway and ventilatory support
      - (a) Intubation as necessary
      - (b) Assisted ventilation as necessary
      - (c) High flow oxygen
    - (2) Circulatory support
      - (a) Avoid fluid excess; monitor IV flow rates carefully
    - (3) Pharmacological interventions
      - (a) Nitroglycerine
      - (b) Furosemide
      - (c) Morphine sulfate
    - (4) Non-pharmacological interventions
      - (a) Position the patient in an upright position with legs dangling
    - (5) Transport decisions

- (a) Appropriate mode
        - (b) Appropriate facility
      - (6) Psychological support/ communication strategies
    - b. High permeability (non-cardiogenic)
      - (1) Airway and ventilatory support
        - (a) Intubation as necessary
        - (b) Assisted ventilation as necessary
        - (c) High flow oxygen
      - (2) Circulatory support
        - (a) Avoid fluid excess; monitor IV flow rates carefully
      - (3) Pharmacological interventions
      - (4) Non-pharmacological interventions
        - (a) Position the patient in an upright position with legs dangling
        - (b) Rapid removal from any environmental toxins
        - (c) Rapid descent in altitude if high altitude pulmonary edema (HAPE) is suspected
      - (5) Transport considerations
        - (a) Appropriate mode
        - (b) Appropriate facility
      - (6) Psychological support/ communication strategies
- D. Pulmonary thromboembolism
  - 1. Epidemiology
    - a. Incidence
      - (1) Responsible for 50,000 death annually
      - (2) 5% of sudden deaths
    - b. Morbidity/ mortality
      - (1) Less than 10% of pulmonary emboli result in death
    - c. Risk factors
      - (1) Recent surgery
      - (2) Pregnancy
      - (3) Oral contraceptives
      - (4) Infection
      - (5) Cancer
      - (6) Sickle cell anemia
      - (7) Long bone fractures
      - (8) Prolonged inactivity
      - (9) Bedridden
  - 2. Anatomy and physiology review
  - 3. Pathophysiology
    - a. Perfusion disorder
    - b. Deep vein stasis
    - c. Injury to vein wall
    - d. Hypercoagulability
    - e. Platelet aggregation
    - f. Embolism size
    - g. Embolism location in the legs
    - h. Embolism location in the lungs
    - i. Complete loss of perfusion in some area of lungs
    - j. Other causes of pulmonary circulation obstruction
      - (1) Air

- (2) Fat
- (3) Foreign objects
- (4) Venous catheters
- (5) Amniotic fluid
- 4. Assessment findings - depend on size and location of the clot
  - a. Evidence of significant life-threatening embolus in a proximal location
    - (1) Altered mentation
    - (2) Severe cyanosis
    - (3) Profound hypotension
    - (4) Cardiac arrest
  - b. Chief complaint
    - (1) Chest pain
    - (2) Dyspnea
    - (3) Cough (typically non-productive)
  - c. History
    - (1) Sudden onset
    - (2) Identification of risk factors
  - d. Physical findings
    - (1) Normal breath sounds or, in severe cases, rales
    - (2) Pleural friction rub
    - (3) Tachycardia
    - (4) Clinical evidence of thrombophlebitis (found in less than 50%)
    - (5) Tachypnea
    - (6) Hemoptysis (fairly rare)
- 5. Management - prevention has major role in management
  - a. Depends on the size of the embolism
  - b. Airway and ventilatory support
    - (1) Intubation as necessary
    - (2) Positive pressure ventilation as necessary
    - (3) High flow oxygen
  - c. Circulatory support
    - (1) CPR as necessary
    - (2) IV therapy; hydration based on clinical symptoms
  - d. Pharmacological interventions
  - e. Non-pharmacological interventions
    - (1) Support body systems
    - (2) Most severe cases will be managed as a cardiac arrest of unknown origin
  - f. Transport considerations
    - (1) Appropriate mode
    - (2) Appropriate facility
  - g. Psychological support/ communication strategies
- E. Spontaneous pneumothorax
  - 1. Epidemiology
    - a. Incidence
      - (1) 18 per 100,000
    - b. Morbidity/ mortality
      - (1) 15-20% partial pneumothorax may be well tolerated
    - c. Risk factors
      - (1) Males
      - (2) Younger age

- (3) Thin body mass
      - (4) History of COPD (secondary spontaneous pneumothorax)
    - 2. Assessment findings
      - a. Chief complaint
        - (1) Shortness of breath
        - (2) Chest pain
        - (3) Sudden onset
      - b. Physical findings
        - (1) Typically minor
          - (a) Pallor
          - (b) Diaphoresis
          - (c) Tachypnea
        - (2) Severe
          - (a) Altered mentation
          - (b) Cyanosis
          - (c) Tachycardia
          - (d) Decreased unilateral breath sounds
          - (e) Local hyperresonance to percussion
          - (f) Subcutaneous emphysema
    - 3. Management
      - a. Airway and ventilatory support
        - (1) Intubation as necessary
        - (2) Assisted ventilation as necessary
        - (3) Oxygen - administration levels based on symptoms and pulse oximetry
        - (4) Watch for the development of a tension pneumothorax
      - b. Circulatory support
        - (1) IV initiation if severe symptoms present
      - c. Pharmacological interventions
        - (1) Not typically necessary; treat symptomatically
      - d. Non-pharmacological interventions
        - (1) Position of comfort/ best ventilation
        - (2) Needle decompression if progression to a tension pneumothorax occurs
      - e. Transport considerations
        - (1) Appropriate mode
        - (2) Appropriate facility
      - f. Psychological support/ communication strategies
- F. Hyperventilation syndrome
  - 1. Epidemiology
    - a. Incidence is unknown
  - 2. Pathophysiology
    - a. Tachypnea without physiologic demand for increased oxygen causes respiratory alkalosis
    - b. Tachypnea caused by anxiety resulting in respiratory alkalosis
    - c. Carbon dioxide is washed out and carbonic acid is reduced
      - (1) Shift in the acid/ base balance occurs toward base
  - 3. Assessment findings
    - a. Chief complaint
      - (1) Dyspnea
      - (2) Chest pain
    - b. Physical findings

- (1) Rapid breathing with high minute volume
- (2) Varying depending on cause of syndrome
- (3) Carpopedal spasms
- c. Caution there are multiple causes of tachypnea that are not hyperventilation syndrome but cause increased oxygen demand
  - (1) Hypoxia
  - (2) High altitude
  - (3) Pulmonary disorders
  - (4) Pneumonia
  - (5) Pulmonary emboli, vascular disease
  - (6) Bronchial asthma
  - (7) Cardiovascular disorders
  - (8) Congestive heart failure
  - (9) Hypotension/ shock
  - (10) Metabolic disorders
  - (11) Acidosis
  - (12) Hepatic failure
  - (13) Neurologic disorders
  - (14) Central nervous system infection, tumors
  - (15) Drugs
  - (16) Fever, sepsis
  - (17) Pain
  - (18) Pregnancy
- 4. Management
  - a. Depends on cause of syndrome
  - b. Airway and ventilatory support
    - (1) Oxygen, rate of administration based on symptoms and pulse oximetry
    - (2) If anxiety hyperventilation is confirmed (especially based on patient's prior history) coached ventilation/ rebreathing techniques might be considered
  - c. Circulatory support
    - (1) Intervention rarely required
  - d. Pharmacological interventions
    - (1) Intervention rarely required
  - e. Non-pharmacological interventions
    - (1) Intervention rarely required
    - (2) Patients with anxiety hyperventilation will require psychological approaches to calm them
    - (3) Have them mimic your respiratory rate and volume
    - (4) Do not place bag over mouth and nose
  - f. Transport considerations
    - (1) Appropriate mode
    - (2) Appropriate facility
  - g. Psychological support/ communication strategies
    - (1) Depend on cause of hyperventilation