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Disorders of the Pleura, Mediastinum, and Chest Wall

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Objectives of Lecture

- To briefly review pertinent clinical anatomy above the diaphragm and beneath the thoracic inlet
- To gain a deeper understanding of the major disorders of the pleura, mediastinum, and chest wall commonly seen in emergency medicine clinical practice

Major Disorders of the Pleura, Mediastinum and Chest Wall

- Mediastinal Masses
- Costochondritis
- Mediastinitis
- Pleural Effusions and Empyema
- Pleurisy
- Pneumomediastinum
- Pneumothorax

Anatomy Highlights

- Pleura
  - Membranous coverings of lungs and chest wall
  - Visceral and parietal components
  - Rich network of lymphatics and capillaries
- Visceral Pleura
  - Lines the surface of the lungs
  - Has no sensory nerves
- Pareital Pleura
  - Lines the surface of the chest wall, diaphragm, and mediastinum
  - Sensory nerve endings – sharp, localizable pain increased with inspiration
  - Central diaphragmatic pleura innervated by phrenic nerve – referred pain to shoulder

Anatomy Highlights

- Pleural Space
  - Contains scant amount of fluid which moves, increases, and decreases - due to – hydrostatic, osmotic, and intrapleural forces
  - Intrapleural pressure is negative – allows lung to stay expanded
  - If intrapleural pressure becomes positive (due to air or fluid), lung can't expand, and becomes "collapsed"
    - Abnormal air – pneumothorax
    - Abnormal blood – hemothorax
    - Abnormal liquid – pleural effusion
      - Transudates
      - Exudates

Costochondritis - Introduction

- Costochondritis is an inflammation of the anterior costal cartilages involving the costochondral and/or sternochondral joints.
- Two forms
  - Septic
  - Aseptic

Costochondritis Pathophysiologic Considerations

- Costochondral cartilage is avascular – nourished by vascular supply in tightly adherent perichondrium
- Avascular nature of cartilage makes treating septic costochondritis difficult
  - Invaded cartilage acts as a foreign body because of it's avascular nature

Costochondritis Etiologies and Risk Factors

- Septic Costochondritis
  - Surgical processes involving chest wall – median sternotomy most common
  - Hematogenous seeding in IVDAs
  - Blunt trauma to perichondrium w/hematogenous seeding from another source
- Aseptic Costochondritis
  - No well established risk factors and etiology often unknown

Costochondral Synonyms

- Anterior chest wall syndrome
- Costosternal syndrome
- Chest wall syndrome
- Costosternal chondrodynia
- Tietze's Syndrome

Tietze's Syndrome

- First described in 1921 by the German surgeon Alexander Tietze (1864-1927).
- Specific inflammation of the first two or three costochondral articulations.

Clinical Presentation, Signs and Symptoms in Costochondritis

- Presentation
  - Pain may be specifically localized or diffuse
  - Pain may be aching, sharp, dull, constant, or only with movement
  - Pain severity from minor irritation to escalating pain with autonomic symptoms
- Physical Exam
  - Should reveal tenderness over costosternal or costochondral junctions or cartilage
  - If swelling, septic etiology most common
  - “Crowing rooster maneuver” and “Horizontal arm flexion test”

Clinical Presentation, Signs and Symptoms in Costochondritis

- Diagnostic findings
  - Aseptic costochondritis is a clinical diagnosis – there are no laboratory or imaging tests which are specific
  - Septic costochondritis is best defined with nuclear medicine studies (gallium)
  - Clinical judgement dictates the need to perform CXR, EKG, and other heart-specific and lung-specific testing

Differential Diagnosis of Costochondritis

- Chest Wall
  - Muscular (myofascial, overuse syndromes)
  - Osseous (tumors, infection Sickle cell)
  - Articular (sternoclavicular, costovertebral)
  - Neurologic (dorsal roots/zoster, ventral roots/herniated disc)
  - Vascular (Mondor's syndrome)
  - Lymphatic (Hodgkin's)
  - Subcutaneous (lipoma, breast)

Differential Diagnosis of Costochondritis

- Gastrointestinal
  - Esophageal spasm
  - Esophagitis
  - Gastro esophageal reflux
  - Gastritis
- Cardiac
  - Myocardial ischemia
- Other Intrathoracic Abnormalities
  - Pulmonary embolus
  - Pleurisy
  - Pneumonia
  - Pericarditis
  - Atraumatic spontaneous pneumothorax

Treatment of Costochondritis

- Treat as any inflamed articulation with rest, heat, anti-inflammatory and analgesic medications

Mediastinitis - General Considerations

- Acute suppurative mediastinitis is a rapidly progressive infection which continues to carry a high mortality rate
- Pre-antibiotic era mortality rate of 50% has improved to only 40% in last 60 years
- Lethality is due to rapid spread and development of fulminant sepsis

Mediastinitis - Etiology and Pathophysiology

- **Etiology**
  - Esophageal perforation (most common)
  - Infections upper respiratory tract
  - Odontogenic infections
  - Trauma and procedures in airway, neck, chest
  - Impacted foreign body
- **Microbiology**
  - Polymicrobial with both aerobes and anaerobes

Mediastinitis - Clinical Presentation

- **Initial Symptoms**
  - Often very subtle
  - Fever, dyspnea, cough chest pain, abdominal pain, back pain
- **Physical Findings**
  - Variable
  - Edema of face, neck, arms chest
  - With progression, possible pericardial effusion, tracheobronchial compression
- **Further Complications**
  - Empyema
  - Erosion of aorta
  - Aspiration pneumonia
  - Costal Osteomeyelitis
- **Terminal Complications**
  - Hypotension
  - Shock
  - Mental confusion
  - Obtundation
  - Renal failure
  - Cardiovascular collapse

Mediastinitis - ED Management

- **Diagnosis**
  - High index of suspicion
  - CXR – widened mediastinum, enlarged cardiac silhouette, gas in soft tissues, air-fluid levels
  - If Dx unclear, may do CT, US, Gastrografin swallow, thoracentesis, pericardiocentesis
- **Treatment**
  - Early surgical consultation
  - Treatment individualized, including
    - Surgical debridement
    - Antibiotics w/anaerobic coverage
    - Hemodynamic support of sepsis and shock

Mediastinal Masses - Clinical Presentation

- 2/3 of patients are asymptomatic at time of diagnosis
- Those who are symptomatic most often have malignancy (80%)
- Symptoms extremely variable depending on location
- Cough, dyspnea, dysphagia, chest pain, superior vena cava syndrome

Masses that originate in mediastinal compartments

- Anterior Compartment
  - Thymomas and thymic related neoplasms
  - Lymphomas
  - Germ cell tumors
  - Cysts
  - Endocrine tumors
    - Thyroid
    - Parathyroid
  - Mesenchymal tumors
  - Primary carcinomas

Masses that originate in mediastinal compartments

- Middle Compartment
  - Lymphomas
  - Cysts
  - Mesenchymal tumors
  - Carcinomas
- Posterior Compartment
  - Neurogenic tumors
  - Cysts
  - Mesenchymal tumors
  - Esophageal neoplasms

Spontaneous Pneumothorax

- Pneumothorax – free air in the intrapleural space
- Spontaneous pneumothorax – occurs in the absence of any precipitating factor (traumatic or iatrogenic
- Primary spontaneous pneumothorax – no clinically apparent lung disease
- Secondary spontaneous pneumothorax – underlying pulmonary disease

Primary Spontaneous Pneumothorax

- 15/100,000/year for men
- 5/100,000/year for women
- Generally young men of taller than average height
- Cigarette smoking and changes in ambient pressure associated factors
- Marfan's Syndrome and Mitral Valve Prolapse higher frequency
- Unrelated to physical exertion

Secondary Spontaneous Pneumothorax

- 1/3rd of all pneumothoraces
- Incidence is three times higher in men
- High association with COPD (incidence of 0.8% in hospitalized patients)
- Occurs in 2% of patients with HIV/AIDS, generally in setting of Pneumocystis carinii pneumonia
- In any patient with cancer, pulmonary metastasis likely

Causes of Secondary Pneumothorax

- Airway Disease
  - COPD
  - Asthma
  - Cystic fibrosis
- Infections
  - Necrotizing bacterial pneumonia/lung abscess
  - Pneumocystis carinii pneumonia
  - Tuberculosis
- Interstitial Lung Disease
  - Sarcoidosis
  - Idiopathic pulmonary fibrosis
  - Lymphoangiomyomatosis
  - Tuberous sclerosis
  - Pneumoconiosis

Causes of Secondary Pneumothorax

- Neoplasms
  - Primary lung cancers
  - Pulmonary/pleural metastasis
- Miscellaneous
  - Connective tissue diseases
  - Pulmonary infarction
  - Endometriosis/catamenial pneumothorax

Catamenial Pneumothorax

- Rarely seen but hypothesized pathophysiology is rather groovy
- Recurrent spontaneous pneumothorax occurs in association with menses (generally within 72 hours)
- Also known as *thoracic endometriosis syndrome*
- Exact etiology unknown, but often responds to ovulation suppressing medications

Pathophysiologic Principles

- Intarpleural pressure
  - Negative w/inspiration, -10mmHg
  - Negative (less) w/expiration, -4mmHg
- Intrabronchial and intra-alveolar pressures
  - Negative w/inspiration, -2mmHg
  - Positive w/expiration, +2mmHg
- Any defect causes air to enter the pleural space until
  - Pressures equalize
  - Defect seals

Pathophysiologic Principles (Continued)

- With loss of negative intrapleural pressure
  - Ipsilateral lung collapse
  - Restrictive ventillatory impairment w/reduced VC, FRC, and TLV
  - V/Q mismatch leads to hypoxemia
- With tension pneumothorax
  - Pleural defect is one-way valve
  - Positive intrapleural pressure leads to compression of contralateral lung w/worsening hypoxia
  - Pressures exceeding 15-20 mmHg impairs venous return . . . cardiovascular collapse and death

Pathophysiologic Principles (Continued)

- Primary spontaneous pneumothorax
  - Rupture of a bleb (subpleural bulla) disrupts the alveolar-pleural barrier
  - Etiology of bullae felt to be due to degradation of elastic fibers in lung
- Secondary spontaneous pneumothorax
  - Underlying lung disease weakens the alveolar-pleural barrier

Clinical Features of Pneumothorax - Symptoms

- Ipsilateral chest pain and dyspnea
- Symptoms generally begin suddenly and while at rest
- Pain worsens w/inspiration
- Mild dyspnea, but extreme dyspnea uncommon (unless tension or underlying lung disease)

Pneumothorax - General Physical Findings

- Physical findings correlate with degree of symptoms and size
- Mild sinus tachycardia
- Decreased or absence breath sounds
- Hyperresonance to percussion
- Unilateral enlargement of the hemithorax
- Decreased excursions with respirations
- Absent tactile fremitus
- Inferior displacement of the liver or spleen
- NOTE – Absence of all or any of these does not exclude pneumothorax (always do a chest x-ray if you're remotely thinking of this diagnosis)

Tension Pneumothorax – Physical Findings

- Signs of asphyxia and decreased CO develop
- Tachycardia (120/min-plus) and hypoxia common
- Hypotension late and ominous
- JVD common
- Contralateral tracheal deviation classically described, actually rare

Pneumothx w/Lung Disease – Physical Findings

- Due to poor pulmonary reserve, dyspnea almost universal
- Physical findings (e.g., hyperexpansion, distant breath sounds, etc.) overlap with underlying lung disease
- Clinical diagnosis difficult
- Pneumothorax should be considered whenever a COPD patient presents with exacerbation of dyspnea

Pneumothorax
Classic Radiographic Appearance

- Diagnosis generally made via CXR
- Classic – thin, visceral pleural line parallel to the chest wall, separated by a radiolucent and devoid of lung tissue
- Average width of band can be used to estimate size – but best to characterize as "small, moderate, large, or total."
- Size important in management decisions

Pneumothorax
Additional Radiographic Issues

- Tension Pneumothorax
  - A clinical diagnosis – should not delay treatment to pursue x-rays
  - If diagnosis not suspected clinically, x-ray shows complete lung collapse, distention of thoracic cavity, and shift of mediastinal structures

Pneumothorax - Additional Radiographic Issues

- When pneumothorax suspected but not seen on x-ray . . .
  - Expiratory films may be of value
    - Volumes of lung are reduced w/expiration and relative size of pneumothorax increased
    - May identify apical pneumothorax
  - Lateral decubitus films
    - May show small amount of intrapleural air along lateral chest border

Pneumothorax - Additional Radiographic Issues

- When underlying lung disease exists
  - Paucity of lung markings makes diagnosis difficult
  - Giant bullae can simulate pneumothorax
    - (Pneumothorax runs parallel to chest wall – giant bulla gives a concave appearance)
    - Thoracic CT may be of value

Pneumothorax – Differential Diagnosis

- Acute pulmonary embolism
  - May present in identical fashion but without radiographic findings
- Acute pleural irritation from any cause
  - Pneumonia, tumor, etc. (most have radiographic findings)
- Acute myocardial infarction
  - Axis deviation, decreased QRS voltage, and T-wave inversions may occur due to mechanical displacement of heart, increased intrathoracic air, acute RV overload, or hypoxia

Spontaneous Pneumomediastinum

- Dx by finding of mediastinal air on CXR and presence of subcutaneous emphysema
- Primary spontaneous pneumomediastinum
  - Often w/exertion following Valsalva maneuver
  - Generally in absence of lung disease
  - Generally a benign course
- Secondary causes
  - Treatment aimed at underlying disorder (e.g., Boerhaave's Syndrome, etc.)

Spontaneous Hemopneumothorax

- Rare but potentially serious
- Lung collapse associated with rupture of vessel in pareitopleural adhesion
- May present as hemorrhagic shock
- Tx w/large-caliber tube thoracostomy (i.e., evacuate pleural space, expand lung, tamponade bleeding)

Management – Tension Pneumothorax

- One of our true emergency diagnoses where rapid recognition and treat truly can make a difference
- Condition worsens with each passing moment and each additional breath
- Do not delay treating for x-ray
- Decompress immediately – whether needle or tube depends on your skills set and where you're at
- Needle thoracostomy is not definitive – always needs to be followed by prompt tube thoracostomy.

Management – Spontaneous Pneumothorax

- Two Primary Goals
  - To evacuate air from the pleural space
  - To prevent recurrence
- Treatment decisions need to be individualized regarding
  - Size of pneumothorax
  - Presence of underlying disease
  - Other comorbidities
  - History of previous pneumothoraces
  - Patient reliability
  - Persistence of air leak
  - Patient reliability for follow-up

Management – Spontaneous Pneumothorax

- Young, healthy patients w/small primary pneumothorax (less than 20%)
  - Observation alone
  - Reabsorption rate of 1-2%/day
  - Rate accelerated x4 w/O_2
  - Admit for 6 hr observation
  - DC if not increase in 6 hrs
  - Good discharge instructions for responsible patients

Management – Spontaneous Pneumothorax

- Primary spontaneous pneumothorax greater than 20%
  - IV catheter aspiration or chest tube drainage
  - IV catheter
    - Low morbidity, cost savings lack of invasiveness
    - Success rates of 45-70%
    - Observe for 6 hrs and DC
    - If failure, may attach catheter to water seal device, or go to chest tube drainage

(Packham S, Jaiswal P: Spontaneous pneumothorax: Use of aspiration and outcomes of management by respiratory and general physicians. *Postgrad Med J* 79:345, 2003.)

Pneumothorax Management - Tube Thoracostomy

- Widely used and treatment of choice in many circumstances
- Indicated for:
  - Large primary spontaneous pneumothoraces
  - Secondary spontaneous pneumothoraces
  - All tension pneumothoraces
  - All patients likely to need ventilation

Pneumothorax Management - Tube Thoracostomy

- Tubes
  - Primary spontaneous pneumothorax
    - 7F-14F
  - Secondary spontaneous pneumothorax
    - 20F-28F
  - If pleural fluid or need for mechanical ventilation
    - Great than 28F

Pneumothorax Management - Tube Thoracostomy

- After insertion, attach to water seal device
  - Left in place until lung expanded and air leak ceased
  - Heimlich valve may be used (one-way flutter valve)
- Application of Suction
  - No longer recommended after standard tube thoracostomy
  - Does not increase rate of lung re-expansion nor improve outcome
  - Suction (20 cm H_2O) used if lung undergoes no re-expansion in 24-48 hours

Outcomes of Pneumothorax

- Primary Spontaneous Pneumothorax
  - Most resolve in 7 days
  - Air leak longer than 2 days less likely to resolve – air leak longer than 4-7 days generally needs surgery
- Secondary Spontaneous Pneumothorax
  - Failure of tube thoracostomy more common due to diseases lading to larger air leak
- Recurrence Rates
  - Primary: 30%
  - Secondary: 50%
  - Recurrence increased w/younger age, low weight/height ratio, and smoking

Pneumothorax Recurrence

- Intervention
  - Preventive treatment indicated if recurrence could be life-threatening, or if patient continues in risky activities (diving, flying)
  - Intervention types
    - Pleurodesis w/sclerosing agents or via pleural abrasion
    - Resection of apical bullae

Pleural Inflammation and Effusion

- Pleural Effusion
  - Abnormally large amount of fluid in the pleural space
  - Most common in Western countries – CHF, then CA, PE, pneumonia
  - Most common worldwide – TB
  - Other causes – uremia, cirrhosis, nephrotic syndrome, intra-abdominal processes, etc
  - Both transudates and exudates

Pleural Inflammation and Effusion – Other Definitions

- **Parapneumonic effusion**
  - effusion due to pneumonia, bronchiectasis, or absecess
- **Pleuritis**
  - inflammation of pleura
- **Complicated parapneumonic effusion**
  - PPE requiring chest tube for resolution
- **Loculated effusion**
  - Adhesions in pleural space
- **Empyema**
  - Pus in pleural space

Pathophysiologic Principles

- Pleural fluid produced from systemic capillaries at parietal pleura – absorbed into pulmonary capillaries at visceral pleura.
- Fluid governed by Starlings law – difference between hydrostatic pressure of systemic and pulmonic circulations
- When influx exceeds outflux, effusion develops
- Effusion may be transudate or exudate.

Transudative Pleural Effusions

- Transudates – ultrafiltrates of plasma with little protein
- Due to increases in hydrostatic pressure
- Primary cause is CHF (90%)
- Cirrhosis and nephrotic syndrome are remaining primary causes (although also have hypoproteinemia)

Exudative Pleural Effusions

- Contain high amounts of protein
- Reflect an abnormality of the pleura itself (increased membrane permeability or lymphatic drainage)
- Any pulmonary or pleural process may result in exudate
- Parapneumonic effusion is most common
- Massive effusions (1/5-2 L) generally due to malignancy

Causes of Pleural Effusions

- **Transudates**
  - Congestive heart failure
  - Cirrhosis with ascites
  - Nephrotic Syndrome
  - Hypoalbuminemia
  - Myxedema
  - Peritoneal dialysis
  - Glomerulonephritis
  - Superior vena cava obstruction
  - Pulmonary embolism

Causes of Pleural Effusions

- **Exudates**
  - Infections
    - Bacterial pneumonia
    - Bronchiectasis
    - Lung abscess
    - Tuberculosis
    - Viral illness
    - Neoplasms
    - Primary lung cancer
    - Mesothelioma
    - Pulmonary/pleural metastasis
    - Lymphoma

Causes of Pleural Effusions

- Exudates
  - Connective Tissue Disease
    - Rheumatoid arthritis
    - Systemic lupus erythematosis
  - Abdominal/Gastrointestinal Disorders
    - Pancreatitis
    - Subphrenic abscess
    - Esophageal rupture
    - Abdominal surgery
  - Miscellaneous
    - Pulmonary infarction
    - Uremia
    - Drug reactions
    - Postpartum
    - Chylothorax

Clinical Features of Pleural Effusion – Symptoms and Signs

- History often indicates diagnosis (CHF, liver disease, uremia, malignancy).
- Symptoms most often due to underlying disease process
- Small pleural effusions – often asymptomatic
- New effusion – often localized pain or referral to shoulder
- Large effusion (> 500 ml) dyspnea on exertion or rest
- Acute pleuritic pain – think pleurisy or pulmonary infarction

Clinical Features of Pleural Effusion – Physical Findings

- Depend on size of effusion
- Often dominated or obscured by underlying disease process
- Classic Physical Findings
  - Diminished breath sounds
  - Dullness to percussion
  - Decreased tactile fremitus
  - Sometimes a localized pleural friction rub
  - With massive effusions – may see signs of mediastinal shift

Clinical Features of Pleural Effusion – X-Ray Findings

- Classic finding – blunting of the costophrenic angle in upright chest
- 250-500 ml of fluid necessary to visualize on AP or PA CXR
- < 250 ml – possibility to view on lateral upright
- >500 ml – obscured hemidiaphram with upright meniscus
- Massive effusion – total hemithoracic opacification

Clinical Features of Pleural Effusion – X-Ray Findings

- **Recumbent Patients**
  - Pleural fluid gravitates superiorly, laterally, and posteriorly
  - Large effusion may show diffuse haziness
  - Cross table lateral in supine position – posterior layering of effusion
  - Lateral decubitus (better) for detection of small effusions
  - Lateral decubitus w/slight Trendelenburg (best) can show as little as 5-15 ml pleural fluid

Management of Pleural Effusion – General Issues

- Management centers on treatment of the underlying disease process
- Circulatory or respiratory compromise a priority
- Treat serious conditions (e.g., PE, pneumonia) without delay

Management of Pleural Effusion – Pain Management

- **NSAIDS**
  - great for pleural pain
- **Opiates**
  - safe and effective
  - use with caution in elderly, debilitaed, COPD, etc., - respiratory depression

Thoracentesis in the ED - Philosophy

- Whether for diagnostic or therapeutic purposes, this needs to be an individualized decision
- In general, unless it's urgently needed for stabilization of the patient's respiratory or circulatory status, best deferred until the patient is admitted

Thoracentesis in the ED - Indications

- **Therapeutic Thoracentesis**
  - To promote urgently needed cardiorespiratory and hemodynamic stability
- **Diagnostic Thoracentesis**
  - To sort out potentially life-threatening circumstances in toxic patient (e.g., empyema, esophageal rupture)
- **Palliative Thoracentesis**
  - Symptomatic relief for known, recurrent malignant effusion, where ED discharge is expected post-procedure

Thoracentesis in the ED - Relative Contraindications

- Coagulopathy and bleeding disorders
- Pleural adhesions due to prior history of empyema have a high risk of pneumothorax

Thoracentesis in the ED - Complications

- Iatrogenic pneumothorax (get CXR post-procedure)
- Hemothorax
- Lung laceration
- Shearing of catheter tip
- Infection
- Transient hypoxia due to VQ mismatch
- Post-expansion pulmonary edema (generally only when > 1500 ml taken off rapidly in one session)
- Hypotension (in patients already intravascularly volume depleted)

Pleural Fluid Analysis Overview

- **Primary Goal**
  - Distinguish between transudates and exudates
  - Transudate directs attention to underlying process (CHF, Cirrhosis, Nephrotic Synd)
  - Exudate – need for more extensive evaluation
- **Pleural Fluid Analysis**
  - pH, protein, LDH, glucose, cell count, gram stain, culture
- **Light's Criteria**
  - 98% sensitivity for diagnosis of exudative effusion

Light's Criteria for Differentiating Transudates from Exudates

- Pleural fluid is considered an exudate if one or more of the following hold true:
  - Pl. Fl. Protein/Serum Protein > 0.5
  - Pl. Fl. LDH/Serum LDH > 0.6
  - Pl. Fl. LDH > 2/3 upper normal serum LDH

Pleural Fluid Analysis - Pleural Fluid Acidosis

- Acidosis is a marker of severe pleural inflammation
- pH less than 7.3 associated with parapneumonic effusions, malignancies, rheumatoid arthritis, tuberculosis, and systemic acidosis
- pH less than 7.0 strongly suggests empyema or esophageal rupture
- pH of 7.0 often exists with low glucose and high LDH
  - Very high probability of empyema
  - Tube thoracostomy indicated

Pleural Fluid Analysis - Bloody Effusion

- Suggests trauma, neoplasm, or pulmonary infarction
- Obtain hematocrit on fluid – if > 50%, a hemothorax exists
  - In the absence of trauma, usually indicates spontaneous rupture of tumor or blood vessel
  - Tube thoracostomy indicated
  - If bleeding > 200 ml/hr, thoracotomy indicated.

Pleural Fluid Analysis - Cell Count

- **Normal fluid** - < 1,000 WBC/cc
- **Exudate** - >10,000 WBC/cc
  - Neutrophil predominance
    - Acute Process
    - Pneumonia, PE, acute TB
  - Monocyte or lymphocyte predominance
    - Chronic process
    - Malignancy or chronic TB

Additional Pleural Fluid Analyses

- **Amylase**
  - Elevated in pancreatitis or esophageal rupture
- **Bacterial antigen testing**
  - May be done on parapneumonic effusion
- **Cytology**
  - Evaluation for malignancy

Key Concepts

- For healthy, young patients with a small (<20%) primary spontaneous pneumothorax, observation alone (with administration of 100% oxygen) is an appropriate treatment option; for larger symptomatic pneumothoraces, simple aspiration with an intravenous catheter is often successful.

Key Concepts

- In most cases of secondary spontaneous pneumothorax, tube thoracostomy should be considered because less invasive approaches are associated with lower rates of success.

Key Concepts

- Application of suction after routine tube thoracostomy is no longer recommended and does not accelerate lung re-expansion.

Key Concepts

- The most common cause of pleural effusion in Western countries is congestive heart failure, followed by malignancy and bacterial pneumonia; however, the diagnosis of pulmonary embolism should not be overlooked with a pleural effusion of uncertain etiology.

Key Concepts

- Therapeutic thoracentesis is indicated for the relief of acute respiratory or cardiovascular compromise.

Key Concepts

- The clearest indication for diagnostic thoracentesis in the emergency department is to diagnose immediately life-threatening conditions, such as empyema or esophageal rupture in a toxic patient; in most other cases diagnostic thoracentesis to distinguish between transudative and exudative processes can be deferred to the inpatient unit.

Bibliography

- Wolf E, Costosternal syndrome: its frequency and importance in differential diagnosis of coronary heart disease. *Arch Intern Med* 1976;136:189-191
- Howell JM, Differential diagnosis of chest discomfort and general approach to myocardial ischemia decision making. *Am J Emerg Med* 1991;9(6):571-579
- Fam AG, Smythe HA. Musculoskeletal chest wall pain. *Can Med Assoc J* 1985;133:379-389
- Fam AG. Approach to musculoskeletal chest wall pain. *Prim Care* 1988;15(4):767-78
- Ingram RJ: Management and outcome of pneumothorax in patients infected with human immunodefficiency divur. *Clin Infec Dis* 23:624, 1996
- Shaw KS, et al: Pediatric spontaneous pneumothorax. *Semin Pediatr Surg* 12:55, 2003
- Sahn SA: Spontaneous pneumothorax. *N Engl J Med* 342:868, 2000
- Soulsby T: British Thoracic Society guidelines for the management of spontaneous pneumothorax: Do we comply with them, and do they work? *J Accid Emerg Med* 15:317, 1998
- Werne CS: Left tension pneumotnorax masquerading as anterior myocardial infarction. *Ann Emerg Med* 14:164, 1985

Bibliography (continued)

- Noppen M, et al: Manual aspiration versus chest tube drainage in first episodes of primary spontaneous pneumothorax. A multicenter, prospective randomized pilot study. *Am J Respir Crit Care Med* 165:1240, 2002.
- Jain SK, Al-Kattan KM, et al: Spontaneous pneumothorax: Determinants of surgical intervention. *J Cardiovasc Surg (Torino)* 39:107, 1998
- Schramel FM, et al: Current aspects of spontaneous pneumothorax. *Eur Respir J* 10:1372,, 1997
- Massard G, Thomas P, Wihlm JM: Minimally invasive management for first and recurrent pneumothorax. *Ann Thorac Surg* 66:592, 1998
- Henschke CI, et al: Pleural effusions: Pathogenesis, radiologic evaluation, and therapy. *J Thoracic Imaging* 4:49, 1989
- Light RW: Pleural effusion due to pulmonary emboli. *Curr Opin Pulm Med* 7:198, 2001