Pleural effusions and Thoracentesis

I. Excessive accumulation of fluid in the pleural space
   a. imbalance between formation and removal

II. Mechanisms:
   a. Increased hydrostatic pressure- increased capillary wedge pressure with CHF
   b. Decreased oncotic pressure- due to hypoalbuminemia
   c. Increased negative pressure in pleural space- large atelectasis
   d. Separation of pleural surfaces, decreasing movement of fluid- like with a trapped lung
   e. Increased permeability 2/2 inflammatory mediators- pneumonia
   f. Impaired lymphatic drainage- blockage by tumor or fibrosis
   g. Movement of ascetic fluid from peritoneal space

III. Signs and Symptoms
   a. Accumulation of fluid produces a restrictive ventilatory defect and decreases total lung capacity, functional capacity, forced vital capacity
   b. May causes V-Q mismatches and compromise cardiac output
   c. Pleuritic chest pain, dyspnea, dry cough
   d. Reduced tactile fremitus, dullness on percussion, diminished breath sounds, pleural rub

IV. Imaging
   a. PA/lateral films- need at least 250ml of fluid before visible on PA
   b. Lateral decubitus is very sensitive, detecting effusions as small as 5ml in experimental studies
   c. U/S, CT

V. Diagnostic Thoracentesis
   a. Indications- new finding of pleural effusion, >10mm thick on lateral decub or u/s
      i. Observation warranted only in secure diagnoses: uncomplicated CHF and viral pleurisy
      ii. Unilateral effusion present, especially left sided
      iii. Bilaterally effusions, unequal sizes
      iv. Pleurisy
      v. Febrile
      vi. A-a oxygen gradient widened out of proportion
   b. Relative Contraindications
      i. Anticoagulation/bleeding diathesis, <25,000 platelets, Cr >6.0
      ii. Small volume of fluid
      iii. Active skin infection at needle insertion

References: Up to Date, Pleural effusions: Evaluation and Management. Cleveland Clinic Journal of Medicine October 2005, All table from CCJM article.
c. Parapneumonic effusions

VI. Types and Causes

a. Transudate: increase in hydrostatic pressure over oncotic pressure
b. Exudate: decrease in oncotic pressure, capillary protein leak and leakage of fluid 2/2 infection, malignancy, immunologic response, lymphatic, inflammation,

VII. Several tests to differentiate transudates from exudates

References: Up to Date, Pleural effusions: Evaluation and Management. Cleveland Clinic Journal of Medicine October 2005, All table from CCJM article.
a. Light’s Criteria (protein and ldh)

**TABLE 2**

**Light’s criteria for distinguishing transudative from exudative pleural fluid**

<table>
<thead>
<tr>
<th>Transudate</th>
<th>Exudate*</th>
<th>Serum Lactate Dehydrogenase</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 0.5</td>
<td>&gt; 0.5</td>
<td>≤ 200 U/L*</td>
</tr>
</tbody>
</table>

*2/3 upper limit of normal serum level
*A single positive criterion is enough to classify the fluid as an exudate

b. Protein, cholesterol, LDH

**TABLE 4**

**Newer criteria for classification of exudates and transudates**

<table>
<thead>
<tr>
<th>Transudate</th>
<th>Exudate*</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 45%*</td>
<td>&gt; 45%*</td>
</tr>
<tr>
<td>≤ 2.9 g/dL</td>
<td>&gt; 2.9 g/dL</td>
</tr>
</tbody>
</table>

*Of serum upper limit of normal

c. Psuedo-exudate: seen in patients with CHF receiving diuretics, initial picture consistent with exudates (with diuretic water moves from pleural fluid to blood, causing protein concentration to increase)

i. Should measure albumin levels: difference of 1.2 g/dl or less indicates exudates, difference greater than 1.2 g/dl indicates transudate

ii. Low cholesterol may also indicate transudate

Definitive diagnosis

**TABLE 5**

**Definitive diagnosis based on pleural fluid analysis**

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urinothorax</td>
<td>pH &lt; 7, transudate, pleural fluid-to-serum creatinine ratio &gt; 1</td>
</tr>
<tr>
<td>Empyema</td>
<td>pus, positive Gram stains or cultures</td>
</tr>
<tr>
<td>Malignancy</td>
<td>Positive cytologic testing</td>
</tr>
<tr>
<td>Chylothorax</td>
<td>Triglycerides &gt; 110 mg/dL, chylomicrons</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>Positive stains or cultures</td>
</tr>
<tr>
<td>Fungal infection</td>
<td></td>
</tr>
<tr>
<td>Hemothorax</td>
<td>Hematocrit &gt; 50% of blood</td>
</tr>
<tr>
<td>Esophageal rupture</td>
<td>pH &lt; 7, high amylase (salivary)</td>
</tr>
</tbody>
</table>

Each of these tests should be ordered based on clinical suspicion

Lab tests:

**TABLE 6**

**Pleural fluid tests**

- **On all effusions**
  - Protein
  - Lactate dehydrogenase
  - Cholesterol
  - Cell count and differential

- **On exudates**
  - Cytologic analysis
  - pH
  - Gram stain and culture
  - Fungal stain/culture
  - Acid-fast bacteria stain/culture

- **Other tests**
  - Glucose
  - Amylase
  - Adenosine deaminase or gamma-interferon level
  - Antinuclear antibody titer
  - Hematocrit
  - Triglycerides
  - Creatinine
  - Albumin

References: Up to Date, Pleural effusions: Evaluation and Management. Cleveland Clinic Journal of Medicine October 2005, All table from CCJM article.
VIII. Specific Tests
   a. Glucose- low glucose in ra, tb, empyema, malignancies
   b. pH- normally 7.64, lower pH in inflammatory and infiltrative processes, below 7.2 indicates poor outcome and need for drainage
   c. Amylase- elevated >200 U/dl in pancreatitis, malignancy, esophageal rupture

IX. Other diagnostic tests
   a. Pleural biopsy- Tb and malignancy
   b. Thoracoscopy- visualize lung, collect samples, VATs.

X. Specific Diseases
   a. SLE, RA
   b. TB
   c. Urinothorax
   d. After CABG
   e. Chylous effusion
   f. Pulmonary Embolism

XI. Therapy
   a. Therapeutic Thoracentesis
   b. Chest tube
   c. Pleural sclerosis (pleurodesis)
   d. Surgical Therapy (VATs)

XII. Diagnostic Approach

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<table>
<thead>
<tr>
<th>Pleural effusion confirmed radiographically</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symptomatic effusion with significant volume of fluid</td>
</tr>
<tr>
<td>Diagnostic thoracentesis with basic tests: Lactate dehydrogenase</td>
</tr>
<tr>
<td>Protein</td>
</tr>
<tr>
<td>Cholesterol</td>
</tr>
<tr>
<td>Cell count and differential*</td>
</tr>
</tbody>
</table>

Determine if fluid is a transudate or exudate (TABLE 2, TABLE 4), consider common causes (TABLE 1) |

No need to perform thoracentesis unless clinical deterioration occurs

*Cytopology may be ordered if malignant disease is suspected, if infection is considered in the differential diagnosis, then testing of the pH and glucose in pleural fluid must be ordered on initial evaluation.
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References: Up to Date, Pleural effusions: Evaluation and Management. Cleveland Clinic Journal of Medicine October 2005, All table from CCJM article.
Vinay Reddy, July 2006

Thoracentesis

Technique
Patient sitting up straight
Insert needle 1-2 interspaces below level of dull percussion
Find point at mid clavicular line, insert needle over superior aspect of rib (be careful in the elderly)
Skin, periosteum of rib, and parietal pleura infiltrated with 1% lidocaine, withdraw fluid with lidocaine needle
Withdraw no more than 1,000 to 1,500 ml at one time
Routine chest xray after is not indicated

Complications
Pain, bleeding, pneumothorax, empyema, infection,

References: Up to Date, Pleural effusions: Evaluation and Management. Cleveland Clinic Journal of Medicine October 2005, All table from CCJM article.