Pleural Fluid Analysis: Back to Basics

Tonya L. Page, MSN, RN, ACNP-BC
Patrick A. Laird, DNP, RN, ACNP-BC

Case Study
70 y/o female with complaints of shortness of breath and orthopnea for 1 month. Symptoms have worsened in last week. No recent infections. Reports low grade fever. 10 lb weight loss in the past 6 months.

History:
Hypertension taking Hydrochlorothiazide (Hctz)
100 pack-year history of smoking, Denies ETOH

Radiology Report:
A homogenous opacification is noted in the right lower zone with the opacity seen to track along the lateral chest wall. The right costophrenic angle is obliterated with a meniscus noted.

Diagnosis:
Right Pleural Effusion

AP Chest X-Ray

Pathophysiology

Normal Pleural Fluid Formation (Entry) = Absorption (Exit)

<table>
<thead>
<tr>
<th>Increased Formation</th>
<th>Decreased Absorption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased permeability</td>
<td>Intrinsic factors</td>
</tr>
<tr>
<td>Increase in microvascular pressure</td>
<td>Inflammation</td>
</tr>
<tr>
<td>Decrease in plasma osmotic pressure</td>
<td>Endocrine abnormalities</td>
</tr>
<tr>
<td>Decrease in pleural pressure</td>
<td>Injury or Anatomy</td>
</tr>
<tr>
<td>Cancer</td>
<td></td>
</tr>
<tr>
<td>Extrinsic factors</td>
<td>Respiratory factors</td>
</tr>
<tr>
<td>Atelectasis</td>
<td>Compression or Blockage</td>
</tr>
<tr>
<td>Increased Venous Pressure</td>
<td></td>
</tr>
</tbody>
</table>

Common Causes
- Heart Failure
- Atelectasis
- Pulmonary Embolism
- Cirrhosis
- Autoimmune conditions (lupus)

Common Causes
- Cancers
- Drug Induced
- Kidney Disease
- Infections (Pneumonia or TB)
Imaging Options
- Conventional Radiology (Chest X-Ray)
- Chest Ultrasound
- Computed Tomography
- MRI
- FDG-PET Scanning

To tap or not to tap….that is the question!
- **Tap**
  - Underlying cause is unknown
- **Not to Tap**
  - Small (≤ 1 cm)
  - Loculated effusions
  - CHF

Case Study
- Because the patient was symptomatic, a diagnostic and therapeutic thoracentesis using ultrasound guidance was performed
- A total of 1100 cc of dark red colored fluid removed

Routine Lab Tests
- Cell count and differential
- pH
- Protein
- Lactate dehydrogenase (LDH)

Routine Lab Tests
- Cytology
- Glucose
- Gram stain and culture

Selected Lab Tests
- Amylase
- Cholesterol
- Triglycerides
- Creatinine
- Adenosine deaminase
- AFB Stain and Culture
Fluid Analysis—Gross Appearance

- Color
- Character
- Odor

Diagnostic Criteria

- **Light’s Criteria**
  - Differentiate between transudative and exudative effusions
  - Pleural fluid protein to serum protein ratio > 0.5
  - Pleural fluid LDH > ⅔ the upper limit of normal
  - Pleural fluid LDH to serum LDH ratio > 0.6

- **Two-Test Rule**
  - Pleural fluid cholesterol > 45 mg/dL
  - Pleural fluid LDH > 0.45 times the upper limit of normal serum LDH

- **Three-Test Rule**
  - Pleural fluid protein > 2.9 g/dL
  - Pleural fluid pleural fluid cholesterol > 45 mg/dL
  - Pleural fluid LDH > 0.45 times the upper limit of normal serum LDH

Definitive Diagnoses by Pleural Fluid Analysis

<table>
<thead>
<tr>
<th>Disease</th>
<th>Diagnostic Pleural Fluid Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empyema</td>
<td>Purulent, putrid odor, positive culture</td>
</tr>
<tr>
<td>Malignancy</td>
<td>Positive cytology</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>Positive AFB stain, culture</td>
</tr>
<tr>
<td>Esophageal Rupture</td>
<td>Low pH, food fragments</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Disease</th>
<th>Diagnostic Pleural Fluid Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chylothorax</td>
<td>Fluid triglycerides &gt; 110 mg/dL</td>
</tr>
<tr>
<td>Cholesterol Effusion</td>
<td>Fluid cholesterol &gt; 200 mg/dL with a cholesterol to triglyceride ratio &gt; 1</td>
</tr>
</tbody>
</table>
Definitive Diagnoses by Pleural Fluid Analysis

<table>
<thead>
<tr>
<th>Disease</th>
<th>Diagnostic Pleural Fluid Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemothorax</td>
<td>Ratio of pleural fluid to blood hematocrit of &gt; 0.5</td>
</tr>
<tr>
<td>Urinothorax</td>
<td>Fluid creatinine to serum creatinine &gt; 1.7</td>
</tr>
</tbody>
</table>

Management

- **Thoracoscopy**
  - Symptomatic exudative pleural effusions without a diagnosis
  - Video-assisted

- **Pleurodesis**
  - Obliterates the pleural space to prevent recurrent pleural effusion
  - Chemical pleurodesis
    - Doxycycline
    - Talc pleurodesis most effective

- **Indwelling Pleural Catheter**
  - Allows for intermittent drainage
  - Can be left in place indefinitely

Management

- Talc pleurodesis **PLUS** indwelling catheter
  - Beneficial in patients with malignant pleural effusions

- Intrapleural fibrinolytic agents

Case Study--Lab Results

<table>
<thead>
<tr>
<th></th>
<th>Pleural Fluid</th>
<th>Serum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein</td>
<td>8 g/dL</td>
<td>7.5 g/dL</td>
</tr>
<tr>
<td>LDH</td>
<td>245 U/L</td>
<td>190 U/L</td>
</tr>
</tbody>
</table>
Case Study
What is your interpretation?
Does this patient meet the criteria for an exudative effusion?
Pleural Fluid Protein/Serum Protein = 1.07
Pleural Fluid LDH/Serum LDH = 1.29

YES!

Case Study
What is your interpretation?
Does this patient meet the criteria for an exudative effusion?
Pleural Fluid Protein/Serum Protein = 1.07

Pleural Fluid LDH/Serum LDH = 1.29

Cytology revealed adenocarcinoma
Patient developed recurrent pleural effusion
Drained >1.2 L on two separate occasions
Right sided indwelling pleural catheter placed
Patient was referred to Heme/Onc for further management

References


References


Contact Information

Tonya L. Page, MSN, RN, ACNP-BC
tonya.l.page@uth.tmc.edu

Patrick A. Laird, DNP, RN, ACNP-BC
patrick.a.laird@uth.tmc.edu