SEROUS FLUIDS: PLEURAL, PERITONEAL, PERICARDIAL FLUID ANALYSIS

Pleural, peritoneal and pericardial spaces contain a small amount of fluid (<2.5 ml) called serous fluid, which is just enough to keep the membrane linings moist. Formation of fluid in these body cavities is simultaneously controlled by four factors:

- Capillary permeability
- Fluid absorption by the lymphatic system
- Hydrostatic pressure (i.e., blood pressure) in these capillaries
- Oncotic (osmotic) pressure produced by presence of plasma proteins in these capillaries

If these four factors are “normal”, serous fluid does not accumulate because production and reabsorption take place at a constant rate. If there is an abnormality in one or more of these four factors, serous fluid does accumulate.

Definition of terms:
1. Serous fluid – fluid that has a composition similar to that of serum
2. Effusion – accumulation of fluid in a body cavity due to a pathologic process
3. Mesothelial cells – cells that cover the surface of serous membranes – lining cells

<table>
<thead>
<tr>
<th>Term</th>
<th>Area</th>
<th>Fluid Collection type</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Pleural</td>
<td>Lung</td>
<td>Thoracentesis</td>
</tr>
<tr>
<td>5. Pericardial</td>
<td>Heart</td>
<td>Pericardiocentesis</td>
</tr>
<tr>
<td>6. Peritoneal</td>
<td>Abdominal Cavity</td>
<td>Peritoneocentesis</td>
</tr>
</tbody>
</table>

7. Paracentesis – general term for puncture procedure to remove fluid from a body cavity
8. Ascites – synonymous with peritoneal fluid - ascites is serous fluid present in the peritoneal cavity
9. Transudates
   a. Caused by an increase in hydrostatic pressure or a decrease in plasma oncotic pressure; fluid moves out of the vessel and into the body cavity
   b. Non-inflammatory, a protein-poor fluid is produced
   c. Associated disease states include: CHF, cirrhosis, nephrotic syndrome (hypoproteinemia)
   d. Systemic, benign. Further testing is usually NOT indicated.

10. Exudates
    a. Caused by an increase in capillary permeability or decrease of absorption by lymphatics; fluid moves out of the vessel and into the body cavity
    b. Inflammatory, a protein-rich fluid is produced
    c. Associated disease states include: infection, malignancy/neoplasm, Rheumatoid Arthritis, trauma
    d. Localized, directly involves body cavity membranes. Further testing is indicated.

<table>
<thead>
<tr>
<th>Comparison of laboratory values</th>
<th>Transudates</th>
<th>Exudates</th>
</tr>
</thead>
<tbody>
<tr>
<td>turbidity</td>
<td>clear</td>
<td>cloudy</td>
</tr>
<tr>
<td>fluid-to-serum protein ratio</td>
<td>&lt;0.5</td>
<td>&gt;0.5</td>
</tr>
<tr>
<td>fluid-to-serum LD ratio</td>
<td>&lt;0.6</td>
<td>&gt;0.6</td>
</tr>
<tr>
<td>WBC cell count</td>
<td>&lt;1000/µl</td>
<td>&gt;1000/µl</td>
</tr>
</tbody>
</table>
11. WBC differential
   a. Normal (benign) cells that can be seen include polymorphonuclear cells (segmented and band neutrophils), mesothelial (lining) cells, lymphocytes, monocyte/macrophage/histiocytes (lymphs and monos are sometimes called mononuclear cells), eosinophils, basophils, mast cells, pyknotic cells
   b. Abnormal (benign) findings include erythrophages, hemosiderin-laden macrophages, infectious agents (bacteria, yeast eg. Cryptococcus)
   c. Abnormal (malignant) cells that may be seen include blast cells, lymphoma cells, tumor cells
   d. Entire cytopsin slide should be scanned on low power to look for presence of malignant cells. Differential is done on 100x (oil).

CASE #2 SEROUS FLUID ANALYSIS - PERITONEAL

A 48-year old woman presents with ascites and pleural effusion. Blood is drawn, and 30.0 cc of peritoneal fluid specimen is obtained by paracentesis and sent to the laboratory for evaluation.

PERITONEAL FLUID RESULTS

<table>
<thead>
<tr>
<th>Physical Exam</th>
<th>Microscopic Exam</th>
<th>Chemical Exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color: yellow</td>
<td>Leukocyte count: 8 cells/µL</td>
<td>Total protein: 2.9 g/dL</td>
</tr>
<tr>
<td>Turbidity: clear</td>
<td>PMNs 100%</td>
<td>LD: 125 U/L</td>
</tr>
<tr>
<td>Clots present: no</td>
<td>Glucose: 67 mg/dL</td>
<td></td>
</tr>
</tbody>
</table>

Gram stain: no organisms seen

BLOOD CHEMISTRY RESULTS:

Total protein: 6.5 g/dL (Reference range: 6.0 to 8.3 g/dL)
Lactate dehydrogenase (LD): 300 U/L (Reference range: 275 to 645 U/L)
Glucose, fasting: 82 mg/dL (Reference range: 70 to 110 mg/dL)
Liver function tests (ALT, AST, GGT, ALP): normal

Cytology examination performed on peritoneal fluid: no malignant cells seen

1. Calculate the fluid-to-serum total protein ratio.
2. Calculate the fluid-to-serum lactate dehydrogenase ratio.
3. Classify this peritoneal fluid specimen as a transudate or exudate.
4. Identify two conditions known to cause this type of effusion.
5. ____T/F Formation of the effusion in this patient could be caused by an increase in hydrostatic pressure or a decrease in oncotic pressure.
CASE #3  SEROUS FLUID ANALYSIS - PLEURAL

A 51-year old man with a history of tuberculosis presents with a unilateral pleural effusion. A pleural fluid specimen is obtained by thoracentesis and sent to the laboratory for evaluation.

**PLEURAL FLUID RESULTS**

<table>
<thead>
<tr>
<th>Physical Exam</th>
<th>Microscopic Exam</th>
<th>Chemical Exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color: yellow</td>
<td>Leukocyte count: 1100 cells/µL</td>
<td>Total protein: 4.2 g/dL</td>
</tr>
<tr>
<td>Turbidity: cloudy</td>
<td>Differential count:</td>
<td>LD: 345 U/L</td>
</tr>
<tr>
<td>Clots present: yes</td>
<td>Monocytes: 57%</td>
<td>Glucose: 55 mg/dL</td>
</tr>
<tr>
<td></td>
<td>Lymphocytes: 40%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PMNs: 3%</td>
<td></td>
</tr>
</tbody>
</table>

Gram stain: no organisms seen; leukocytes present

**BLOOD CHEMISTRY RESULTS**

- Total protein: 7.0 g/dL (Reference range: 6.0 to 8.3 g/dL)
- Lactate dehydrogenase (LD): 520 U/L (Reference range: 275 to 645 U/L)
- Glucose, fasting: 75 mg/dL (Reference range: 70 to 110 mg/dL)

1. Calculate the fluid-to-serum total protein ratio.
2. Calculate the fluid-to-serum lactate dehydrogenase ratio.
3. Classify this pleural fluid specimen as a transudate or exudate.
4. Identify two conditions known to cause this type of effusion.
5. Of what significance is the differential count and gram stain in this particular case?
6. Of what significance is the presence of clots in this specimen?