Serous fluids

Reference Books:

- **Urinanalysis and body fluids** (Susan King Strasinger- Marjorie Schaub De Lorenzo) Fifth edition

The closed cavities of the body—namely, the pleural, pericardial, and peritoneal cavities—are each lined by two membranes referred to as the serous membranes. One membrane lines the cavity wall ***(parietal membrane),*** and the other covers the organs within the cavity ***(visceral membrane).*** The fluid between the membranes is called ***serous fluid*****,** and it provides lubrication between the parietal and visceral membranes. Lubrication is necessary to prevent the friction between the two membranes that occurs as a result of movement of the enclosed organs.

Formation

Serous fluids are formed as ultrafiltrates of plasma. Under normal conditions, oncotic pressure from serum proteins is the same in the capillaries on both sides of the membrane. Therefore, the hydrostatic pressure in the parietal and visceral capillaries causes fluid to enter between the membranes. The filtration of the plasma ultrafiltrate results in increased oncotic pressure in the capillaries that favors reabsorption of fluid back into the capillaries. This produces a continuous exchange of serous fluid and maintains the normal volume of fluid between the membranes.

Specimen Collection and Handling

- Fluids for laboratory examination are collected by needle aspiration from the respective cavities. These aspiration procedures are referred to as ***thoracentesis*** (pleural), ***pericardiocentesis*** (pericardial), and ***paracentesis*** (peritoneal). Abundant fluid (greater than 100 mL) is usually collected.
- An ethylene diamine tetraacetic acid (EDTA) tube is used for cell counts and the differential. Sterile heparinized evacuated tubes are used for microbiology and cytology. Chemistry tests can be run on clotted specimens in plain tubes or on heparinized tubes.

Disruption of the mechanisms of serous fluid formation and reabsorption causes an increase in fluid between the membranes. This is termed an ***effusion*****.** Primary causes of effusions include increased hydrostatic pressure (congestive heart failure), decreased oncotic pressure (hypoproteinemia), increased capillary permeability (inflammation and infection), and lymphatic obstruction (tumors)

Transudates and Exudates

- A general classification of the cause of an effusion can be accomplished by separating the fluid into the category of ***transudate or exudate.***
- Effusions that form because of a systemic disorder that disrupts the balance in the regulation of fluid filtration and reabsorption—such as the changes in hydrostatic pressure created by congestive heart failure or the hypoproteinemia associated with the nephrotic syndrome are called **transudates.**
- **Exudates** are produced by conditions that directly involve the membranes of the particular cavity, including infections and malignancies.

Laboratory Differentiation of Transudates and Exudates

	Transudate	Exudate
Appearance	Clear	Cloudy
Fluid:serum protein ratio	<0.5	>0.5
Fluid:serum LD ratio	<0.6	>0.6
WBC count	<1000/μL	>1000/μL
Spontaneous clotting	No	Possible
Pleural fluid cholesterol	<45-60 mg/dL	>45-60 mg/dL
Pleural fluid:serum cholesterol ratio	<0.3	>0.3
Pleural fluid:bilirubin ratio	<0.6	>0.6
Serum-ascites albumin gradient	>1.1	<1.1

Pleural fluid

- Pleural fluid is obtained from the pleural cavity, located between the parietal pleural membrane lining the chest wall and the visceral pleural membrane covering the lungs. Pleural effusions may be of either transudative or exudative origin.
- Two procedures are helpful when analyzing pleural fluid to differentiate between transudates and exudates. These are the pleural fluid cholesterol and fluid : serum cholesterol ratio and the pleural fluid : serum total bilirubin ratio. A pleural fluid cholesterol greater than 60 mg/dL or a pleural fluid: serum cholesterol ratio greater than 0.3 provides reliable in formation that the fluid is an exudate. A fluid : serum total bilirubin ratio of 0.6 or more also indicates the presence of an exudate.

Correlation of Pleural Fluid Appearance and Disease

Appearance	Disease
Clear, pale yellow	Normal
Turbid, white	Microbial infection (tuberculosis)
Bloody	Hemothorax Hemorrhagic effusion, pulmonary embolis, tuberculosis, malignancy
Milky	Chylous material from thoracic duct leakage Pseudochylous material from chronic inflammation
Brown	Rupture of amoebic liver abscess
Black	Aspergillous
Viscous	Malignant mesothelioma (increased hyaluronic acid)

- To differentiate between a hemothorax and hemorrhagic exudate, a hematocrit can be run on the fluid. If the blood is from a hemothorax, the fluid hematocrit is more than 50% of the whole blood hematocrit, because the effusion is actually occurring from the inpouring of blood from the injury. A chronic membrane disease effusion contains both blood and increased pleural fluid, resulting in a much lower hematocrit.
- Chylous material contains a high concentration of triglycerides, whereas pseudochylous material has a higher concentration of cholesterol.

	Chylous Effusion	Pseudochylous Effusion
Cause	Thoracic duct leakage	Chronic inflammation
Appearance	Milky/white	Milky/green tinge
Leukocytes	Predominantly lymphocytes	Mixed cells
Cholesterol crystals	Absent	Present
Triglycerides	>110 mg/dL	<50 mg/dL
Sudan III staining	Strongly positive	Negative/weakly positive

Differentiation Between Chylous and Pseudochylous Pleural Effusions

Cell	Significance
Neutrophils	Pneumonia Pancreatitis Pulmonary infarction
Lymphocytes	Tuberculosis Viral infection Autoimmune disorders Malignancy
Mesothelial cells	Normal and reactive forms have no clinical significance Decreased mesothelial cells are associated with tuberculosis
Plasma cells	Tuberculosis
Malignant cells	Primary adenocarcinoma and small-cell carcinoma Metastatic carcinoma

Significance of Cells Seen in Pleural Fluid

Test	Significance
Glucose	Decreased in rheumatoid inflammation Decreased in purulent infection
Lactate	Elevated in bacterial infection
Triglyceride	Elevated in chylous effusions
pH	Decreased in pneumonia not responding to antibiotics Markedly decreased with esophageal rupture
ADA	Elevated in tuberculosis and malignancy
Amylase	Elevated in pancreatitis, esophageal rupture, and malignancy

Significance of Chemical Testing of Pleural Fluid

ADA: Adenosine deaminase

Pericardial Fluid

Normally, only a small amount (10 to 50 ml) of fluid is found between the pericardial serous membranes. Pericardial effusions are primarily the result of changes in the permeability of the membranes due to infection **(pericarditis),** malignancy, and trauma-producing exudates. Metabolic disorders such as uremia, hypothyroidism, and autoimmune disorders are the primary causes of transudates

Significance of Pericardial Fluid Testing

Test	Significance
Appearance	
Clear, pale yellow	Normal, transudate
Blood-streaked	Infection, malignancy
Grossly bloody	Cardiac puncture, anticoagulant medications
Milky	Chylous and pseudochylous material
Differential	
Increased neutrophils	Bacterial endocarditis
Malignant cells	Metastatic carcinoma
Carcinoembryonic antigen	Metastatic carcinoma
Gram stain and culture	Bacterial endocarditis
Acid-fast stain	Tubercular effusion
Adenosine deaminase	Tubercular effusion

Peritoneal Fluid

Accumulation of fluid between the peritoneal membranes is called ***ascites,*** and the fluid is commonly referred to as ascitic fluid rather than peritoneal fluid. In addition to the causes of transudative effusions discussed previously, hepatic disorders such as ***cirrhosis*** are frequent causes o ascitic transudates. Bacterial infections ***(peritonitis***)—often as a result of intestinal perforation or a ruptured appendix—and malignancy are the most frequent causes of exudative fluids

Significance of Peritoneal Fluid Testing

Test	Significance
Appearance	
Clear, pale yellow	Normal
Turbid	Microbial infection
Green	Gallbladder, pancreatic disorders
Blood-streaked	Trauma, infection, or malignancy
Milky	Lymphatic trauma and blockage
Peritoneal lavage	>100,000 RBCs/μL indicates blunt trauma injury
WBC count	
<500 cells/μL	Normal
>500 cells/μL	Bacterial peritonitis, cirrhosis
Differential	Bacterial peritonitis
	Malignancy

Carcinoembryonic antigen	Malignancy of gastrointestinal origin
CA 125	Malignancy of ovarian origin
Glucose	Decreased in tubercular peritonitis, malignancy
Amylase	Increased in pancreatitis, gastrointestinal perforation
Alkaline phosphatase	Increased in gastrointestinal perforation
Blood urea nitrogen/ creatinine	Ruptured or punctured bladder
Gram stain and culture	Bacterial peritonitis
Acid-fast stain	Tubercular peritonitis
Adenosine deaminase	Tubercular peritonitis