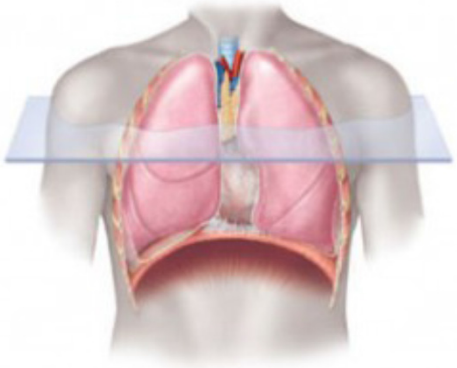
Pleural Effusion

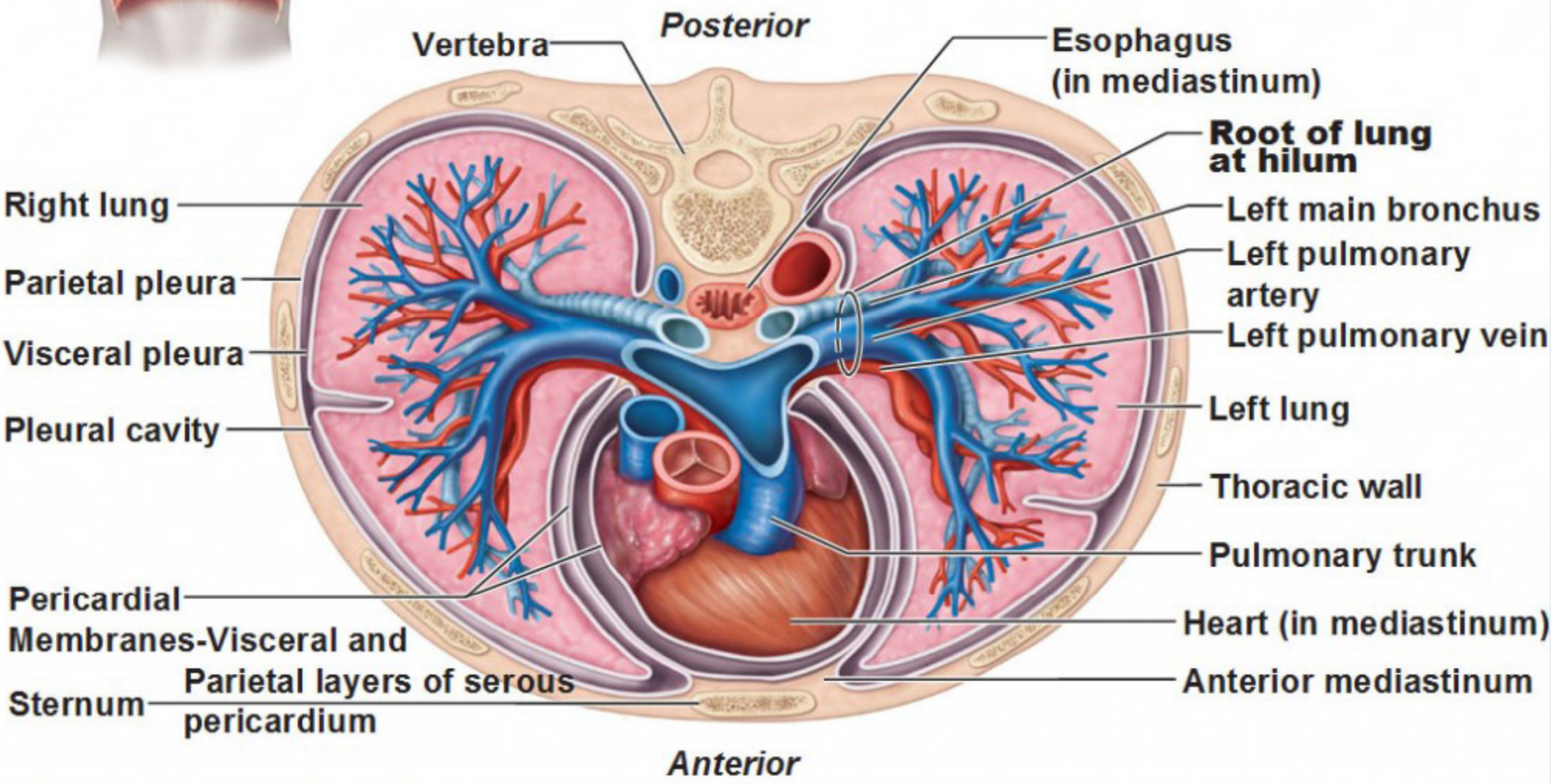
ABDULLAH ALHARBI , MD,FCCP

Objectives:

- Describe the pathophysiology of a pleural effusion
- Describe the main causes of a pleural effusion
- Differentiate among the manifestations of fluid collections
- Describe the signs and symptoms of a pleural effusion
- Explain diagnostic methods
- Describe the various treatment options

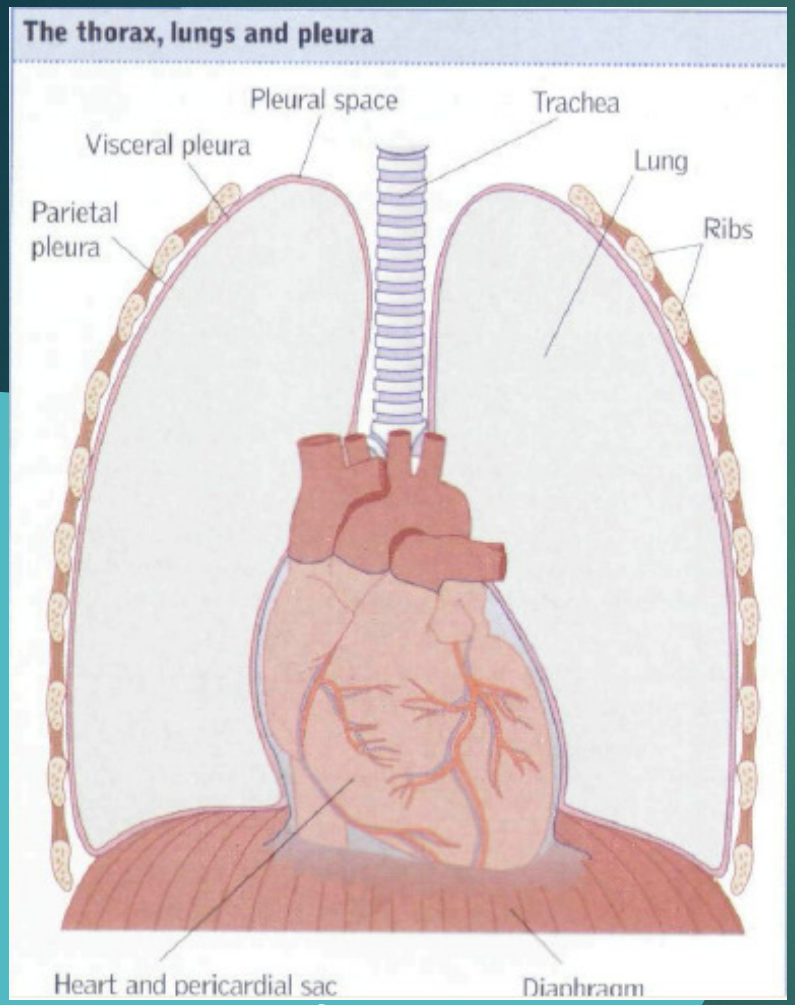
Pleurae



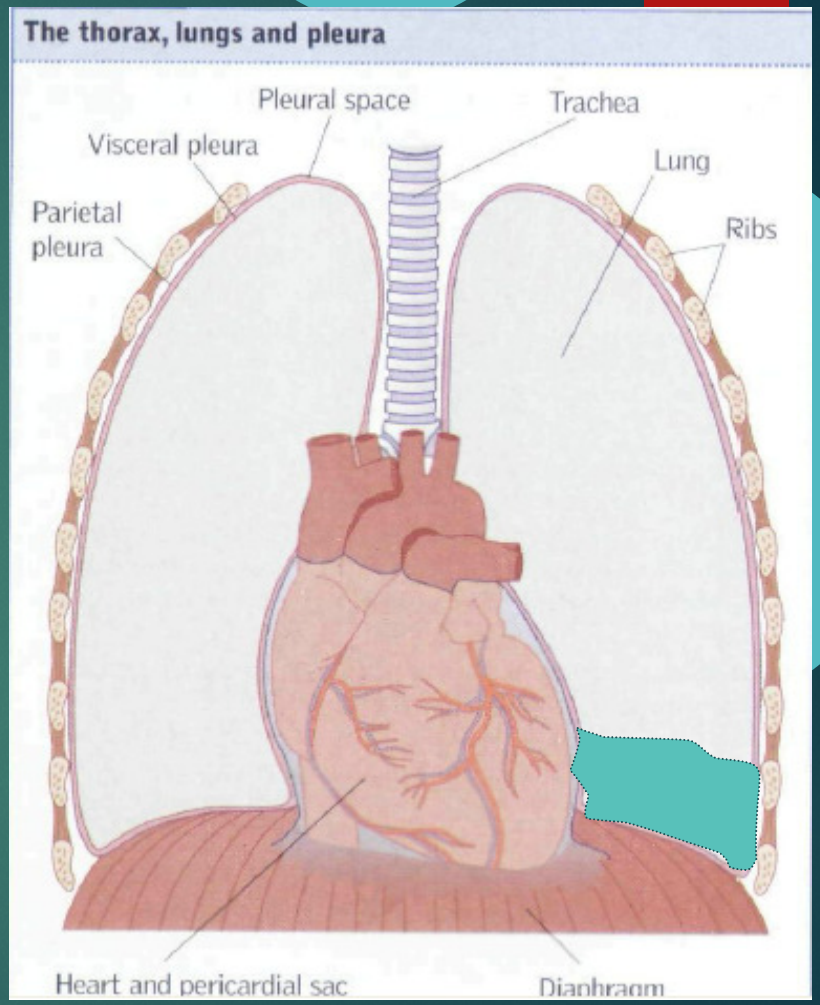


Transverse section through the thorax, viewed from above.

Lungs, pleural membranes, and major organs in the mediastinum are shown.


The thorax, lungs and pleura
Pleural space
Trachea
Visceral pleura
Lung
Parietal pleura
Ribs
Heart and pericardial sac
Diaphragm

)


The thorax, lungs and pleura
Pleural space
Trachea
Visceral pleura
Lung
Parietal pleura
Ribs
Heart and pericardial sac
Diaphragm

Pleura

- Serous fluid that allows for the parietal pleura (outer lining) and visceral pleura (inner lining) to glide over each other without separation
- contains about 5-15ml of fluid at one time
- Pleural fluid is produced by the parietal pleura and absorbed by the visceral pleura as a continuous process.
- The visceral pleura absorbs fluid, which then drains into the lymphatic system and returns to the blood
- about 100-200ml of fluid circulates though the pleural space within a 24-hour period

Clinical Presentation

- History
  - Dyspnea
  - Pleuritic chest pain
  - Cough
  - Other symptoms related to underlying cause
- Physical exam (Findings usually present for effusions > 300 mL)
  - Dullness to percussion, decreased tactile fremitus
  - Asymmetric chest expansion
  - Decreased breath sounds
  - Egophony
  - **Tracheal shift away from** the affected side

Development of Pleural Effusion

- ↑ **PULMONARY CAPILLARY PRESSURE** (CHF)
- ↑ **CAPILLARY PERMEABILITY** (Pneumonia)
- ↓ **INTRAPLEURAL PRESSURE** (atelectasis)
- ↓ **PLASMA ONCOTIC PRESSURE** (hypoalbuminemia)
- ↑ **PLEURAL MEMBRANE PERMEABILITY** (malignancy)

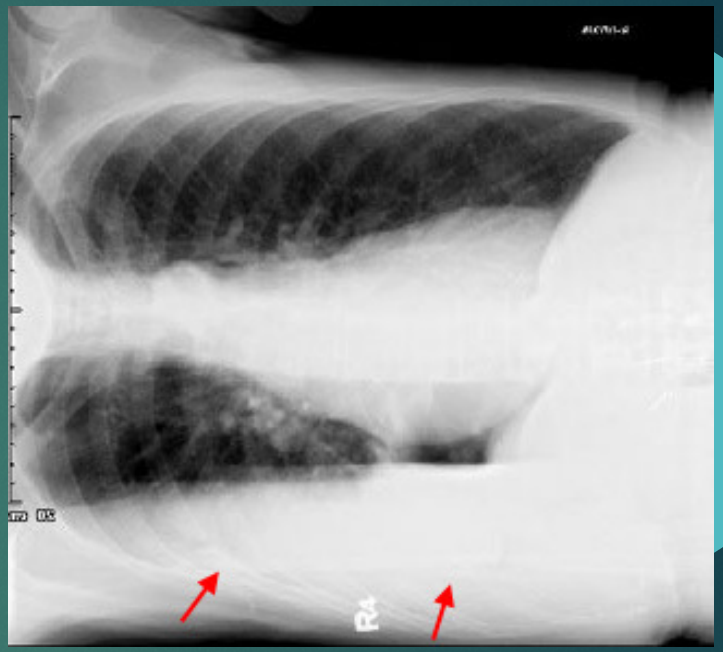
LYMPHATIC OBSTRUCTION (malignancy)

DIAPHRAGMATIC DEFECT (hepatic hydrothorax)

THORACIC DUCT RUPTURE (chylothorax)

Imaging Studies-Chest Radiographs

PA - usually around 250-500 mL needed before visible

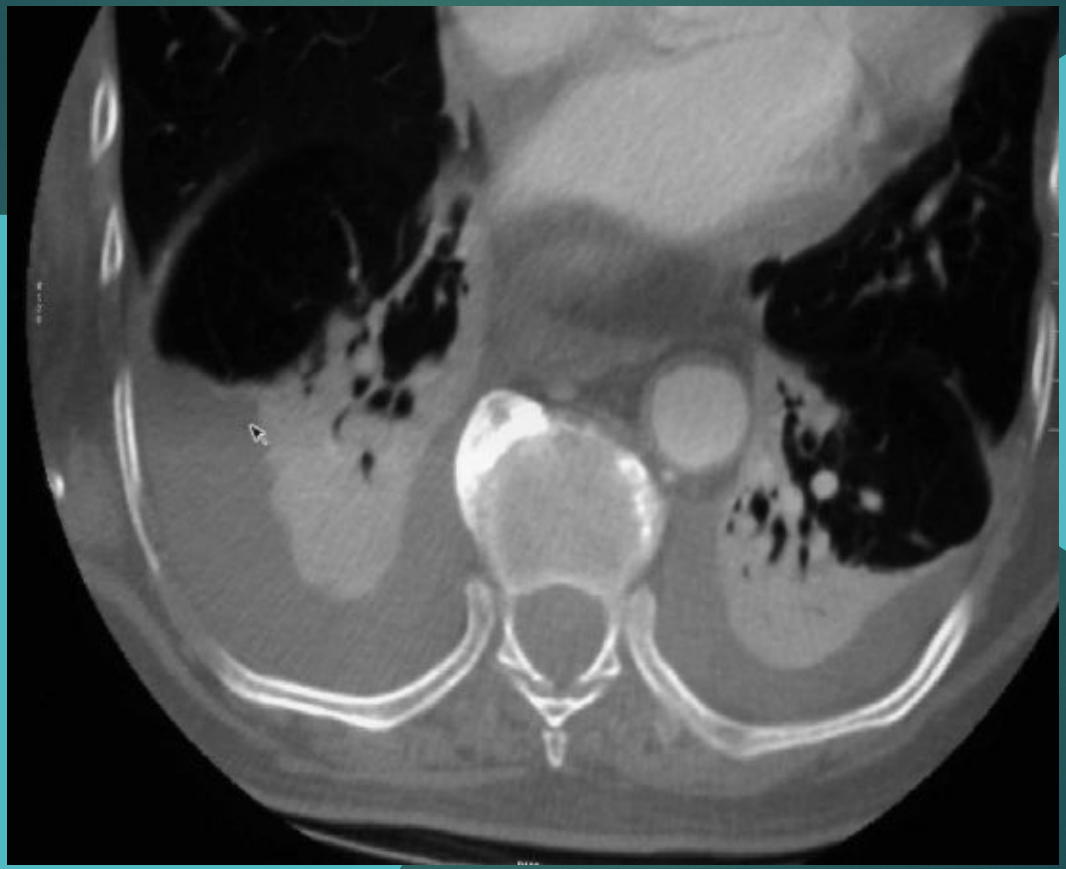


Lateral Decubitus – very sensitive, can detect effusions as small as 50 mL

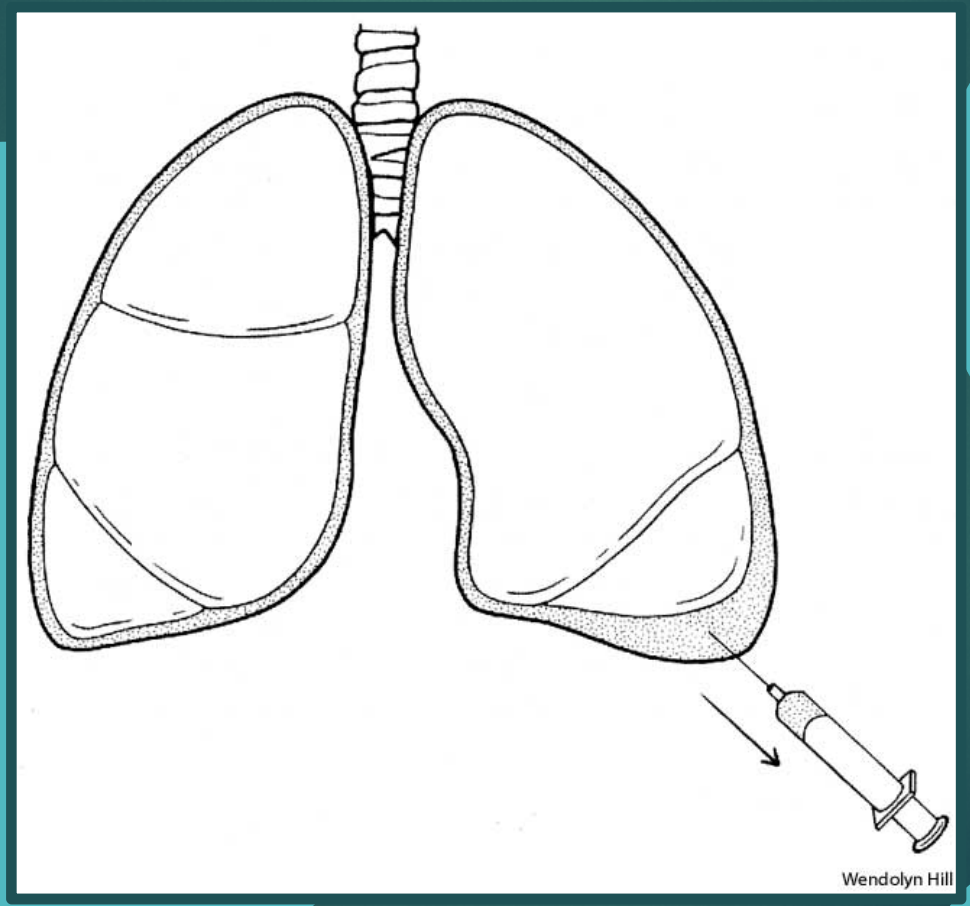
Imaging Studies

- CT Scan
  - Better characterization of underlying lung parenchyma and certain processes that may be obscured on radiographs by large pleural effusions
- Ultrasound
  - Cheap and available at bedside
  - Can help identify free vs. loculated effusions
  - Thoracentesis is facilitated by ultrasound guidance

CT Scan



Thoracocentesis



Indications for thoracentesis

- Pleural effusion of unknown etiology, with >10mm depth on lateral decubitus CXR or Ultrasound
- Therapeutically for symptomatic relief
- Concern for empyema
- Air fluid level in pleural space

Pleural Fluid Evaluation
5 Cs

- Color
- Cytology
- Culture
- Cell count
- Chemistry

Lights Criteria

- Pleural effusion is exudative if one or more of the following:
  - Ratio of pleural fluid protein level to serum protein level > 0.5
  - Ratio of pleural fluid LDH level to serum LDH level > 0.6
  - Pleural fluid LDH level > 2/3 the upper limit of normal for serum LDH level.
- **98% sensitive and 83% specific for exudative effusion using Lights criteria.**
- **Absence of all 3 criteria = transudative**

Transudative vs Exudative

- Transudative
  - CHF
  - Nephrotic syndrome
  - Hypoalbuminemia
  - Hepatic hydrothorax
  - Atelectasis
  - Hypothyrodism

- Exudative
  - Pneumonia
  - Malignancy
  - PE
  - Inflammatory (pancreatitis, ARDS, uremic pleurisy etc
  - Connective tissue disease

Routine Pleural Fluid Tests for Pleural Effusion

Test	*Test value*	*Suggested diagnosis*	*Comments*
Adenosine deaminase (ADA)	>40 U per L (667 nkat per L)	Tuberculosis (>90 percent), empyema (60 percent), complicated parapneumonic effusion (30 percent), malignancy (5 percent), rheumatoid arthritis[5]	In the United States, ADA is not routinely requested because of the low prevalence of tuberculous pleurisy.
Cytology	Present	Malignancy	Actively dividing mesothelial cells can mimic an adenocarcinoma.
Glucose	<60 mg per dL (3.3 mmol per L)	Complicated parapneumonic effusion or empyema, tuberculosis (20 percent), malignancy (<10 percent), rheumatoid arthritis[5]	In general, pleural fluids with a low glucose level also have low pH and high LDH levels.
Lactate dehydrogenase (LDH)	>Two thirds of upper limits of normal for serum LDH	Any condition causing an exudate	Very high levels of pleural fluid LDH (>1,000 U per L) typically are found in patients with complicated parapneumonic pleural effusion and in about 40 percent of those with tuberculous pleurisy.[5]
LDH fluid to serum ratio	>0.6	Any condition causing an exudate	Most patients who meet the criteria for an exudative effusion with LDH but not with protein levels have either parapneumonic effusions or malignancy.[3]
Protein fluid to serum ratio	>0.5	Any condition causing an exudate	A pleural fluid protein level >3 mg per dL suggests an exudate, but when taken alone this parameter misclassifies more than 10 percent of exudates

Optional Pleural Fluid Tests for Pleural Effusion

Test	*Test value*	*Suggested diagnosis*	*Comments*
Amylase	>Upper limit of normal	Malignancy (<20 percent), pancreatic disease, esophageal rupture[5,16]	Obtain when esophageal rupture or pancreatic disease is suspected. The amylase in malignancy and esophageal rupture is of the salivary type.
Cholesterol	>45 to 60 mg per dL (1.16 to 1.55 mmol per L)	Any condition causing an exudate	Measure if chylothorax or pseudochylothorax is suspected. This parameter taken alone misclassifies 10 percent of exudates and 20 percent of transudates.[13]
Culture	Positive	Infection	Obtain in all parapneumonic pleural effusions because a positive Gram stain or culture should lead to prompt chest tube drainage.[14,15]
Hematocrit fluid to blood ratio	≥0.5	Hemothorax	Obtain when pleural fluid is bloody. Hemothorax most often originates from blunt or penetrating chest trauma.
Interferon*	Different cutoff points	Tuberculosis[17]	Consider when ADA is unavailable or nondiagnostic and tuberculosis is suspected.
NT-proBNP	>1,500 pg per mL	Heart failure[18]	If available, consider testing when heart failure is suspected and exudate criteria are met.[19]

pH	< 7.20	Complicated parapneumonic effusion or empyema, malignancy (< 10 percent), tuberculosis (< 10 percent), esophageal rupture[5]	Obtain in all nonpurulent effusions if infection is suspected. A low pleural fluid pH indicates the need for tube drainage only for parapneumonic pleural effusions.
Polymerase chain reaction†	Positive	Infection[20,21]	Consider when infection is suspected. Sensitivity of polymerase chain reaction to detect *Mycobacterium tuberculosis* in pleural fluid varies from 40 to 80 percent and is lower in patients with negative mycobacterial cultures.
Triglycerides	> 110 mg per dL (1.24 mmol per L)	Chylothorax	Obtain when pleural fluid is cloudy or milky. Chylothorax is caused by lymphoma or trauma. Not all chylous pleural effusions appear milky white or whitish.
Tumor markers‡	Different cutoff points	Malignancy	Consider when malignancy is suspected and thoracoscopy is being considered. Except for telomerase activity,[22] individual tests tend to have low sensitivity (< 30 percent) when looking for the utmost specificity.[23,24]

Cell count

- Lymphocytic (> 50%)
  - CA (30-35%)
  - TB (15-20%)
  - Sarcoidosis
- PMNs
  - Empyema
  - Parapneumonic
  - Rheumatoid
  - Pulmonary infarction
- PMN or Lymphocytic
  - PE
  - Conn tissue disease
  - Post-cardiac injury
- Eosinophilic (> 10%)
  - Trauma
  - PTX
  - CA
  - Asbestos, parasites
  - Pneumonia
- RBC > 100,000/mm
  - CA
  - Trauma
  - Pulmonary infarction

Treatment

- Thoracentesis – then treat underlying disease
  - Uncomplicated pneumonia – antibiotics
- Hemithorax involved/empyema – tube thoracostomy +/- VATS
- Malignant effusion- chest tube +/- pleurodesis (sclerosants)

  VATS

Summary

- Pleural effusions are commonly encountered on wards
- Thoracentesis is not immediately indicated if there is a obvious explanation for pleural effusion without atypical features
- Pleural effusions are classified as transudative vs exudative.
- CHF, pneumonia, malignancy and PE comprise the vast majority of causes for pleural effusions.