Pleural Disease

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Academic Half Day
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Objectives

1. Describe the symptoms and physical exam findings of a pleural effusion.

2. Describe the indications for thoracentesis.

3. Describe the appropriate tests to order to evaluate pleural fluid according to Light's criteria, 2-test and 3-test rule. Know how to determine if the fluid is transudative or exudative.

4. Describe the differential for transudative effusions and describe the evaluation that can help determine when a transudative effusion is falsely exudative (especially after diuretics have been given.)

5. Describe the differential for exudative effusions. Know the indications for chest tube drainage of exudative pleural effusions.

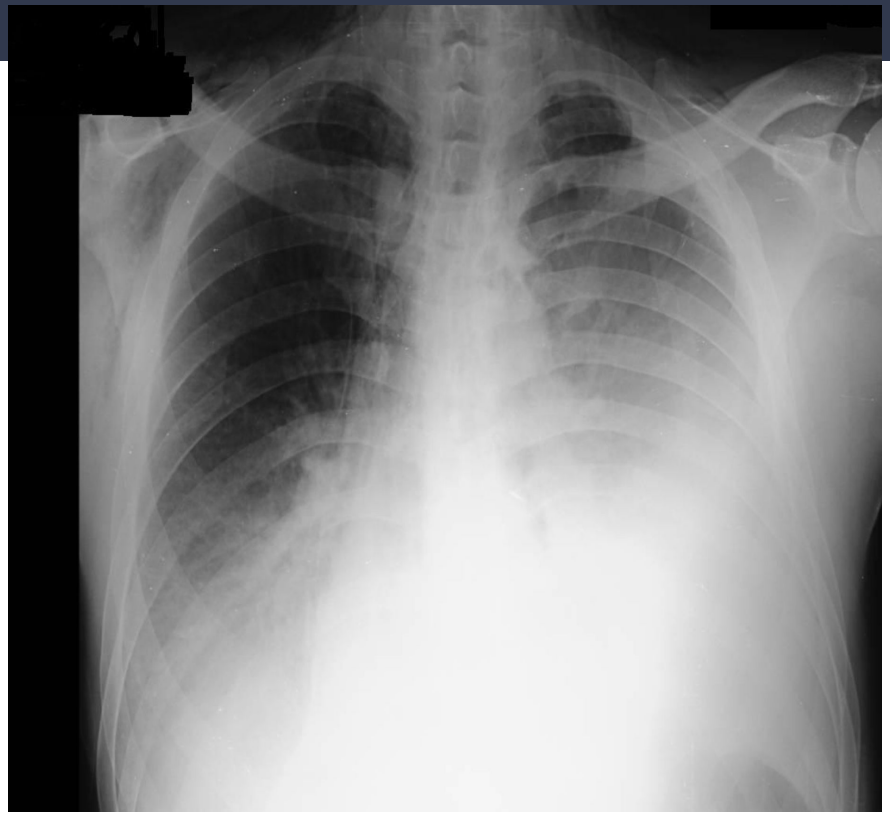
Case

A 67 year old man presents to the emergency department with a 5-day history of fever and cough that is productive of green phlegm.

He has a history of tobacco use and ischemic cardiomyopathy with an LVEF of 25%.

He is admitted with a presumptive diagnosis of pneumonia and is started on antibiotics.

A CXR is obtained and shows a left-sided infiltrate and moderate-size effusion.



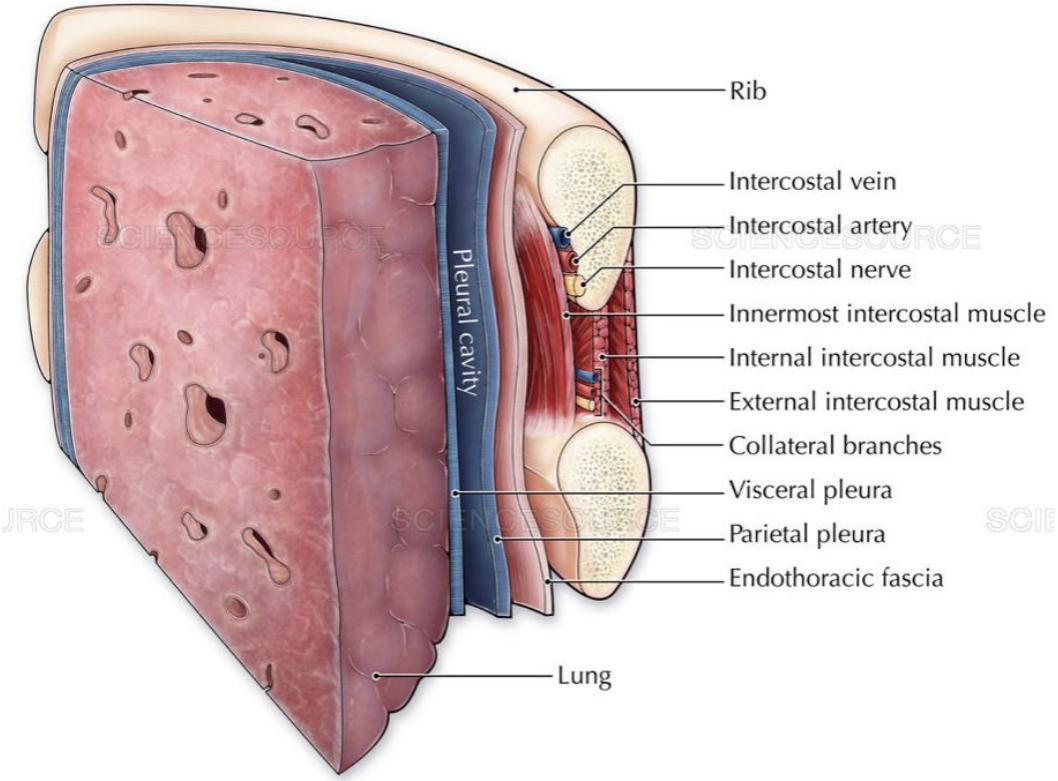
Question 1

B. The effusion is a new finding and its etiology is unknown

Why should a diagnostic thoracentesis be performed on this patient?

a) **This patient's effusion is likely related to his congestive heart failure (CHF)**
b) **The effusion is a new finding and its etiology is unknown**
c) **Thoracentesis should be performed on all pleural effusion**
d) **This patient's effusion is malignant given his smoking history**

Pleural Anatomy

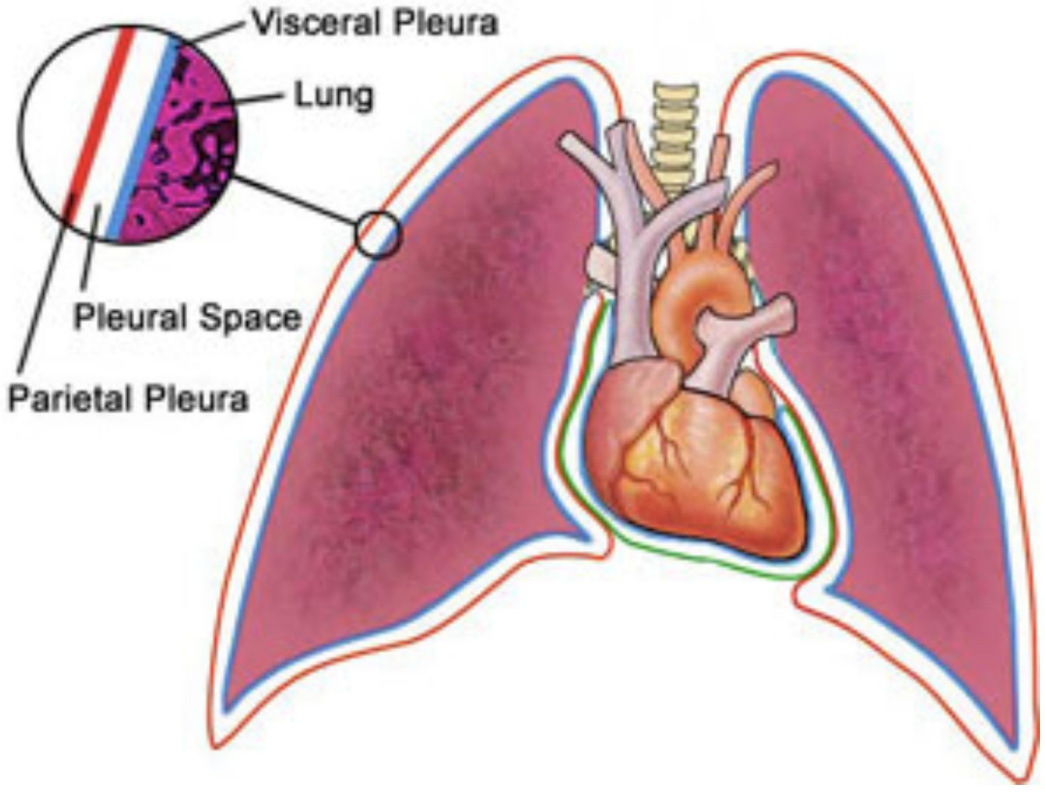


- **Visceral Pleura:**
  - Envelops the lung
  - Mesothelial cells
  - Blood supply: bronchial arteries
  - Lymphatics: pulmonary parenchyma
  - No nerve fibers
  - Venous drainage: pulmonary vein

- **Parietal Pleura:**
  - Inner surface of chest wall
  - Blood supply: intercostal arteries
  - Lymphatics: thoracic duct
  - Pain fibers (intercostal nerves)
  - Venous drainage: SVC
  - Pleural fluid absorption : 1L daily fluid flux

Pleural Anatomy

- *Potential space* (relative vacuum)
- Role in respiration
- Lubricant
- 5-10 cc normal pleural fluid
  - Clear
  - Low protein
  - 60-70% monocytes and macrophages
  - pH >7.60
  - Glucose = plasma



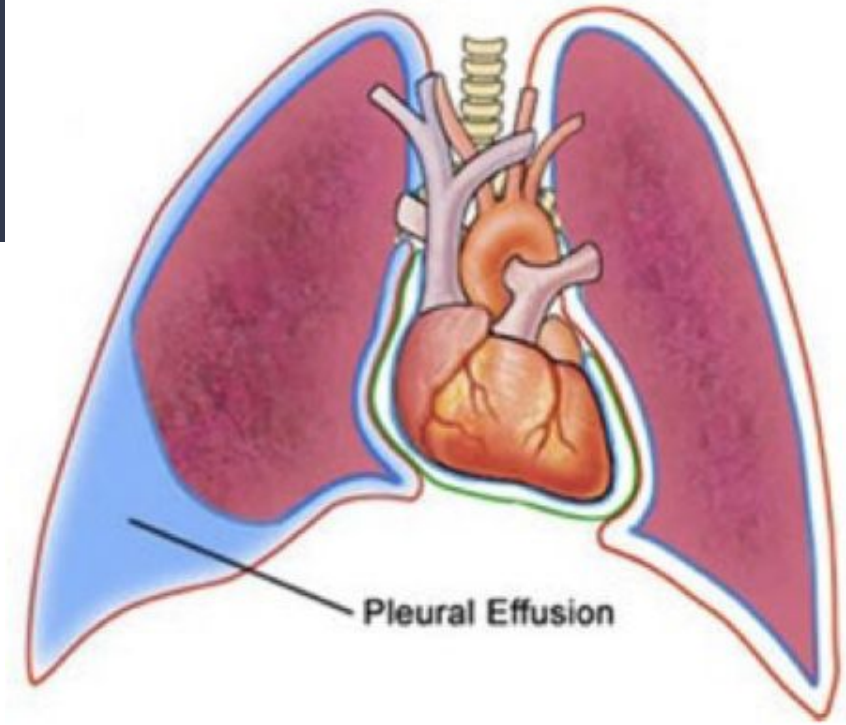
Pathophysiology

Two Mechanisms:

1. Excessive formation
    a. Increase by 30 fold to create effusion
2. Disruption in absorption

Consequences: Dyspnea

1. Restriction in lung expansion
2. *Diaphragmatic strain*

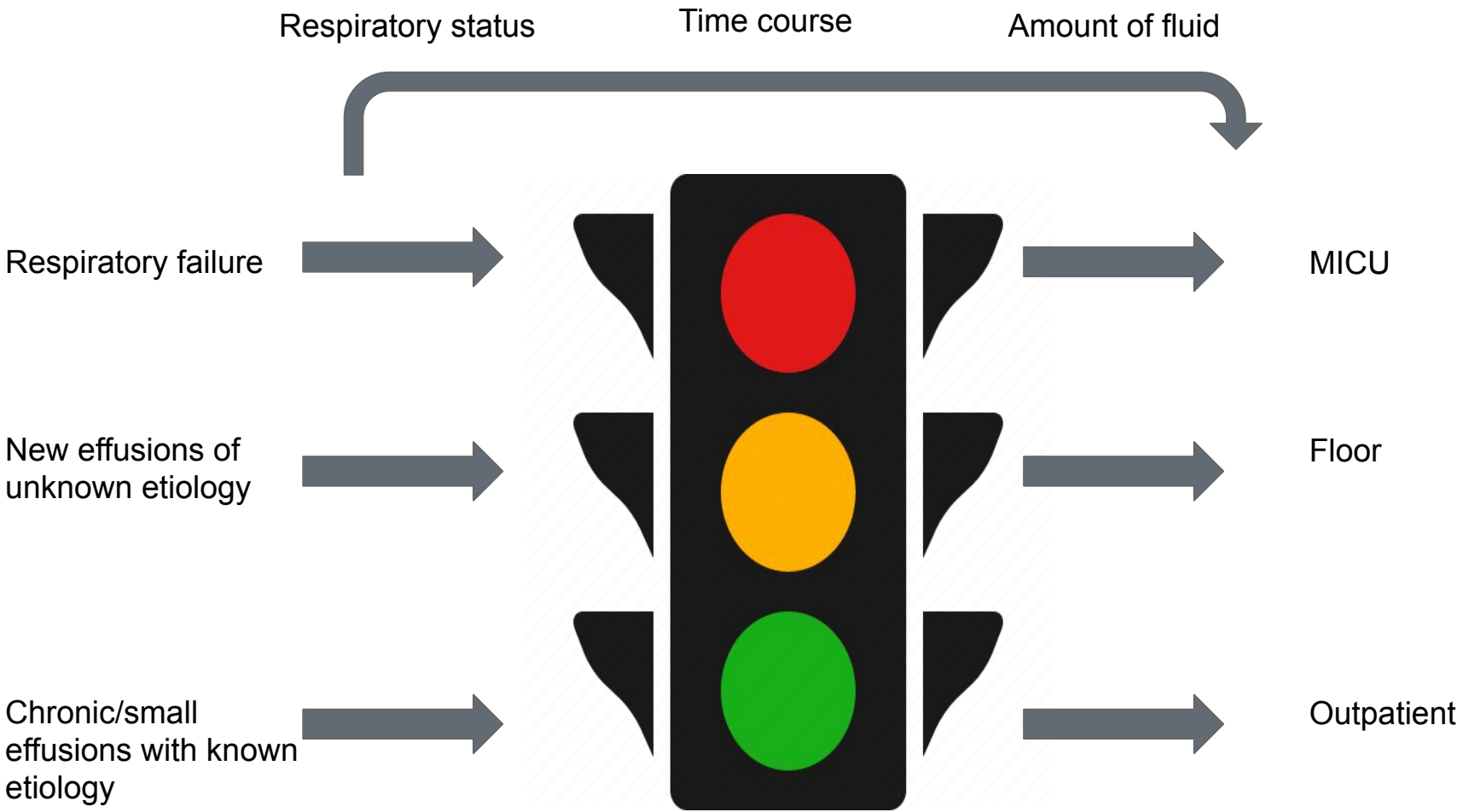


Diagnosis

Box 1 | Important history points for patients with suspected or confirmed effusions

- Severity, duration, and rate of onset of breathlessness, cough, or chest pain
- Presence of constitutional symptoms such as fevers, sweats, or weight loss
- Recent injury or interventions to chest
- Recent illnesses, especially related to chest
- Recent hospital admissions or operations, especially cardiac surgery
- History of malignancy, or current active malignancy
- Previous exposure to tuberculosis
- Full occupational history, with names and dates of employers if known*
- Exposure to asbestos (or asbestos-like substances), with clear relation to occupation and description of level of exposure (for example, did the patient work with a substance directly?)*
- Tobacco smoking history
- Drugs, including recent changes to prescriptions and the use of any anticoagulants
- Assessment of evidence of uncontrolled cardiac, hepatic, or renal failure

*These may be more easily and fully explored in the secondary care setting


Respiratory status
Time course
Amount of fluid
Respiratory failure
New effusions of unknown etiology
Chronic/small effusions with known etiology
MICU
Floor
Outpatient

L. Moitessier

LEOPOLDI AUENBRUGGER

INVENTUM NOVUM

EX

PERCUSSIONE THORACIS HUMANI

UT SIGNO

ABSTRUSOS INTERNI

PECTORIS MORBOS

DETEGENDI

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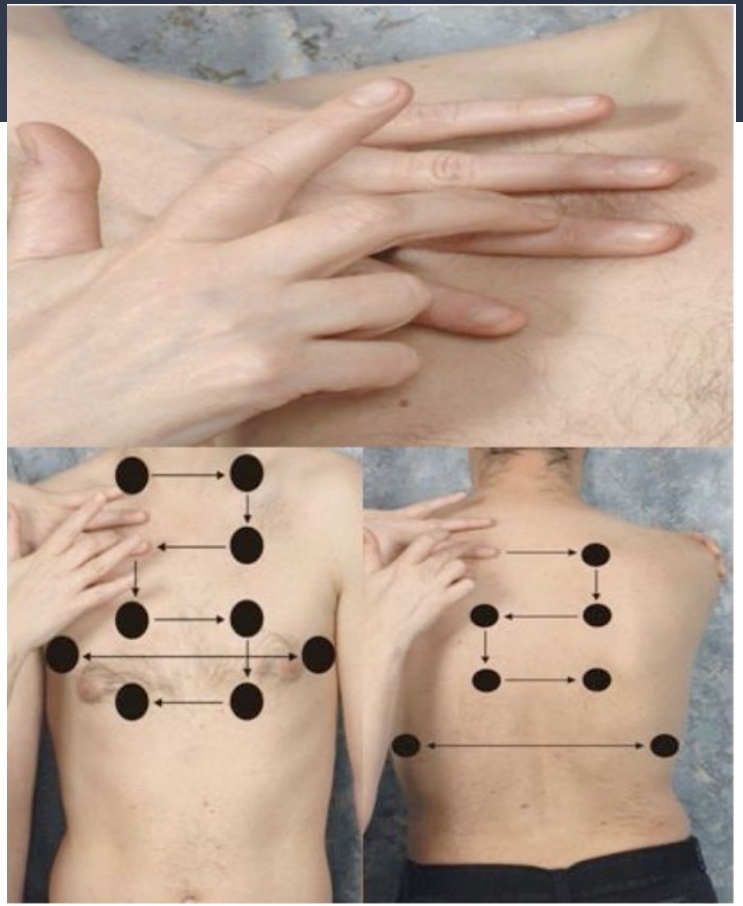
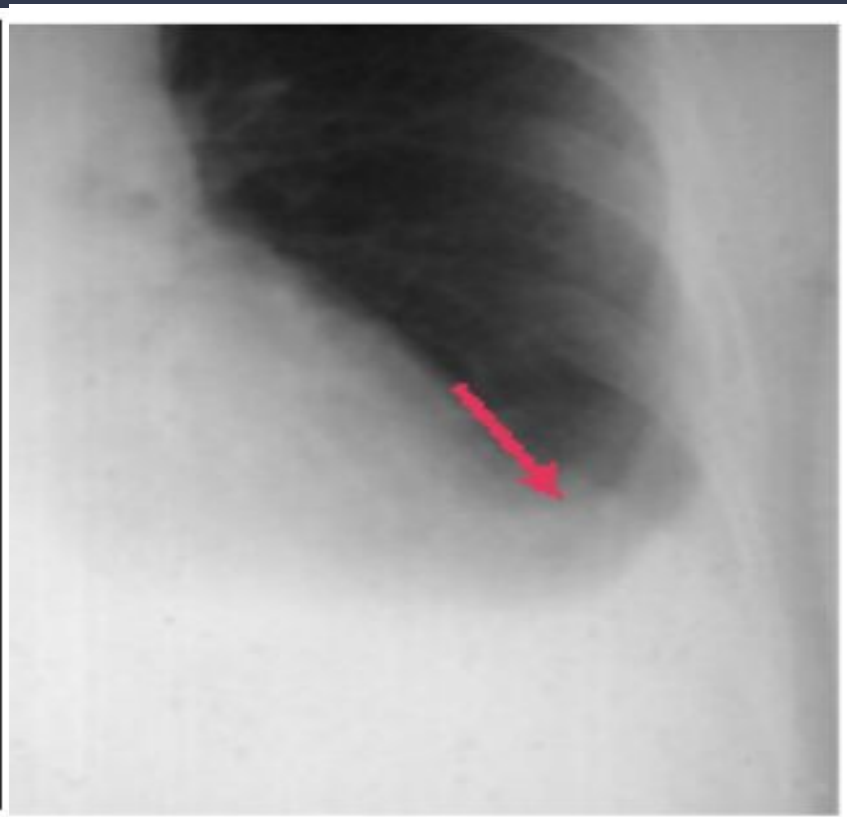
Physical Exam

- Depends on volume
  - > 300 cc
- Dullness to percussion
  - > 500 cc
- Decreased tactile fremitus
  - > 500 cc
- Decreased breath sounds
  - > 500 cc
- Egophany
  - > 1000 cc
  - At upper level of effusion

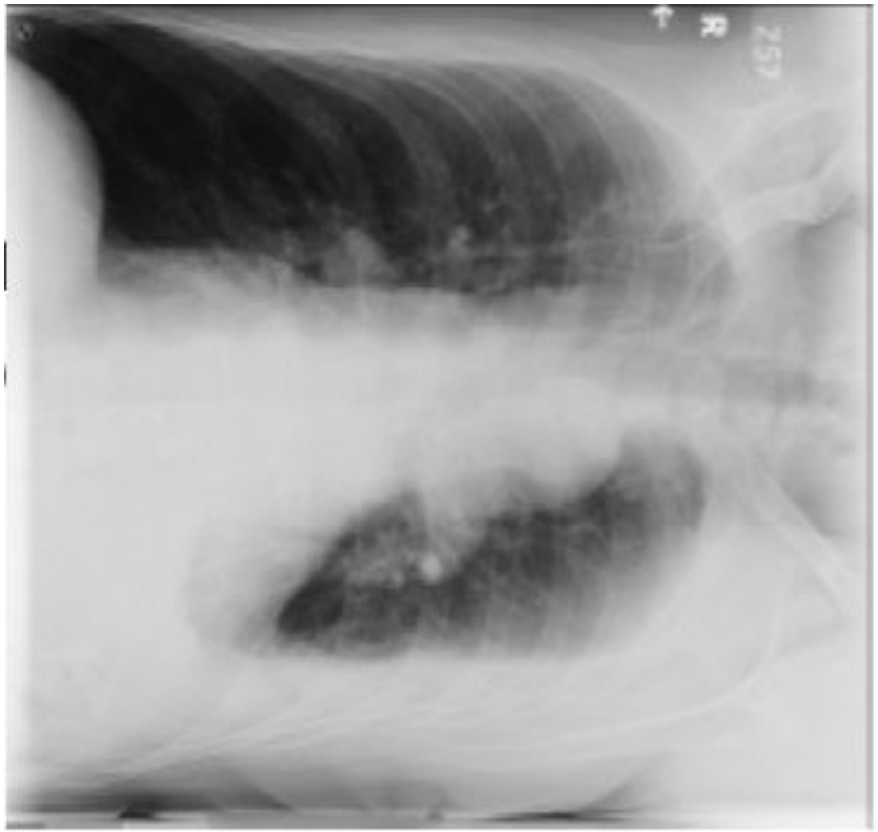


CXR: Blunting of the costophrenic angle



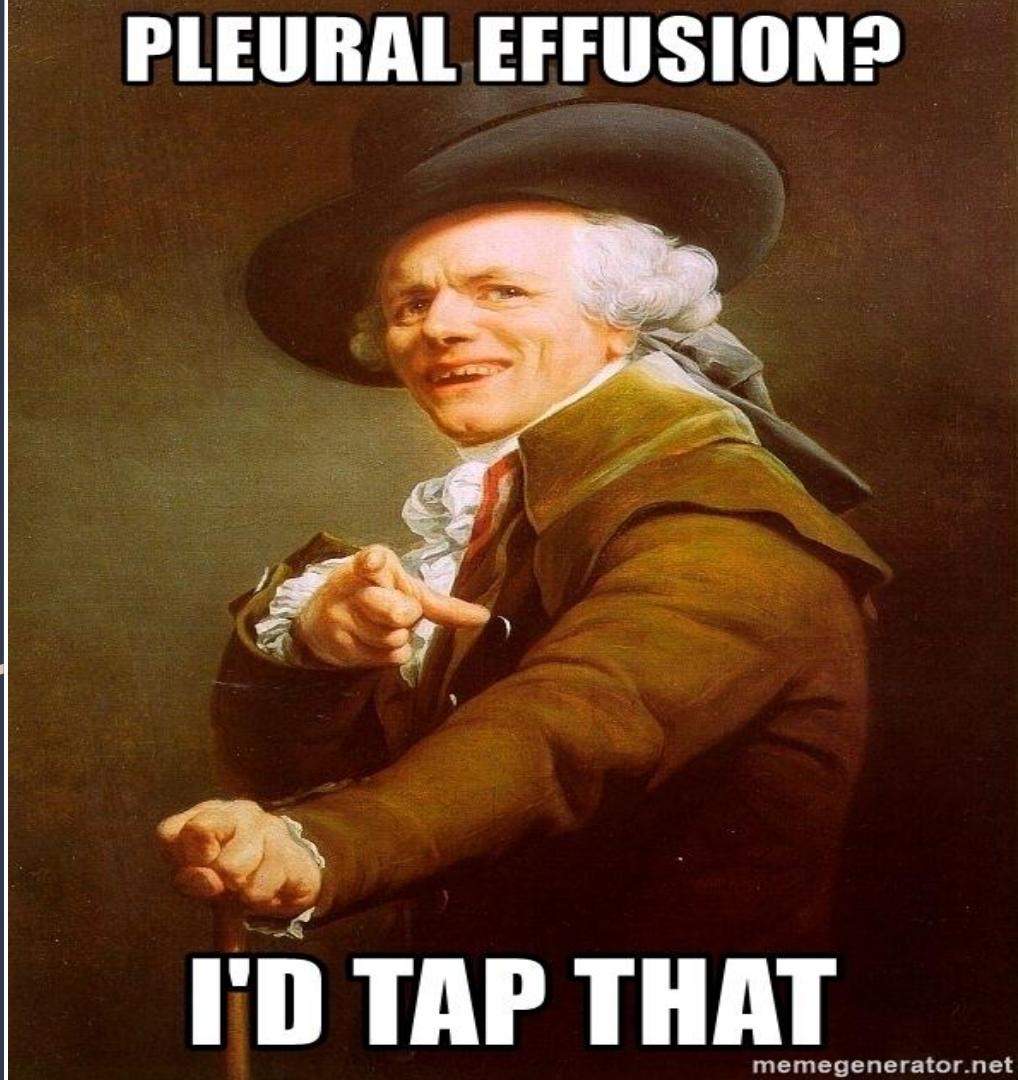
CXR: Meniscus Sign

CXR: Lateral Decubitus



CXR: Mediastinal Shift

To tap or not to tap?



Question 2

D. Lactate Dehydrogenase (LDH)

Which of the following studies can be used to determine if the patient's effusion is due to his CHF (a transudate) or is a parapneumonic effusion (an exudate)?

a) **Pleural fluid pH**
b) **Pleural fluid glucose**
c) **Pleural fluid cell count**
d) **Lactate dehydrogenase (LDH)**

THE STORY BEHIND LIGHT'S CRITERIA

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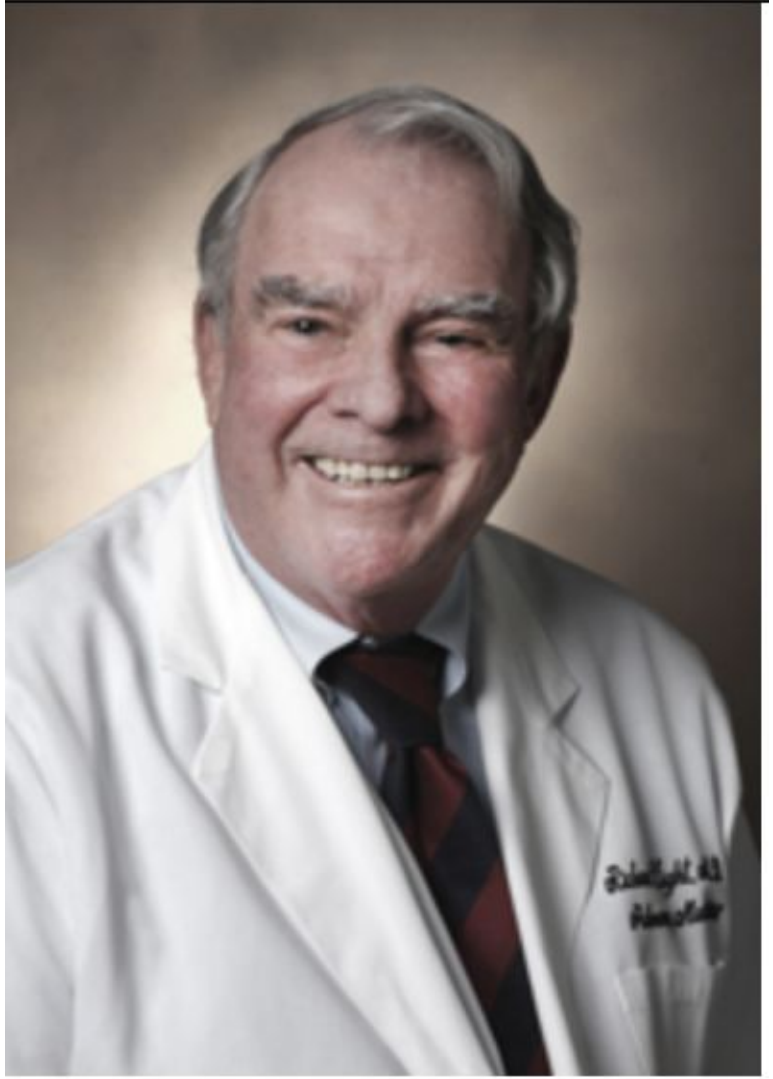


Study	Sensitivity %	Specificity %	Accuracy %	PPV %	NPV %
Light ('72)	99	98		99	98
Meisel ('90)	90	82	86	87	
Roth ('90)	100	72			
Valdez ('91)	95	78	91	95	80
Romero ('93)	98	77	95		
Burgess ('95)	98	85	93	93	96
Costa ('95)	98	82			
Vives ('96)	99	78	95	95	93

TABLE 2

Light's criteria for distinguishing transudative from exudative pleural fluid

	PLEURAL/SERUM PROTEIN RATIO	PLEURAL/SERUM LACTATE DEHYDROGENASE RATIO	SERUM LACTATE DEHYDROGENASE
Transudate	≤ 0.5	≤ 0.6	≤ 200 U/L*
Exudate†	> 0.5	> 0.6	> 200 U/L*

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

Light's Criteria	Sensitivity (%)	Specificity (%)
Light's Criteria (1 or more of the following	98	83
Pleural fluid protein / Serum protein >0.5	86	84
Pleural fluid LDH / Serum LDH >0.6	90	82
Pleural fluid LDH > 2/3 * Serum LDH upper limit of normal	82	89

Other Exudate Criteria:

- Pleural fluid cholesterol : 45-60 mg/dL
- Pleural fluid / serum cholesterol : > 0.3

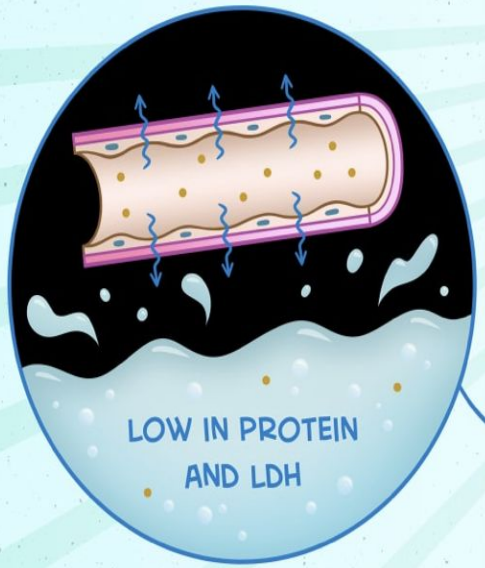
PLEURAL EFFUSION

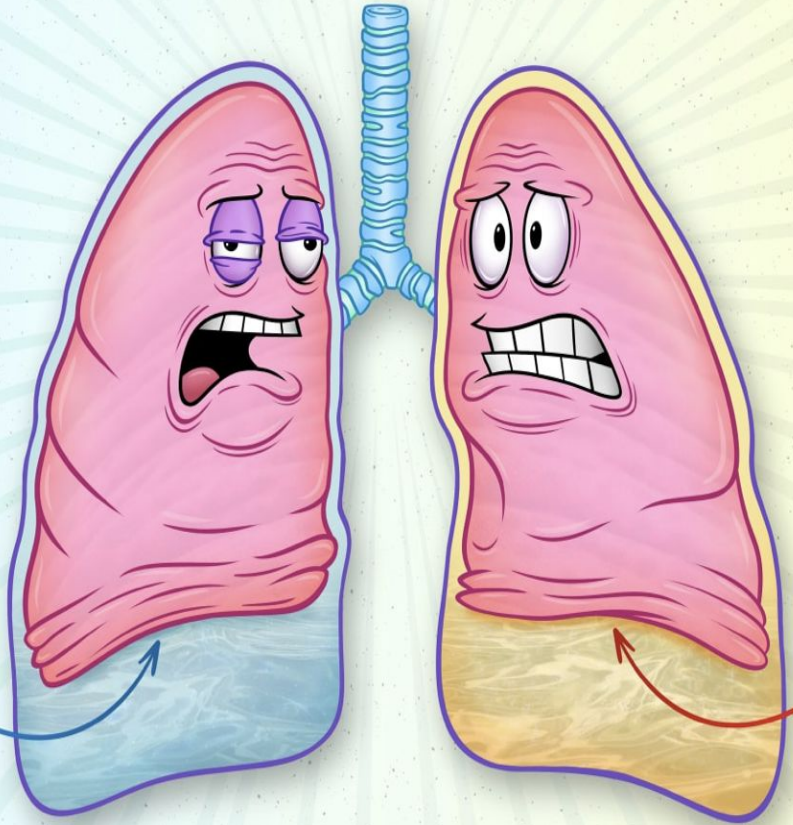
ACCUMULATION OF FLUID WITHIN THE PLEURAL SPACE

TRANSUDATIVE

OCCURS DUE TO INCREASED HYDROSTATIC PRESSURE OR LOW PLASMA ONCOTIC PRESSURE

E.G., CHF, CIRRHOSIS, NEPHROTIC SYNDROME, PE, HYPOALBUMINEMIA





EXUDATIVE

OCCURS DUE TO INFLAMMATION AND INCREASED CAPILLARY PERMEABILITY

E.G., PNEUMONIA, CANCER, TB, VIRAL INFECTION, PE, AUTOIMMUNE

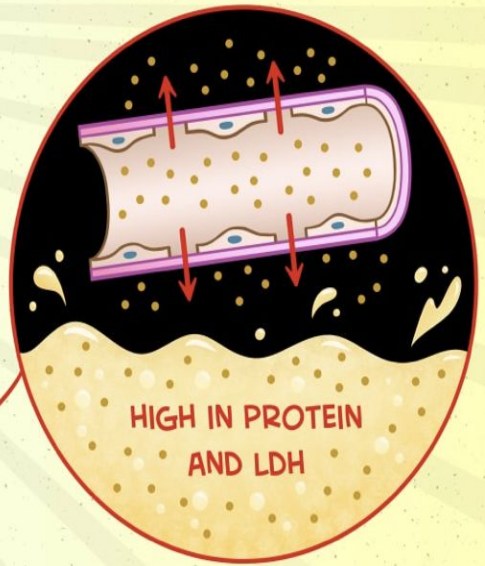
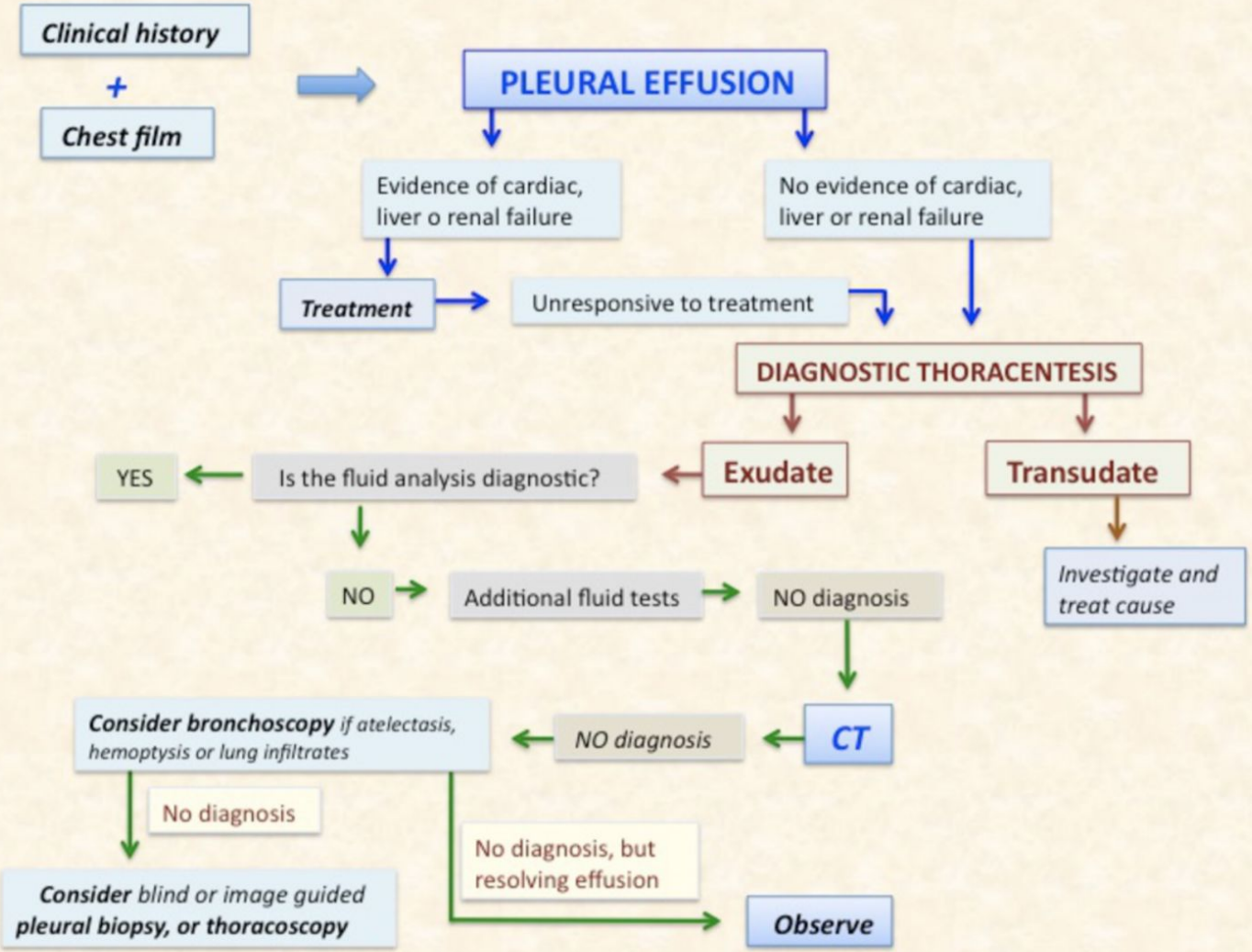


TABLE 2

Leading Causes of Pleural Effusion in the United States*

CAUSE	*ANNUAL INCIDENCE*	*TRANSUDATE*	*EXUDATE*
Congestive heart failure	500,000	Yes	No
Pneumonia	300,000	No	Yes
Cancer	200,000	No	Yes
Pulmonary embolism	150,000	Sometimes	Sometimes
Viral disease	100,000	No	Yes
Coronary-artery bypass surgery	60,000	No	Yes
Cirrhosis	50,000	Yes	No


Clinical history
+
Chest film
PLEURAL EFFUSION
Evidence of cardiac, liver o renal failure
No evidence of cardiac, liver or renal failure
Treatment
Unresponsive to treatment
DIAGNOSTIC THORACENTESIS
Exudate
Transudate
YES
Is the fluid analysis diagnostic?
Investigate and treat cause
NO
Additional fluid tests
NO diagnosis
CT
NO diagnosis
Consider bronchoscopy if atelectasis, hemoptysis or lung infiltrates
No diagnosis
No diagnosis, but resolving effusion
Consider blind or image guided pleural biopsy, or thoracoscopy
Observe

Question 3

C. Hepatic Hydrothorax

The fluid from thoracentesis has a pH of 7.3, which can be consistent with either CHF or a parapneumonic effusion. Which of the following types of pleural effusions have a pleural fluid pH greater than 7.2?

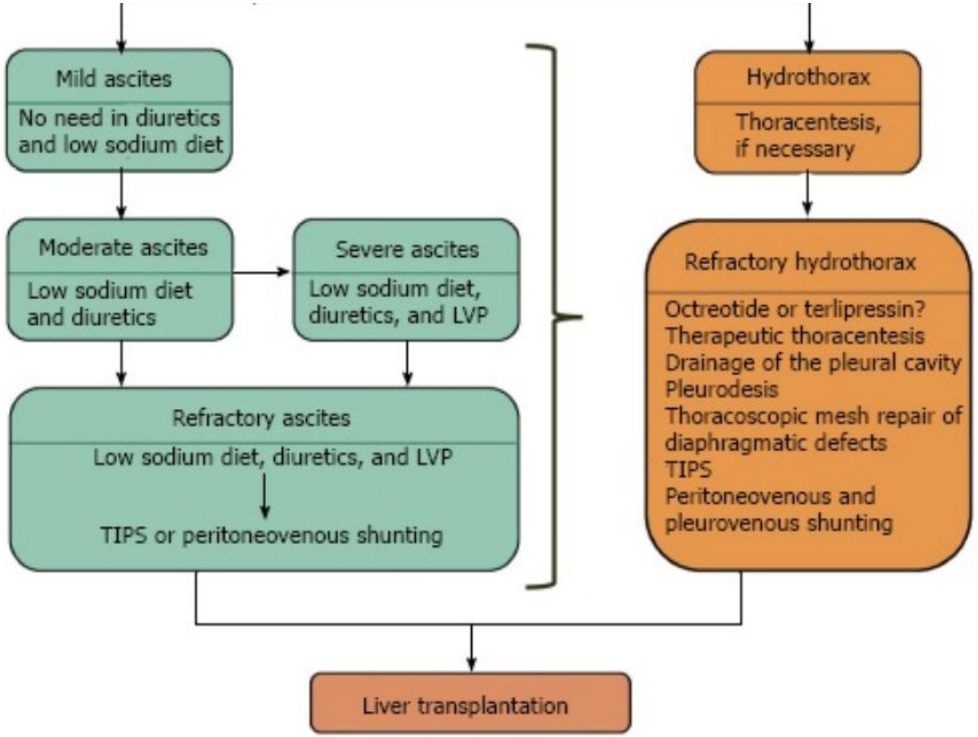
a) **Empyema**
b) **Rheumatoid pleuritis**
c) **Hepatic hydrothorax**
d) **Urinothorax**

Pleural fluid acidosis

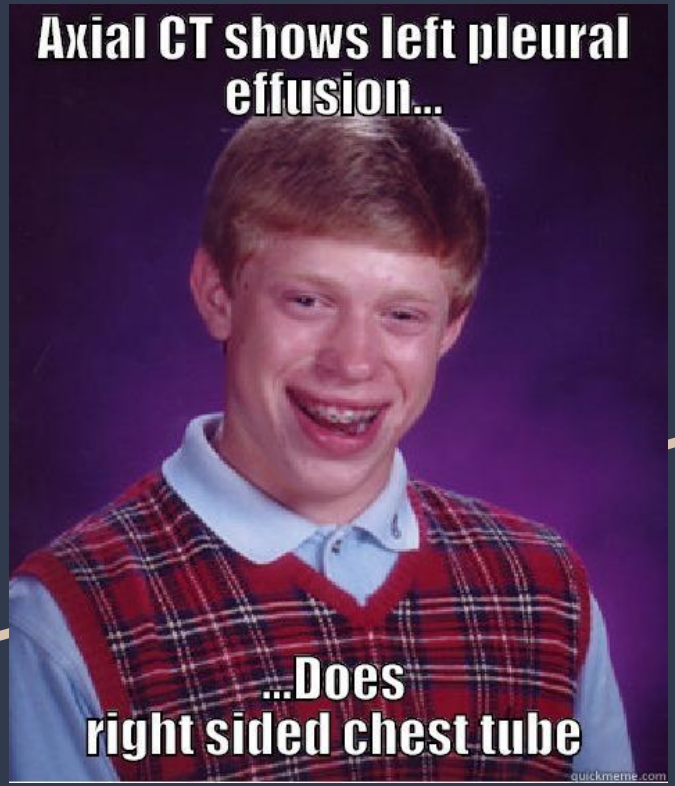
pH < 7.3
Esophageal rupture
Empyema (pH < 7.2); Complicated Parapneumonic
Rheumatoid pleuritis
Malignant pleural disease
Tuberculous pleuritis
Lupus pleuritis
Urinothorax (Transudate)
Hemothorax
Systemic acidosis

Hepatic Hydrothorax

- Serous *transudate* ; pH > 7.3
- Passage of ascitic fluid from peritoneal cavity into pleural space
- 20% have no significant ascites
- Unilateral R>L (17%) or Bilateral (3%)



Empyema



- *Exudate (pus);* pH < 7.2
- 50% associated with PNA
- Gram stain + organisms
- PMN predominance
- Low glucose
- Elevated LDH > 1000
- *Chest tube drainage*

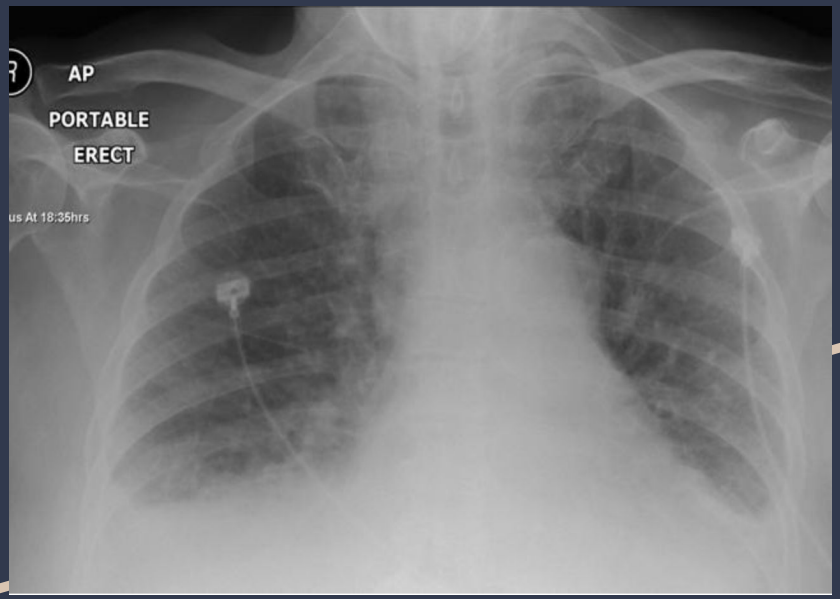
Question 4

D. Effusion due to CHF

Results of the patient's pleural fluid and serum glucose measurements are 56 mg/dL and 90 mg/dL, respectively. Which of the following types of effusions typically have a pleural fluid glucose concentration similar to that of blood glucose?

a) **Malignant effusion**
b) **Lupus pleuritis**
c) **Esophageal rupture**
d) **Effusion due to CHF**

CHF



- *Transudative* effusion
- Result of pulmonary venous hypertension + increased hydrostatic pressure
- Rate of pleural fluid accumulation exceeds reabsorption
- Bilateral effusions; R > L
- Low cell count, low protein
- Treat heart failure
- If large effusion with profound dyspnea > thoracentesis
- If exudative - **evaluate proBNP**

Question 5

A. Typical parapneumonic effusion

Results of additional pleural fluid studies reveal an LDH of 670 U/L and a protein level of 3.4 g/dL. Gram stain and culture are negative. pH is 7.3. Based on these values, what is the most likely cause of this patient's pleural effusion?

a) **Typical parapneumonic effusion**
b) **Complicated parapneumonic effusion**
c) **Empyema**
d) **CHF**

Parapneumonic effusion

- *Exudative*
- 20-40% patients with PNA
  - Primarily bacterial
  - PMN predominant
- Higher mortality rate

3 phases

1. Early exudative phase
2. Intermediate fibropurulent phase
   a. *Chest tube drainage*
   b. Intrapleural lytics
3. Late organizing phase

Parapneumonic effusion

- Intervention :
  - 50% of hemithorax
  - Loculated
  - Complicated
    - +Gram stain , +Cx
    - Purulent, pH < 7.2 (empyema)
    - Glucose < 60, LDH >3x ULN

Thank you!