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Pleural fluid analysis

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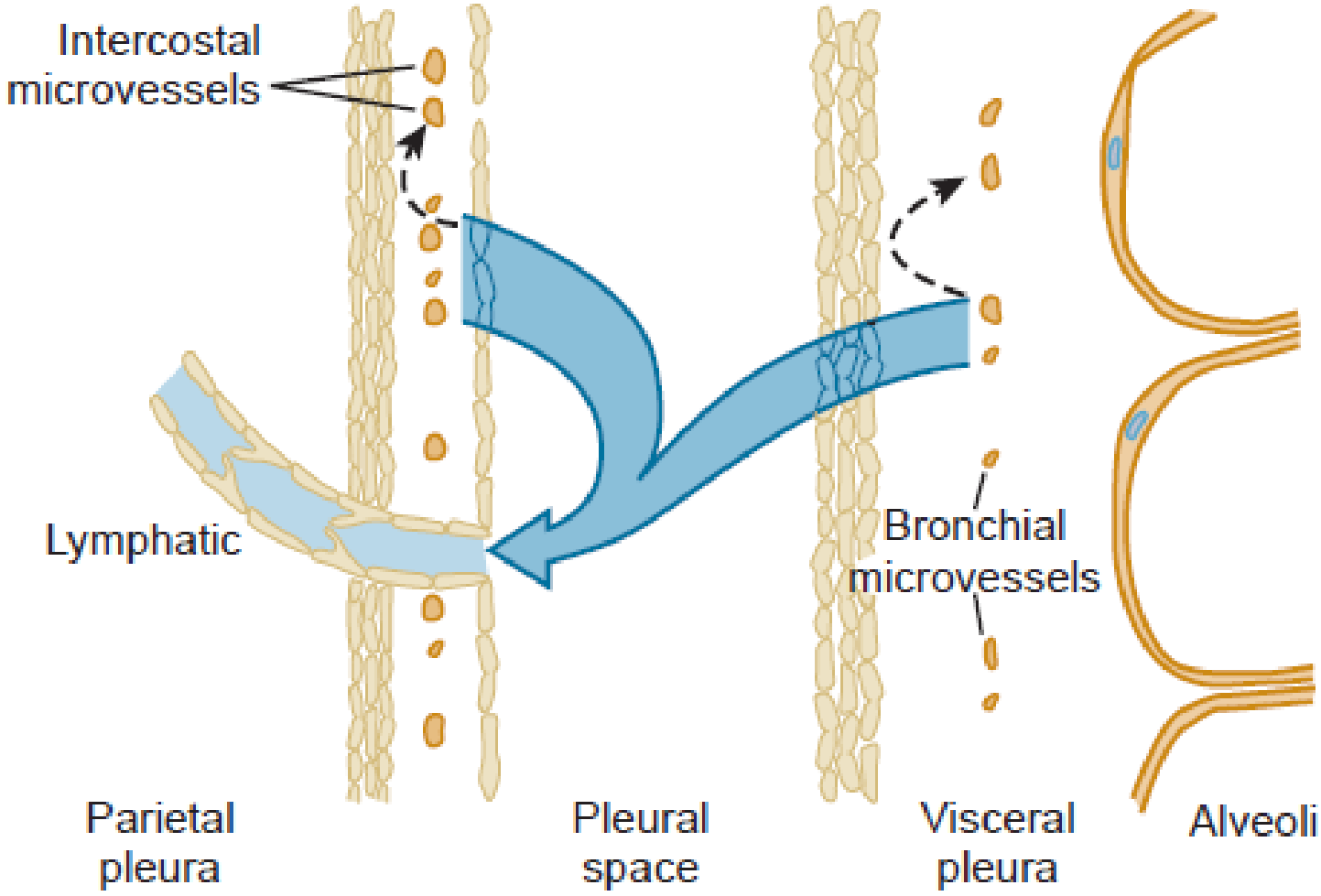
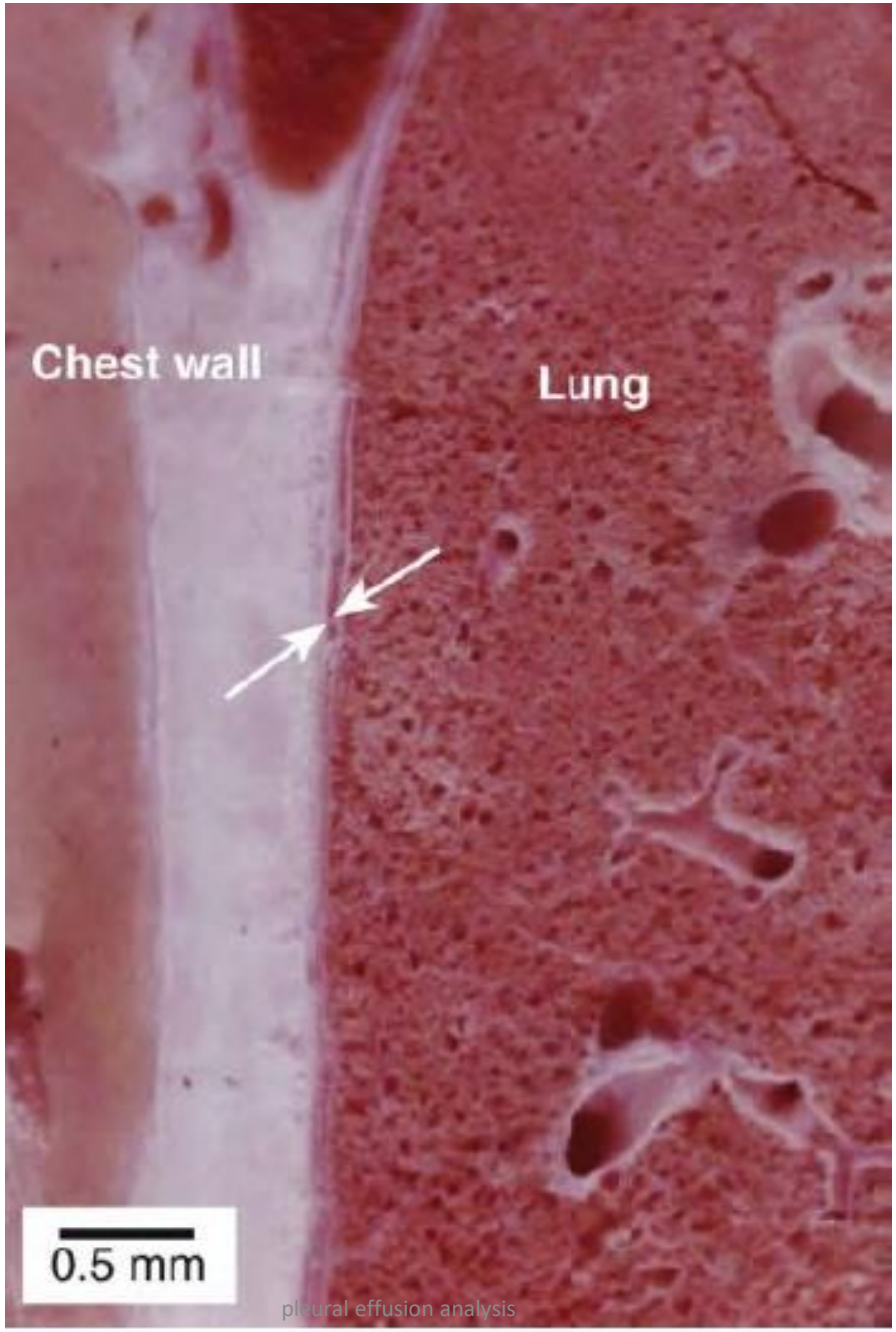


Figure 79-3 Schema showing normal pleural liquid turnover. The initial microvascular filtrate in the parietal and visceral pleura is partly reabsorbed (*dashed arrows*). The remaining low-protein interstitial liquid flows across the leaky pleural mesothelial layers into the pleural space. The pleural liquid exits the pleural space via the parietal pleural lymphatic stomata. (Reproduced with permission from Staub, NC, Wiener-Kronish JP,


Chest wall
Lung
0.5 mm

Normal pleural fluid

- The origin of the fluid does not appear to be the interstitial spaces of the lung because the protein level in the interstitial spaces is normally approximately 4.5 g/dL, whereas the protein level in normal pleural fluid is only approximately **1 to 1.5 g/dL**

- the amount of pleural fluid formed daily in a 50-kg individual would be approximately **15 mL**

Cells/biochemical properties

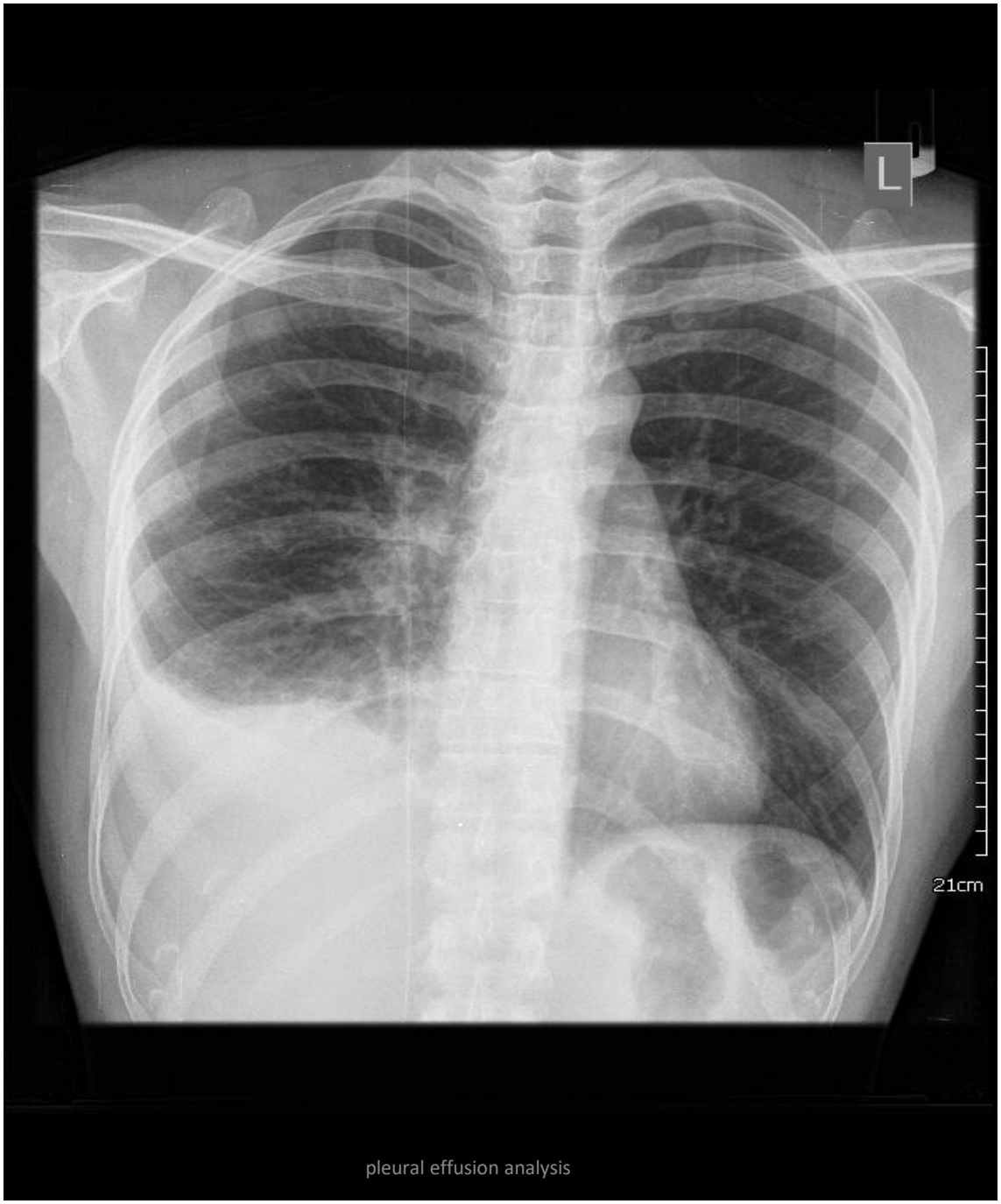
- **the mean white blood cell count was 1,716 cells/mm3 and the mean red cell count was approximately 700 cells/mm3**
- **In humans, approximately 75% of the cells in the pleural fluid are macrophages and 25% are lymphocytes, with mesothelial cells, neutrophils, and eosinophils accounting for less than 2% each**

- **A small amount of protein is normally present in the pleural fluid.**
- **In rabbits, the protein concentration averages 1.33 g/dL, whereas in dogs, it averages 1.06 g/dL**

PATHOGENESIS OF PLEURAL EFFUSIONS

- **Normally, a small amount (0.01 mL/kg/hour) of fluid constantly enters the pleural space from the capillaries in the parietal pleura.**
- **Almost all of this fluid is removed by the lymphatics in the parietal pleura, which have a capacity to remove at least 0.20 mL/kg/hour.**

- **capacity of the lymphatics to remove fluid exceeds the normal rate of fluid formation by a factor of 20.**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$$\dot{Q}_r = L_p \cdot A\left[\left(P_{cap} - P_{pl}\right) - \sigma_d\left(\pi_{cap} - \pi_{pl}\right)\right] \quad (2.1)$$

[Q with dot above]r is the liquid movement; *Lp* is the filtration coefficient/unit area or the hydraulic water conductivity of the membrane; *A* is the surface area of the membrane; *P* and *π* are the hydrostatic and oncotic pressures, respectively, of the capillary (cap) and pleural (pl) space; and σ*d* is the solute reflection coefficient for protein, a measure of the membrane's ability to restrict the passage of large molecules

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)

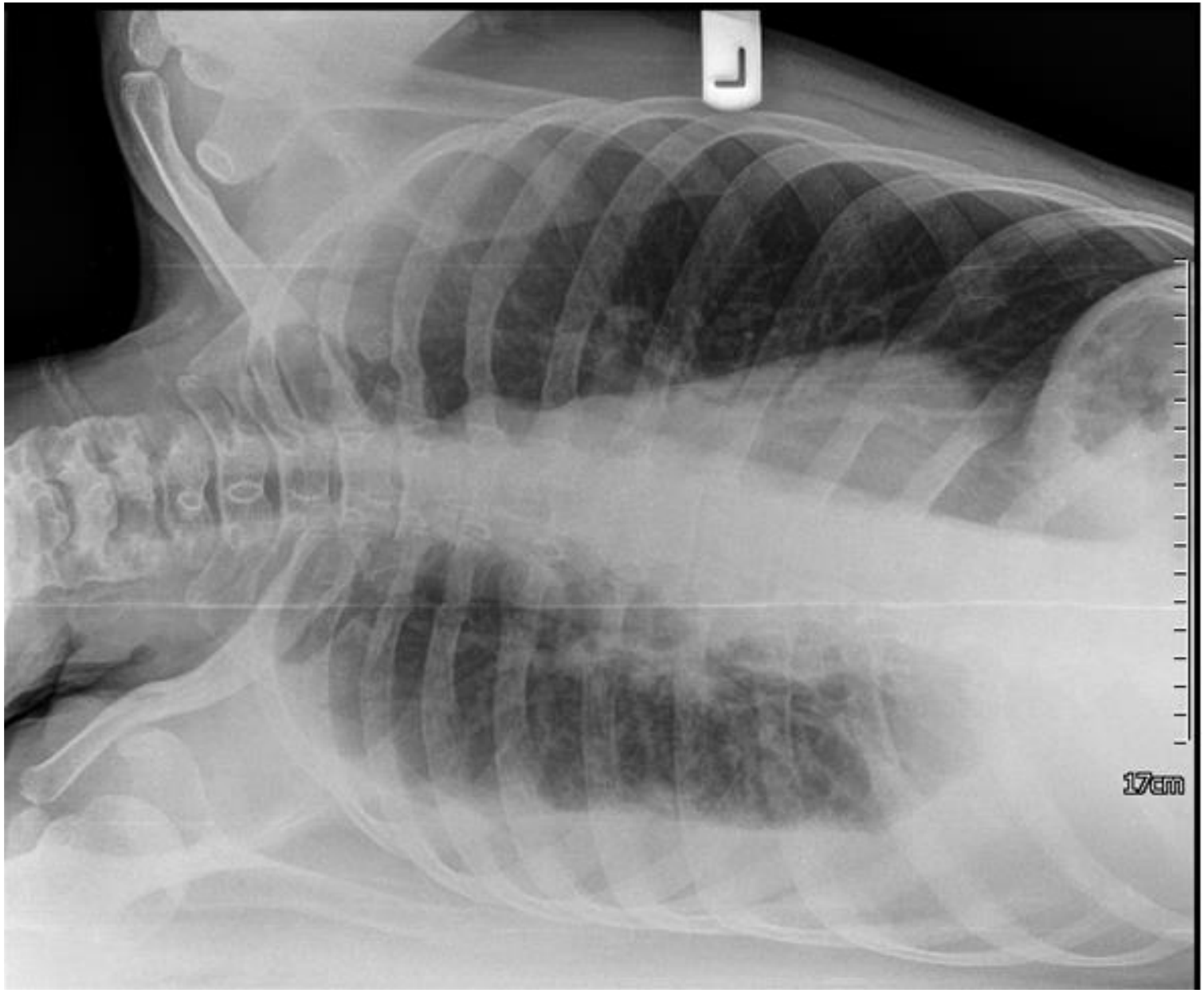
thoracic duct rupture (chylothorax)

Indications for Thoracentesis

1. **Pleural effusion >10 mm thick on lateral decubitus radiography of unclear cause.**

2. **CHF :If effusion persists >3 days despite diuresis, or if the patient has fever, pleurisy, unilateral or markedly asymmetric pleural effusions in the absence of cardiomegaly, or if other atypical features are present (disproportionately widened A-a gradient) → thoracentesis is indicated.**

3. **Therapeutic thoracentesis**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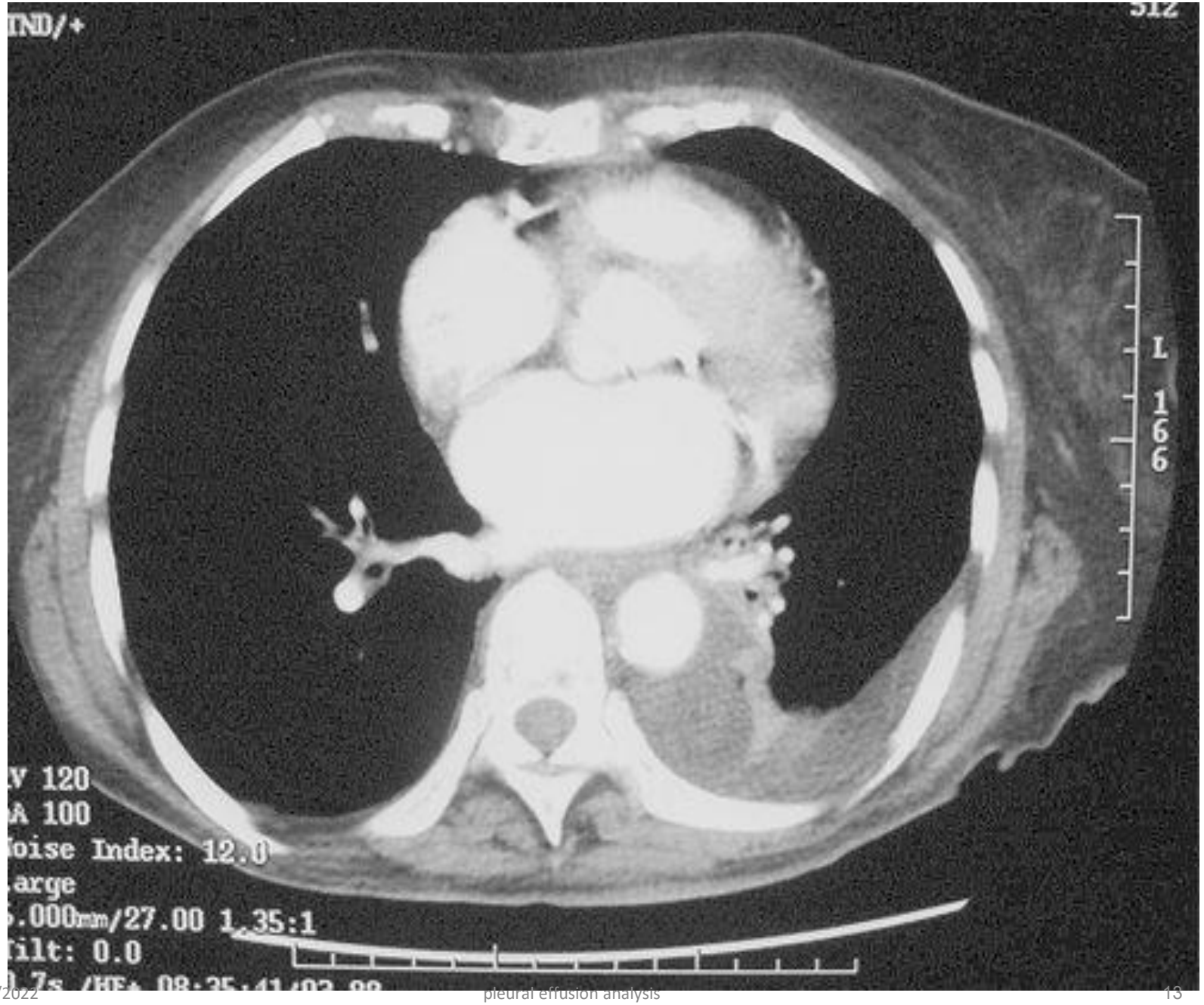
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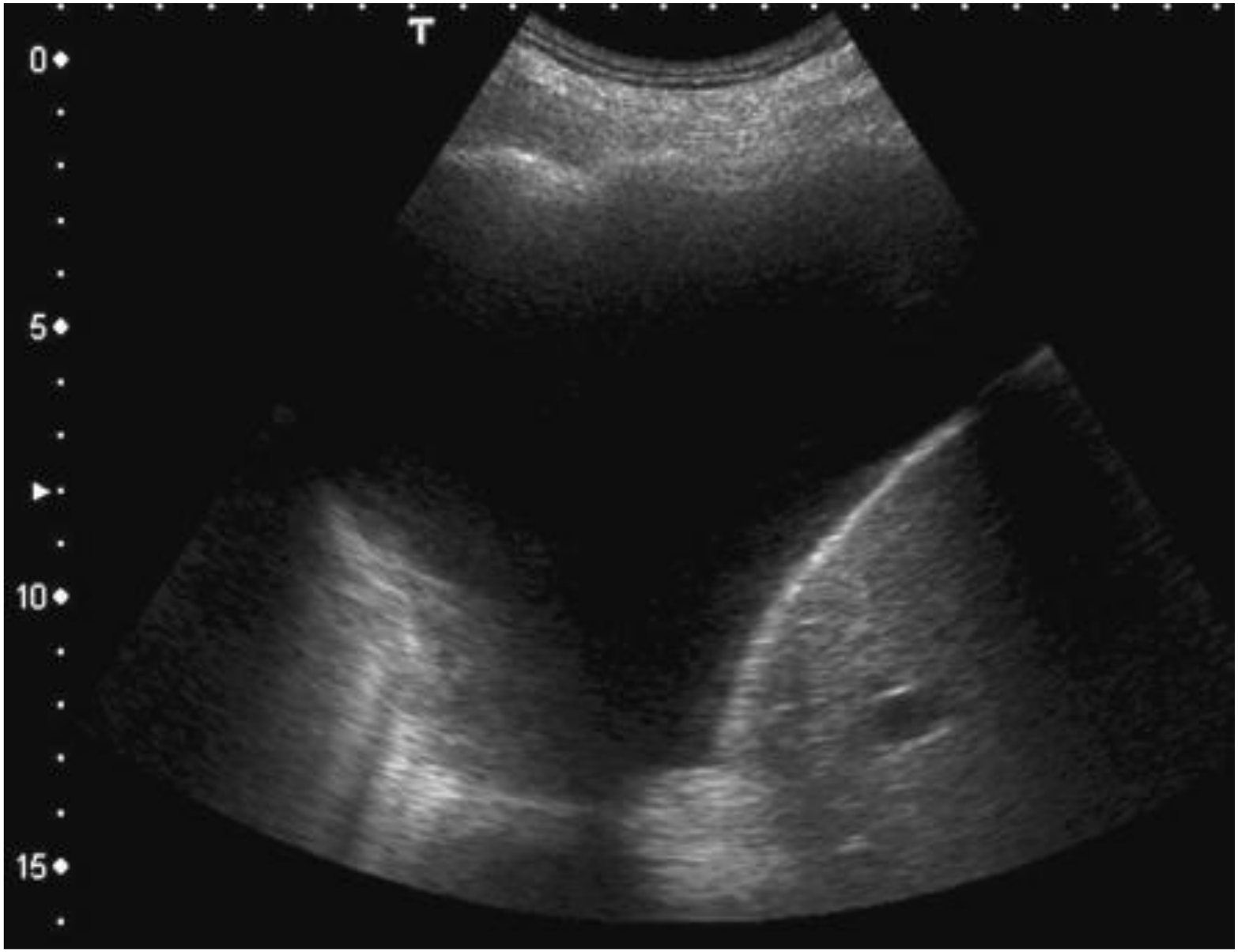
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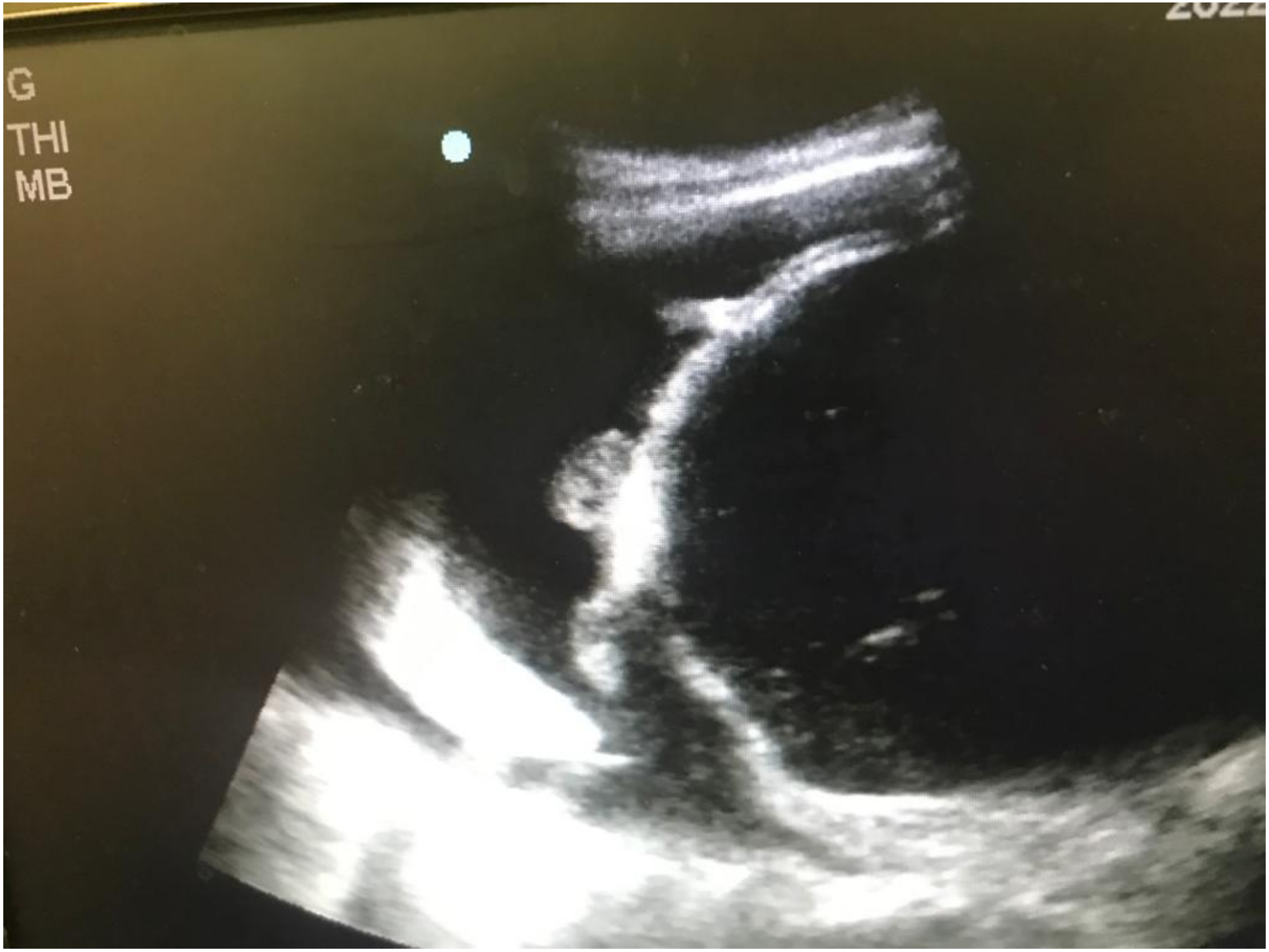
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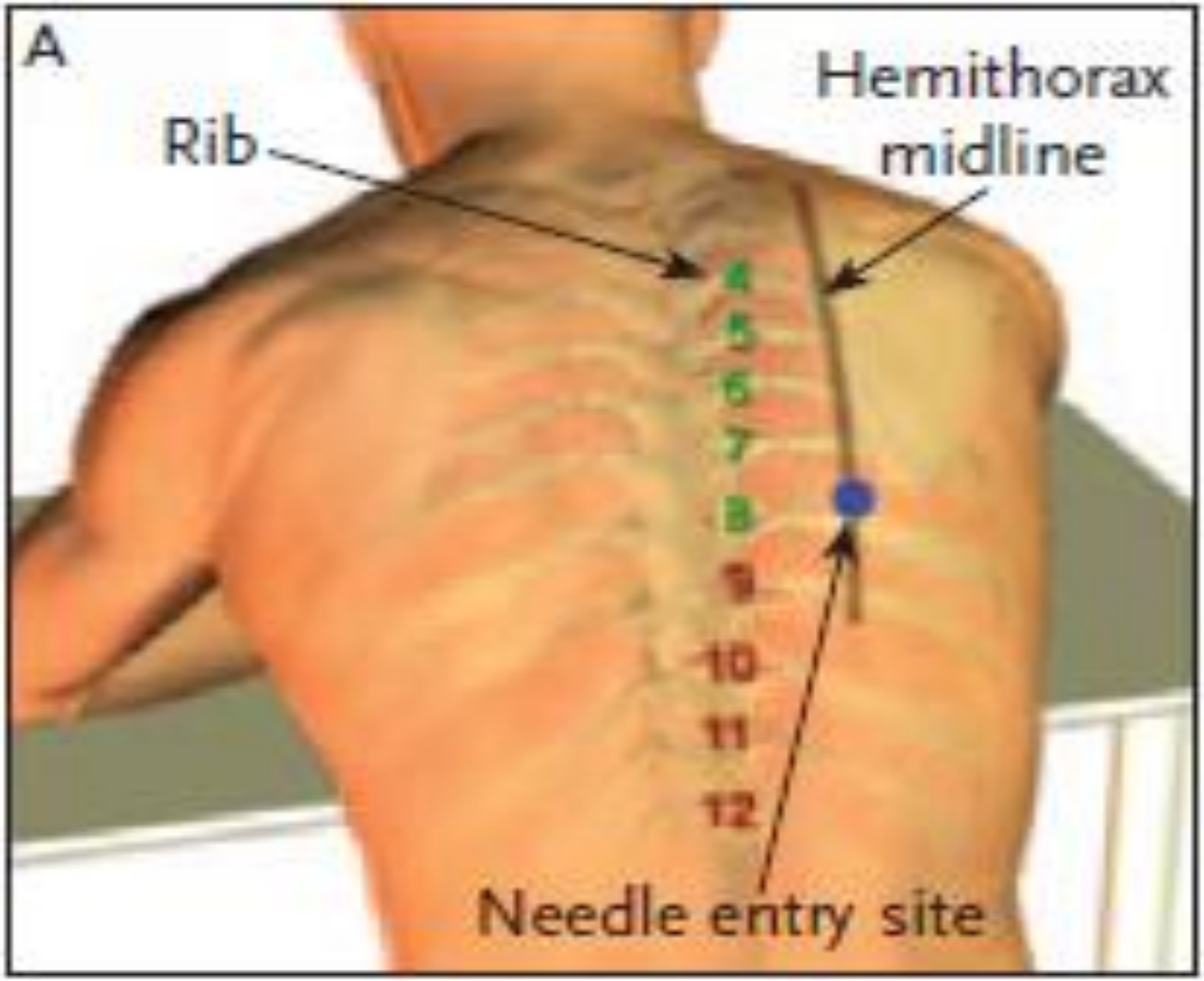
Clinical Symptoms and Signs

Symptoms

- Dyspnea is the most common symptoms at presentation and usually indicates large (>500 mL) effusion
- Chest pain
- Other symptoms occurring with pleural effusions are associated more closely with the underlying disease process.

Signs

- Dullness or decreased resonance to percussion
- Diminished or inaudible breath sounds
- Decreased tactile fremitus
- Egophony
- Pleural friction rub
- Asymmetric expansion of thoracic cage
- Mediastinal shift
- Other findings that provide clues to the cause of pleural effusion



Positioning of the patient and anatomical landmarks

Contrindication

- **Thoracocentesis is a safe procedure when performed by an experienced operator.**

- **No absolute contraindications.**
- **Relative contraindications:**
- **anticoagulation or bleeding diathesis**
- **very small pleural effusion**
- **mechanical ventilation with high PEEP**
- **active skin infection at the point of needle insertion**
- **single lung or hepatosplenomegaly**

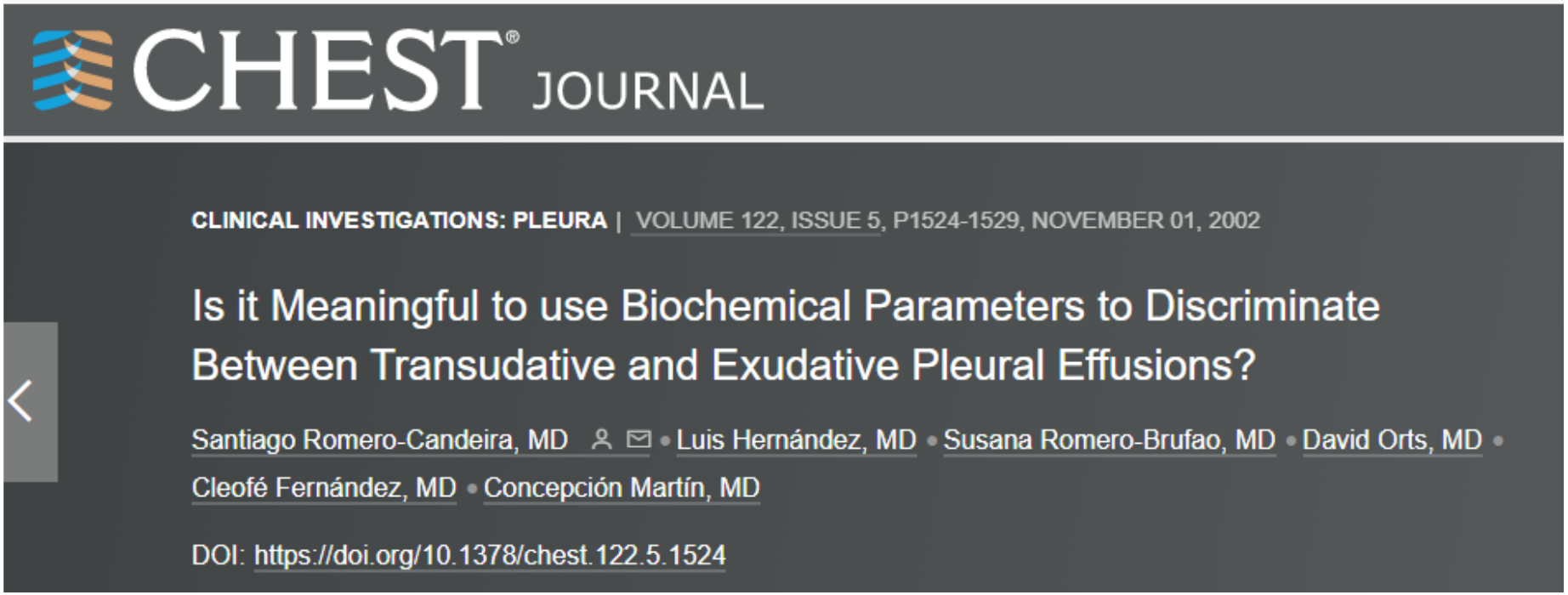
SEPARATION OF TRANSUDATIVE FROM EXUDATIVE EFFUSIONS

- A transudative pleural effusion develops when the systemic factors influencing the formation or absorption of pleural fluid are altered so that pleural fluid accumulates

- an exudative pleural effusion develops when the pleural surfaces or the capillaries in the location where the fluid originates are altered such that fluid accumulates

Back to basics

- pulmonary specialists are not very accurate at doing this on the basis of clinical history, physical examination, and radiographic findings



Light's Criteria

- **Exudative pleural effusion:**
  - **Pleural fluid protein/serum protein ratio greater than 0.5.**

  OR
  - **Pleural fluid LDH/serum LDH ratio greater than 0.6.**

  OR
  - **Pleural fluid LDH greater than two thirds the upper limits of normal of the serum LDH.**

- Light's criteria classify virtually all exudates correctly but misclassify about **25%** of transudates as exudates.

TABLE 3. SENSITIVITY OF TESTS TO DISTINGUISH EXUDATIVE FROM TRANSUDATIVE EFFUSIONS.*

TEST	SENSITIVITY FOR EXUDATE	SPECIFICITY FOR EXUDATE
	%	
Light's criteria (one or more of the following three)	98	83
Ratio of pleural-fluid protein level to serum protein level >0.5	86	84
Ratio of pleural-fluid LDH level to serum LDH level >0.6	90	82
Pleural-fluid LDH level >two thirds the upper limit of normal for serum LDH level	82	89
Pleural-fluid cholesterol level >60 mg/dl (1.55 mmol/liter)	54	92
Pleural-fluid cholesterol level >43 mg/dl (1.10 mmol/liter)	75	80
Ratio of pleural-fluid cholesterol level to serum cholesterol level >0.3	89	81
Serum albumin level − pleural-fluid albumin level ≤1.2 g/dl	87	92

*LDH denotes lactate dehydrogenase.

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Other Diagnostic Criteria

- **Exudative pleural effusion**
  - **Pleural fluid protein >3 g/dL (29 g/L)**
  - **Pleural fluid cholesterol >45 mg/dL (1.16 mmol/L)**
  - **Pleural fluid LDH >60 percent of upper limits of normal serum value.**
  - **a pleural fluid-to-serum bilirubin ratio above 0.6**
  - **a high level of oxidative stress markers**
- **soluble leukocyte selectin , cytokines ,uric acid , and a pleural fluid-to-serum cholinesterase ratio above 0.23**

Light’s Criteria

- Light's criteria identify approximately 25% of transudative effusions as exudates.
- The protein ratio is less than 0.65, the LDH ratio is less than 1.0 and the level of the LDH is less than the upper limit of normal

- It is suggested that the protein gradient first be examined because it is already available from Light's criteria.
- Protein gradient more than 3.1 g/dl
- If the protein gradient is not definitive, then one may use the albumin gradient or serum or pleural the NT-pro-BNP(more than 1,500 pg/mL)

SEPARATION OF TRANSUDATIVE FROM EXUDATIVE EFFUSIONS

- **dichotomized into transudates or exudates on the basis of a single cutoff point.**
- **An alternative approach is to use likelihood ratios for identifying whether a pleural fluid is a transudate or an exudate**

- **Very high or very low values are almost always indicative of exudates and transudates, respectively, whereas values near the cutoff levels can be associated with either transudates or exudates**

Other Characteristics of Transudates

- clear, straw colored, nonviscid, and odorless
- It takes a pleural fluid RBC count of more than 10,000/mm_3 to give the pleural fluid a pinkish tinge
- the discovery of blood tinged pleural fluid does not mean that the fluid is not a transudate

- The LDH isoenzyme present in RBCs is LDH-1, and

in one study of 23 patients with bloody pleural effusions (pleural fluid red cell counts greater than 100,000/mm_3), the fraction of LDH-1 in the pleural fluid was only slightly increased

Other Characteristics of Transudates

- The pleural fluid white blood cell (WBC) count of most transudates is less than 1,000/mm^3, but approximately 20% have WBC counts that exceed 1,000/mm^3
- Pleural fluid WBC counts above 10,000/mm^3 are rare with transudative pleural effusion

- The pleural fluid pH with transudative pleural effusions is higher than the simultaneously obtained blood pH ,probably because of active transport of bicarbonate from the blood into the pleural space

Probrain Natriuretic Peptide (BNP)

- The serum levels of BNP are used to help establish the diagnosis of CHF.
- In clinical practice, levels above 500 pg/mL are considered diagnostic of CHF whereas levels below 100 pg/mL are thought to make the diagnosis of CHF unlikely
- There is not a close correlation between the BNP levels and the NT-pro-BNP levels ($r = 0.78$)
- The BNP levels are only about 10% of the NT-pro-BNP levels.

NT-pro-BNP

- The pleural fluid NT-pro-BNP is also superior to the BNP and the protein gradient in identifying patients with heart failure who meet Light's criteria for exudates

- Other workers have demonstrated that there is a close relationship between the levels of NTpro-BNP in the pleural fluid and serum

- measurement of the pleural fluid NT-pro-BNP levels provides no additional information beyond the serum measurements

Appearance of Fluid

- Black pleural fluid has been reported with infection due to *Aspergillus niger*, infection due to *Rhizopus oryzae*, pigment laden macrophages following massive bleeding due to metastatic carcinoma and melanoma

- high viscosity is suggestive of malignant mesothelioma; the high viscosity is secondary to an elevated pleural fluid hyaluronic acid level

- The odor of all pleura fluids(feculent/urine)

Figure 1. Pleural fluid before (left) and after (right) centrifugation. The centrifugation resulted in a change of color of the pleural fluid from deep brown (left) to yellow (right)-instead of clearing of pleural fluid-suggesting that the pleural fluid is not empyema. The change of color of pleural fluid may be explained by the precipitation of red cells after centrifugation

Red Blood Cell Count

- Only 5,000 to 10,000 RBCs per mm^3 need be present to impart a red color to pleural fluid.
- If a pleural effusion has a total volume of 500 mL and the RBC count in the peripheral blood is 5 million/mm^3, a leak of only 1 mL blood into the pleural space will result in a blood-tinged pleural effusion.
- presence of blood-tinged or serosanguineous pleural fluid has little diagnostic significance
- If the hematocrit of the pleural fluid is greater than 50% of the peripheral hematocrit, a hemothorax is present, and one should consider inserting a chest tube

TABLE 2. TESTS INDICATED, ACCORDING TO THE APPEARANCE OF THE PLEURAL FLUID.

APPEARANCE OF FLUID	TEST INDICATED	INTERPRETATION OF RESULT
Bloody	Hematocrit	<1% → nonsignificant 1–20% → cancer, pulmonary embolus, or trauma >50% of peripheral hematocrit → hemothorax
Cloudy or turbid†	Centrifugation	Turbid supernatant → high lipid levels
Turbid supernatant	Triglyceride level	>110 mg/dl → chylothorax >50 mg/dl, but ≤110 mg/dl → obtain lipoprotein analysis Presence of chylomicrons → chylothorax ≤50 mg/dl and cholesterol >250 mg/dl → pseudochylothorax
Putrid odor	Stain and culture	Putrid odor → possible anaerobic infection

*To convert values for triglycerides to millimoles per liter, multiply by 0.01129. To convert values for cholesterol to millimoles per liter, multiply by 0.02586.

†This appearance is consistent with the presence of either cells and debris or high lipid levels.

White Blood Cell Count

- The pleural fluid for cell counts and differentials should be collected in a test tube with an anticoagulant
- automated counters provide accurate pleural fluid WBC counts
- Pleural fluid WBC counts above 10,000/mm_3 are most commonly seen with parapneumonic effusions

- The pleural fluid WBC count is of limited diagnostic use
- pleural fluid WBC counts above 50,000/mm_3 with both pancreatic disease and pulmonary embolization

Differential White Cell Count

Examination of a Wright's stain of pleural fluid is one of the most informative tests on pleural fluid. Because the pleural fluid WBC count is frequently less than 5,000/mm^3, it is useful to concentrate the cells before staining. This is easily accomplished by centrifuging approximately 10 mL of fluid and then resuspending the button of cells in approximately 0.5 mL of supernatant. After thorough mixing, slides that are similar to those for examining peripheral blood are made and stained in the usual way. Occasionally, large amounts of fibrinogen adhere to the cells. In such cases, resuspension in saline solution, followed by centrifugation, is indicated in order to evaluate cellular morphologic features. Automatic cell counters do not provide sufficiently accurate differential cell counts for clinical use (59,60), presumably because of the high number of mesothelial, lymphoid, and tumors cells in pleural fluid.

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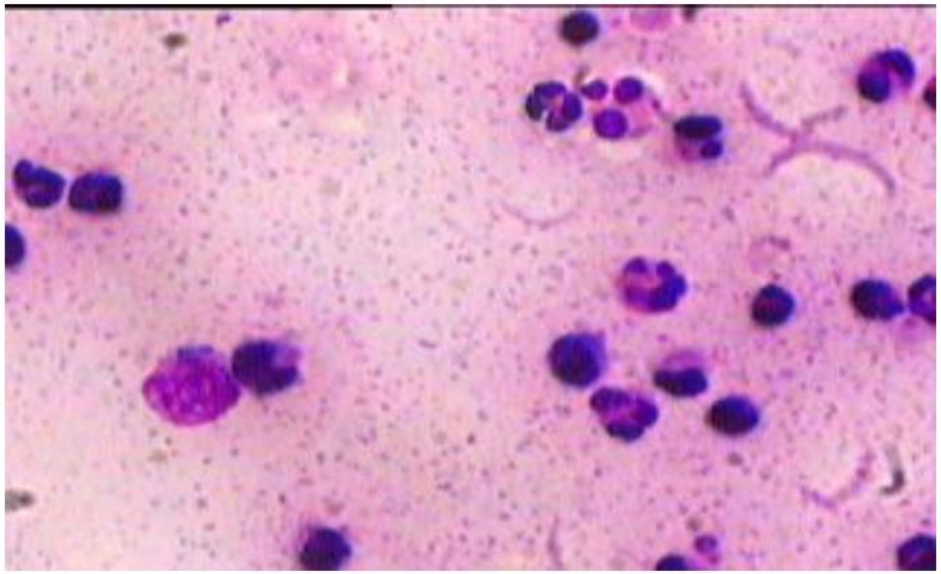


Fig 1. Pleural fluid smear with Neutrophil predominance in Tubercular effusion

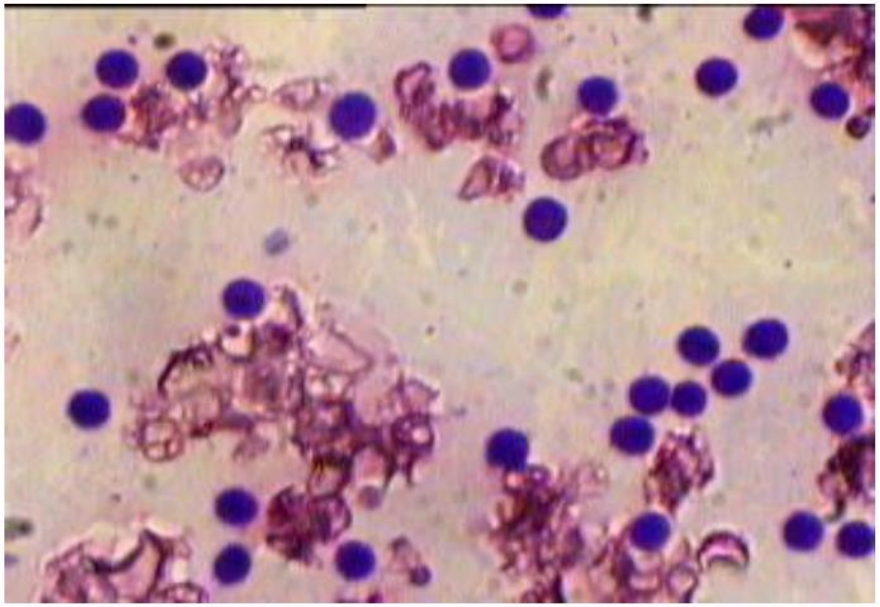


Fig. 3. Pleural fluid smear with Lymphocyte predominance in Malignant effusion

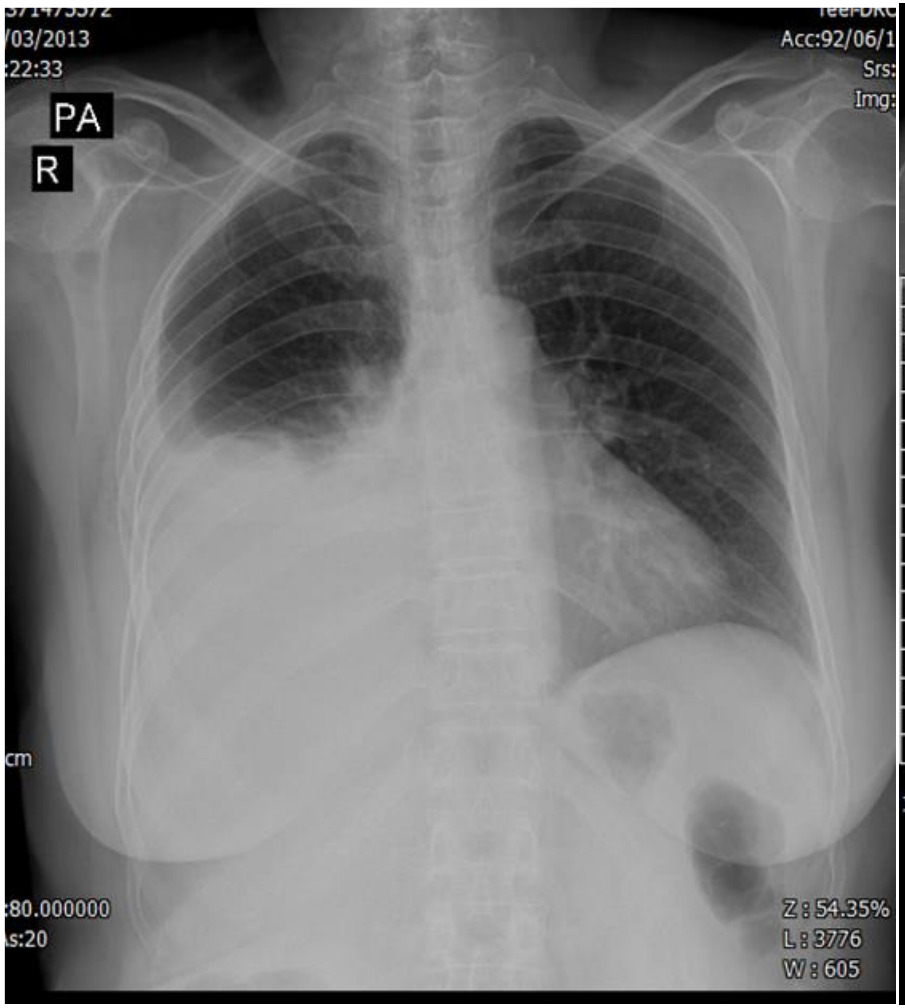
4 INSTEAD OF 2 CATEGORIES

- Although most laboratories divide pleural fluid WBCs into polymorphonuclear leukocytes and mononuclear cells, I prefer to divide them into four categories—PMN leukocytes, lymphocytes, other mononuclear cells, and eosinophils— because of the diagnostic significance of small lymphocytes

- The mononuclear cells include mesothelial cells, macrophages, plasma cells, and malignant cells.

Neutrophils

- Although more than 10% of transudative pleural effusions contain predominantly neutrophils, pleural fluid neutrophilia in transudates has no clinical significance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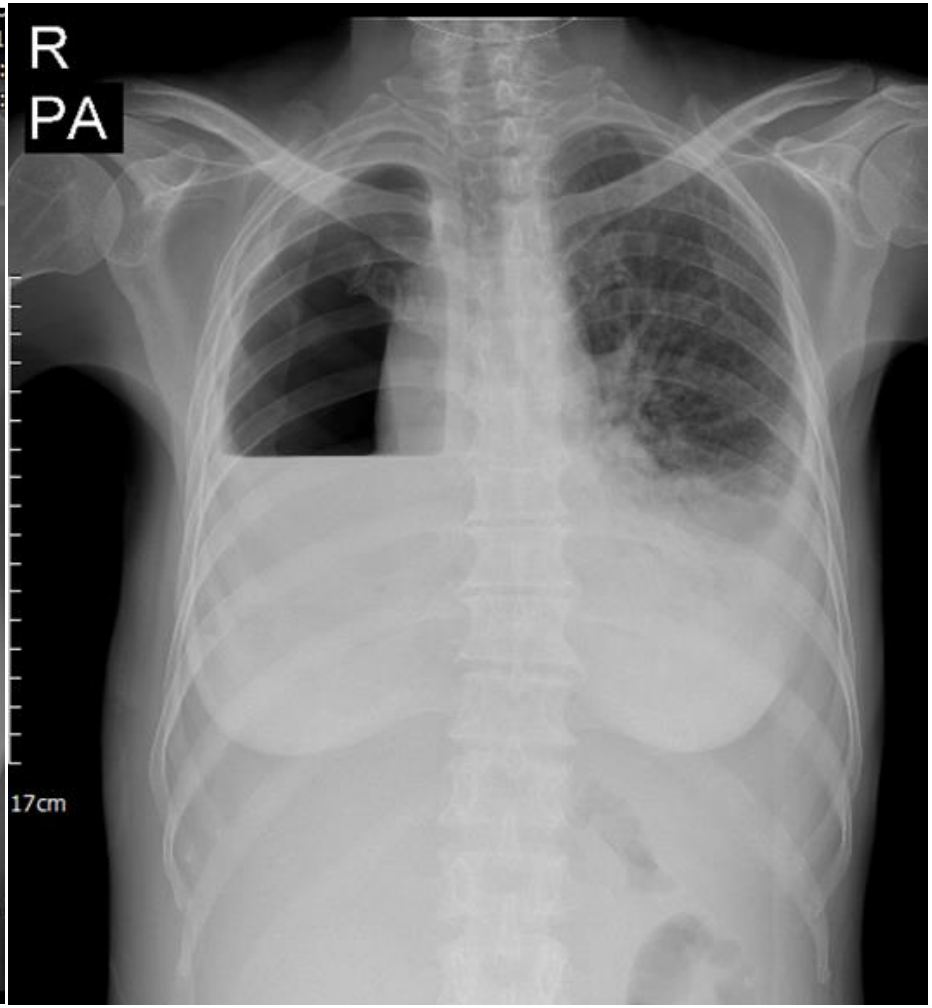
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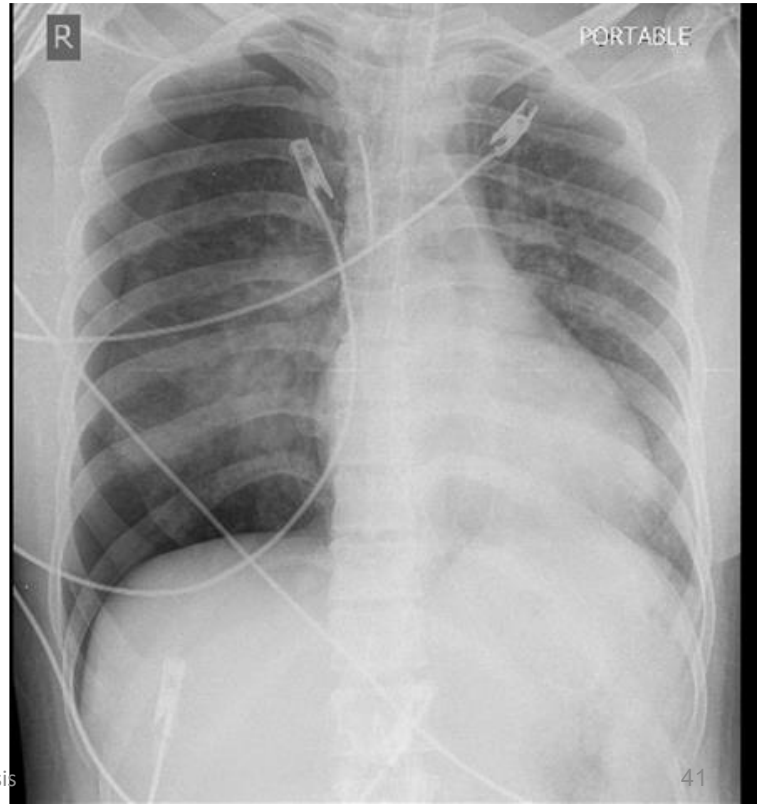
Eosinophils

- Approximately 7% of pleural fluids are characterized by pleural fluid eosinophilia (>10%)
- Most clinicians believe that significant numbers of eosinophils (>10%) in pleural fluid should be a clue to the origin of the pleural effusion
- In most instances, the pleural fluid eosinophilia is due to either air or blood in the pleural space

Eosinophils

- The mechanism responsible for the pleural fluid eosinophilia in response to air in the pleural space is unknown but is probably related to IL-5



Eosinophils

- Pulmonary infarction
- Benign asbestos pleural effusion
- Parasitic disease(Hydatid cyst)
- Fungal infection
- Drugs(dantrolene, bromocriptine, and nitrofurantoin)
- Malignancy (carcinoma, lymphoma)
- Churg-Strauss syndrome

Eosinophils

- If the patient has pneumonia and pleural effusion, the presence of pleural fluid eosinophilia is a good prognostic sign because such an effusion rarely becomes infected.

- The origin of approximately 40% of eosinophilic effusions is not established, and these effusions resolve spontaneously.

Lymphocytes

- The discovery that more than 50% of the WBCs in an exudative pleural effusion are **small lymphocytes** is diagnostically important because it means that the patient probably has a **malignant disease, tuberculous pleuritis, or a pleural effusion after CABG surgery**.

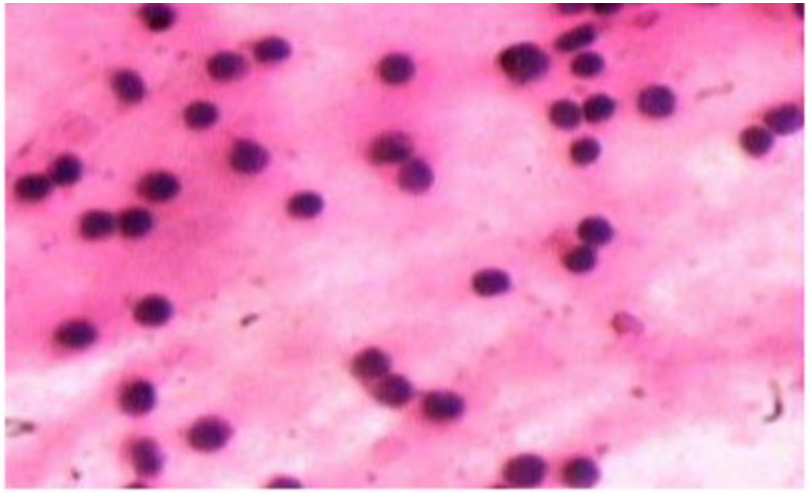
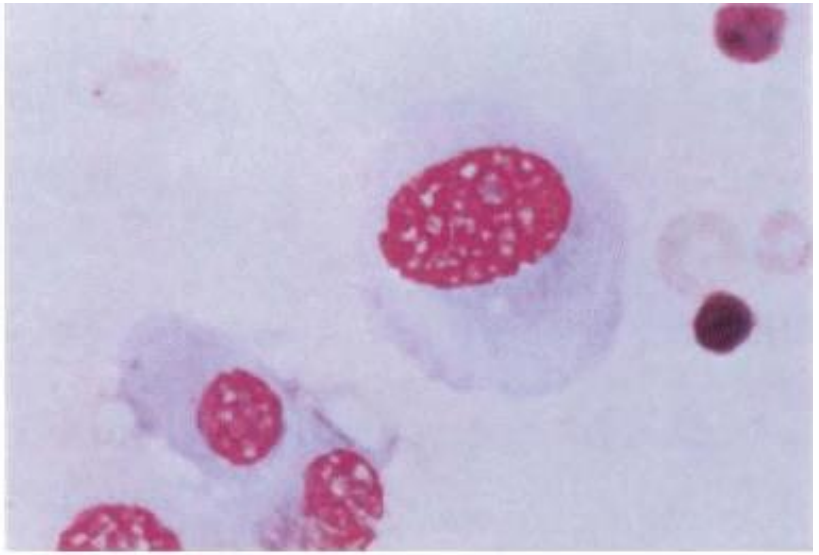


Fig. 2. Pleural fluid smear with Lymphocyte predominance in Tubercular effusion

Several papers have assessed the diagnostic utility of separating pleural lymphocytes into T and B lymphocytes .In general, this separation has not been useful diagnostically

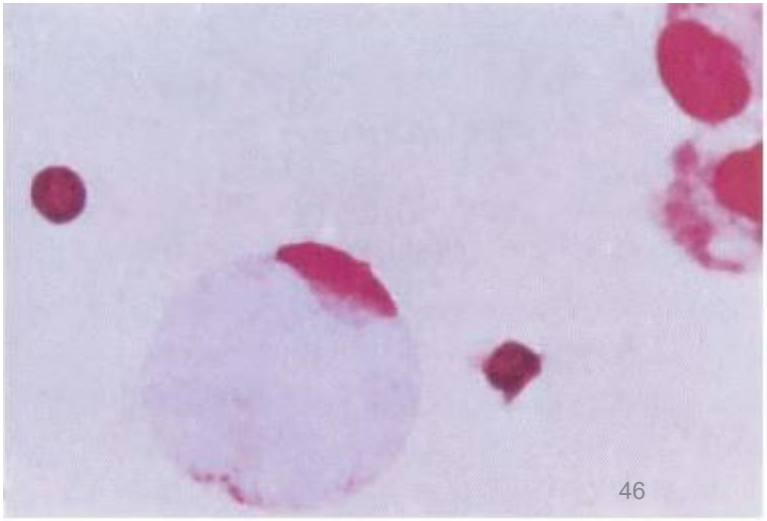
Mesothelial Cells

- their presence or absence is often useful diagnostically because these cells are uncommon in tuberculous effusions
- mesothelial cells, particularly in their activated form, may be confused with malignant cells



Other cell

- In general, the presence of macrophages in pleural fluid is of limited diagnostic use
- The presence of numerous plasma cells in the pleural fluid suggests multiple myeloma.
- Smaller numbers of plasma cells are not of any particular diagnostic importance



GLUCOSE MEASUREMENT

- a low pleural fluid glucose level (<60 mg/dL) indicates that the patient probably has one of four disorders, namely:

parapneumonic effusion

malignant disease

rheumatoid disease

tuberculous pleuritic

- Paragonimiasis
- hemothorax
- Churg-Strauss syndrome
- occasionally lupus pleuritis

glucose measurement and malignant effusion

- Approximately 15% to 25% of patients with malignant pleural effusions have pleural fluid glucose levels below 60 mg/dL and the level may be less than 10 mg/dL.
- Patients with malignant pleural effusions and a low glucose level have a greater tumor burden in their pleural space than do those with normal pleural fluid glucose levels.
- low pleural fluid glucose : more likely to have positive pleural fluid cytology and a positive pleural biopsy , are less likely to have a good result from chemical pleurodesis ,and have a shortened life expectancy

glucose measurement

- **In my experience, it is not necessary to obtain pleural fluid glucose levels with the patient fasting or to take the serum glucose level into consideration when evaluating the pleural fluid glucose level**.

LACTIC ACID DEHYDROGENASE MEASUREMENT

- Most patients who meet the criteria for exudative pleural effusions with LDH but not with protein levels have either parapneumonic effusions or malignant pleural disease.
- pleural fluid LDH is a reliable indicator of the **degree of pleural inflammation**; the higher the LDH, the more inflamed the pleural surfaces.
- Serial measurement of the pleural fluid LDH levels is informative when one is dealing with a patient with an undiagnosed pleural effusion
- presence of blood in the pleural fluid, however, usually does not adversely affect the measurement of the LDH

pH AND Pco_2 MEASUREMENT

The pleural fluid pH is frequently not measured correctly (148,149,150). Chandler et al. (148) surveyed the methods by which pleural fluid pHs were measured at 277 acute care institutions in the southeastern part of the United States in 1998. They reported that the pleural fluid pH was measured with the blood gas machine in only 32% of the institutions, whereas it was measured with dip stick or pH indicator paper in 56% and by a pH meter in 12% (148). A survey of 267 pulmonologists in 2008 from the United States revealed that 39% of the physicians who use the pleural fluid pH in the management of parapneumonic effusions were wrong in their assumption that their laboratory used the blood gas machine to measure pleural fluid pH (150). It has been shown that neither pH indicator strip paper (148,151,152) nor pH meters (151) are sufficiently accurate for clinical use. Bowling et al. (153) recently reported similar results from North Carolina. In this study, only 2 of 11 hospitals measured pleural fluid pH with a blood gas analyzer. In a second study (153), 43% of 221 pulmonologists who use the pleural fluid pH were not aware that only pH's obtained with the blood gas machine are sufficiently accurate. The above studies demonstrate that it is important for physicians who order pleural fluid pH to know how their hospital measures the pleural fluid pH. The pH meter gives a reading that is approximately 0.20 to 0.30 too high because it measures the pH at

pH MEASUREMENT

- At times, laboratory personnel object to injecting the pleural fluid through blood gas machines for fear of the

development of clots.

This objection can be overcome if a clot-catching apparatus is inserted between the syringe and blood gas machine

- When the pleural fluid pH is used as a diagnostic test, it must be measured with the same care as arterial pH. The fluid should be collected anaerobically in a heparinized syringe

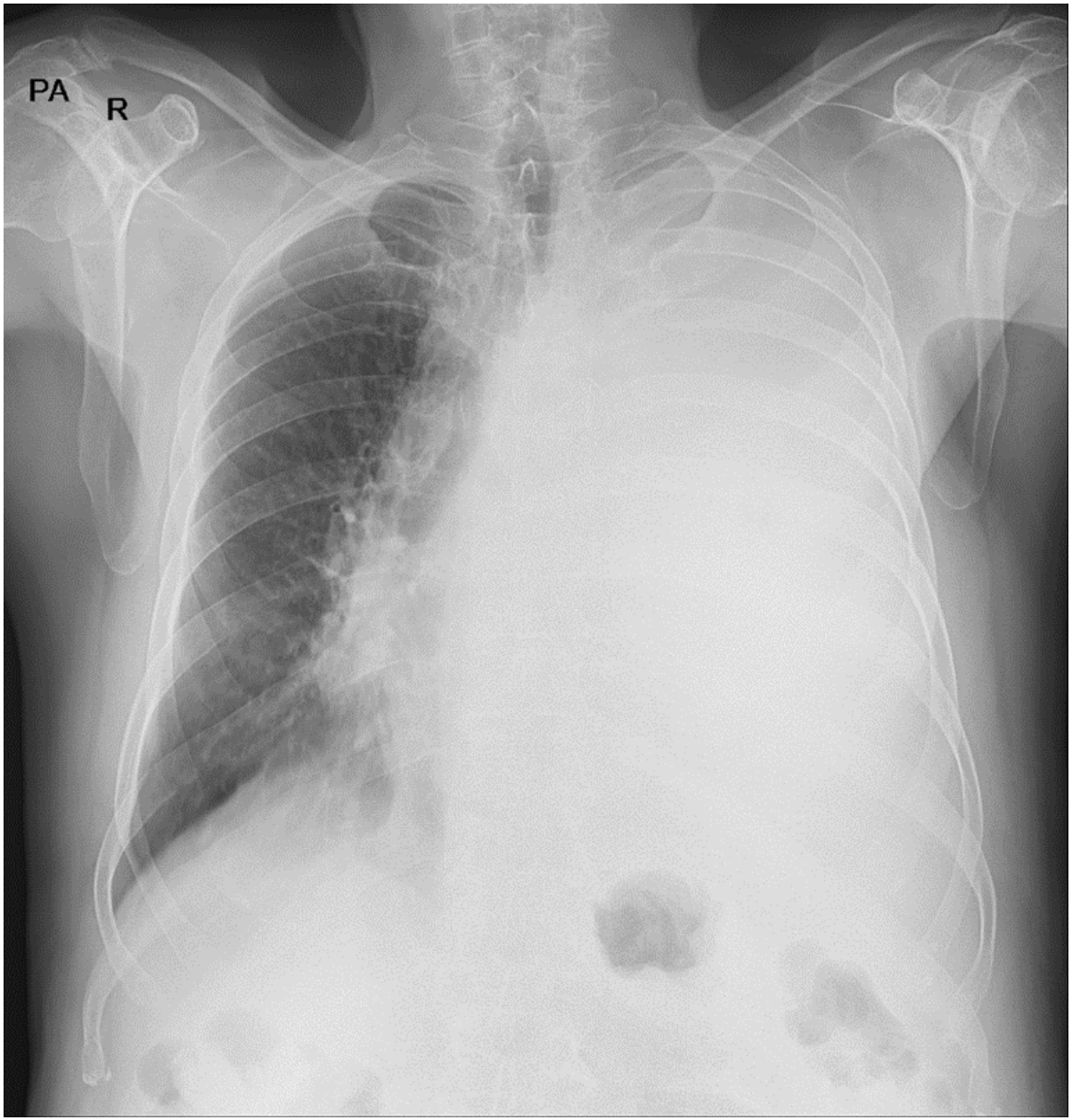
pH AND Pco_2 MEASUREMENT

- **pleural fluid pH is less than 7.2**
  - (1) complicated parapneumonic effusion
  - (2) esophageal rupture
  - (3)rheumatoid pleuritic
  - (4) tuberculous pleuritic
  - (5) malignant pleural disease
  - (6) hemothorax
  - (7) systemic acidosis
  - (8) paragonimiasis
  - (9) lupus pleuritic
  - (10)urinothorax

pH AND Pco_2 MEASUREMENT

- *Proteus* organisms, the pleural fluid pH may be elevated because these organisms produce ammonia by their urea splitting ability, which can increase the pH
- In patients with parapneumonic effusions, the pleural fluid pH may fall before the pleural fluid glucose level becomes depressed

- It should be noted that the pH can vary markedly from locule to locule in patients with parapneumonic effusions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TESTS FOR DIAGNOSING PLEURAL MALIGNANCY

Cytologic examination of pleural fluid is one of the most informative laboratory procedures in the diagnosis of pleural effusions because with it a definitive diagnosis can be made in more than 50% of patients with malignant disease involving the pleura. It is important to process pleural fluid specimens expeditiously when they are submitted for cytology. Specimens maintained at room temperature deteriorate markedly within 48 hours as do refrigerated specimens maintained for 96 hours (168). The optimal amount of pleural fluid to submit for direct smear and cell block preparations appears to be 150 ml although the diagnosis of malignancy can be established in most patients with 10 ml pleural fluid (169).

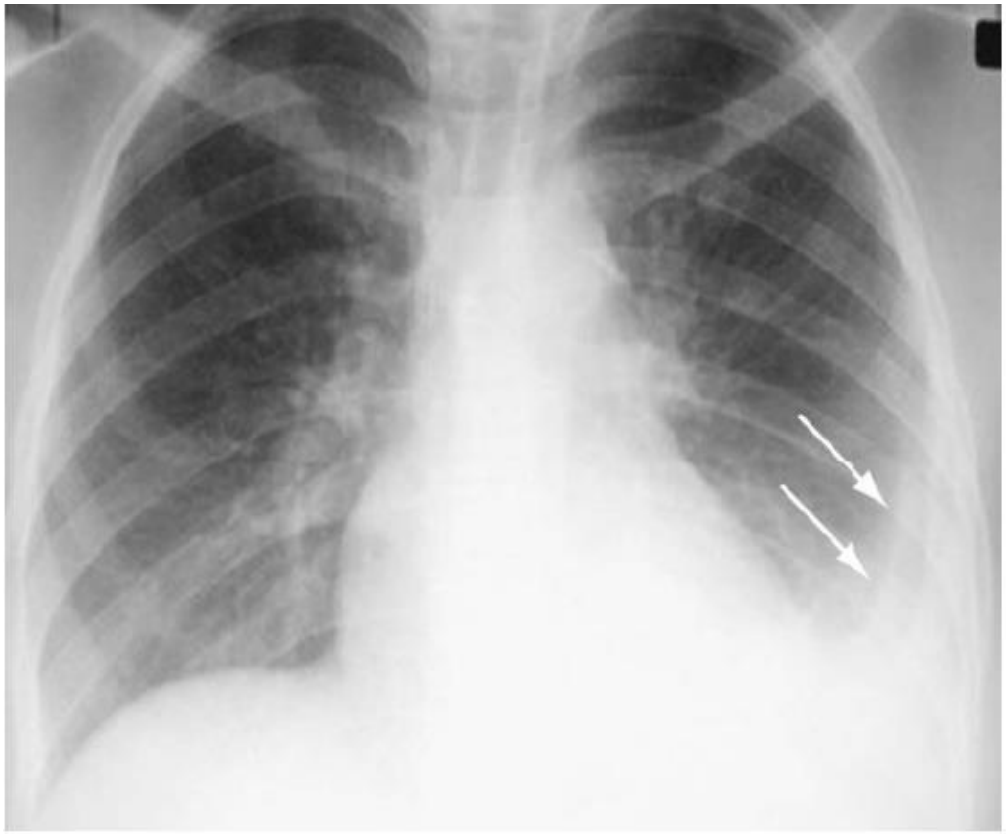
The accuracy of the cytologic diagnosis of malignant pleural effusions has been reported to be anywhere between 40% and 87%

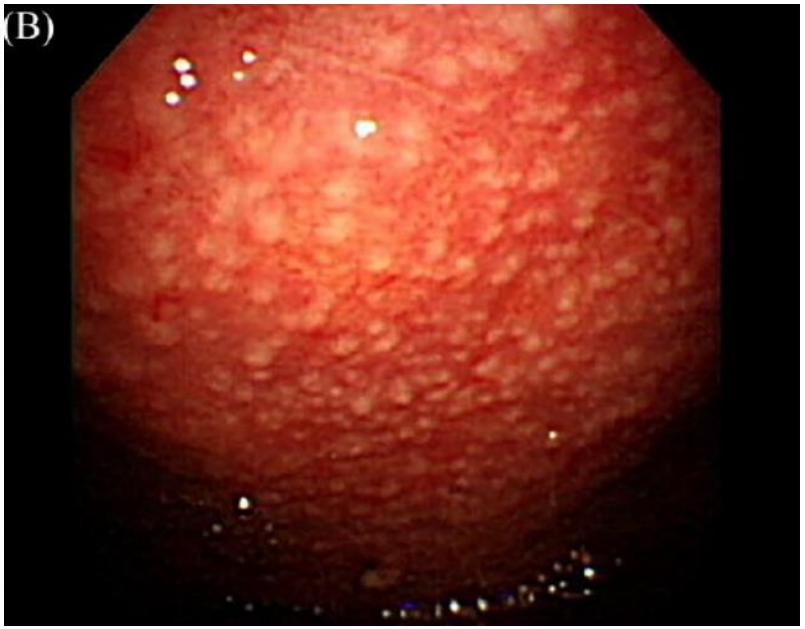
TESTS FOR DIAGNOSING PLEURAL MALIGNANCY

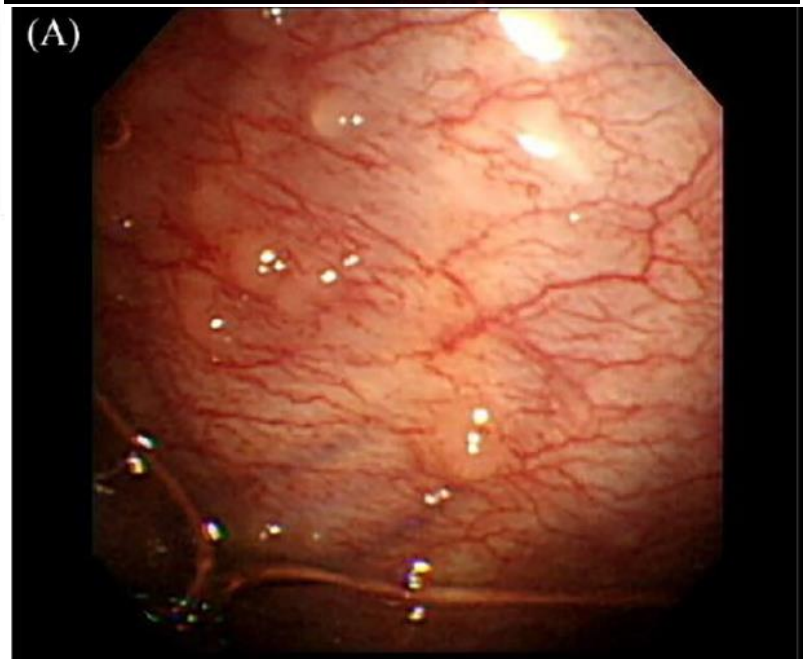
- If **both cell blocks and smears** are prepared and examined, the percentage of positive diagnoses will be greater than if only one method is used

- it is unusual for the results of pleural fluid cytologic tests to be positive in patients with squamous cell carcinoma because the pleural effusions are usually due to bronchial obstruction or lymphatic blockade

- Nucleolar Organizer Regions
- Immunohistochemical Studies
- Electron Microscopic Examination
- Histochemical Studies
- Tumor Markers in Pleural Fluid
- Soluble Mesothelin Related Protein (SMRP)
- Oncogenes
- Hyaluronic Acid
- Lectin Binding
- Flow Cytometry




(B)


(A)

TESTS FOR DIAGNOSING PLEURAL TUBERCULOSIS(ADA)

- ADA is the enzyme that catalyzes the conversion of adenosine to inosine.
- In general, a cutoff level of between 40 and 45 U/L is used with levels above this being indicative of tuberculosis.
- The higher the level, the more likely the patient is to have tuberculosis.

Adenosine Deaminase Measurement (ADA)

- Liang et al. performed a meta-analysis of 63 articles evaluating the diagnostic usefulness of ADA that included 2,796 patients with tuberculous pleuritis and5,297 patients with other diseases.
- They reported that the mean sensitivity was 0.92, the mean specificity was 0.90, the mean positive likelihood ratio was 0.903 and the mean negative likelihood ratio was 0.10
- The pleural fluid ADA level can be used to exclude the diagnosis of tuberculous pleuraleffusions in patients with undiagnosed lymphocytic pleural effusions??

Other cause of ADA elevation

- **rheumatoid pleuritis and empyema**
- **pleural fluid lymphocyte-to-neutrophil ratio greater than0.75, the specificity of the test is increased**

- **very small percent of other neoplasms , with Q fever ,with brucellosis and with Legionnaire's disease**

Adenosine Deaminase Measurement (ADA)

- An ADA level above 70 U/L in a patient who does not have an empyema or rheumatoid arthritis (RA) is essentially diagnostic of tuberculous pleuritis.

An ADA level above 40 is suggestive of tuberculosis, and the higher the ADA, the more likely the diagnosis of tuberculous pleuritic

- if 0.9 mL pleural fluid is added to a test tube containing 0.10 mL of a mixture of 50% glycerol and 50% ethylene glycol, the pleural fluid can be mailed by regular mail with no loss of ADA activity

Interferon-Gamma

Which test should be used to establish the diagnosis of tuberculous pleuritis? Greco et al. (279) reviewed all English language studies from 1978 to November 2000. The studies included 4,738 patients on whom ADA was measured and 1,189 patients on whom interferon-gamma was measured. These researchers reported that the maximum joint sensitivity and specificity for ADA was 93%, whereas it was 96% for interferon-gamma (279). Because there is not much difference in the performance of the two tests and as ADA is much less expensive, ADA appears to be the preferred test.

the IGRA should not beused in assessing whether patients have tuberculous pleuritis.

Polymerase Chain Reaction

- At present, the U.S. Food and Drug Administration (FDA) has not given its approval for the use of these tests on extrapulmonary materials

- In general, PCR on pleural fluid has been less sensitive than the PCR on other specimens, possibly due to the low numbers of tuberculous bacilli present in pleural fluid and possibly due to the manner in which the DNA is extracted .
- PCR has also been tried on pleural biopsy specimens and the results have not been particularly promising

Rheumatoid Factor

view of the last-mentioned study, I recommend that RF titers be determined in pleural fluid when the diagnosis of rheumatoid pleuritis is considered. The demonstration of a pleural fluid RF titer equal to or greater than 1:320 and equal to or greater than the serum titer is strong evidence that the patient has a rheumatoid pleural effusion.

MICROBIOLOGIC STUDIES ON PLEURAL FLUID
Cultures

- For aerobic and anaerobic bacterial cultures, the pleural fluid should be inoculated directly into **blood culture media** at the bedside because the number of positive cultures will increase with this method

- In one study of 62 patients with suspected pleural infection, the addition of the blood culture bottle culture to the standard culture increased the proportion of patients with identifiable pathogens from 37.7% to 58.5%.

MICROBIOLOGIC STUDIES ON PLEURAL FLUID
Cultures

- Culturing pleural fluid from chest tube drainage should be discouraged. Cultures from chest tubes yield inaccurate culture results when compared with direct aspirates

- For mycobacterial cultures, use of a BACTEC system with bedside inoculation provides higher yields and faster results than do conventional methods(18 vs 35 days)

- Routine smears for mycobacteria are not indicated because they are almost always negative, unless the patient has a tuberculous empyema or unless the patient is HIV positive.

TABLE 8.1 ■ Differential Diagnosis of Pleural Effusion

I. Transudative pleural effusions

- A. Congestive heart failure
- B. Cirrhosis
- C. Nephrotic syndrome
- D. Superior vena caval obstruction
- E. Urinothorax
- F. Peritoneal dialysis
- G. Glomerulonephritis
- H. Myxedema
- I. Cerebrospinal fluid leaks to pleura
- J. Hypoalbuminemia
- K. Sarcoidosis

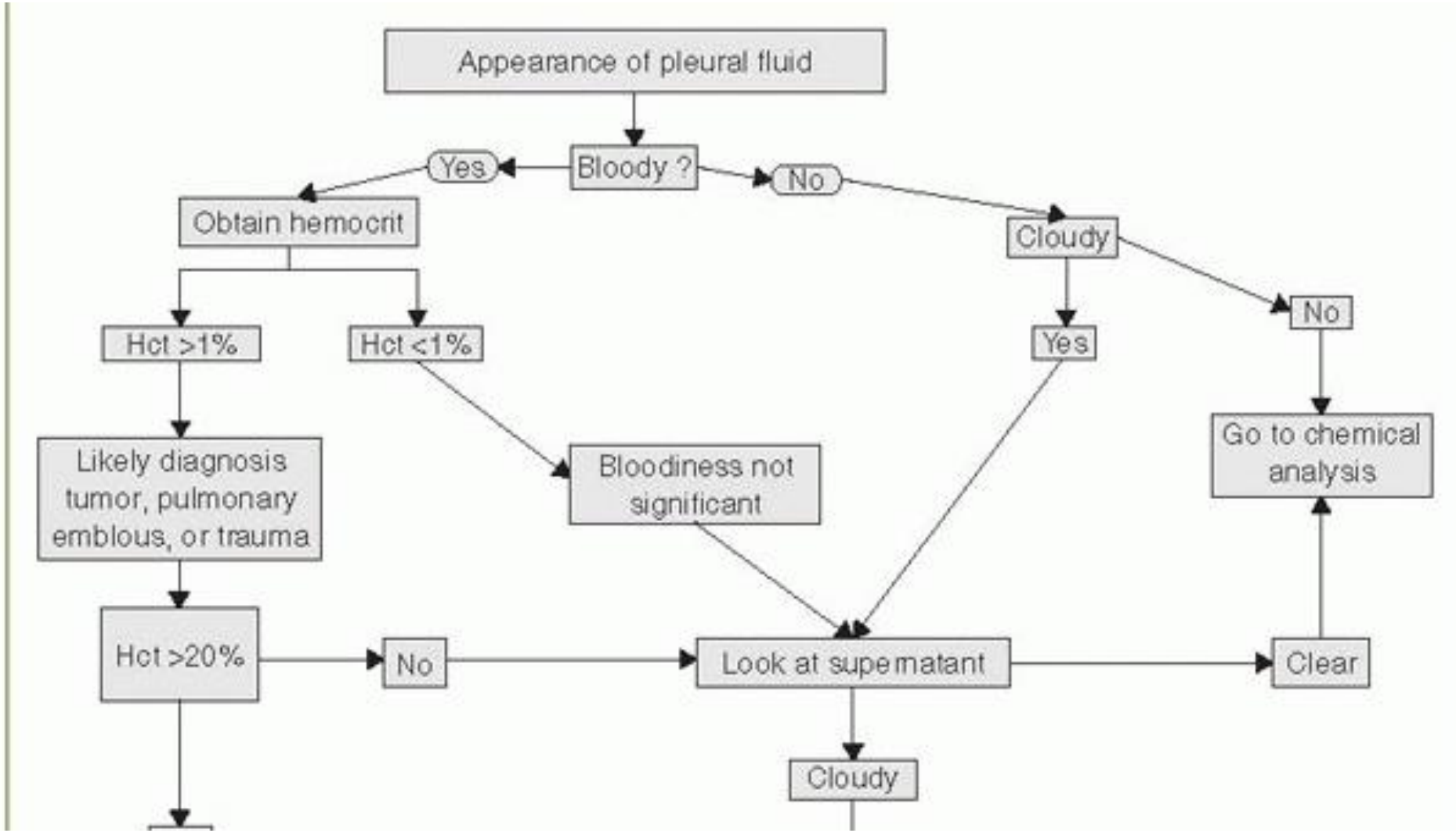
EXUDATIVE PLEURAL EFFUSIONS

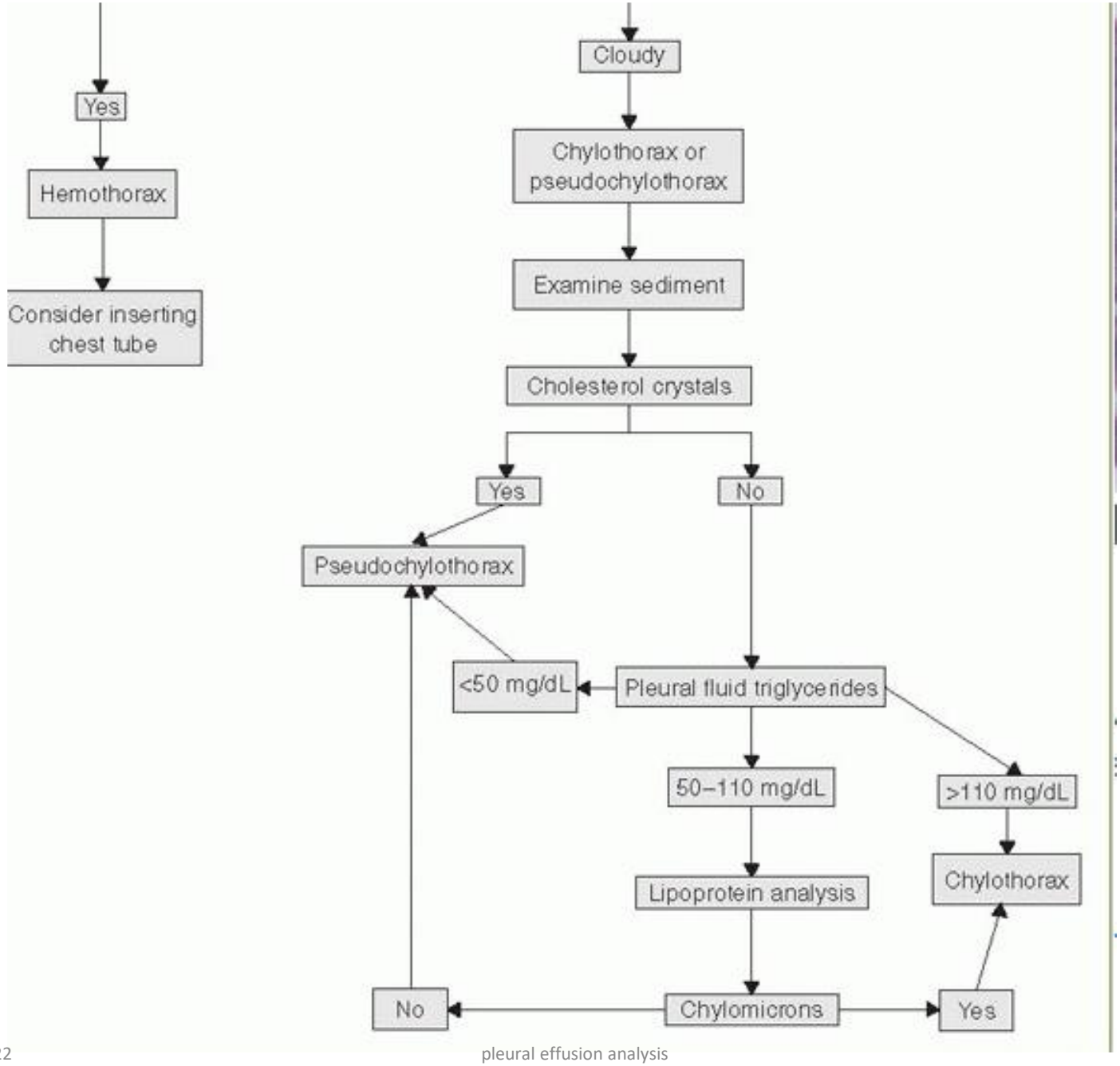
Neoplastic diseases
Infectious diseases
Pulmonary embolism
Gastrointestinal disease
Collagen vascular diseases
Postcardiac injury syndrome
Post–CABG
Asbestos exposure
Sarcoidosis
Uremia

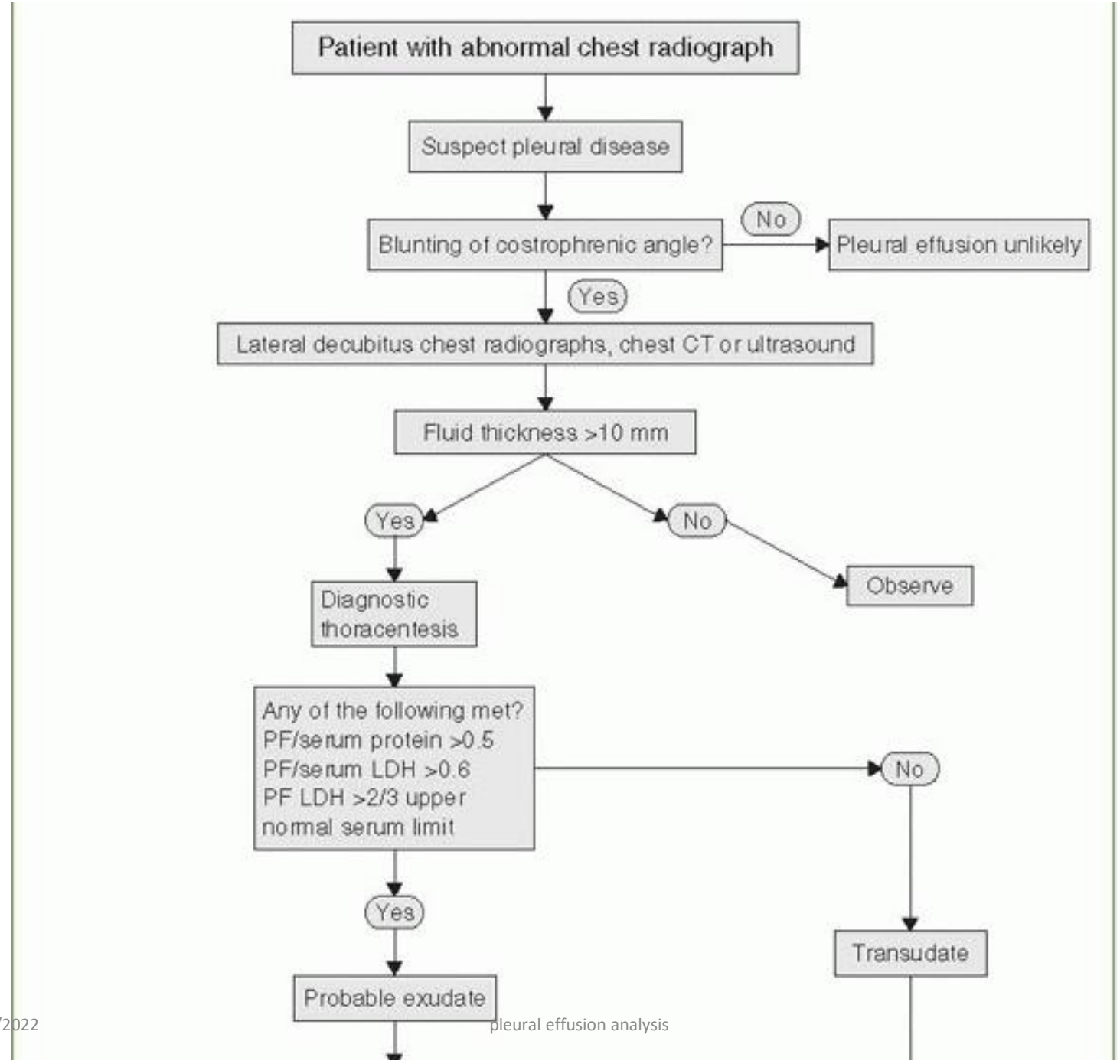
Meigs' syndrome
Ovarian hyperstimulation sy
Yellow nail syndrome
Drug-induced pleural disease
Radiation therapy
Electric burns
Iatrogenic injury
Hemothorax
Chylothorax

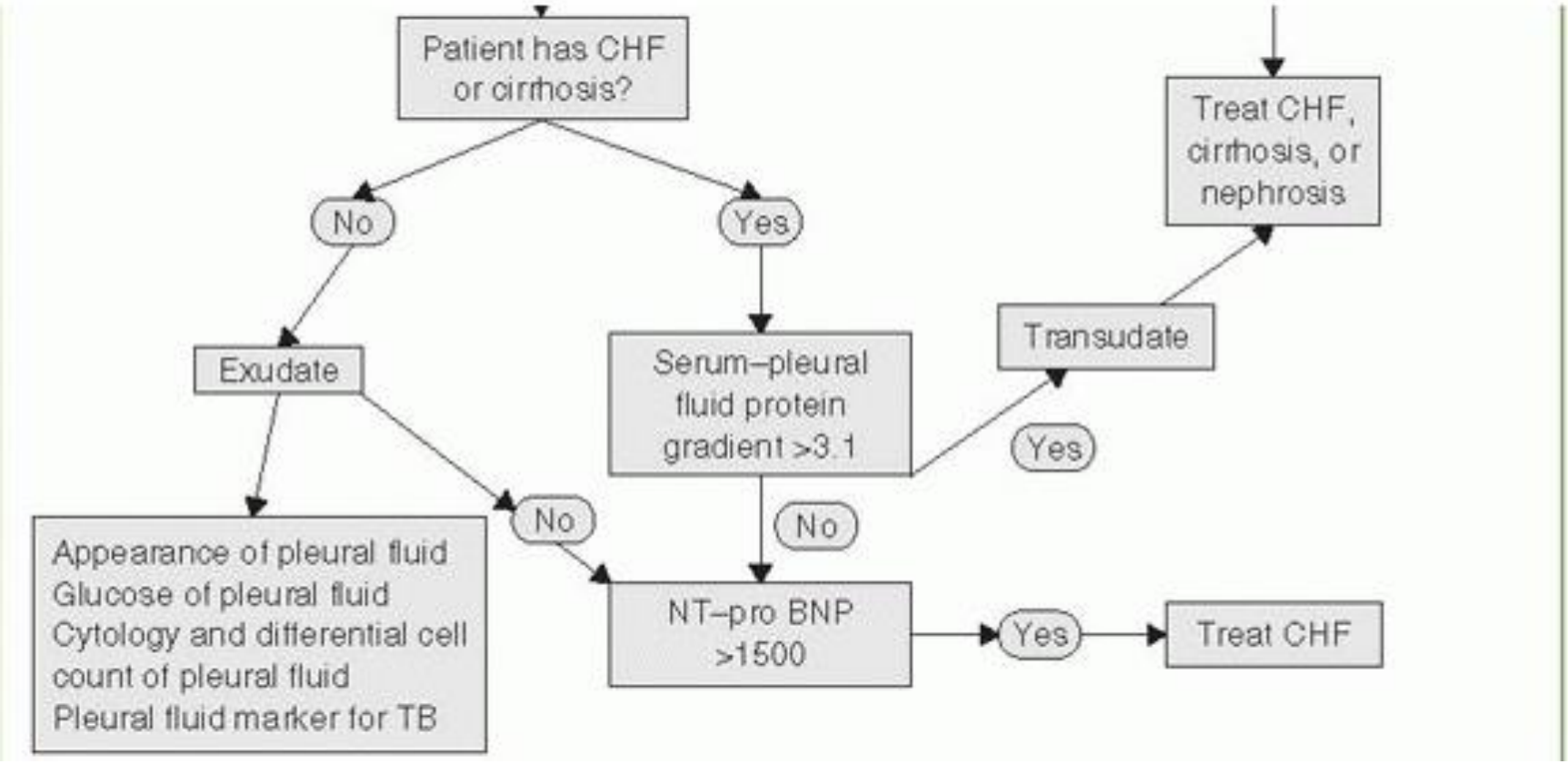
Table 79-2 Approximate Annual Incidence of Various Types of Pleural Effusions in the United States

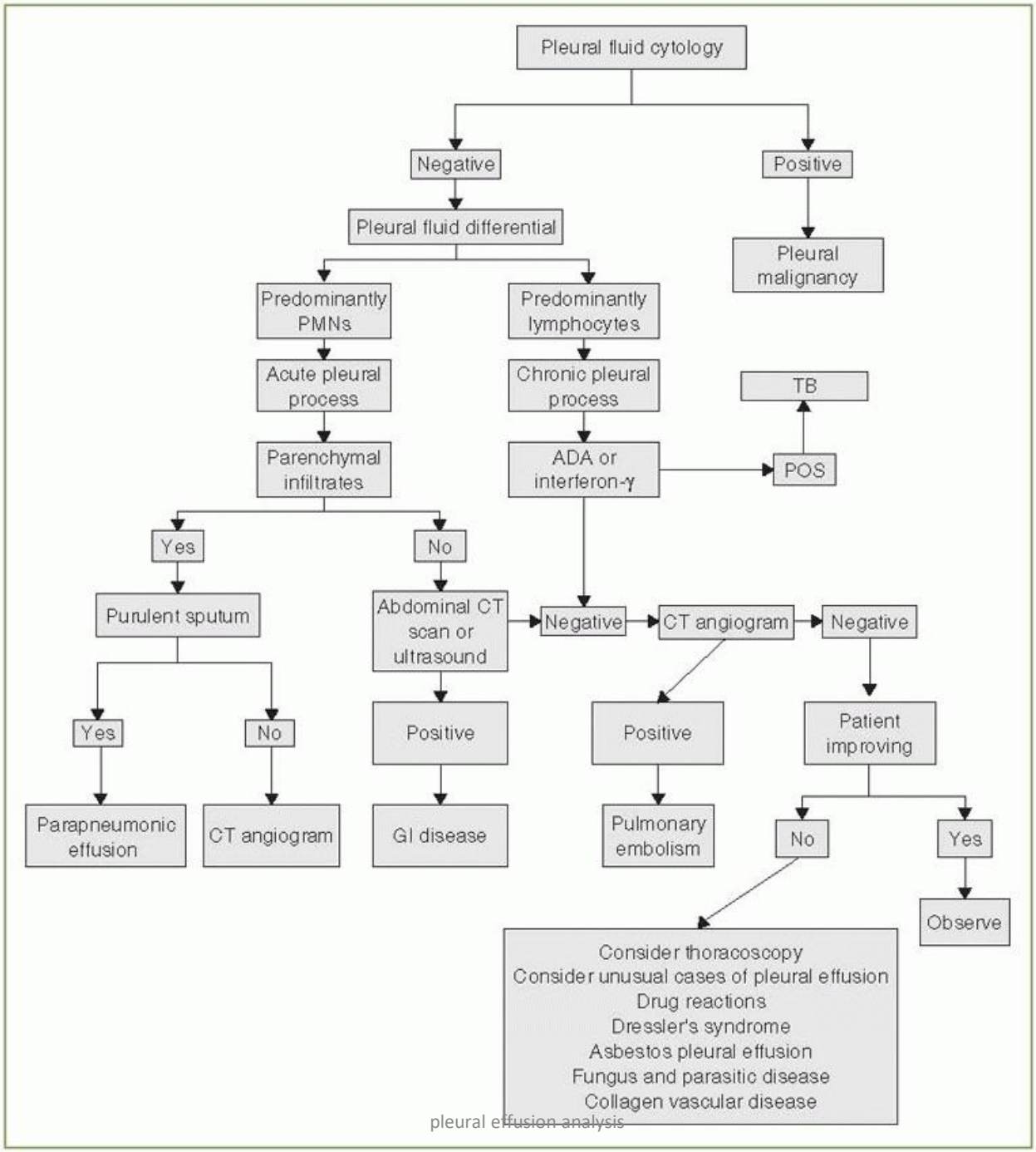
Type of Effusion	Incidence
Congestive heart failure	500,000
Pneumonia (bacterial)	300,000
Malignant disease	200,000
Lung	60,000
Breast	50,000
Lymphoma	40,000
Other	50,000
Pulmonary embolism	150,000
Viral disease	100,000
Post–coronary artery bypass surgery	60,000
Cirrhosis with ascites	50,000
Gastrointestinal disease	25,000
Collagen vascular disease	6000
Tuberculosis	2500
Asbestos exposure	2000
Mesothelioma	1500


Appearance of pleural fluid
Bloody ?
Yes
No
Obtain hemocrit
Cloudy
Hct >1%
Hct <1%
Yes
No
Likely diagnosis tumor, pulmonary emblous, or trauma
Bloodiness not significant
Go to chemical analysis
Hct >20%
No
Look at supernatant
Clear
Cloudy


Yes
Hemothorax
Consider inserting chest tube
Cloudy
Chylothorax or pseudochylothorax
Examine sediment
Cholesterol crystals
Yes
No
Pseudochylothorax
<50 mg/dL
Pleural fluid triglycerides
50–110 mg/dL
>110 mg/dL
Lipoprotein analysis
Chylothorax
No
Chylomicrons
Yes


Patient with abnormal chest radiograph
Suspect pleural disease
Blunting of costrophrenic angle?
No
Pleural effusion unlikely
Yes
Lateral decubitus chest radiographs, chest CT or ultrasound
Fluid thickness >10 mm
Yes
No
Observe
Diagnostic thoracentesis
Any of the following met?
PF/serum protein >0.5
PF/serum LDH >0.6
PF LDH >2/3 upper normal serum limit
No
Yes
Transudate
Probable exudate


Patient has CHF or cirrhosis?
No
Yes
Exudate
Serum–pleural fluid protein gradient >3.1
Transudate
Treat CHF, cirrhosis, or nephrosis
Yes
No
No
Appearance of pleural fluid
Glucose of pleural fluid
Cytology and differential cell count of pleural fluid
Pleural fluid marker for TB
NT–pro BNP >1500
Yes
Treat CHF


Pleural fluid cytology
Negative
Positive
Pleural fluid differential
Pleural malignancy
Predominantly PMNs
Predominantly lymphocytes
Acute pleural process
Chronic pleural process
TB
Parenchymal infiltrates
ADA or interferon-γ
POS
Yes
No
Purulent sputum
Abdominal CT scan or ultrasound
Negative
CT angiogram
Negative
Yes
No
Positive
Positive
Patient improving
Parapneumonic effusion
CT angiogram
GI disease
Pulmonary embolism
No
Yes
Observe
Consider thoracoscopy
Consider unusual cases of pleural effusion
Drug reactions
Dressler's syndrome
Asbestos pleural effusion
Fungus and parasitic disease
Collagen vascular disease

OPTIONS WHEN NO DIAGNOSIS IS OBTAINED AFTER INITIAL THORACENTESIS

- **The first thing that we recommend is a CT angiogram??**

- **If the CT angiogram scan does not demonstrate a pulmonary embolus, then there are five options,**
- **observation**
- **needle biopsy of the pleura**
- **bronchoscopy**
- **thoracoscopy**
- **thoracotomy with open biopsy.**

Observation

- This is probably the best option if the patient is improving and there are no parenchymal infiltrates.

- no diagnosis is ever established in approximately 15% of patients with exudative pleural effusion

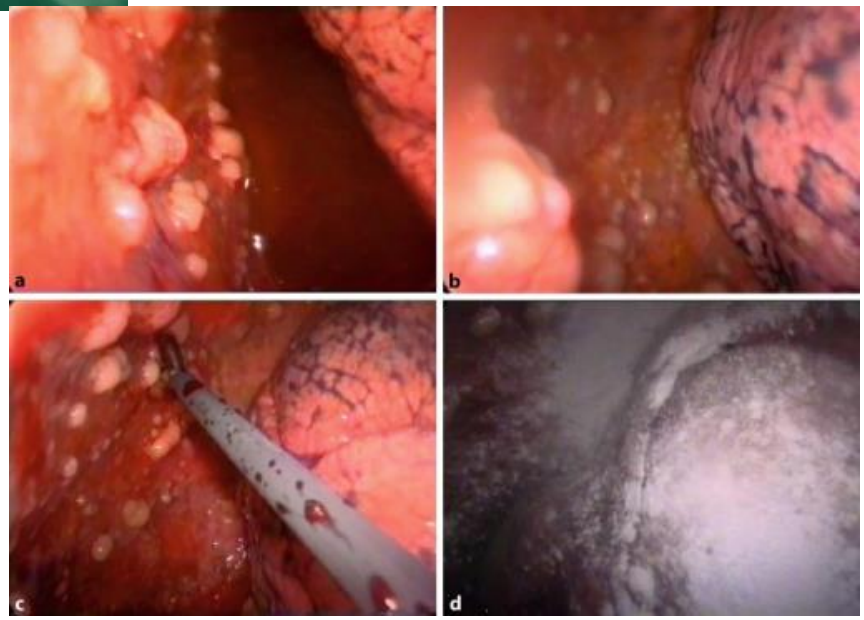
bronchoscopy

(a) A pulmonary infiltrate on CXR or CT scan

(b) Hemoptysis is present

(c) The pleural effusion is massive, that is, it occupies more than three fourths of hemithorax

(d) Themediastinum is shifted toward the side of the effusion;


a
b
c
d

Thoracoscopy

- Thoracoscopy is indicated in the patient with an undiagnosed pleural effusion who is not improving spontaneously and in whom there is a significant likelihood that malignancy or tuberculosis is responsible for the pleural effusion.

- pleural biopsy is usually not indicated for the diagnosis of tuberculous pleuritis.

THANKS