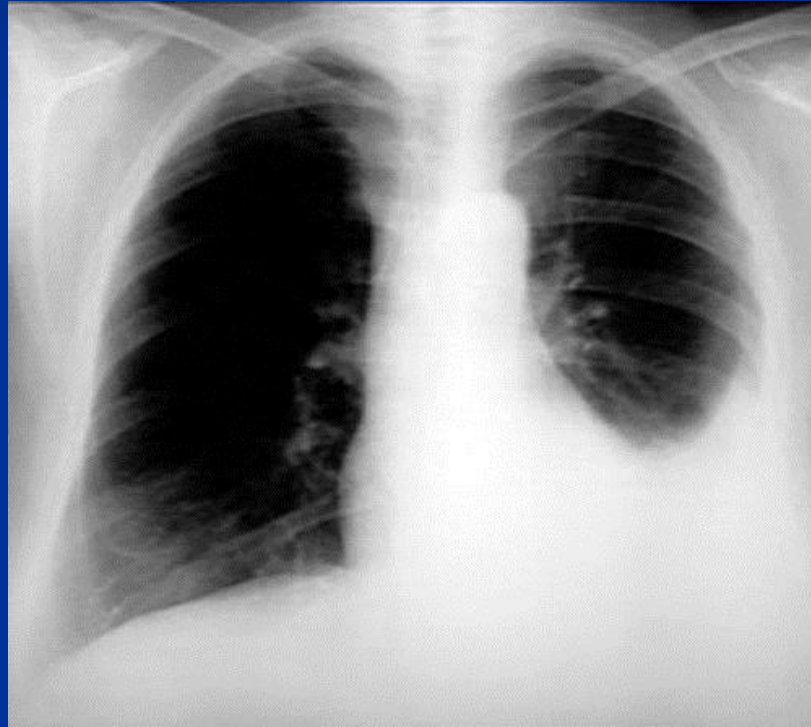
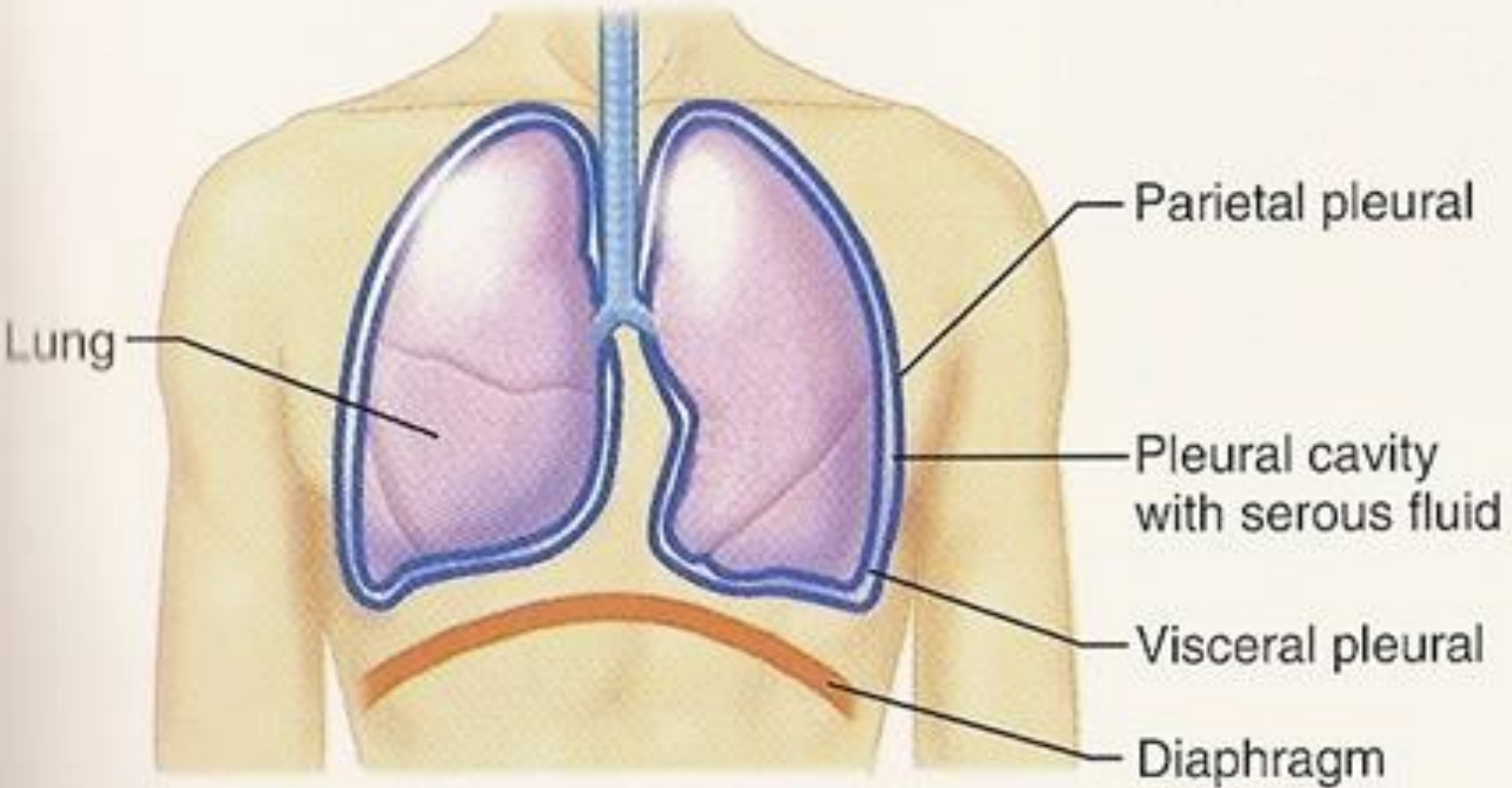


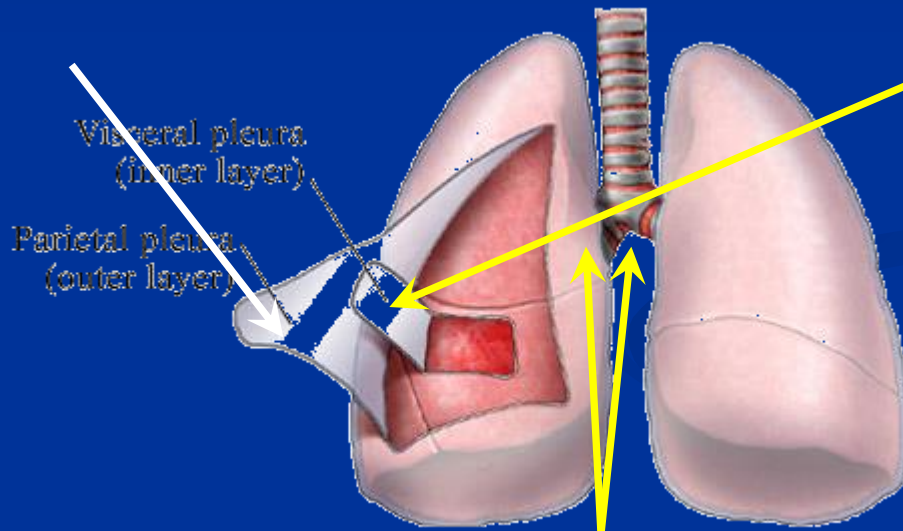
Pleural Effusion



PLEURA



Parietal pleura



Visceral pleura
(inner layer)

Parietal pleura
(outer layer)

Visceral pleura

Hilum

PLEURAL EFFUSION

Normally the pleural space contains:

- 3.5 to 7.0 ml of clear liquid
- low protein content
- small number of mononuclear cells

Pleural effusion: presence of large amount of fluid in the pleural space irrespective of the underlying causes

PLEURAL FLUID FORMATION AND ABSORTION

- The rate of fluid **formation** is 0.02 ml/kg/hour.
- The rate of fluid **clearance** is 0.2 ml/kg/hour.

Starling's Law

Fluid movement

Starling's law :

$$L \cdot A [(P_{CAP} - P_{Pl}) - (\sigma_{CAP} - \sigma_{Pl})]$$

L: Filtration coefficient

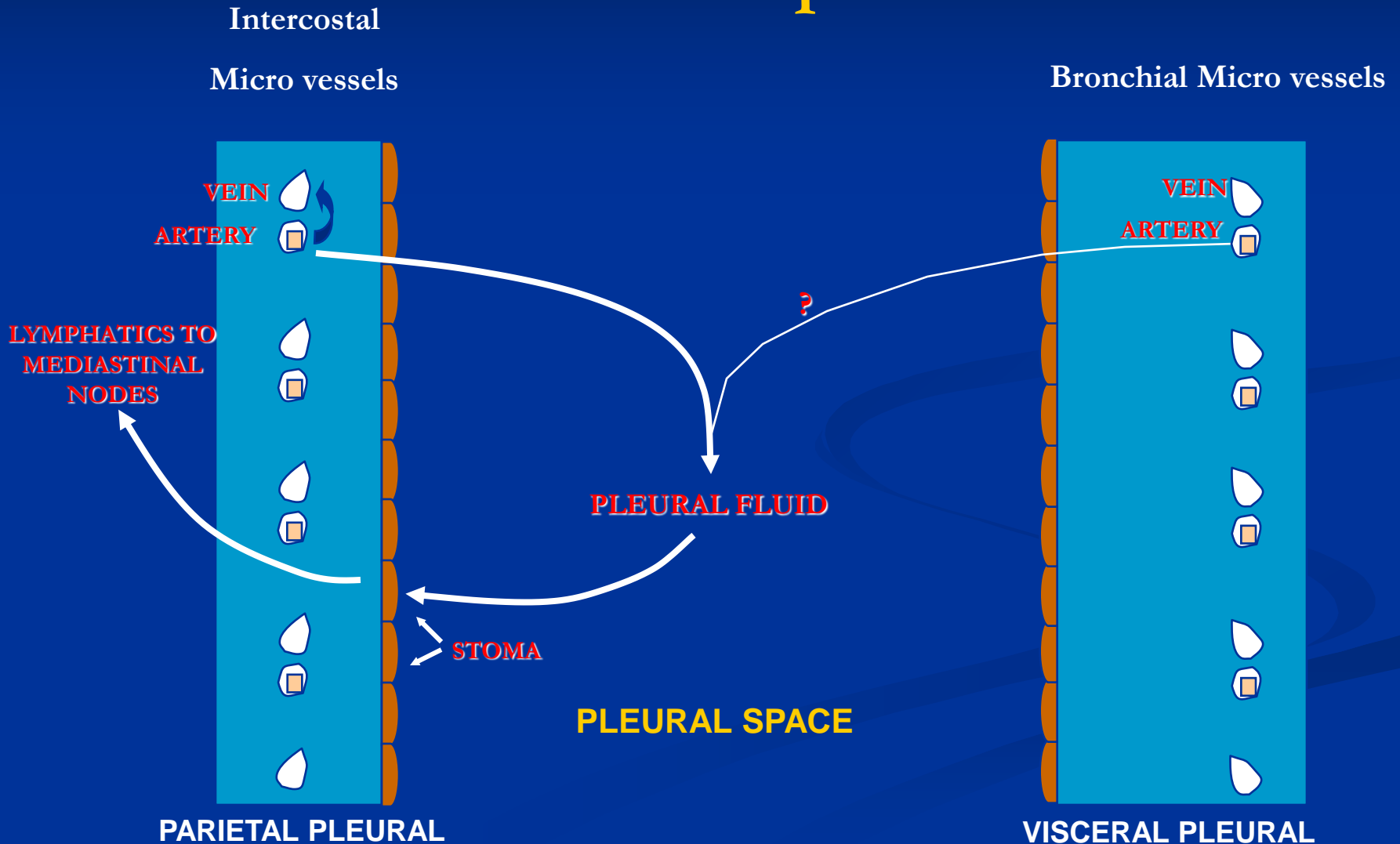
A: Surface area

Cap: Capillary

Pl: Pleural

Pleural Fluid Formation and Absorption

Pleural Space



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)

TABLE 1. LEADING CAUSES OF PLEURAL EFFUSION IN THE UNITED STATES, ACCORDING TO ANALYSIS OF PATIENTS SUBJECTED TO THORACENTESIS.*

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

*Adapted from Light.¹

Other causes of pleural effusion: nephrotic syndrome, TB, collagen vascular disease, urinothorax, SVC syndrome, Meigs syndrome, rheumatoid arthritis, pancreatitis, yellow-nail syndrome, drugs

Symptoms

key symptom **shortness of breath**

Fluid filling the pleural space makes it hard for the lungs to fully expand, causing the patient to take many breaths so as to get enough oxygen.

If parietal pleura is irritated **mild pain** or a **sharp stabbing**

pleuritic type of pain.
symptom

Some patients will have a **dry cough**.

Symptoms

Occasionally -----> **no symptoms** at all.

- This is more likely when the effusion collects gradually
- Chest examination will reveal stony dullness, and decrease/absent breath sounds

Pleural Effusion

- **Pleural effusion** is an abnormal accumulation of fluid in the pleural space. The 5 major types of pleural effusion are:
 - Transudate,
 - Exudate,
 - Empyema,
 - Hemorrhagic pleural effusion or hemothorax and
 - Chylous or chyliform effusion.

Evaluation

■ History:

dyspnea

pleuritic chest pain

cough

fever

hemoptysis

wt. loss

trauma

hx cancer

cardiac surgery

■ Physical:

Dullness to percussion

Decreased breath sounds

Absent tactile fremitus

Causes of Pleural Effusion

Leading Causes of Pleural Effusion in the United States*

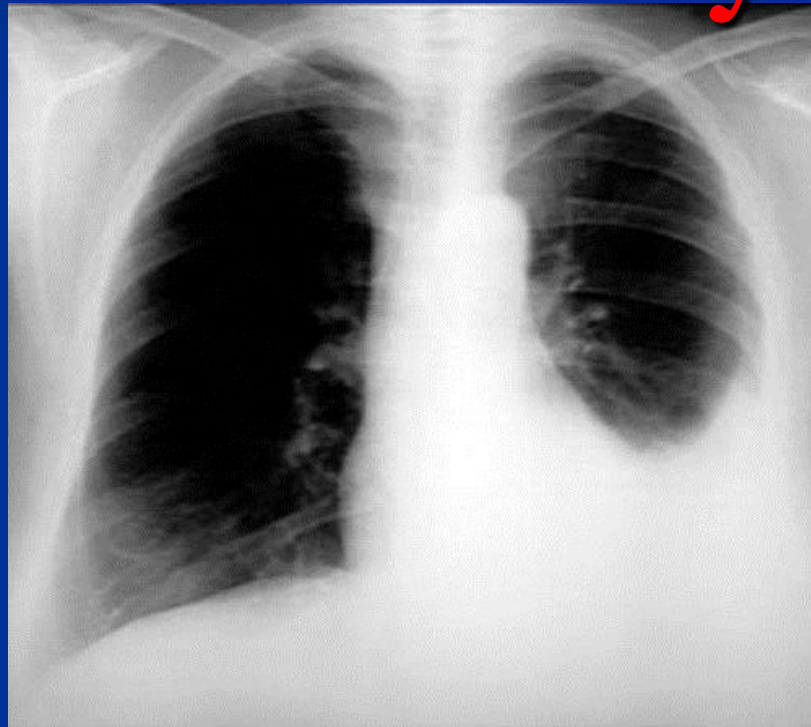
<i>Cause</i>	<i>Annual incidence</i>	<i>Transudate</i>	<i>Exudate</i>
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*—Based on analysis of patients subjected to thoracentesis.

Other causes of pleural effusion: nephrotic syndrome, TB, collagen vascular disease, urinothorax, SVC syndrome, Meigs syndrome, rheumatoid arthritis, pancreatitis, yellow-nail syndrome, drugs

Light. NEJM 2002; 346:1971
Annual incidence in the US

Chest Xray



Chest X-Ray

PA



Lateral decubitus



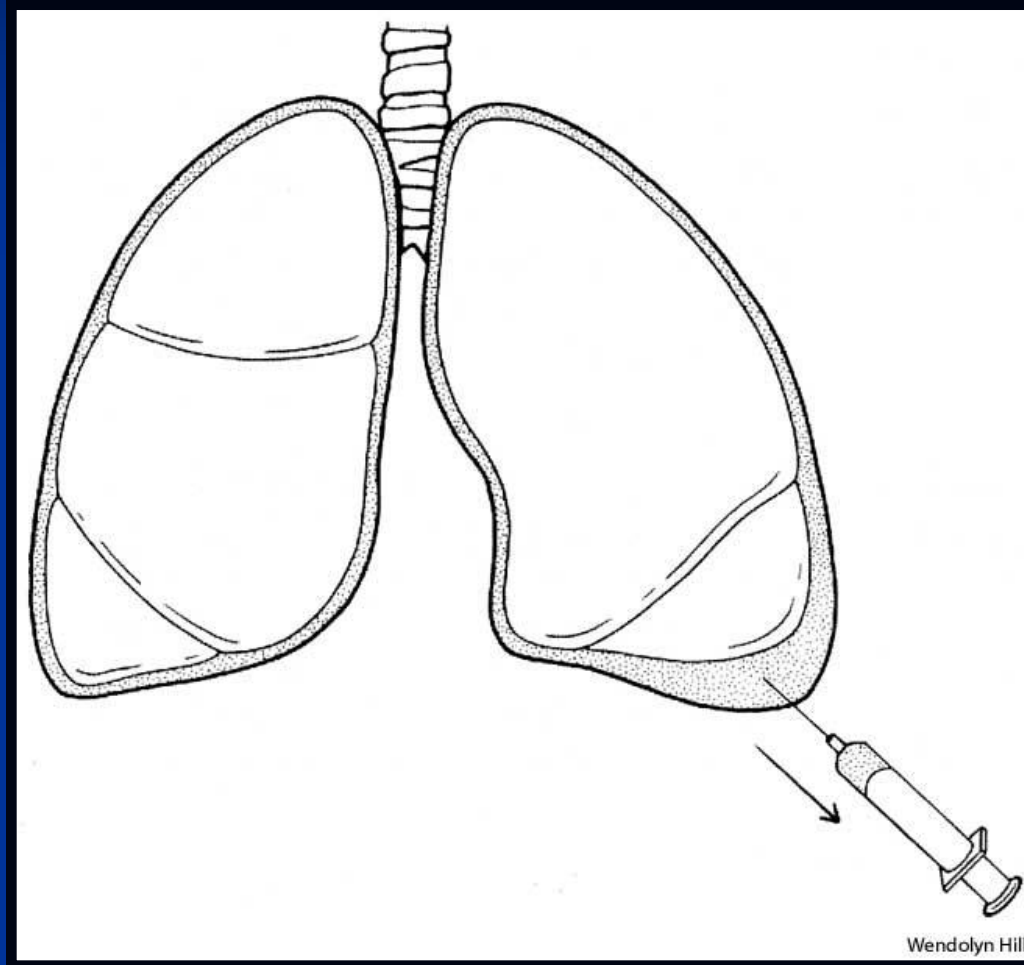
Pleural effusion



Pleural effusion



Thoracentesis



Indications for thoracentesis

- Effusions larger than 1cm height of unknown origin
- No need for thoracentesis for patient with obvious cause (CHF with bilateral effusions).
However:
 - In heart failure: febrile/pleuritic pain, unilateral, no cardiomegaly, no response to diuresis

Pleural fluid analysis

Appearance

- Bloody → Hct <1% not significant, 1-20%= CA, PE, Trauma
>50% serum Hct = hemothorax
- Cloudy → trig level >110mg/dl = chylothorax
- Putrid odor → stain and culture = infection?

Transudate vs Exudate?

Exudate v Transudate

Patient's serum protein is normal

- Pleural protein is less than 25 g/l = **Transudate**
- Pleural Protein more than 35 g/l. = **Exudate**
- If not, Light's criteria

Light's Criteria

Pleural fluid is exudate if one or more:

Pleural fluid protein:serum protein > 0.5

Pleural fluid LDH:serum LDH > 0.6

Pleural fluid LDH $> 2/3$ upper limit nl serum LDH

Transudate

CHF

Cirrhosis

Nephrotic syndrome

Exudate

Pneumonia

Malignancy

Pulmonary Embolism

Exudative Effusion

- Cell count - Neutrophil predom → acute pleural process (pneumonia, PE)
- Lymphocytic predom → chronic process (Cancer, TB, CABG)
- Culture/stain- infected fluid
- Glucose- low level (<60mg/dl)(pneumonia, CA)
- Cytology- malignancy (non-dx- thoracoscopy)
- pH- parapneumonic <7.2 -must drain fluid
malignant < 7.2 –poor prognosis

EXUDATIVE EFFUSIONS

- 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

EXUDATIVE EFFUSIONS

Other Tests

■ Suspected TB

- Adenosine deaminase (> 50 IU/L)
- B₂ - microglobulin
- Lysozyme III (> 20mcg/mL)
- PCR (Sens 100%, Spec 95%)
- AFB (smear 10-20%; cx 25-50%)
- PPD

■ Suspected Rheumatoid

- Pleural RF
- Low glucose

■ Suspected SLE

- Serum Complement
- Pleural ANA
- LE cells prep?

■ Suspected Pneumonia

- pH

■ Suspected Pancreatitis

- Pleural Amylase

Malignant Effusions

- Clinical features suggestive of malignancy:

Symptoms > 1mo, absence of fever, blood-tinged fluid, chest CT suggesting malignancy

- Lung > breast > lymphoma/leukemia

- metastatic adenocarcinoma positive cytology 70%

- Lymphoma 25-50%

- Mesothelioma 10%

- Squamous Cell Carcinoma 20%

- Sarcoma within pleura 25%

- Pleural fluid: bloody, lymphocytic, decreased or nl glucose and pH, cytology

Treatment

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

VATS

UNDIAGNOSED PLEURAL EFFUSIONS

- 15-20% of effusions
- Careful review of history, PE, meds, risk factors
- Consider occult abdominal process
- Consider PE

UNDIAGNOSED PLEURAL EFFUSIONS

Cont'd

- Risk factors for TB or malignant effusion
 - Weight loss > 4.5 kg (10 pounds)
 - Fever > 38 C
 - Positive PPD
 - Large effusion ($> 1/2$ hemithorax)
 - $< 95\%$ lymphs in pleural fluid
- If ANY factor present, evaluate for TB, CA

BEYOND THORACENTESIS

- Pleural Biopsy
 - Most helpful in evaluating for TB
 - Limited utility for CA
- Thoracoscopy
 - Most helpful in evaluating for malignancy

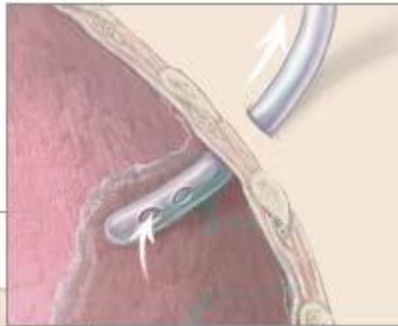
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VATS

Indications for Chest Tube

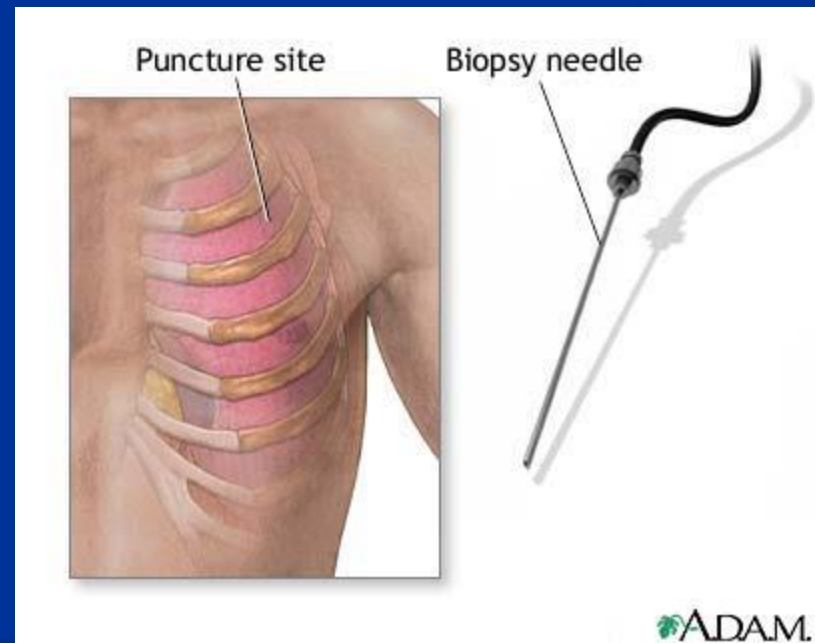
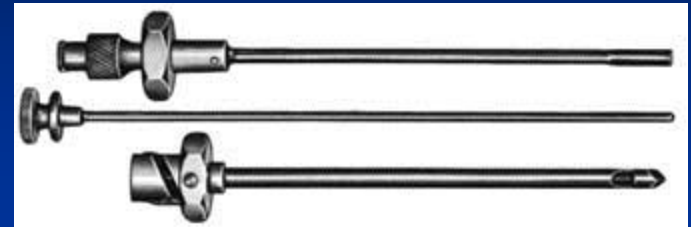
- Empyema
- Complicated parapneumonic effusion PH <7.2
- Hemothorax
- Malignant effusion- chest tube +/- pleurodesis (sclerosants)



Chest tube
drains fluid from
pleural space

Pleural Biopsy

- Most helpful in evaluating for TB
- Limited utility for CA



Thoracoscopy

