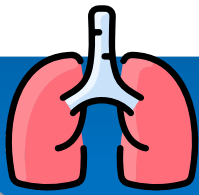




Round : Internal medicine.....

Group no : A4.....

Done By : Batool ALzubaidi.....



PLEURAL DISEASES

I. PATHOPHYSIOLOGY

- A. PLEURAL EFFUSIONS
- B. PNEUMOTHORAX

II. CLASSIC FINDINGS OF PLEURAL DISEASES

- A. PLEURAL EFFUSIONS
- B. PNEUMOTHORAX

III. COMPLICATIONS OF BRONCHIECTASIS

- A. PLEURAL EFFUSIONS
- B. PNEUMOTHORAX

IV. DIAGNOSTIC APPROACH TO PLEURAL DISEASES

- A. PLEURAL EFFUSIONS
- B. PNEUMOTHORAX

V. TREATMENT OF PLEURAL DISEASES

- A. PLEURAL EFFUSIONS
- B. PNEUMOTHORAX

I. PATHOPHYSIOLOGY

A. PLEURAL EFFUSIONS → Increased amount of fluid building up in pleural space (between parietal and visceral pleura)

1. Transudative Effusions

03:09

• Pathophysiology:

- ↑ Pulmonary capillary wedge pressure (PCWP) or ↓ Pulmonary capillary osmotic pressure → ↑ Movement of fluid from pulmonary capillaries into pleural space
- Transudative effusions contain ↓ LDH, given no lung injury, and ↓ Protein as capillaries are not increasingly leaky and permeable

• Causes of Transudative Effusions:

a) Congestive Heart Failure (CHF)

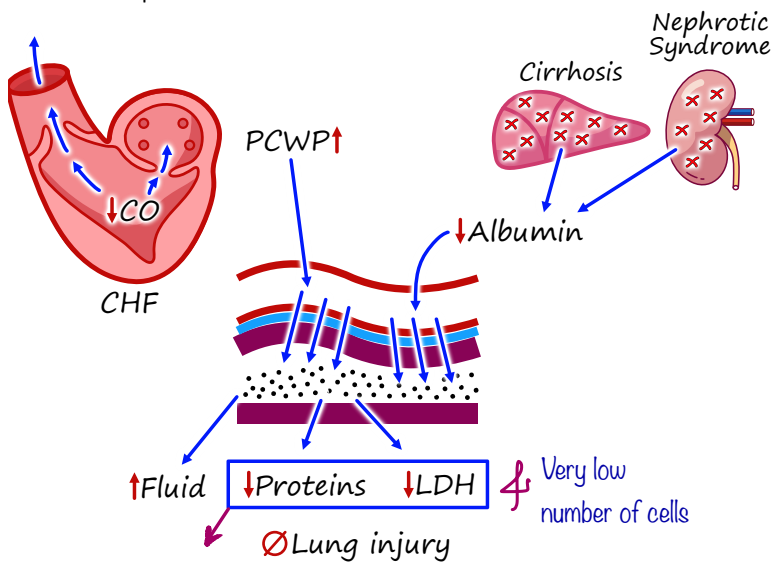
- Left-sided CHF → ↓ Cardiac output → ↑ Left atrial pressure
Due to impaired filling → ↑ PCWP → Both systolic and diastolic
- This may also present with Pulmonary Edema
- This is the most common cause of Transudative Effusions

b) Cirrhosis

- ↓ Production of albumin → Hypoalbuminemia → ↓ Oncotic pressure
- This may also present with Ascites

c) Nephrotic Syndrome

- ↑ Albuminuria → Hypoalbuminemia → ↓ Oncotic pressure
- This may also present with heavy proteinuria, periorbital edema, and hyperlipidemia



They are markers of lung injury, inflammation, increased capillary permeability

∅ Lung injury

Because there's only few of them

When cardiac output is low blood isn't getting out of the heart and will back up in the left atrium and pulmonary veins increasing pulmonary capillary wedge pressure = the pressure inside of these capillaries is high = higher hydrostatic pressure = things like water, electrolytes, certain types of filtrates and very little amount of proteins will start leaking into the pleural space

Patient might have destruction or injury to the synthetic function of albumin (you lose the ability to make albumin) that could be because of cirrhosis which decreases level of albumin in the bloodstream ... or they're losing high levels of albumin in the urine which happens in case of nephrotic syndrome where they have injury to their podocytes

Function of albumin is to keep water and certain things inside bloodstream if you have less of it they won't stay in bloodstream = oncotic pressure decreases causing fluid to not remain in the bloodstream and instead go out into the pleural space increasing the amount of fluid there



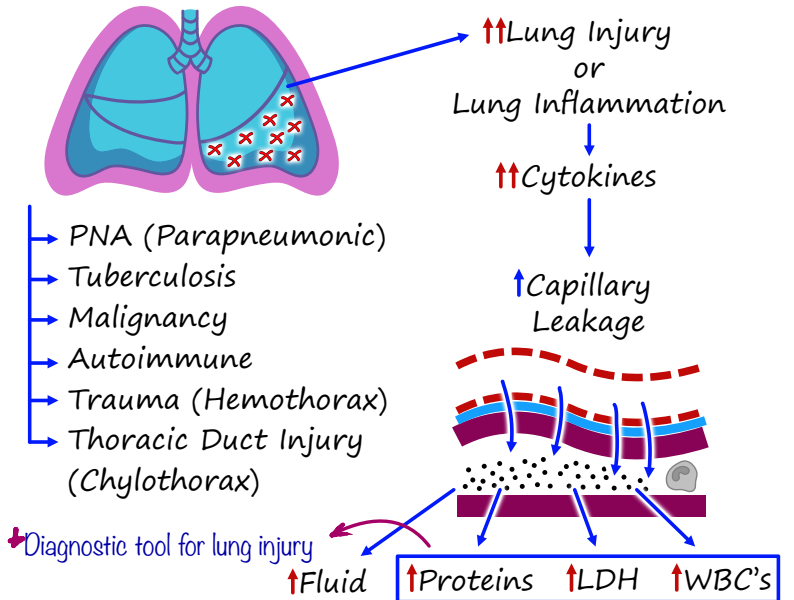
There's some type of lung injury or inflammation in lung parenchyma and tiny blood vessels

2. Exudative Effusions

06:50

● Pathophysiology:

- Lung injury of Lung inflammation → ↑Cytokine release (e.g. TNF-alpha and IL-1) → ↑Pulmonary arteriole vasodilation and ↑Capillary permeability → ↑Leakage of fluid from pulmonary capillaries into pleural space
- Exudative effusions contain ↑LDH given the presence of lung injury and ↑Protein as capillaries are increasingly leaky and permeable from cytokines



● Causes of Exudative Effusions:

The most common cause

a) Parapneumonic Effusions

- Pneumonia → Lung/pleural inflammation → ↑Capillary permeability
 - Additionally, some bacteria and WBCs may leak into the pleural space → ↑Risk of Empyema formation if not treated

b) Tuberculosis

- TB → Causes Caseous Necrosis leading to pleural-parenchymal injury → ↑Capillary permeability
 - Additionally, some of the TB bacteria may leak into the pleural space

c) Lung Cancer

- Lung cancer near the pleural-parenchymal interface that precipitates lung injury → ↑Capillary permeability
 - Additionally, some of the malignant cells may leak into the pleural space

d) Autoimmune (e.g. RA, SLE)

- Autoantibodies attack the pleural-parenchymal interface → Precipitates lung injury → ↑Capillary permeability
- Assess for antibody involvement:
 - SLE → ANA and Anti-dsDNA antibodies
 - RA → RF and Anti-CCP antibodies

e) Hemothorax

- Trauma to the chest wall → Pleural-parenchymal injury → ↑Capillary permeability
 - Additionally, any blood vessels in the vicinity may also be damaged and lead to blood leaking into the pleural space, thus the name Hemothorax

Hemothorax



f) Chylothorax

- Thoracic duct injury → Pleural-parenchymal injury → ↑Capillary permeability
 - Additionally, Chyle (e.g. Lymph that is rich in triglycerides) may leak into the pleural space, thus the name Chylothorax

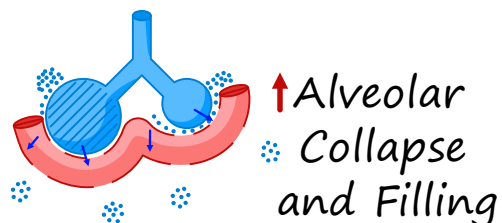
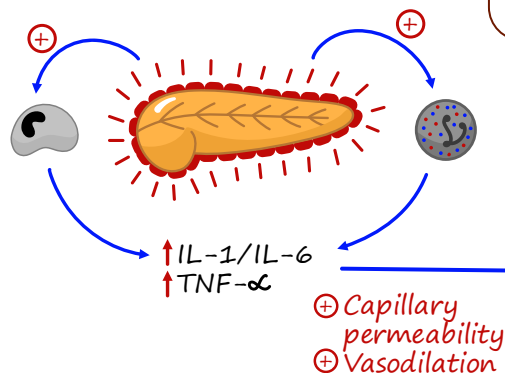
Chylothorax



g) Pancreatitis

- Pancreatitis → Triggers massive cytokine release into systemic circulation → Systemic inflammation and ↑Capillary permeability at the pleural-parenchymal interface
 - Additionally, one enzyme that is rich in the pleural fluid is amylase, which aids in the diagnosis

Acute Pancreatitis



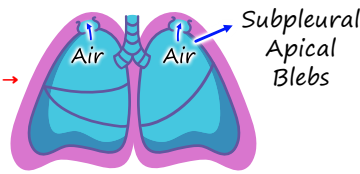
B. PNEUMOTHORAX

1. Primary Spontaneous Pneumothorax

12:58

- **Pathophysiology:**

- **Subpleural Apical Blebs** may rupture from shearing forces → Air may leak into the pleural space → **Pneumothorax**



⊖ Lung Injury or Disease

→ Tall
→ Thin
→ Young
→ Male

± Ehlers-Danlos, Marfan

- **Causes of Primary Spontaneous Pneumothorax:**

↑ Shearing Forces of Subpleural Apical Blebs

- **Triggers for Bleb Formation:**

- **Tall and Thin Patients** → Increased stress at the pleural apex
- **Smoking** → Weakens alveolar walls
- **Marfan Syndrome** → Weakness of the connective tissue around alveolar walls and pleura

- **Triggers for Bleb Rupture:**

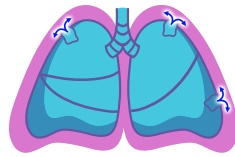
- **Sudden changes in intrathoracic pressure** (e.g. coughing, heavy lifting, or diving)

2. Secondary Spontaneous Pneumothorax

15:28

- **Pathophysiology:**

- **Underlying lung disease (Bullae or Lung Necrosis)** → ↑ Risk of diseased lung tissue rupturing → Air may leak into the pleural space → **Pneumothorax**



⊕ Lung Injury or Disease

↑ Hyperinflation (Bullae, Blebs)

→ COPD
→ Asthma

↑ Lung Necrosis

→ Infections
→ Malignancy

- **Causes of Secondary Spontaneous Pneumothorax:**

a) Lung Bullae or Blebs

- **COPD and Asthma:**

- **Airway obstruction** → Air trapping → Dynamic hyperinflation → ↑ Intrapulmonary pressure → Rupture of hyperinflated alveoli

b) Lung Necrosis

- **Necrotizing Pulmonary Infections:**

- **Tuberculosis and PJP** → Necrosis of lung tissue near pleural-parenchymal interface → Rupture of interface

- **Lung Cancer:**

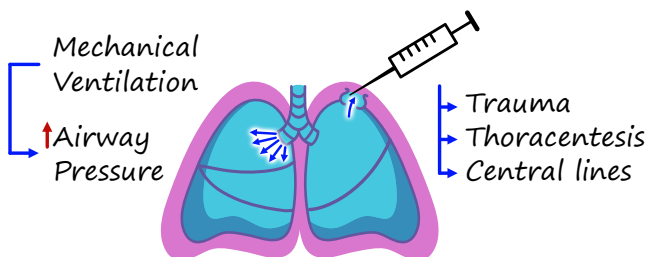
- **Adenocarcinoma and Large Cell Carcinoma** → Necrosis of the pleural-parenchymal interface → Rupture of interface

3. Traumatic Pneumothorax

17:21

- **Pathophysiology:**

- **Pleural puncture or ↑ Pulmonary airway pressures** → Injury to pleural-parenchymal interface → Air may leak into the pleural space → **Pneumothorax**



- **Causes of Traumatic Pneumothorax:**

a) Pleural Puncture

- **Trauma:**

- **MVA, Stabbing, Gunshot** → Direct injury to the pleural-parenchymal interface

- **Thoracentesis:**

- The procedure is done to drain the pleural fluid but may lead to an inadvertent pleural puncture (e.g. iatrogenic)

- **Central Line Placement:**

- The procedure is done to insert a catheter into the **Internal Jugular or Subclavian Vein**, but may lead to an inadvertent pleural puncture (e.g. iatrogenic)

b) ↑ Pulmonary Airway Pressures

- **Mechanical ventilation** → May deliver **larger than normal** amounts of volume and pressure into the alveoli → May lead to overdistention and trauma of the alveoli → **Alveolar rupture occurs**



II. CLASSIC FINDINGS OF PLEURAL DISEASES

A. PLEURAL EFFUSIONS

00:42

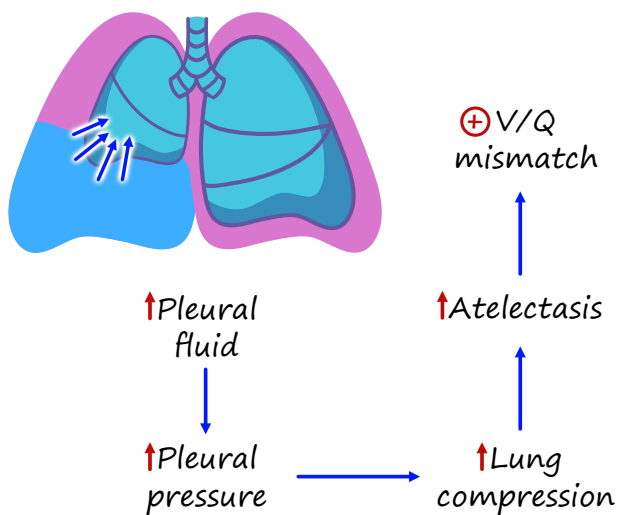
1. **Pleuritic Chest Pain** → Most common presentation
 - Due to injury or inflammation at or near the pleural tissue lining → Pain felt when patient take a breath in and out
2. **↓ Tactile Fremitus on the Affected Side**
 - This occurs due to fluid in the pleural space **dampening the sound vibrations** → Thus, "99" would not be felt well on the hypothenar eminence
3. **Dullness to Percussion on the Affected Side**
 - The fluid in the pleural cavity provides an **increased density** in comparison to air → Thus, it appears **duller** when **percussed**
4. **↓ Breath Sounds on the Affected side**
 - The presence of a **large pleural effusion** may **dampen breath sounds** given there is a large barrier between the chest wall, bronchi, and alveoli due to the presence of the Effusion

B. PNEUMOTHORAX

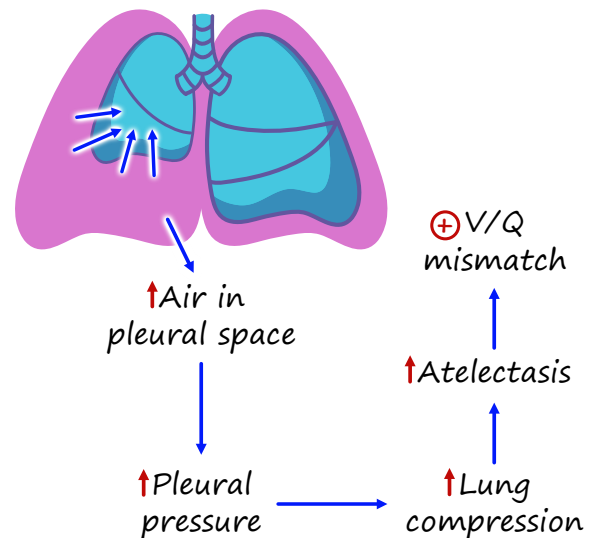
11:29

1. **Pleuritic Chest Pain**
 - Due to injury or inflammation at or near the pleural tissue lining
2. **↓ Tactile Fremitus on the Affected Side**
 - This occurs due to air in the pleural space **dampening the sound vibrations** → Thus, "99" would not be felt well on the hypothenar eminence
3. **Hyper-Resonance to Percussion on the Affected Side**
 - The air in the pleural cavity provides a significantly decreased density → Thus, it appears **hyper-resonant** when **percussed**
4. **↓ Breath Sounds on the Affected Side**
 - The presence of a **large pneumothorax** may **dampen breath sounds** as there is a large barrier between the chest wall, bronchi, and alveoli due to the Pneumothorax

Pleural Effusions



Pneumothorax



A. PLEURAL EFFUSIONS

20:52

1. Respiratory Failure

● **Pathophysiology:**

Large pleural effusions →

↑ Pleural pressure → Compress alveoli →

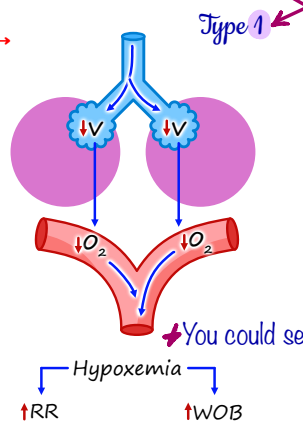
Atelectasis occurs → V/Q mismatch →

Impaired gas exchange

● **Presentation:**

- Dyspnea, ↑RR, and ↑WOB
- Hypoxia
- CXR with the presence of Effusions

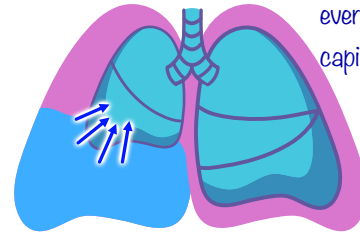
Respiratory Failure



Pleural Effusions

Reduction in the ventilation process even though perfusion to pulmonary capillaries is completely normal

⊕ V/Q mismatch



↑ Pleural fluid
↓
↑ Pleural pressure

↑ Atelectasis
Alveolar collapse
↑ Lung compression

2. Empyema

23:47

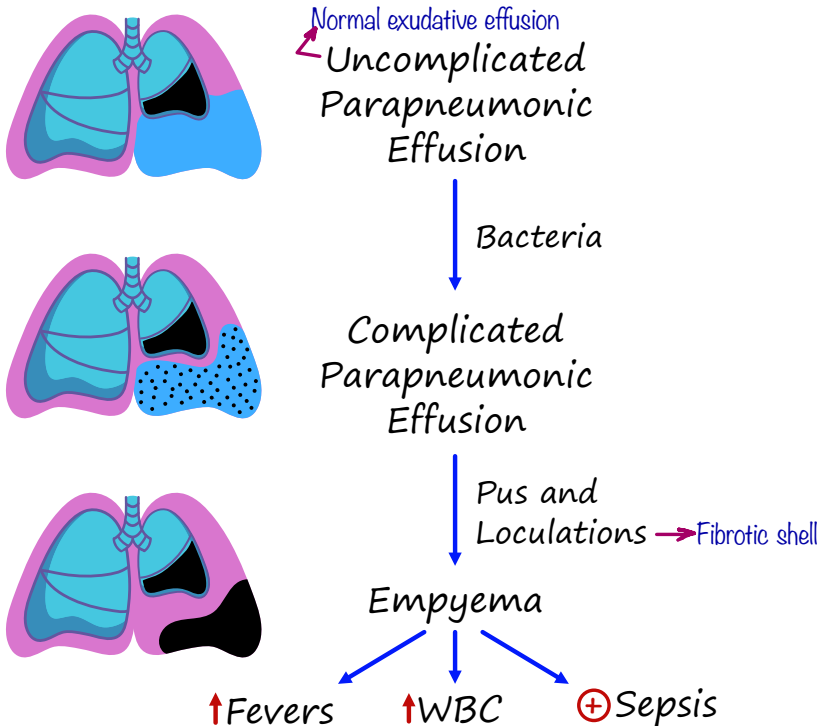
● **Pathophysiology:**

- Pneumonia → ↑ Capillary permeability → **Parapneumonic Effusion** → Bacteria and WBCs may invade the pleural space → **Infection of the pleural fluid** may become **thick, viscous, and loculated**

● **Presentation:**

- Persistent pleuritic chest pain
- Fevers and Leukocytosis
- CXR with the presence of a loculated effusion

Empyema



1. Respiratory Failure → Type 1

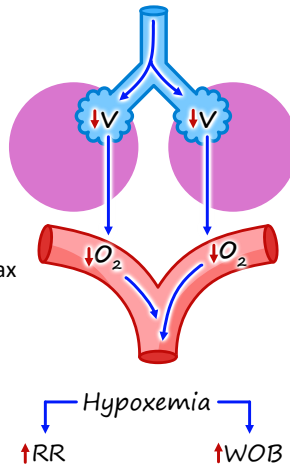
30:11

Pathophysiology:

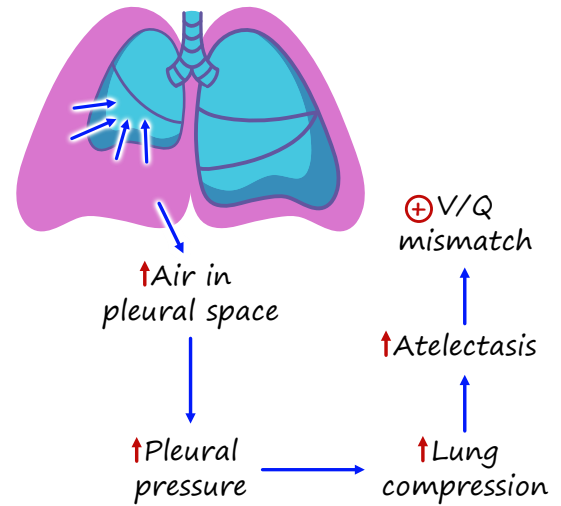
- Large pleural pneumothorax →
↑Pleural pressure → Compress
alveoli → Atelectasis occurs → V/Q
mismatch → Impaired gas exchange

Presentation:

- Dyspnea, ↑RR, and ↑WOB
- Hypoxia
- CXR with the presence of Pneumothorax



Pneumothorax



2. Tension Pneumothorax

31:36

Pathophysiology:

One-way valve mechanism

During Inspiration:

- Air leaks into the pleural space across a defect in the chest wall or a parenchymal-pleural interface defect → Allows air to pressurize the pleural space

During Expiration:

- Air is unable to leak out of the pleural space as the defect in the chest wall or pleural parenchymal interface closes off → Allows no air to leave the pleural space → Accumulation of air continues to pressurize the pleural space

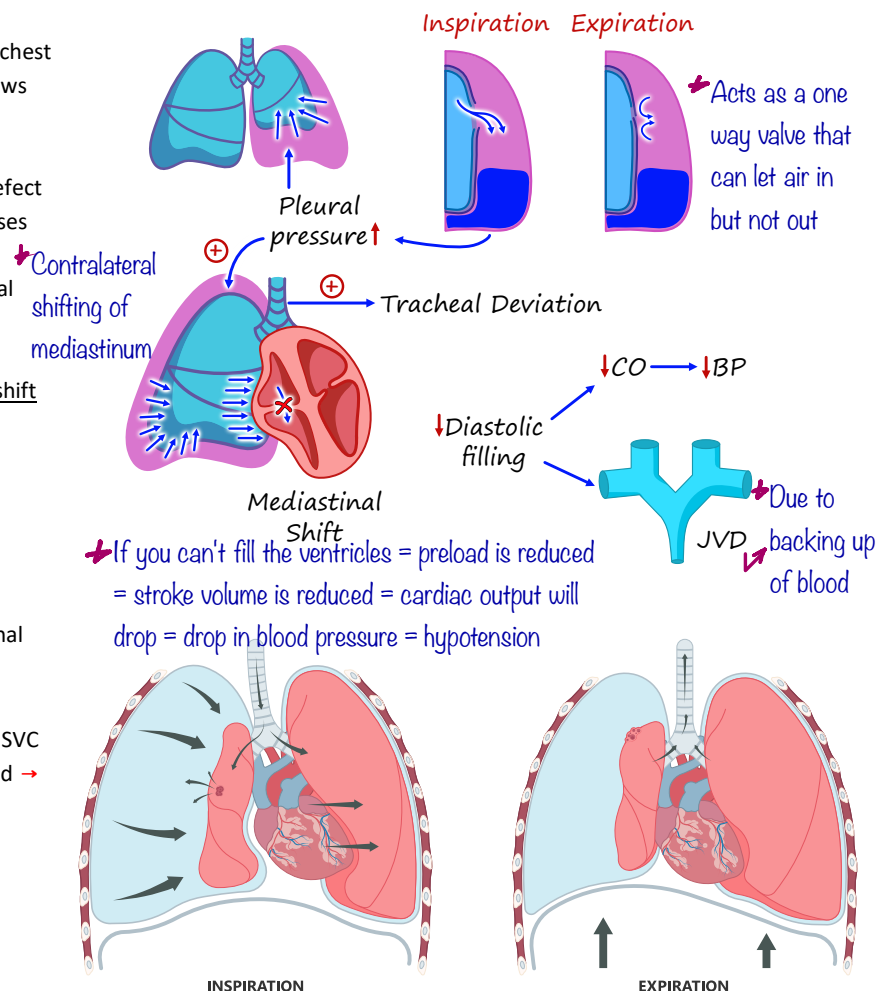
Total End Result:

- ↑Pleural pressure → **Mediastinum** and its contents shift to the contralateral side

Presentation:

- Tracheal deviation** to the side **contralateral** to the pneumothorax
- Absent breath sounds** on the affected side
- JVD**
 - This is due to the SVC being compressed from mediastinal shifting causing SVC backflow
- Hypotension/Shock**
 - This is due to **impaired diastolic filling** from the IVC and SVC being compressed from mediastinal shifting → ↓Preload → ↓Stroke volume → ↓Cardiac output → ↓BP
- CXR with the presence of a Pneumothorax**

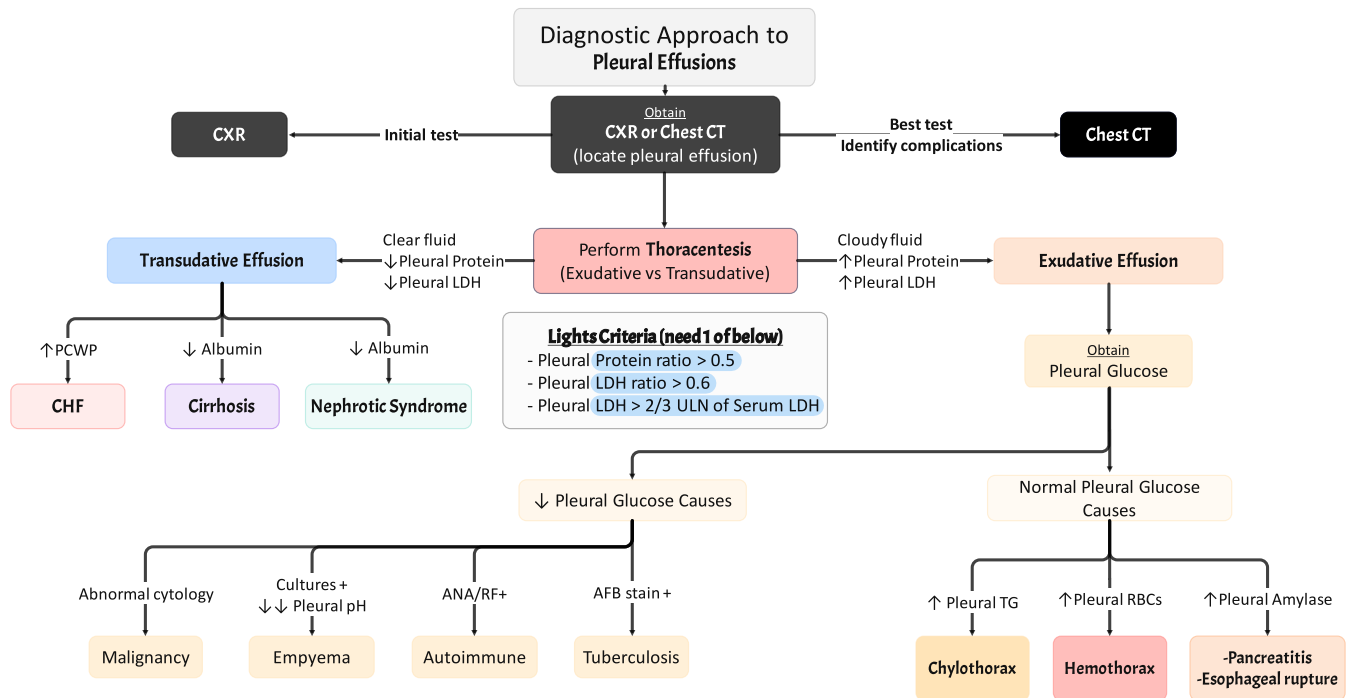
Tension Pneumothorax



IV. DIAGNOSTIC APPROACH TO PLEURAL DISEASES

A. PLEURAL EFFUSIONS

36:38



1. Assess for Radiographic Evidence of Pleural Effusions

a) Obtain CXR

- **Purpose:**
 - Assess for suggestive findings of pleural effusion in a patient presenting with dyspnea and pleuritic chest pain
 - Rule out other lung pathologies (e.g. PNA, Pneumothorax, Pulmonary edema, etc.)
- **Abnormal findings**
 - **"Meniscus Sign"**
 - This is a small and concave appearance of the pleural fluid in the pleural space (usually on an upright CXR)
 - **"Blunting" of Costophrenic Angle**
 - Loss of clear visibility of costophrenic angle given fluid in the pleural space is blurring that angle

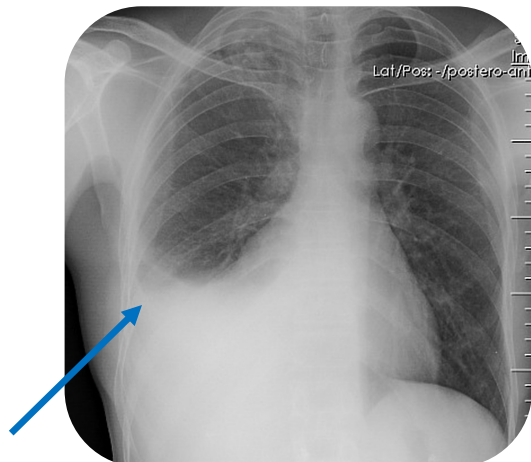


FIGURE 1. CXR OF A PLEURAL EFFUSION INDICATING A MENISCUS SIGN

b) Obtain Chest CT

- **Purpose**
 - Most accurately detects pleural effusions and allows identification of possible etiologies (e.g. PNA, Lung cancer, etc.)
 - Allows identification of possible complications (e.g. Empyema)
- **Abnormal findings**
 - Provides detection of size and location of pleural effusion
 - Can identify loculated pleural effusions

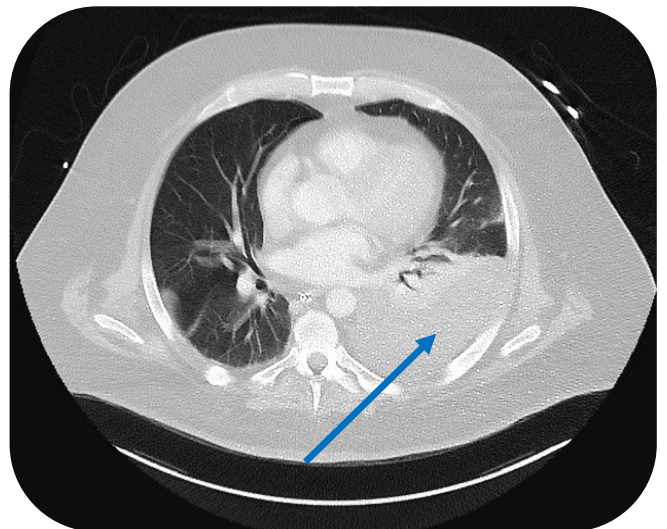


FIGURE 2. CT INDICATING A PLEURAL EFFUSION



2. Assess for Evidence of **Transudative or Exudative Pleural Effusion**

40:07

Obtain a **Thoracentesis**

• **Purpose:**

- Identify if the pleural effusion on imaging is exudative or transudative as this guides appropriate therapy
 - Utilization of Light's criteria is required for differentiation
- Can also be utilized if pleural effusion is causing respiratory failure as it will provide diagnostic and therapeutic utility

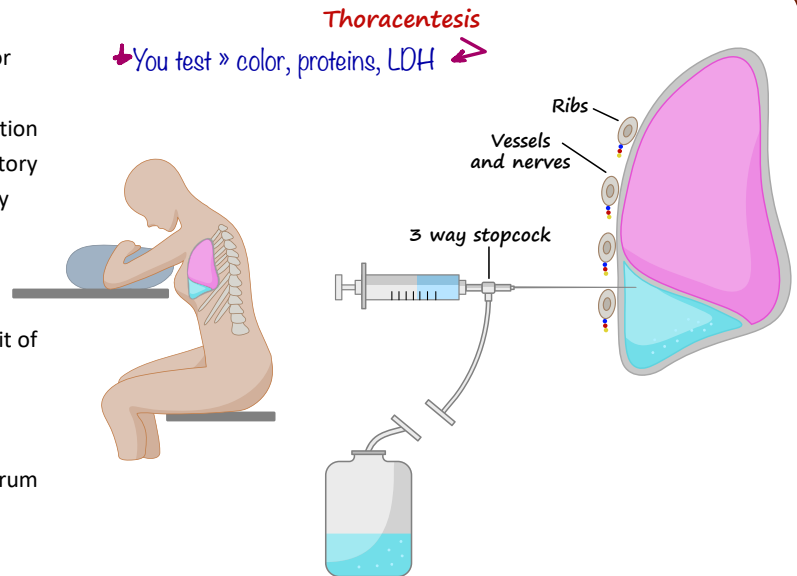
• **Abnormal Findings:**

○ **Transudative Effusion**

- Pleural **protein ratio** < 0.5
- Pleural **LDH ratio** < 0.6 or Pleural LDH $< 2/3$ upper limit of normal (ULN) of serum LDH

○ **Exudative Effusion**

- Pleural **protein ratio** > 0.5
- Pleural **LDH ratio** > 0.6 or Pleural LDH $> 2/3$ ULN of serum LDH



3. Assess for Causes of **Exudative Effusion**

Obtain **Pleural Glucose**

• **Purpose:**

- Narrows the differential diagnosis of the exudative effusion cause

• **Abnormal findings:**

i) $\downarrow\downarrow$ **Pleural Glucose**

○ **Malignancy:**

- Obtain cytology of pleural fluid:
 - Malignant cells in the pleural fluid suggest malignancy such as lung cancer

○ **Empyema:**

- Obtain Pleural pH, Pleural WBCs, and Pleural cultures:
 - $\downarrow\downarrow$ Pleural pH (< 7.2), $\uparrow\uparrow$ Pleural WBCs ($> 50K$), and Cultures (+) $\rightarrow$ Supports empyema vs complicated parapneumonic effusion
 - **Complicated parapneumonic effusion:**
 - No loculations or purulent appearing pleural fluid
 - **Empyema**
 - Loculations are present, and pleural fluid is purulent appearing

○ **Autoimmune:**

- Obtain ANA, Anti-dsDNA, RF, and anti-CCP antibodies
 - SLE $\rightarrow$ (+) ANA and Anti-dsDNA antibodies
 - RA $\rightarrow$ (+) RF and Anti-CCP antibodies

○ **Tuberculosis:**

- Obtain AFB stain and Adenosine deaminase (ADA) levels
 - (+) AFB stain and $\uparrow$ ADA levels suggest TB

ii) **Normal Pleural Glucose**

○ **Chylothorax:**

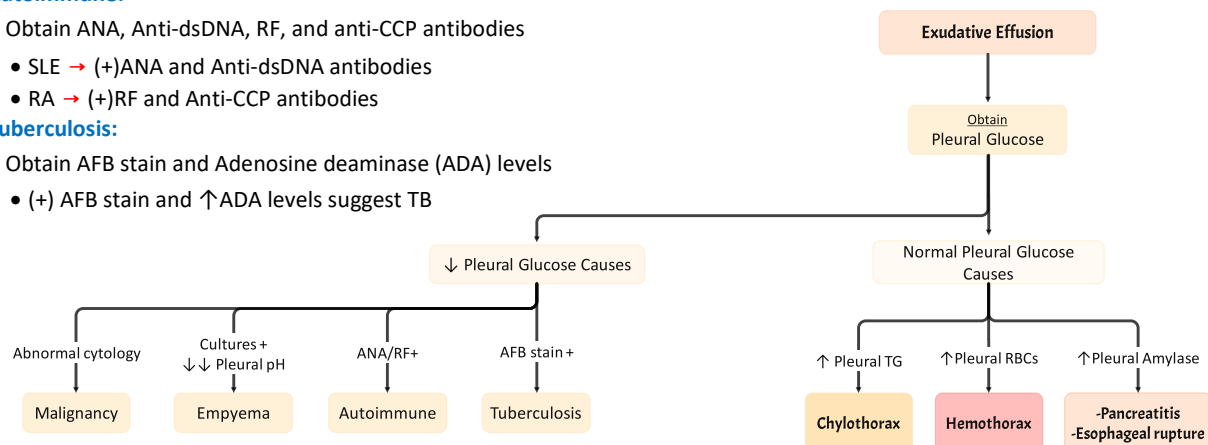
- Obtain triglyceride level
 - $\uparrow$ **pleural triglyceride levels** with milky-appearing pleural fluid suggest chylothorax

○ **Hemothorax:**

- Obtain Pleural RBCs and cytology
 - $\uparrow$ Pleural RBCs with normal cytology may help rule out malignancy and if evidence of trauma is present may suggest hemothorax

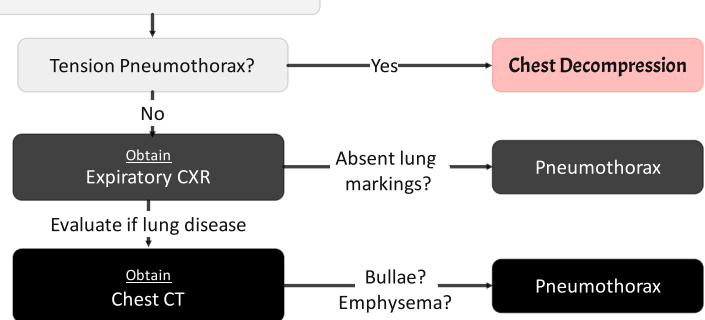
○ **Pancreatitis:**

- Obtain Pleural amylase level
 - $\uparrow$ **Pleural amylase level** suggests pancreatitis or esophageal rupture



1. Assess for the presence of **Tension Pneumothorax****Obtain a Clinical Diagnosis**

- The presence of the following suggests tension pneumothorax:
 - Tracheal deviation to the side contralateral to the pneumothorax
 - Absent breath sounds on the affected side
 - JVD
 - Hypotension/Shock
- If the following is present **needle decompression at the 2nd intercostal space at the midclavicular line** should be initiated instead of waiting for a CXR

Diagnostic Approach to Pneumothorax2. Assess for **Radiographic Evidence of Pneumothorax****a) Obtain a CXR (should be an Expiratory CXR)**

- **Purpose:**
 - Assess for suggestive findings of pneumothorax in a patient presenting with dyspnea and pleuritic chest pain
 - Rule out other lung pathologies (e.g., PNA, Pneumothorax, Pulmonary edema, etc.)
- **Abnormal Findings:**
 - Absent lung markings on the affected side
 - Visualization of the pleural line detached away from the chest wall



FIGURE 3. LEFT TENSION PNEUMOTHORAX CXR

b) Obtain a Chest CT

- **Purpose**
 - CXR was inconclusive for pneumothorax, but suspicion remains high for a pneumothorax not seen on CXR (e.g., small pneumothorax)
 - Assessing for underlying lung disease that may have contributed to this pneumothorax (e.g., Bullae or Necrotizing PNA)
- **Abnormal Findings:**
 - Absent lung markings on the affected side
 - Visualization of the pleural line detached away from the chest wall
 - Detection of underlying lung disease as the cause

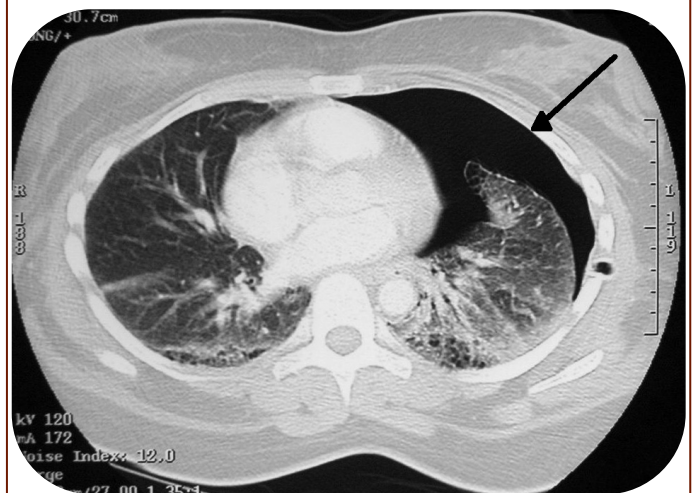


FIGURE 4. PNEUMOTHORAX CT

V. TREATMENT OF PLEURAL DISEASES

A. PLEURAL EFFUSIONS

41:41

1. Removal of Pleural Fluid

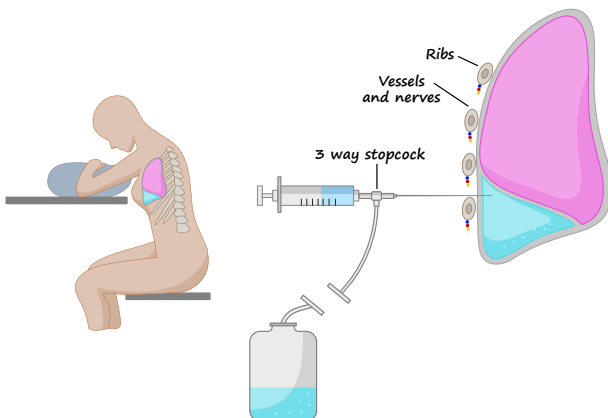
a) Diuretic Therapy

- **Treatment:**
 - Furosemide
- **Indication:**
 - Pleural effusions secondary to CHF
- **Purpose:**
 - ↓PCWP → Reducing pulmonary edema and pleural effusion
- **Monitoring:**
 - Monitor BP and HR as aggressive diuresis may cause so much volume removal that it may cause hypotension and organ malperfusion (e.g., AKI)

b) Thoracentesis

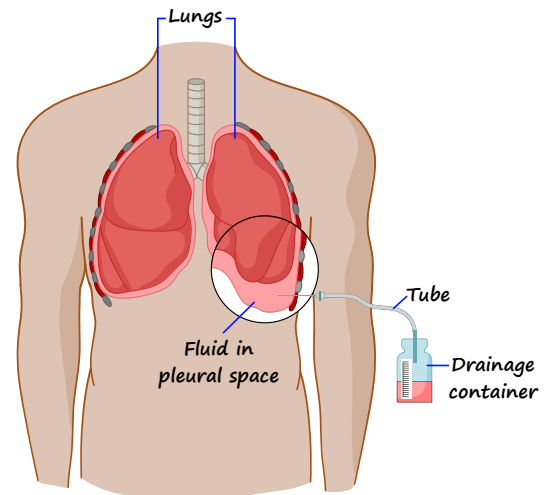
- **Treatment:**
 - Therapeutic Thoracentesis via U/S or landmark-guidance
 - Insert **above the rib** to avoid **neurovascular injury**
- **Indications:**
 - Pleural effusions with associated **severe respiratory failure**
 - Indicated in pleural effusions secondary to CHF **refractory to diuretic therapy**
- **Purpose:**
 - Remove pleural fluid from the pleural space as to reduce the amount of compression of alveoli thus allowing for improvement in gas exchange
- **Monitoring:**
 - Monitor for improvement in respiratory failure such as improvement in RR, WOB, and oxygenation
 - Monitor for **post-procedure pneumothorax**

Thoracentesis



c) Indwelling Pleural Catheter

- **Treatment:**
 - A pleural catheter is placed into the pleural space and allows **continuous removal of pleural fluid**
- **Indication:**
 - **Malignant Pleural Effusions** → Due to ↑ recurrence
 - **Refractory pleural effusions** despite **diuretic therapy** and **periodic thoracentesis**
- **Purpose:**
 - Prevention of recurrence of pleural effusions
- **Monitoring:**
 - Improvement in symptoms
 - Reduced need for repeated thoracentesis



	Uncomplicated	Complicated	Empyema
Pleural Fluid Analysis	- Slightly cloudy	- Cloudy	- Purulent
	- Pleural pH > 7.2		- Pleural pH < 7.2
	- Pleural glucose normal		- Pleural glucose low
	- Pleural WBC < 50k		- Pleural WBC > 50k
Imaging Findings	- Cultures negative		- Cultures positive
			- Loculations (split pleural sign)
Treatment	- Antibiotics	- Antibiotics ± drainage	- Antibiotics + drainage



d) **Thoracostomy Tube** (e.g. Chest tube)

- **Treatment:**

- Placement of a large tube into the pleural space through the 4th and 5th intercostal space at the anterior axillary line

- **Indication:**

- Empyema
- Hemothorax

- **Purpose:**

- **Empyema**
 - Remove infected material from the pleural space if an empyema is present
 - It also may allow the instillation of tPA into the pleural space to break of loculations in empyema
- **Hemothorax**
 - Remove blood from the pleural space allowing monitoring of ongoing bleeding which may guide decision for surgery

- **Monitoring:**

- **Empyema**
 - Monitor output from the chest tube to assess if infected material is being removed effectively
- **Hemothorax**
 - Monitor output from the chest tube to assess need for surgery if large volumes in chest tube

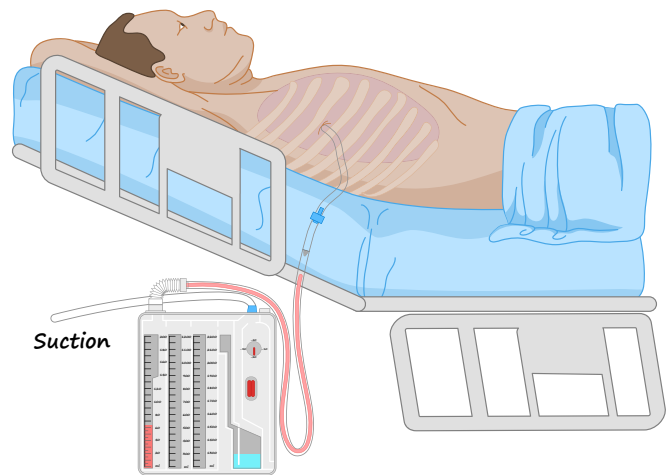
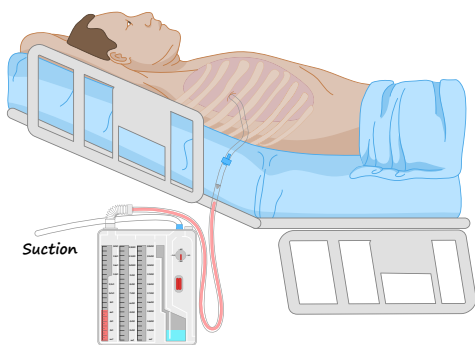


FIGURE 5. CHEST TUBE

2. Treatment of Empyema

a) Thoracostomy Tube (e.g. Chest Tube)

- **Indication:**
 - Empyema
- **Purpose:**
 - Empyema
 - Remove infected material from the pleural space if an empyema is present
 - It also may allow the instillation of tPA into the pleural space to break of loculations in empyema
- **Monitoring:**
 - Empyema
 - Monitor output from the chest tube to assess if infected material is being removed effectively



b) Antibiotic Therapy

- **Treatment:**
 - Empiric antibiotics
 - Vancomycin
 - This is preferred for MRSA coverage
 - Cefepime or Piperacillin-tazobactam
 - This is preferred for pseudomonas coverage
 - Targeted Antibiotic therapy
 - Antibiotics should be narrowed once cultures reveal the pathogen as the cause
- **Indications:**
 - Presence of empyema
- **Purpose:**
 - Eradication of pleural infection
- **Monitoring:**
 - Monitor for resolution of empyema on CXR or CT scan
 - Monitor for improvement in fevers and leukocytosis

c) Video Assisted Thoracoscopic Surgery (VATS)

- **Treatment:**
 - A thoracoscope is used and allows the guidance of the instruments into the empyema → Allows the removal of loculated material and ensures drainage
- **Indications:**
 - Presence of an empyema refractory to tube thoracostomy and antibiotics
- **Purpose:**
 - Removal of empyema
- **Monitoring:**
 - Monitor for resolution of empyema on CXR or CT scan
 - Monitor for improvement in fevers and leukocytosis

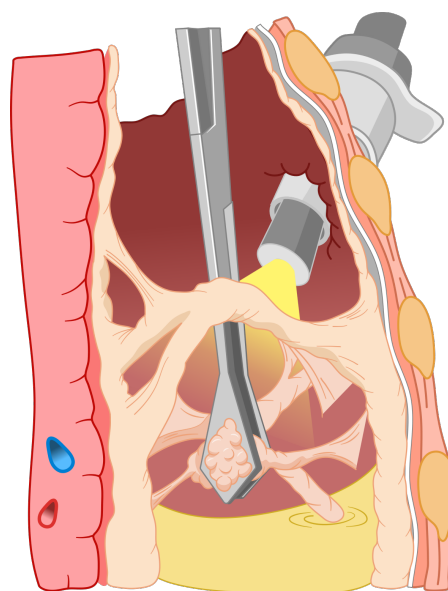
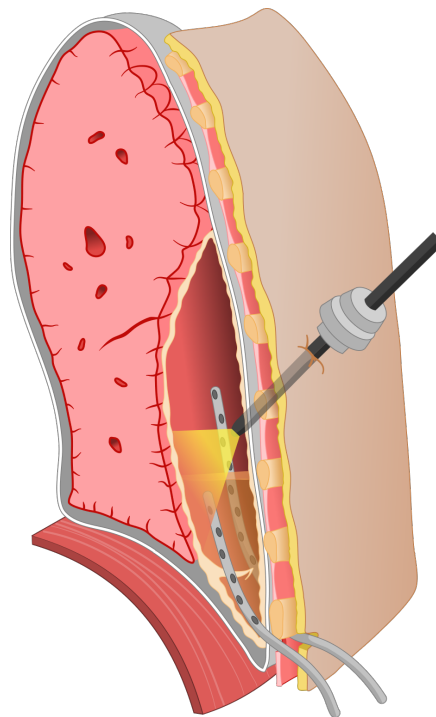


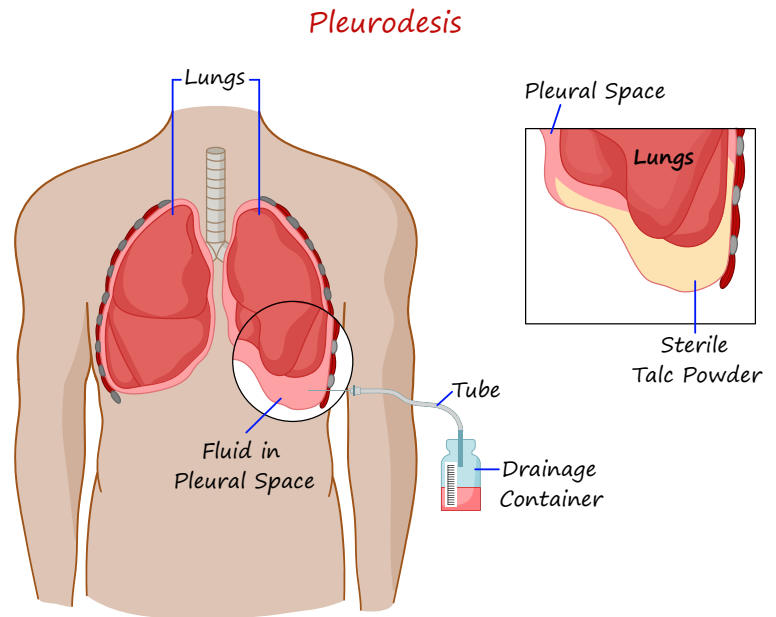
FIGURE 6. VIDEO ASSISTED THORACOSCOPIC SURGERY (VATS)



3. Treatment of Refractory Pleural Effusions

a) Pleurodesis

- **Treatment:**
 - **Mechanical Pleurodesis**
 - VATS is utilized to provide mechanical abrasions against the pleural lining to create a fibrotic reaction and subsequent obliteration of the pleural space
 - Chemical pleurodesis
 - Talc or Doxycycline is installed into the chest tube which drains into the pleural space and creates a fibrotic reaction and subsequent obliteration of the pleural space
- **Indications:**
 - Refractory pleural effusions secondary to malignancy that have not responded to indwelling pleural catheters and require periodic thoracentesis
- **Purpose:**
 - Prevent recurrence of pleural effusions
- **Monitoring:**
 - Monitor for resolution of effusion on CXR or CT scan



B. PNEUMOTHORAX

45:00

1. Removal of Pleural Air

a) Oxygen Supplementation and Observation

- **Indications:**
 - **Small Pneumothorax**
 - $< 2\text{cm}$ distance between the pleural line and chest wall
- **Purpose:**
 - Oxygen supplementation helps with resorbing the air from the pneumothorax
- **Monitoring:**
 - Monitor serial CXR for enlargement
 - This may necessitate a chest tube
 - Monitor for worsening symptoms (e.g. respiratory failure)
 - This may necessitate a chest tube



b) Thoracostomy Tube (e.g. Chest Tube)

45:40

● Indications:

- Large Pneumothorax
 - > 2cm distance between the pleural line and chest wall
- Symptomatic pneumothorax regardless of size
 - Symptoms include: Dyspnea, tachypnea, ↑WOB, hypoxia
- Tension Pneumothorax

● Purpose:

- Remove air from the pleural space to allow expansion of the affected lung

● Monitoring:

- Monitor serial CXR for improvement vs enlargement in pneumothorax

○ Monitor chest tube for the following:

▪ Collection Chamber

● Volume Output:

- ↓ Drainage of empyema
 - This may trigger discussion of tPA instillation
- ↑ Bloody output
 - This may trigger surgical intervention

▪ Water Seal Chamber

● Air Leak:

- This may indicate a pneumothorax is still present
- This may indicate the chest tube is not in position
- This may indicate dysfunction in the tubing system

▪ Suction Chamber

● Excessive Bubbling:

- This may indicate excessive suction → Requires a reduction in suction pressure

● Chest Tube Settings:

○ Suction:

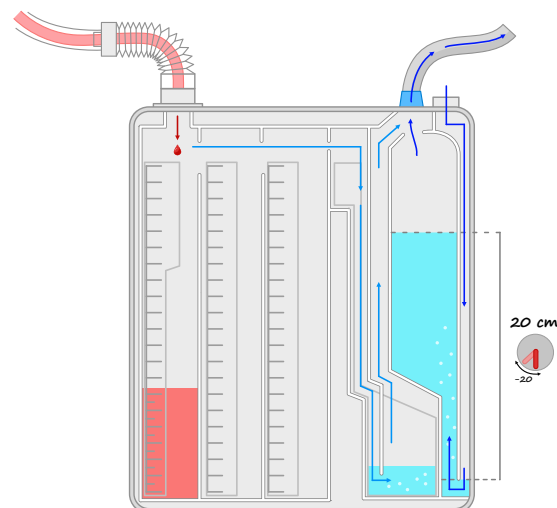
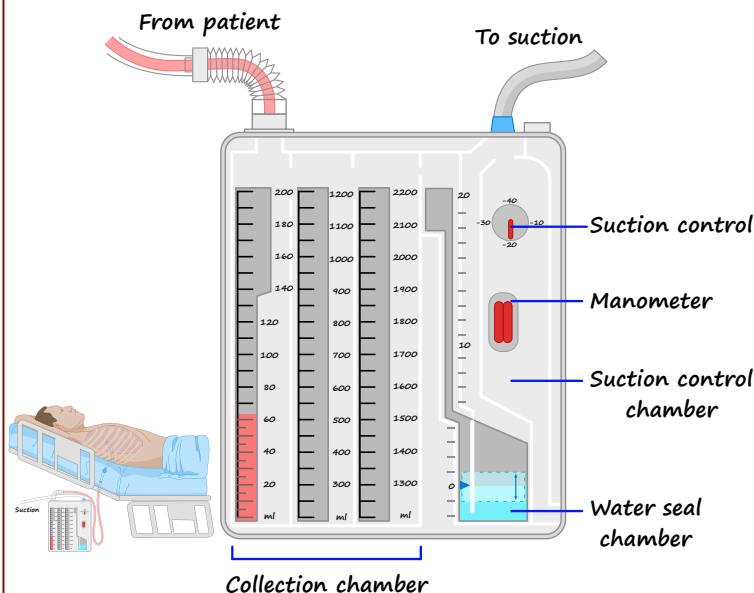
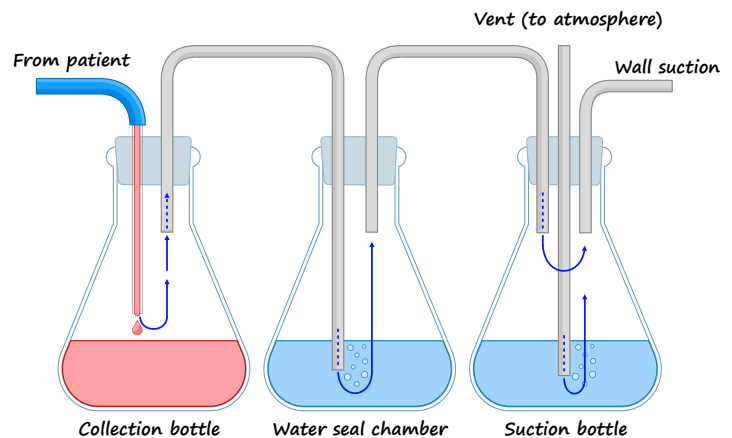
- This is the initial setting for the chest tube which allows for re-expansion of the lung
 - This is done by setting the suction to -20mmHg and monitoring for an air leak

○ Water Seal:

- This is the next setting for the chest tube if while on suction the lung is re-expanded and there is no air leak present
 - This is done by turning off suction pressure, and the chest tube is set to water seal and monitored for an air leak

○ Clamp Trial:

- This is the next step for the chest tube if while on the water seal the lung remains expanded and no air leak is present
 - This is done by clamping the tubing from the chest tube thus to reciprocate a scenario without a chest tube working in the patient's favor
 - If the lung remains expanded then the chest tube is unclamped and removed



2. Treatment of Refractory Pneumothorax

a) Pleurodesis

- **Treatment:**

- **Mechanical Pleurodesis**

- VATS is utilized to provide mechanical abrasions against the pleural lining to create a fibrotic reaction and subsequent obliteration of the pleural space

- **Chemical Pleurodesis**

- Talc or Doxycycline is installed into the chest tube which drains into pleural space and creates a fibrotic reaction and subsequent obliteration of the pleural space

- **Indications:**

- Recurrent pneumothorax
- Persistent pneumothorax that has not responded to chest tube placement and management

- **Purpose:**

- Prevent recurrence of pneumothorax

- **Monitoring:**

- Monitor for resolution of pneumothorax on CXR or CT scan

