TENSION PNEUMOTHORAX AND MASSIVE PLEURAL EFFUSION

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OUTLINE

a) Nomenclature and anatomy.
b) First 5 minutes and diagnosis.
c) Management strategies.
d) Follow-up, monitoring and complications.
e) Special considerations.

BASIC NOMENCLATURE

- Pneumothorax is the presence of air in the potential space between the visceral and parietal pleura.
- A pleural effusion is an abnormal collection of fluid between the visceral and parietal pleura of the lungs.

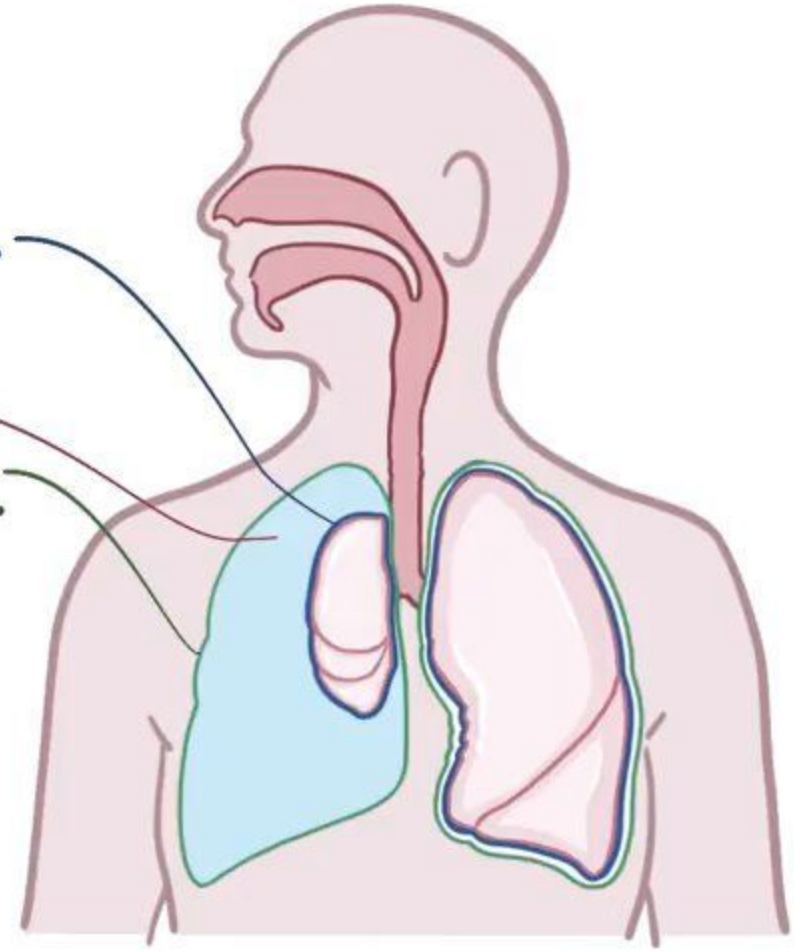
PLEURA

↳ BLANKET that COVERS our LUNGS

INNER VISCERAL PLEURA

SPACE

OUTER PARIETAL PLEURA

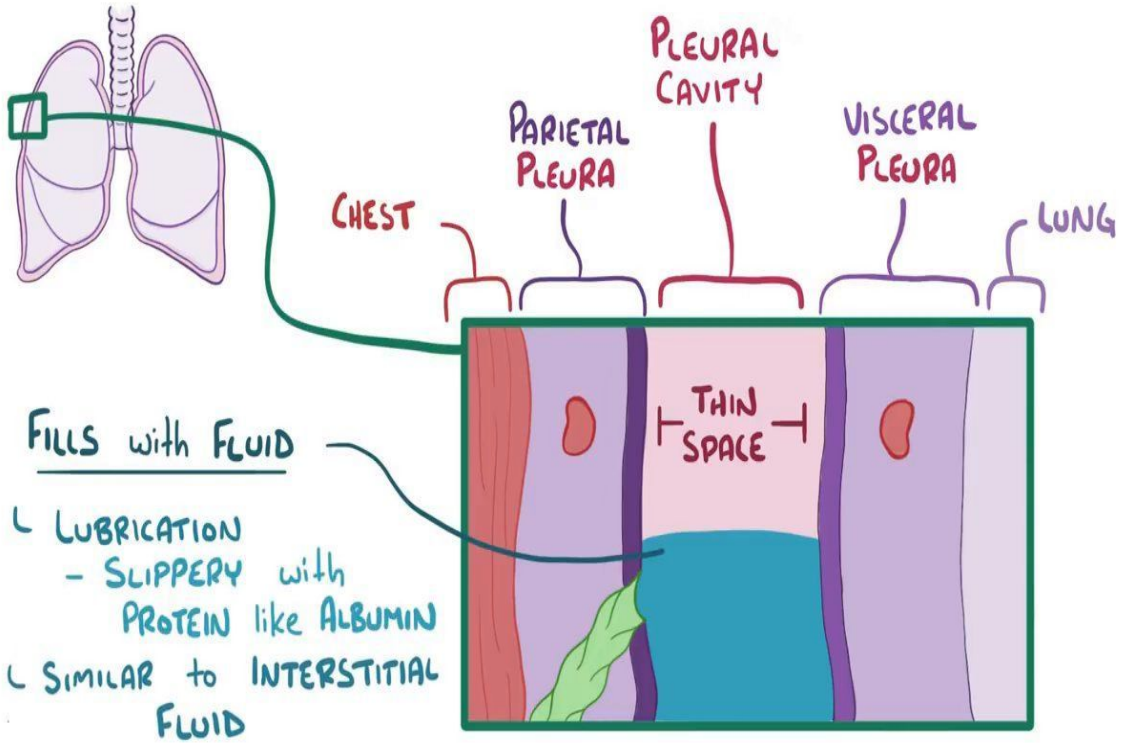


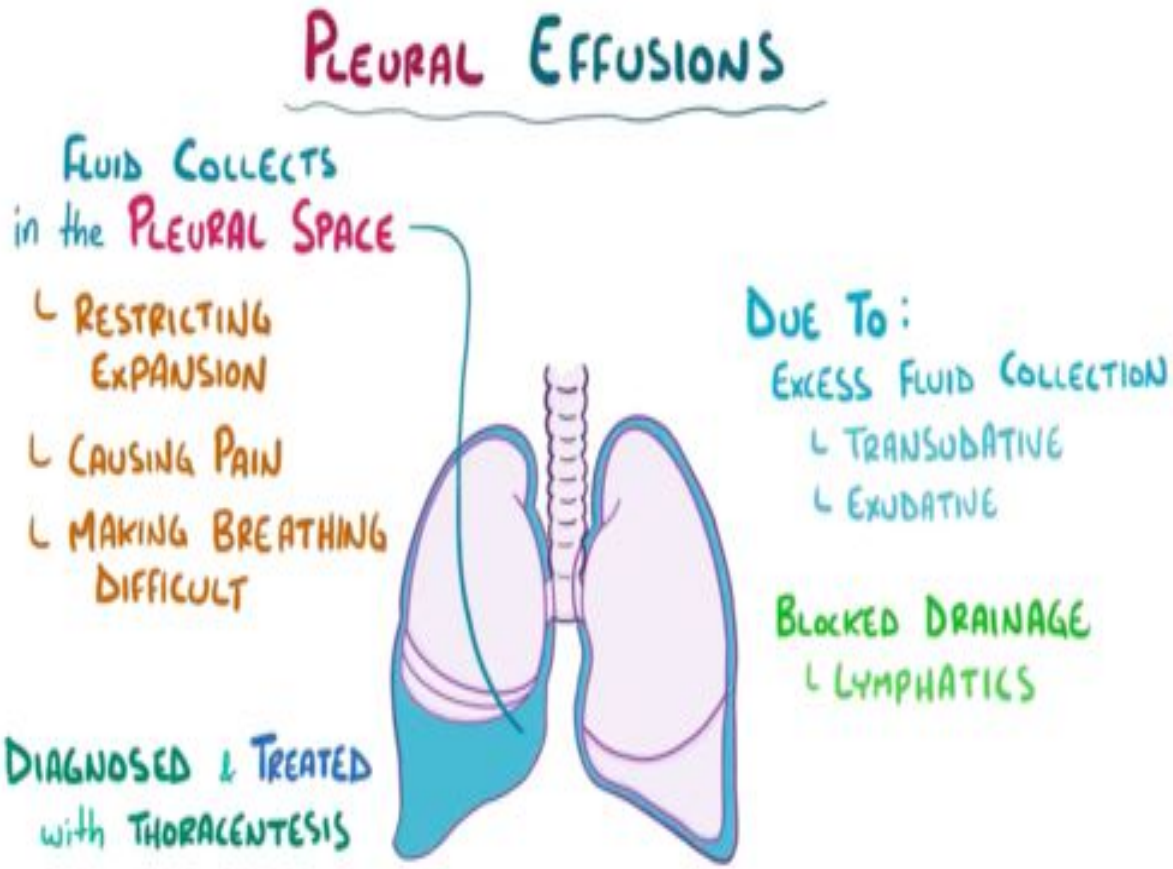
if AIR gets in ↓

PNEUMOTHORAX

* SPONTANEOUS
  - ↳ PRIMARY - w/out a TRIGGERING EVENT in a NORMAL
  - ↳ SECONDARY
* TRAUMATIC

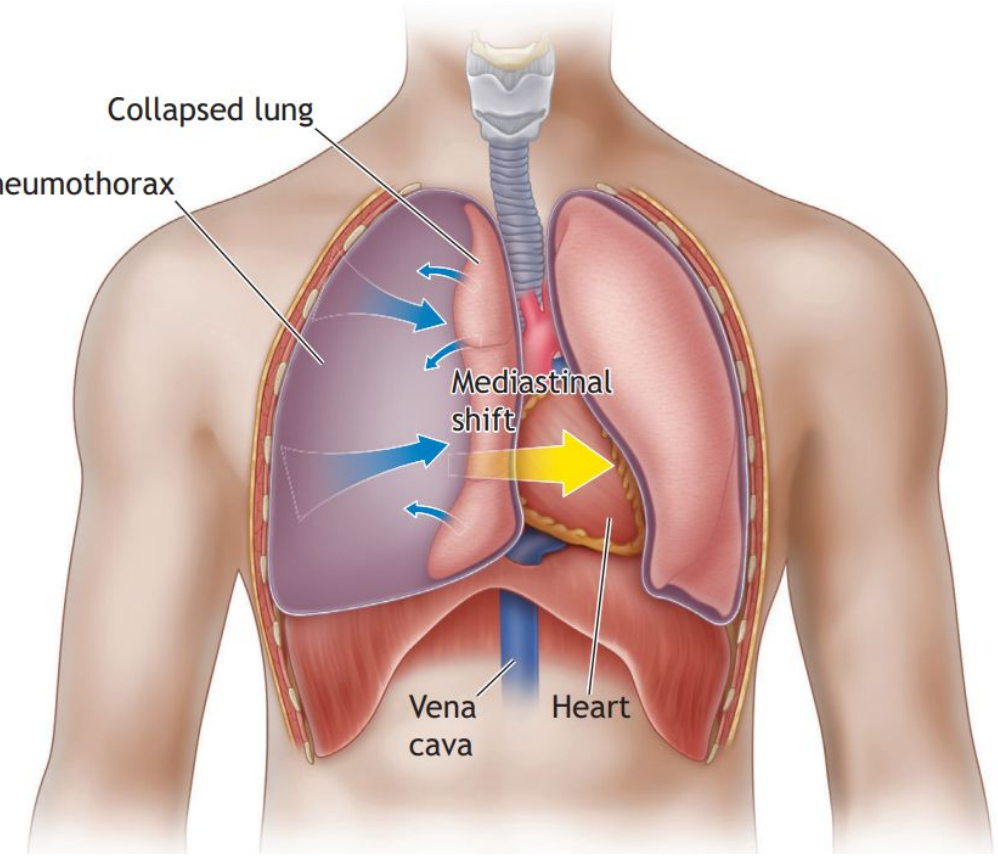
PLEURAL EFFUSION





TENSION PNEUMOTHORAX

- This is an emergency condition in which a pneumothorax presents with **hemodynamic instability secondary to the displacement of mediastinal structures and a decreased cardiac preload.**



FIRST 5 MINUTES

ABCDE (on arrival to ER)

- Airway obstruction?
- Breathing support
- Circulation control- IV fluids, control bleeding
- Disability e.g. nerve lesion or spine injury
- Exposure and environmental control
- VITALS (!!of vital importance!!)
- DON’T FORGET GLUCOSE

ON EXAMINATION

- **Air hunger** and **Tachycardia** are the most commonly encountered physical examination findings.

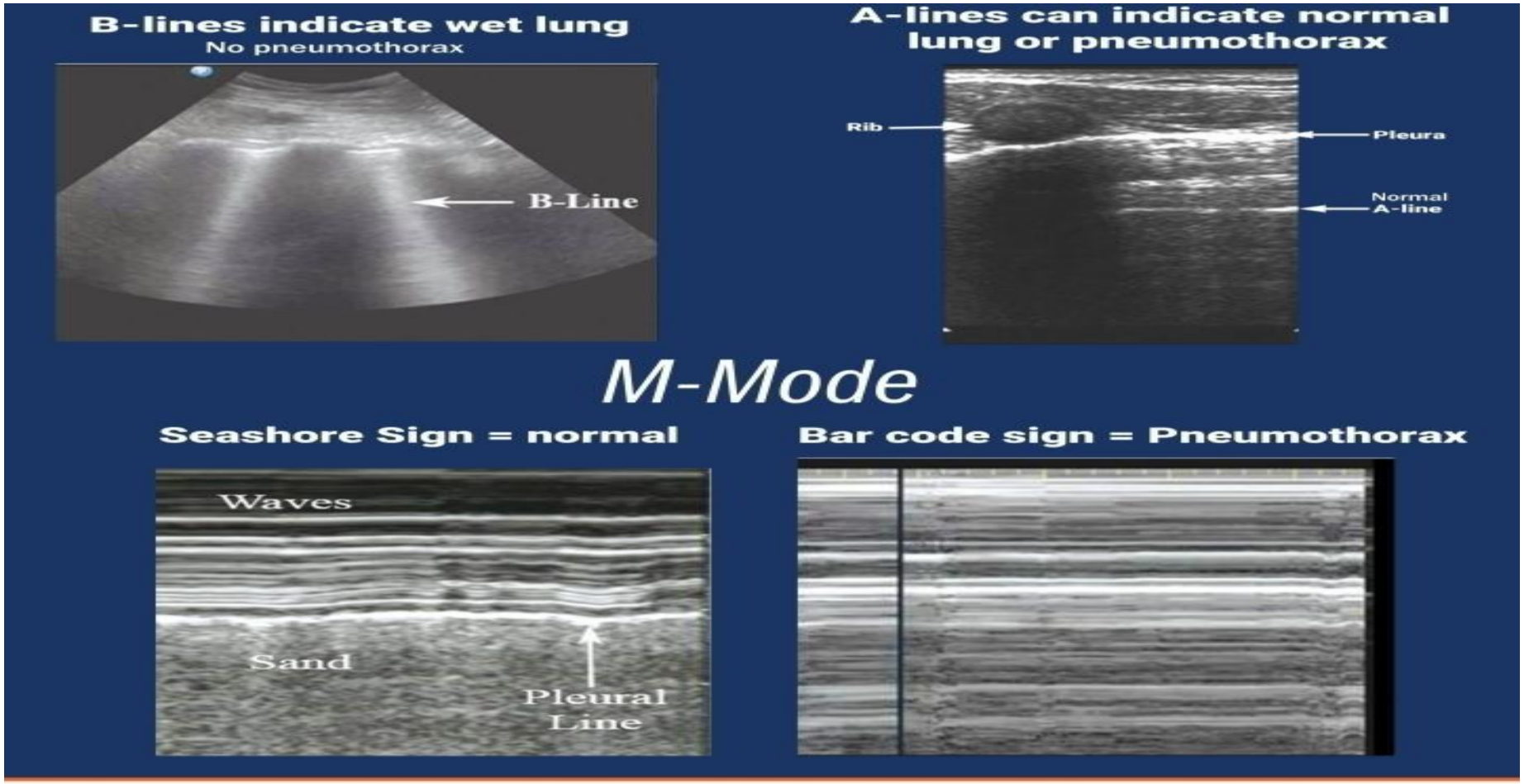
Additional findings include ;

- **Unequal chest wall movement/ expansion** with respiration.
- May have **tachypnoea/ abnormal breathing pattern due to pleurisy.**
- Tracheal/**mediastinal shift**
- **hyper resonance** to percussion in pneumothorax and **stony dullness** in massive effusions,
- the lack of unilateral **tactile fremitus (i.e., asymmetric tactile fremitus)**
- **decreased breath sounds**
- The absence of any of the typical exam findings ***does not exclude the diagnosis***.

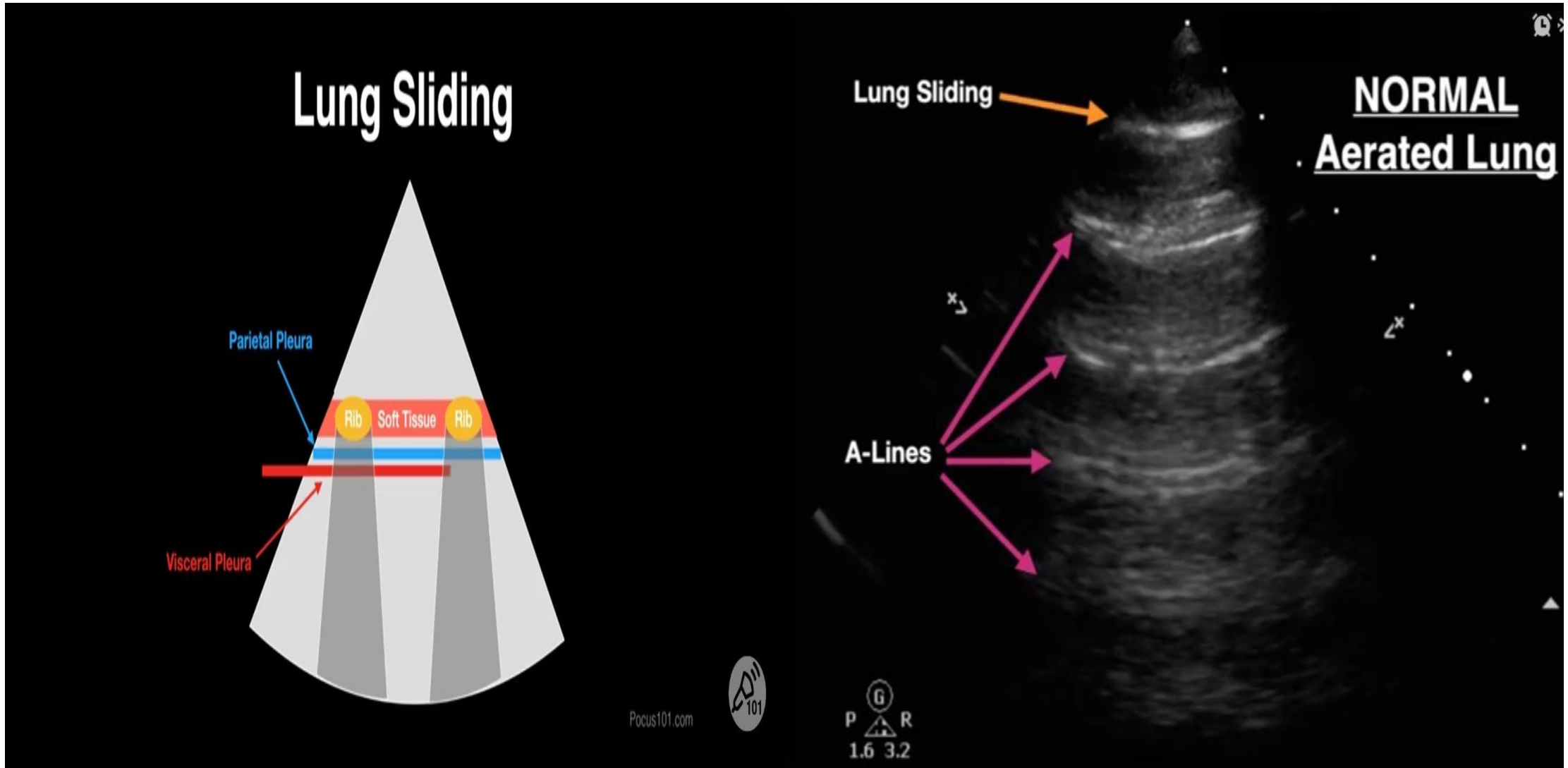
BEDSIDE LUNG ULTRASOUND

- Pleural ultrasound is as **sensitive** as CXR or better in diagnosing pleural effusions and can detect as little as 5-20 mL of fluid
- A pneumothorax is also suggested if lung sliding and/or lung pulse is **absent** but false positives can occur. The presence of a lung point on pleural ultrasonography is diagnostic of pneumothorax.

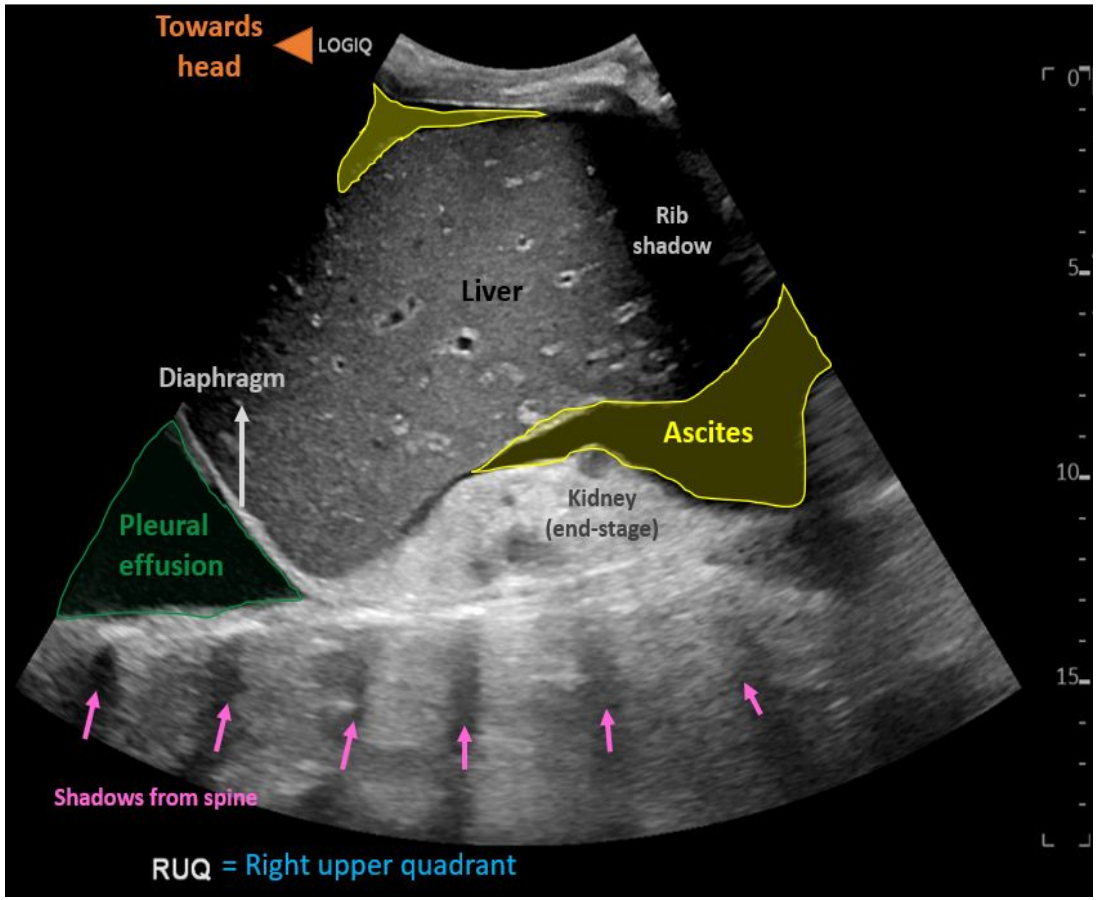
BEDSIDE LUNG ULTRASOUND PNEUMOTHORAX

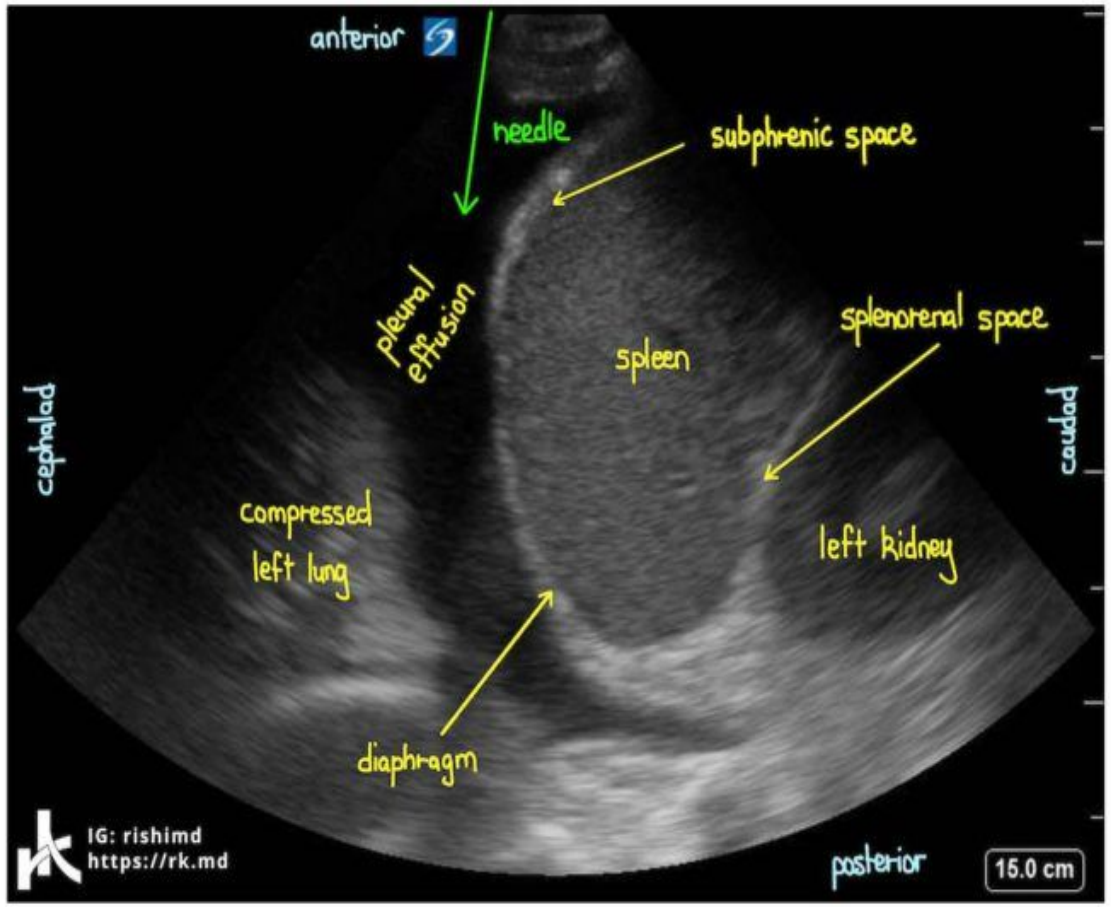


BEDSIDE LUNG ULTRASOUND

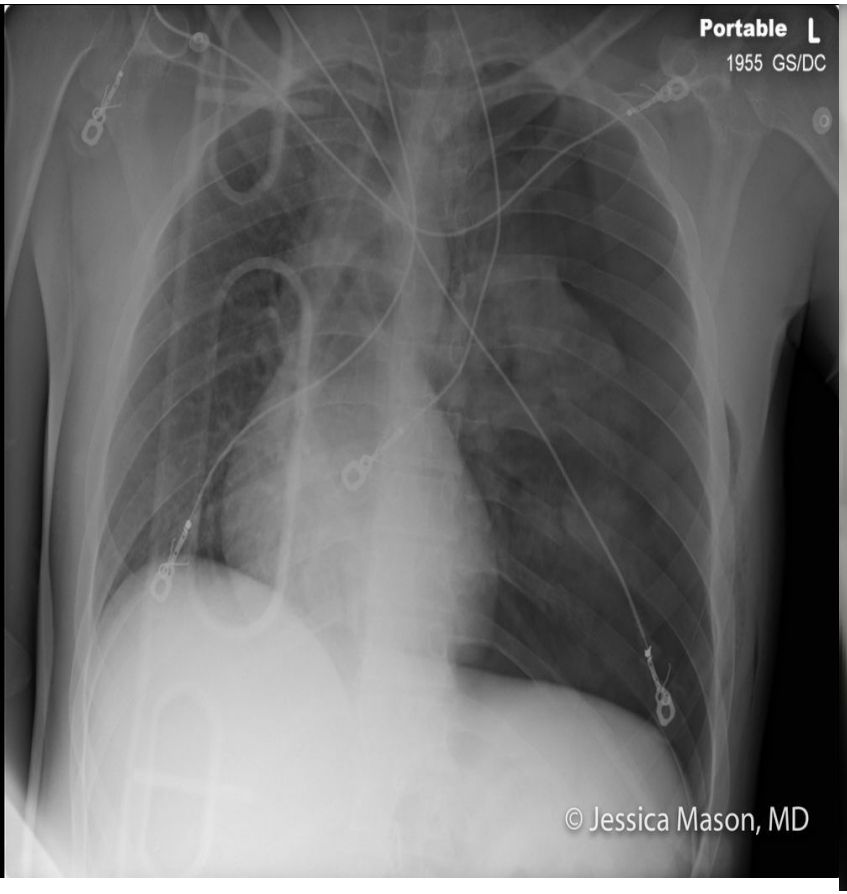


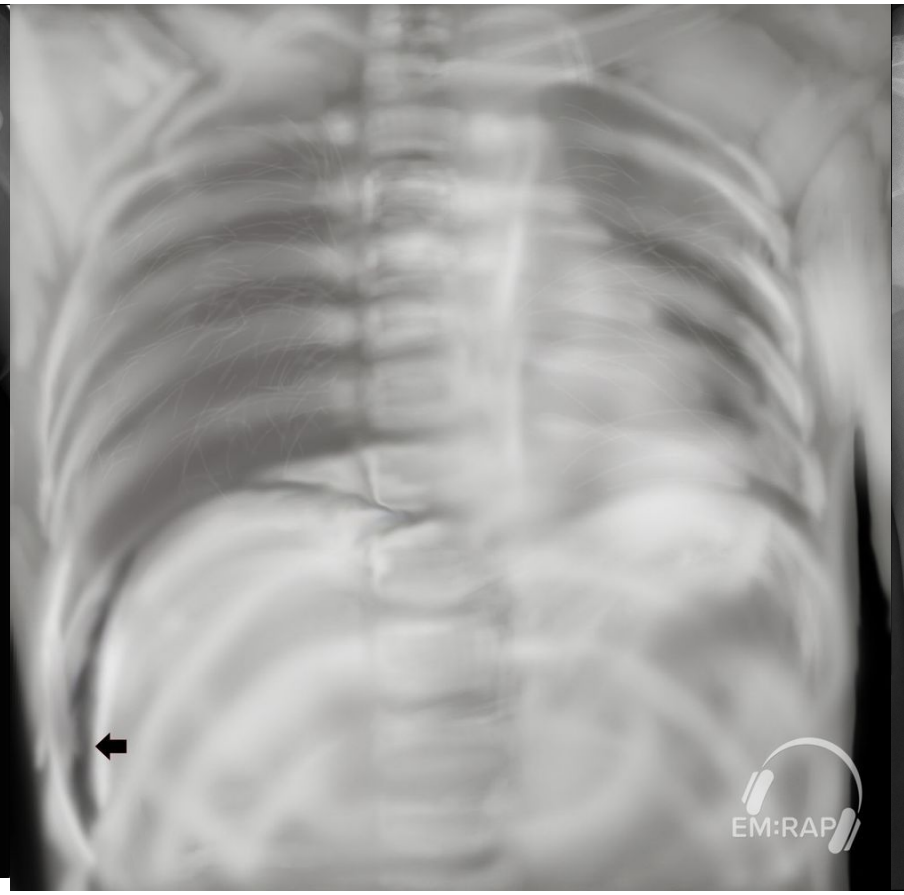
EFFUSION ON POCUS

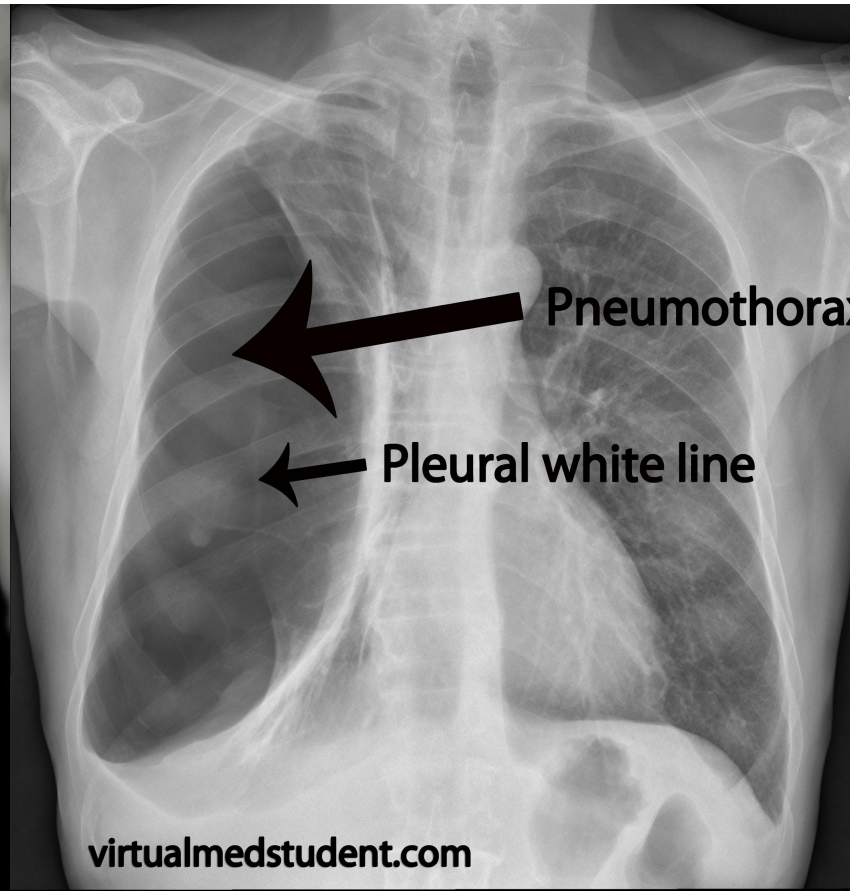




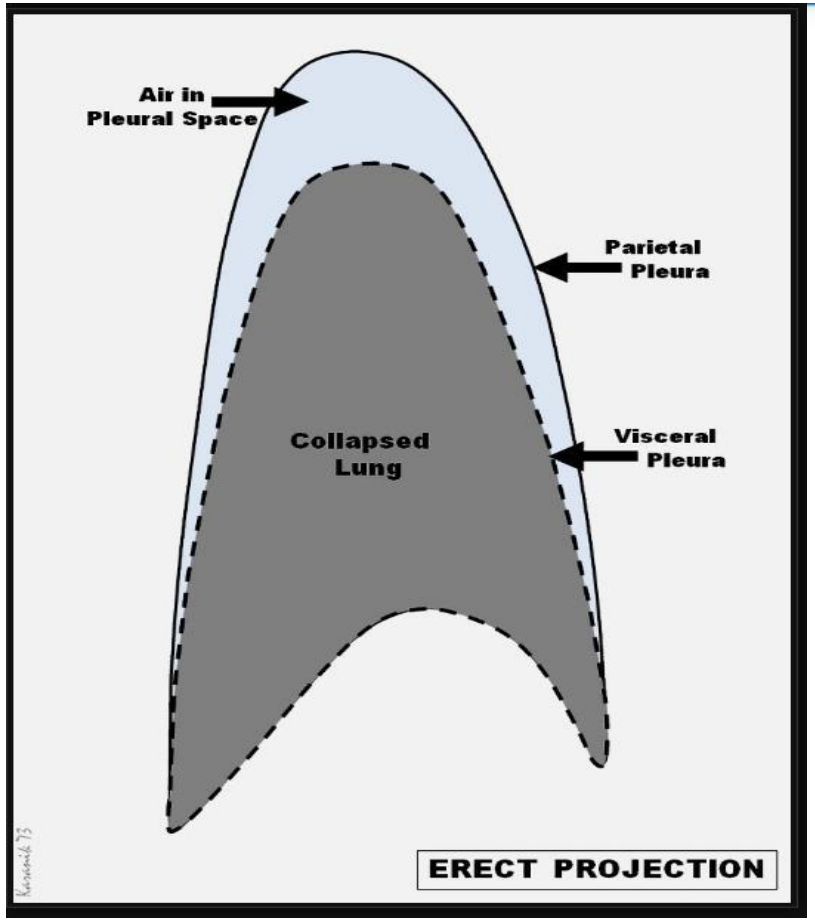
PLAIN RADIOGRAPHY

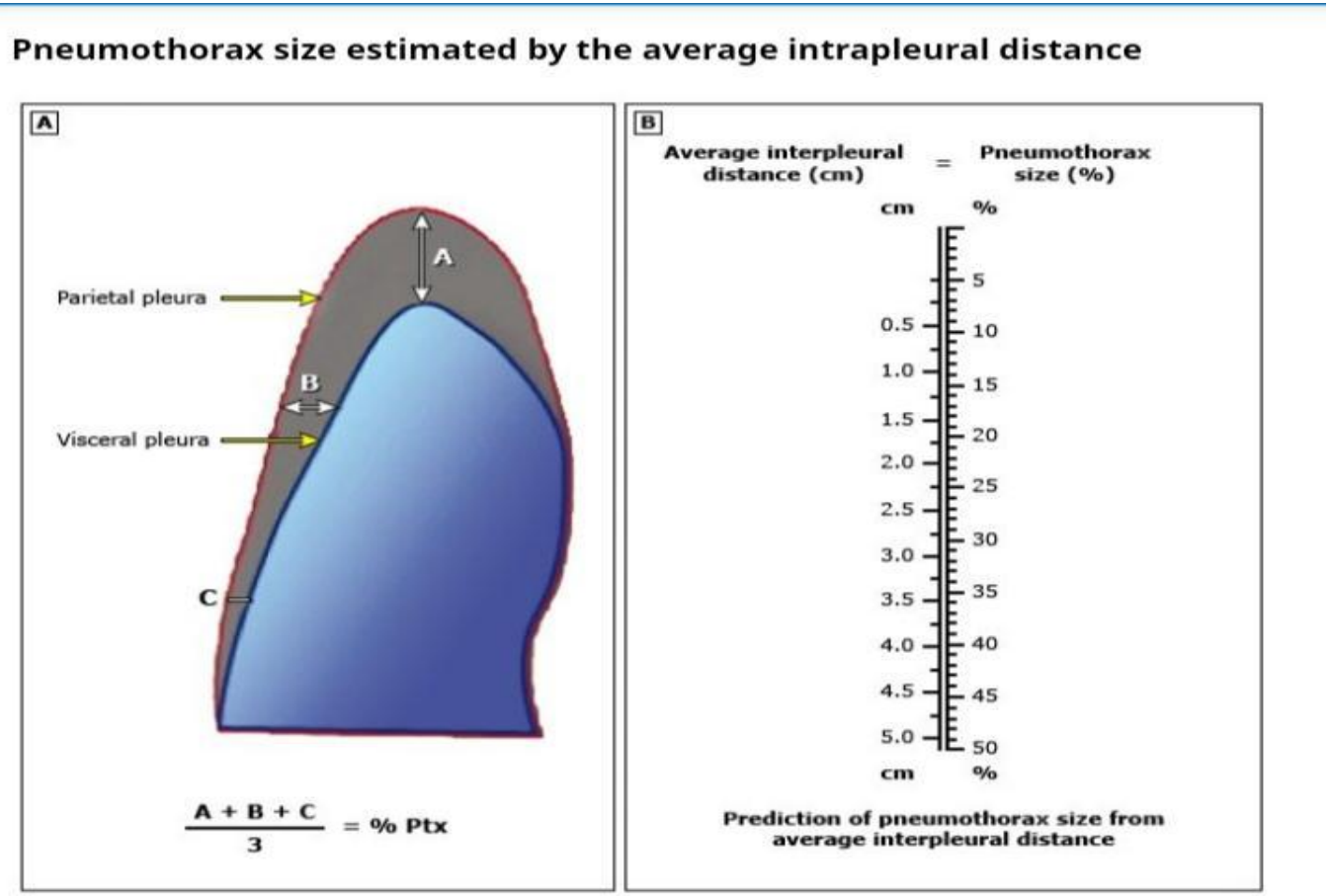






SIZE ESTIMATION (SMALL/LARGE?)





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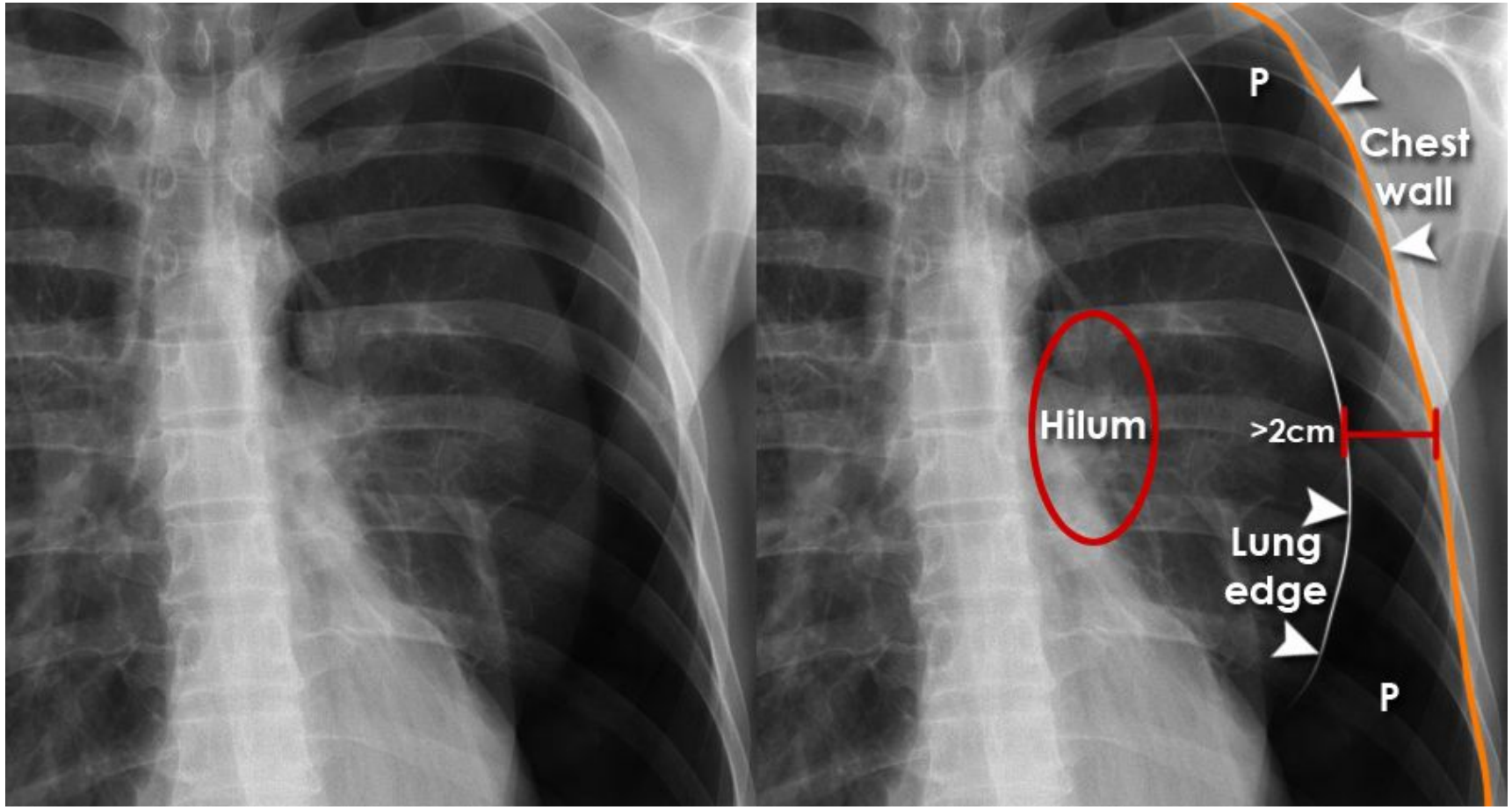
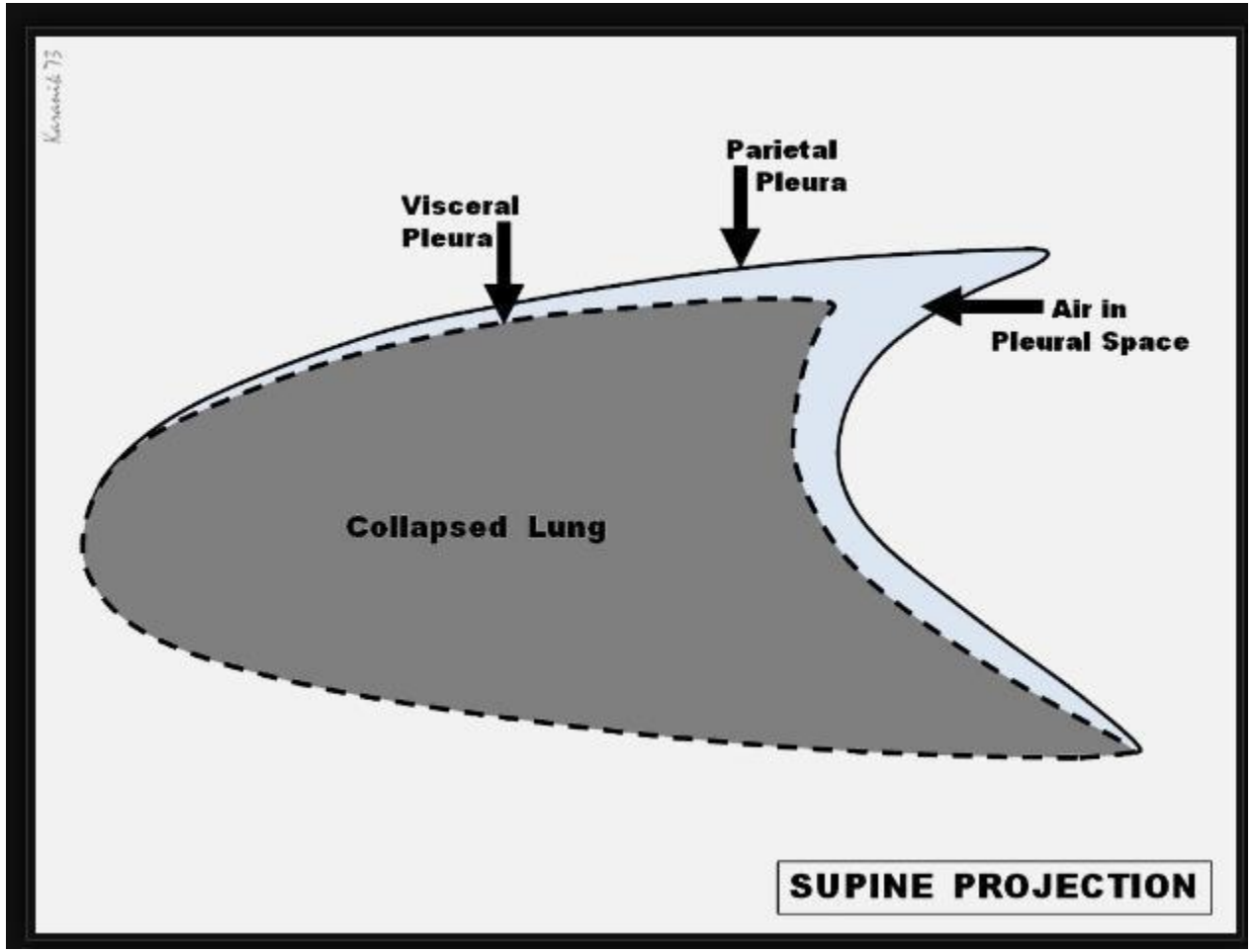


THE DEEP SULCUS SIGN



COMPUTED TOMOGRAPHY

- For patients in whom the diagnosis is uncertain, **Chest CT is the most accurate method available for detection based upon its superior ability to distinguish gas from other structures** including the lung parenchyma, the pleural membranes, and the mediastinum.

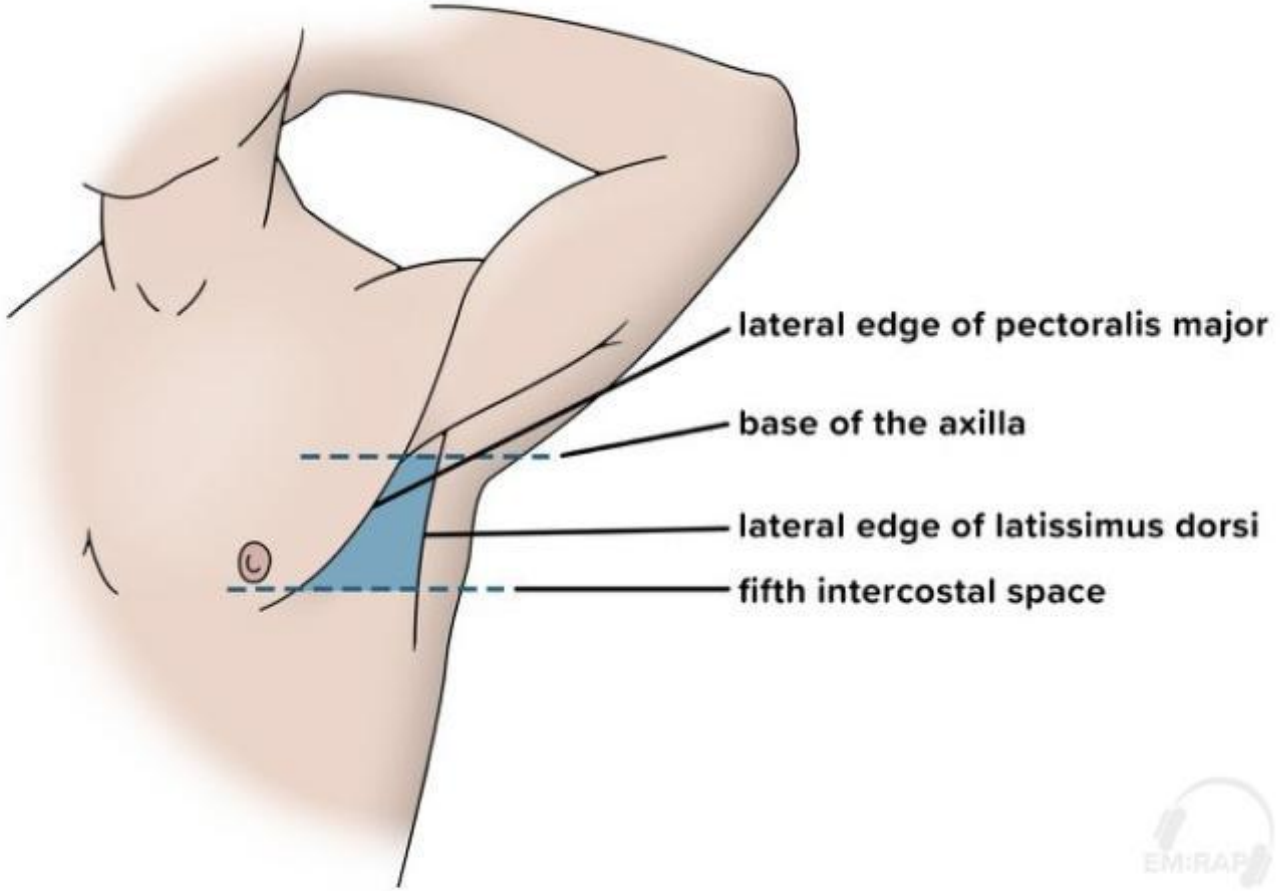
OXYGEN THERAPY

- **Supplemental oxygen (for a minimum of six hours) and observation is an option for SSP that is small (<2 cm from the pleural line to the chest wall) and who are asymptomatic or minimally symptomatic.**
- **Supplemental oxygen is administered to virtually all patients with SSP to treat hypoxemia and facilitate absorption of air from the pleural space.**

THORACOSTOMY

- Thoracostomy is a procedure in which a **thoracostomy tube or catheter is placed through the chest wall into the pleural cavity to drain a pneumothorax.**
- In hemodynamically unstable patients in whom there is **a high suspicion of tension pneumothorax, needle thoracostomy should be performed as a lifesaving (albeit temporizing) measure by reducing the intrapleural pressure and restoring venous return to the heart.**

THE TRIANGLE OF SAFETY



PATIENT PREPARATION

- **Prophylactic antibiotics**
- For patients with penetrating thoracic trauma, we recommend **administering prophylactic antibiotics prior** to thoracostomy tube or catheter placement.
- **Rates of empyema and pneumonia are significantly decreased when antibiotics are given prior** to thoracostomy tube placement

SEDATION/ANALGESIA

- In emergency clinical settings, the thoracostomy tube or catheter can readily be inserted under local anaesthesia (e.g., 1% lidocaine**) with or without an intercostal nerve block.**
- Keep in **mind the potential toxicity of lidocaine**.
- The maximum allowable dose is **4 to 5 mg/kg without epinephrine and 5 to 7 mg/kg with epinephrine**

INSERTION TECHNIQUES

- Sharp vs blunt?
- the trocar method should be used with caution since this technique significantly increases the risk of organ perforation

ANTERIOR VS AXILLARY APPROACH

- This **anterior approach has been shown to have a high failure rate** which prompted the 2019 ATLS update to recommend a lateral approach in the **“triangle of safety.”**
- The **chest wall is thicker at the anterior axillary location in overweight and obese patients**.

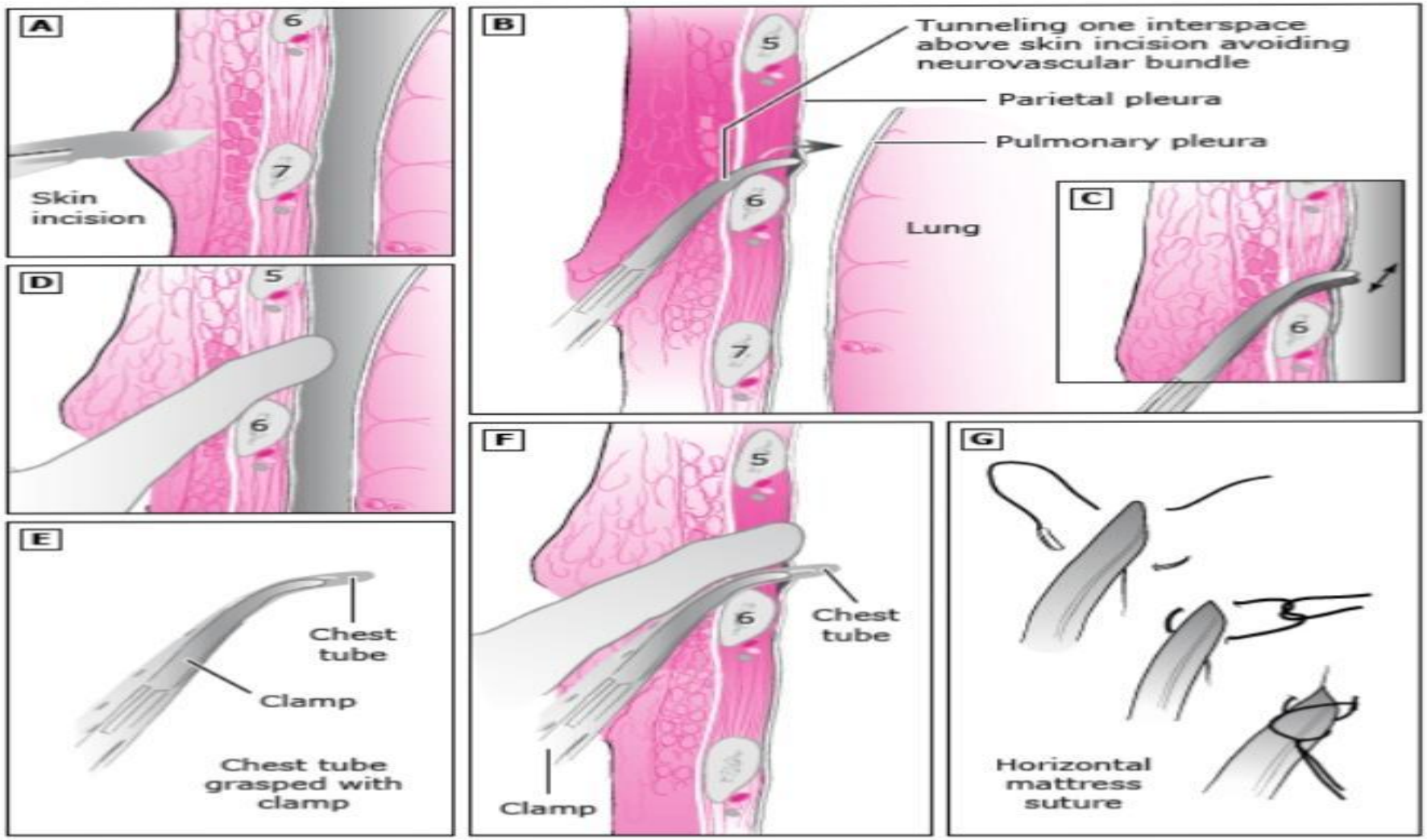
RECOMMENDED SIZE?

- **ATLS Guidelines now recommend 28-32 French** chest tubes in the treatment of traumatic hemothorax based on a 2012 study showing equivalent outcomes.

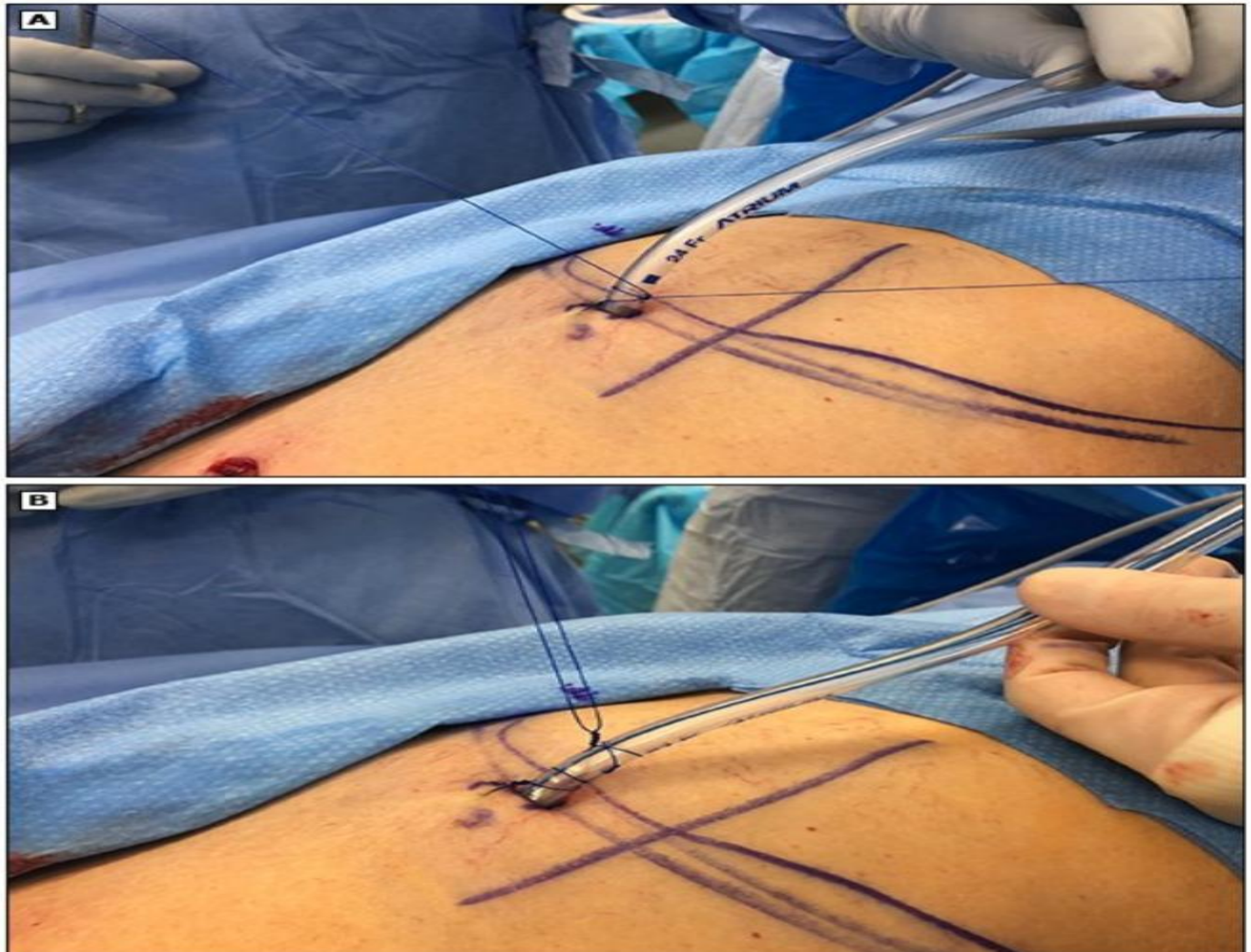
FINGER THORACOSTOMY?

- Although few studies have directly compared it to needle thoracostomy, **finger thoracostomy provides another option for decompression, with high reported reliability in the prehospital setting.**

BLUNT DISSECTION



SECURING THE TUBE



POST PLACEMENT

- **Send fluid for analysis**
- **Monitor and document the initial drainage** from the tube.
- **If the lung has been in a state of significant compression** due to a large effusion or pneumothorax, **be aware of re-expansion pulmonary oedema and be prepared to treat it.**
- **clamp the tube for a period of time if a patient starts coughing while fluid is draining from a newly placed thoracostomy tube.**
- Allow the patient's cough to subside before removing more fluid.

Pleural Effusion

Light's criteria met?

Pleural protein ÷ serum protein >0.5
Pleural LDH ÷ serum LDH >0.6
Pleural LDH >2/3 ULN serum LDH

None → **Transudative**

≥1 → **Exudative**

Transudative

Common

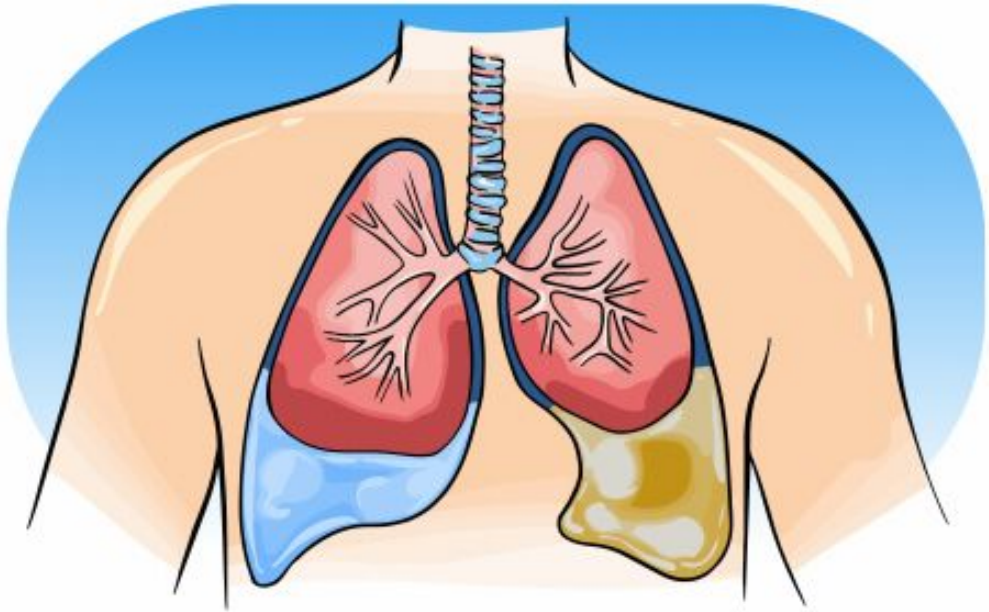
- CHF
- Liver disease
- ESRD
- Nephrotic syndrome
- Pulmonary embolism

Rare

VASCULAR
- Brachiocephalic occlusion
- SVC syndrome

TRAPPED LUNG
- Endobronchial lesion
- Visceral pleural adhesions

↓PROTEIN FLUID
- Central line
- CSF
- Peritoneal dialysis
- Urine



Exudative

Primary Etiologies

Common

- Infection
- Cancer
- Autoimmune
- Drugs
- Pulmonary embolism

Rare

- Chylothorax
- Asbestos

Secondary Etiologies

Right-sided
- Meigs' syndrome
- Endometriosis

Left-sided
- Pancreatitis
- Esophageal rupture

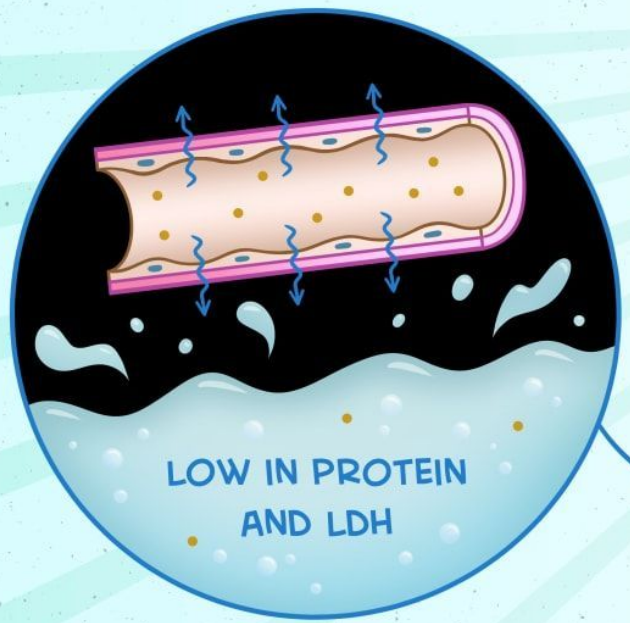
PLEURAL EFFUSION

ACCUMULATION OF FLUID WITHIN THE PLEURAL SPACE

TRANSUDATIVE

OCCURS DUE TO INCREASED HYDOSTATIC PRESSURE OR LOW PLASMA ONCOTIC PRESSURE

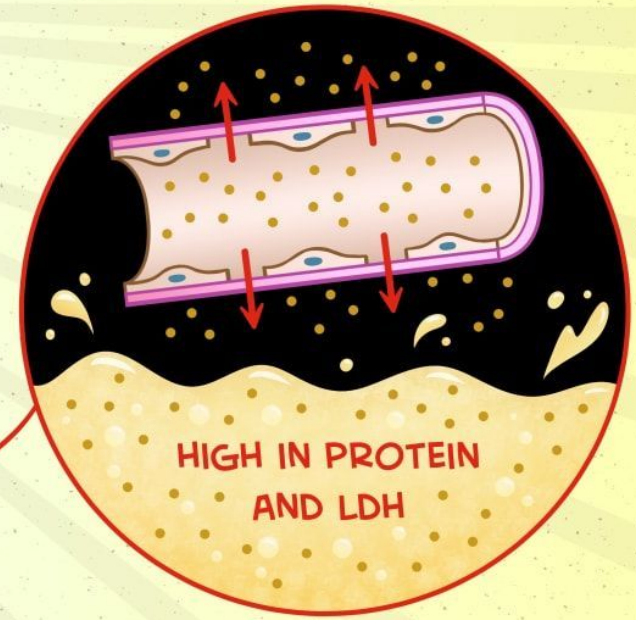
E.G., CHF, CIRRHOSIS, NEPHROTIC SYNDROME, PE, HYPOALBUMINEMIA

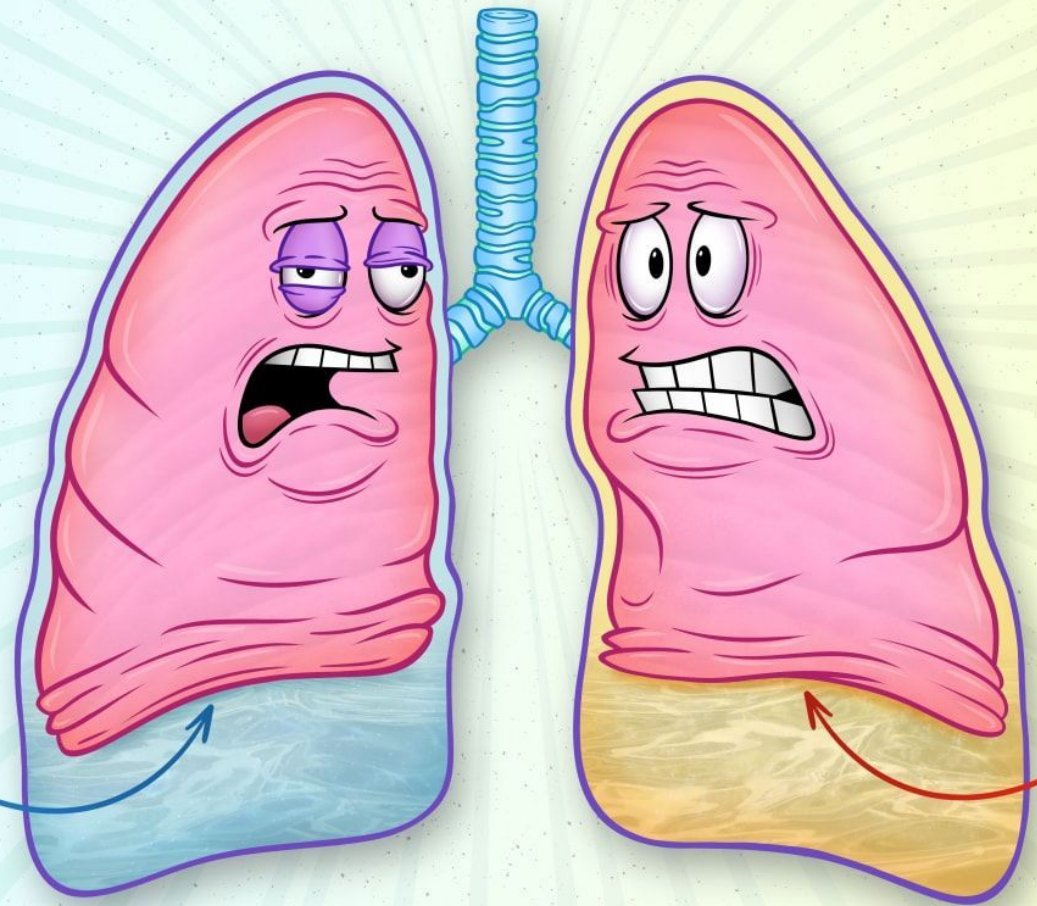


EXUDATIVE

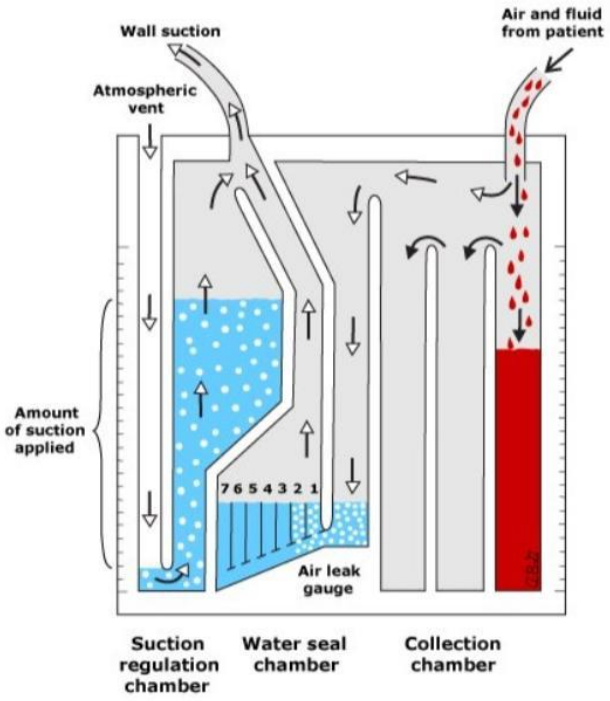
OCCURS DUE TO INFLAMMATION AND INCREASED CAPILLARY PERMEABILITY

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



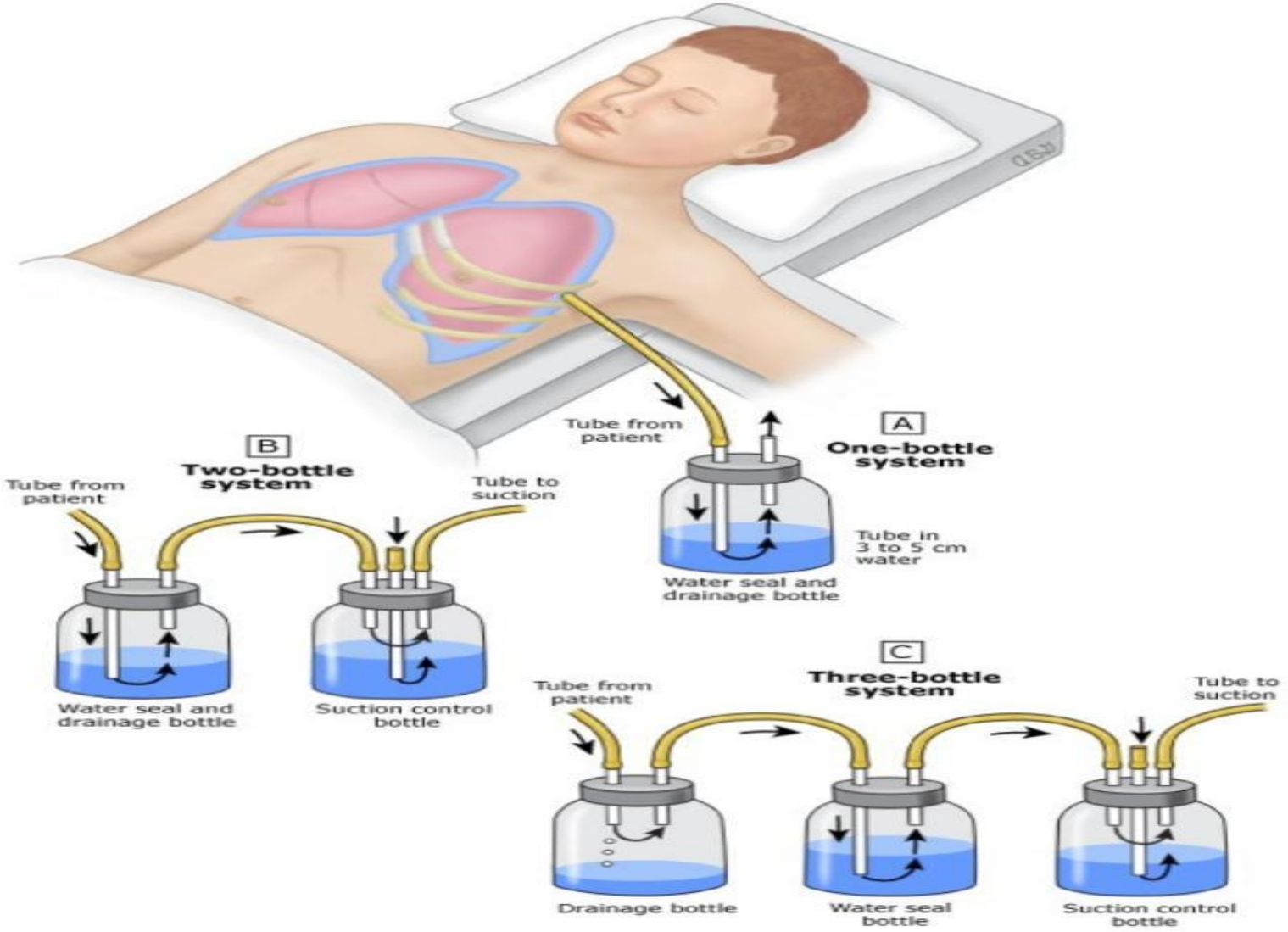


UNDER WATER SEAL DRAINAGE SYSTEM



Pleur-evac

BOTTLE DRAINAGE SYSTEMS



LEVELS OF SUCTION

- The typical initial level of suction used in the clinical setting is -10 to -20 cm H_2O of water (adult and pediatric populations), which can be adjusted if there is a failure to drain.
- Commercial closed-drainage systems typically allow the suction level to be adjusted between 0 and -40 cm of water.

SPEED OF DRAINAGE

- Even without symptoms, for patients without any signs of a mediastinal shift from the effusion, **we limit initial fluid drainage (1.5 litres in adults, 20 mL/kg in children) by clamping the thoracostomy tube or catheter and waiting at least one hour before draining additional fluid.**
- **Patients with mediastinal shift** contralateral to the tube or catheter **may tolerate a larger amount of initial fluid removal** because a certain amount of fluid can be removed to return the mediastinum to midline **before the lung starts to reinflate**.

COMPLICATIONS

- Death or further morbidity due to **bleeding, hypoxia, analgesia/sedation, or inability to rapidly perform the procedure**
- **Analgesia/sedation**-related complications
- Injury to one or more **chest wall structures**
- Injury to one or more **intrathoracic structures**
- Injury to one or more **extra thoracic structures**

PROCEDURAL COMPLICATIONS CONTINUED…

- Hemoptysis
- **Peripheral nerve injury** (e.g., intercostal nerve, phrenic nerve, thoracic nerve)
- **Drug/allergic reaction** (latex, anesthetic, prep solution, analgesics, sedatives, antibiotic)
- Improper extra thoracic position of catheter/tube
- **Catheter/tube leak** due to side port outside of the thorax or faulty drainage device connections

PROCEDURAL COMPLICATIONS CONTINUED…

- Tube loss due to **failure to properly secure the catheter/tube in place**
- **Inappropriate catheter/tube positioning** due to failure to check postprocedure chest radiograph or adjust catheter/tube position based on radiograph
- Misinterpretation of needle thoracostomy findings
- **Inappropriately sized size catheter/tube requiring repeat procedure**

PROCEDURAL COMPLICATIONS CONTINUED…

- Dysrhythmia
- **Improper skin incision** that causes unnecessary cosmetic impact
- Damage to another medical device near the operative site
- Improperly connected Heimlich valve (ie, wrong direction)
- **Improper setup of a water seal-drainage** reservoir-suction apparatus

RE-EXPANSION PULMONARY EDEMA

- RPE is an uncommon but potentially life-threatening complication of tube thoracostomy that usually arises **after rapid re-expansion of a lung that has collapsed for at least three days due to either pneumothorax or effusion.**

TRANSPORT OF THE PATIENT

- **Do not clamp the chest tube for transport**, as this can lead to a build-up of air/fluid in the pleural space and **may possibly create a tension physiology**.
- Instead, **set the system to water seal when suction is not available**.

FOLLOW UP THORACOSTOMY CARE

- **Follow-up thoracostomy management (one to five days)** — involves;

a) daily bedside assessment for symptoms, for the presence of **an air leak, and for complications of the catheter or chest tube (e.g., blockage, pain, bleeding).**

b) Daily imaging with chest radiography is not always necessary, although **frequent imaging is typically performed to assess the degree of lung expansion**.

SPECIAL CONSIDERATION

- **Patients with concomitant empyema or hemothorax** –are thought to benefit from large-bore tubes for drainage since small-bore catheters are at increased risk of blockage from clots or debris.
- In the case of hemothorax, **the purpose of a chest tube is also to monitor the rate of blood loss, making a large-bore tube desirable.**

SPECIAL CONSIDERATION

- **Patients who are unstable with tension pneumothorax** – In patients with tension pneumothorax, a large-bore tube is often placed based upon the **likelihood of a large or persistent air leak.**

SPECIAL CONSIDERATION

- **Patients with barotrauma from mechanical ventilation** – experts prefer large-bore chest tubes in patients with barotrauma since the air leak is likely to be large and may lead to tension pneumothorax,

SPECIAL CONSIDERATION

- **Pregnancy** – The **management of pneumothorax in pregnancy is similar** to that for patients who are not pregnant **except pleurodesis is generally deferred until after delivery.**
- For those who are **at risk of developing pneumothorax during labour and delivery,** most experts advise a multidisciplinary approach that involves **elective, assisted delivery at or near-term, with regional anaesthesia to reduce maternal effort.**
- **Regional anaesthesia is also preferable** in those in whom cesarean section is indicated.

DISPOSITION

- Admit and fully workup **All patients with pleural effusion or empyema**.
- **Admit Symptomatic, large spontaneous or cases not resolved on repeat imaging** OR Unreliable follow-up or poor social situation
- Consider **Surgery IF Recurrent ipsilateral primary pneumothorax or Persistent air leak, incomplete re-expansion after 4-7 d**

THANK YOU

REFERRENCES

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