Chest Trauma



E J Arteen
FRCSI

* The Thoracoabdomen part :- from the trans nipple line to the costal cartilage , contain 4 structure:- liver- spleen- upper 1/2 of [fundus] stomach -diaphragm...

* The abdominal Trauma → 95% Blunt trauma...
→ 5% penetrating trauma...

* The chest Trauma → 80% Blunt trauma...
→ 20% penetrating trauma...

* Types of thoracotomy :- 1- postro lateral [preferred in trauma cases]
2- Anto lateral

* Types of Respiratory failure :- ① Type I: $\downarrow O_2$ [hypoxia] - normal or low CO_2 lead to deep rapid breathing [Kaussmal Breathing]...
...↑ tempreture ← lead to ↑ Basal metabolic rate ←

② Type II: Hypoxia - Hypercarbia...

③ mixed: type I and become tired → ↑CO_2 so become type II... [need tube]
↓ due to sepsis for example...

* posterior to the 2nd costal cartilage there is T_4-T_5 disc...

* pt has fracture rib 11 or 12 due to Chest trauma this indicate severe trauma... [may associated with head injury or severe abdominal trauma or transsection to great vesseles or cerebrovascular trauma]...
all in top ribs are unlikely to be fractured.

* from 4th rib to 9th rib → more likely to be fractured...
↓ at the angle of the rib [the most curved + weak part of the rib]...

* The 1st and 2nd ribs are flat and protected by muscle so unlikely to be fractured... [severe fracture]
↓ not has angle...
→ if the trauma in 1st and 2nd rib may lead to transsection of the Aorta or abdominal injury and widening of mediastinum so we should do FAST...

CHEST TRAUMA







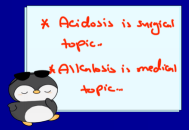




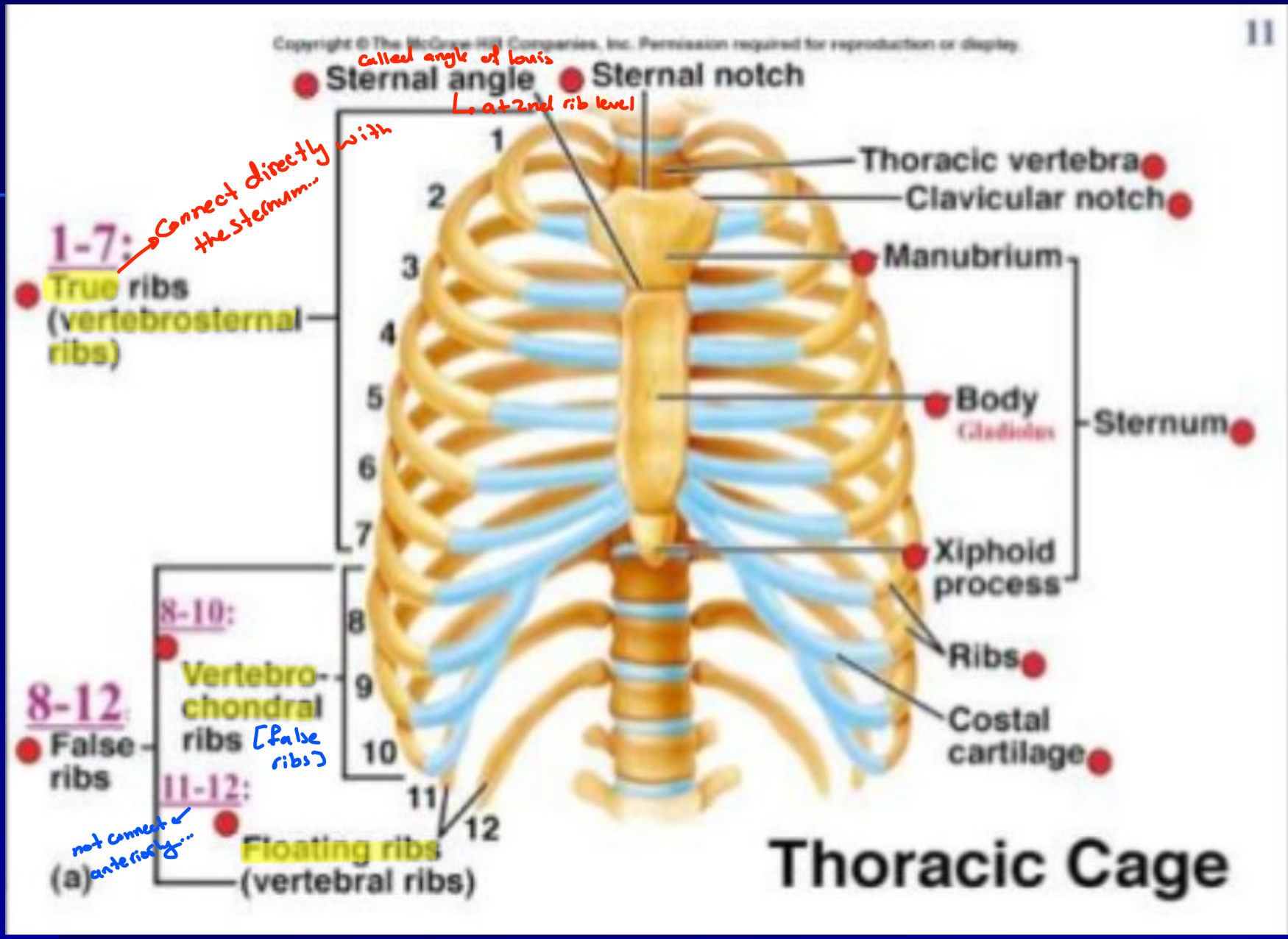
Epidemiology

- Third of MVC have chest injuries .
- 80% blunt chest trauma .
- 20 -25% mortality.
- Majority of deaths are preventable.
- Less than 10% in BCT 25% of PCT need exploration.

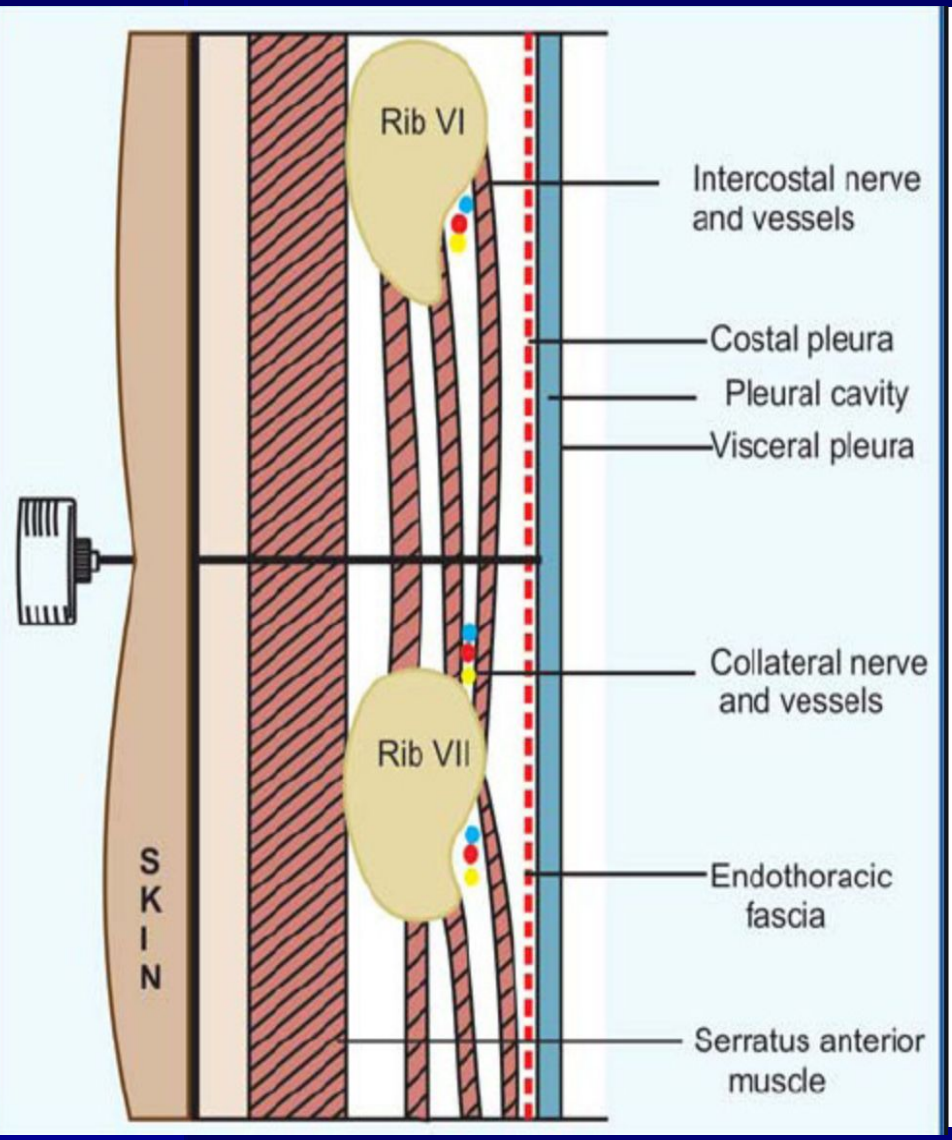
- ***The physiologic consequences of Thoracic Trauma are Hypoxia, Hypercarbia, and Acidosis.***

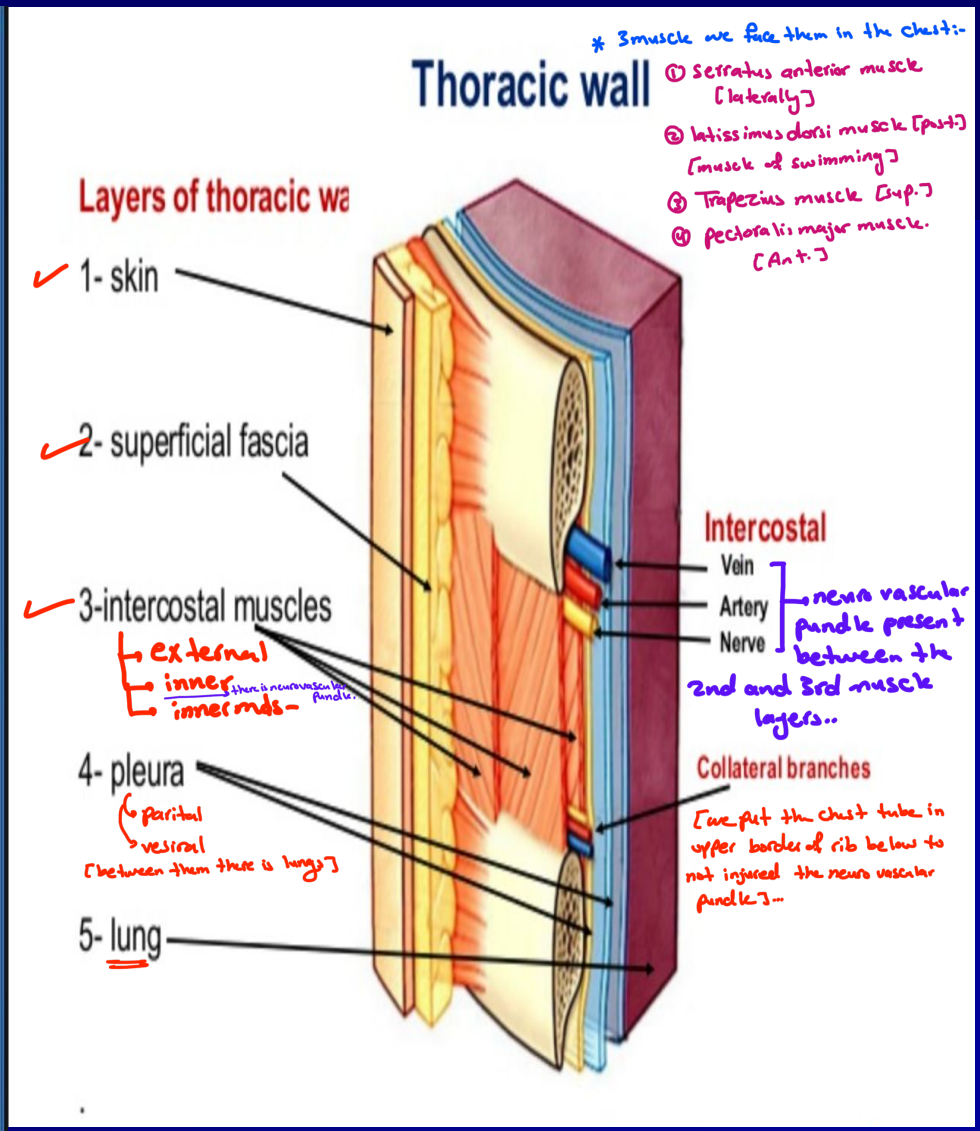


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Thoracic Cage


Rib VI
Intercostal nerve and vessels
Costal pleura
Pleural cavity
Visceral pleura
Collateral nerve and vessels
Rib VII
Endothoracic fascia
Serratus anterior muscle
SKIN


* 3muscle we face them in the chest:-
Thoracic wall
① Serratus anterior muscle [laterally]
② latissimus dorsi muscle [post.] [muscle of swimming]
③ Trapezius muscle [sup.]
④ pectoralis major muscle. [Ant.]
Layers of thoracic wa
1- skin
2- superficial fascia
3-intercostal muscles
external
inner
innermds-
4- pleura
parietal
vesical
[between them there is lungs]
5- lung
Intercostal
Vein
Artery
Nerve
neuro vascular bundle present between the 2nd and 3rd muscle layers..
Collateral branches
[we put the chest tube in upper border of rib below to not injured the neuro vascular bundle]..

Blunt chest trauma

- ***Acceleration Deceleration Injury.***
  - **MVC (RTA) .**
  - **Fall from height >3 meter.**
  - **Sports.**
- ***Compression injury.***
- ***Blast injuries.***



Penetrating Chest Injuries

- ***High velocity***
  - **Missile**
  - **Missile fragments**
- ***Low velocity***
  - **Stab injuries.**

in abdomen: peritoneal cavity ... 30% ... so we should ... exploration in case of stab if the pt clinically stable- ... injury ... 50% ... peritoneal irritation ... under observation

* Tracheal length = 1/2 esophagus length | * wide of trachea :- 1.5-2.5 cm in Males and 1-2cm in Females → بتتنفس
[11-12cm] [25cm] ↳ more wider for endotracheal tube...

→ The trachea end in the Carina [Lt. - Rt Bronchus]

Immediate Life Threating Injuries

* normally in the pericardial sac there is:- 10-50 cc fluid...
→ The symptom appear if there is Blood :- 150-250 cc in pericardial sac...

- **Tension Pneumothorax.** ← we do firstly decompression x-ray لا تستنى
- **Cardiac Tamponade .** ← if the pt severely dystress need Aspiration of Blood...
  - ↳ Blood in the pericardia sac > 50cc ...
- **Massive Hemothorax.**
  - ↳ more than 1.5L of Blood in the pleural cavity..
  - [Blood > 200mL/hr within 3-4hr in chest tube]
- **Tracheal Disruption.** ← from the bifurcation of trachea [within 1 inch of Carina]
  - fatal ← trachea لا تنقطع ← ↳ in chest tube form bubbles...
- **Open Pneumothorax.**
  - ↳ Called Sucking chest wound...
  - بيدخل ويطلع هواء

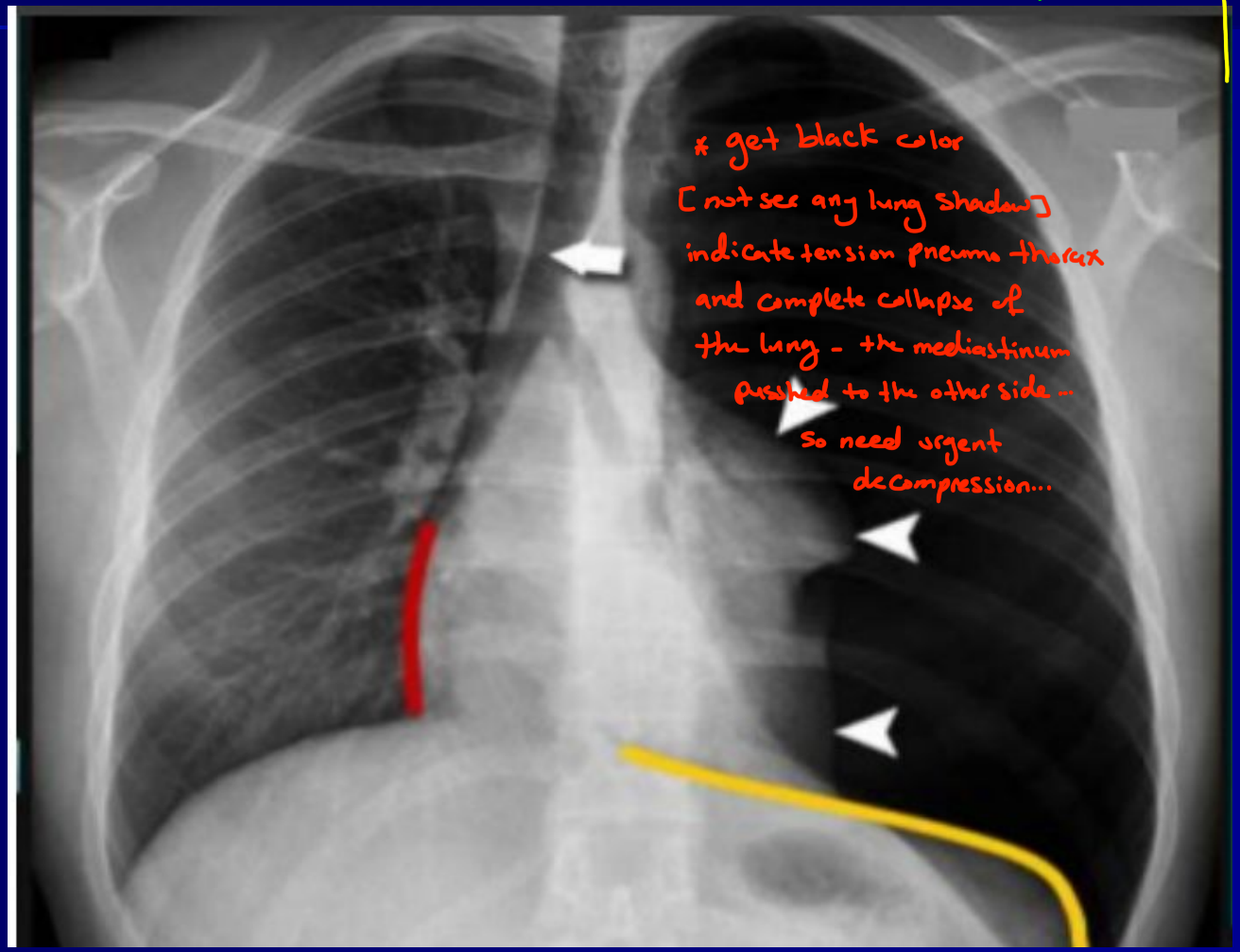
→ these 3 we can prevent the death

* The massive hemothorax need: thoracotomy [chest exploration] → بتشق عن طريق الـ intercostal A. لازم تكون
  - ↳ in chest tube → >200mL/hr within 3-4hr...
    - ↳ 1.5L immediatly...
  - Ant:- → 1-6 From internal mamary A.
    - ↳ then from sup. epigastric...
  - Post: from descending thoracic Aorta

[The internal mamary A. come from 1st part of subclavian A.]
↳ thyrocervical A.- vertebral A. :هي اللي
Center in transverse process of C6...
[But V.A enter from transverse process of C7]..

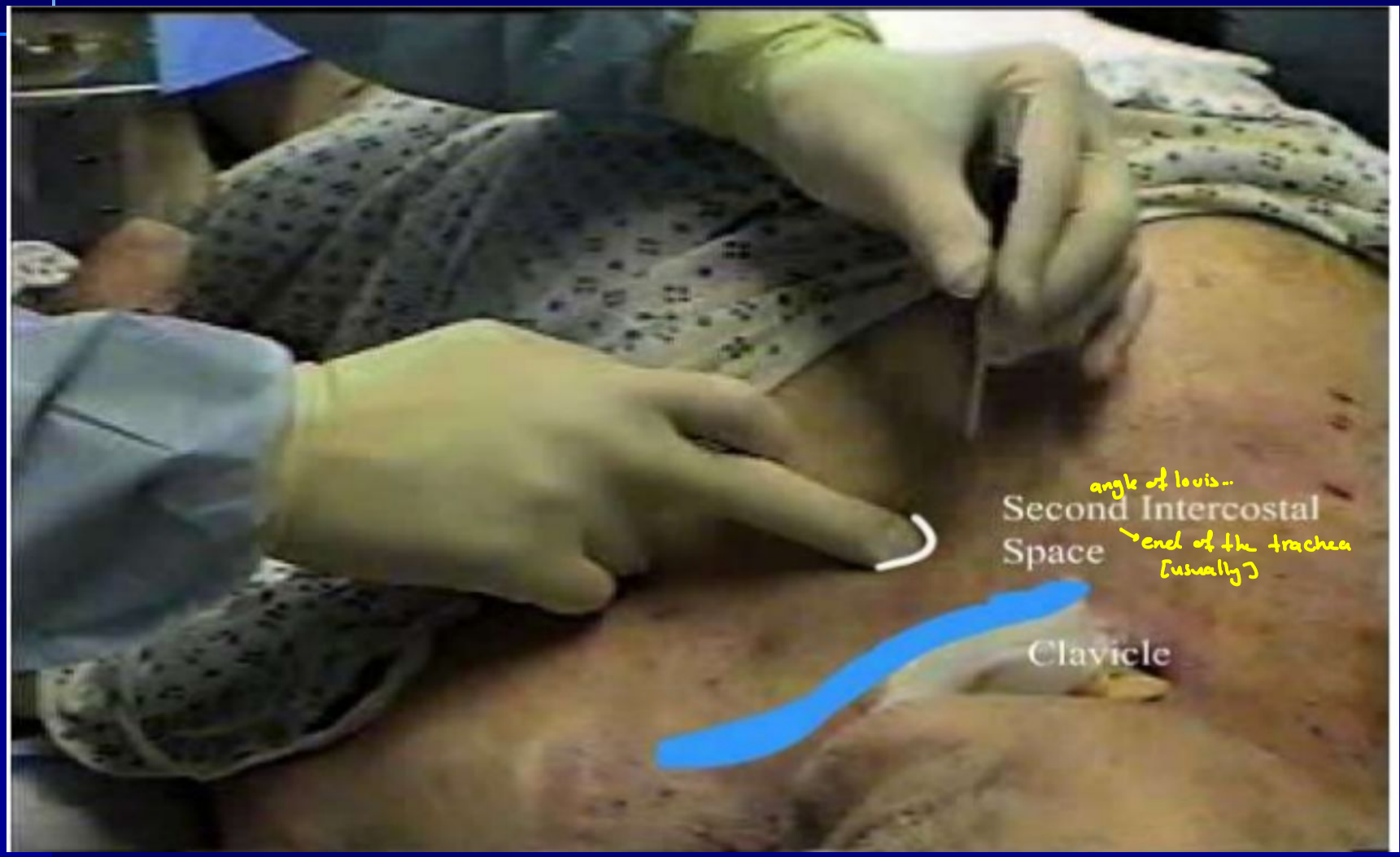
Tension Pneumothorax

Tension pneumothorax	massive hemothorax
- the mediastinum pushed to the other side. [4/5] - Trachea push to the other side - Tympanic sound in percussion	- Trachea in same position - dull sound 1.5 L Blood ~ 6) - absent breath sound.



Needle Decompression

↳ in tension pneumothorax we enter at 2nd rib [mid clavicular line] or 4th-5th rib at ant. axillary line in adult pt...
↓
espically in children



Open Pneumothorax

- ***Sucking Chest Wound***

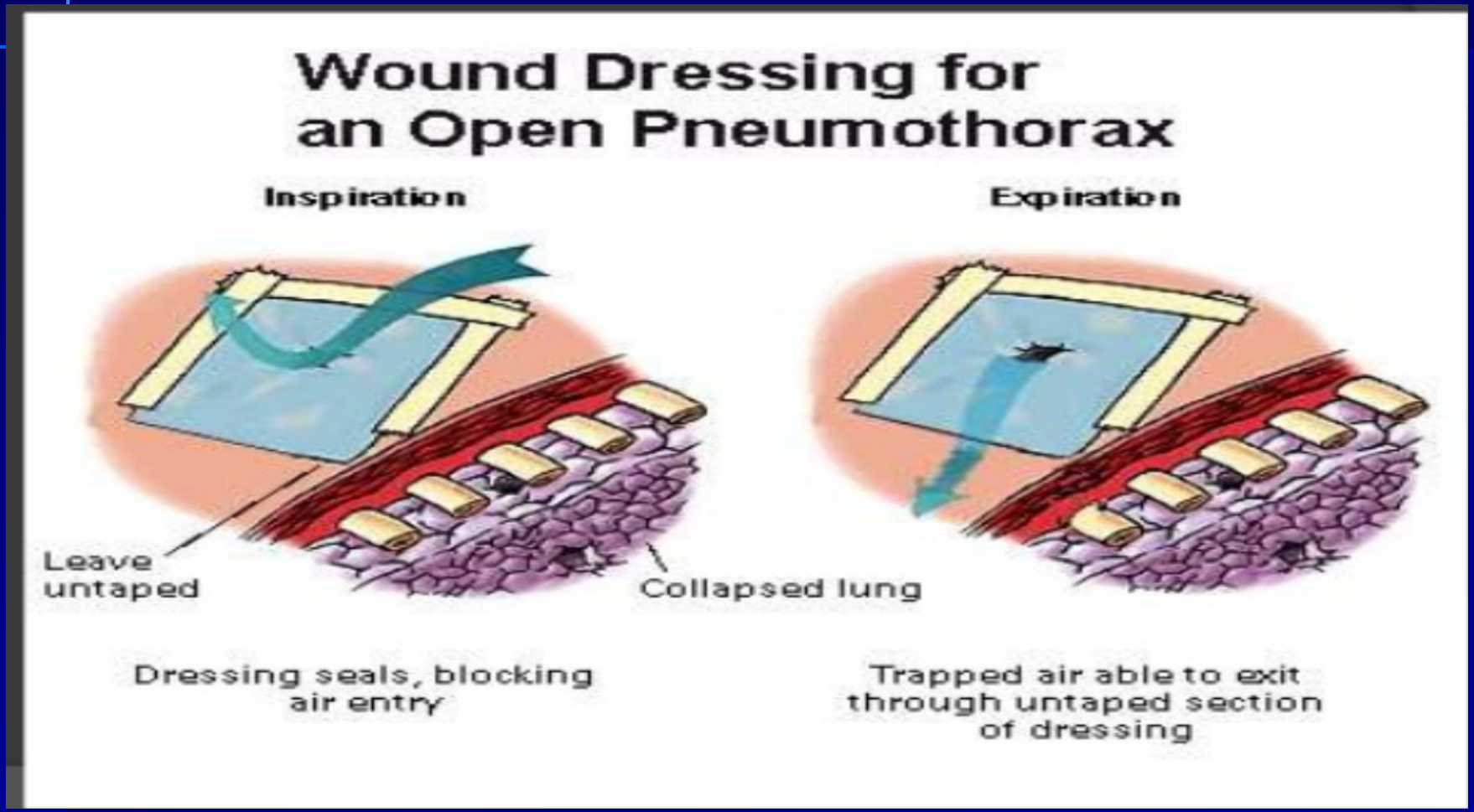
- **Respiratory distress.** [severe] + air hunger
- **Preferential path of air when wound diameter > 2/3 diameter of trachea.** الخروج بالصدر
- **Cover Three sides .** (مثل الجبس)
  - and leave side open :- لأنه لما يطلع exp. هواء كتير فيزيد الضغط ما يطلع insp. فيكتر هواء فيزيد الضغط
  - to prevent the tension pneumothorax..
  - by vaseline gauze.
- **Emergency ICT insertion .**

* The pleural pressure [-ve] = -3 to -6 mm Hg if there is air open in the pleural cavity become atmospheric pressure..

Some should close the opening..

Chest tube
- for Blood: بنختار الكبيرة [حتى ما يصير clotting]
- for air: بنختار الصغيرة

Occlusive Dressing



Signs Indicative of Chest Injury

- **Shock** — with penetrating injury it's due to vascular injury inside the chest...
- **Cyanosis** — Bluish discloration of skin and mucus membrane
- **Hemoptysis** — with frothy sputum — when there is rib fracture + penterating injury...
- **Chest wall contusion** — The seat belt injury lead to thoracoabdominal injury
  - lead to
    - in abdomen:- injury of SI - muscle spray if there is L1 fracture...
    - in chest: shoulder dislocation...
- **Flail chest**
- **Chest wounds** [sucking]
- **Jugular vein distension** — indicate
  - tension pneumothorax...
  - cardiac tymponad...
- **Tracheal deviation** — in tension pneumothorax...

* The tension pnumothorax pt has not neck vein [JVJ] destention if the pt has hemorrhage — lead to collapsed vessels [flat]

Assessment of chest wall

- Contusions.
- Tenderness.
- Asymmetry.
- Open wounds or Impaled objects.
- Crepitus
- Paradoxical movement.



Assess Respiration

- ***Respiratory Rate and Effort***
  - **Tachypnea**
  - **Bradypnea**
  - **Labored**
  - **Retraction** of intercostal muscle [in children < pneumonia, Bronchiolitis] ...
  - **Progressive respiratory distress**

So we should do serial repeated clinical examination in → abdomen...
→ chest...

→ extended FAST for heart...
→ to see if there is sternal fracture, hemothorax, Cardiac tamponad, pneumothorax...

Assessment of chest wall

1. *Breath sounds*

- **Absent or decreased.** indicate:- pneumothorax or hemothorax..
- **Unilateral or bilateral.**
- **Location.**
- **Bowel sounds in the chest.** indicate:- rupture diaphragm (more in lt.)

لازم يتعمل repair... Rt side diaphragm rupture في ~5% لانه لما Rt side في bowel بيطلع هنا Rt لان الجهة اللي liver فيها

* The lt side diaphragm rupture → SI, sigmoid C, part of stomach اللي بيطلع هنا
  ↳ form bowel sound in the chest..

Assessment of chest wall

- **Breath sounds percussion**
  - ***Hyper resonance***
- **Pneumothorax .**
- **Tension pneumothorax.**
  - ***Hypo resonance*** [Dull Sound]
- **Hemothorax.**

Assessment of Chest Wall

- **Compare both sides at the same time to look for *Asymmetry.***

* normal chest expantion:- 5cm



Rib fracture

- Most common chest wall injury from direct trauma.
- 40% of blunt chest trauma and 10% of polytrauma patient have two rib fracture.
- More common in adults , common in elderly.
- Most common 4th to 9th rib.
- Fracture 1st and 2nd rib high force.
- Injury rib 8th,9th 10th with (liver-spleen-kidney) injuries .

penterating

the main complian is the pain (usually last for weeks).. (at least 1 month)

L due to osteoporosis...

(under the scapula) in lt side may associated with spleen injury but in Rt may associated with liver injury...

(the pain more severe)

lead to hematuria

* if the rib fracture occur at the lateral side (especially at the angle..) → lead to severe pain
→ most common site of rib fracture at the angle of rib...

[stabalized by the muscles ... Ant fract ... vertebrae ... post ... So they more tolerated by pt than lateral rib fracture...]

* The Children ribs are spring like (عظام الأضلاع مرنة) [يتثنى بسهولة → كسر صعب]
(if it fractured:- very severe trauma يحتاج [serious injury])

* The lung Contusion may occur in children without rib fracture..

Signs of rib fracture

OSRF تحت ٣ * The splenic injury treated conservative [80%]
repeat CT after 5 days يعيد CT
- if he grade II → return to normal daily activity after 5-6 weeks...
- if he grade III → return to normal daily activity after 10 weeks
[to prevent the rupture or delayed healing]...

- Localized pain, tenderness .
- Pain worse with palpation.
- Pain worse with coughing, deep breathing .

unable to cough [need admission + multi modal pain control strategy]...
pain killer & opioids يخفف الألم مثل

- *Management*
- Analgesia is essential in treatment *(Multi Modal Pain Control Strategy).*

كلهم يعطى
1. NSAIDs...
2. gamma pentine...
3. para cetamole...
4. opioids...

- High concentration of O2.
- Positive pressure ventilation.
  - to expand the lung.
- Deep Breathing Analgesia.
- Non-circumferential splinting.
  - حتى تخرج هواء للتنفس براحة
  - to release the pain
- SSRF.
  - not applicable for all pt...
  - surgical stabilization of rib fracture → بتقلل مدة الرجوع

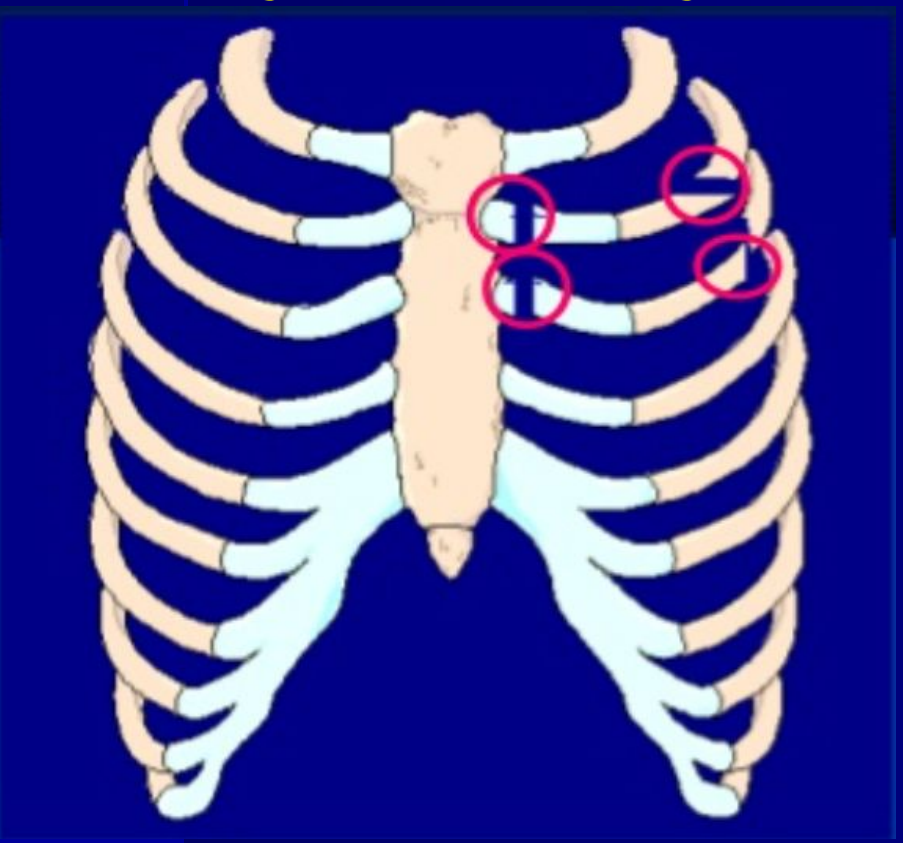
Flail Chest

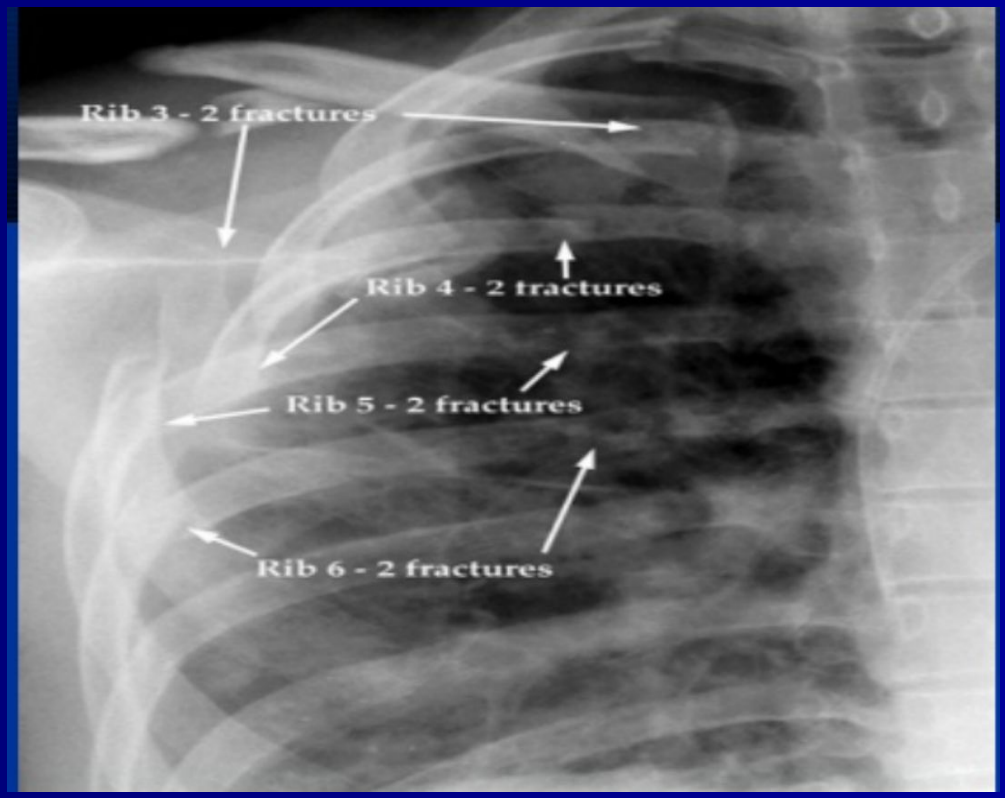
* The flial chest types → Anatomical → fractured rib without Paradoxical movment
  → Clinical [≥ fractured segment ل
  ... [insp. بتخلي الـ

↳ paradoxical movment with respiration...

- Two or more adjacent ribs fractured in two or more places.
- ***A segment of the Chest Wall does not have Bony Continuity with the Rest of the Thoracic***

[chest wall]





S/S of flail chest

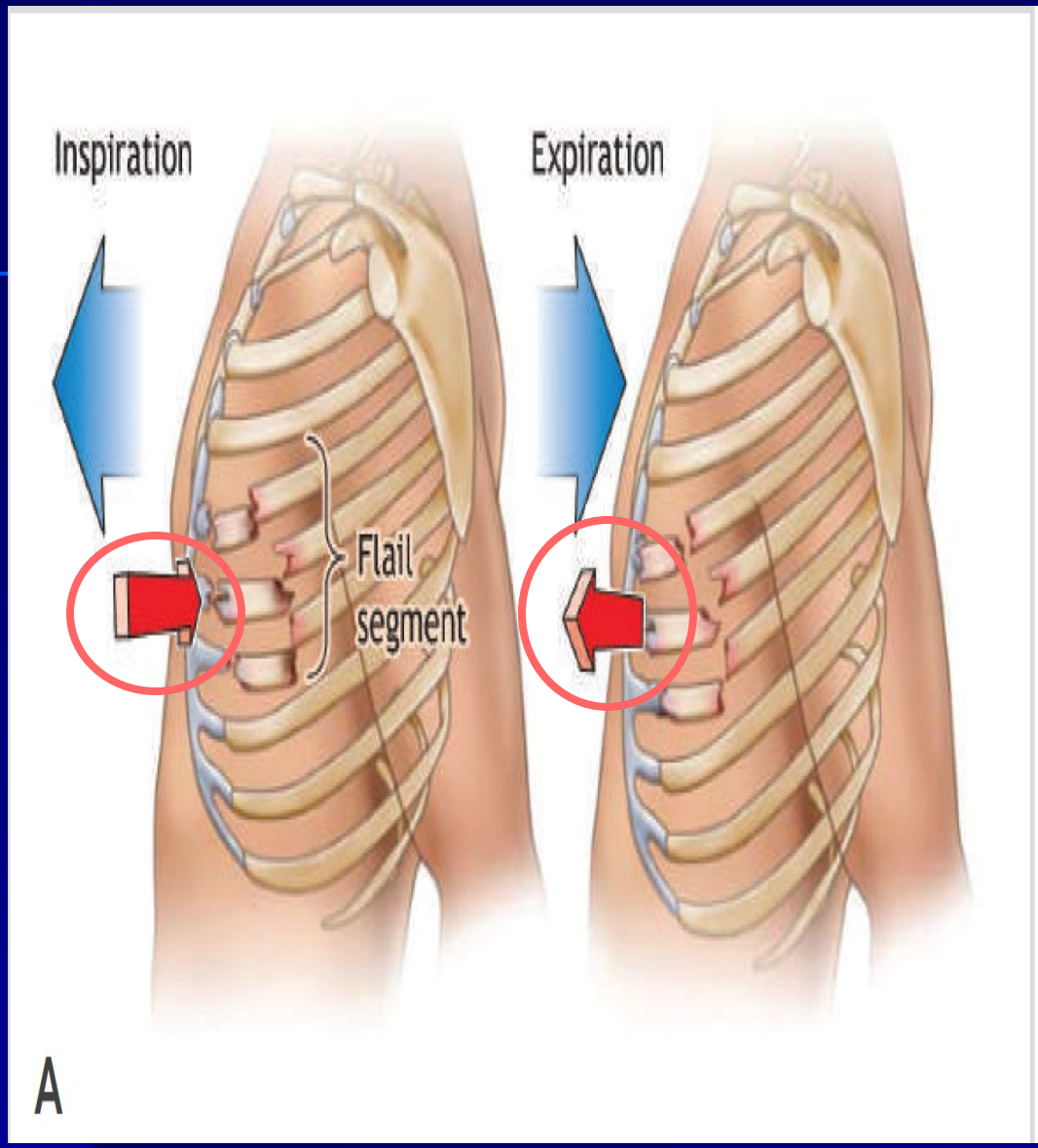
- Shortness of breath.
- Paradoxical movement with respiration.
- Bruising , swelling.
- Crepitus.
- May not be obvious soon after injury.
- *80% needs ICU admissions, 50% need ETI.*

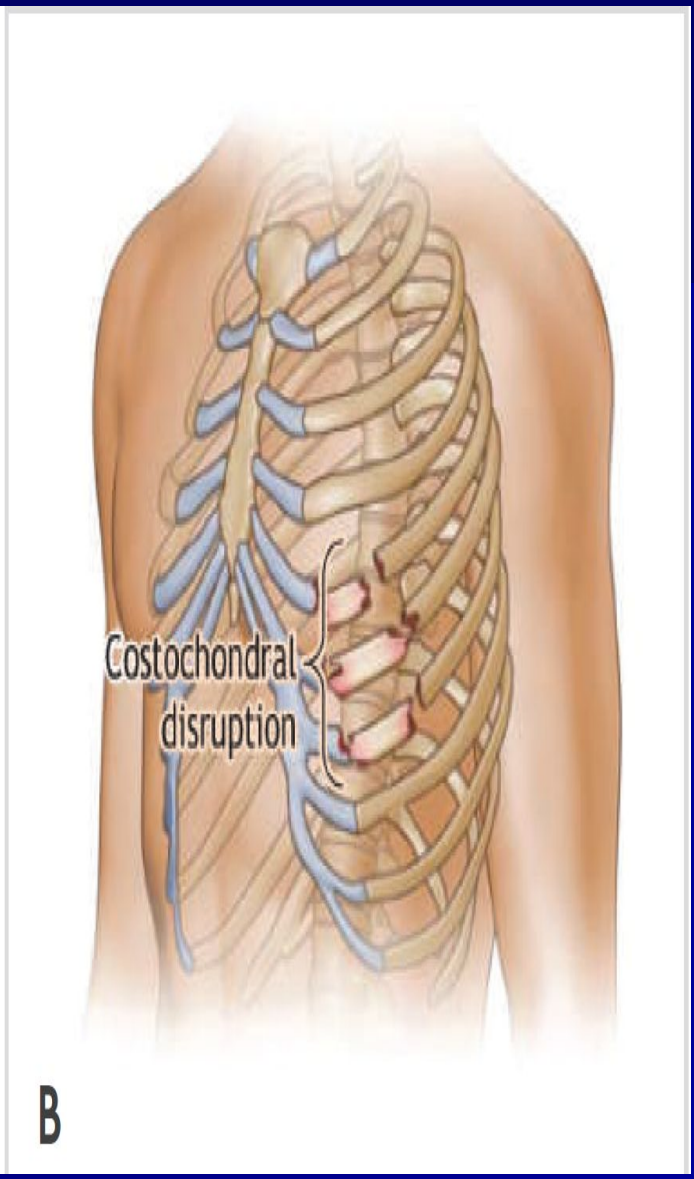
clinical

we don't elicit it... [Bleeding يا سيدي جاي بيطلع بالـ]

endotracheal intubation

* 16% mortality rate in flial chest cases..


Inspiration
Expiration
Flail segment
A


Costochondral disruption
B

Treatment of flail chest

- ABC's with C Spine control as indicated.
- High flow humidified O2.
- Monitor patient for signs of pneumothorax or tension pneumothorax.
- Adequate analgesia.
- Adequate ventilation, and careful fluid resuscitation.
- Use gloved hand as splint till bulky dressing can be put on patient.

Bulky Dressing for splint of Flail Chest

Clip slide



- Use Trauma bandage and Triangular Bandages to splint ribs.

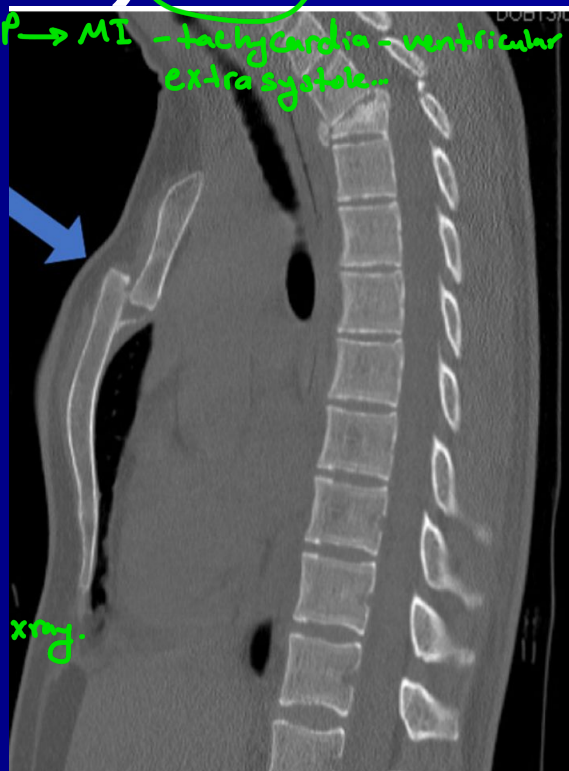
thoracic epidural anathesia ← ممكن نعمل ولكن غير محبذة
masking of abdominal symptoms + lead to Hypo tension... ← بتعمل في الـ flial chest لو

at upper border of rib below... ← intercostal nerve Block ← ممكن نعمل

بسبب:- rib fracture لو غير محبذة
the short duration [6-8hr] ← لأنها غير المدة

Sternal fracture

- Blunt trauma is leading cause (steering wheel injury)deceleration injury and blunt chest trauma 5% in MVC.
- 25% of sternal fractures are isolated.
- *Blunt Cardiac Injury* (cardiac contusion) 2%.
- Lateral chest x-ray is diagnostic.
- Seat belt injury increase its Incidence, but decrease severity.
- *Treatment :* is conservative most cases analgesia is essential.

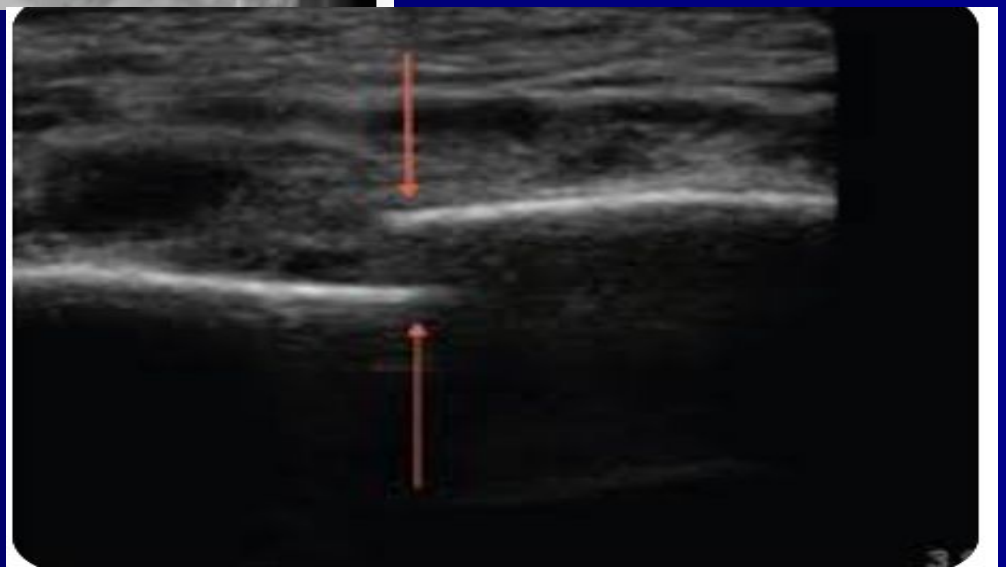


* The CT more sensitive than xray in rib fracture..

← لازم نشوف حديث ال ## في حد طريقة sternum displaced

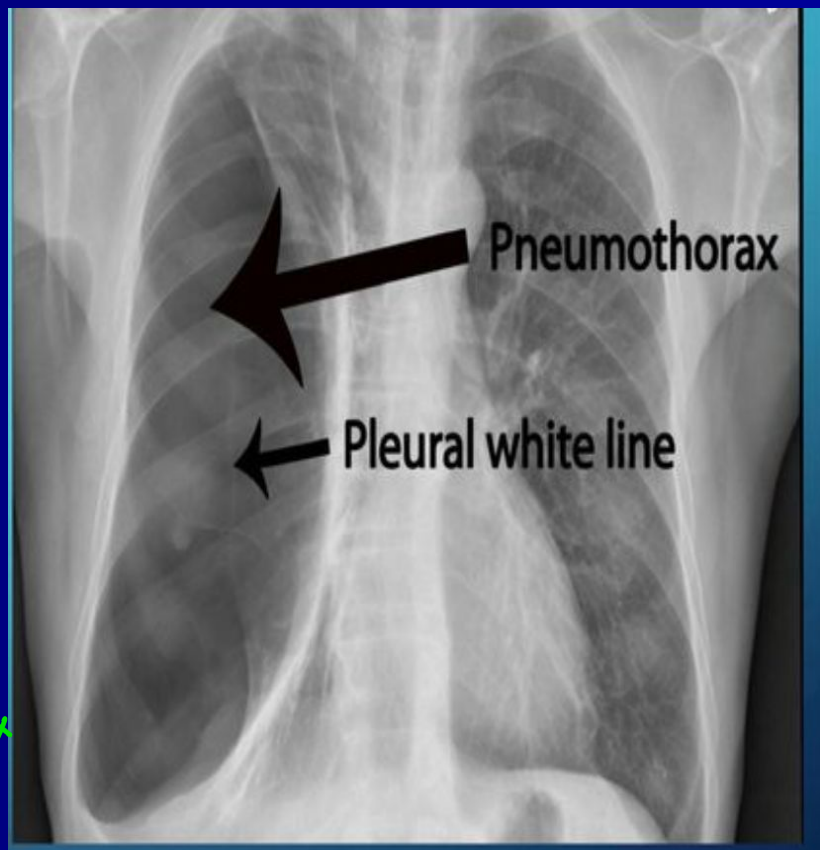




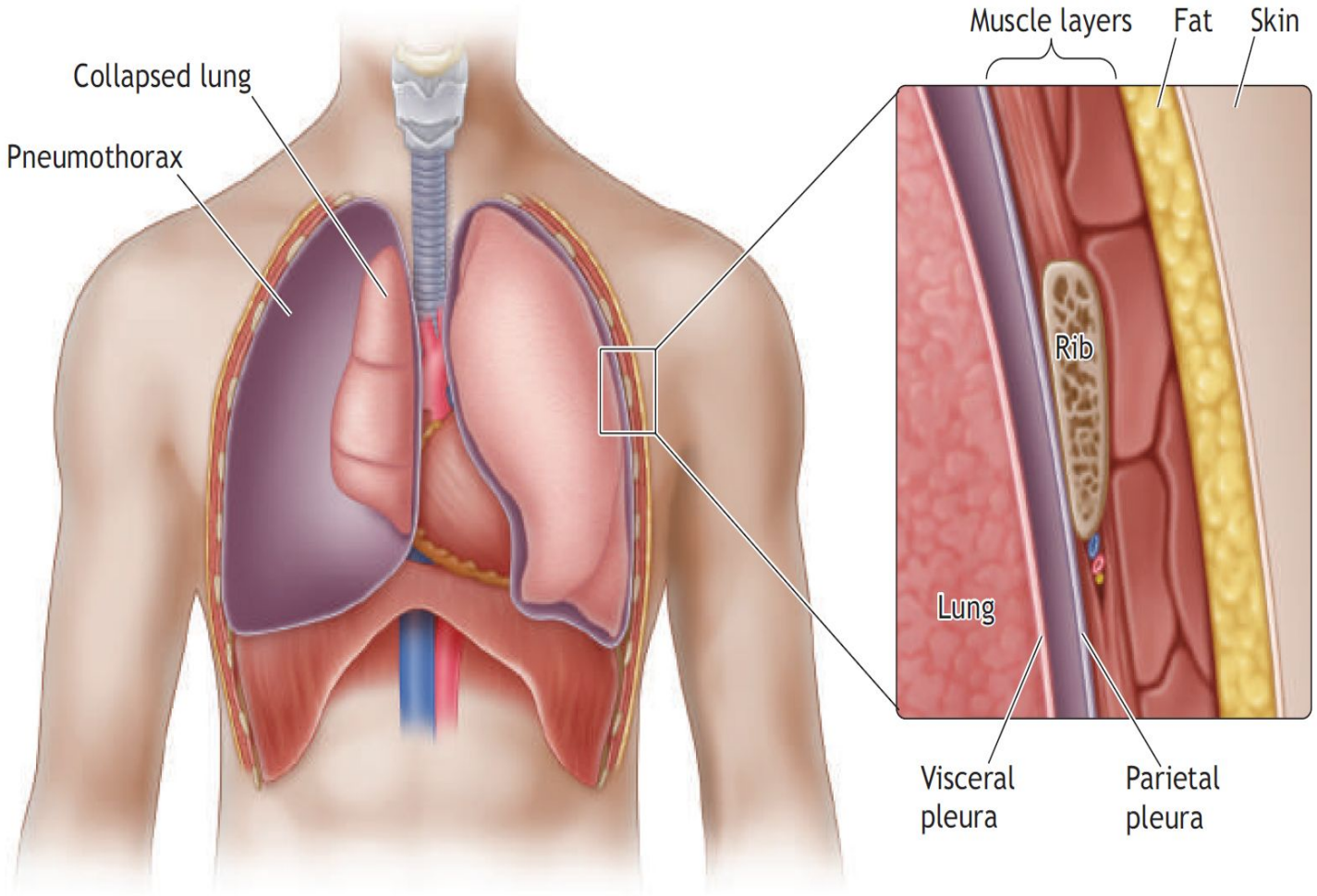


Simple pneumothorax

- ***Open in lung Tissue that leaks air in to Pleural Cavity.***
- **Blunt thoracic trauma is usual cause.**
- **May be spontaneous .**
- **Usually self correcting.**
- ***S/S:*** **Chest pain ,Dyspnea , Tachypnea, Decrease breath sounds in the affected side.**



* in hemothorax we put the chest tube below + large diameter..
* if there is hemopneumothorax we put 2 tube → sup. for air [2-3cm under water seal]
→ inf. for Blood...



Simple Pneumothorax. Pneumothorax results from air entering the potential space between the visceral and parietal pleura.

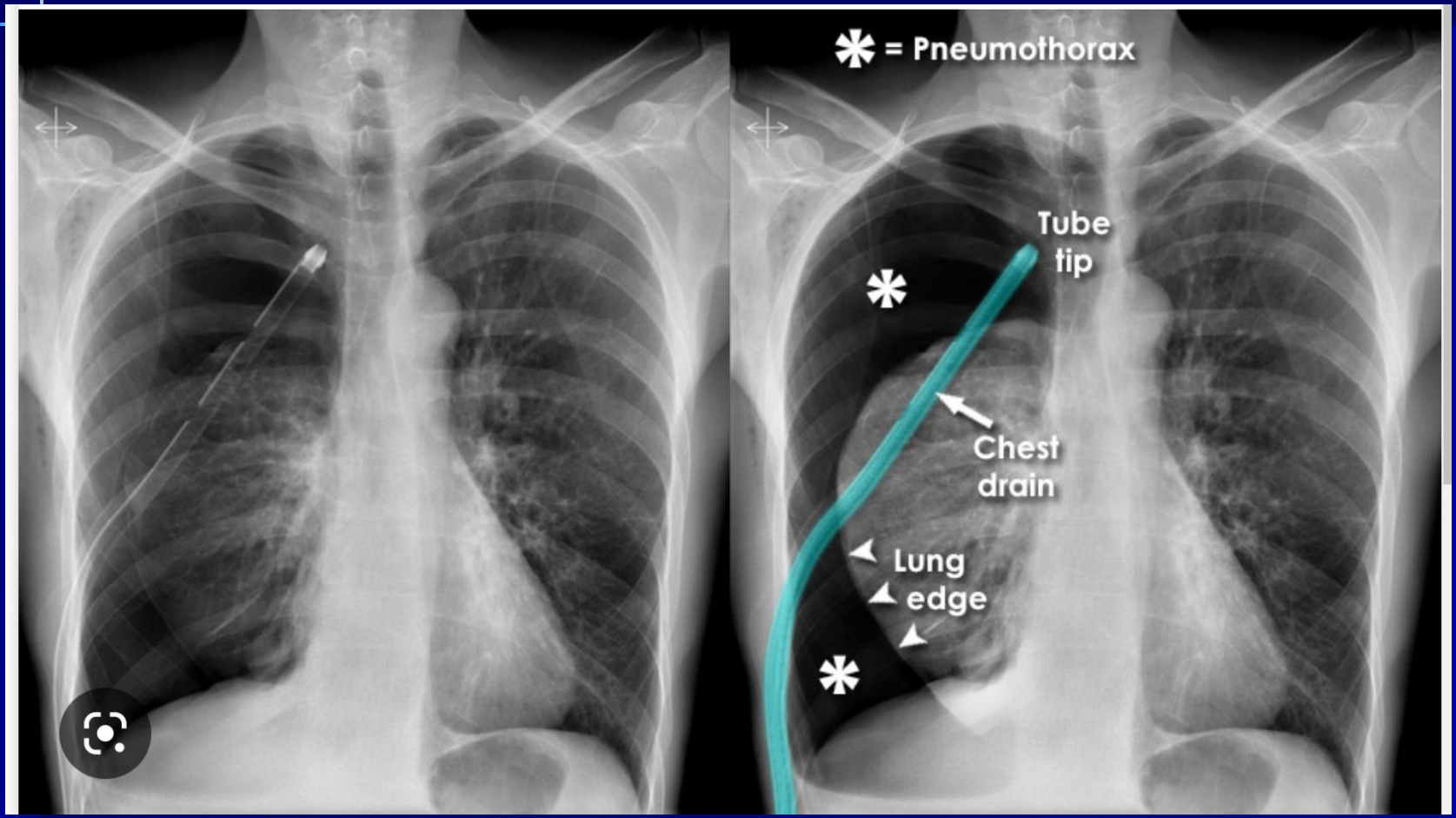
Treatment of simple(closed) pneumothorax

- Any pneumothorax is ***Best Treated with Chest Tube*** placed in the fifth intercostal space, just anterior to the midaxillary line .

- Observation and aspiration of a small, asymptomatic pneumothorax may be appropriate decision.

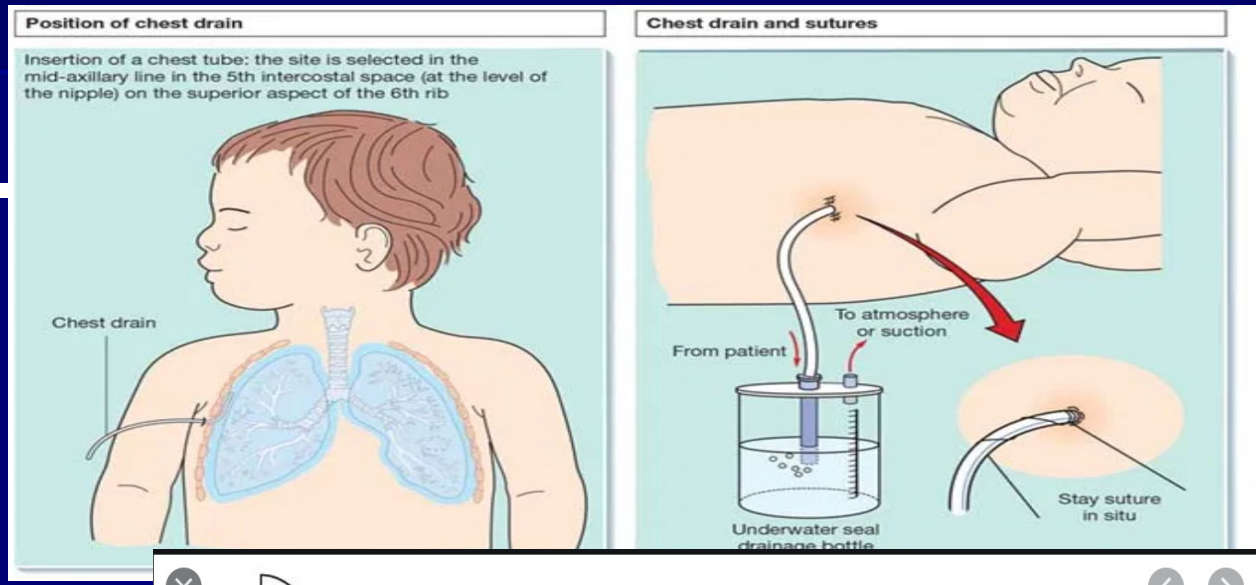
- After inserting a chest tube and connecting it to an underwater seal apparatus with or without suction, a ***chest x-ray examination is done to confirm appropriate placement and re-expansion of the lung.***

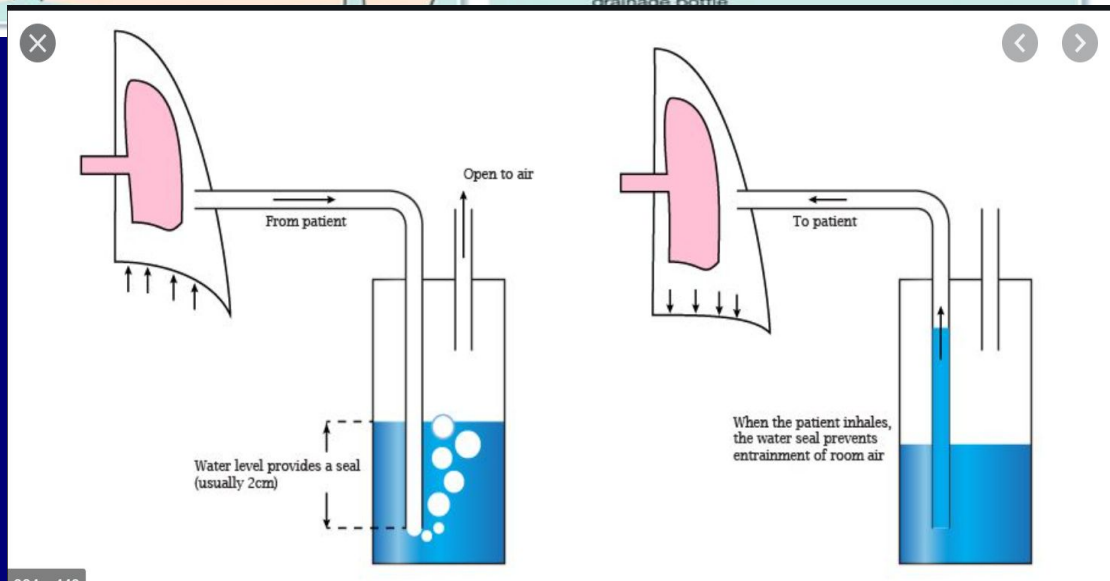
Chest tube insertion



Chest Tube Indication for Insertion

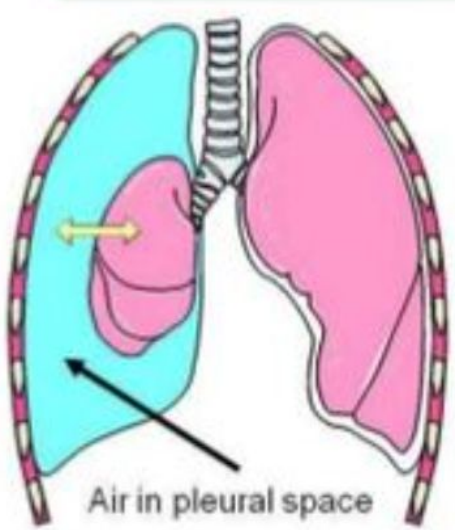
- Traumatic pneumothorax.
- Traumatic Hemothorax.
- Drainage of empyema.
- Post thoracotomy.

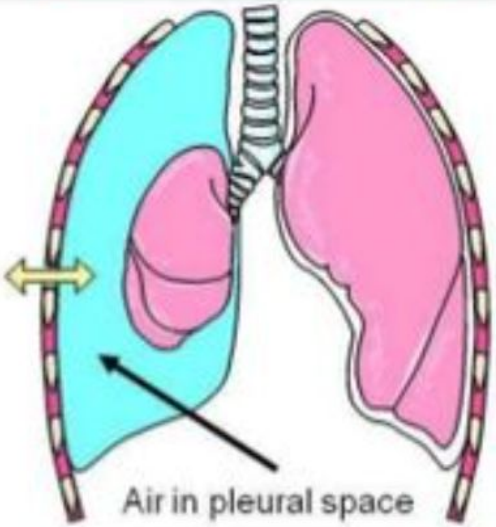


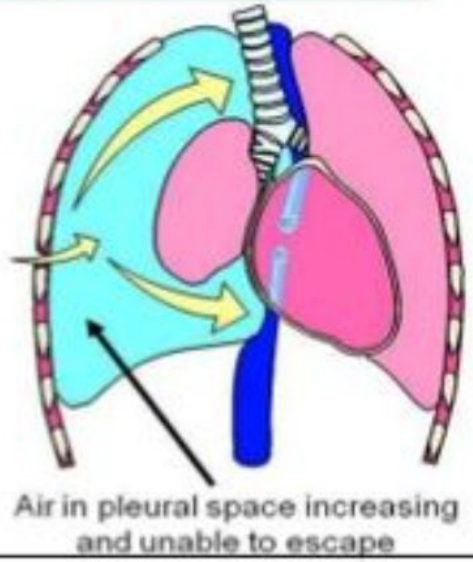


Pneumothorax

- **Closed** pneumothorax
- **Open** pneumothorax
- **Tension** pneumothorax



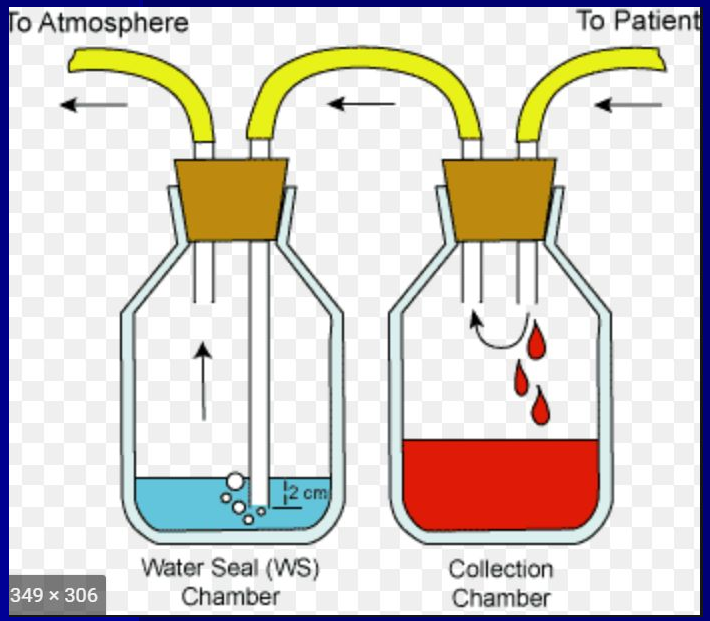


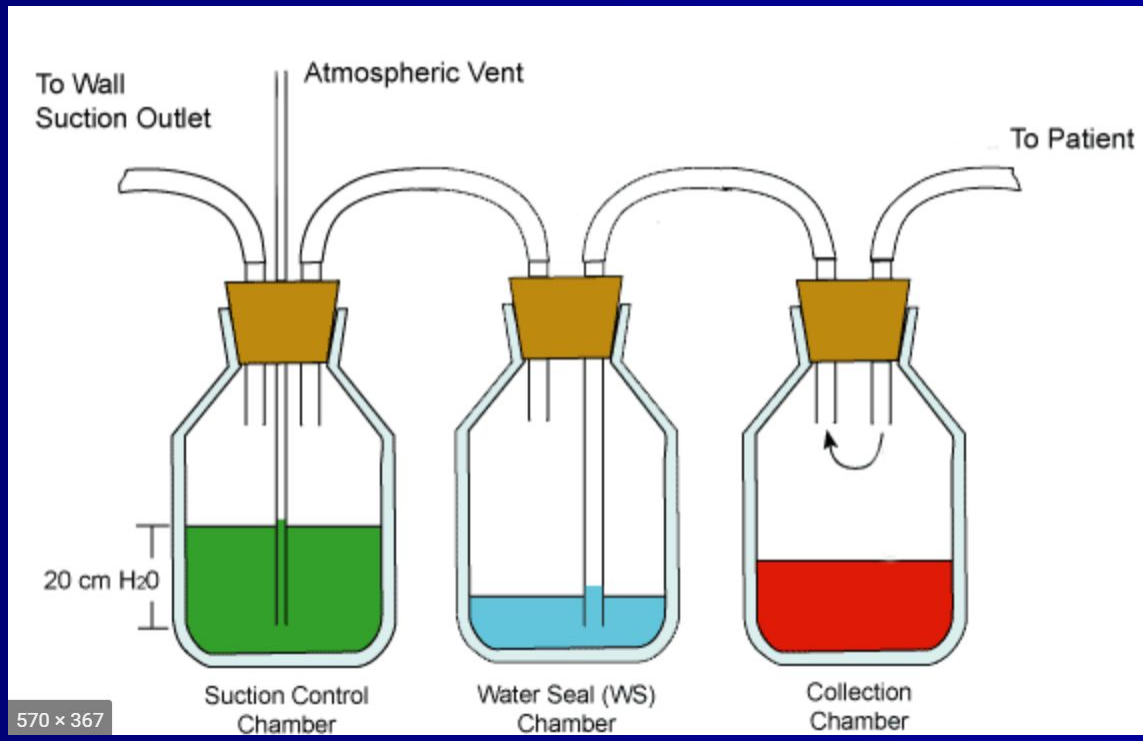


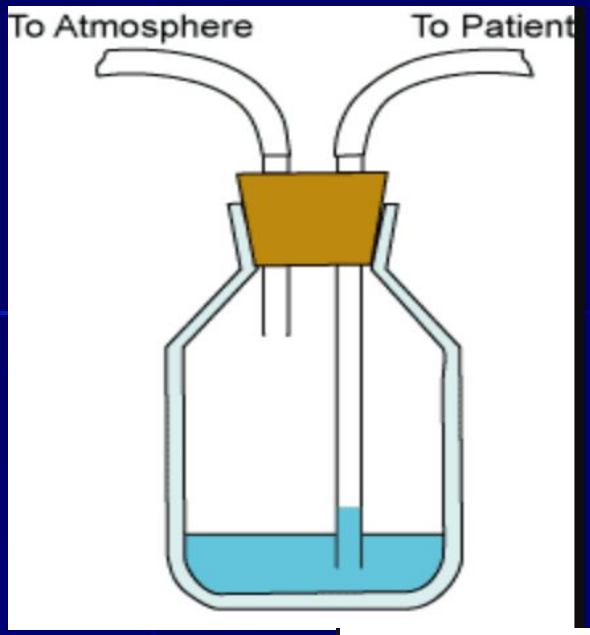
The pleural cavity pressure is < the atmospheric pressure	The pleural cavity pressure is = the atmospheric pressure	The pleural cavity pressure is > the atmospheric pressure

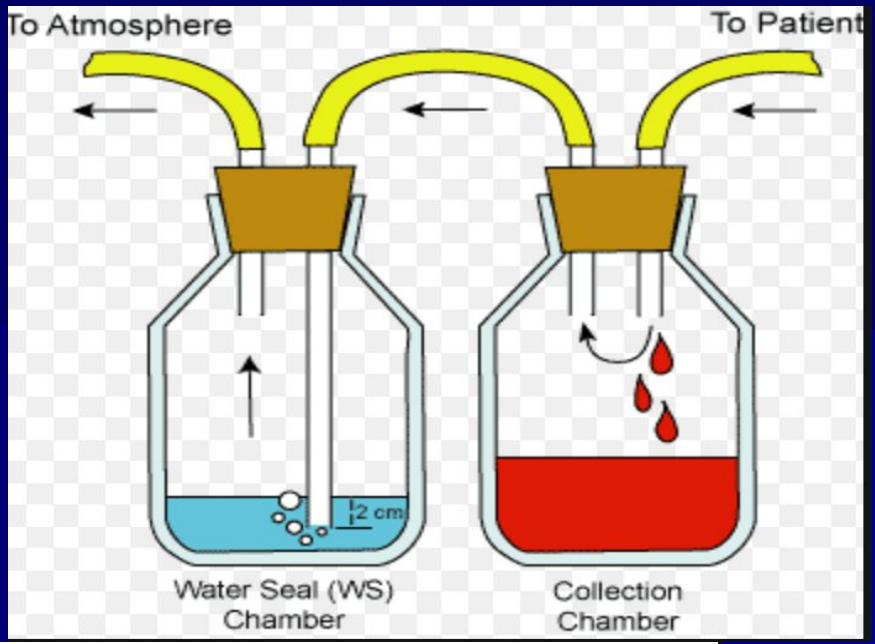
Complication of CHEST Insertion

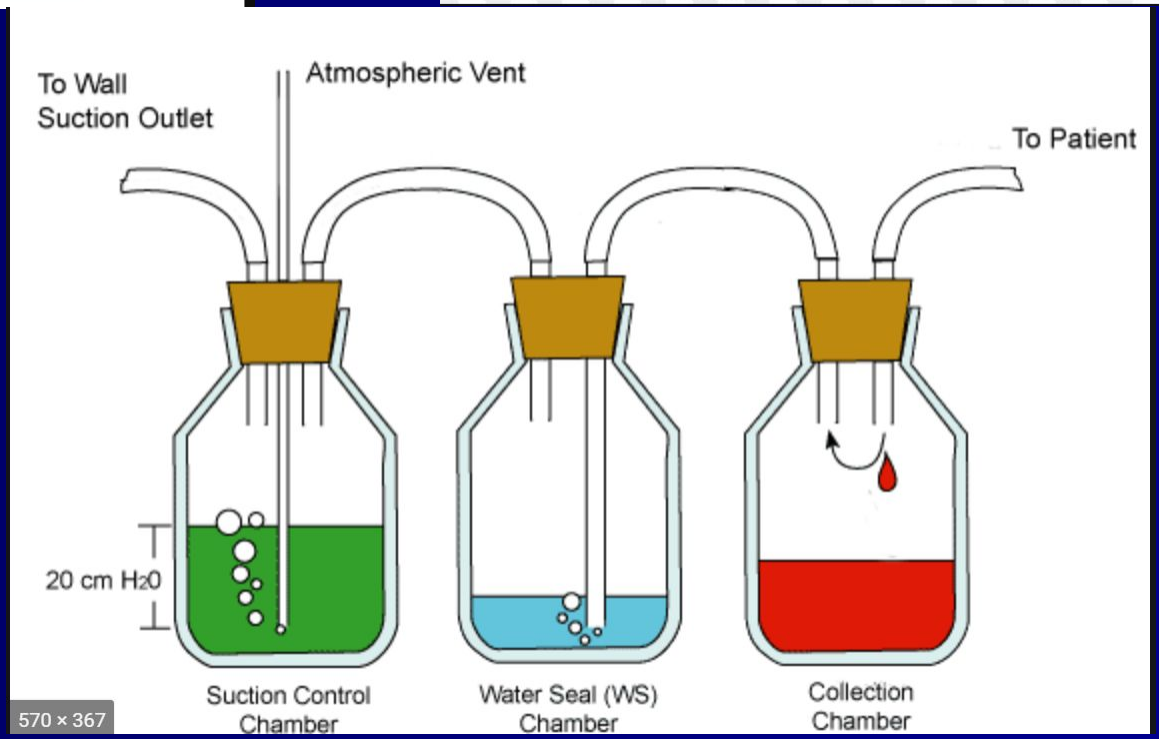
- Hemorrhage.
- Damage of Intercostal Vessels and Nerves.
- Lung and Mediastinal injury
- Infection

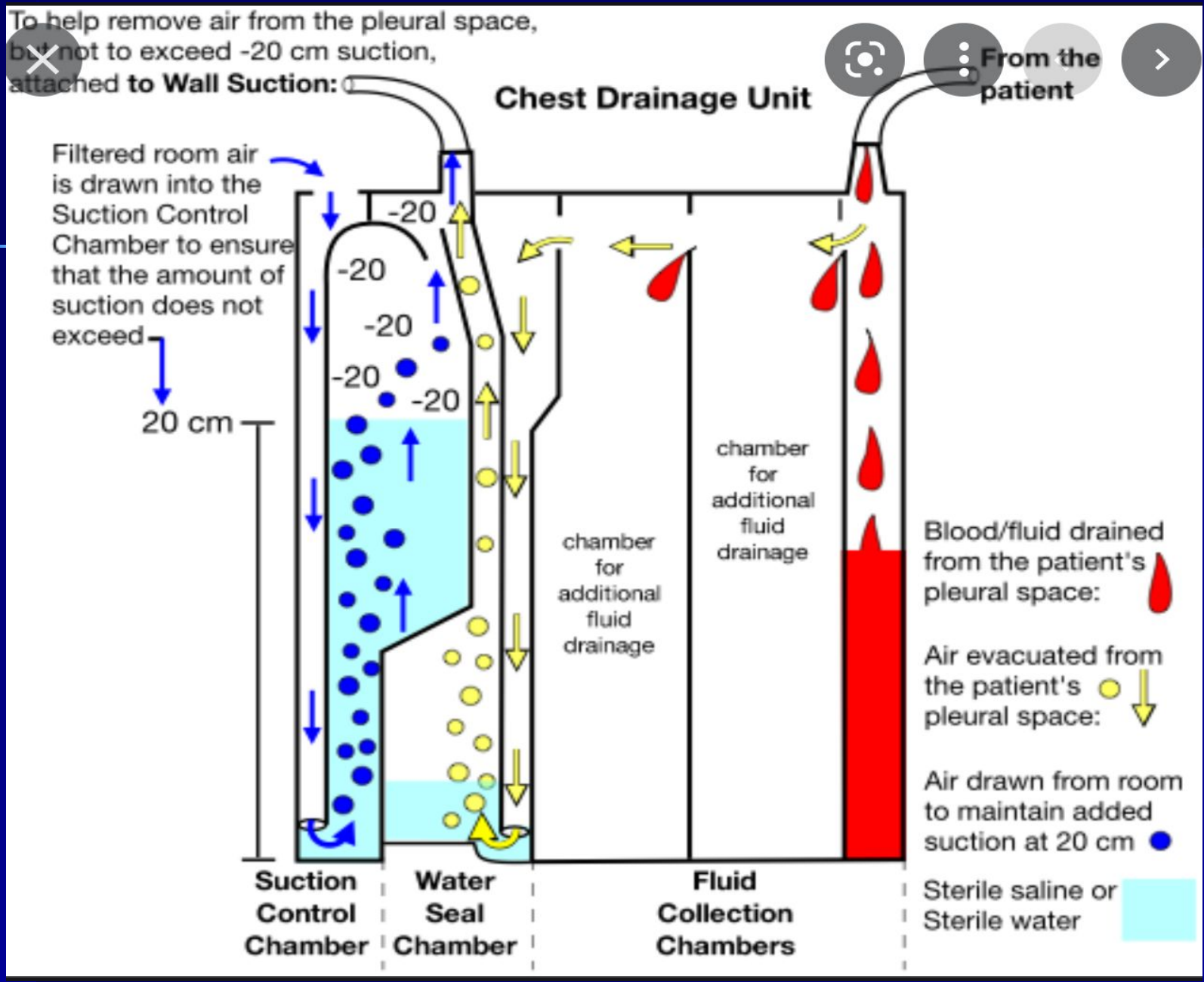


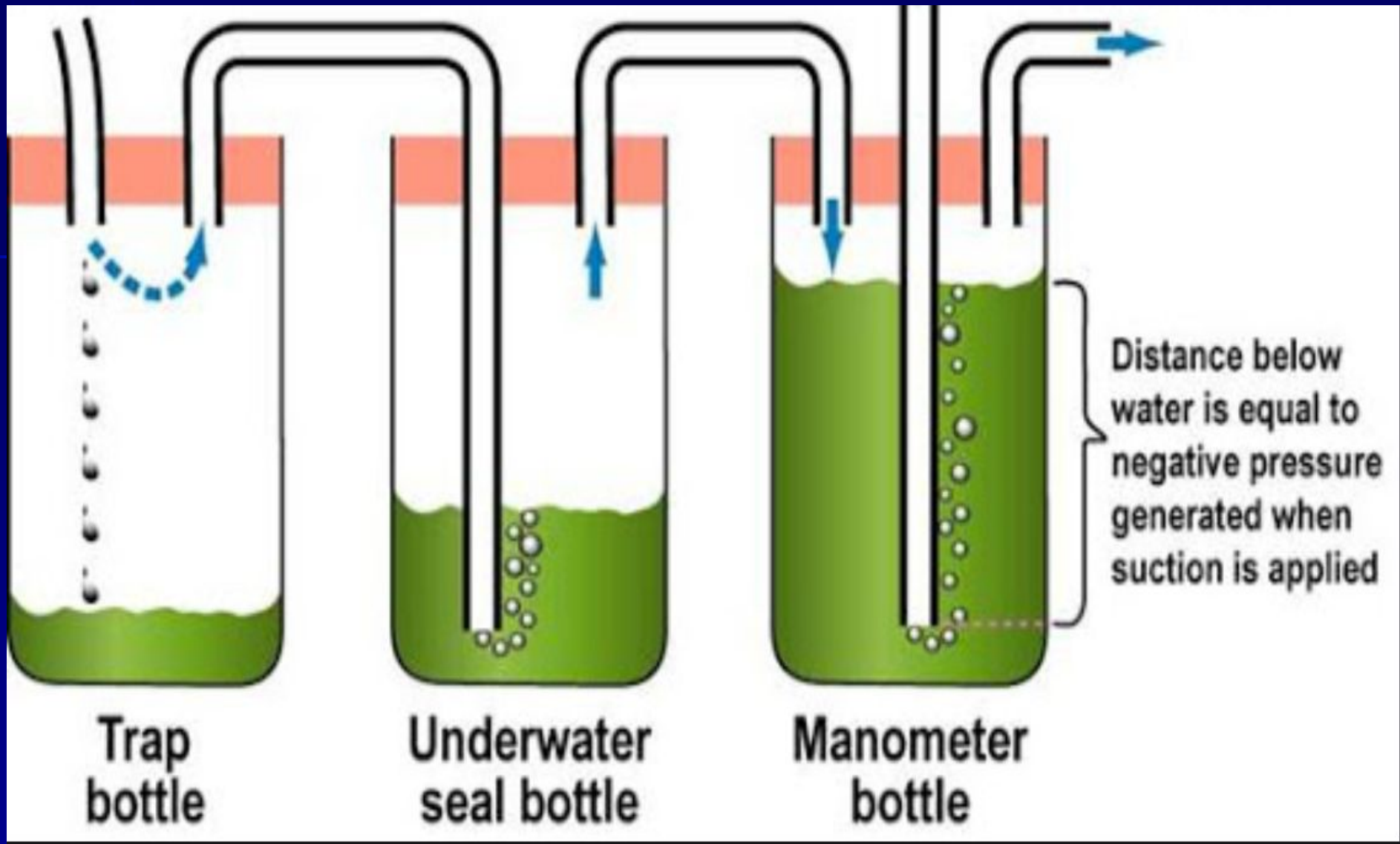



To Atmosphere
To Patient


To Atmosphere
To Patient
2 cm
Water Seal (WS) Chamber
Collection Chamber


To Wall Suction Outlet
Atmospheric Vent
To Patient
20 cm H20
Suction Control Chamber
Water Seal (WS) Chamber
Collection Chamber
570 × 367


To help remove air from the pleural space, but not to exceed -20 cm suction, attached to Wall Suction:
Chest Drainage Unit
From the patient
Filtered room air is drawn into the Suction Control Chamber to ensure that the amount of suction does not exceed
20 cm
-20
-20
-20
-20
-20
chamber for additional fluid drainage
chamber for additional fluid drainage
Blood/fluid drained from the patient's pleural space:
Air evacuated from the patient's pleural space:
Air drawn from room to maintain added suction at 20 cm
Sterile saline or Sterile water
Suction Control Chamber
Water Seal Chamber
Fluid Collection Chambers

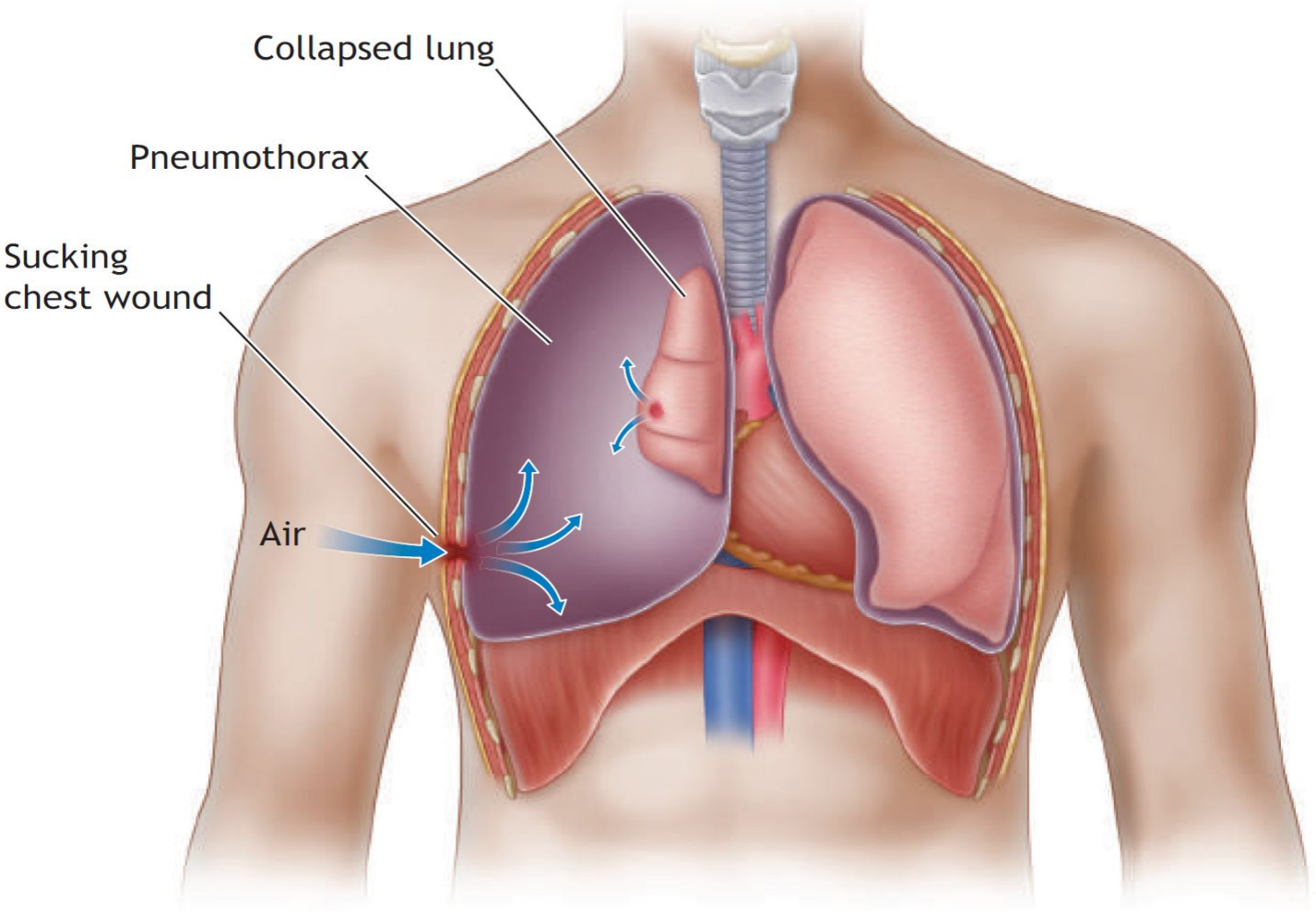

Distance below water is equal to negative pressure generated when suction is applied
Trap bottle
Underwater seal bottle
Manometer bottle

Open Pneumothorax

(↳ lung expantion حتى تتحط chest tube بنفس الجهة من الصدر بعد ما تحطي vassline gauze بجيب ايده بالفتحة لتسكرها لحد ما يجيب)

- Opening in the chest wall that allow air into pleural cavity.
- Causes lung to collapse due to increase pressure in pleural cavity.
- Equilibration between ITP and Atmospheric pressure is Immediate.

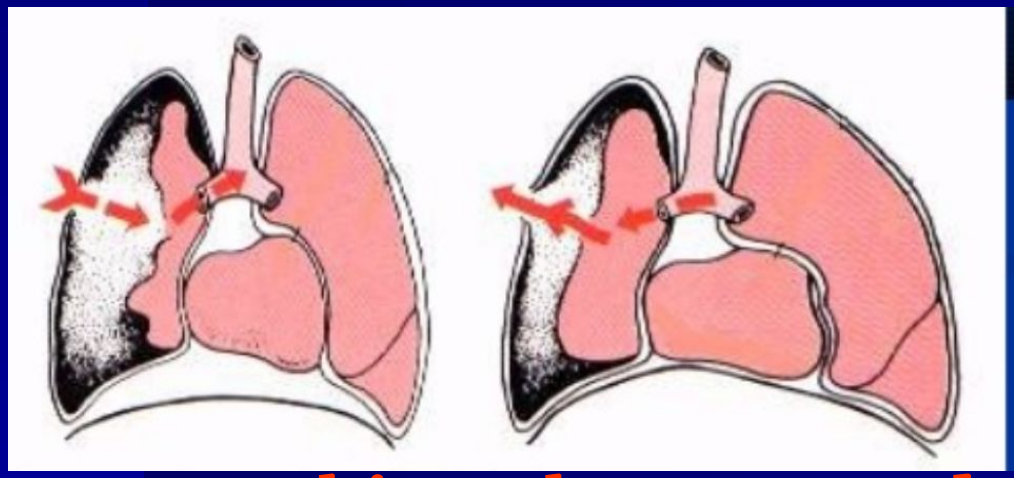



Collapsed lung
Pneumothorax
Sucking
chest wound
Air

S/S of Open Pneumothorax

- **Dyspnea Hypoxia and Hypercarbia.**
- **Sudden sharp chest pain.**
- **Decrease breath sounds on affected side.**
- **Red bubbles in expiration from wound.**
- ***Surgical Emphysema (Subcutaneous Emphysema).***

Accumulation of air in SC fat from pressure of air in pleural cavity from *Neck to Groin.*



Sucking chest wound



Surgical Sub cutaneous emphysema





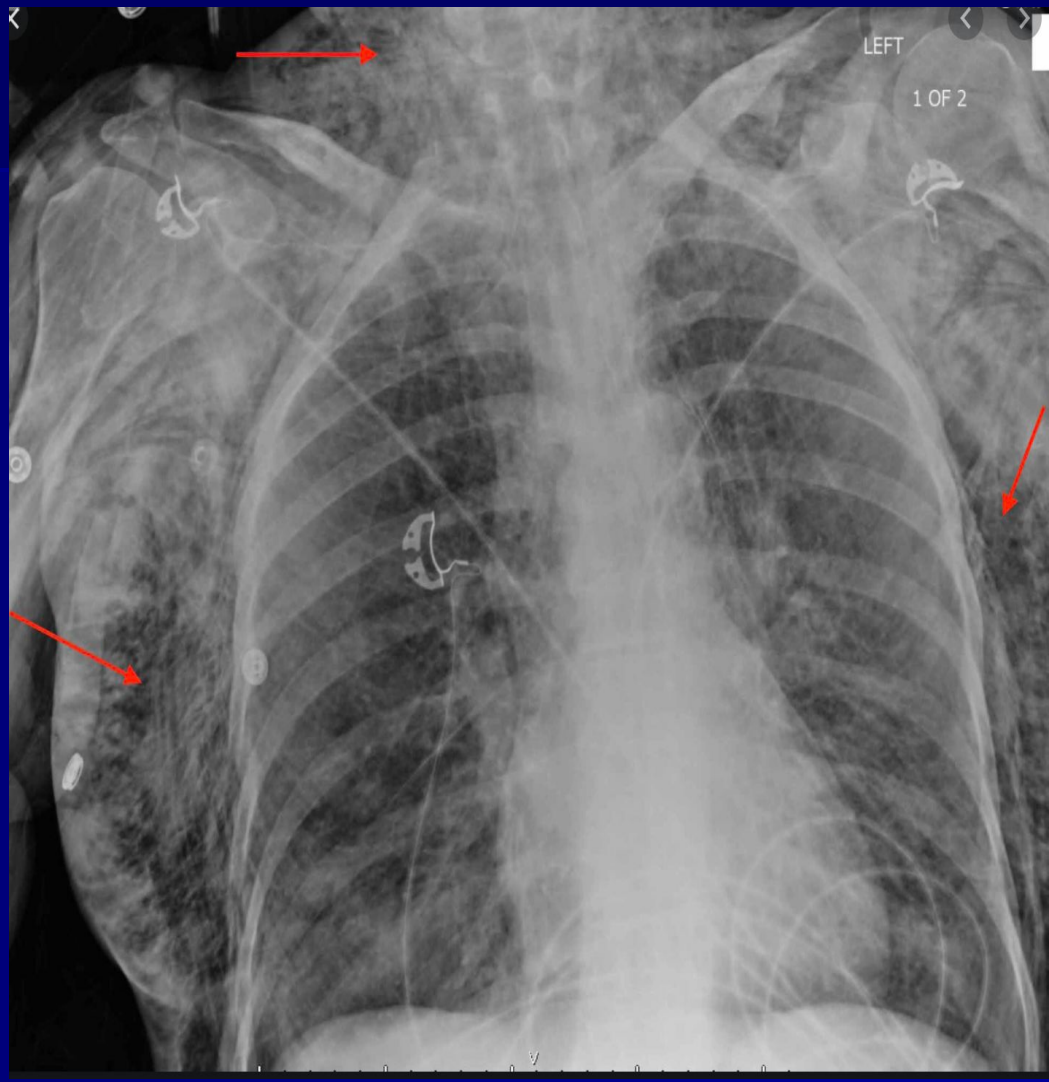




FIGURE 4-4 Dressing for Treatment of Open Pneumothorax. Promptly close the defect with a sterile occlusive dressing that is large enough to overlap the wound's edges. Tape it securely on three sides to provide a flutter-valve effect.

Management of OP

- Ensure patent air way .
- Close the chest wall defect with occlusive dressing with petrolatum gauze.
- Place patient in sitting position.
- Monitor respiration.

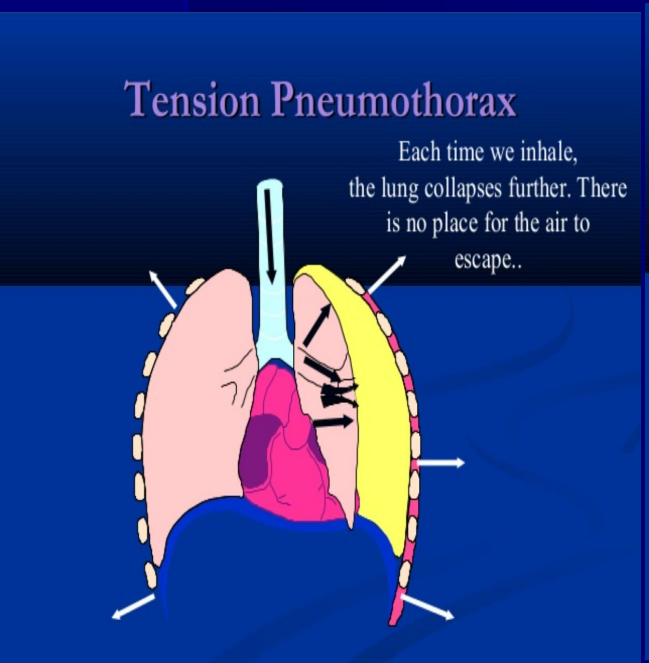


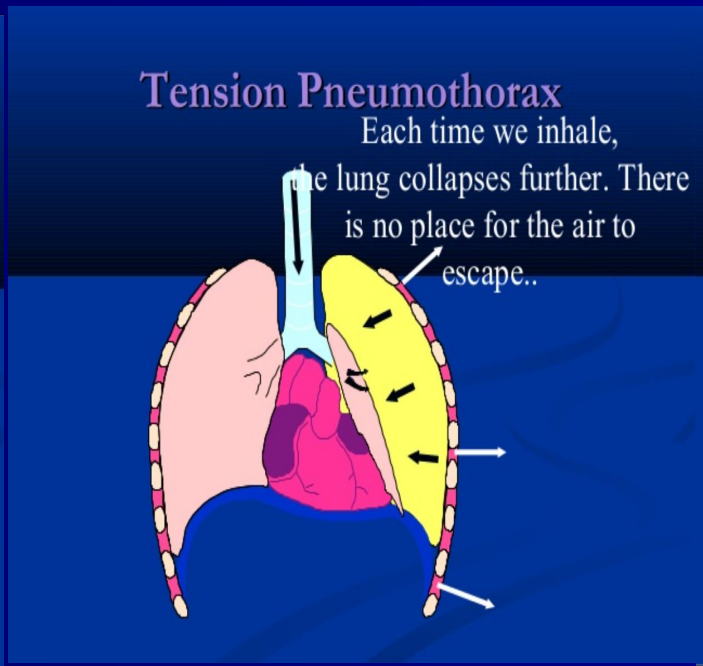
"Asherman Chest Seal®"

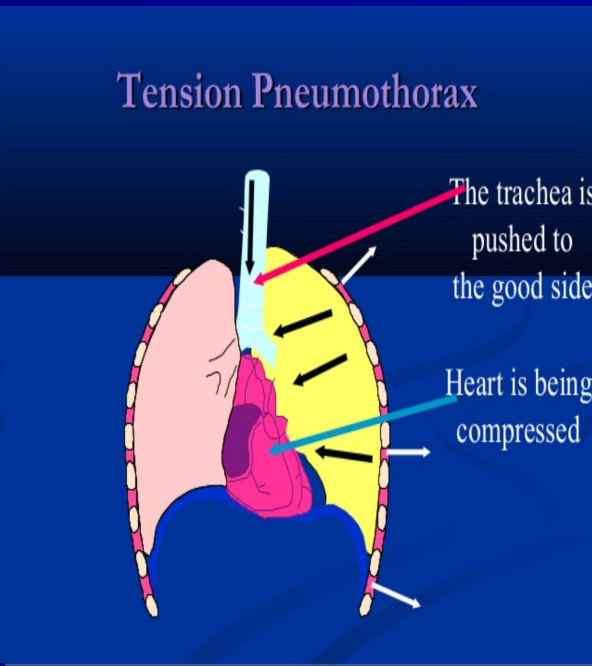


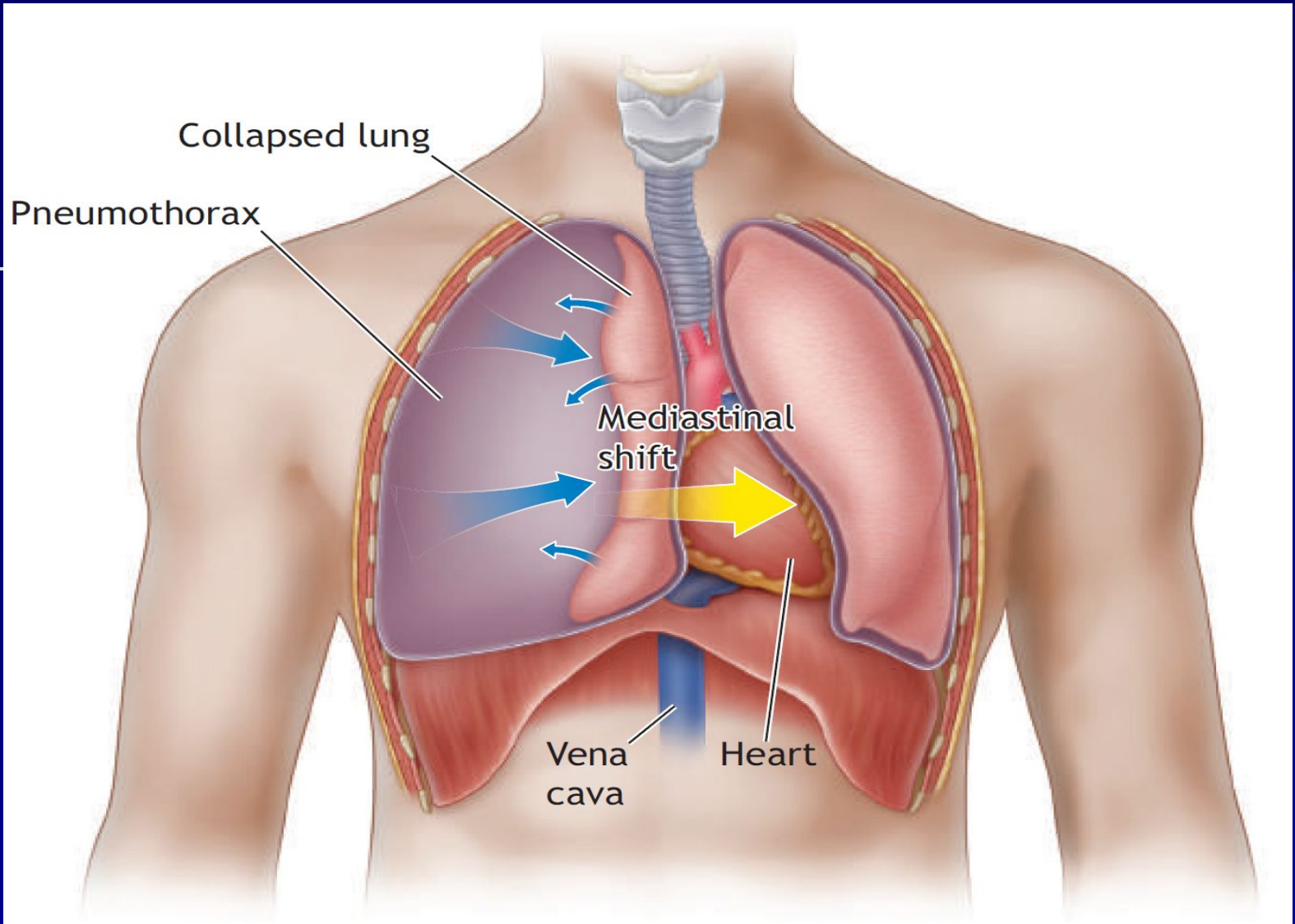
Tension pneumothorax

- **Air build in pleural space with nowhere for air to escape.**
- **Result on collapse of lung in the affected side which cause pressure on the other lung mediastinum, and great vessels.**







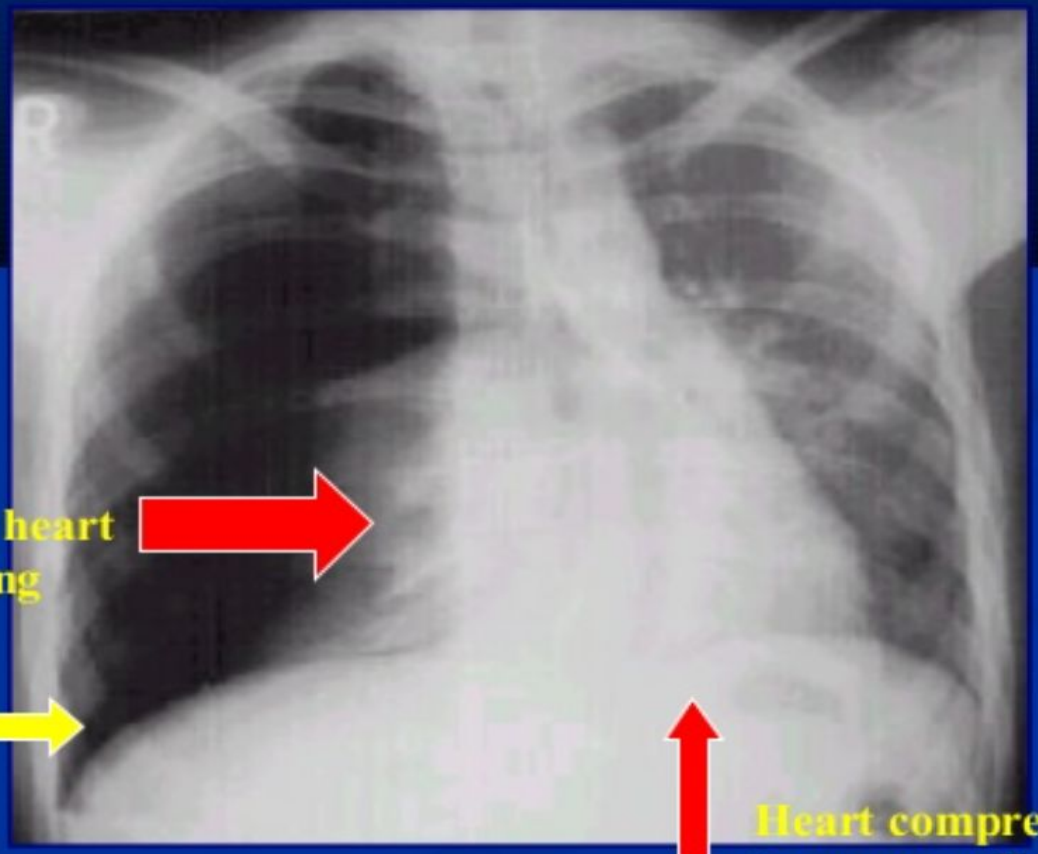


■ **FIGURE 4-1 Tension Pneumothorax.** A "one-way valve" air leak occurs from the lung or through the chest wall, and air is forced into the thoracic cavity, eventually collapsing the affected lung.

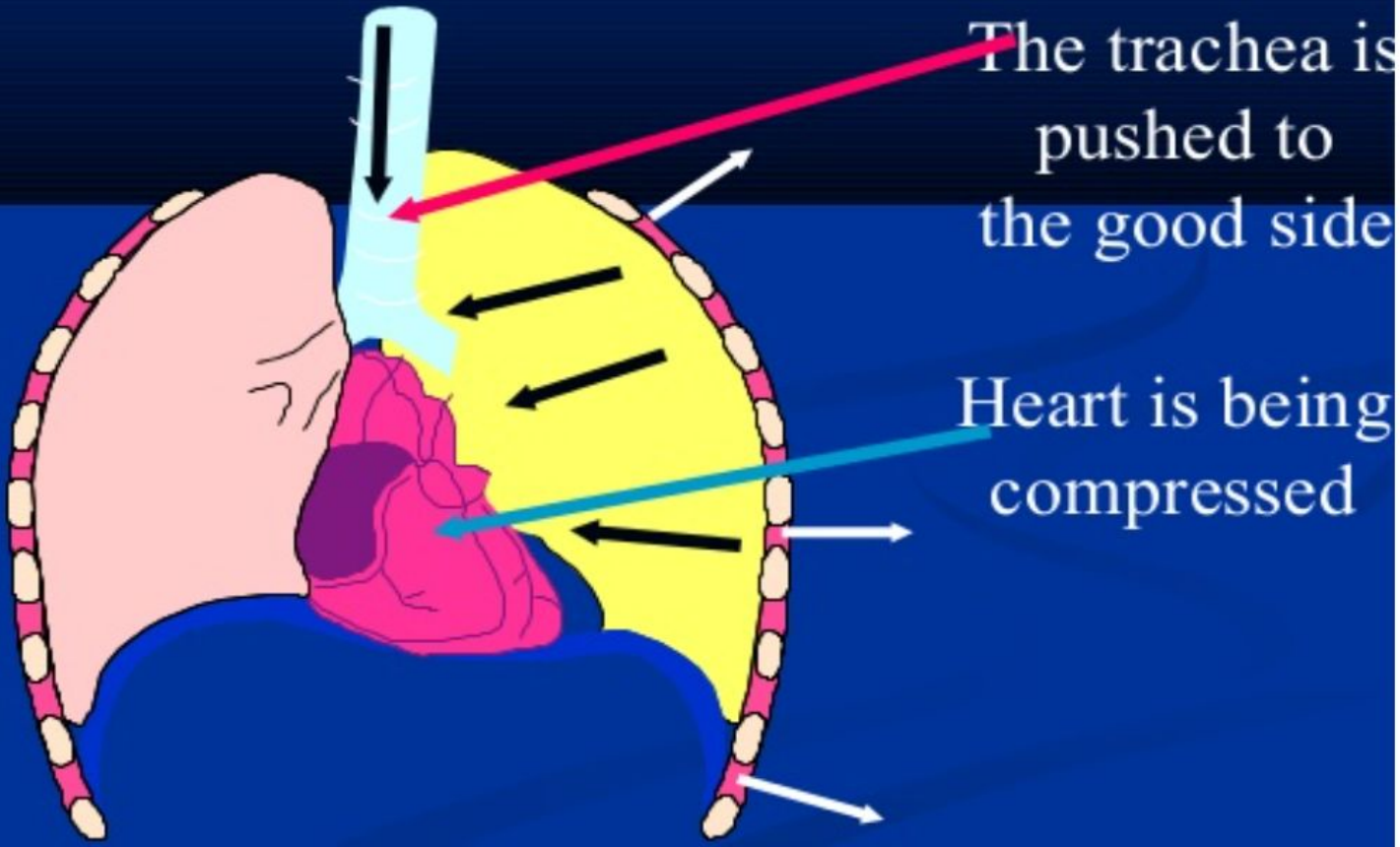
S/S of Tension Pneumothorax

- Anxiety , Restlessness.
- Severe Dyspnea.
- Absent Breath Sounds in affected side.
- Tachypnea.
- Tachycardia.
- Poor color.
- JVD
- Accessory muscle use.
- Narrow Pulse Pressure
- Hypotension.
- Tracheal deviation.

Tension Pneumothorax

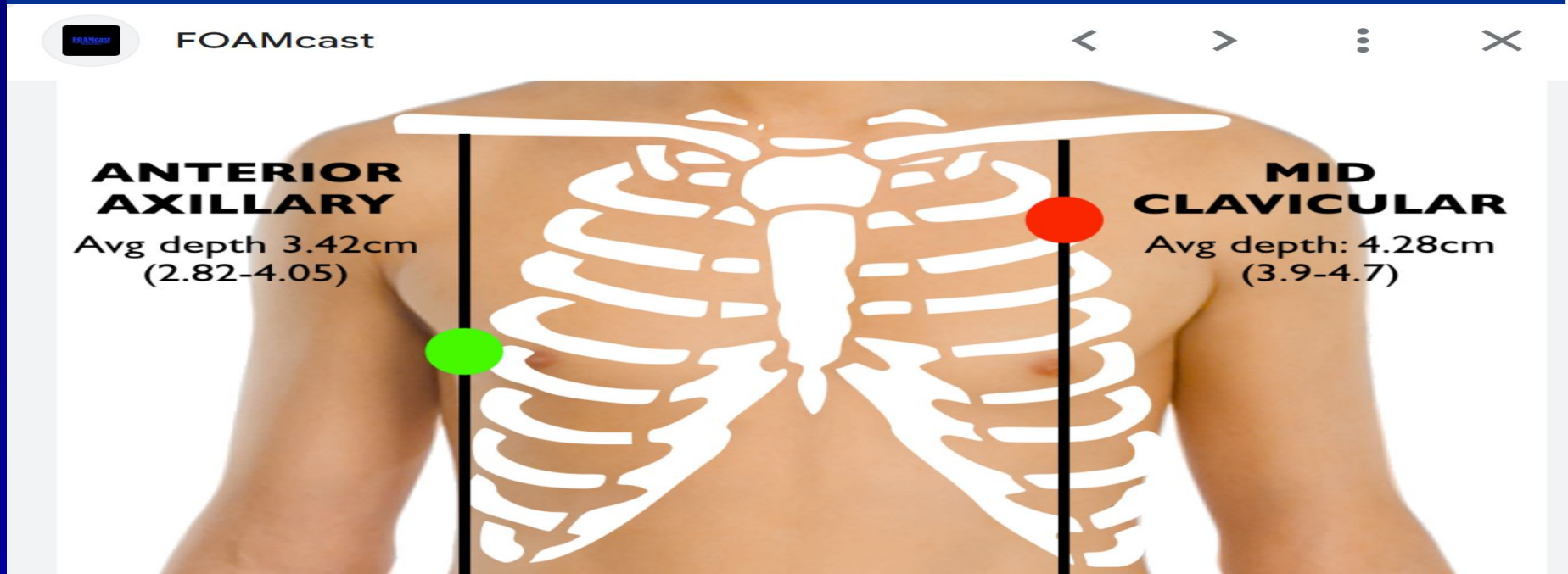


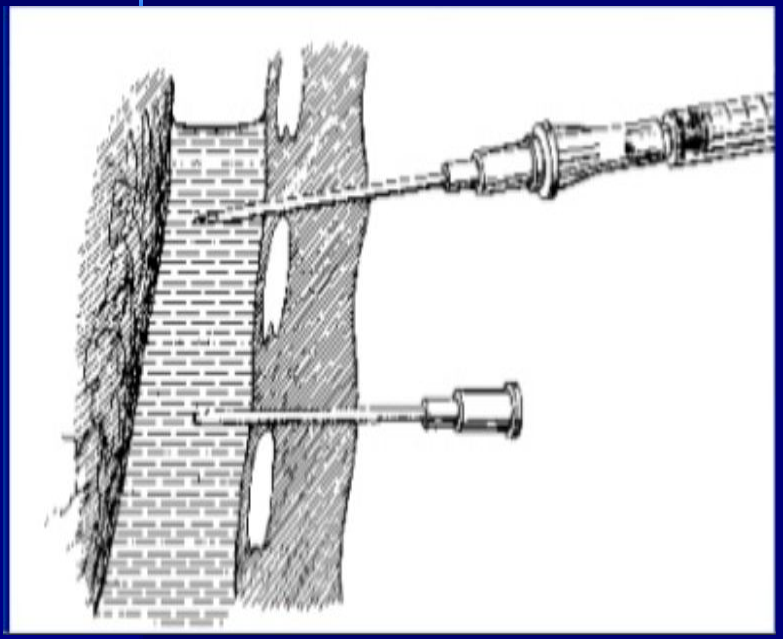
Tension Pneumothorax



Management of TP

- Ensure open air way
- Decompress the affected side.
- *Management*
- Needle chest decompression.
- 4th intercostal space anterior axillary line.





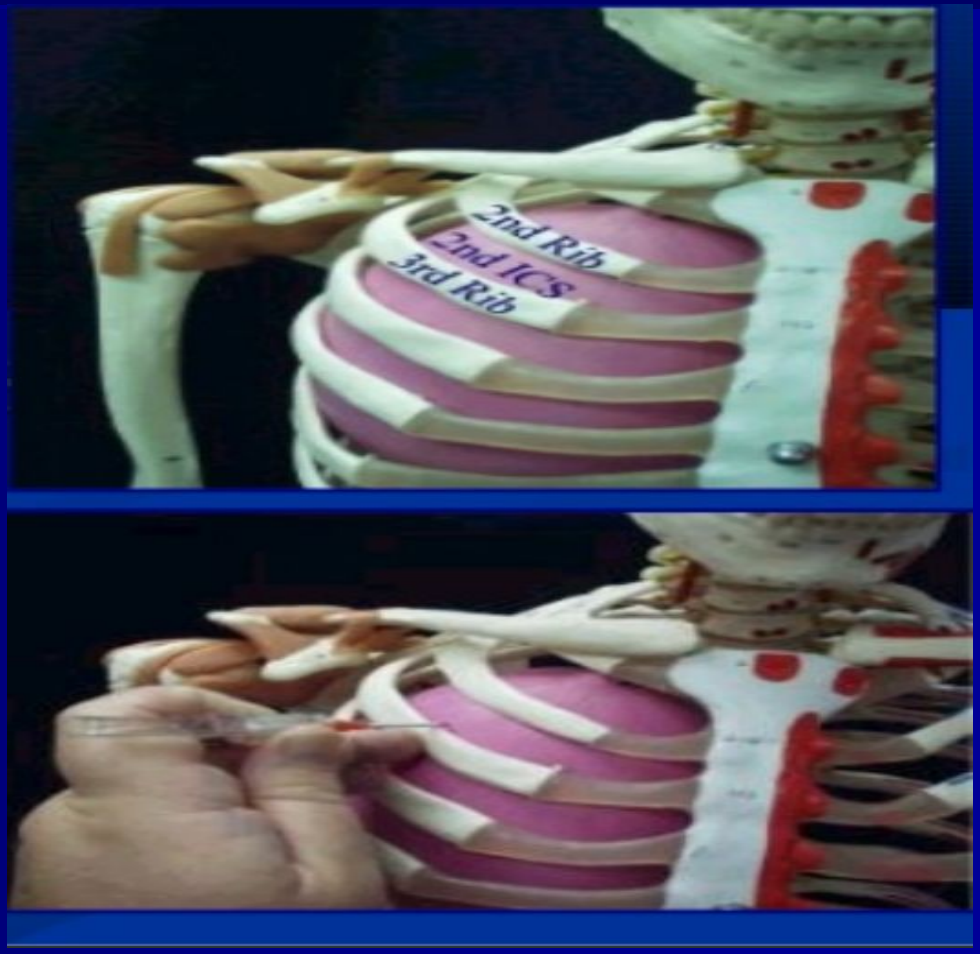

2nd Rib
2nd ICS
3rd Rib

TABLE 4-1 DIFFERENTIATING TENSION PNEUMOTHORAX AND MASSIVE HEMOTHORAX

CONDITION	PHYSICAL SIGNS				
	BREATH SOUNDS	PERCUSSION	TRACHEAL POSITION	NECK VEINS	CHEST MOVEMENT
Tension pneumothorax	Decreased or absent	Hyperresonant	Deviated away	Distended	Expanded immobile
Massive hemothorax	Decreased	Dull	Midline	Collapsed	Mobile

Cardiac Tamponade

- Cardiac tamponade is compression of the heart by an accumulation of fluid in the pericardial sac PS.
- Decreased cardiac output due to decreased Venous return as PS cannot expand any more.
- The human pericardial sac is a fixed fibrous structure, and a relatively small amount of blood can restrict cardiac activity and interfere with cardiac filling.
- Cardiac tamponade most commonly results from penetrating injuries, although blunt injury also can cause the pericardium to fill wit



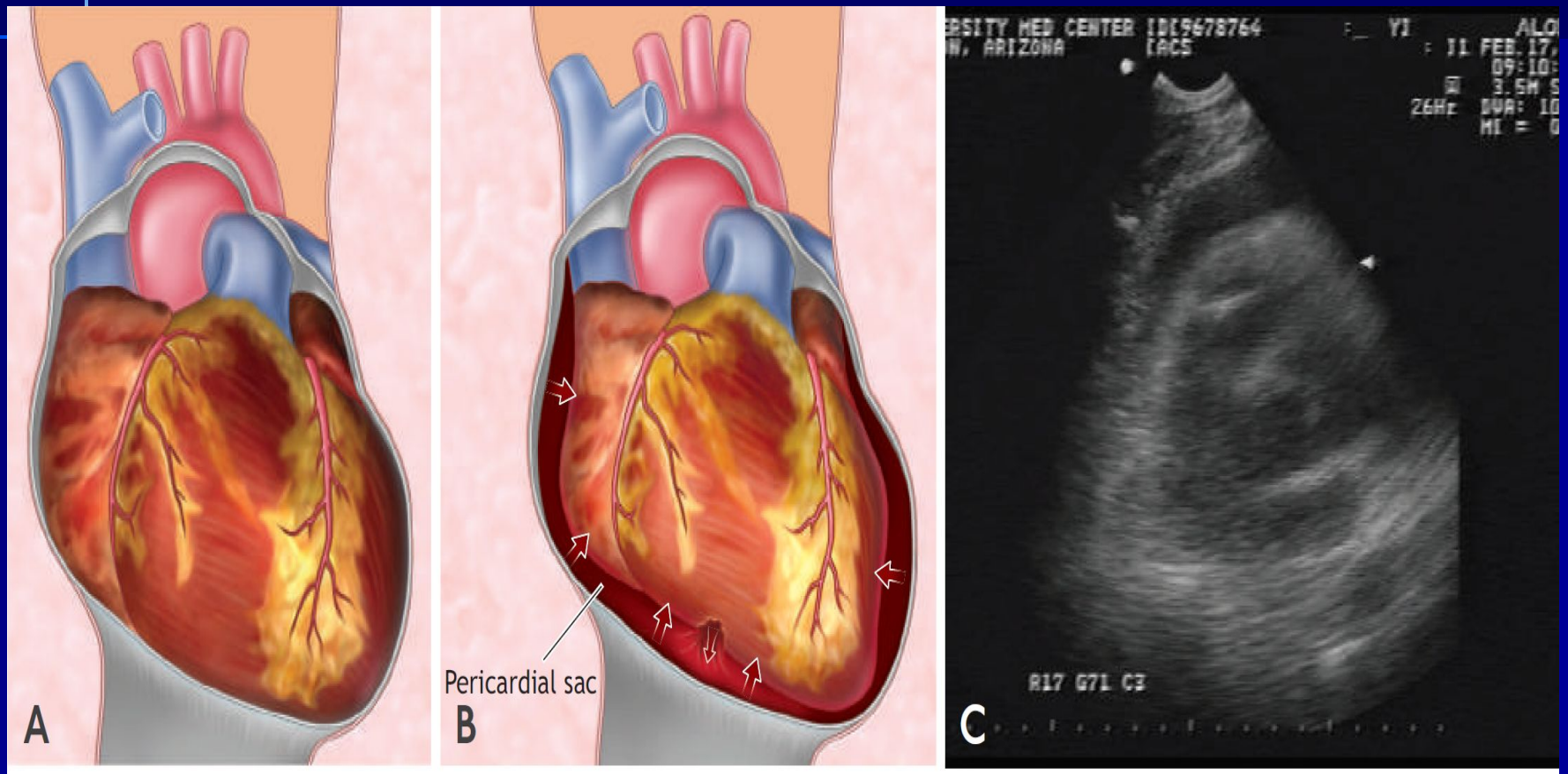
Cardiac tamponade

- *Beck's Triad*
  - Muffled heart sounds.
  - Distended neck veins.
  - Hypotension.

Not always present

- Left Tension Pneumothorax may mimic CT.
- *FAST* is 90–95% accurate in accurate in diagnosis Cardiac Tamponade.
- May takes time to appear *(RE FAST is necessary).*
- When CT is diagnosed, emergency thoracotomy or sternotomy should be performed ASAP.
- *Pericardiocentesis* should represent a life saving

Cardiac Tamponade



■ FIGURE 4-6 **Cardiac Tamponade. A.** Normal heart. **B.** Cardiac tamponade can result from penetrating or blunt injuries that cause the pericardium to fill with blood from the heart, great vessels, or pericardial vessels. **C.** Ultrasound image showing cardiac tamponade.

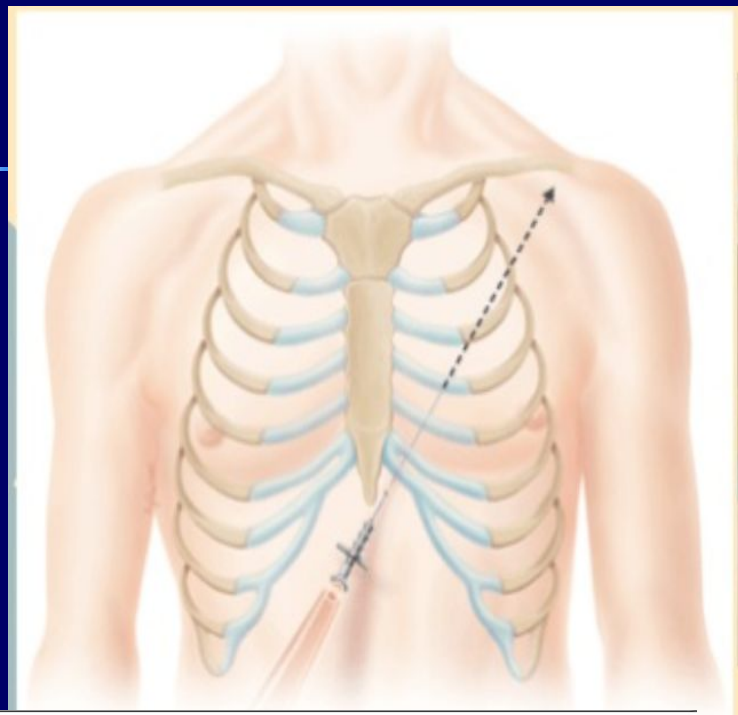
Cardiac tamponade



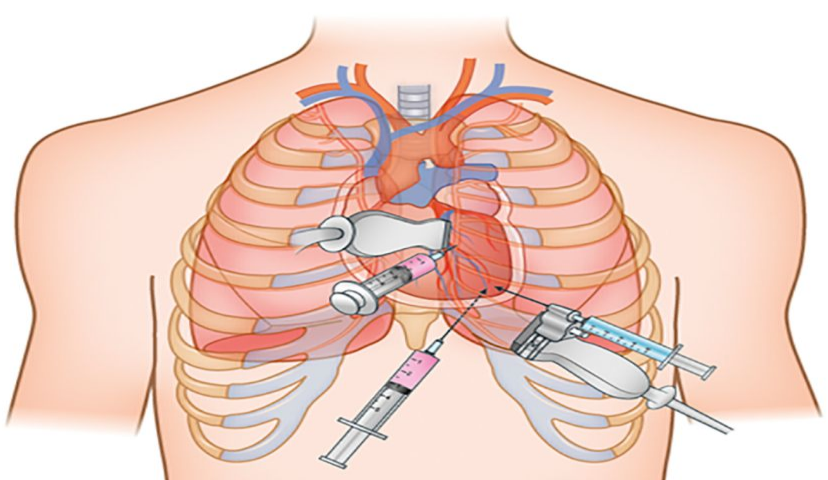
Pericardiocentesis

- Using aseptic technique, Insert at least 3" needle at the angle of the Xiphoid Cartilage at the 7th rib
- Advance needle at 45 degree towards the clavicle while aspirating syringe till blood return is seen
- Continue to Aspirate till syringe is full then discard blood and attempt again till signs of no more blood

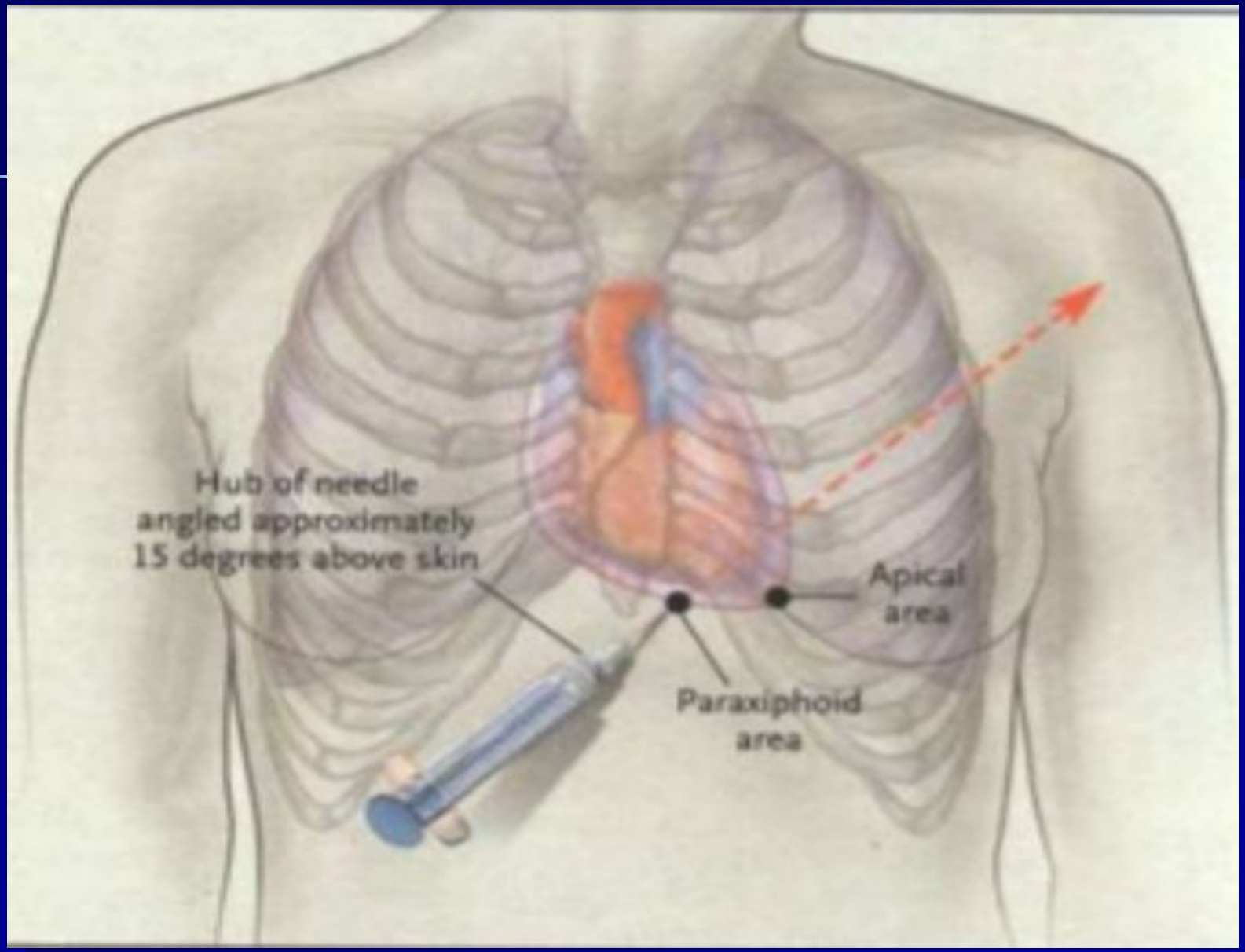
Pericardiocentesis





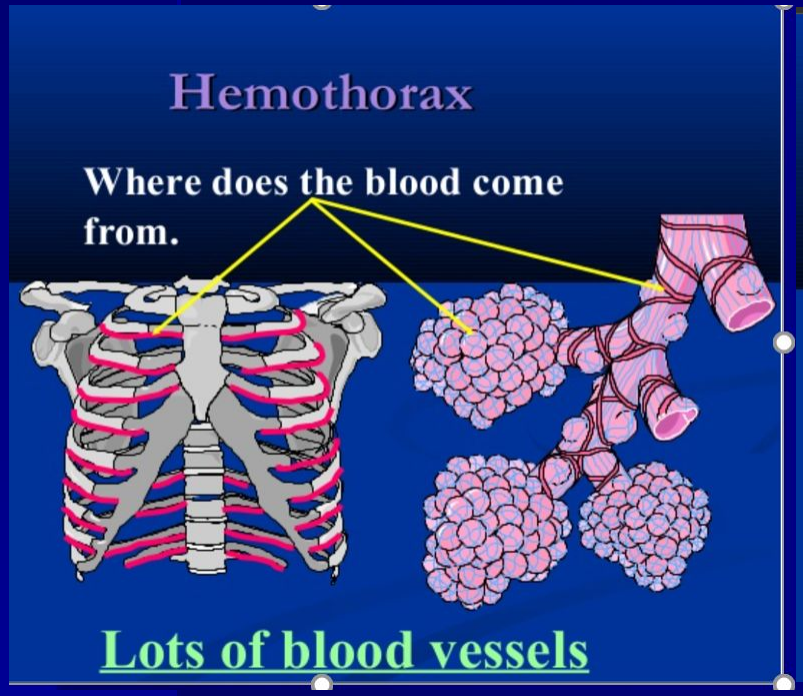


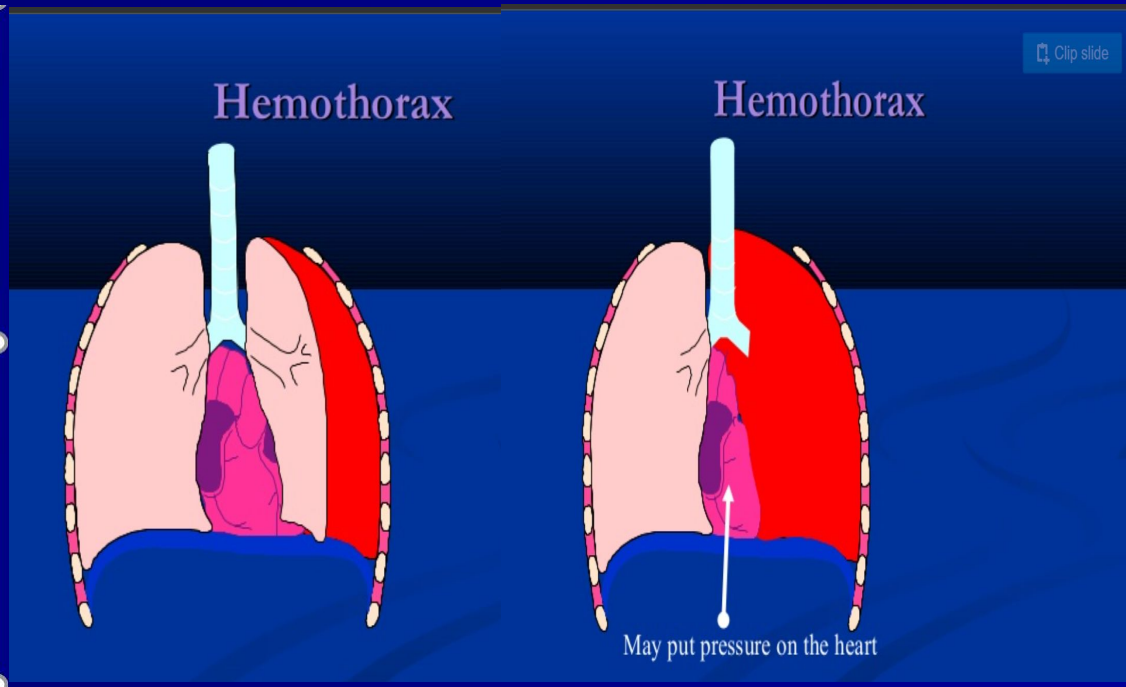



Hub of needle
angled approximately
15 degrees above skin
Apical
area
Paraxiphoid
area

Hemothorax

- Occurs when pleural space fill with blood.
- Usually from laceration of blood vessel in thorax.



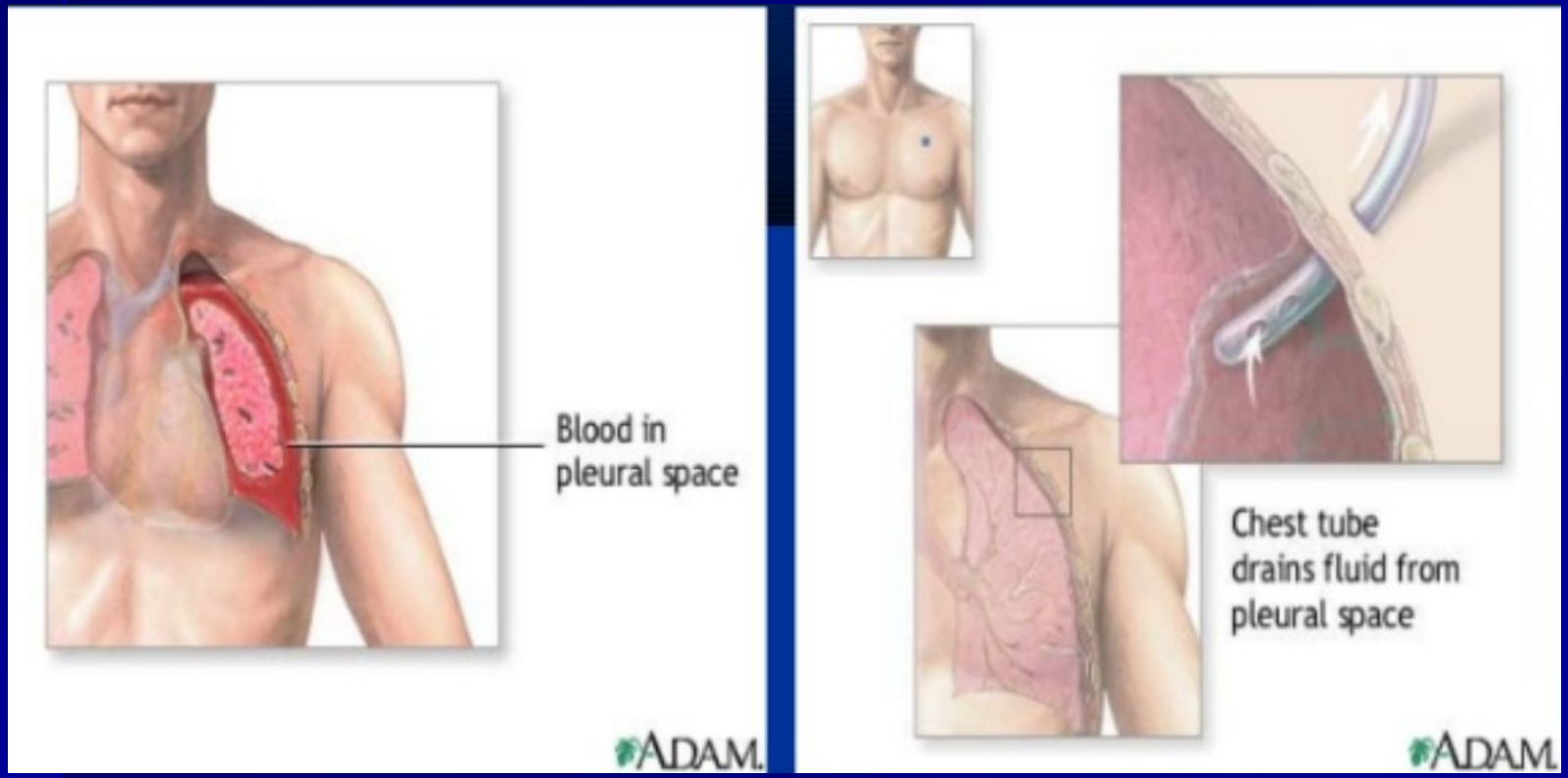


S/S of hemothorax

- Anxiety.
- Tachypnea.
- Signs of shock.
- Frothy bloody sputum.
- Diminished breath sounds on affected side
- Tachycardia.

Treatment of Hemothorax

- Establish air way high O2 flow.
- Drainage by chest tube.
- Thoracotomy.



Massive hemothorax

- More than 1.5 liter of blood in pleural cavity.
- Continuing blood loss (200 mL/hr for 2 to 4 hours).
- Persistent need for blood transfusion is an indication for thoracotomy.

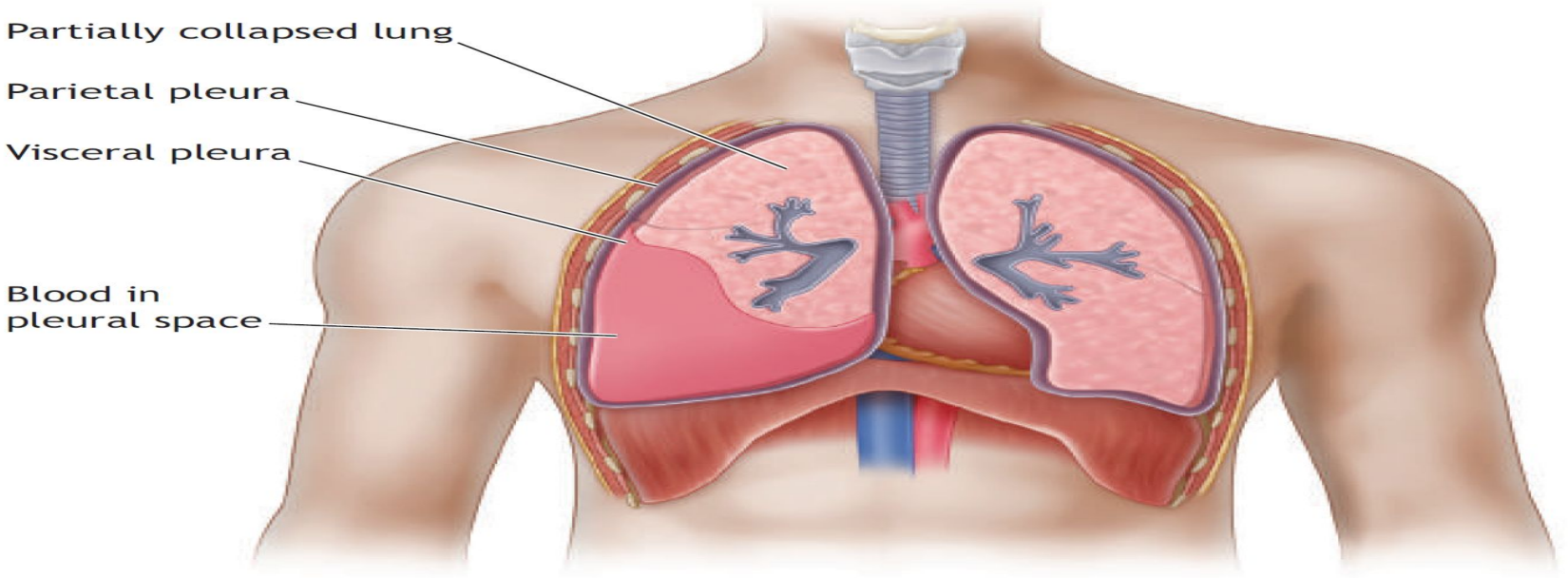
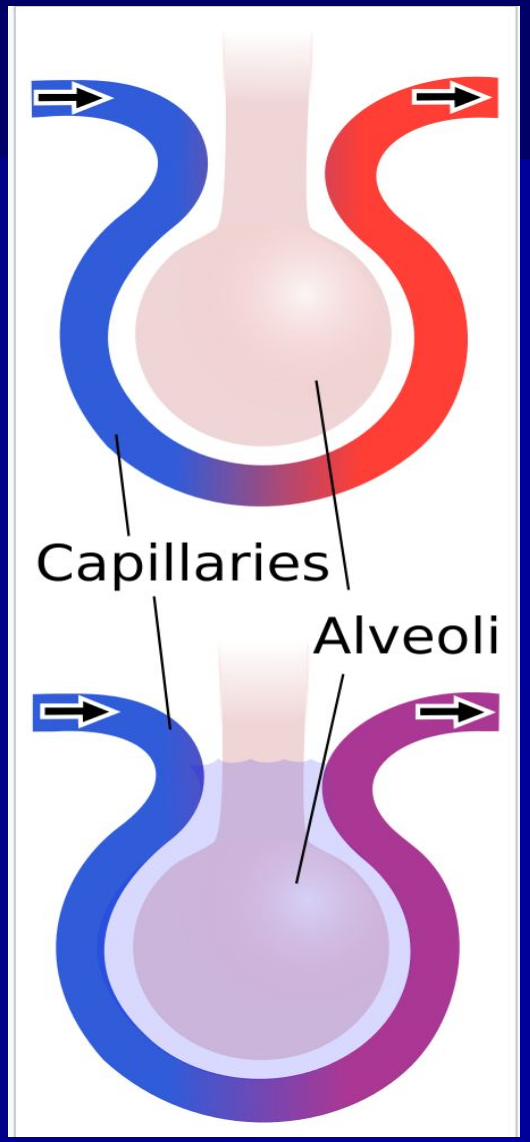


FIGURE 4-5 Massive Hemothorax. This condition results from the rapid accumulation of more than 1500 mL of blood or one-third or more of the patient's blood volume in the chest cavity.

Pulmonary contusion

- A pulmonary contusion is a Bruise of the lung, caused by Thoracic Trauma.
- Blood and other fluids accumulate in the lung tissue, interfering with ventilation and potentially leading to hypoxia.
- Pulmonary contusion can occur without rib fractures or flail chest in children.
- Can be fatal and develop ***Over Time*** leading to respiratory failure.



Component of pulmonary contusion

