*STATE MEDICAL UNIVERSITY OF MEDICINE AND FARMACEUTICS*
*«N.TESTEMITANU»*
*DEPARTMENT OF SURGERY N2*

# NON-SUPPURATIVE PLEURO-PULMONARY DISEASES. SURGICAL PATHOLOGY OF THE DIAPHRAGM.

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# NON-SUPPURATIVE PLEURO-PULMONARY DISEASES.

- *Hydatid cyst.*
- *Pulmonary alveolar echinococcosis.*
- *Pneumothorax (spontaneous, posttraumatic,tension).*
- *Hemothorax.*
- *Chylothorax.*
- *Bronchogenic cysts and benign tumors of lung.*

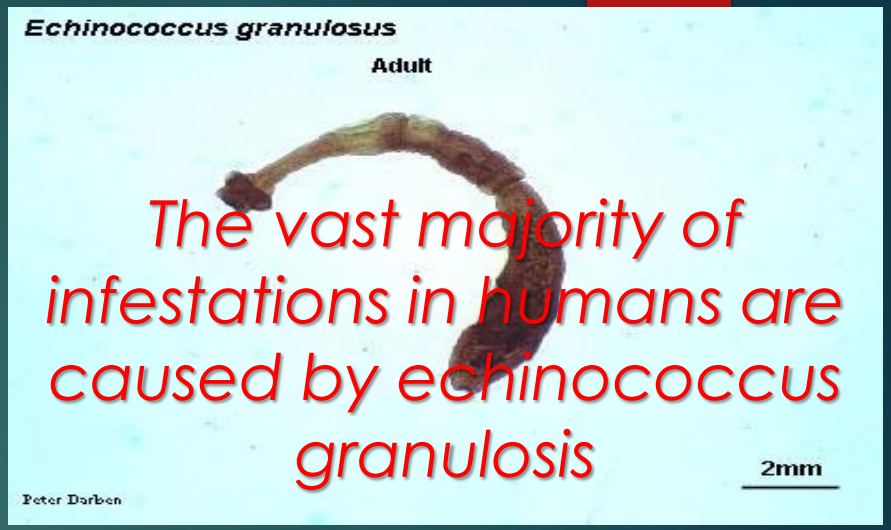
# SURGICAL PATHOLOGY OF THE DIAPHRAGM.

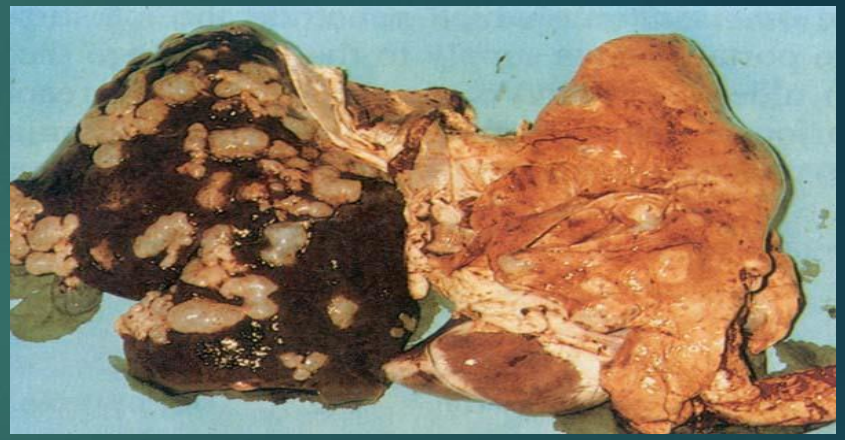
- *Diaphragmatic hernias.*
- *Esophageal hiatal hernias.*
- *Nontraumatic true hernias.*
- *Diaphragmatic relaxation (diaphragmatic eventration).*

# *ECHINOCOCCUS GRANULOSUS* (AND *MULTILOCULARIS*)

# What is it?

- Human Echinococcosis is caused by the larval stages of cestodes (tapeworms) of the genus Echinococcus
- **E. granulosus**
  - Causes cystic Echinococcosis
  - This form is most frequently encountered
- **E. multilocularis**
  - Causes alveolar Echinococcosis
    - Looks like little alveoli
    - Can travel to any part of the body



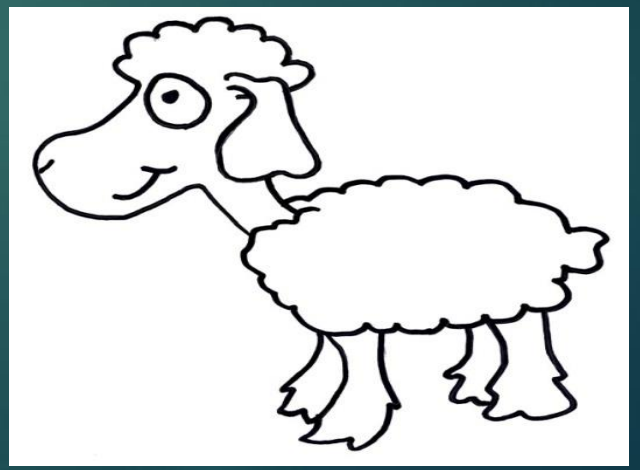



## Differences

| | E. granulosus | E. multilocularis |
|---|---|---|
| **Metacestodes** | Develops a thick laminated layer and grows into a large single cyst | Thin outer wall that grows and infiltrates processes into surrounding host tissues like a cancer |

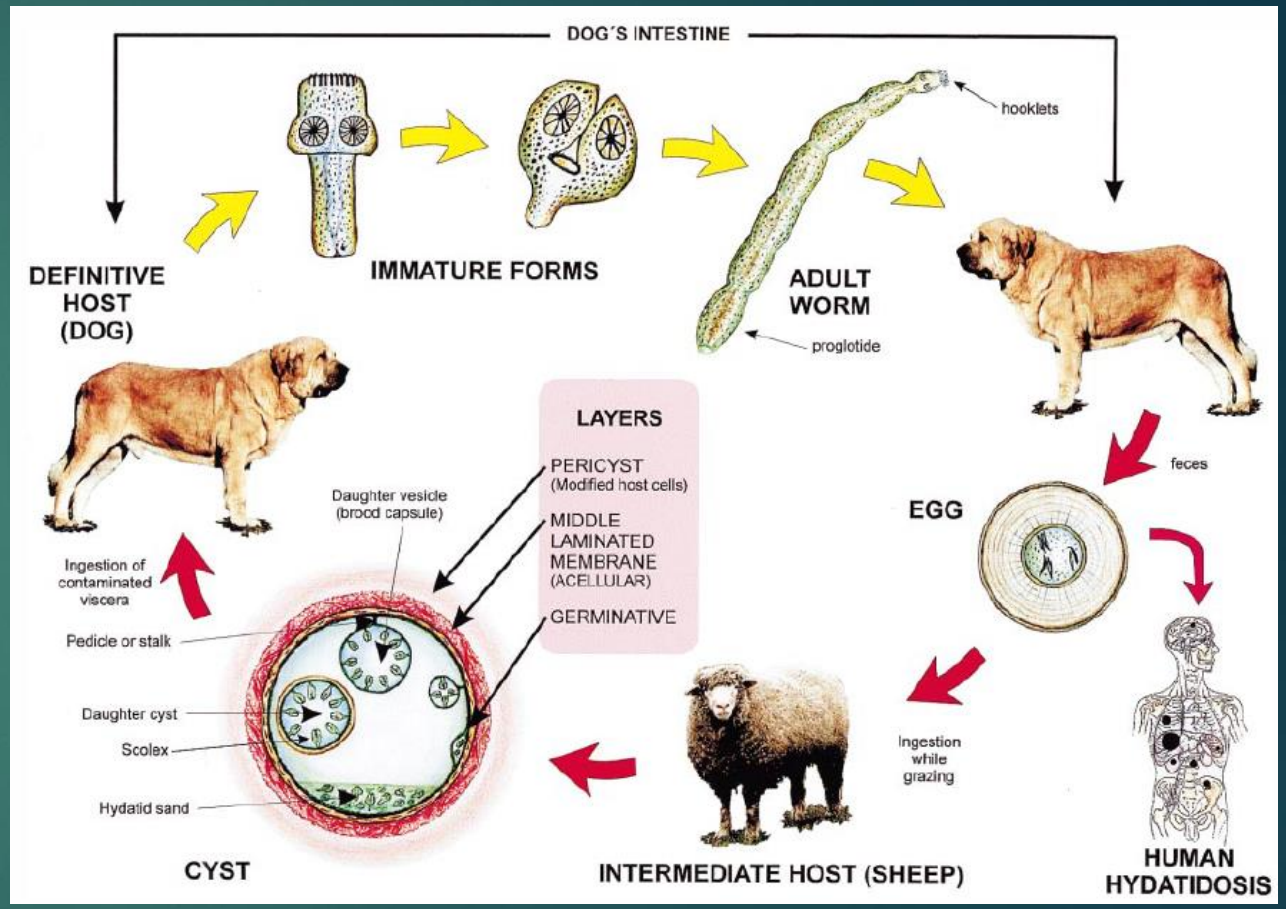
# Definitive Host/Intermediate Host:

- Echinococcus granulosus:
  - Definitive Host: dogs and other carnivores
  - Intermediate Host: mammals, including humans or herbivorous species
- Echinococcus multilocularis:
  - Definitive Host: mainly foxes but dogs, cats, coyotes and wolves also
  - Intermediate Host: small rodents, rarely humans

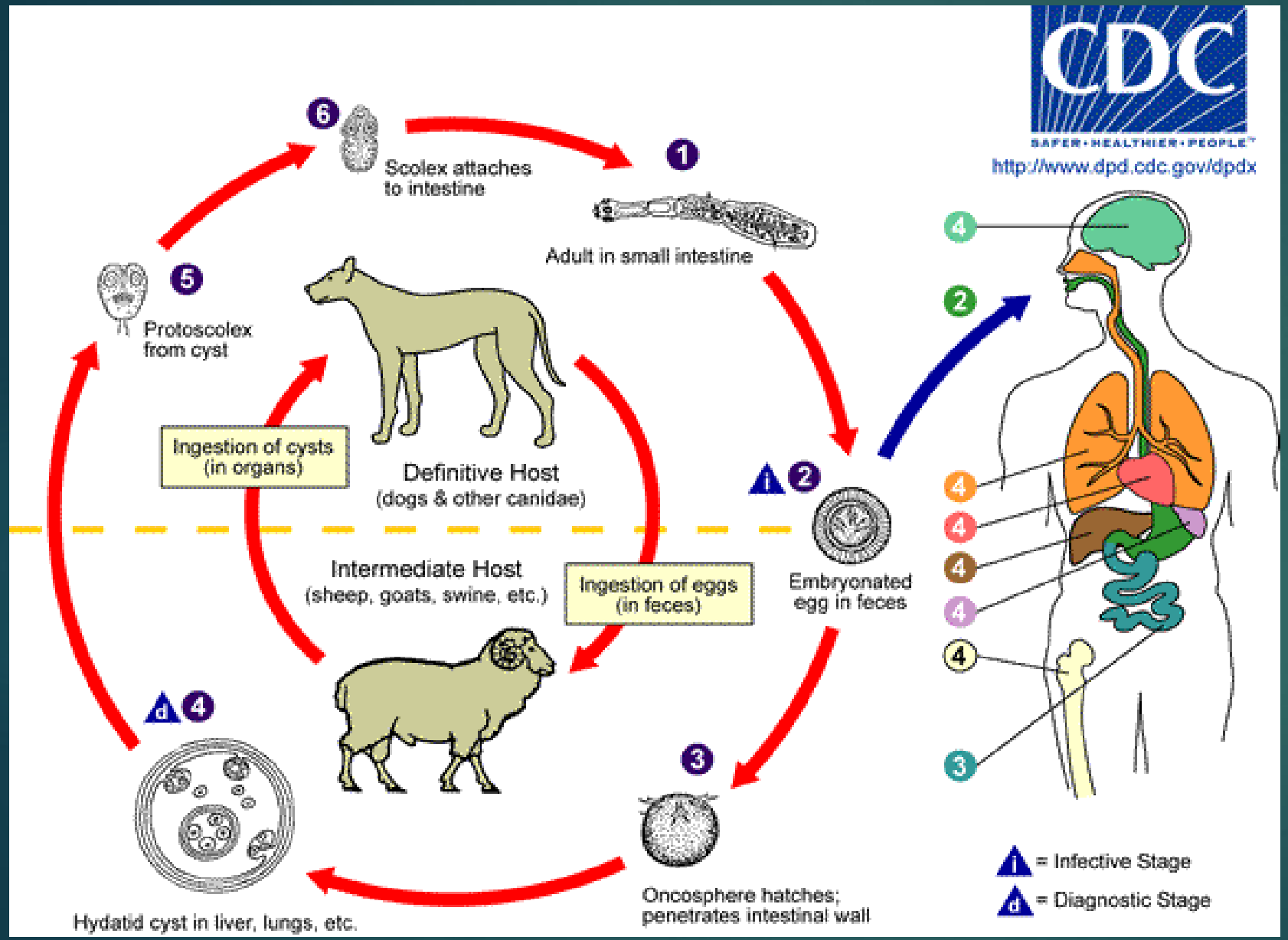


# Life cycle of E granulosis

- Involves **two hosts**
  - Dog / carnivore – **definitive host**
  - Sheep – **intermediate host** (most common)
- Adult worm of the parasite lives in the proximal small bowel of the definitive host
- Eggs are released into the hosts intestine and excreted in feces
- Intermediate host ingest ovum while grazing on contaminated ground
- Ovum loses its protective layer during digestion in duodenum
- Released **hexacanth embryo** or **oncosphere** passes through intestinal wall into portal circulation
- Develops into a cyst
- Life cycle is completed when definitive host eats the viscera of the intermediate host



# Lifecycle:Cystic Echinococcosis (*Echinococcus granulosus*)




Humans are aberrant intermediate hosts, and become infected by ingesting eggs 2 Oncospheres are released in the intestine 3 and hydatid cysts develop in a variety of organs 4. If cysts rupture, the liberated protoscolices may create secondary cysts in other sites within the body (secondary echinococcosis).

# Pathogenesis (pulmonary hydatid cyst)

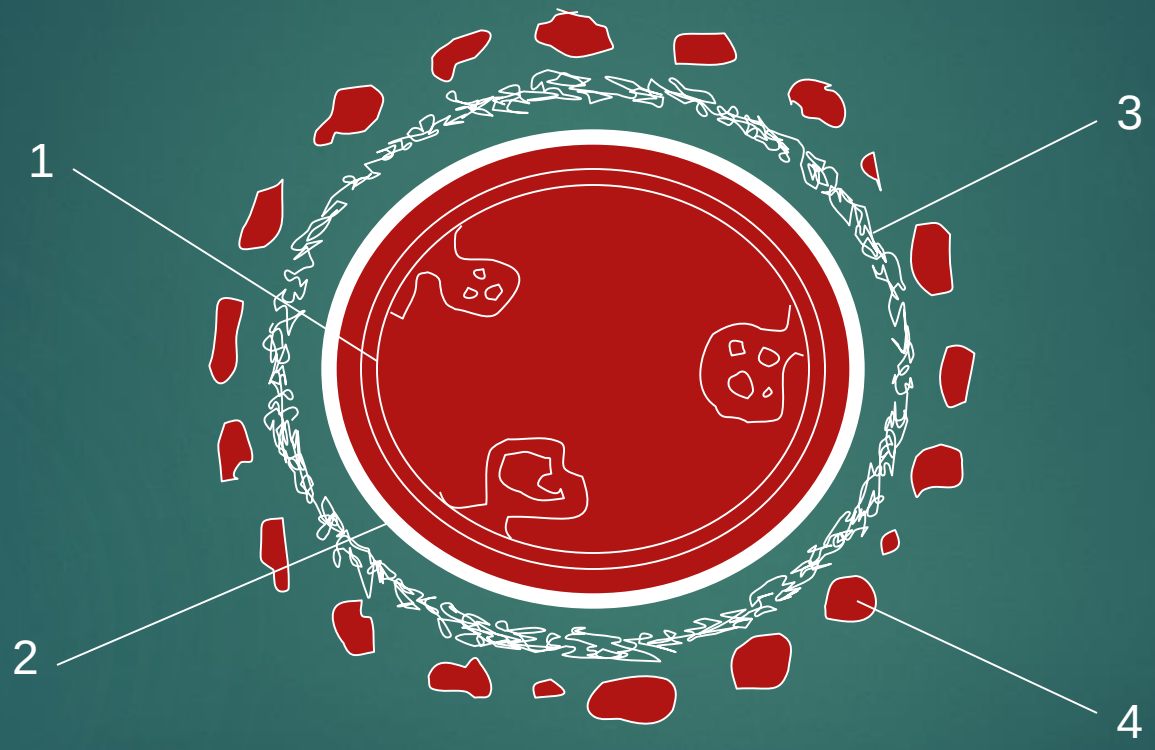
## Primary echinococcosis:

- The digestive tract → intestine → the portal vein → liver (first capillary filter, where hexacanthous embryos attach 50-60%) → vena cava inferior → right cord → lung (second capillary filter 17-20%);
- Lymph → thoracic lymphatic duct → superior vena cava → right cord → lung;

## Secondary echinococcosis:

- Secondary pulmonary echinococcosis occurs hematogenously from localized hydatid cyst → inferior vena cava → right heart → lung;
- Secondary pleural echinococcosis occurs by spontaneous rupture of the cyst in the pleural cavity or sowing of the pleura during puncture or surgical act;

# STRUCTURE OF THE HIDATIC CYST




**Pericyst (4)**

- Outer layer
- Composed of inflamed fibrous tissue derived from the host
- Form a dense and fibrous protective zone

**Ectocyst (2+3)**

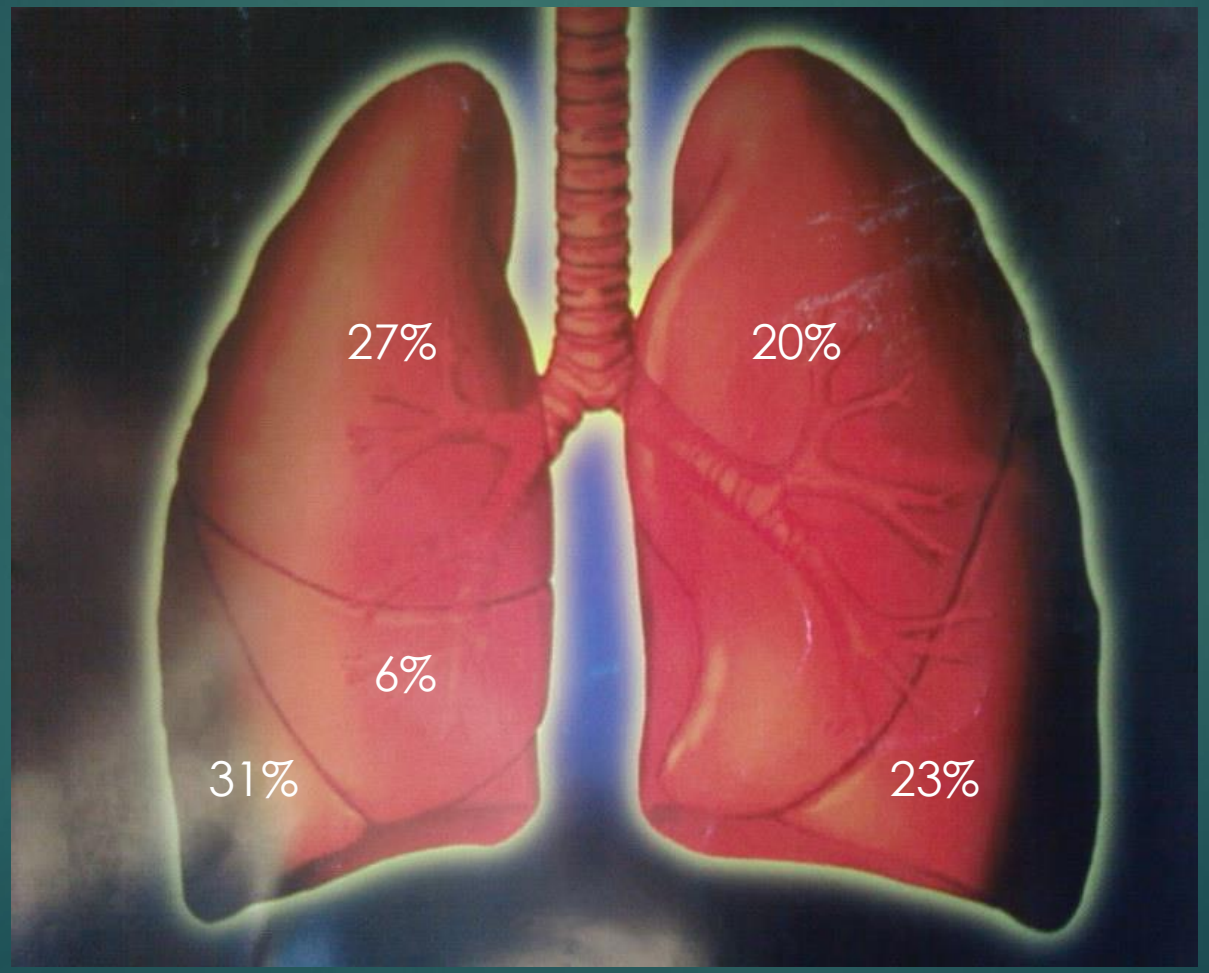
- Middle layer
- Acellular, laminated membrane

**Endocyst (1)**

- Innermost layer
- Germinative layer
- Gives rise to secondary cysts / brood capsules / daughter cysts

**1- Germintative layer; 2- Cuticular (fibrous) capsule; 3- Adventice; 4- Pericyst.**

# *Incidence of pulmonary hydatid cyst*



# Clinical Features

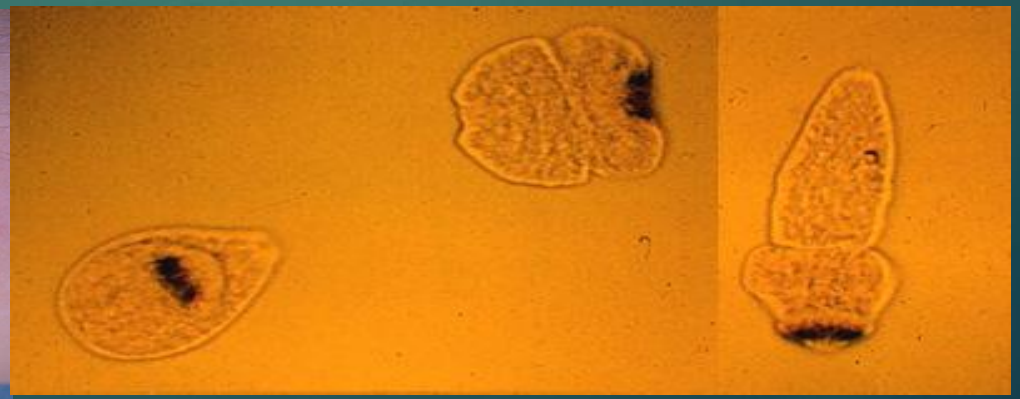
- A pulmonary hydatid cyst (PHC) most commonly produces symptoms of cough followed by chest pain, breathlessness, expectoration, fever, hemoptysis, and anaphylactic phenomena.
- Hemoptysis is more common presenting complaints in adults' population.
- Screening for the presence of hepatic hydatid cysts should be done in all patients with PHCs because of the high incidence of the coexistence.

# Clinical Features

- Usually, cysts greater than 5 cm leads to bronchial compression.
- Cyst rupture, secondary infection, suppuration & pneumothorax are the common presenting complications of PHC.
- Urticaria & wheezing to anaphylaxis may occur due to hypersensitivity of the ruptured cyst which at times may be life  threatening.
- A generalized toxic reaction may be due to the presence of parasites.

# Diagnosis

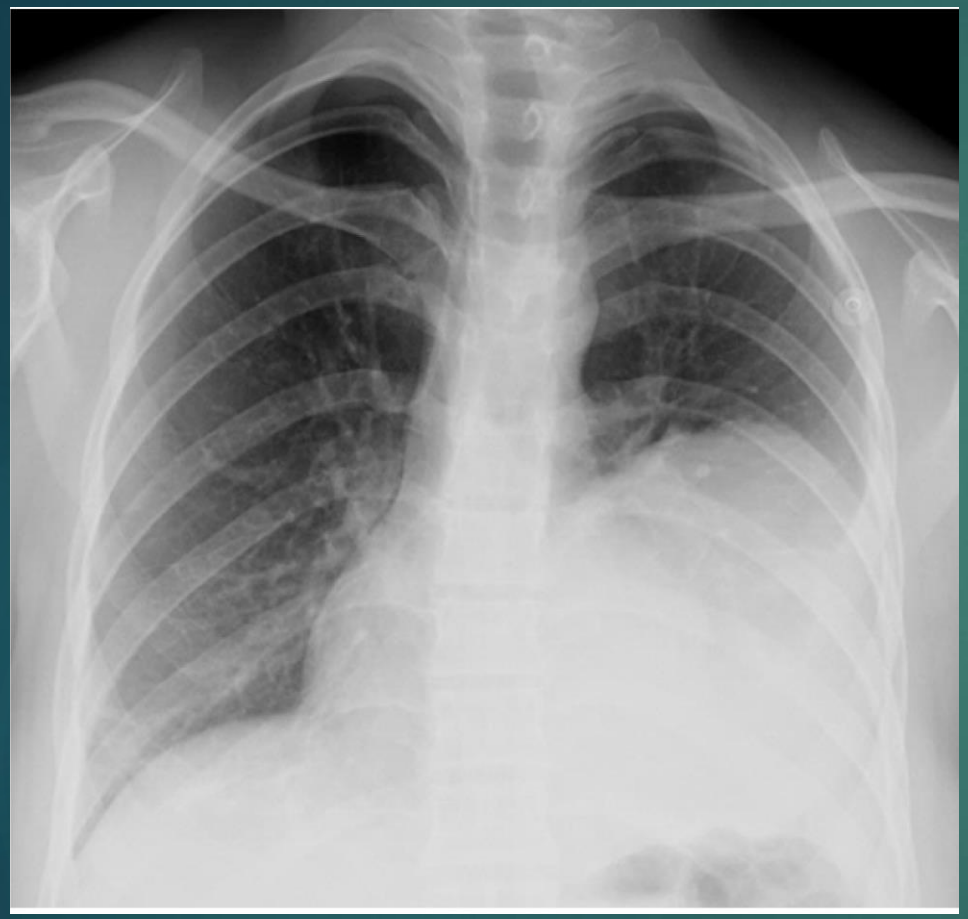
- *Peripheral blood:* showing leukocytosis, eosinophilia, and raised erythrocyte sedimentation rate are nonspecific.
- *Imagery*
  - Hydatids are found during X-ray, ultrasonography, CT scans
- *Immunodiagnostic techniques*
  - Generally less sensitive then imagery and positive in only **50%** of patients with **pulmonary hydatidosis**
- *Microscopy*
  - Fluid aspirated from hydatid cyst will show many protoscolices

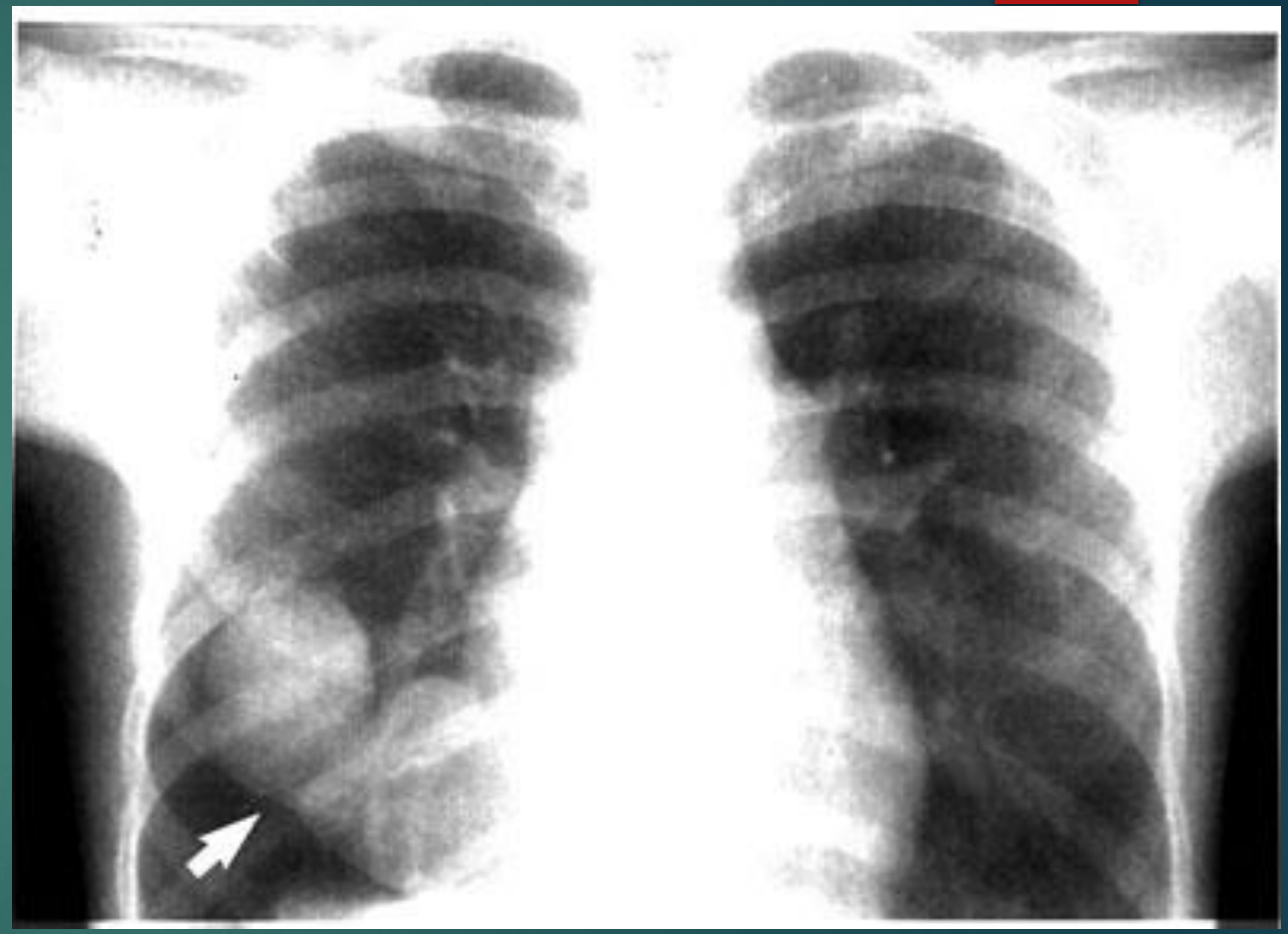


# Diagnosis: Imaging techniques

- Chest X-ray is the initial investigation tool for PHC
- Better imaging modalities like CT & MRI are most useful to image PHC and its complications.
- PHCs are usually solitary but multiple cysts may also be found.
- Calcification and daughter cyst formation is rare in PHCs unlike extrapulmonary hydatid cysts.
- The pleural hydatid cysts may calcify.

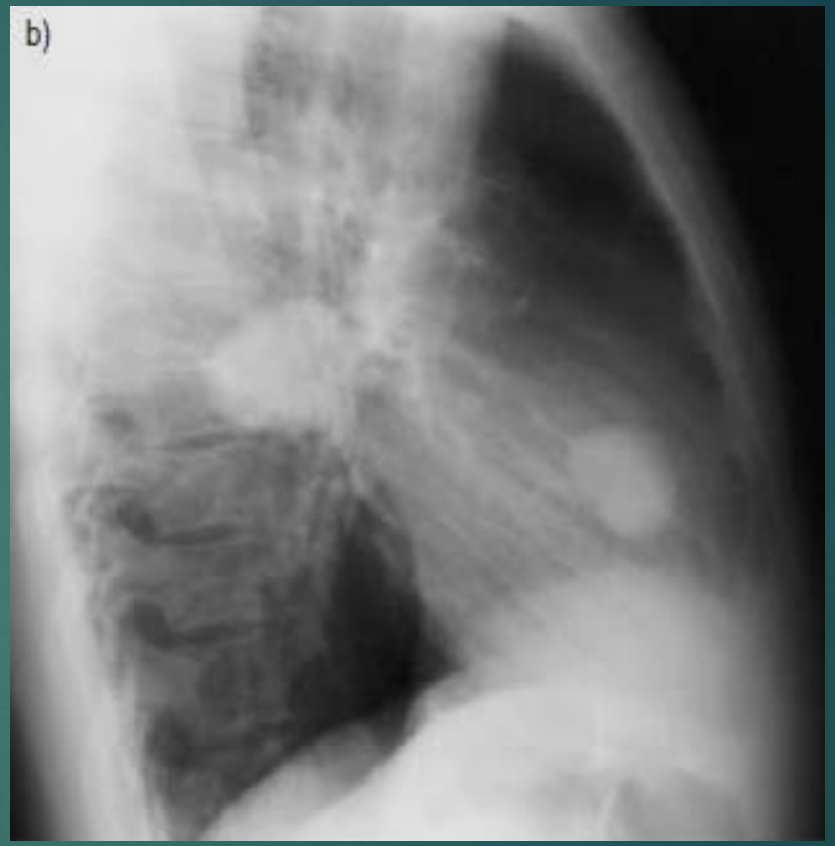
# Chest X-ray showing hydatid cyst of left & right lung





The radiological features  are sharply defined, round-to-oval homogenous opacity of variable size. Peripherally located cysts are larger than those located at the major bronchovascular structures.

# Uncomplicated cysts



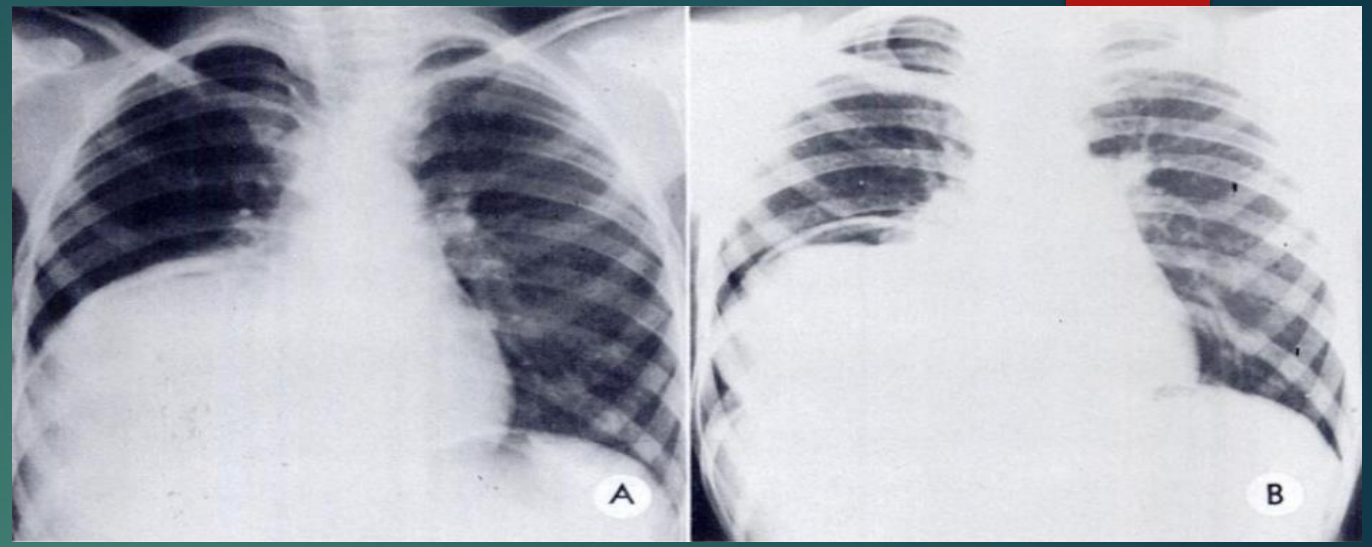

Well defined,homogenous, round to oval masses
Surrounded by normal lung tissue
Cyst **shape may vary** on inspiratory and expiratory films

# Computed tomography

✓CT features of PHCs are smooth walls of variable thickness and homogenous internal contents of water or near-water density.

# Computed tomography

✓**Cyst growth** causes **erosions in the bronchioles** that are included in the pericyst
✓If there is any air into the potential space between the pericyst and ectocyst the local detachment of parasitic membranes from the pericyst occurs which is known as "the sign of detachment."
✓Air collection appears as a **thin radiolucent crescent** in the upper part of the cyst, known as the **crescent or meniscus sign**





Some authors consider this as sign of **impending rupture** and indication for emergency thoracotomy.

# Radiologic signs related to ruptured PHC

## *Double-arch or cumbo sign*

**Air continues to enter** this space between pericyst and ectocyst

- Two layers seperate completely
- Cyst shrinks and **ruptures**
- Allows for passage of **air into the endocyst by** cyst–bronchial tree communication.
- Air-fluid level inside the endocyst + air between the pericyst and ectocyst = **onion peel** appearance


*Cumbo sign: Double air arc is seen in (a) chest radiography and (b) CT scan*

# Radiologic signs related to ruptured PHC

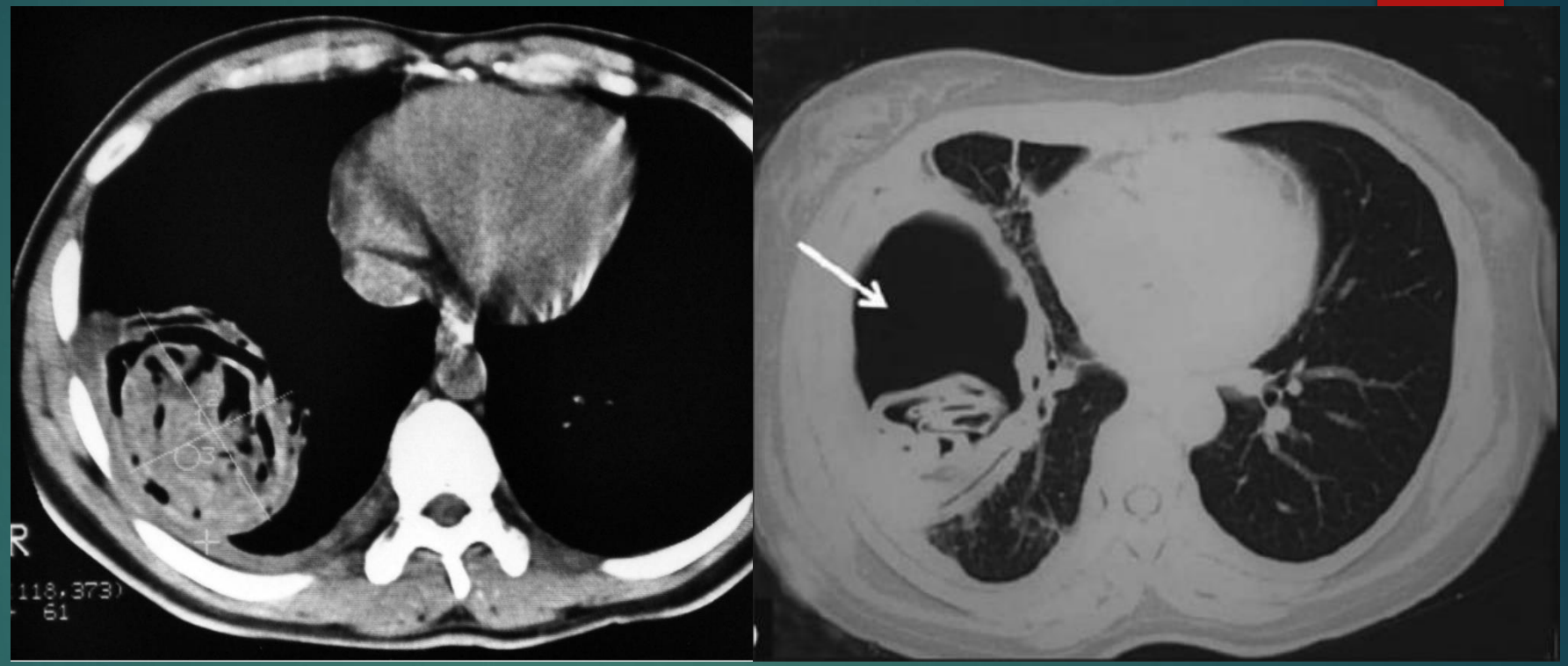
***Serpent sign***

After **partial expectoration** of the **endocyst fluid** and scolices

- ✓ Cyst empties
- ✓ **Collapsed membranes** can be seen inside the cyst

# Radiologic signs related to ruptured PHC

***Whirl sign***

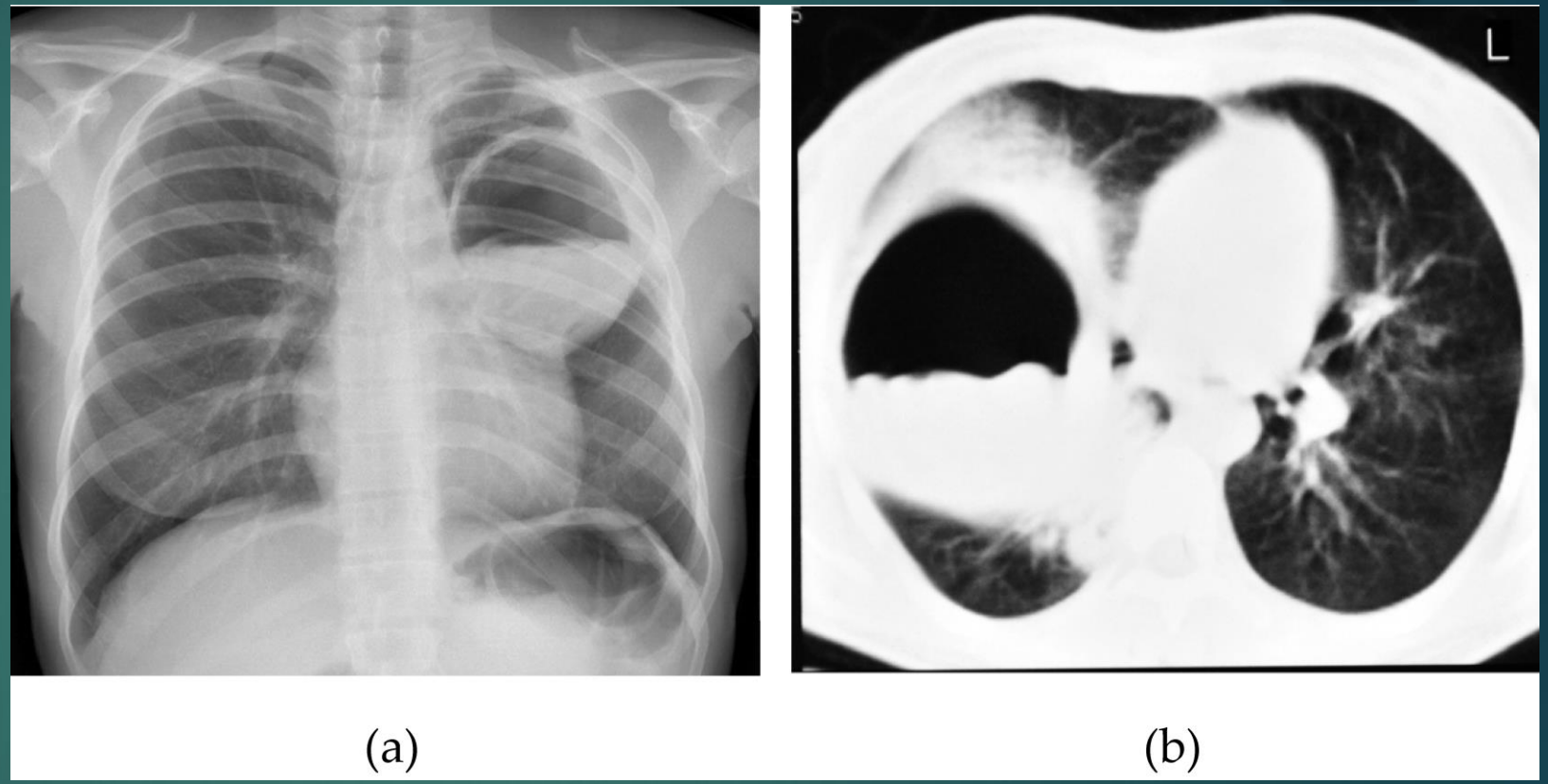


*Whirl sign: floating detached membranes in the cystic cavity with minimal pleural effusion.*

# Radiologic signs related to ruptured PHC

***Water lily or Camelot sign:***

When it has **completely collapsed** Crumpled **endocyst floats freely** in the cyst fluid




***Water lily or Camelot sign: (a) chest radiography shows a cavitary lesion with a germinative layer in the left lung. (b) On CT scan (mediastinal window), a cystic cavitary lesion with dependent wavy contour created by floated parasitic membranes is seen.***

# Laboratory Tests

- ✓Intradermoreaction Cassoni, Cassoni-Tâbărnă;
- ✓Test of eosinophilia provoked;
- ✓Weinberg-Pirvu reaction (complement fixation);
- ✓Immunoelectrophoresis or electrosyneresis,
- ✓ indirect immunofluorescence,
- ✓enzyme-linked immunosorbent assay (ELISA),
- ✓or hemagglutination are the serological evidence of echinococcosis.

- ➢ The hydatid serology is not sensitive tool for isolated pulmonary hydatidosis.
- ➢ Serologic tests may still be remain positive long time after cyst removal.

# Differential diagnostic

TUBERCULOM;

BRONCHOPULMONARY CANCER (PRIMITIVE AND METASTATIC);

BENIGN TUMORS;

AERIAL CYSTS;

BRONCHIECTATIC DISEASE;

RELAXATION OF THE DIAPHRAGM;

ANEURYSMS OF THE AORTA CROSS.

# Treatment of PHC

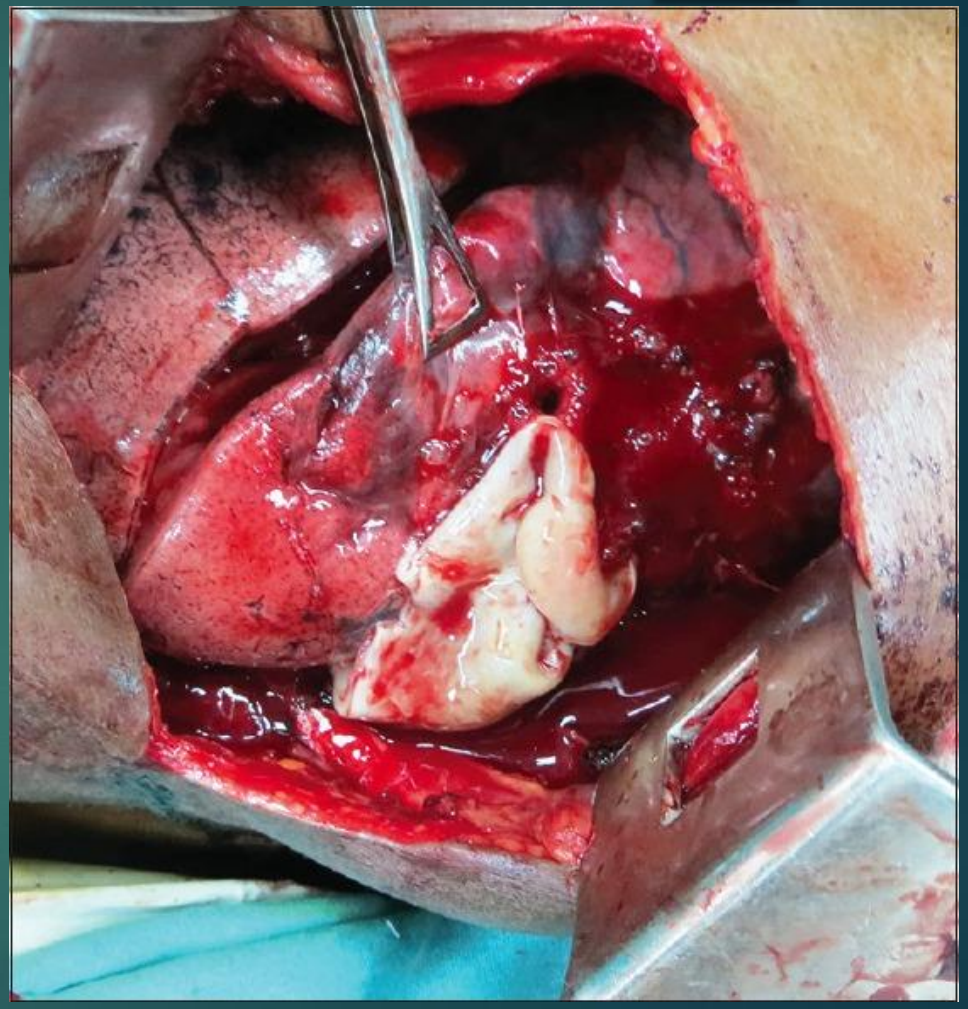
- PHCs may be treated pharmacologically and/or surgery.
- Surgical intervention is the treatment of choice.
- PHCs are sometimes treated pharmacologically by oral administration of benzimidazoles group of drugs like mebendazole or albendazole which includes :
  - ✓ smaller cysts,
  - ✓ patients with contraindication for surgery,
  - ✓ disseminated disease,
  - ✓ multiple cysts,
  - ✓ recurrent cysts,
  - ✓ patients with intraoperative spillage of hydatid fluid.

# Contraindications of medical management:

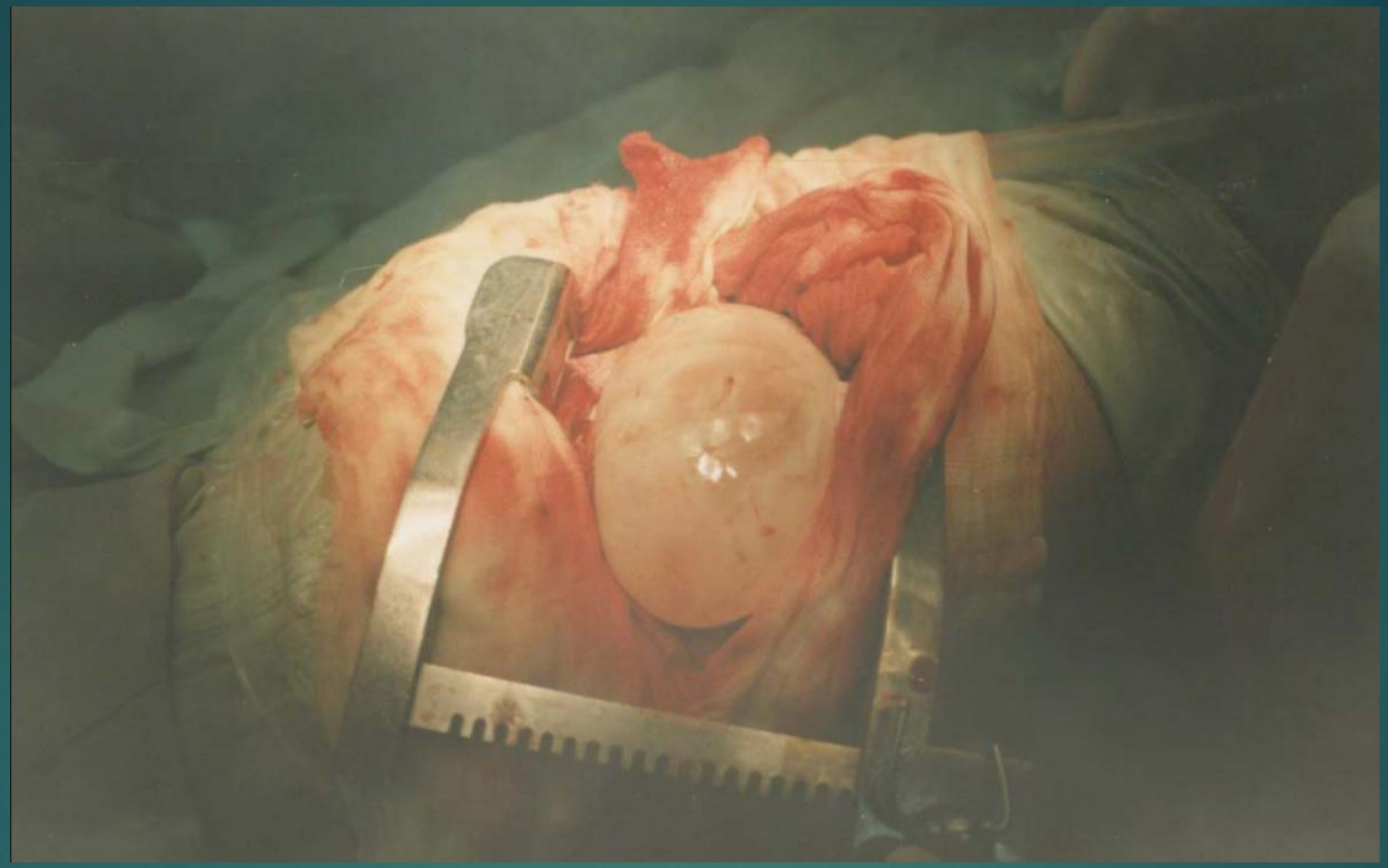
- ✓ Patients who developed complications during medical management.
- ✓ Cysts larger than 6 cm in diameter are at risk of rupture,
- ✓ Inactive or calcified cysts,
- ✓ Patients who are prone for bone marrow depression, pregnancy, specifically the first trimester of pregnancy.

# Surgery

- ✓ Surgery is the gold standard treatment of choice for PHCs of any size.
- ✓ Large cysts that are superficial and vulnerable to rupture, infected cysts, cysts in close proximity to vital anatomical structures, and cysts exerting substantial mass effect are treated surgically.



Operative picture of enucleation of hydatid cyst



*Right thoracotomy incision showing a very large white cyst delivered from the right lung, surrounded by gauze pads soaked with hypertonic saline.*

# Surgical techniques

- Enucleation (Ugon method):

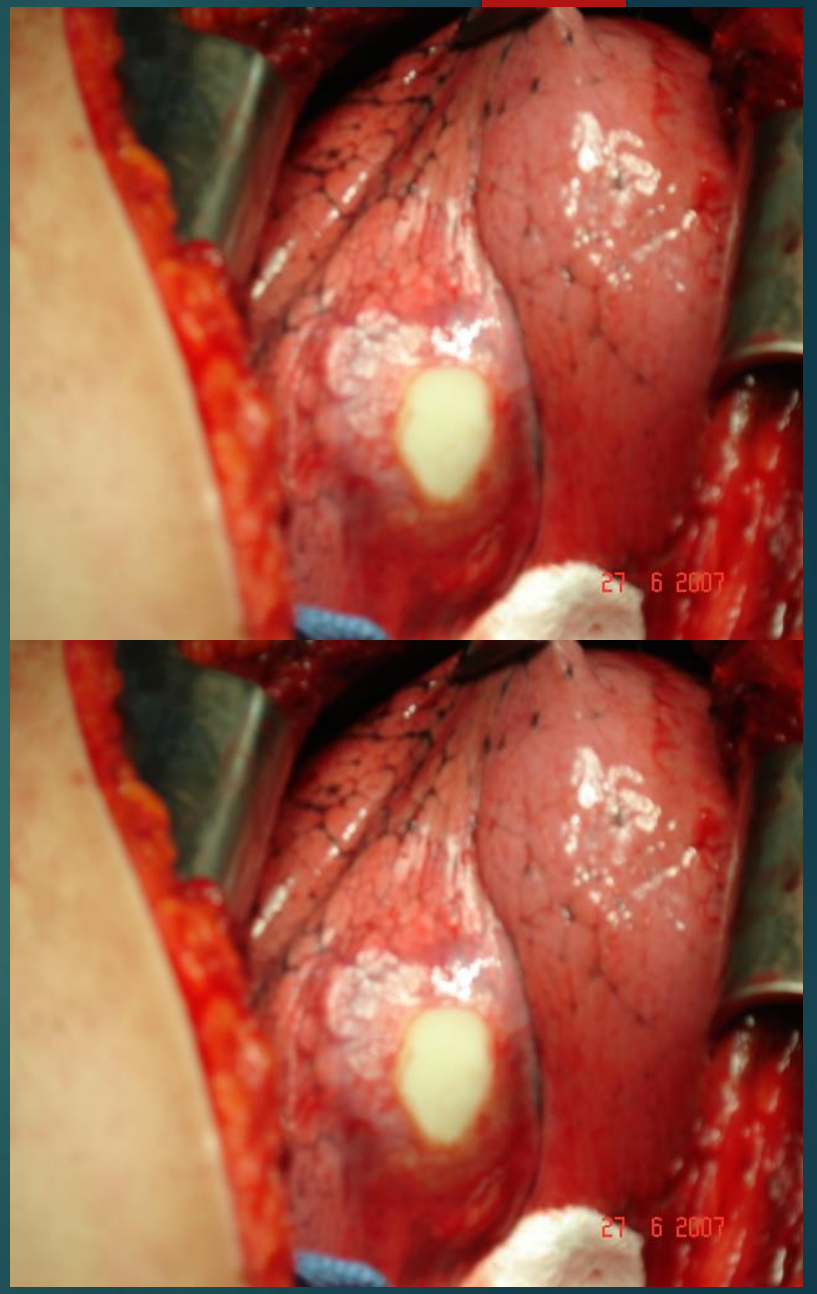
- ✓ It consists of removal of the cyst with its intact germinative membrane.
- ✓ It is suitable for the small PHCs with little risk of rupture.
- ✓ Larger cysts should not be treated because of the risk of rupture. Postoperative complications like air leak and infection may occur in few cases due to the presence of pericyst.

Intact specimen of hydatid cyst of lung

# Surgical techniques

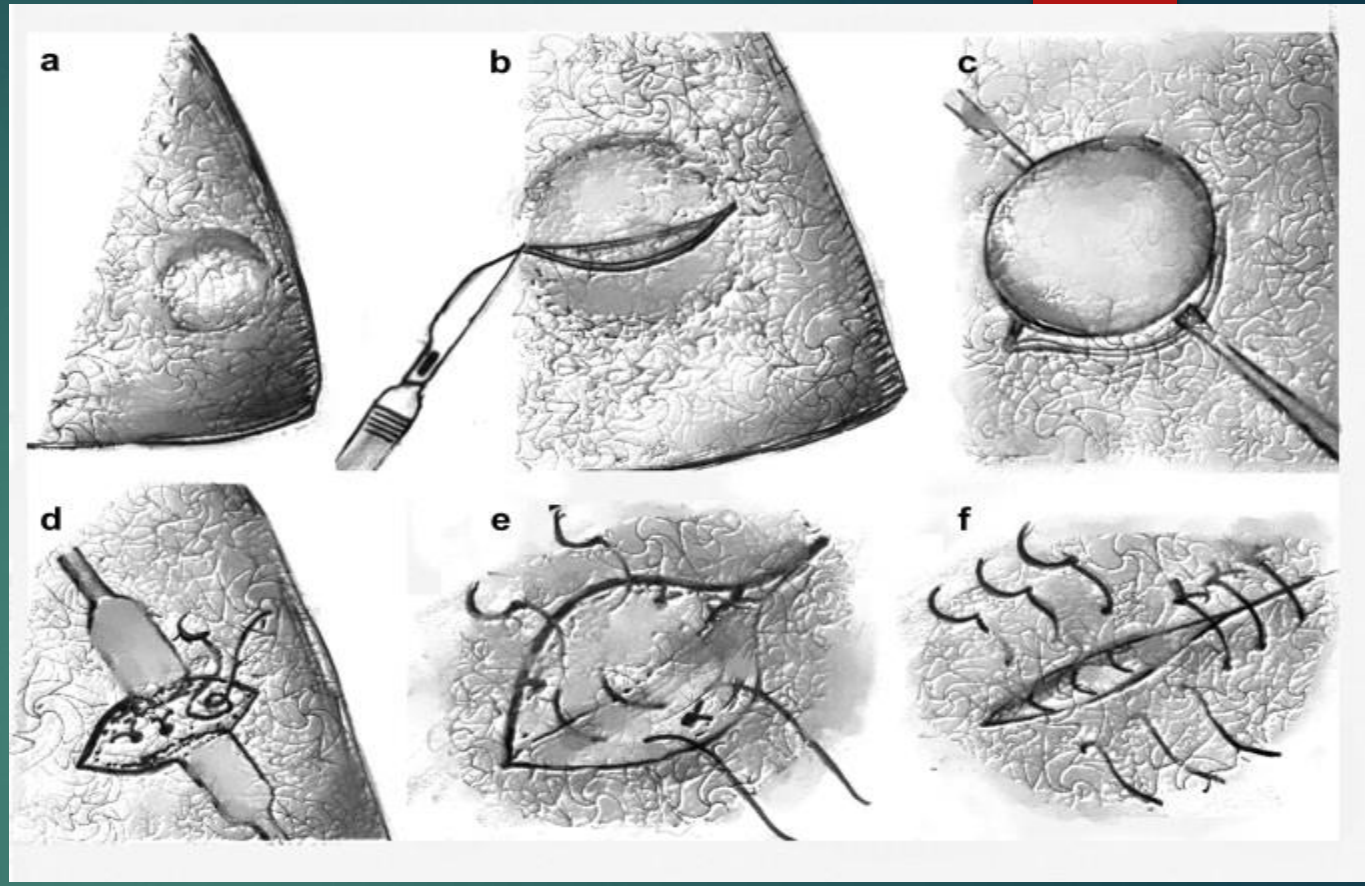
•Pericystectomy (Perez--Fontana method):

- ✓ This procedure involves removal of hydatid cyst along with the pericyst which allows complete removal of the parasite.
- ✓ Though pericyst is not a part of the parasite, pericystectomy may lead to increased risk of airway leak.



# Surgical techniques

•*Cystotomy with capitonnage (Barrett's method):*




- ✓ Cystotomy involves aspirating fluid from the cyst along with removal of the germinative membrane (Barret technique).
- ✓ Capitonnage helps in reduction of the risk of the infection of the residual cavity, airway leak, and empyema formation, but there is a risk of disfigurement of the lung parenchyma.

# Surgical techniques

- Cystostomy with closure of the bronchial openings and capitonnage (Posadas method):

✓ The procedure is similar to Barrett's method, but in this method the opened airways are closed prior to capitonnage.

✓ This helps in reduction of risk of the infection of left over cystic cavity, airway leak, as well as empyema formation.

✓ Hence, the outcome of this procedure is satisfactory except that it may lead to atelectasis due to lung parenchyma disfigurement.

- Cystostomy with the closure of the bronchial openings alone:

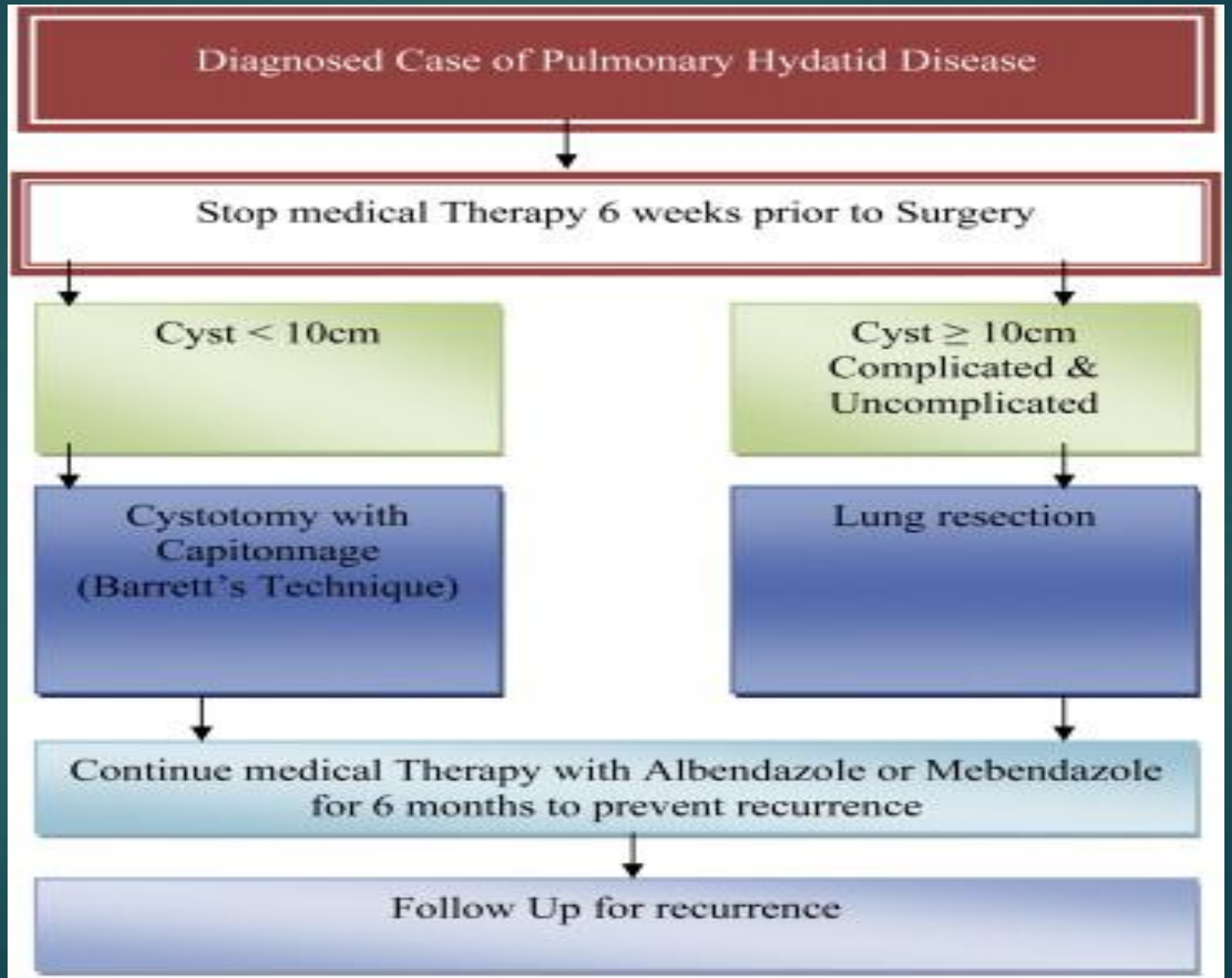
✓ In this method, the capitonnage procedure is not done which results in less disfigurement of the lung parenchyma but carries an increased risk of air leak and infection is increased.

# Surgical techniques

- Segmental resection:
  - ✓ This procedure is reserved for ruptured hydatid cyst.
  - ✓ The method follows the conventional anatomic or nonanatomic resection technique.
  - ✓ This procedure has reduced infection and recurrence rate.
  - ✓ There is reduction of lung volume and hence the compliance.

- Lobectomy:
  - ✓ This procedure involves anatomic resection of one or more of the lobes of the lung involving the cysts.

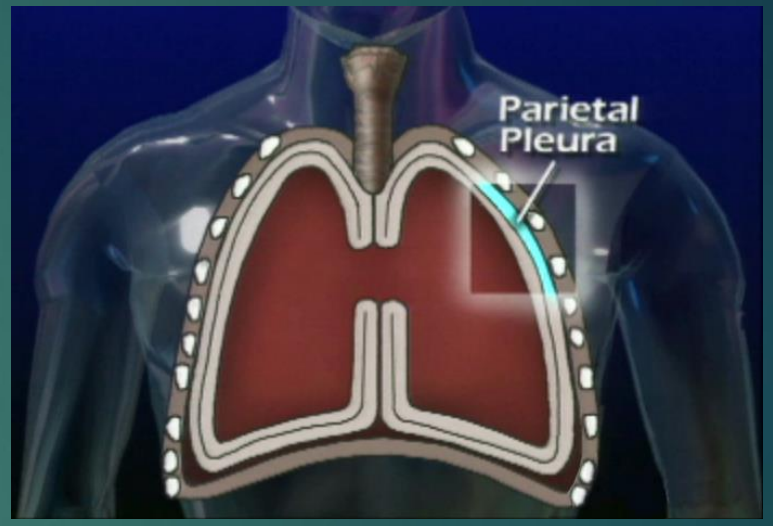
# TREATMENT ALGORITHM FOR SURGICAL INTERVENTION.

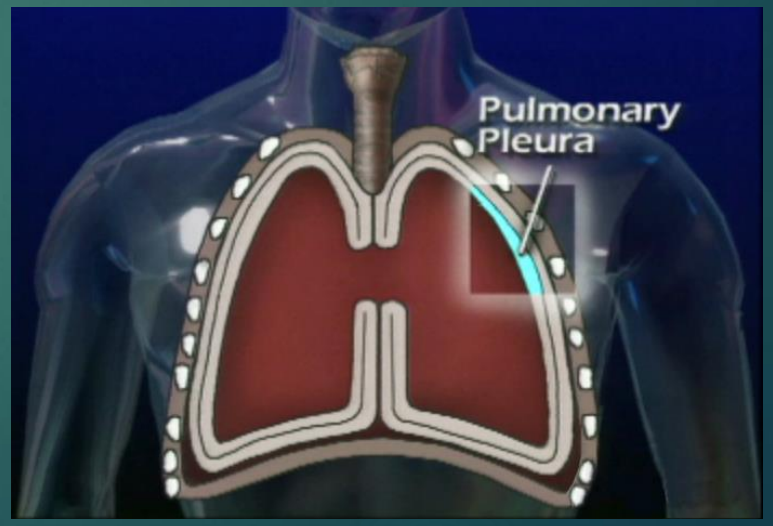


# Pleural anatomy

Lungs are surrounded by thin tissue called the pleura

- Parietal pleura lines the chest wall
- Visceral pleura covers the lung (sometimes called the pulmonary pleura**)**

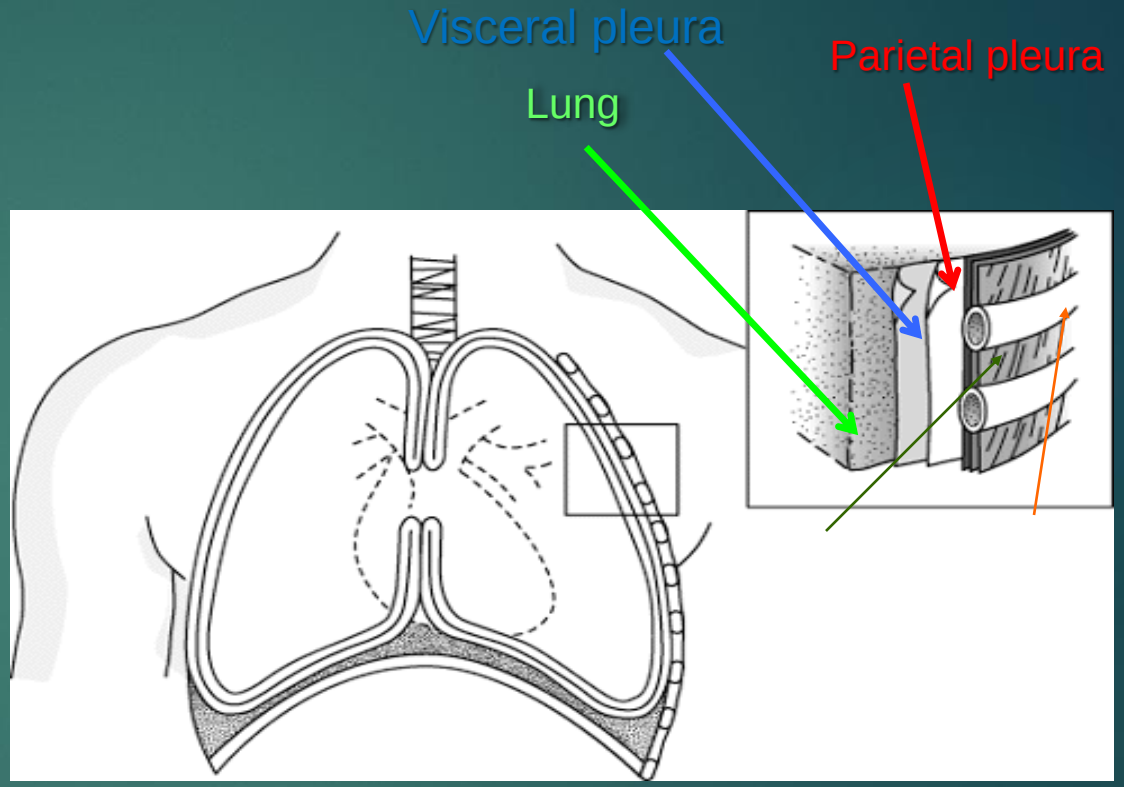


# Pleural anatomy

Normally, the two membranes are separated only by the lubricating pleural fluid

Fluid reduces friction, allowing the pleura to slide easily during breathing




***Normal Pleural Fluid Quantity: Approximately- 25mL per lung***

# Pleural physiology

- The area between the pleurae is called the pleural space (sometimes referred to as "potential space")
- Normally, vacuum (negative pressure) in the pleural space keeps the two pleurae together and allows the lung to expand and contract
- During inspiration, the intrapleural pressure is approximately -8cm$H_20$ (below atmosphere)
- During exhalation, intrapleural pressure is approximately -4cm$H_20$

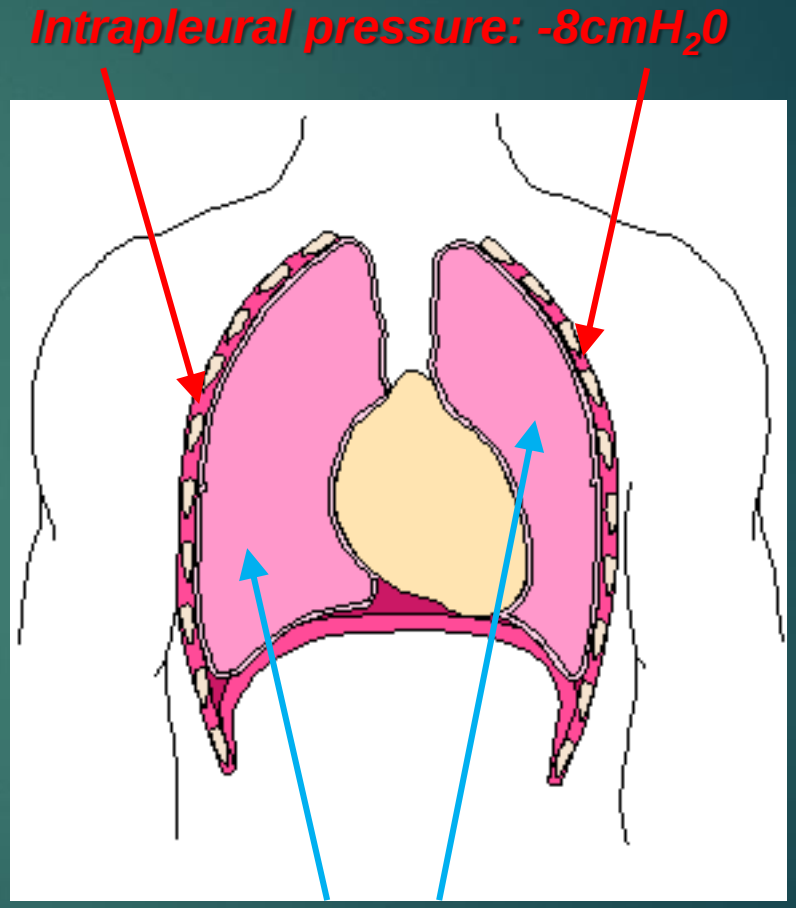
# Pressures

- Intrapulmonary pressure rises and falls with breathing
- Equalizes to the atmospheric pressure at end-exhalation (defined as 0 $cmH_2O$) because other pressures are compared to it as a baseline
- Intrapleural pressure also fluctuates with breathing ~ 4 $cmH_2O$ less than the intrapulmonary pressure
- The pressure difference of 4 $cmH_2O$ across the alveolar wall creates the force that keeps the stretched lungs adherent to the chest wall

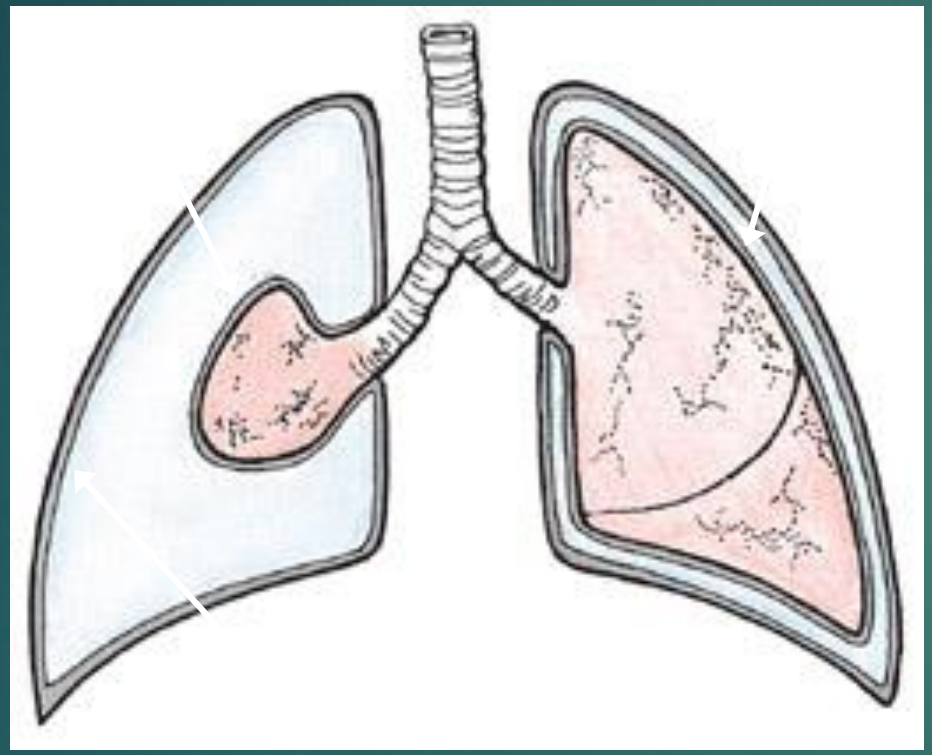
# Anatomy & physiology of the chest

## *When pressures are disrupted:*

the air or fluid enters the pleural space between the parietal and visceral pleura, the pressure gradient  disappears and the lung collapses.

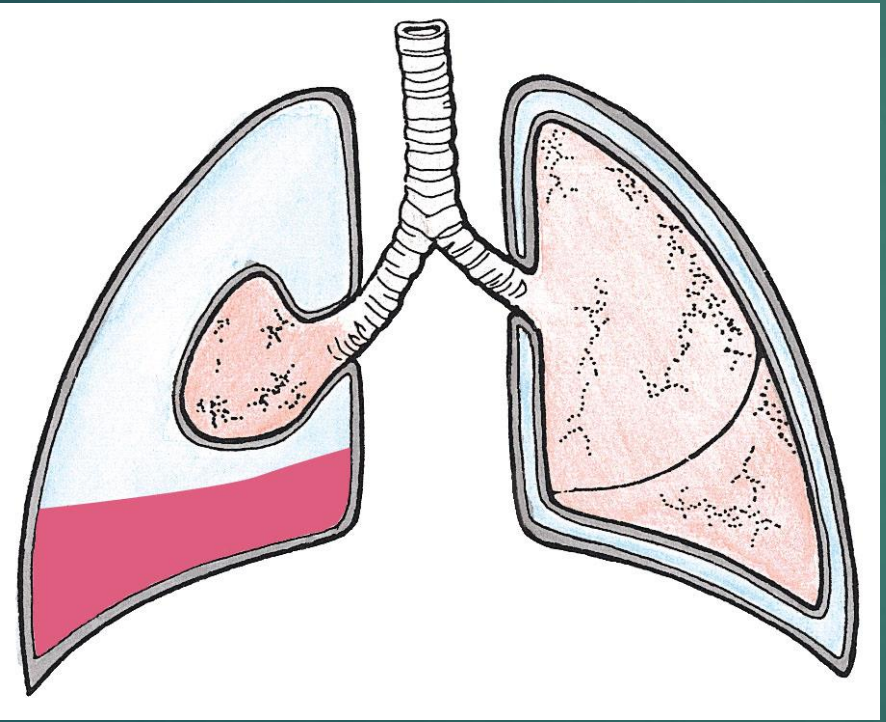


# Conditions requiring chest drainage



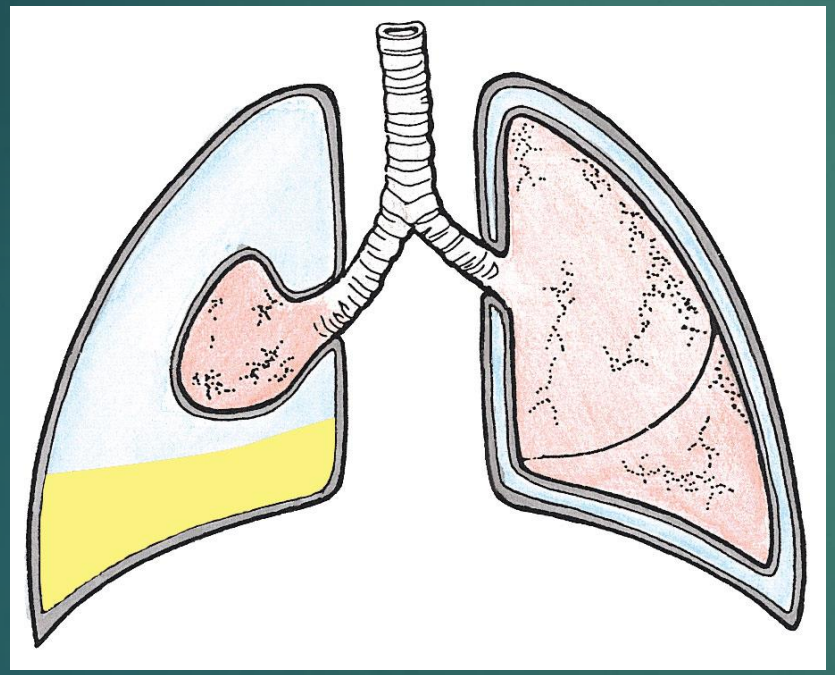
*Air between the pleurae is a pneumothorax*

# Conditions requiring chest drainage



*Blood in the pleural space is a hemothorax*

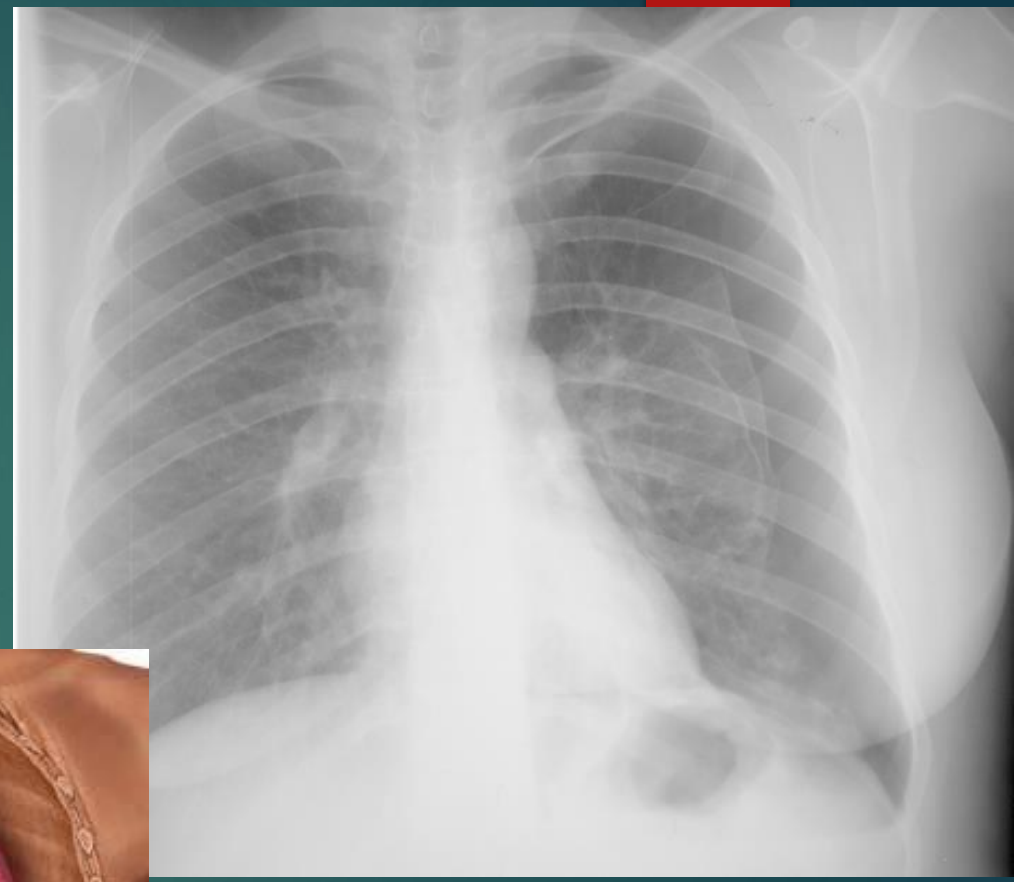
# Conditions requiring chest drainage



*Transudate or exudate in the pleural space is a pleural effusion*

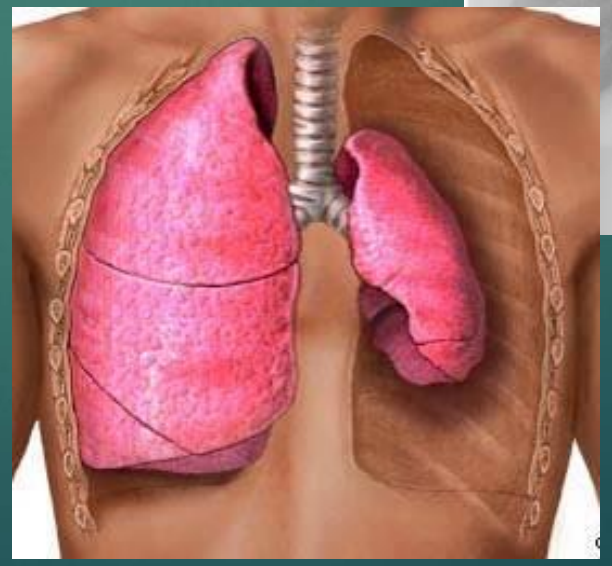
# Pneumothorax Defined as:

- Definition – *"What?"*
  - ✓ *"Pneumo"*- gas *"Thorax"* – chest cavity



Pneumothorax

- Occurs when there is an opening on the surface of the lung or in the airways, in the chest wall — or both, creating an actual space



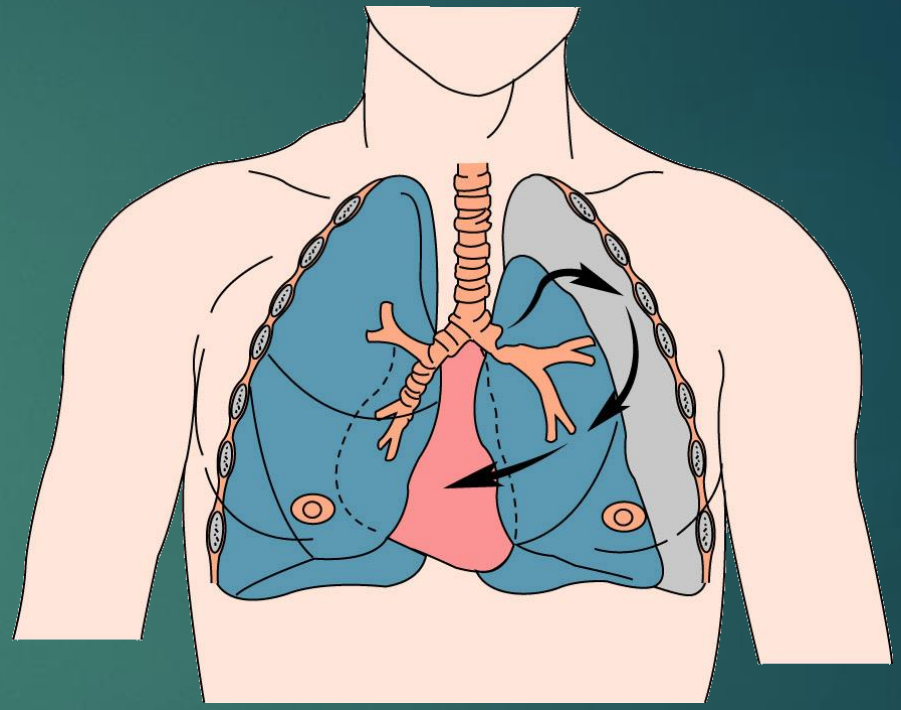
# Types of Pneumothorax

- Spontaneous Pneumothorax
  I. Primary - rupture of subpleural bleb
  II. Secondary - underlying lung/pleural disease
    - ✓ Emphysema
    - ✓ Chronic bronchitis, asthma, TB, …
- Traumatic Pneumothorax
  I. Open
    - ✓ Chest wall is penetrated : outside air enters pleural space
  II. Closed
    - ✓ Chest wall is intact Ex. Fractured rib

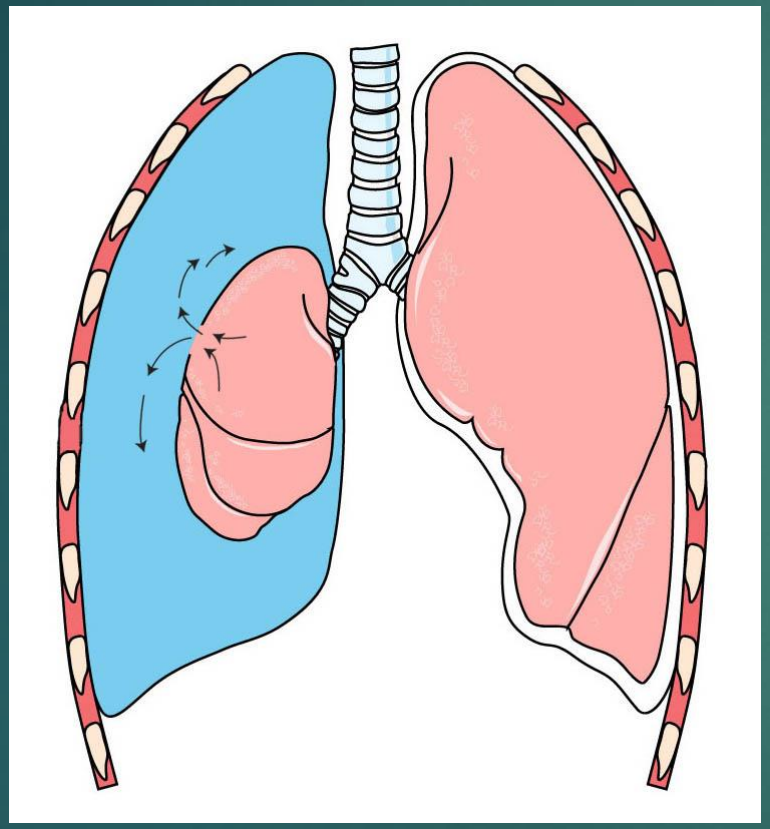
- Iatrogenic – thoracentesis, transthoracic needle lung biopsy, etc.

# Closed pneumothorax

- Chest wall is intact
- Rupture of the lung and visceral pleura (or airway) allows air into the pleural space



# Closed pneumothorax



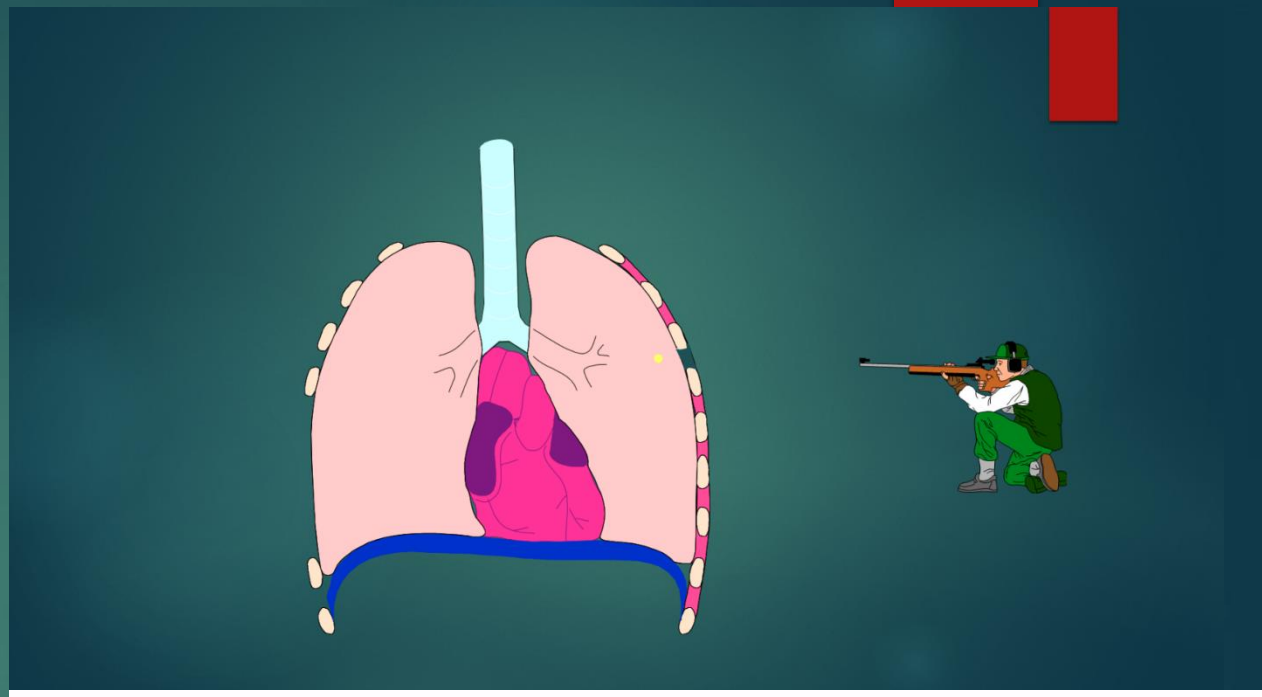
- In a closed pneumothorax, a patient who is breathing spontaneously can have an equilibration of pressures across the collapsed lung
- The patient will have symptoms, but this is not life-threatening

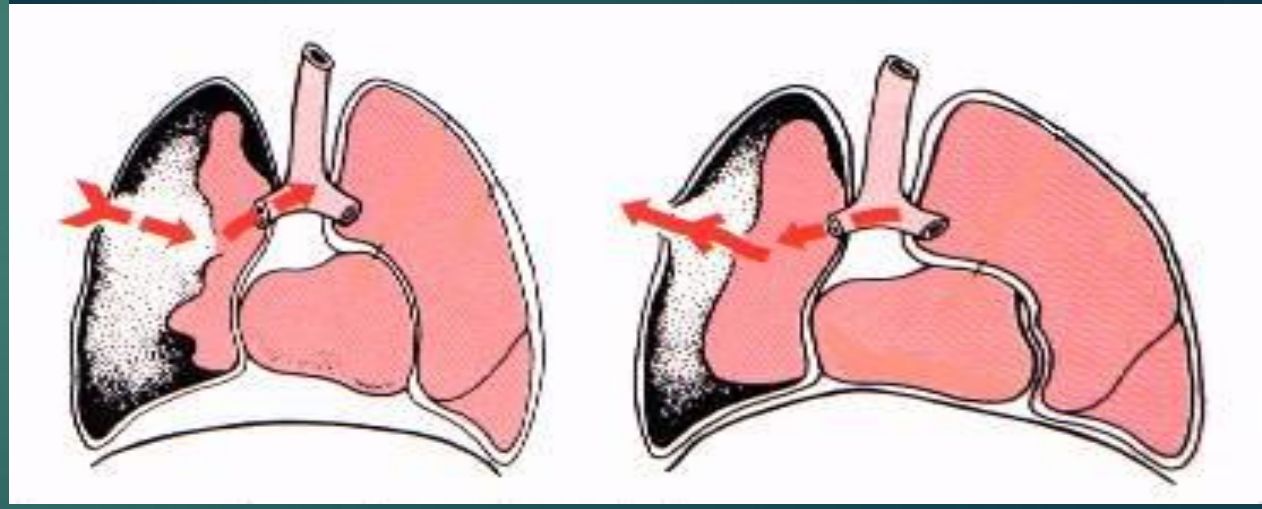
# Open pneumothorax

- Opening in the chest wall (with or without lung puncture)
- Allows atmospheric air to enter the pleural space
- Penetrating trauma: stab, gunshot, impalement

# Open pneumothorax

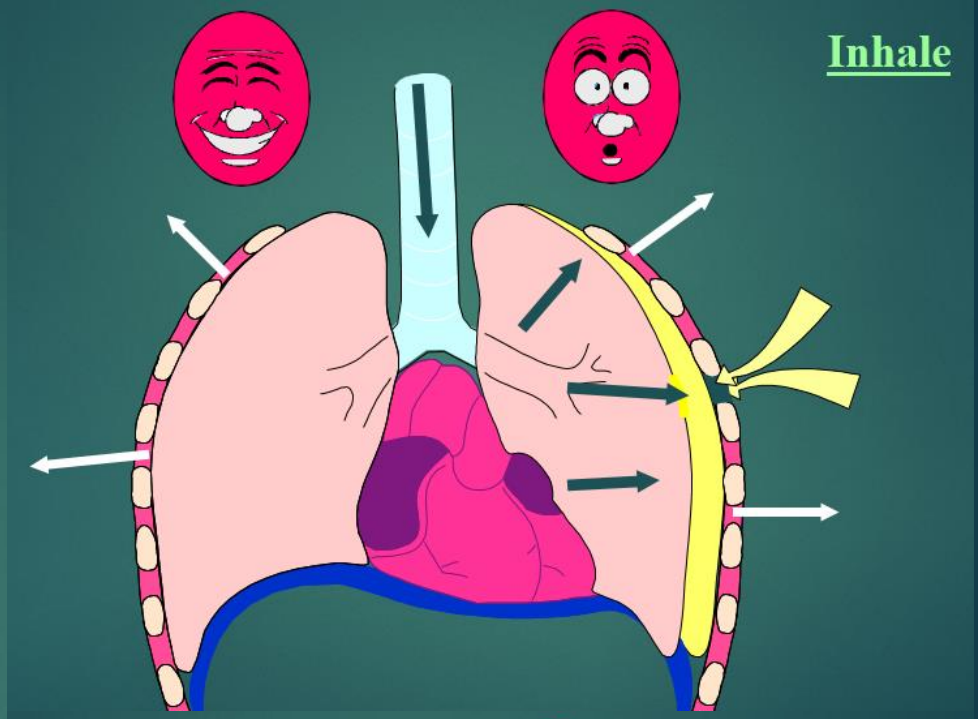
- An open pneumothorax is also called a "sucking chest wound"
- With the pressure changes in the chest that normally occur with breathing, air moves in and out of the chest through the opening in the chest wall

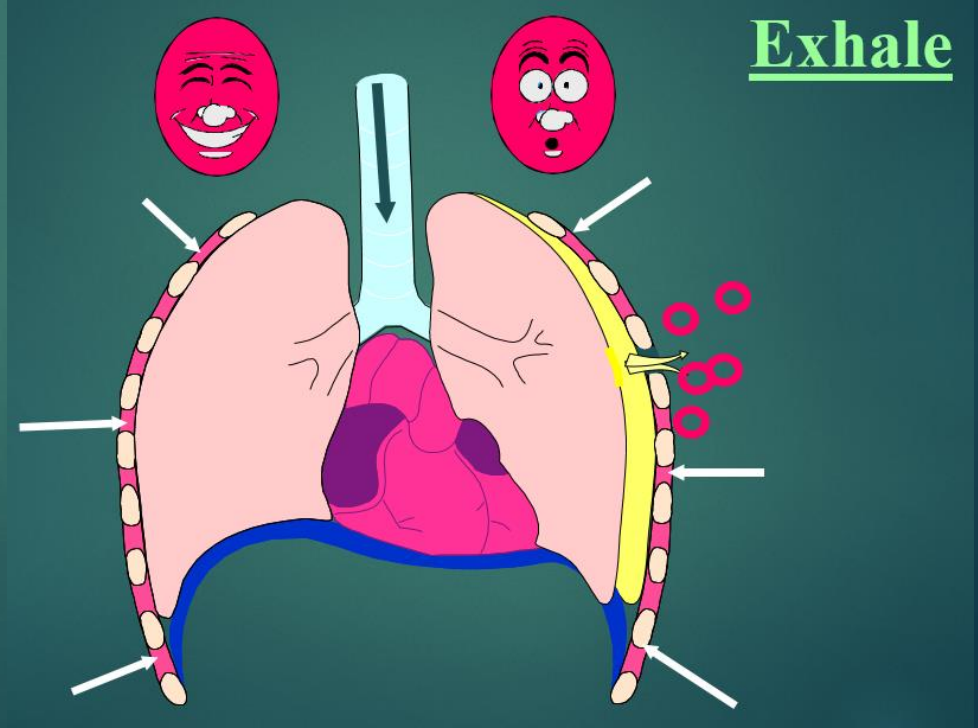




# Open Pneumothorax

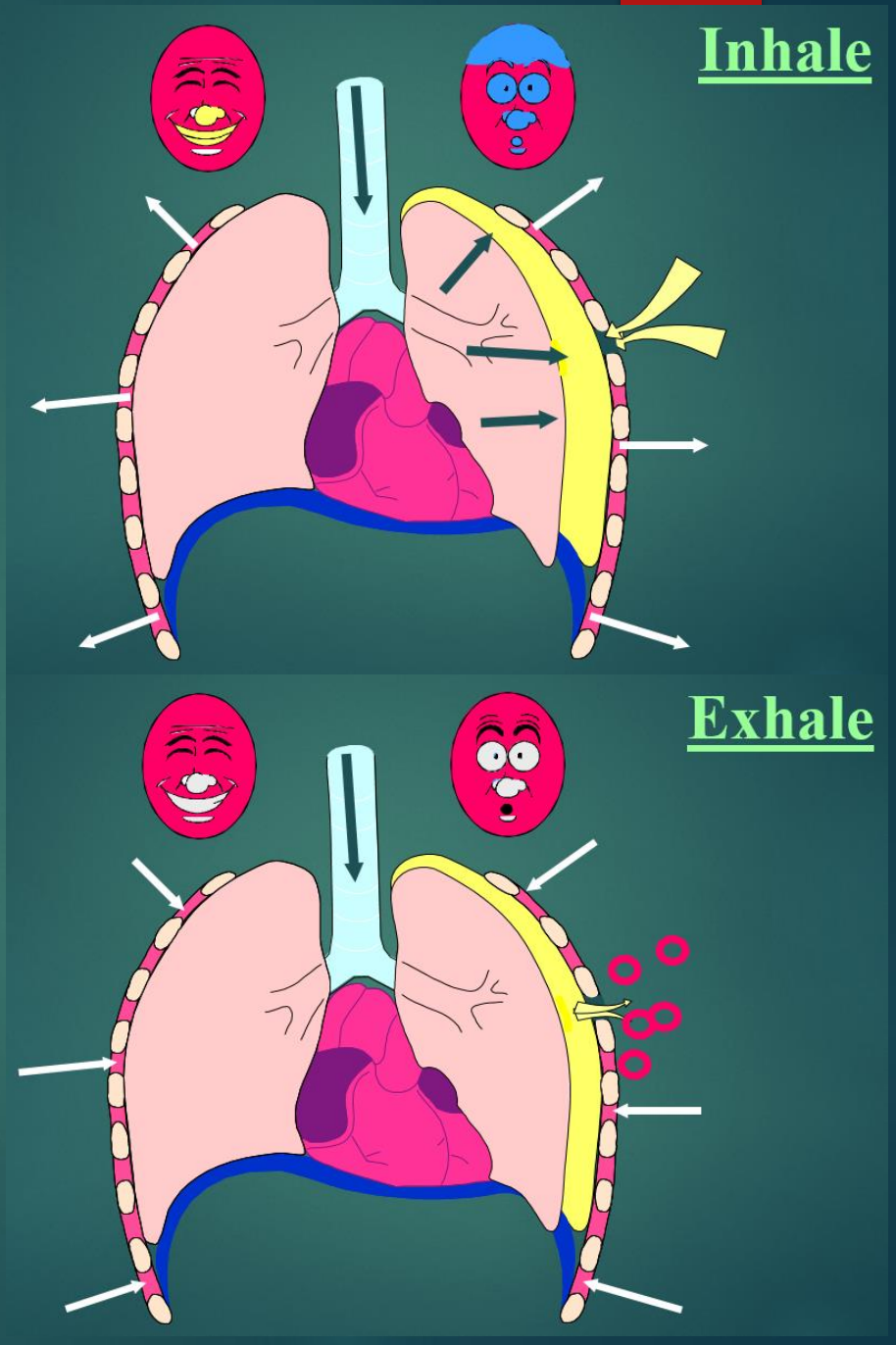
- *When the opening is sufficiently large, respiratory mechanics are impaired.*
- *Sometimes can causes the lung to collapse due to increased pressure in pleural cavity*



# Open Pneumothorax

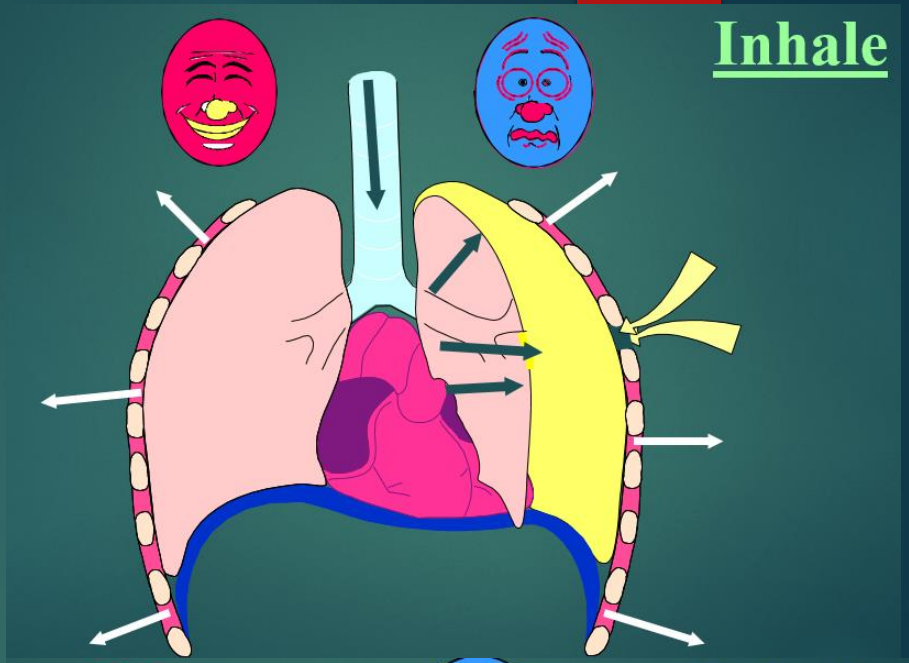
- Can be life threatening and can deteriorate rapidly if is not correct

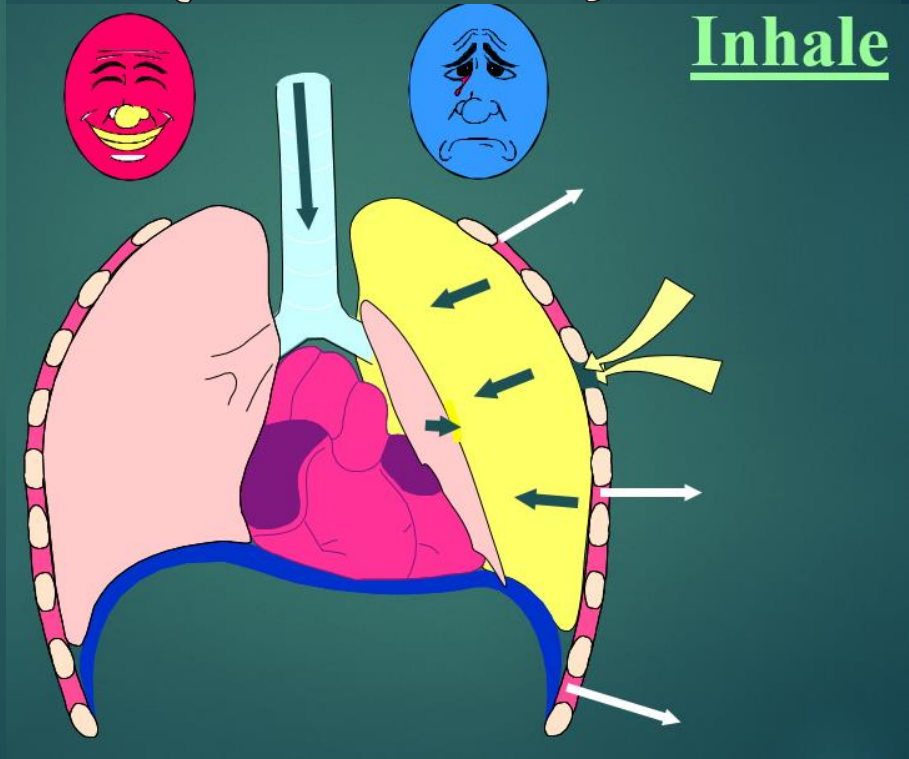


# Open Pneumothorax

- ✓ *Immediate management is to cover the wound with a rectangular sterile occlusive dressing.*
- ✓ *Tube thoracostomy should be done when the patient is stabilized.*
- ✓ *The wound may require later surgical repair.*

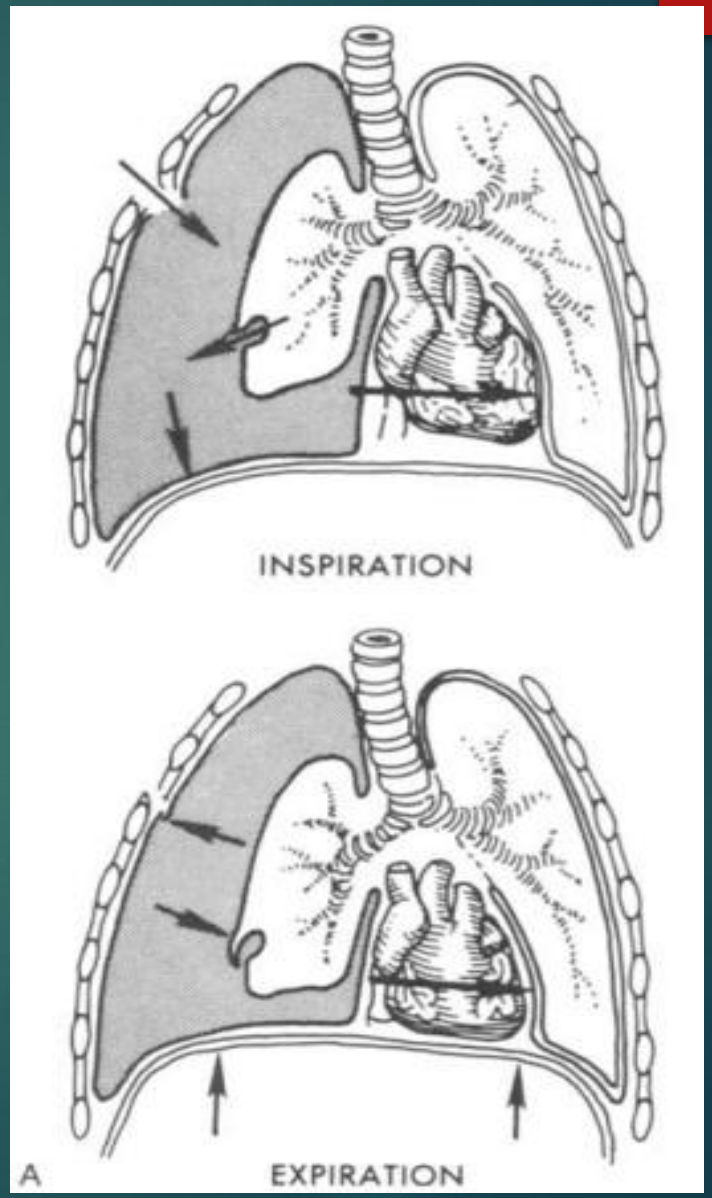
*Thus, the basic principle is to change the open pneumothorax into the closed one*



# Tension pneumothorax:

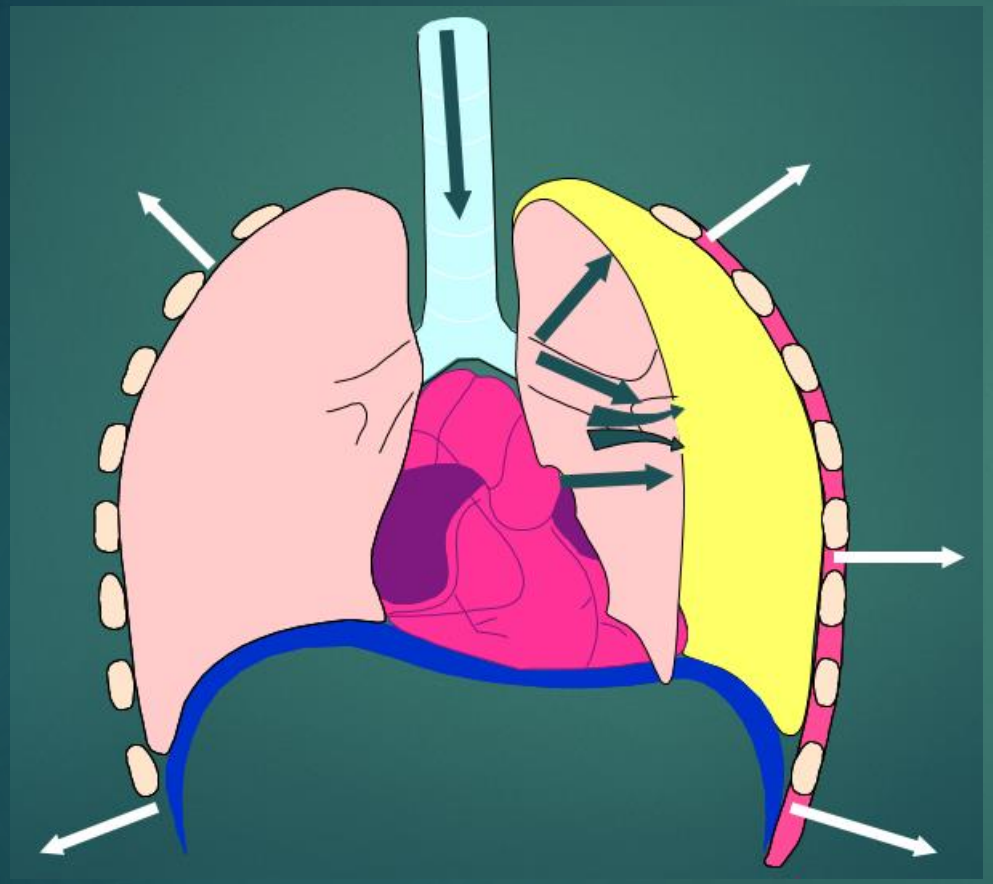
- The accumulation of air under pressure in the pleural space
  - ✓ "Ball-valve mechanism"
  - ✓ Injury to pleura creates a tissue flap that opens on inspiration and closes on expiration

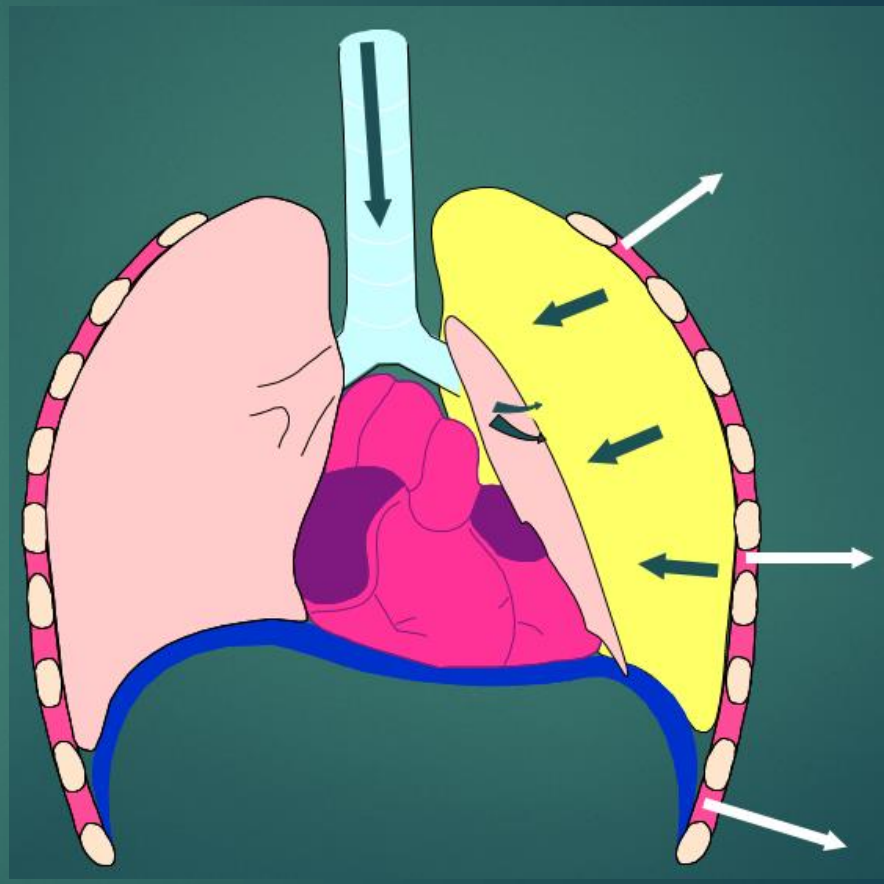


# Tension pneumothorax:

- So the air pressure within the thorax mounts higher than atmospheric pressure, compresses the lung, may displace the mediastinum and its structures (including the lung) toward the opposite side, and cause cardiopulmonary impairment (decrease cardiac output)

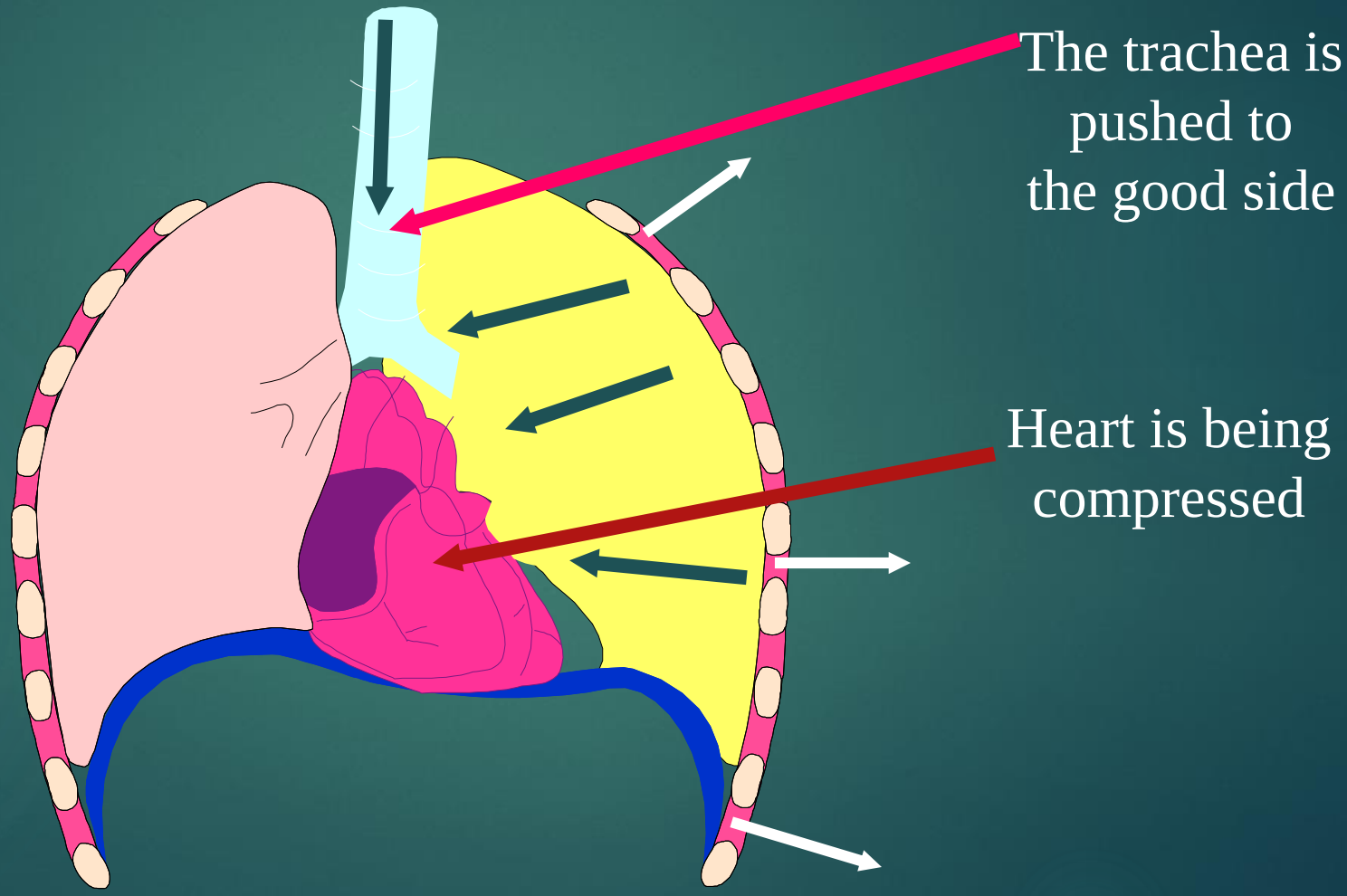
# Tension Pneumothorax



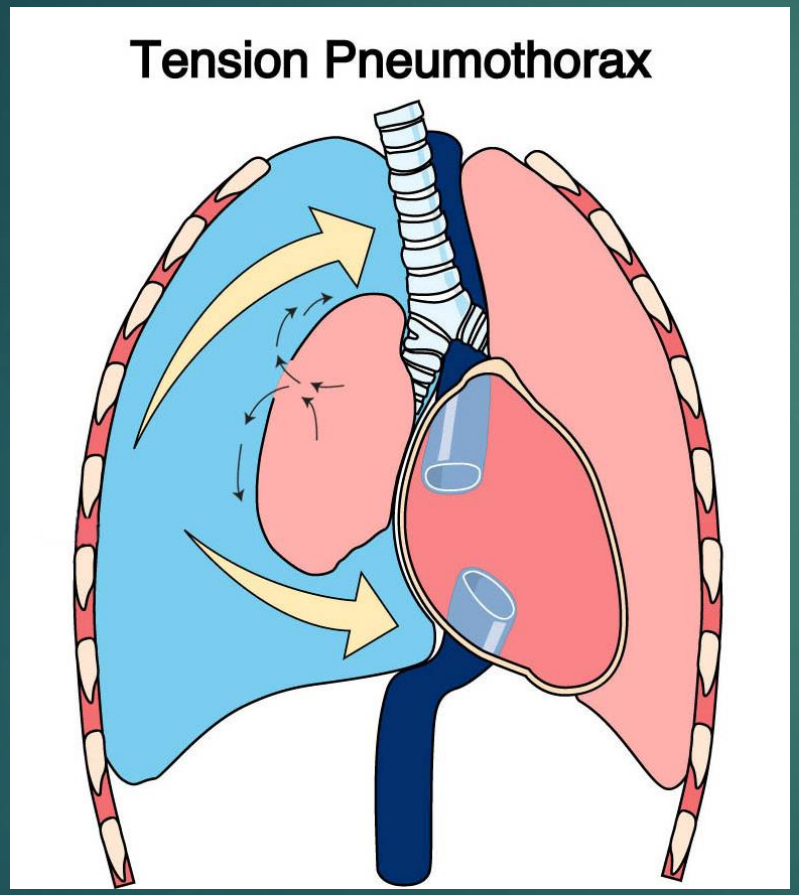


***Each time we inhale, the lung collapses further. There is no place for the air to escape..***

# Tension Pneumothorax

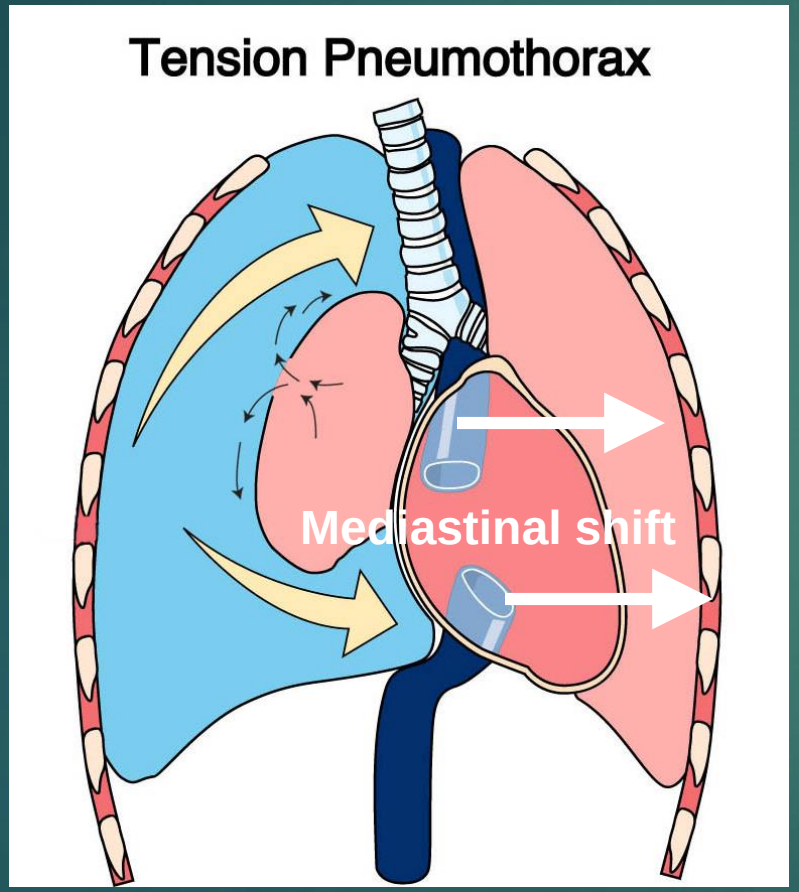


# Tension pneumothorax




- So, tension pneumothorax creates positive pressure in the pleural space that continues to build
- That pressure is then transmitted to the mediastinum (heart and great vessels)

# Tension pneumatorax: mediastinal shift




- Mediastinal shift occurs when the pressure gets so high that it pushes the heart and great vessels into the unaffected side of the chest

# Tension pneumatorax: mediastinal shift

- Mediastinal shift can quickly lead to cardiovascular collapse
- The vena cava and the right side of the heart cannot accept venous return
- With no venous return, there is no cardiac output
- No cardiac output = not able to sustain life

- ***CONCLUSION: A tension pneumothorax can kill***

# Tension pneumothorax

- Immediate, live-saving treatment is placing a needle to relieve pressure followed by chest tube

# Clinical Presentation

- Sudden onset chest pain sharp in nature
- Sense of impending doom
- Dyspnea
- Shortness of breath
- Tachypnea
- Tachycardia
- Cyanosis
- Decrease or abscent  breath sounds

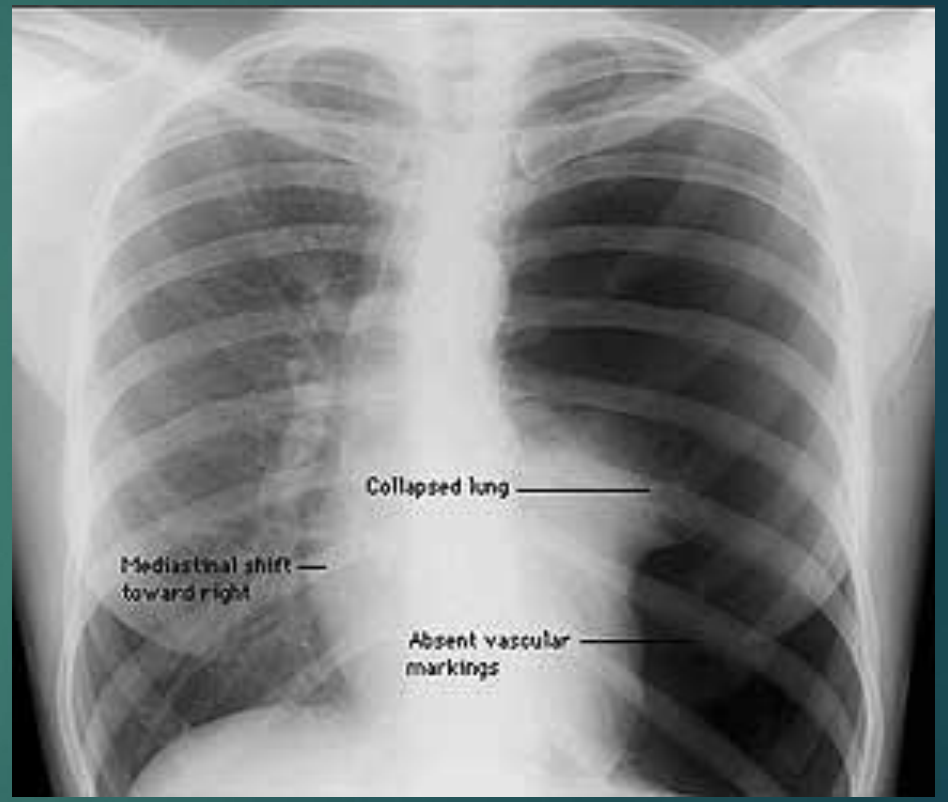
# Physical Exam - Signs

Unstable patients vs. Stable patients

- Vital Signs
- Asymmetric chest expansion
- Deviated trachea
- Diminished breath sounds unilaterally
- Hyper-resonance unilaterally
- Decreased tactile fremitus

# Imaging

- Plain Radiographs
  - Upright PA on inspiration
    - Detect other pathologies: pneumonia, cardiac, etc.
  - Partially collapsed lung
  - Tension Pneumothorax
    - Trachea and mediastinum deviate contralaterally
    - Ipsilateral depressed hemi-diaphragm
- Chest CT
  - Not routine
  - Only to assess the need for surgery (thoracotomy)



# Diagnosis

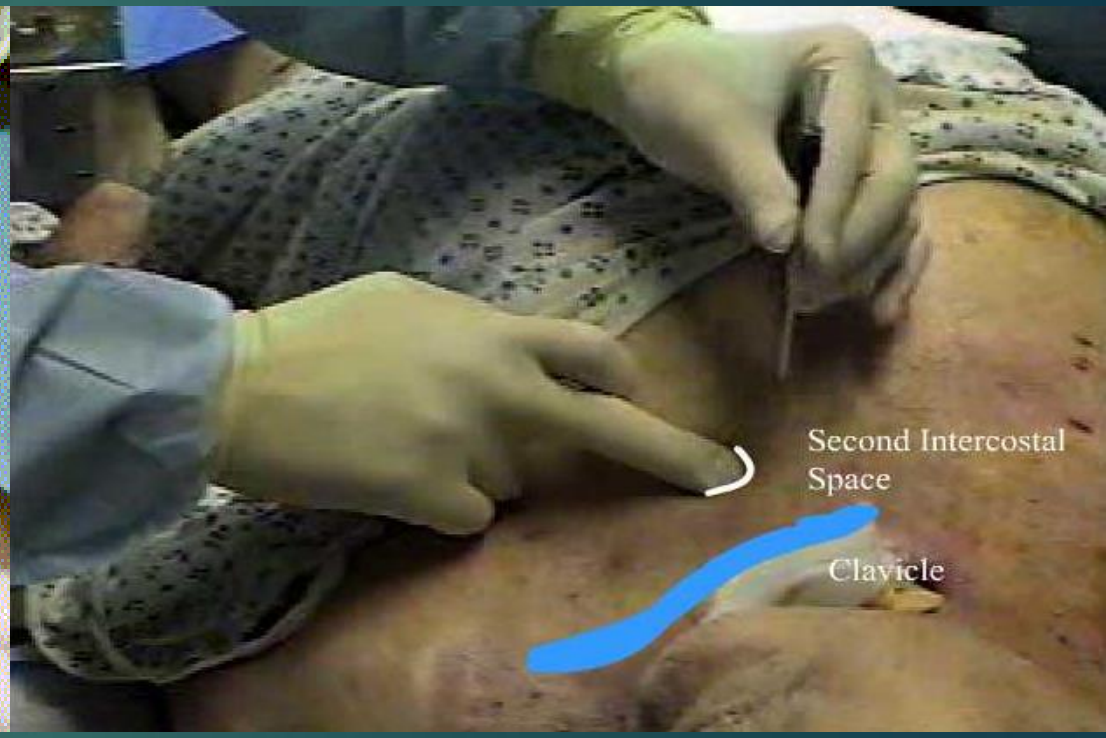
- Unstable patient
  - Thoracentesis
    - Rapid release of air
    - Vital signs stabilize rapidly
- Stable patient
  - CXR
    - Monitor size by measuring distance from lateral lung margin to chest wall
    - Be sure that pneumothorax is not expanding

# Treatment

- Small pneumothorax
  - ✓ Resolve over days to weeks
  - ✓ Supplemental oxygen and observation
- Tension pneumothorax
  - ✓ Immediate decompression via chest tube or needle thoracostomy

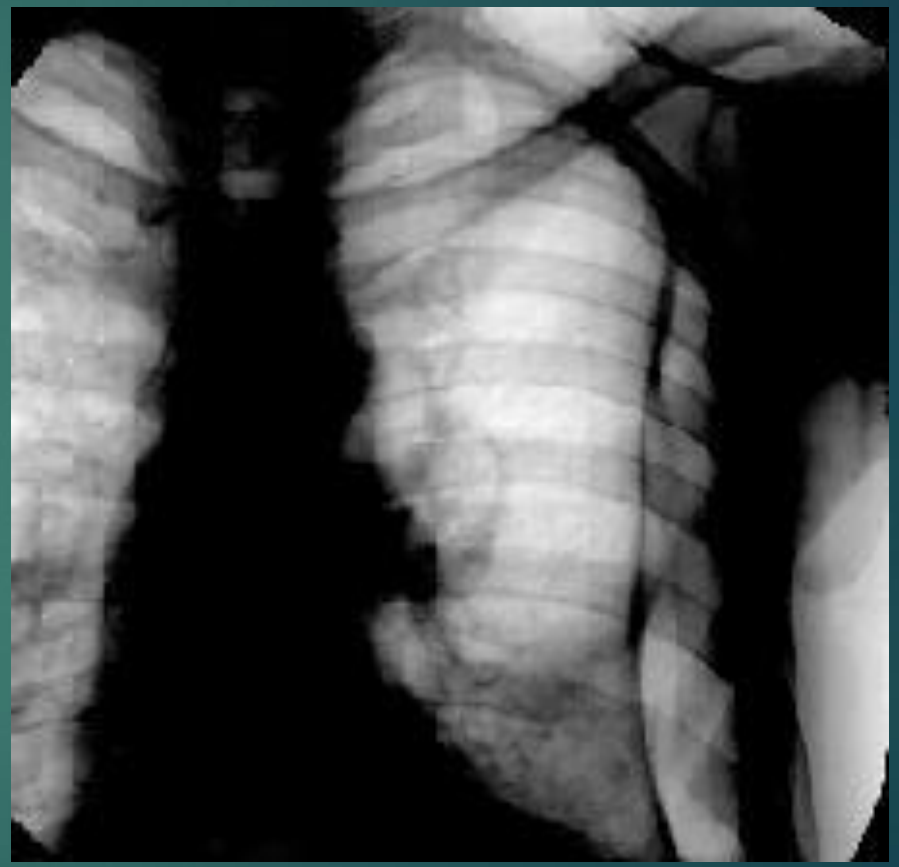
# NEEDLE CHEST DECOMPRESSION


# Needle Decompression



# SPONTANEOUS PNEUMOTHORAX

is the entry of air in a pleural space with the further lung collapse, which not associated with traumatic damage of chest or pulmonary tissue.



# Etiology

- SP is caused by a rupture of a cyst or a small sac (bleb) on the surface of the lung (apical segment of upper lobe and or superior segment of lower lobe)

- A pneumothorax can also develop as a result of underlying lung diseases, including cystic fibrosis, chronic obstructive pulmonary disease (COPD), lung cancer, and infections of the lungs.

# Pathogenesis

✓ As a result of spontaneous disrupture of lung blebs and subpleural air cysts occurs the damage of pleural visceral membrane.

✓ It causes entry of air in pleural space.

✓ Owing to its leakage the elastic pulmonary tissue collapses.

✓ The degree of the collapse of lung depends on amount of air, that has penetrated a pleural space.

# Types of spontaneous pneumothorax

- A spontaneous pneumothorax, also referred to as a primary pneumothorax, occurs in the absence of a traumatic injury to the chest or a known lung disease

- A secondary (also termed complicated) pneumothorax occurs as a result of an underlying condition

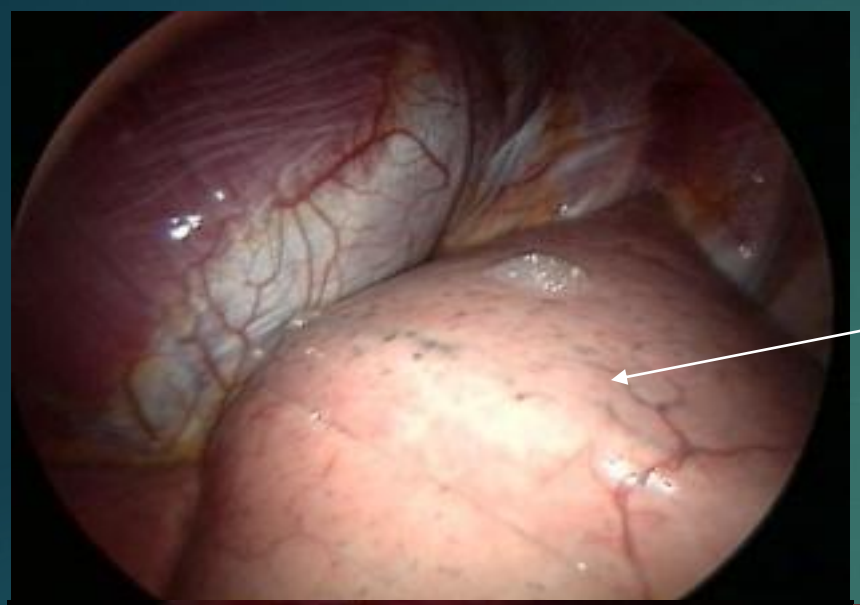
# CLASSIFICATION

- Unilateral or bilateral.
- Partial (lung collapse to 1/3 of its volume).
- Subtotal (lung collapse to 2/3 of its volume).
- Total (lung collapse more than 2/3 of its volume).
- Tension or valvular (complete collapse of lungs and shift of mediastinum in the opposite side).
- Rigid (neglected pneumothorax with thickened visceral pleura).

Subtotal spontaneous pneumothorax

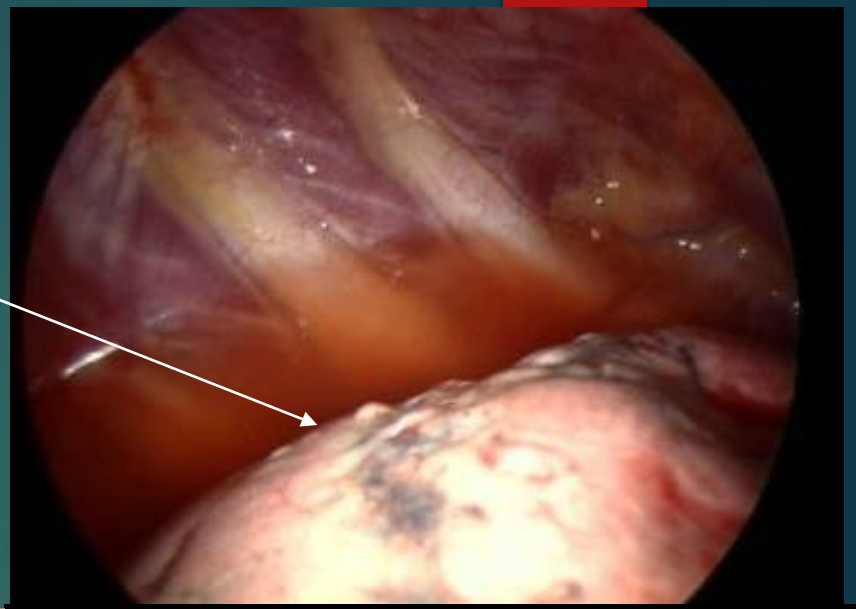
Total spontaneous pneumothorax

# ENDOTHORACIC IMAGE IN NORMAL LUNG & IN SPONTANEOUS PNEUMATHORAX

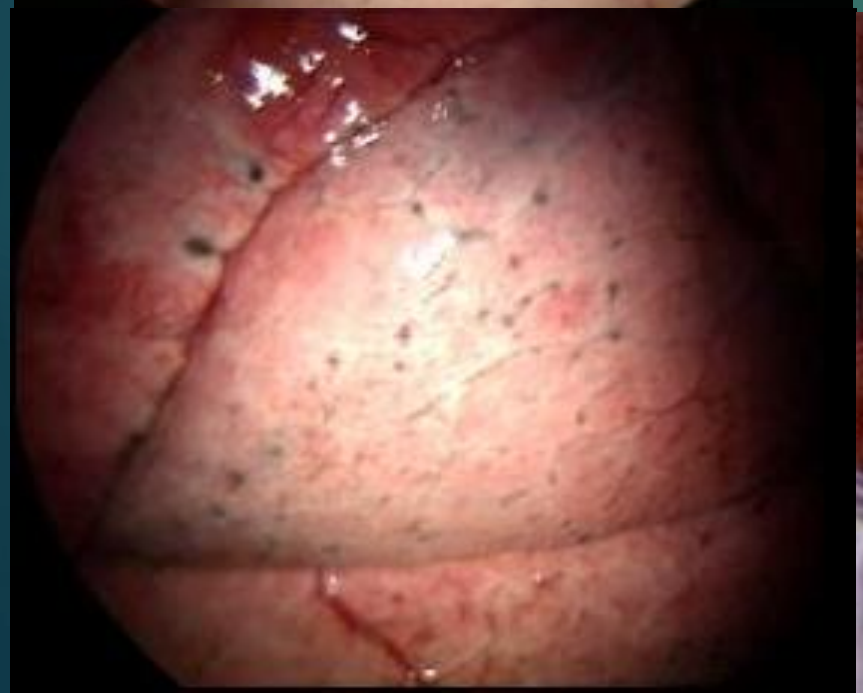


Normal

Blebs



Bubbles

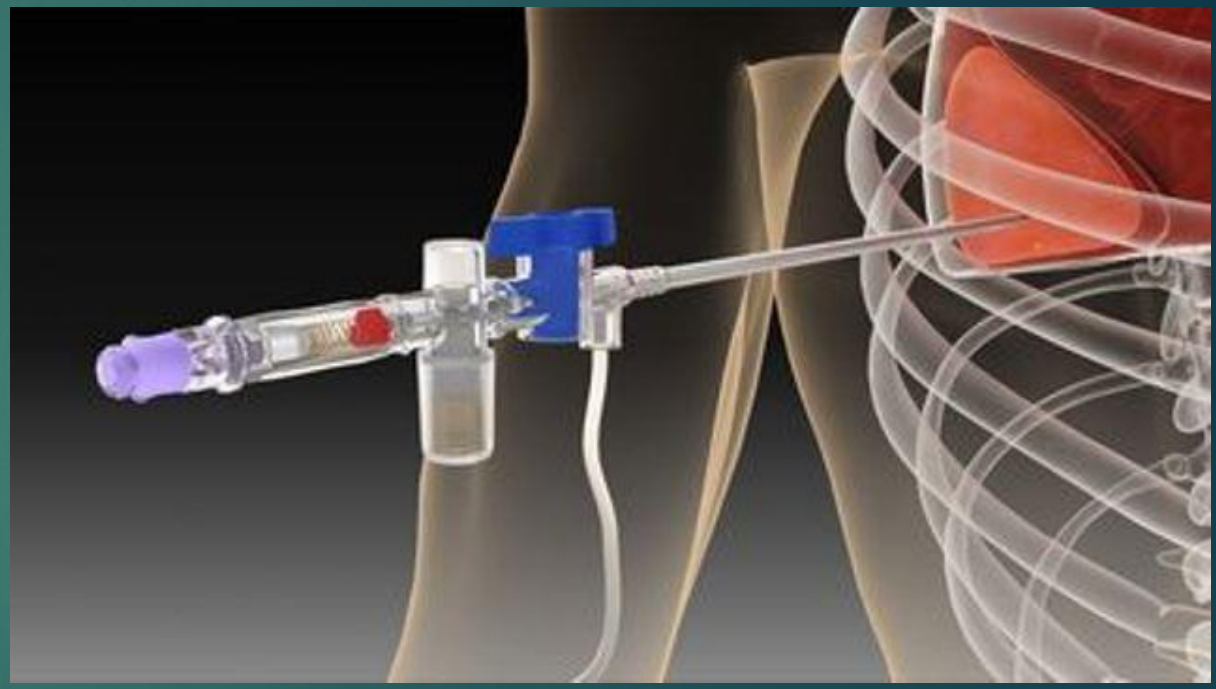


# Diagnosis

- ✓Complaint and anamnesis of disease.
- ✓Physical findings.
- ✓Routine chest film (direct and lateral projection).
- ✓Thoracentesis
- ✓Thoracoscopy.
- ✓Tomography of lungs.

# Management of SP

- Needle aspiration (NA) is as effective as large-bore (>20 F) chest.
- NA should not be repeated unless there were technical difficulties.
- Following failed NA, small-bore (<14 F) chest drain insertion is recommended.



# Management of SP

Chemical pleurodesis- the instillation of substances into the pleural space should lead to an aseptic inflammation, with dense adhesions leading ultimately to pleural symphysis.
Tetracycline used to be recommended as the first-line sclerosant therapy for both primary and secondary pneumothoraces as it proved to be the most effective sclerosant.

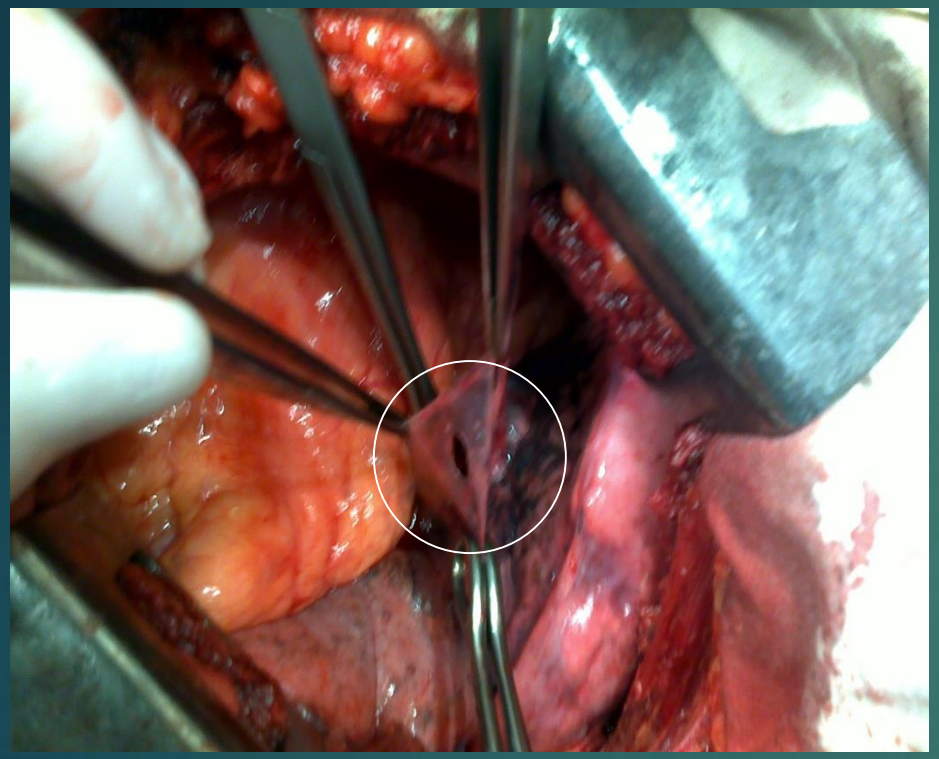
# Indications for surgical treatment as follows:

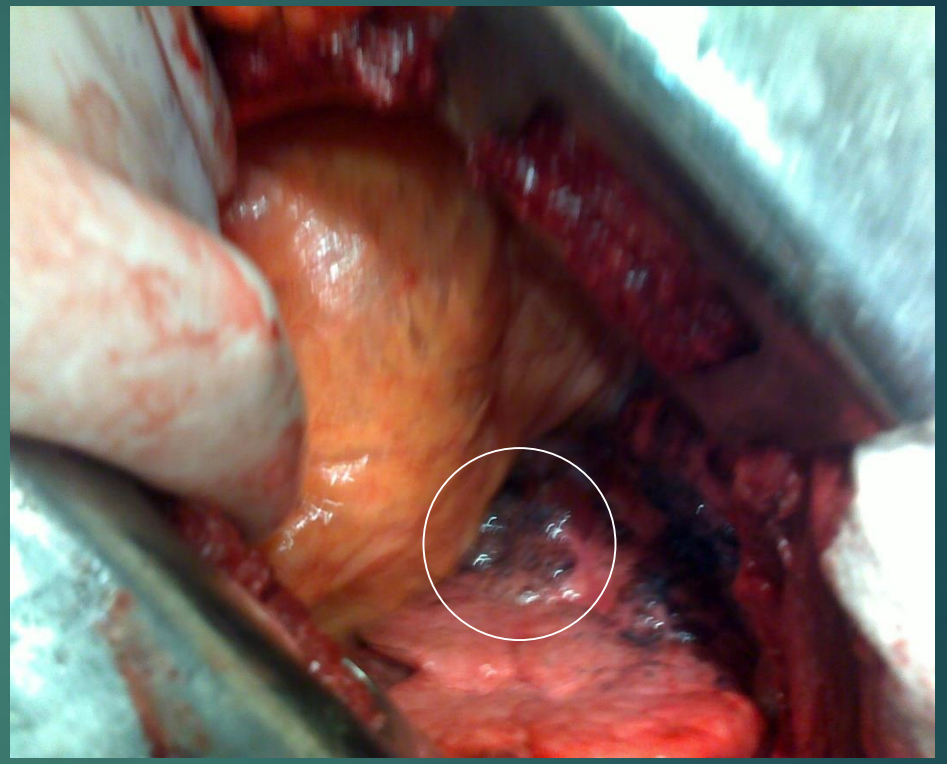
- ✓Second ipsilateral pneumothorax.
- ✓First contralateral pneumothorax.
- ✓Synchronous bilateral spontaneous pneumothorax.
- ✓Persistent air leak (despite 5–7 days of chest tube drainage) or failure of lung re-expansion.
- ✓Spontaneous haemothorax.
- ✓Professions at risk (eg, pilots, divers).
- ✓Pregnancy.

# Surgical strategies:

- Open thoracotomy and pleurectomy remain the procedure with the lowest recurrence rate (approximately 1%) for difficult or recurrent pneumothoraces.
- Video-assisted thoracoscopic surgery (VATS) with pleurectomy and pleural abrasion is better tolerated but has a higher recurrence rate of approximately 5%.

# Surgical treatment:





Volume of operation depends on extension of the process: liquidation of alveolar fistula, wedged resection of lung or lobectomy.

# Hemothorax

- Hemothorax is the presence of blood in the pleural space.
- The source of blood may be the chest wall, lung parenchyma, heart, or great vessels.
- Hemothorax is usually a consequence of blunt or penetrating trauma.
- Much less commonly, it may be a complication of disease, may be iatrogenically induced, or may develop spontaneously.

# Bleeding into pleural space

- ✓ May result from either extrapleural or intrapleural injury.

## Extrapleural injury

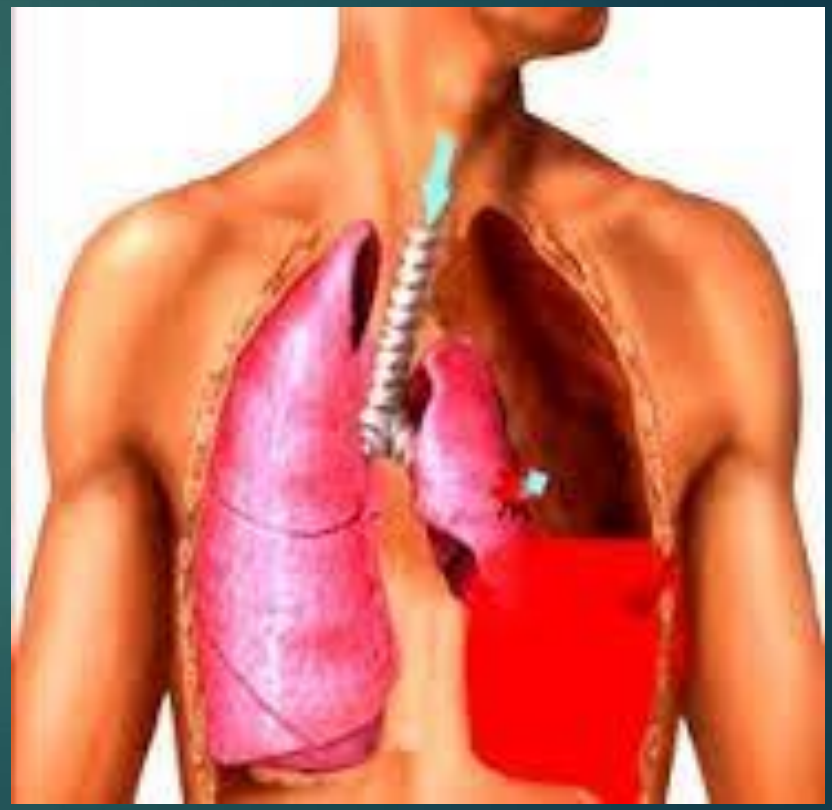
- Traumatic disruption of the chest wall tissues.
- The most likely sources of significant or persistent bleeding from chest wall injuries are the intercostal and internal mammary arteries.
- In nontraumatic cases, rare disease processes within the chest wall (eg, bony exostoses) can be responsible.

# Intrapleural injury

- Massive hemothorax  may result from injury to major arterial or venous structures contained within the thorax or from the heart itself:
- ✓ The aorta and its brachiocephalic branches,
- ✓ the main or branch pulmonary arteries,
- ✓ the superior vena cava
- ✓ the brachiocephalic veins,
- ✓ the inferior vena cava,
- ✓ the azygos vein, and the major pulmonary veins.
- Injury to the heart can produce a hemothorax if a communication exists between the pericardium and the pleural space.

# Etiology

- ✓ The most common cause of hemothorax is trauma.
  - Penetrating injuries of the lungs, heart, great vessels, or chest wall are obvious causes of hemothorax;
  - They may be accidental, deliberate, or iatrogenic in origin.
  - In particular, central venous catheter and thoracostomy tube placement are cited as primary iatrogenic causes.
  - Blunt chest trauma can occasionally result in hemothorax by laceration of internal vessels.



# Etiology

- ✓ The causes of nontraumatic or spontaneous hemothorax include the following:
  - Neoplasia (primary or metastatic)
  - Blood dyscrasias, including complications of anticoagulation
  - Pulmonary embolism with infarction
  - Bullous emphysema
  - Necrotizing infections
  - Tuberculosis
  - Pulmonary arteriovenous fistulae
  - Hereditary hemorrhagic telangiectasia
  - Nonpulmonary intrathoracic vascular pathology (eg, thoracic aortic aneurysm or aneurysm of the internal mammary artery)
  - Catamenial

# Pathophysiology

The physiologic response to the development of a hemothorax is manifested in two major areas: hemodynamic and respiratory.

## Hemodynamic response

- Hemodynamic changes vary, depending on the amount of bleeding and the rapidity of blood loss.
- Significant signs of shock with signs of poor perfusion occur with loss of blood volume of 30% or more (1500-2000 mL).

# Pathophysiology

## Respiratory response

- The space-occupying effect of a large accumulation of blood within the pleural space may hamper normal respiratory movement. In trauma cases, abnormalities of ventilation and oxygenation may result, especially if associated with injuries to the chest wall.
- A large enough collection of blood causes the patient to experience dyspnea and may produce the clinical finding of tachypnea.

# *Late physiologic sequelae of unresolved hemothorax*

Two pathologic states are associated with the later stages of hemothorax: empyema and fibrothorax.

- Empyema results from bacterial contamination of the retained hemothorax. If undetected or improperly treated, this can lead to bacteremia and septic shock.
- Fibrothorax results when fibrin deposition develops in an organized hemothorax and coats both the parietal and visceral pleural surfaces.

# Clinical manifestations

- History: Trauma or recent surgical intervention is usually self-evident.
- Chest pain and dyspnea are common symptoms.
- Tachypnea;
- Shallow breaths. Findings include diminished ipsilateral breath sounds and a dull percussion note.
- If substantial systemic blood loss has occurred, hypotension and tachycardia are present.
- Respiratory distress reflects both pulmonary compromise and hemorrhagic shock.

# Blunt intrathoracic injuries

- Large hemothoraces are usually related to injury of vascular structures.
- Hemodynamic manifestations are those of hemorrhagic shock, can range from mild to profound, depending on the amount and rate of bleeding into the chest cavity and the nature and severity of associated injuries.
- Related respiratory manifestations include tachypnea and, in some cases, hypoxemia.
- A variety of physical findings such as bruising, pain, instability or crepitus upon palpation over fractured ribs, chest-wall deformity, or paradoxical chest-wall movement may lead to the possibility of coexisting hemothorax in cases of blunt chest wall injury.
- Dullness to percussion over a portion of the affected hemithorax.
- Decreased or absent breath sounds upon auscultation are noted over the area of hemothorax.

# Paraclinical investigations

- Measurement of the hematocrit of pleural fluid is virtually never needed in a patient with a traumatic hemothorax, but may be indicated for the analysis of a bloody effusion from a nontraumatic cause.
- In such cases, a pleural effusion with a hematocrit value more than 50% of that of the circulating hematocrit is considered a hemothorax.
- PLAIN RADIOGRAPHY OF THE UPRIGHT CHEST may be adequate to establish diagnosis by showing blunting at the costophrenic angle.
- In blunt trauma cases, hemothorax is frequently associated with other chest injuries visible on the chest radiograph, such as rib fractures, pneumothorax, or a widening of the superior mediastinum.

# Paraclinical investigations

- Ultrasonography

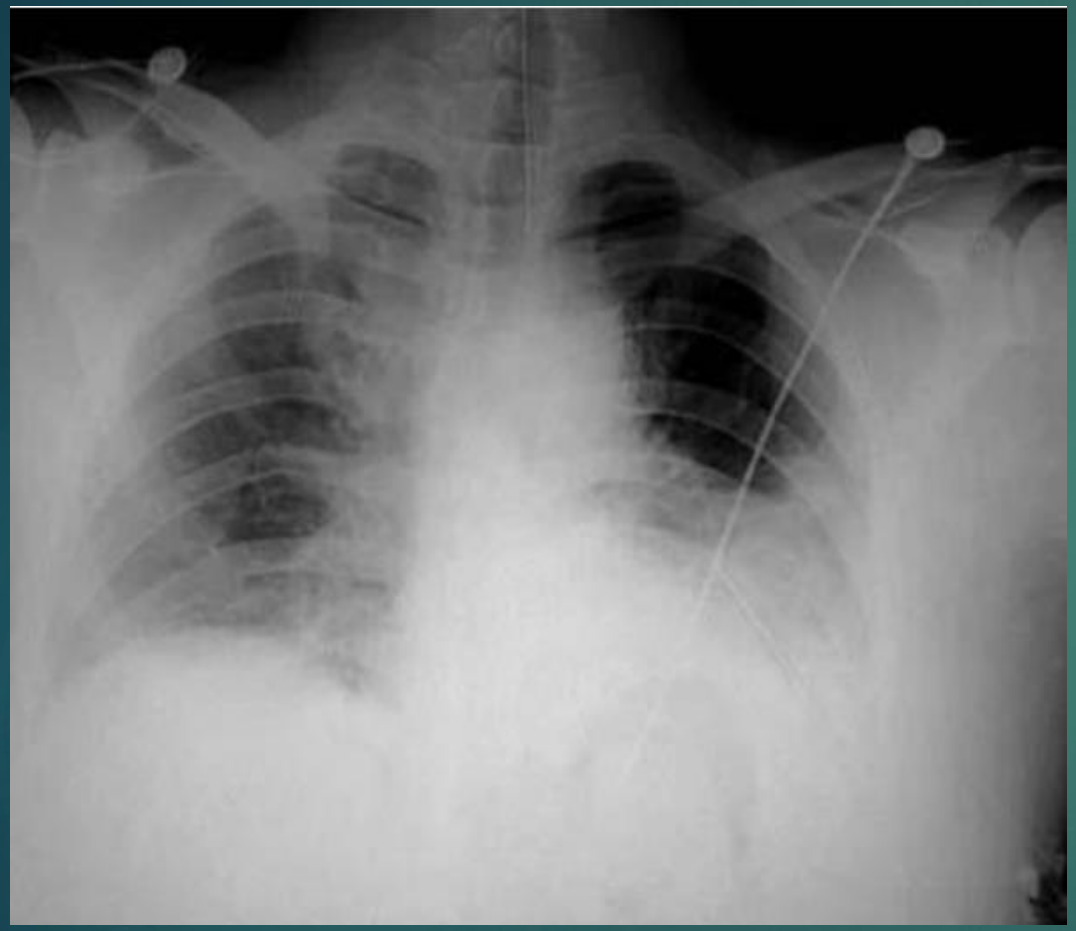
Ultrasonography more likely plays a complementary role in specific cases where the chest x-ray findings of hemothorax are equivocal.

- Computed Tomography

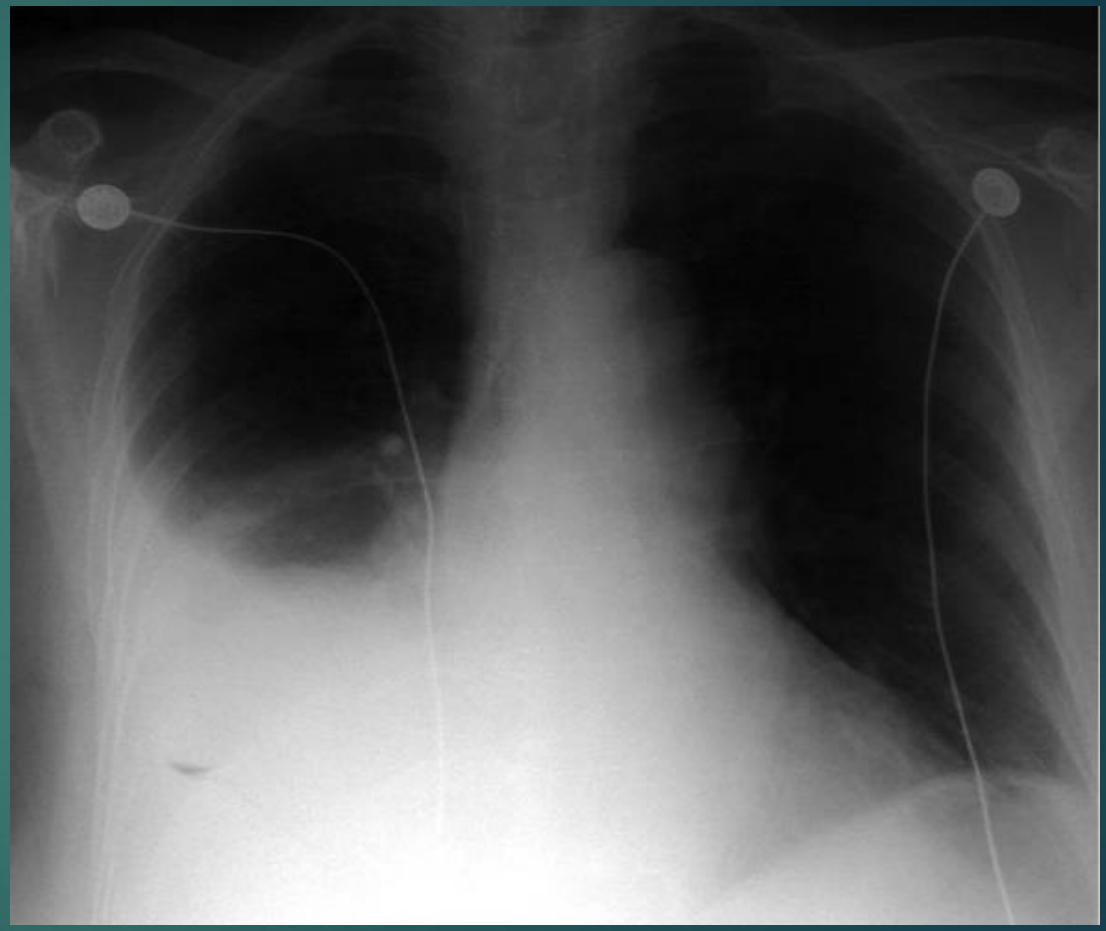
Thoracic CT has a definite role to play in evaluation of hemothorax, particularly if plain radiography results are ambiguous.

CT is a highly accurate diagnostic study for pleural fluid or blood and is particularly helpful in localizing loculated collections of blood.

# Chest radiography

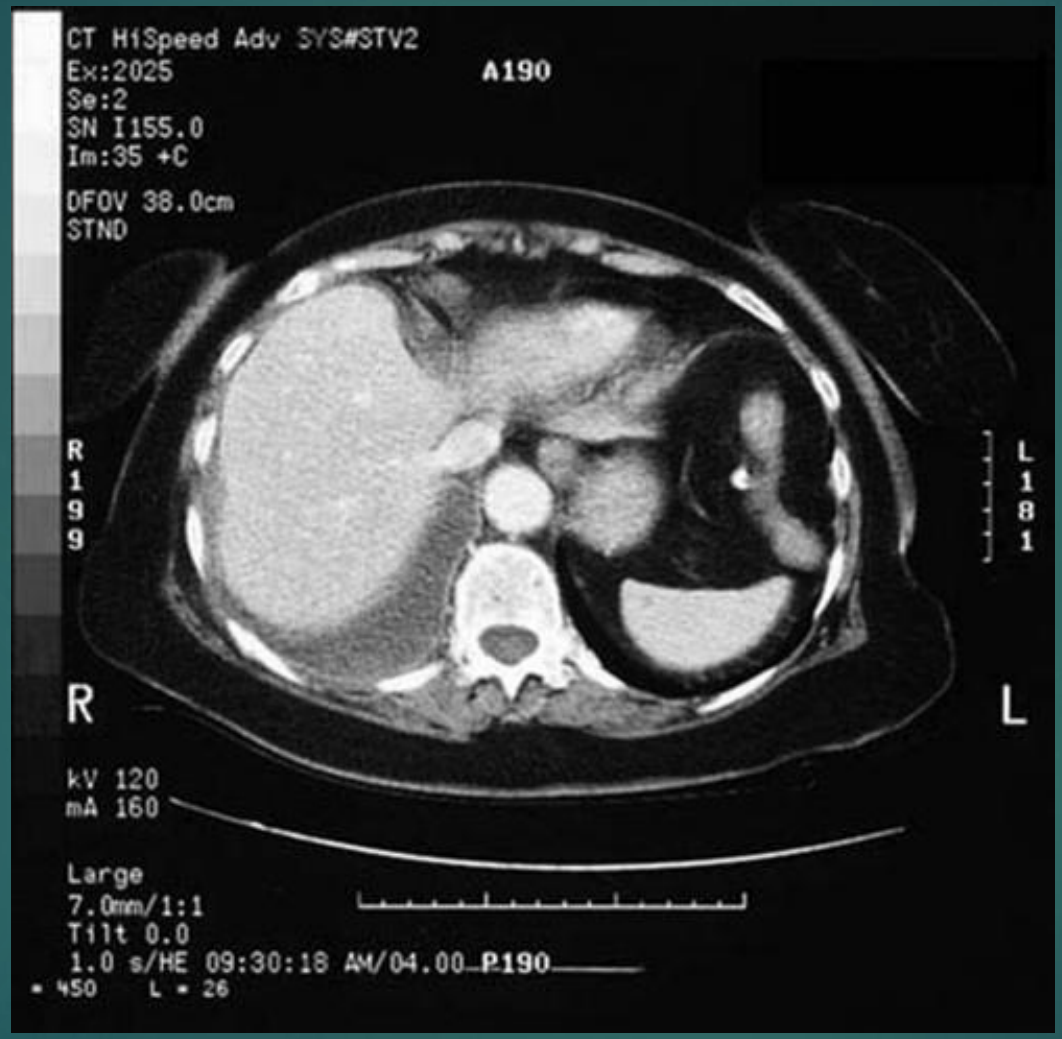


Left hemothorax in patient with rib fractures.



Upright posteroanterior chest radiograph of patient with right hemothorax.

# Computed Tomography




Contrast-enhanced CT scan of patient with right hemothorax.

# Management & Treatment

## Emergency Department Care

- Initial treatment is directed toward cardiopulmonary stabilization and evacuation of the pleural blood collection.
- Administer oxygen and reassess airway, breathing, and circulation. *ABC*
- Evaluate for the possibility of tension pneumothorax. Needle decompression of a tension pneumothorax may be necessary.
- If the patient has any respiratory distress, perform thoracostomy.

# Management & Treatment

## Surgical Treatment

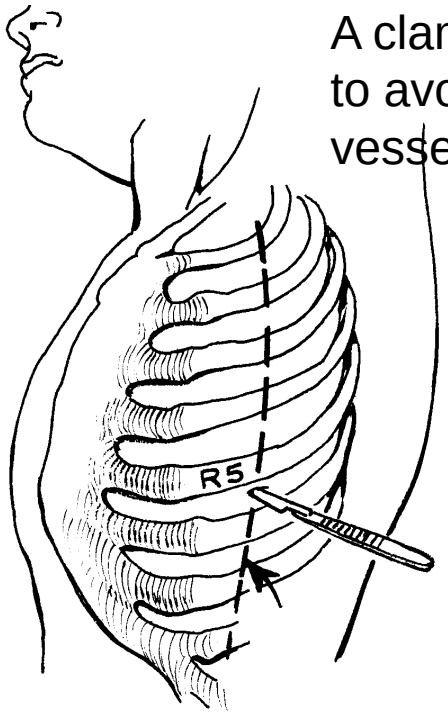
- Tube thoracostomy drainage is the primary mode of treatment for hemothorax.
- Preferably, a video-assisted thoracoscopic surgery (VATS) procedure should be undertaken to evacuate the pleural space.
- In nontraumatic cases of hemothorax resulting from surgically correctable intrathoracic pathology, correction of the underlying disease process and evacuation of the hemothorax should be undertaken.
- This may include stapling or resection of bullous disease, resection of cavitary disease, resection of necrotic lung tissue, sequestration of arteriovenous malformations, or resection or repair of vascular abnormalities such as aortic aneurysms.

# Surgical Treatment

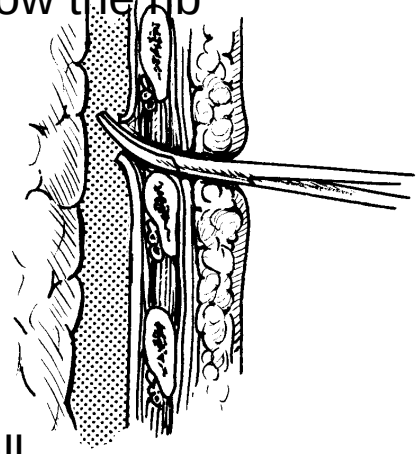
- *Surgical exploration in cases of traumatic hemothorax should be performed in the following circumstances:*

- Evacuation of more than 1000 mL of blood immediately after tube thoracostomy; this is considered a massive hemothorax
- Continued bleeding from the chest, defined as 150-200 mL/hr for 2-4 hours
- Repeated blood transfusion is required to maintain hemodynamic stability

# Thoracostomy a.k.a. Chest tube

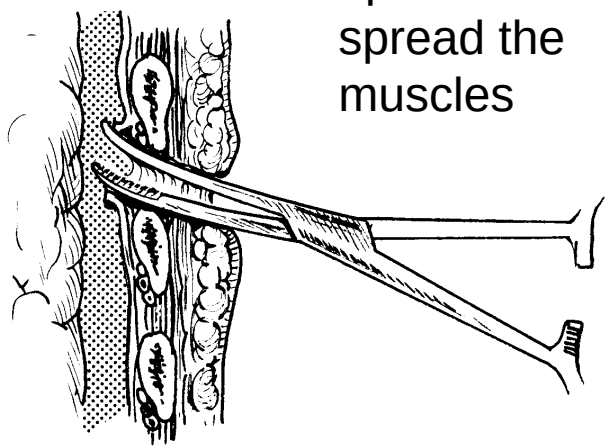



A clamp dissects over the rib to avoid the nerves and vessels below the rib

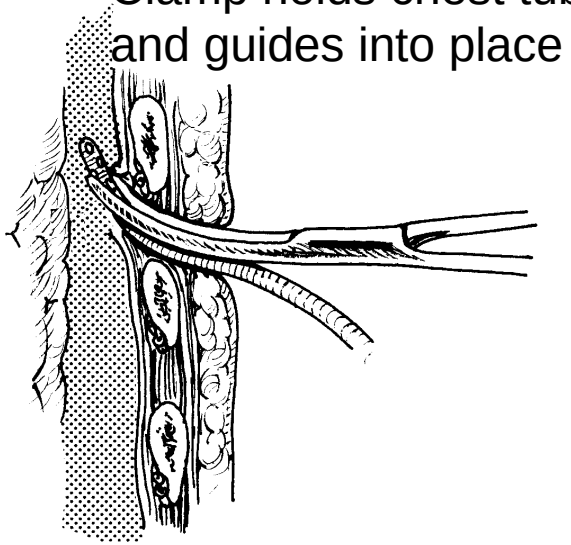


Small incision

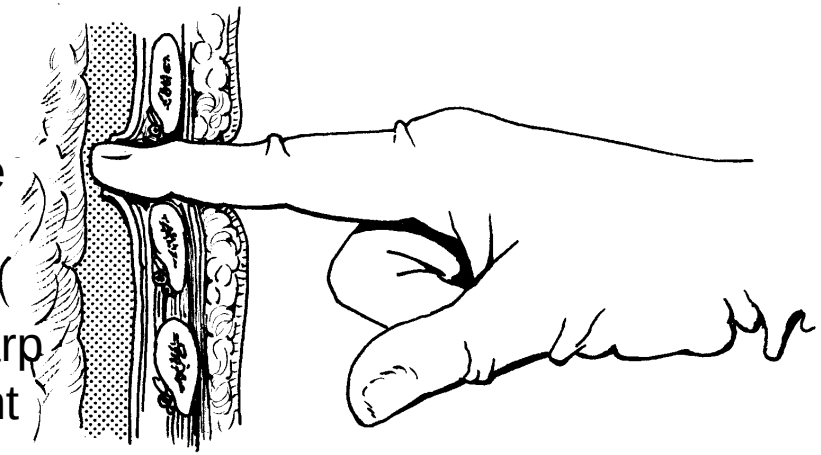
The clamp opens to spread the muscles



Clamp holds chest tube and guides into place



Finger is used to explore the space to avoid sharp instrument



# Remove air

Choose site

Explore with finger

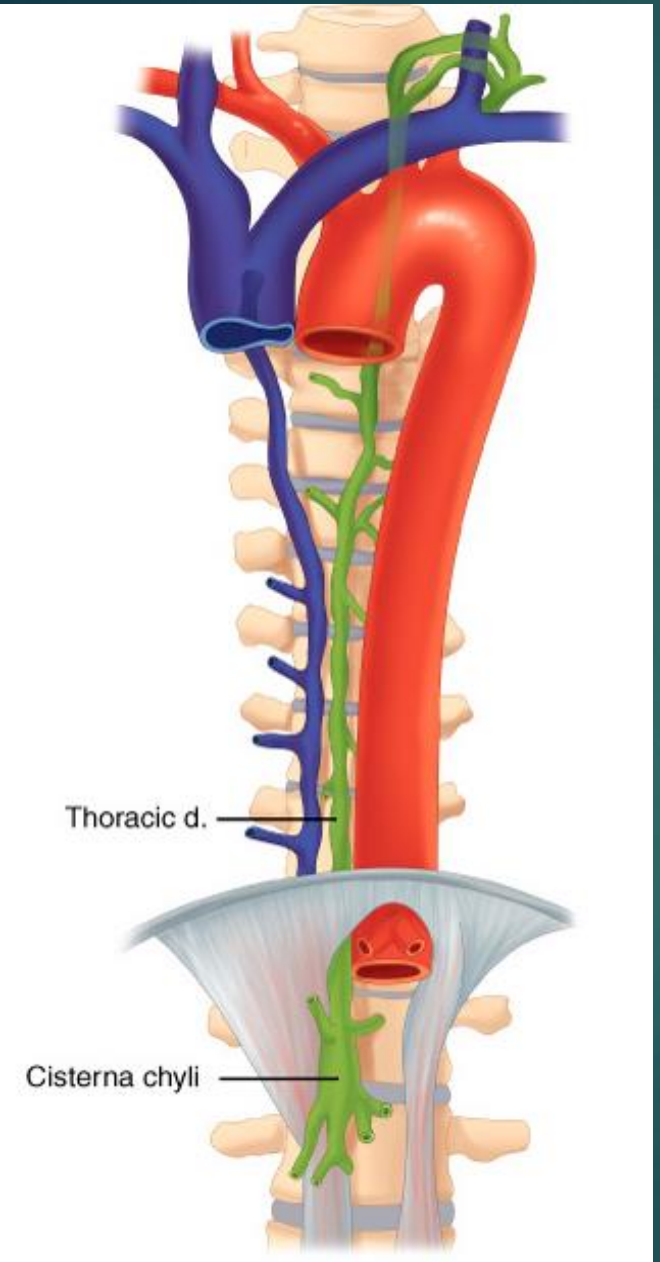
Place tube with clamp

Suture tube to chest

# Chylothorax

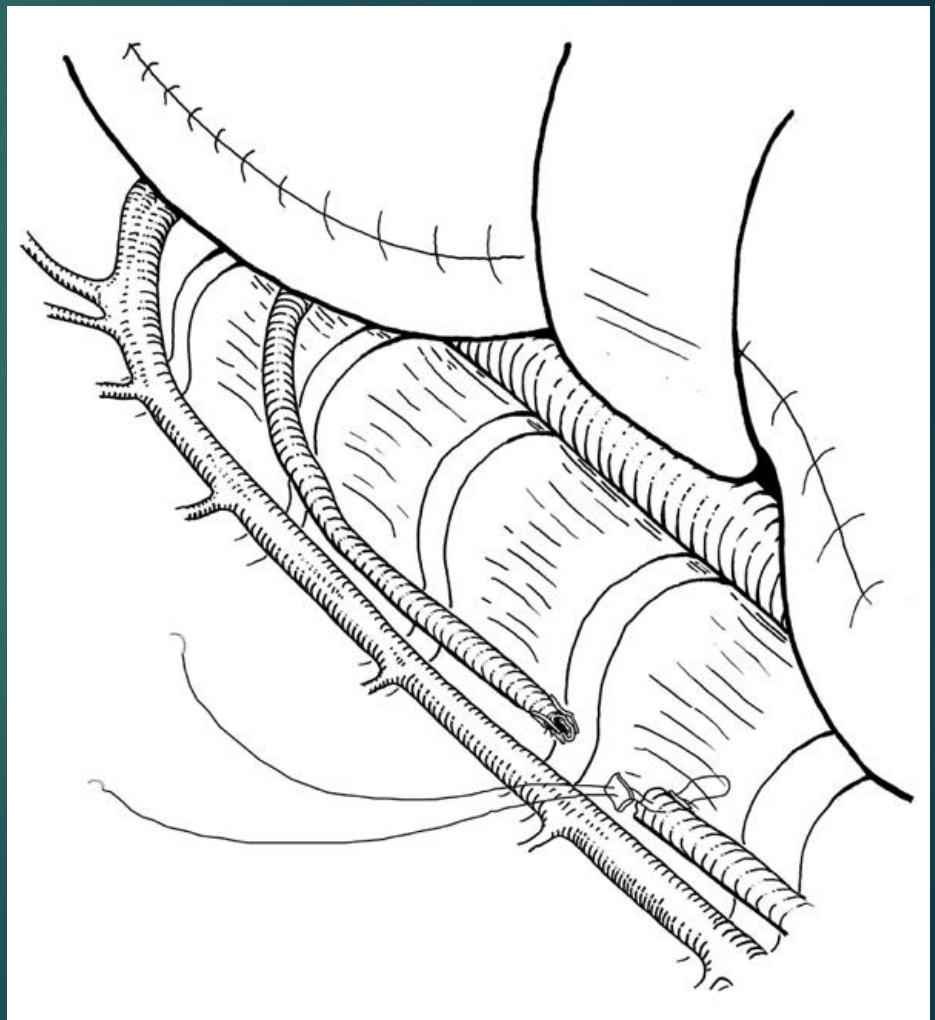
- Chylothorax refers to the presence of lymphatic fluid in the pleural space secondary to leakage from the thoracic duct or one of its main tributaries.
- However, in up to 50% of individuals, the route of thoracic duct is anomalous and unpredictable, thus making it more susceptible to damage during surgical procedures.
- This is a relatively rare condition that may develop as a complication of thoracic and esophageal surgery, as well as from nontraumatic causes such as hematologic malignancies.

# Normal thoracic duct anatomy




- The esophagus comes into close proximity to the thoracic duct as it enters the chest from its origin in the abdomen at the cisterna chyli.

- The duct is most frequently injured during dissection of the distal esophagus.



# Chylothorax

## Etiopathophysiology

- A tear or leak in the thoracic duct causes chylous fluid to collect in the pleural cavity, which can cause acute or chronic alterations in the pulmonary mechanics.
- In a normal adult, the thoracic duct transports up to 4 L of chyle per day, allowing a rapid and large accumulation of fluid in the chest.
- If this leakage is left untreated, protein, volume, and lymphocyte depletion can lead to serious metabolic effects and death.

# Etiopathophysiology Nontraumatic Chylothorax

- Malignant etiologies account for more than 50% of chylothorax diagnoses and are separated into:

1. lymphomatous
2. and nonlymphomatous causes.

- Nonmalignant etiologies are separated into:

1. idiopathic,
2. congenital,
3. and miscellaneous.

# Etiopathophysiology Traumatic Chylothorax

- Trauma is the second leading cause of chylothorax (25%).
- Iatrogenic injury to the thoracic duct has been reported with most thoracic procedures.
- In particular, cardiothoracic surgery has been associated with chylothorax in children.
- Nonsurgical traumatic injury is a rare cause, usually secondary to penetrating trauma.

# Chylothorax Clinical Presentation

## I. History

- Usually, patients with chylothorax remain asymptomatic until a large amount of chyle accumulates in the pleural space.
- The average latent period between the insult and the onset of symptoms is 7-10 days. Symptoms include the following:

1. Dyspnea
2. Tachypnea
3. Classic symptoms of pleural effusion

## II. Physical Examination

- Findings on physical examination are nonspecific and include the following:

1. Decreased breath sounds
2. Shifting dullness

# DIFFERENTIAL DIAGNOSIS

- Pseudochylothorax:

- ✓ which results from accumulation of cholesterol crystals in a chronic existing effusion.
- ✓ The most common cause of pseudochylothorax is chronic rheumatoid pleurisy, followed by tuberculosis and poorly treated empyema.

- Hemothorax
- Parapneumonic Pleural Effusions and Empyema Thoracis

# Chylothorax Differential Diagnoses

Other conditions to consider in patients with suspected chylothorax include the following:

- Acquired immunodeficiency syndrome (AIDS)-related complex
- Congestive heart failure
- Exudative pleural effusion
- Malignant pleural effusion

# Chylothorax Workup

## Laboratory Studies

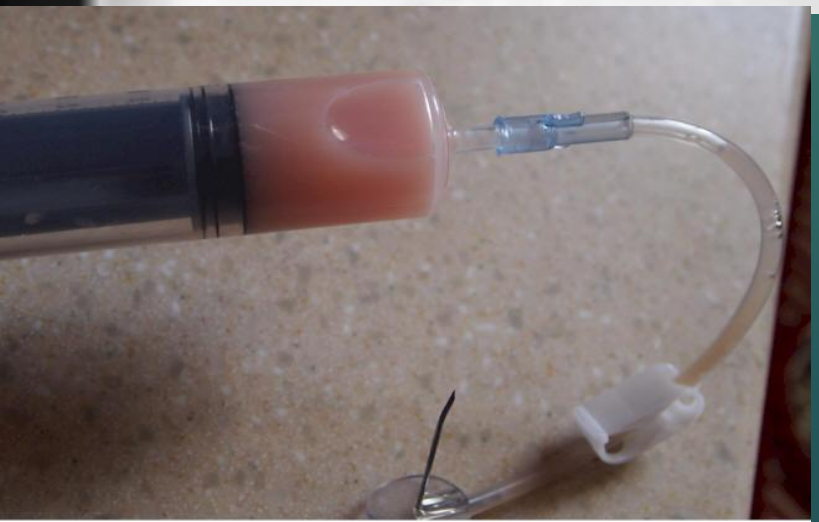
- The following laboratory studies are not required for diagnosis but are useful to determine the metabolic and nutritional status of the patient:
- Serum electrolyte tests
- Serum albumin test
- Complete blood cell (CBC) count with differential to assess for lymphocyte depletion

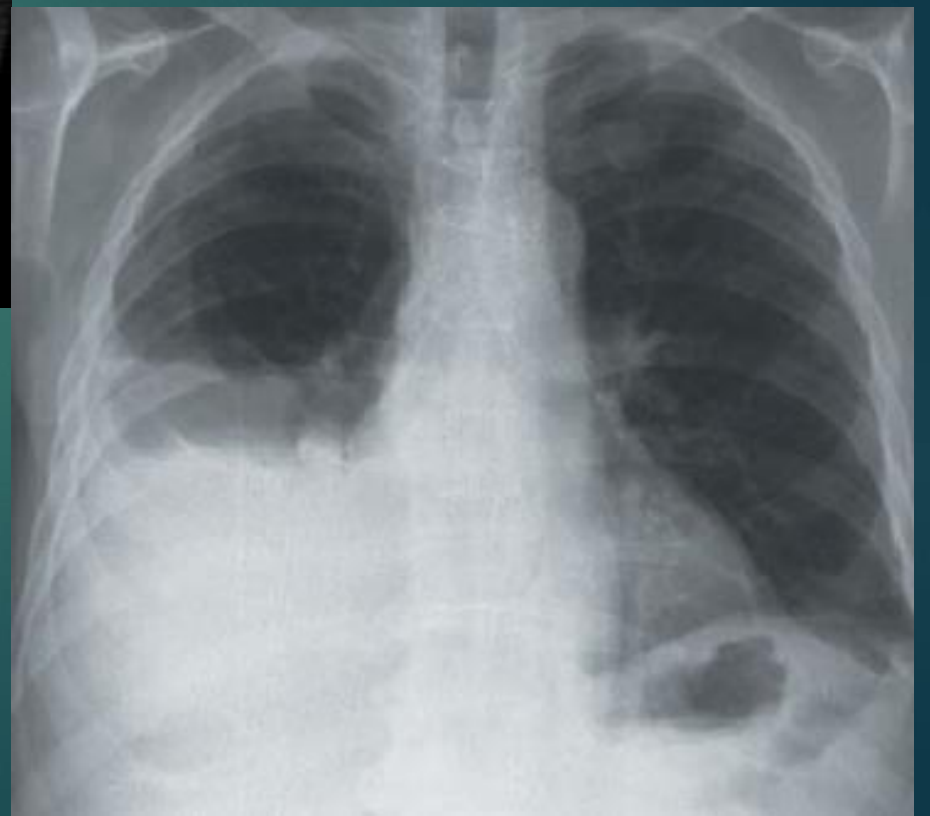
# Chylothorax Workup

## Imaging Studies

- **Chest radiographic** findings are nonspecific for chylothorax and indistinguishable from other causes of pleural effusion; however, they may help to rule out other causes of the patient's symptoms.
- Determine if effusion is bilateral.
- Look for a mediastinal shift.
- If the etiology of the chylothorax is unknown, obtain **computed tomography (CT)** scanning or **magnetic resonance imaging (MRI)** of the chest and abdomen for evaluation of the lymphatic vessels, and to rule out vascular abnormalities and/or malignancy.

# Chylothorax (CXR & CT)



# Chylothorax Workup

## Imaging Studies

- Lymphangiography is useful when the anatomy of the thoracic duct needs to be defined preoperatively or when the site of the leak is not clinically obvious, and it may facilitate minimally invasive management when it is being considered.
- Lymphoscintigraphy is also useful for the localization of the leak, evaluation of the thoracic duct patency, and differentiation of partial from complete thoracic duct transection.

# Procedures

Thoracentesis and pleural fluid analysis are the criterion standards to establish a diagnosis of chylothorax.

Alternatively, in a postsurgical patient, tube thoracostomy output can be analyzed.

Pleural fluid analysis for triglyceride content helps to confirm the diagnosis of chylothorax.

# Chylothorax Treatment & Management

## Medical Care

- Patients with chylothorax can be treated by conservative means or surgery. Certain principles are common to both treatment options, including

1. treating the underlying cause,
2. decreasing chyle production,
3. draining and obliterating the pleural space,
4. providing appropriate fluid and nutritional replacement,
5. and instituting necessary respiratory care.

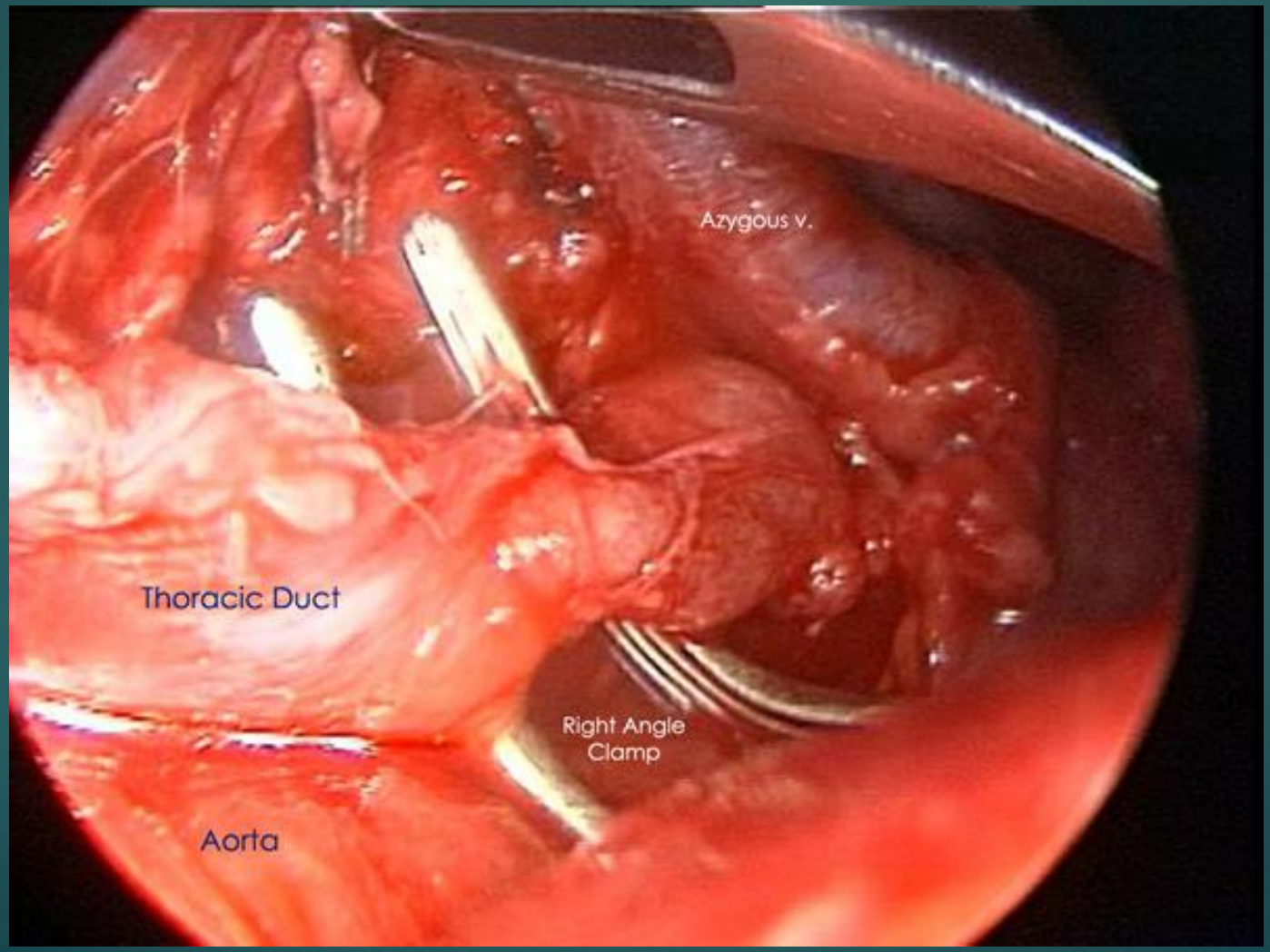
# Indications for Surgical Treatment

- Chyle leak greater than 1 L/d for 5 days or a persistent leak for more than 2 weeks despite conservative management
- Nutritional or metabolic complications, including electrolyte depletion and immunosuppression
- Loculated chylothorax, fibrin clots, or trapped lung
- Postesophagectomy chylothorax (Patients with this carry a high mortality rate if treated conservatively.)
- Surgical options depend on the site of injury and the etiology of the chylothorax.

# Thoracic duct ligation

- Thoracic duct ligation is the criterion standard.
- The duct is usually ligated between the eighth and twelfth thoracic vertebrae, just above the aortic hiatus.
- The approach is usually through the right chest, either by an open right thoracotomy or through a thoracoscope.

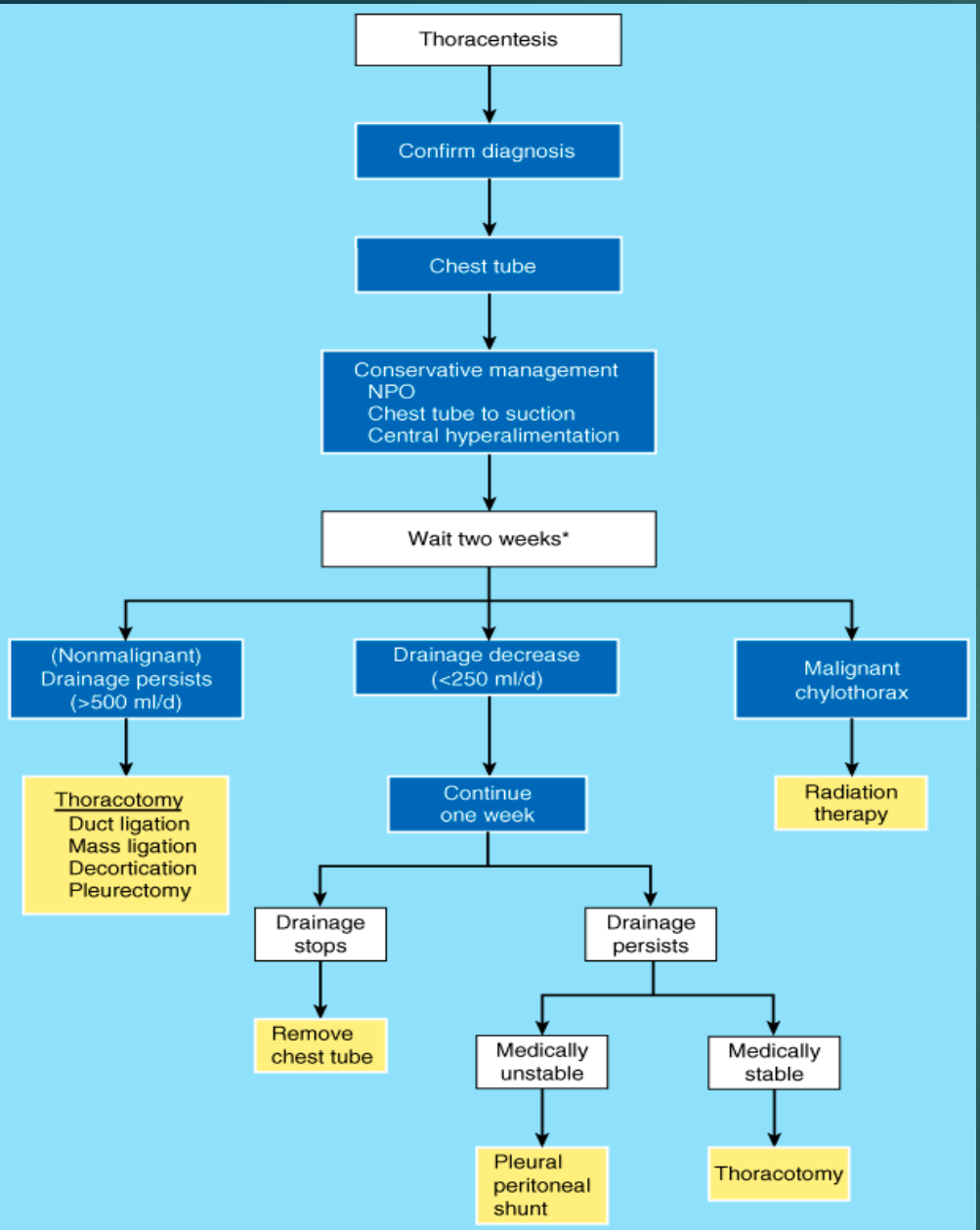
# Thoracic duct ligation via video-assisted thoracoscopy



# Other interventions

- thoracoscopic parietal pleural clipping in congenital chylothorax
- A pleuroperitoneal shunt can be successful for refractory chylothorax but can be complicated by infection and obstruction.
- Pleurodesis is often used for malignant chylothorax.
- Surgical pleurectomy is a treatment option.
- Lymphatic embolization may be effective in patients with traumatic leak and pulmonary lymphatic perfusion syndrome.

# Algorithm for the management of chylothorax



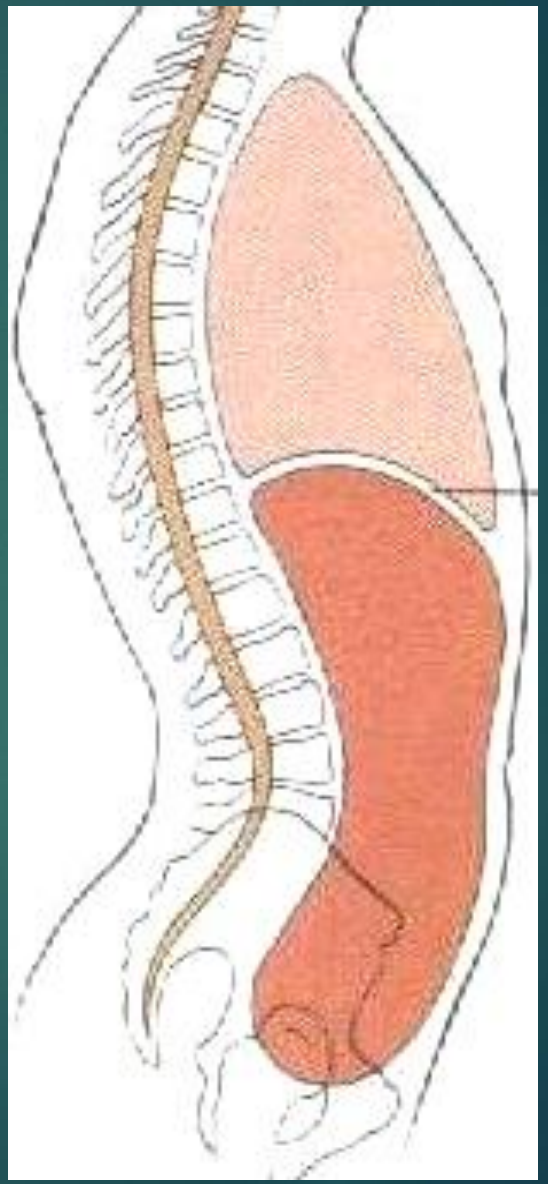

*If high output persists (>500 mL/d), early surgical ligation of the thoracic duct may be considered. NPO = nothing by mouth.

# USMF “N.Testemițanu”


## Surgical pathology of diaphragm

# Diaphragm
## (anatomo-physiological definitions)

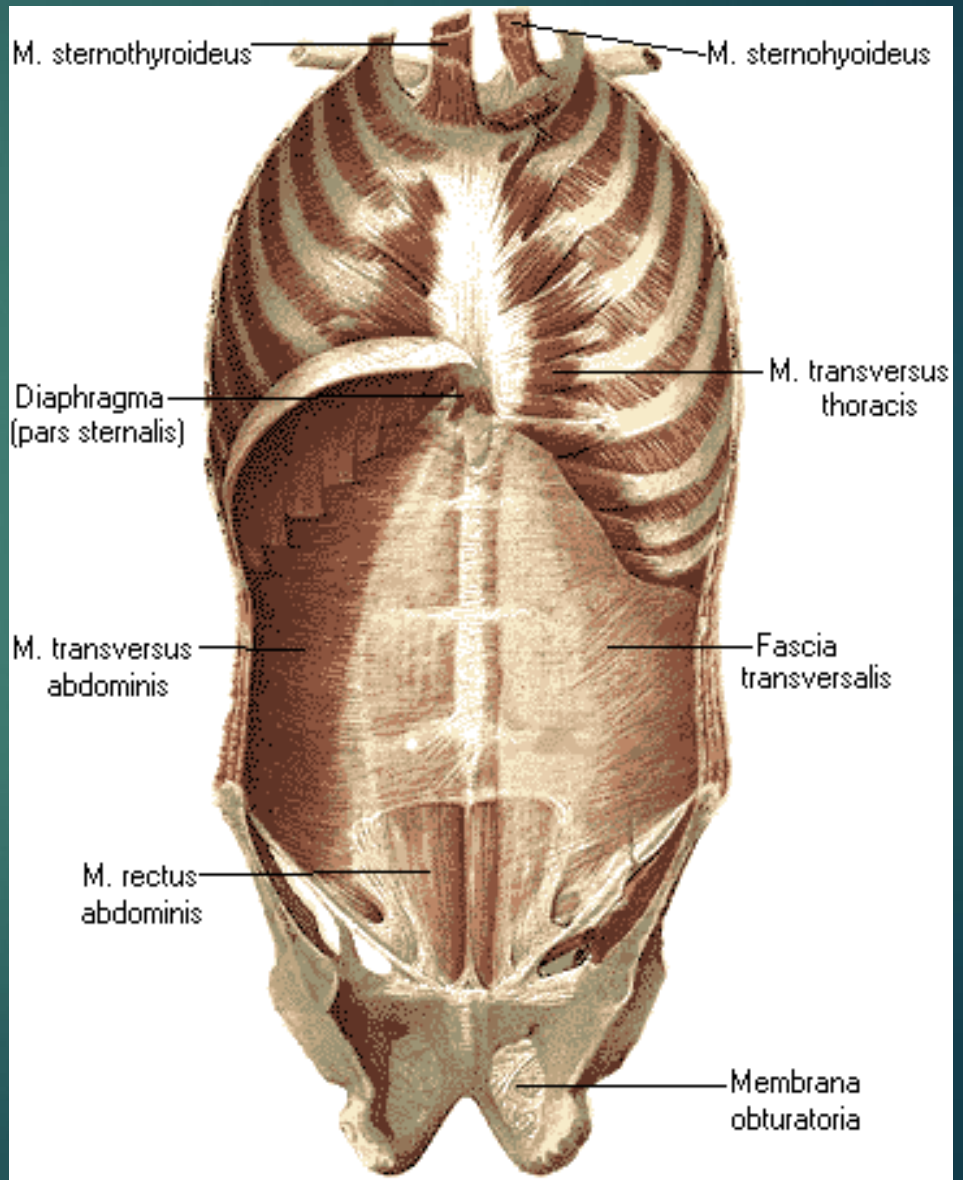
- ***Represents the musculo-membranous septum dividing 2 anatomical cavities: thorax and abdomen which works with different pressure regimens:***
  - ***torax- negative***
  - ***abdomen- positive***
- ***Because of the superiority of intra-abdominal pressure diaphragm proeminates to the thorax***



# Diaphragm

- It consists of 2 halves that pass one to another without limitation
- It starts from the lower thoracic aperture and lumbar vertebrae.
- It is distinguished:
  - Centrum tendineum
  - Parts muscularis

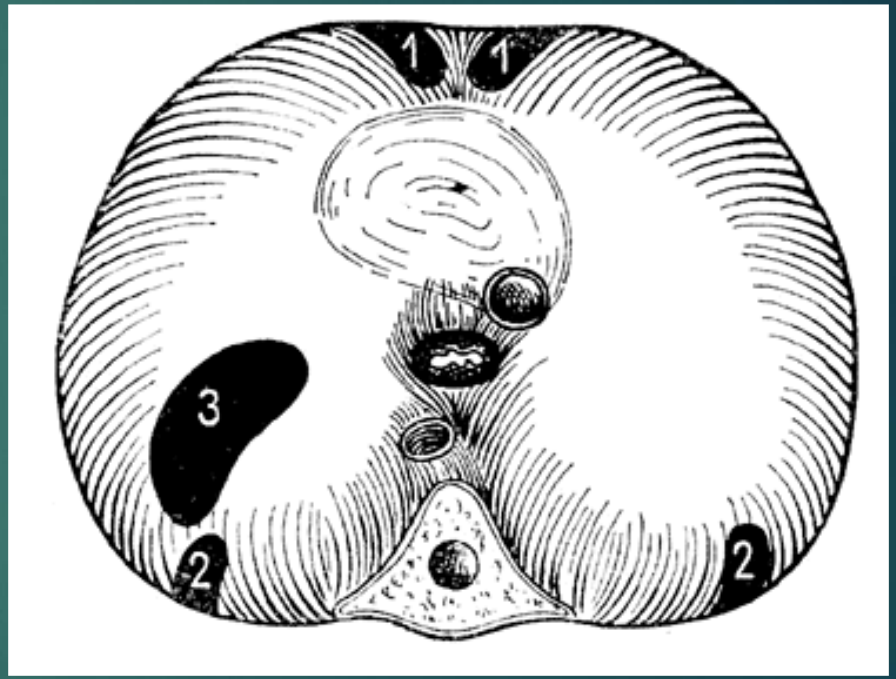
*pars sternalis*
*pars costalis*
*pars liumbalis*



# Weak points of the diaphragm

(Potential areas of herniation with surgical concern)

- *1- Larrey slot (left side), hiatus Morgagni (right side)*
- *2- Bochdalek triangle*
- *3 –pars tendineum of diafraphm.*




Larrey J.D., (1819)
Morgagni G.B. (1762)
Bochdalek V.A. (1848)

# Diaphragm hernia

*Definition:*

*represents the penetration of the abdominal viscera into the thoracic cavity through the diaphragm's orifice being preformed either as a result of diaphragmatic injury*

# Classification of diaphragmal hernias:

on dependence of embriogenesis

**Embrional**

**Congenital**

**fetale**

**Aquired**

- **Hiatal ventral**
- **Retro-costoxifoidal**
- **Hernias of the diaphragmatic dome**

# Classification of diaphragm hernias (DH):

**On dependence of hernial sac presence**

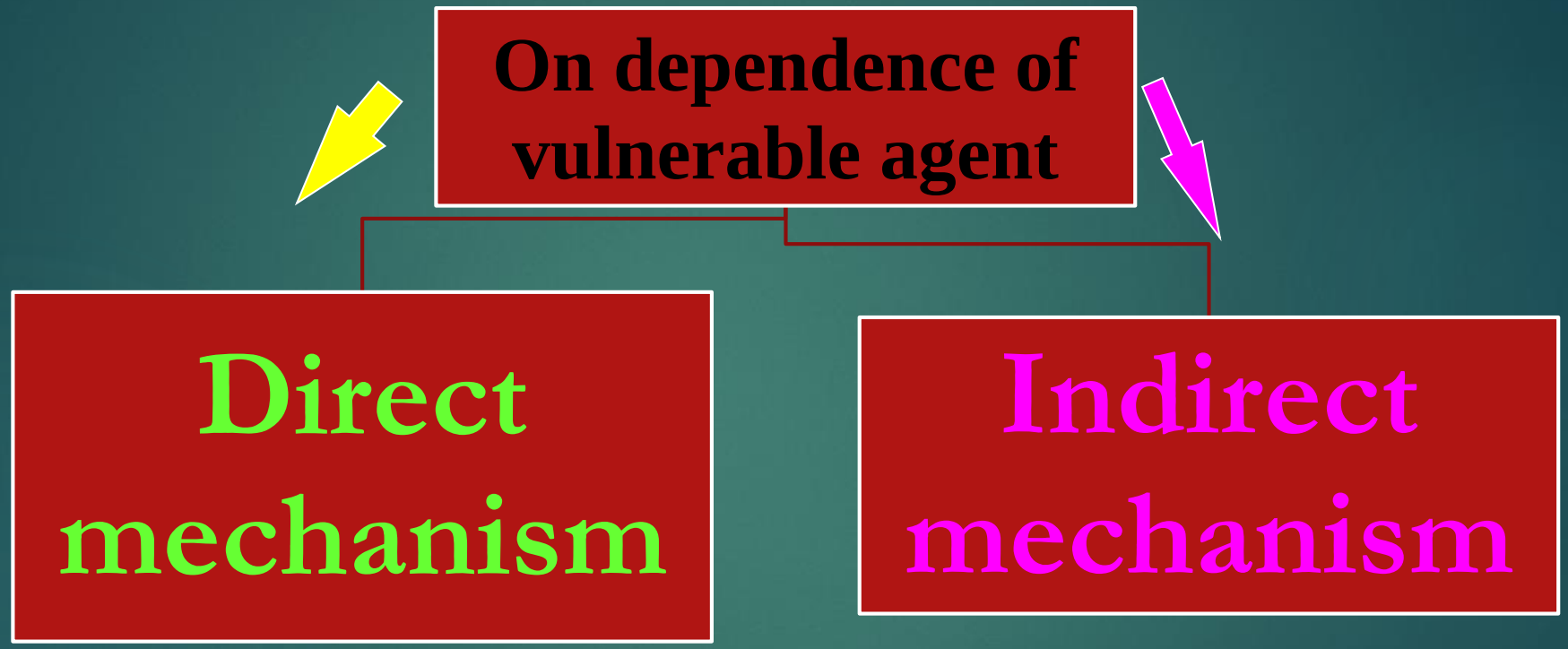
- **DH vera,** *true (with sac)*
- **DH false,** *(without sac)*

**On dependence of mechanism of evolution**

- *Traumatic*
- *Nontraumatic*

1. *Hernias through congenital defects of diaphragm (false hernias)*
2. *Hernias in weak points of diaphragm or through its clefts (true hernia)*
3. *Esophageal hiatus hernias and preformed natural orifices*

# Posttraumatic DH




- Firearms
- Cold steel arms
- Leak after phrenoraphy

- Severe thoraco-abdominal trauma
- Labor in women with suddenly increased intra-abdominal pressure

# General characteristics of traumatic diaphragmal hernia

- Absence of hernia sac
- Gun wounds can affect any area of the diaphragm
- Ruptures by contusion in 6 times are more common for left hemidiaphragm than in right due to role of "shield" of the liver.
- It's rare, but very serious rupture of both diaphragmatic domes
- A rare type of traumatic diaphragmatic hernia is hernia in neighboring intercostal space (hernia Moreaux).
- Content: may be herniated stomach, spleen, omentum, small intestine, sometimes left lobe of the liver

# Diphragmal Hernia (clinical signs)

- **Is multiforme with digestive and thoracic symptoms.**
- *is determined by compression and strangulation of translocated abdominal organs into the chest cavity with gastrointestinal syndrome.*
- *Lung compression and mediastinal displacement by herniated organs lead to cardiopulmonary syndrome.*
- *The presence of diaphragmal hernia induce it's function disorders*

# Traumatic DH

*Simptomatology (Carter,Giuseffi):*

- **Acute phase - signs of hemorrhagic or traumatic shock**
- **Chronic phase - is prolonged, oligosimptomatic (periodic episodes of dyspnea, cough, palpitations, dysphagia, dyspeptic disorders)**
- **Phase of complications - (bowel obstruction, cardiorespiratory failure)**

# Imaging

- *Chest X-ray*
- *Radiography with barium*
- *Ultrasound*
- *CT*
- *MRI*

# Principles of surgical treatment of DH

- *Established diaphragmatic hernia is a surgical indication due to the danger and seriousness of strangulation.*
- *Contraindications – aged patients and poor biological state*
- *The surgical technique consists in reducing of herniated abdominal viscera and repair of the defect with nonabsorbable sutures. In large hernias might be applicated plasty with prosthetic or synthetic material.*
- *Thoracic approach is preferable, thoraco-abdominal mixed approach is indicated in cases when it is impossible to release the viscero-abdominal adhesions*

# Hiatal hernias

Definition:

*represents the stomach intrusion into the thorax through a defect of esophageal hiatus of the diaphragm.*

# Classification of hiatal hernias

- **Congenital**
- **Acquired**

- **Sliding hiatal hernias (axial)**
- **Paraesophageal hernias**

# Classification of sliding hernias (B.V.Petrovschii, N.N.Kanşin )

- Esophageal
- Cardial
- Cardiofundal
- Giant (gastric subtotal and total hernias)

- of traction
- pulsatile
- mixed

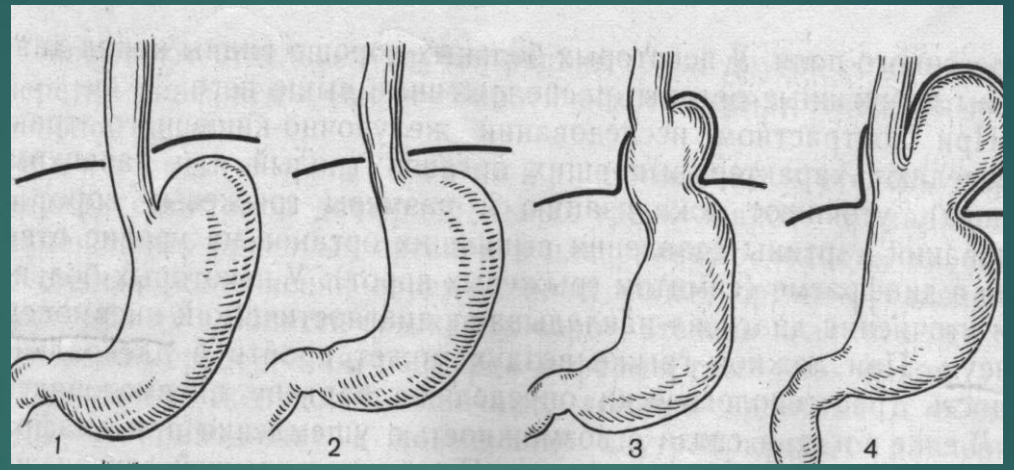
- **It delimits the esophagus with acquired shortening**

√ **gr.I- cardia is disposed with 4 cm above the diaphragm**

√ **gr.II- excess of this limit**

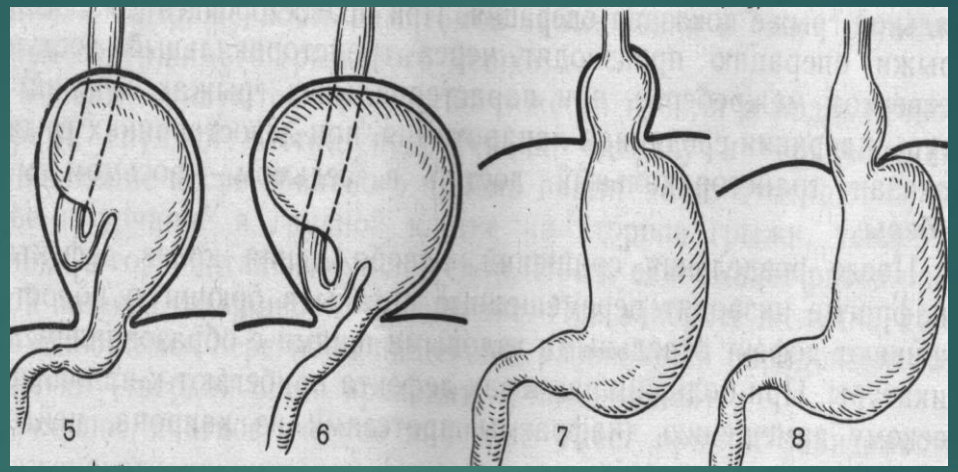
- **Congenital short esophagus (thoracic stomach)**

# Different types of hiatal hernias



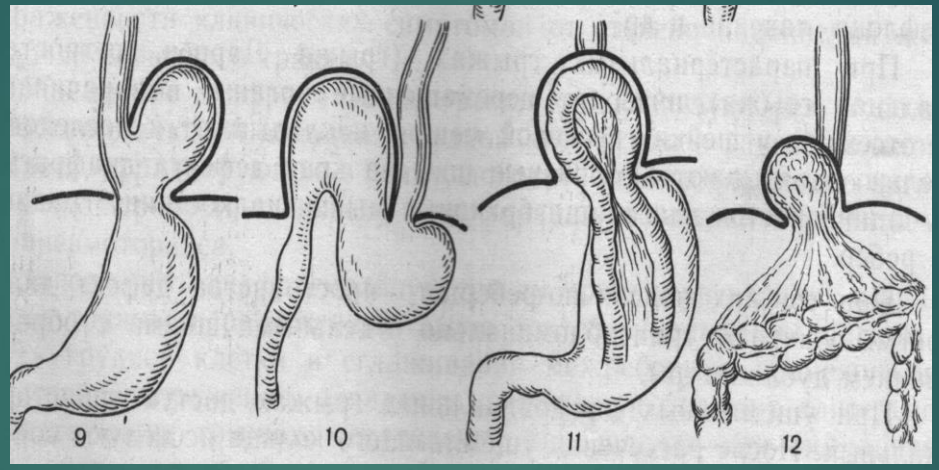

- *1- normal position of esophag, diaphragm and stomach*
- *2- esophageal*
- *3- cardial*
- *4- cardiofundal*

# Different types of hiatal hernias




- *5- subtotal gastric*
- *6- total gastric*
- *7- esophag with acquired shortening*
- *8- congenital short esophagus*

# Different types of hiatal hernias




- 9- *gastric subtotal*
- *10- antral*
- *11- intestinal*
- *12- epiploic hernia*

# Hiatal hernias (Etiopathogenesis)

- Conditions that increase intra-abdominal pressure, constipation, biliary colic, chronic pancreatitis, obesity, multiple pregnancies, thoracoabdominal trauma etc.
- Conditions leading to increased intragastric pressure - pyloric stenosis, antral mucosal prolapse, etc..
- Expanding congenital or acquired hiatal ring
- Iatrogenic causes-gastrectomy, vagotomy

# Clinical signs in hiatal sliding hernias

***Is dominated by gastroesofagean reflux:***

- **epigastric and retrosternal pain**
- **heartburn and postprandial regurgitation**
- **pseudo-angina crisis**
- **cardio-respiratory disorders (cough, cyanosis)**
- **Iron deficiency anemia**

# Clinical signs in paraesophageal hernias

***Is dominated by  compression syndrome:***

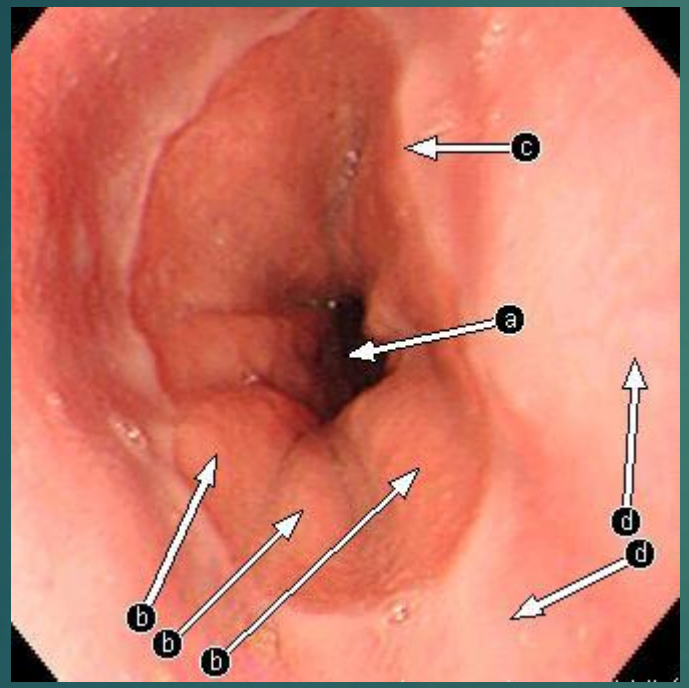
- **Epigastric pain or in left hypocondrium**
- **Pain in left hemithorax**
- **Dyspepsia, distention of abdomen, constipations**
- **Upper digestive hemorrhage**
- **cardio-respiratory disorders (cough, cyanosis)**

# Paraclinical explorations in hiatal hernias

- **X-ray with barium**
- **Endoscopy**
- **Esophageal pH-metry**
- **Bernstein Fruin and Pacini test**
- **Esophageal manometry**
- **Esocinematography**

# Sliding hiatal hernia

(endoscopical aspect)




**a. the parcel of the hernial sac**

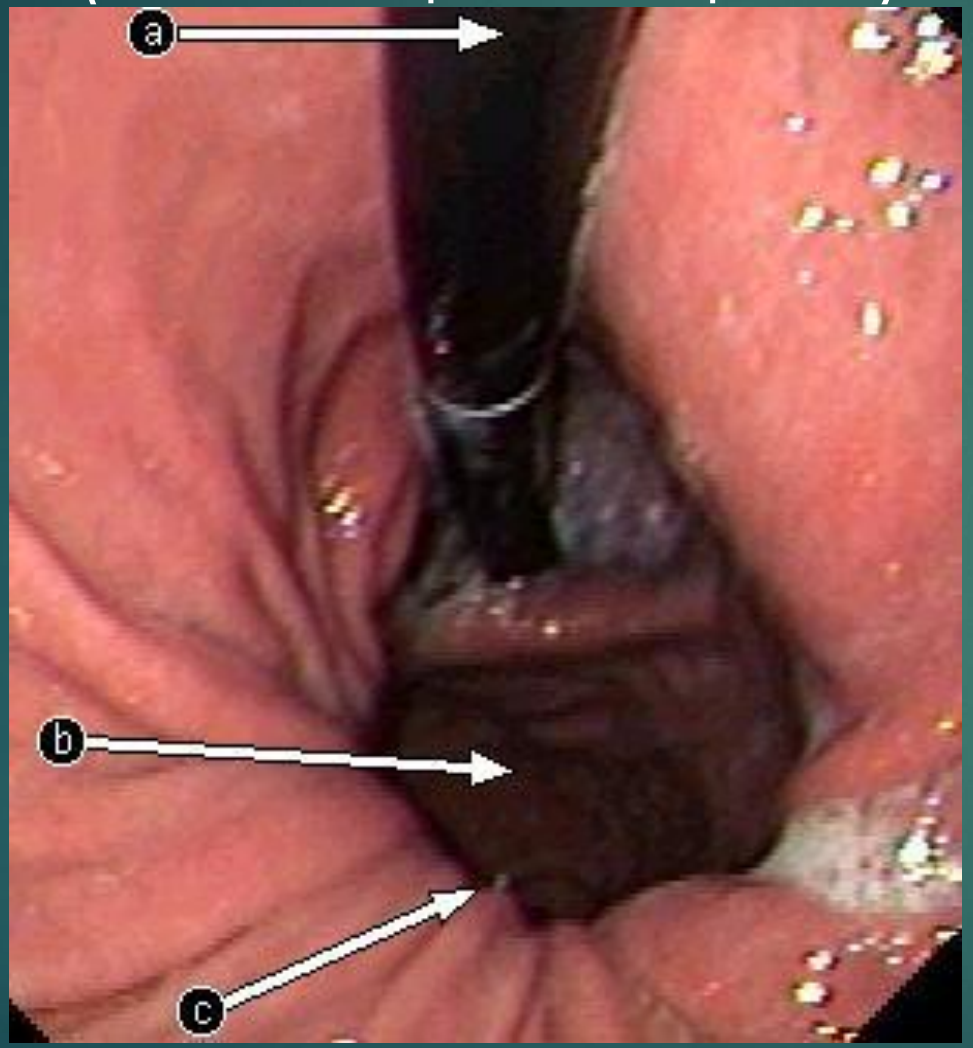
**b. Gastric folds prolabated in the parcel**

**c. Irregular  Z line**

**d. Esophageal mucosa**

# Paraesophageal hernia

(endoscopical aspect)




a. **Endoscop**

b. **The sac of paraesophageal hernia**

c. **Prolabation of gastric folds in thorax through hiatus**

# Hiatal hernias (Differential diagnosis)

- Chronic lung abscesses
- Mediastinal tumors
- Chystic tumors of diaphragm
- Retro-costo-xiphoid hernias
- Esophageal Cancer

- Cancer of stomach
- Gastro-duodenal ulcers

# Complications of hiatal hernias

- Peptic esophagitis
- Digestive hemorrhage
- Peptic ulcers of esophagus
- Hemorrhagic gastritis in hernia
- Lung, cord compression
- Strangulation of hernia with/without perforation
- Trombophlebitis

# Conservative treatment

- **diet**
- **Medications**

√ alcalinizants

√ H2 blockers

√ anticholinergics

√ PPI

√ sedative etc.

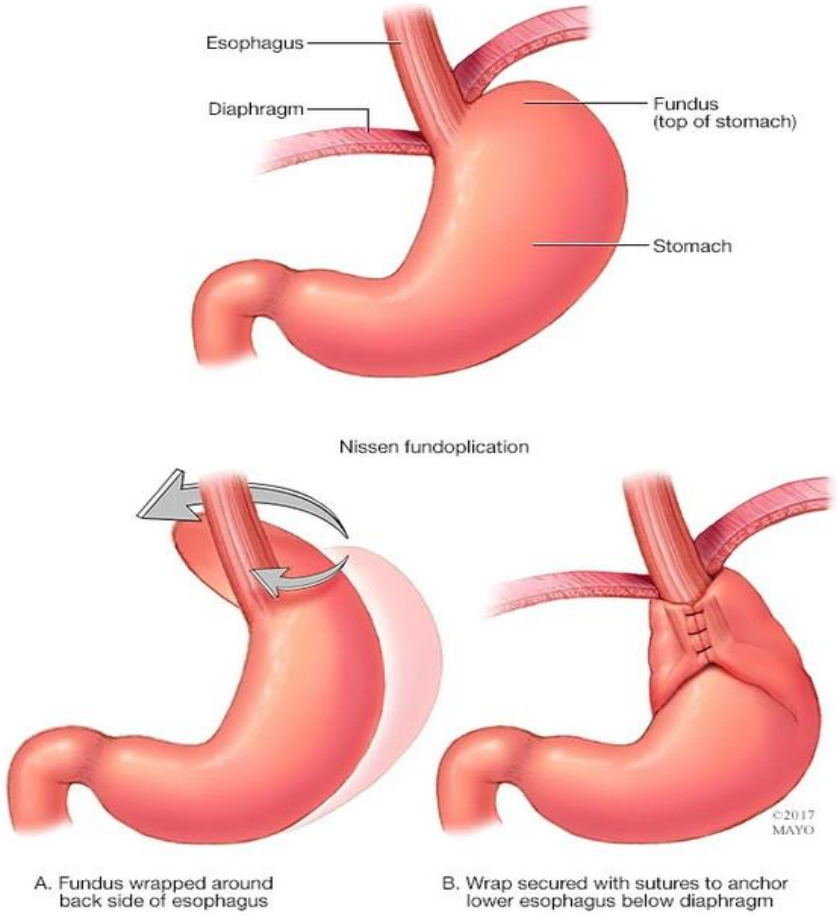
# Indications for surgical treatment

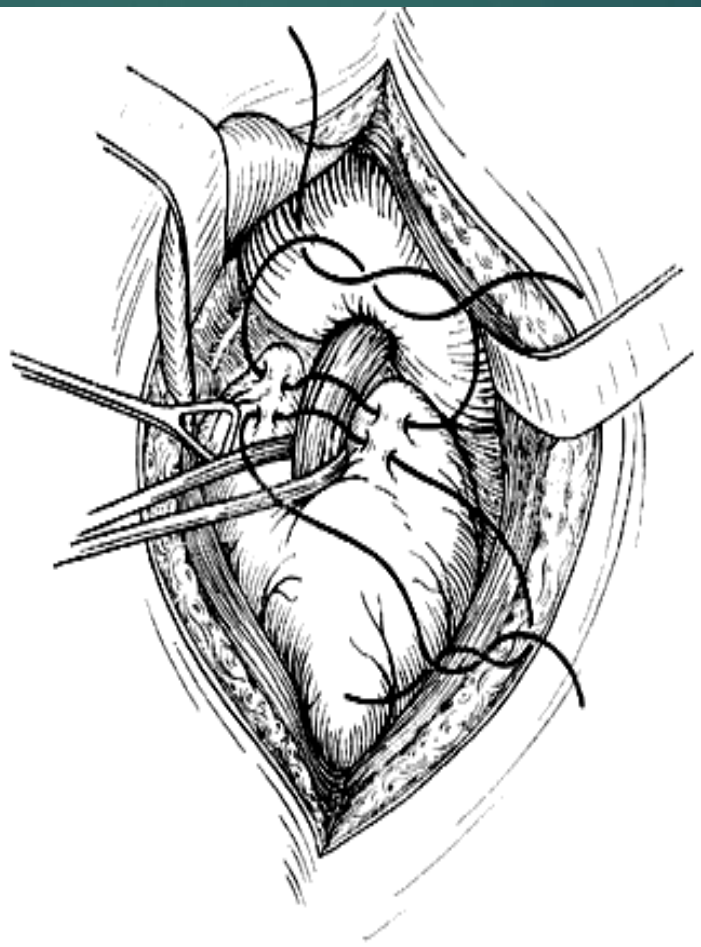
- Paraesophageal HH (high risc of complications)
- Large HH
- HH with complications
- HH with gastroesophageal reflux resistent to conservative treatment
- HH with respiratory complications
- HH with cardiac disturbances
- HH associated with cholelithiasis and gastroduodenal ulcer
- Reccurent HH

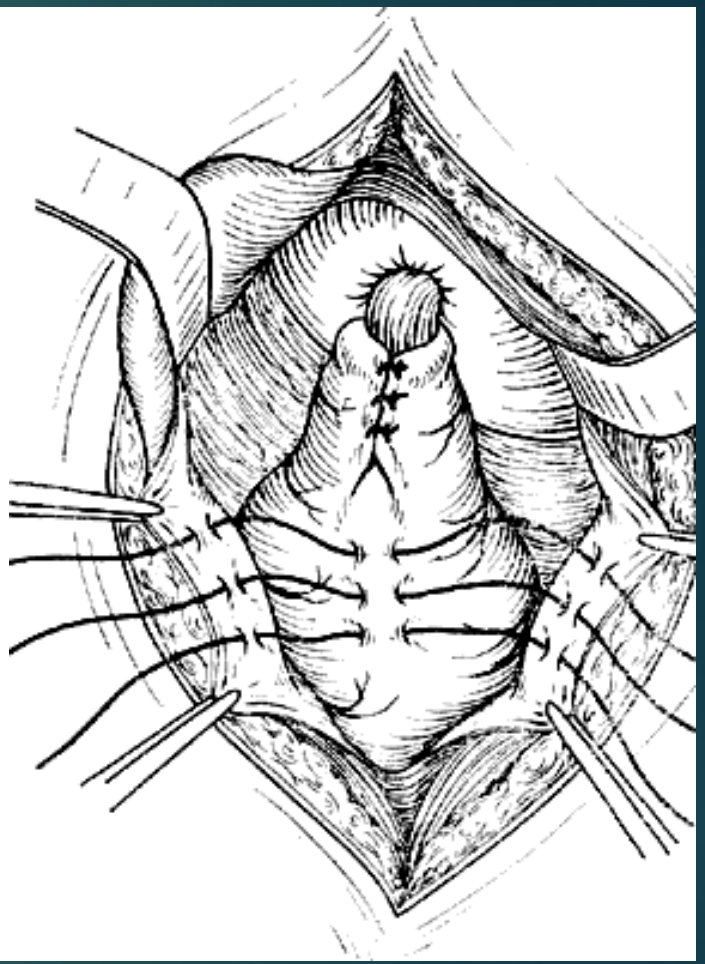
# Surgical techniques in hiatal sliding hernias

- **Total Fundoplications (360°)**
  - √ **Nissen- Rossetti**
- **Partial Fundoplications (270°- 180°)**
  - √ **via abdominal approach (Toupet, Dor, Hill)**
  - √ **via thoracic access (Belsey-Mark IV, Collis, Allisson)**
- **Laparoscopic Fundoplications**
  - √ **Nissen, Toupet**

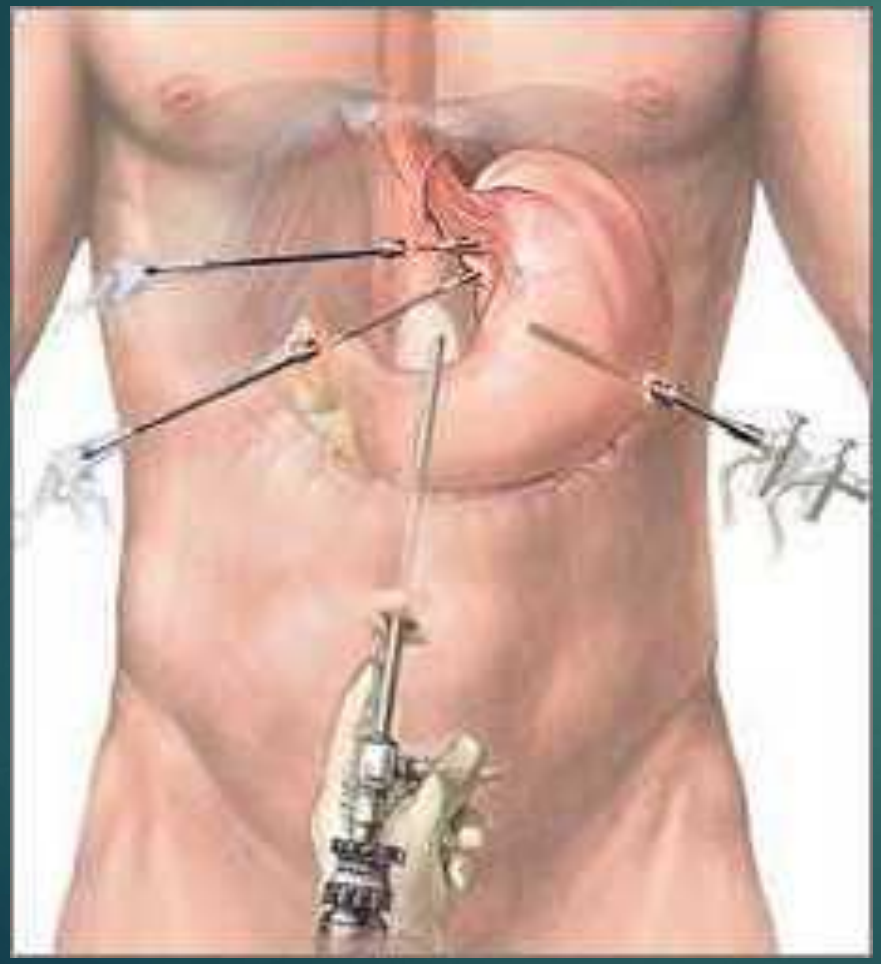
# Transabdominal repair of hiatal hernias
*(by Nissen-Rossetti)*

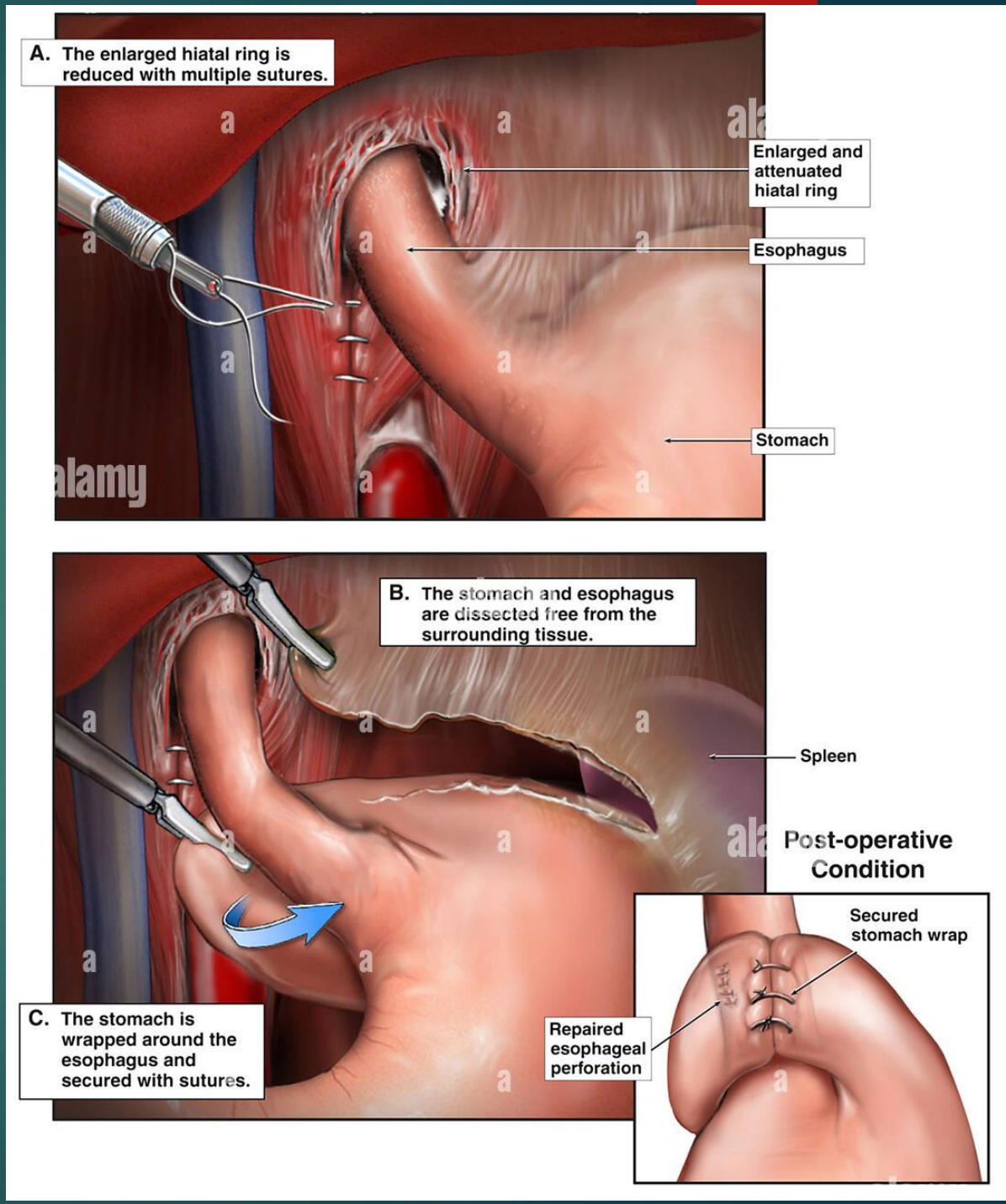




# Fundoplication Nissen via laparoscopic approach

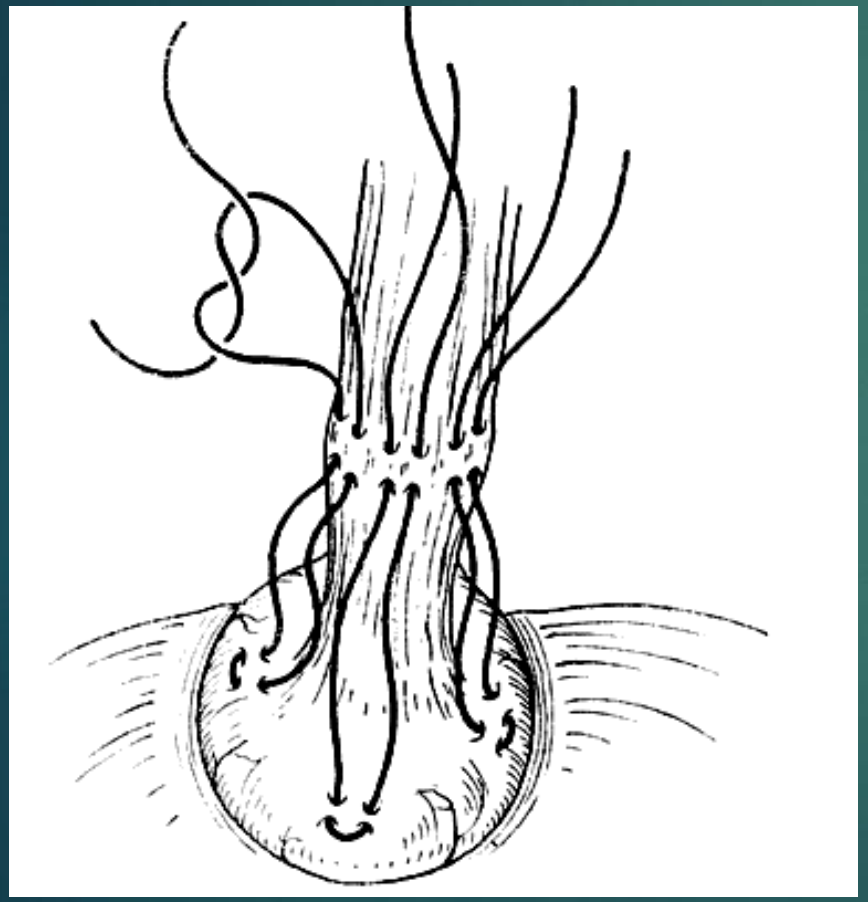


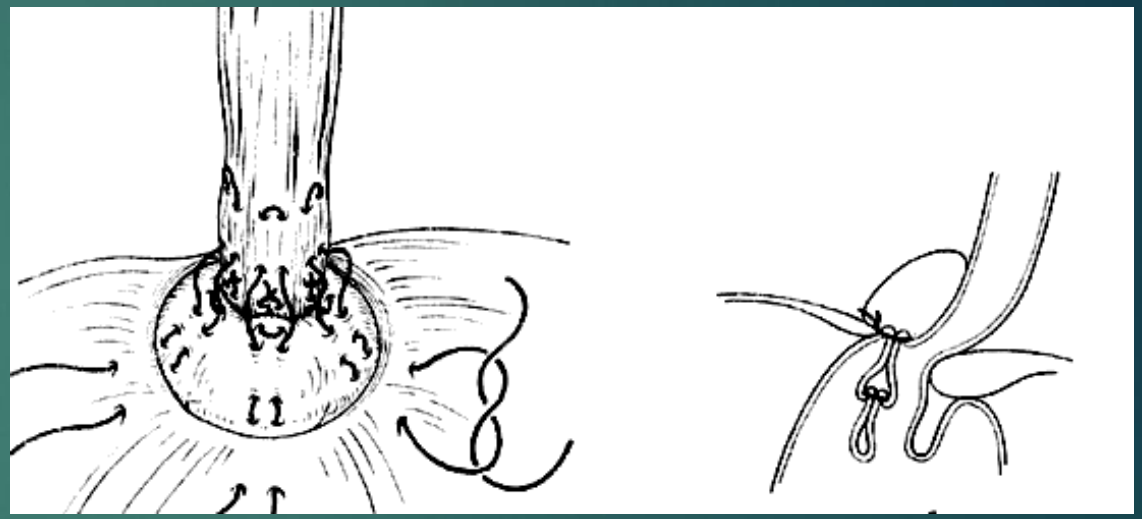


# Transthoracic repair of HH

## ( by Belsey Mark IV)

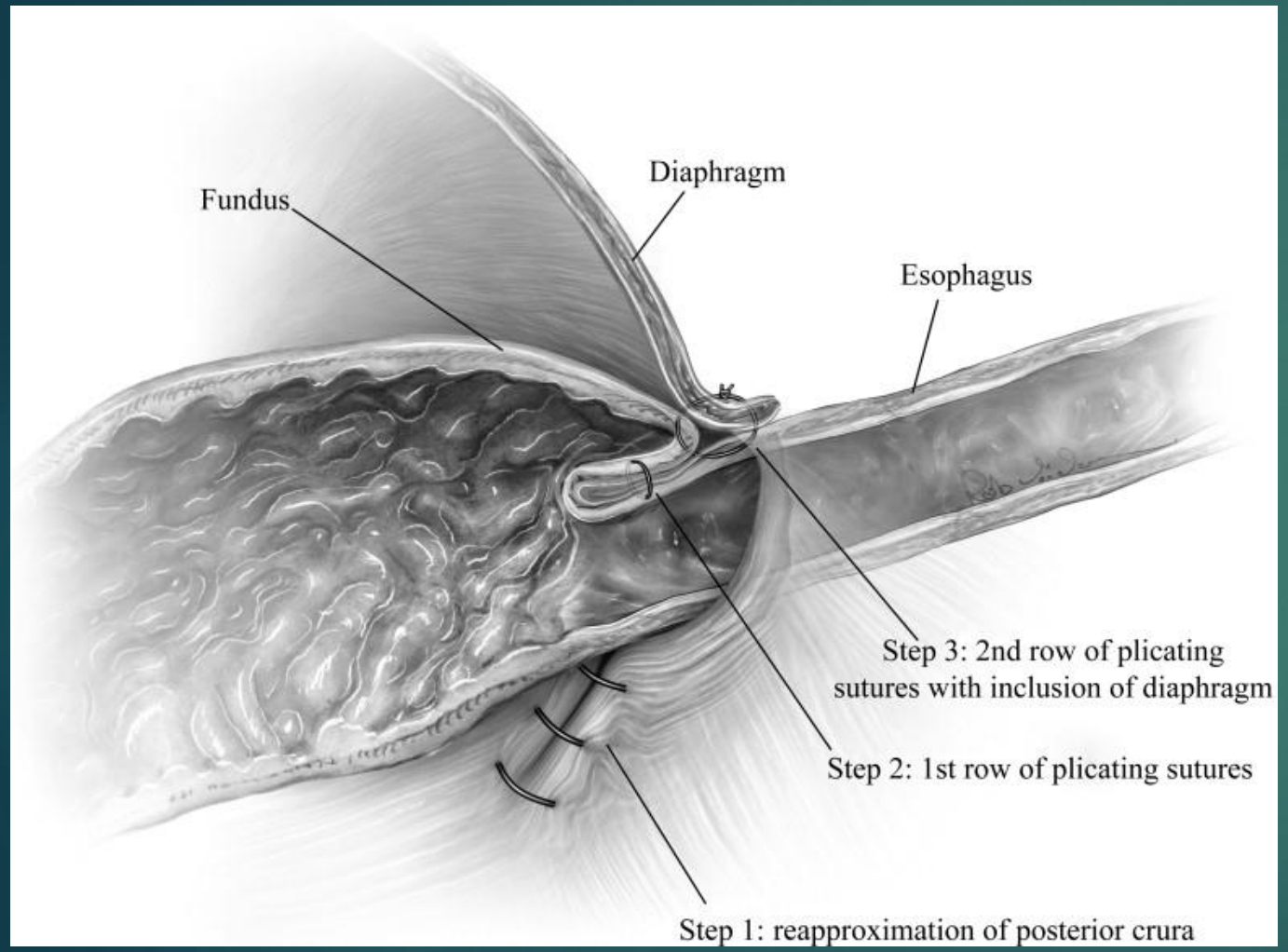
- ✓ *The goal is to return the "high-pressure zone" of the cardia, otherwise known as the lower gastroesophageal sphincter (LES) to its normal anatomical position below the diaphragm.*





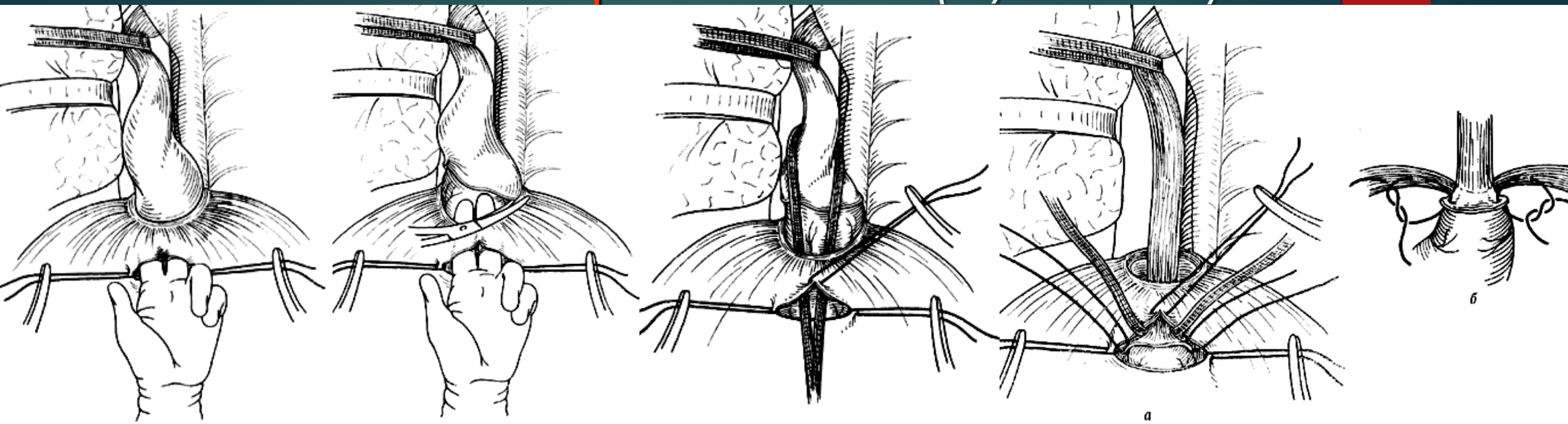
# Transthoracic repair of HH

## ( by Belsey Mark IV)

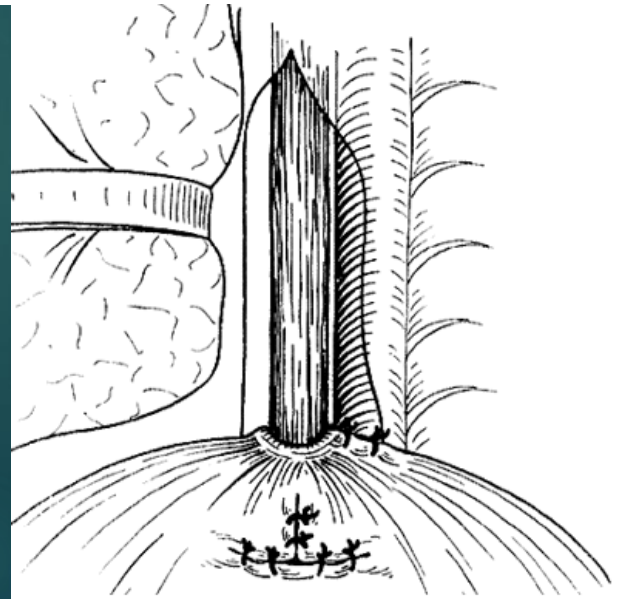



A final sagittal view of the Belsey Mark IV demonstrates the 3 steps of the repair:
step 1—narrowing of the esophageal hiatus;
step 2—first mattressed row of the 240° fundoplication;
step 3—second mattressed row of sutures that incorporate the diaphragm, securing the 240° plication to the diaphragm's peritoneal surface and maintaining the GEJ in the abdomen.

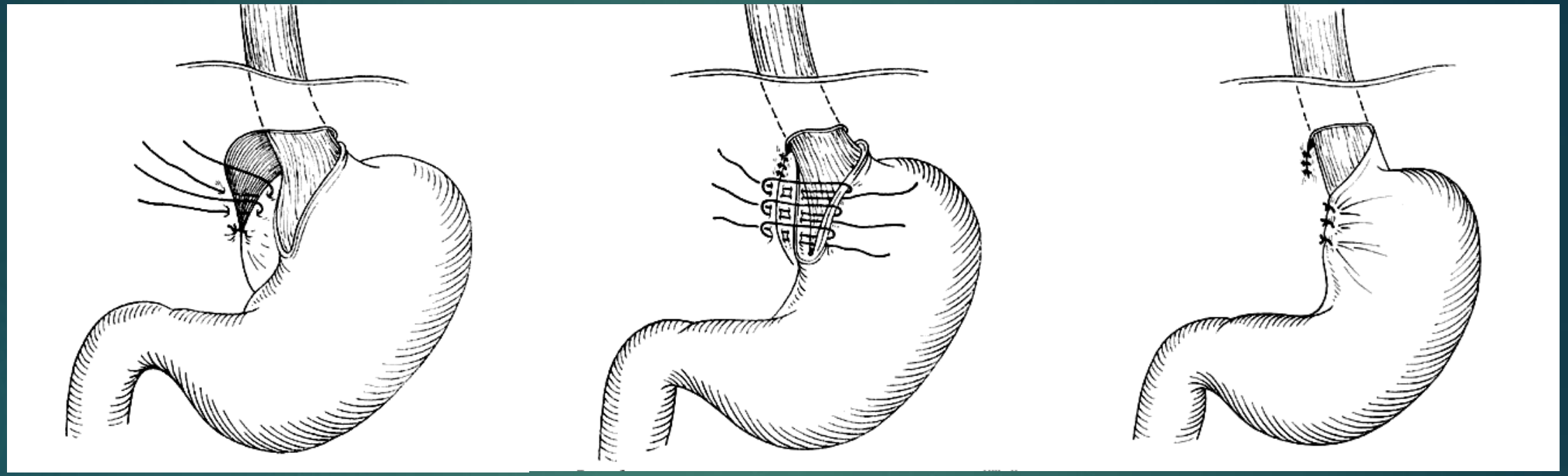
# Transthoracic repair of HH *(by Allisson)*




- ✓ *The essential steps in the Allison repair consisted of suture of the stretched phrenicoesophageal ligament to its normal attachment at the diaphragm*
- ✓ *Closure of the hiatus by reapproximation of the obturated muscle bundles of the right crus of the diaphragm.*

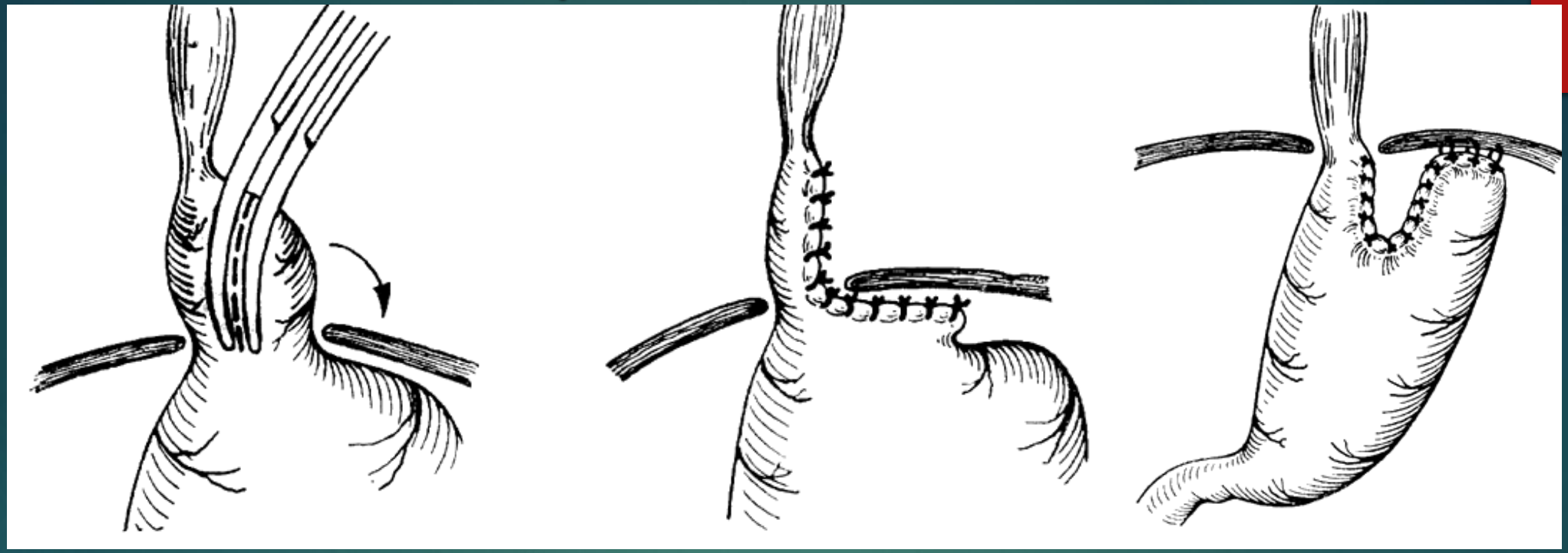


# Transthoracic repair of HH *(by Hill)*



- ✓ *The Hill repair for correction of hiatal hernia and surgical management of gastroesophageal reflux disease is defined as a cardia calibration plus posterior gastropexy.*
- ✓ *The repair includes restoration of the gastroesophageal junction (GEJ) with posterior anchoring and reconstruction of the gastroesophageal flap-valve mechanism (GEV).*

# Transthoracic repair of HH *(by Collis)*



- ✓ *Collis' original description was of a technique which caused a functional "lengthening of the esophagus" by performing a vertical gastroplasty in order to create a tubular length of neo-esophagus created from the gastric fundus.*
- ✓ *The original operation did not include a fundoplication.*
- ✓ *Later, a transthoracic fundoplication was added to the Collis gastroplasty in order to correct the underlying disease, and probable cause of the shortening itself.*

# Intra- and postoperative complications

- *In abdominal aproach are possible:*
  - *Perforation of abdominal part of esophagus,*
  - *spleen and liver rupture,*
  - *hemorrhage from short gastric and inferior frenic vessels,*
  - *dysphagia, gastrostasis*

- *In thoracic aproach are possible:*
  - *Pleura and lung lesions,*

  *bleeding,*

  *pleural effusions, bronchopulmonary complications,*

  *disturbances of cardiac rithm, pulmonary embolism,*

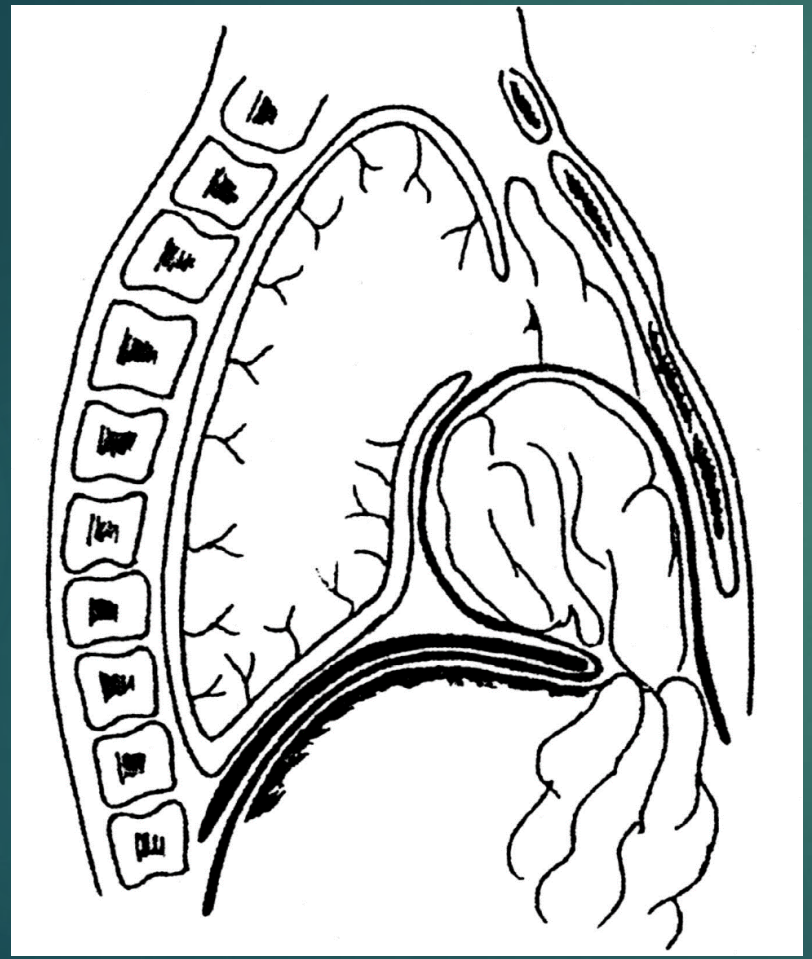
  *shock*

# Retro-costo-xiphoid hernias

## Definition:

*occurs through a slit in anterior part of diaphragm represented by a gap Larrey (left side) or a gap Morgagni (right side) with involvment of abdominal viscera in thoracic cavity*

# Retro-costo-xiphoid hernias



- **Synonims-** *anterior diaphragmal hernia, parasternal hernia, hernias in Morgagni-Larrey gaps*
- **Frequency- 3%** *from all number of diaphragmal hernias*

# Retro-costo-xiphoid hernias (etiopathogenesis)

- **Congenital-** agenesis or insufficient development of fascia of sternocostal insertion

- **Aquired** - A. Intraabdominal hypertention through cough or effort
  - B. Intrathoracic negative pressure
    - always with hernial sac,
      right sided are most frequent

# Retro-costo-xiphoid hernias (Clinical signs)

1. *Frequent clinical signs are absent or olygosymptomathic*
2. *The onset may be acute in the form of strangulation with occlusive syndrome*
3. *May show a mixed gastrointestinal and thoracic symptoms*

- ►*moderate epigastric or retrosternal pain*
- ►*pain on the base of hemichest, dyspnea, cough, cianosis*
- ►*palpitations, disturbances of cardiac rithm, pseudoangina pain*
- ►*pain or abdominal discomfort, flatulence, constipation*

# Retro-costo-xiphoid hernias ( imaging)

- Chest X-ray
- X-ray with barrium
- Ultrasound
- CT
- MRI

- Peritoneoscintigraphy with Tc-99

# Retro-costo-xiphoid hernias (differencial diagnosis)

- Pleuropericardiac cysts
- Dermoid cysts, teratomas
- Lipomas in inferior and medial mediastinum
- Cystic sequestration lung
- Basal pulmonary hydatid cyst
- Diaphragmal cysts and tumors
- Paraesophageal large HH
- Residual lung cavities
- Pericarditis

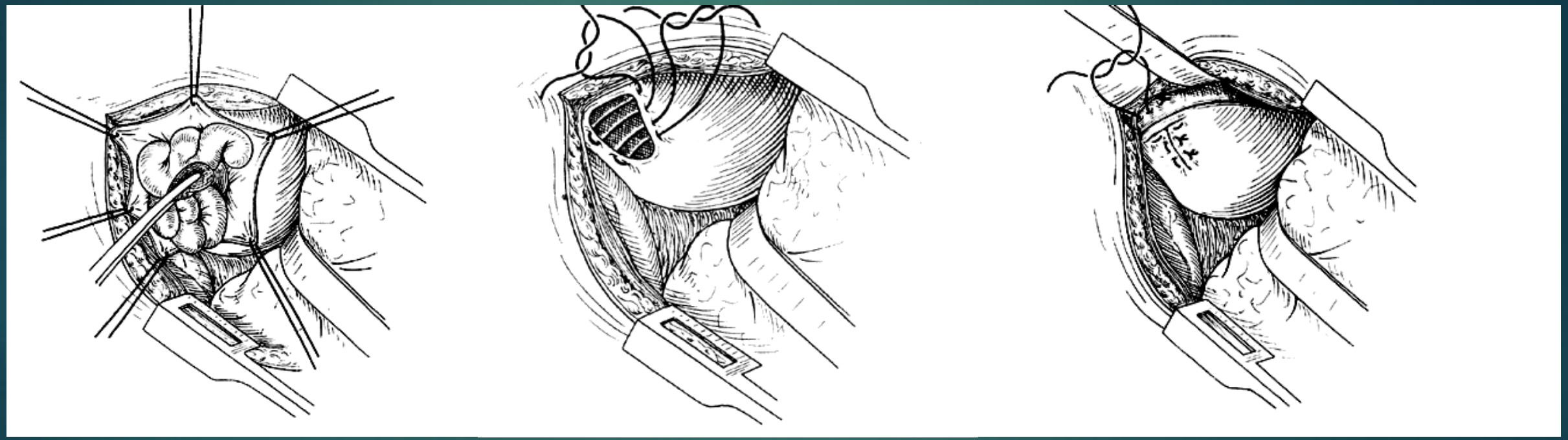
# Retro-costo-xiphoid hernias (Evolution, Prognosis, Complications)

- ✓ *Evolution is usually prolonged*
- ✓ *Can be evidenced mediastinal compression syndromes*
- ✓ *Clinical manifestations of bronchial tree compression*
- ✓ *Strangulation of hernia is rare and is manifested by signs of occlusion*

# Retro-costo-xiphoid hernias (surgical treatment)

- **Thoracic way**
  - Is indicated in large hernias without digestive complains
  - Adherence syndrome raises difficulties of intraoperative sac dissection

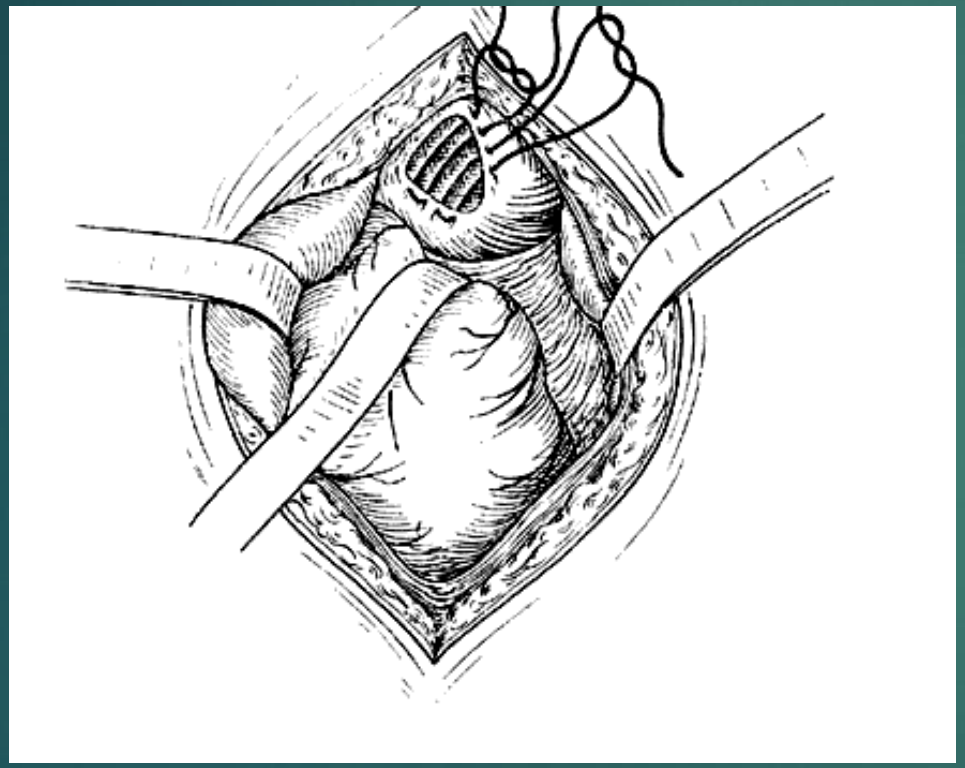
# *Transthoracic surgical correction in retro-costo-xiphoid hernias*

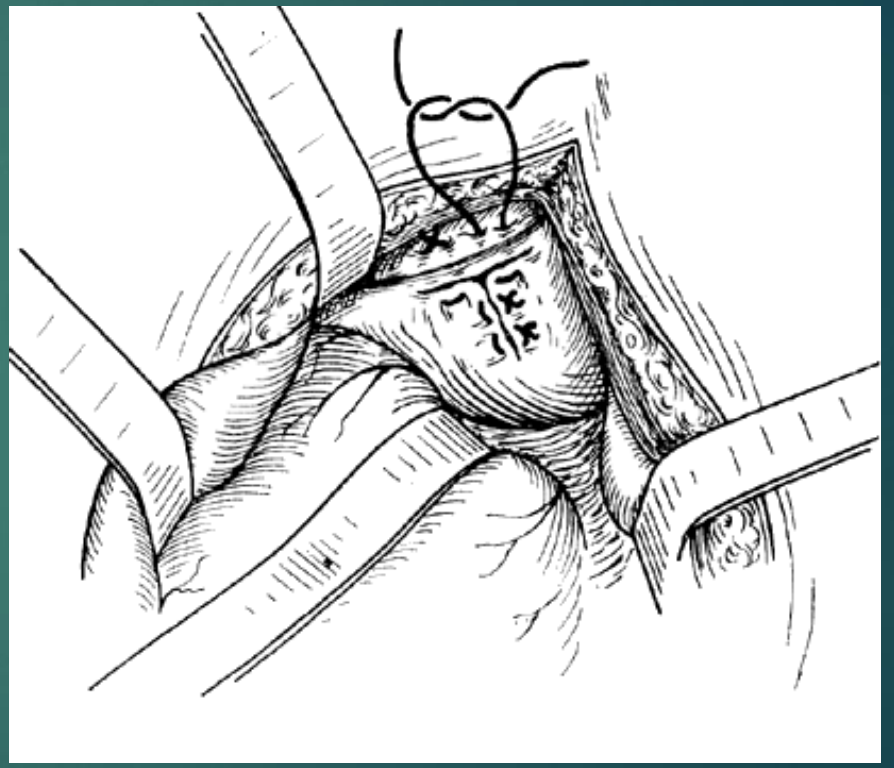


# Retro-costo-xiphoid hernias (surgical treatment)

- **Abdominal access**
  - Management of hernial defect
  - Management of digestive complications caused by hernia strangulation (omentum or intestinum resection)

# Transabdominal surgical correction in retro-costo-xiphoid hernias



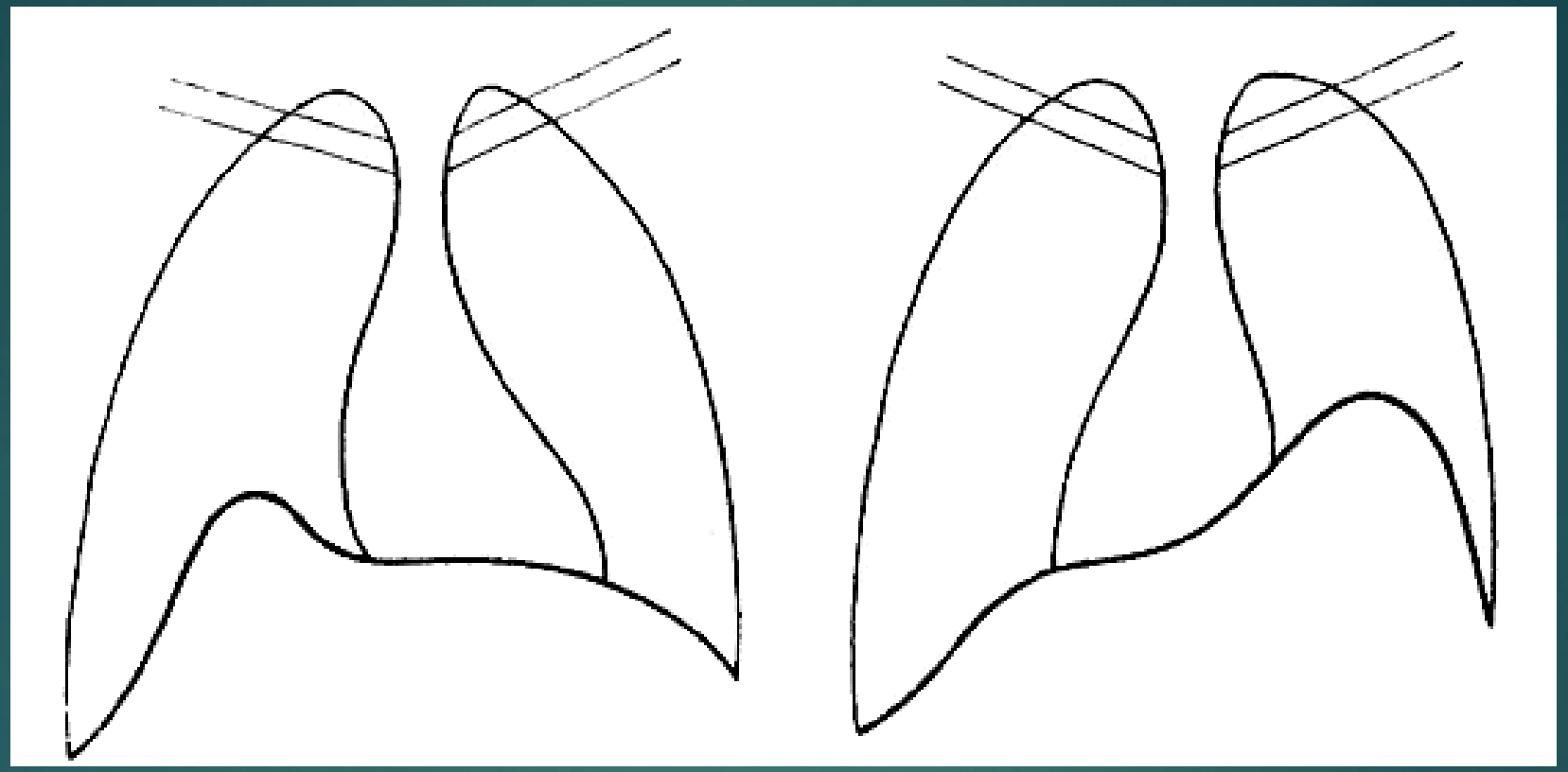


# Diaphragm relaxation

## Definition:

represents the permanent lifting and or high position of hemidiaphragm or part of it

# diaphragm relaxation



- Synonyms - diaphragmatic eventration, diaphragm "en brioche", diaphragmatic muscle hypoplasia

# Diaphragm relaxation
## (etiopathogenesis)

**Congenital –**

*due to developmental defects of the diaphragm or phrenic nerve.*

**Acquired –**

*1) phrenic nerve injury from various causes: infectious diseases (diphtheria, tuberculosis, syphilis), crushing by inflammatory scarring, phrenicectomy, degenerative or traumatic cervical spondylosis.*

*2) traumatic (dilacerations or rupture of muscle fibers)*

- **Depending on the spread: Total - (a whole hemidiaphragm eventration), partial (sectoral)**

- **Depending on localization:**

**A. Eventration of left hemidiaphragm**

**B. Eventration of right hemidiaphragm**

# Diaphragm relaxation (Clinical manifestation)

**Digestive signs**

- √ **stomach involvment** (postprandial epigastric pain, vomiting, flatulence)
- √ **cardia involvment -** induce the esophageal signs (retrosternal pain, dysphagia, sialorrhea)

# Diaphragm relaxation (Clinical manifestation)

## Respiratory signs:

√ dyspnea, which is exacerbated by feed

## Cardiac signs:

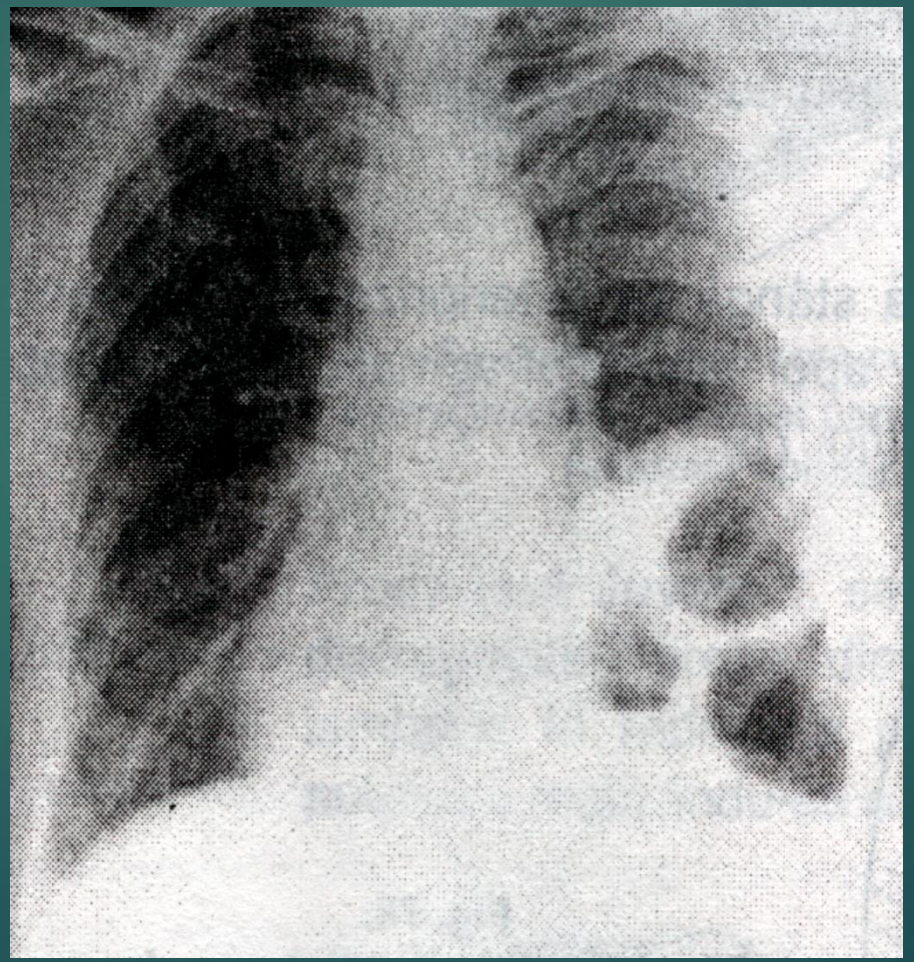
√ palpitations, pseudoangina seizures, evoluated after feed due to cord compression by full stomach

# Diaphragm relaxation (imaging)

- X-ray
- Radiography with barium
- Ultrasound
- CT
- MRI

- Pneumoperitoneum

# Left diaphragm relaxation
## (frontal radiography)



# *Diaphragm relaxation*
## *(Differential diagnosis)*

- **Diaphragmal hernia**
- **Cystic tumors of diaphragm**
- **Solid tumors of diaphragm**
- **Pseudotumoral mass**
- **Hydatid cyst**

# Diaphragm relaxation

(Surgical treatment is indicated in symptomathic forms of pathology)

## Access:

Abdominal- subcostal incision

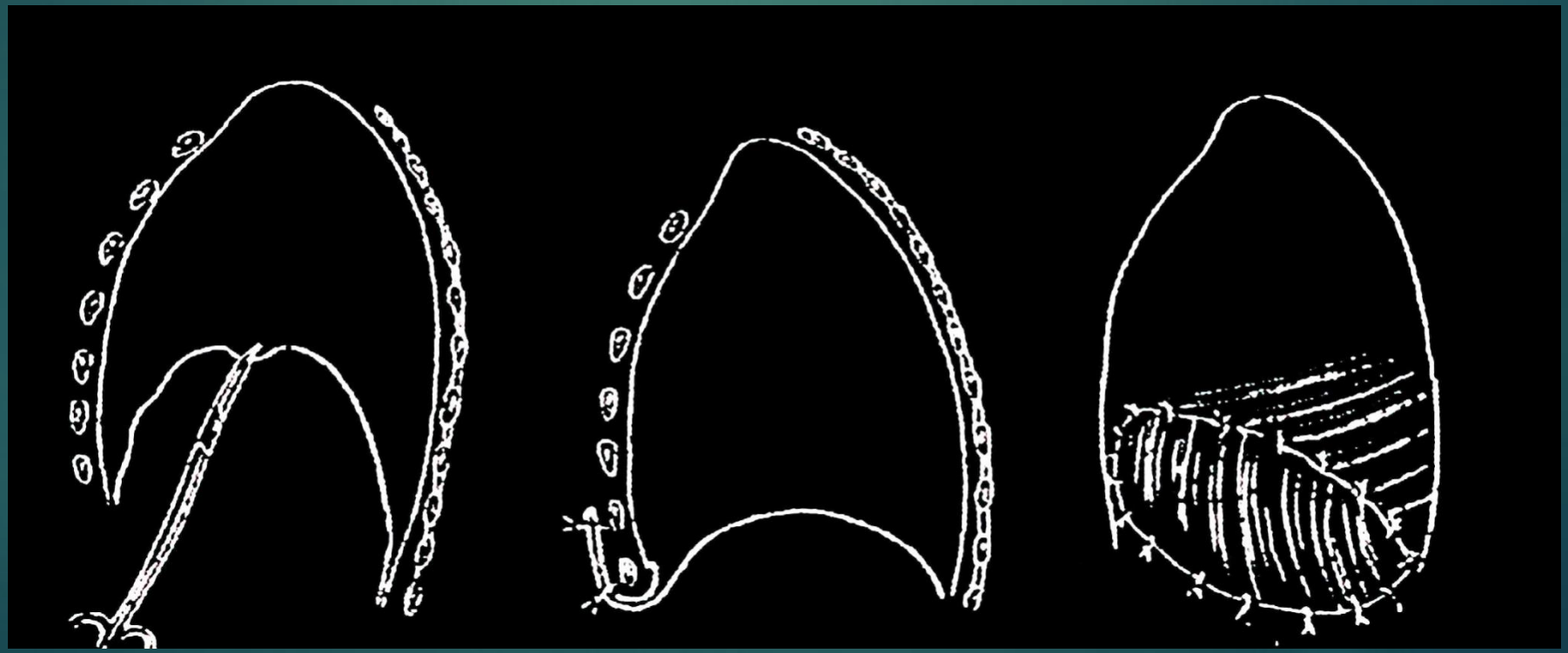
Thoracic- left or right anterolateral thoracotomy

## Methods:

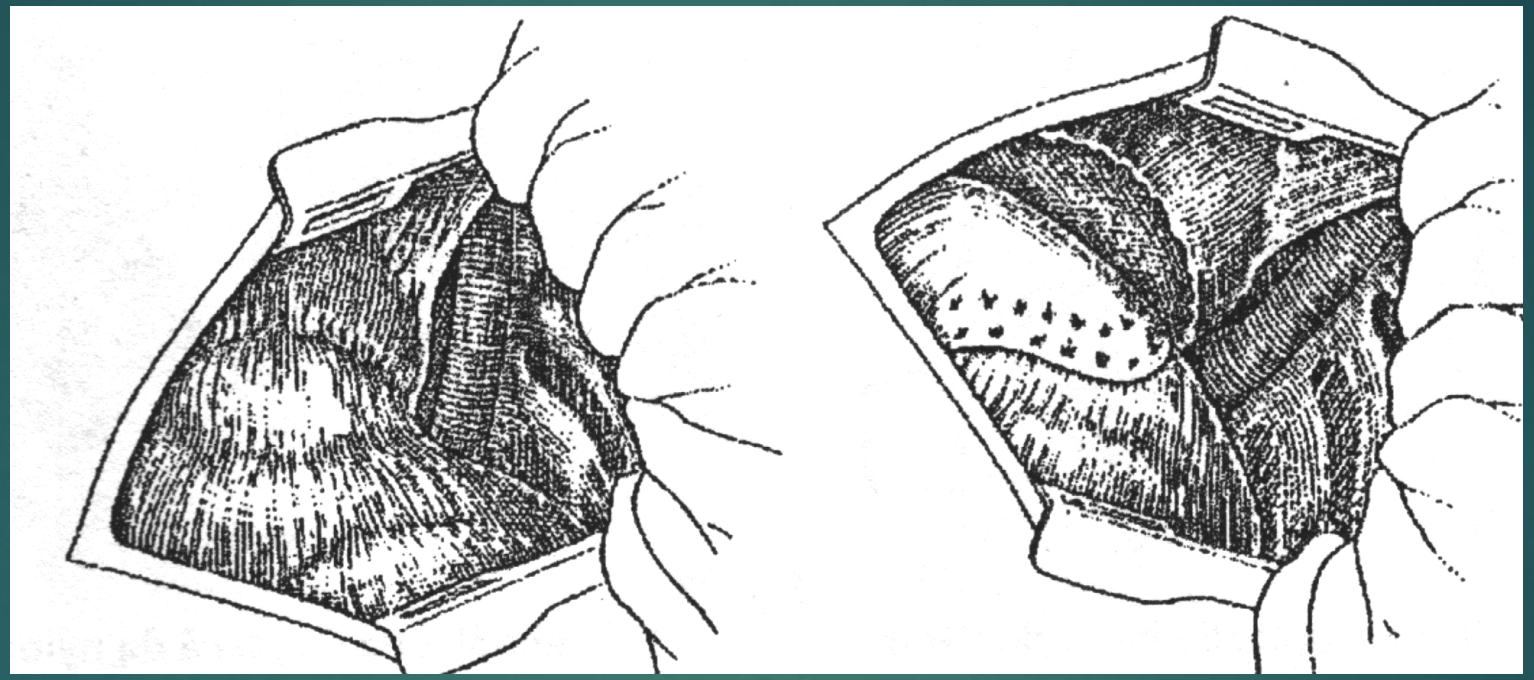
- diaphragm folding
- excision followed by suturing
- incision followed by suturing
- diaphragm restoration under tension
- phrenoplasty

# *Diaphragm folding through abdominal access (by Nissen)*

- **Traction and exteriorisation of diaphragm**
- **Anterior swinging of diaphragmatic fold**
- **Fixing it to external thorax surface**



# Diaphragm folding through thoracotomy (by Dor-Jean)



- *Lifting of diaphragmatic dome*
- *Separation of pericardic sac from diaphragm followed by suturing*

# Diaphragm folding through thoracotomy ( by Perrotin J.)