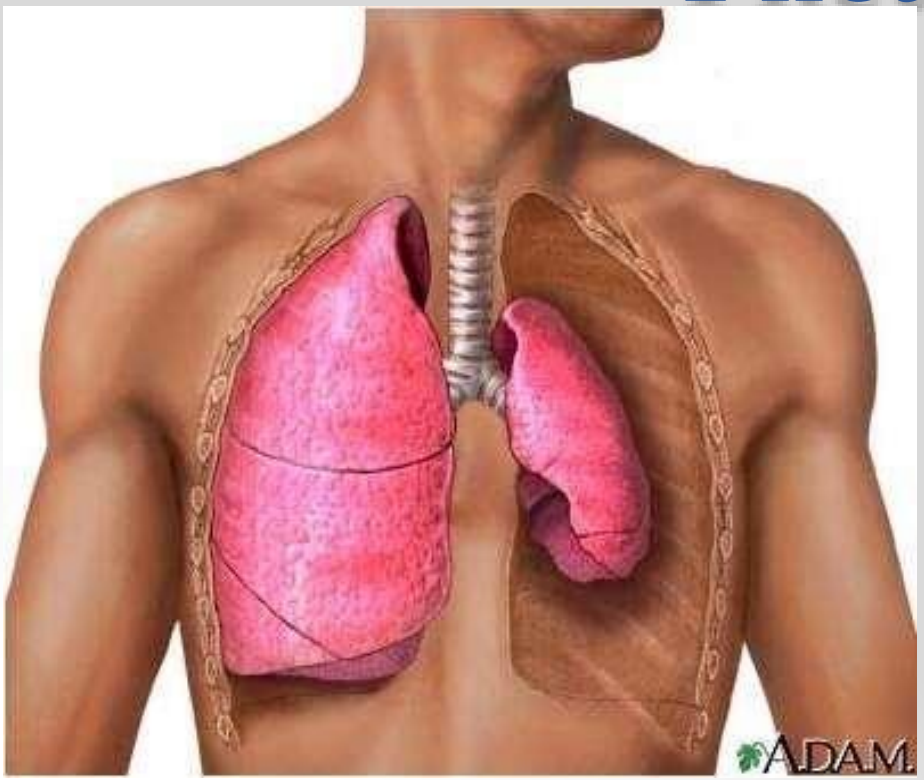
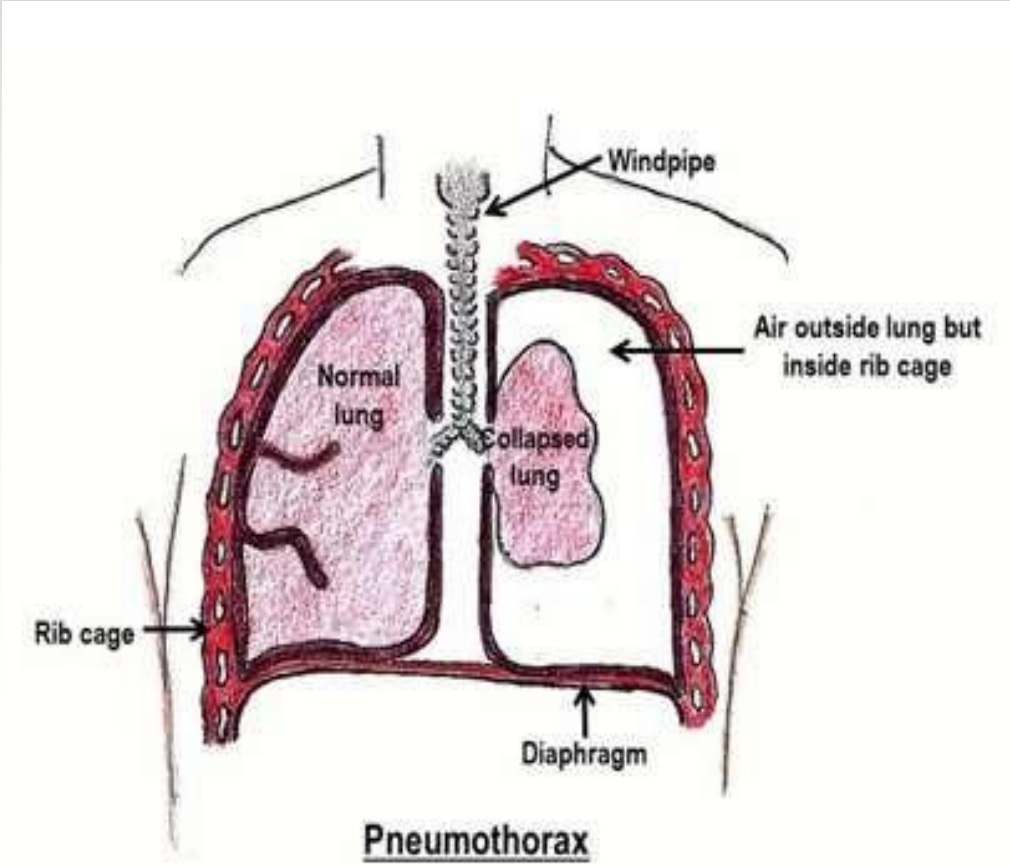
Pneumothorax



Dr Ummar

WHAT IS PNEUMOTHORAX

- Pneumothorax is defined as presence of air in the pleural space.



Pathophysiology

- Blebs and bullae are also known as emphysema-like changes (ELCs)
- The probable cause of pneumothorax is rupture of an apical bleb or bulla
- Because the compliance of blebs or bullae in the apices is lower compared with that of similar lesions situated in the lower parts of the lungs

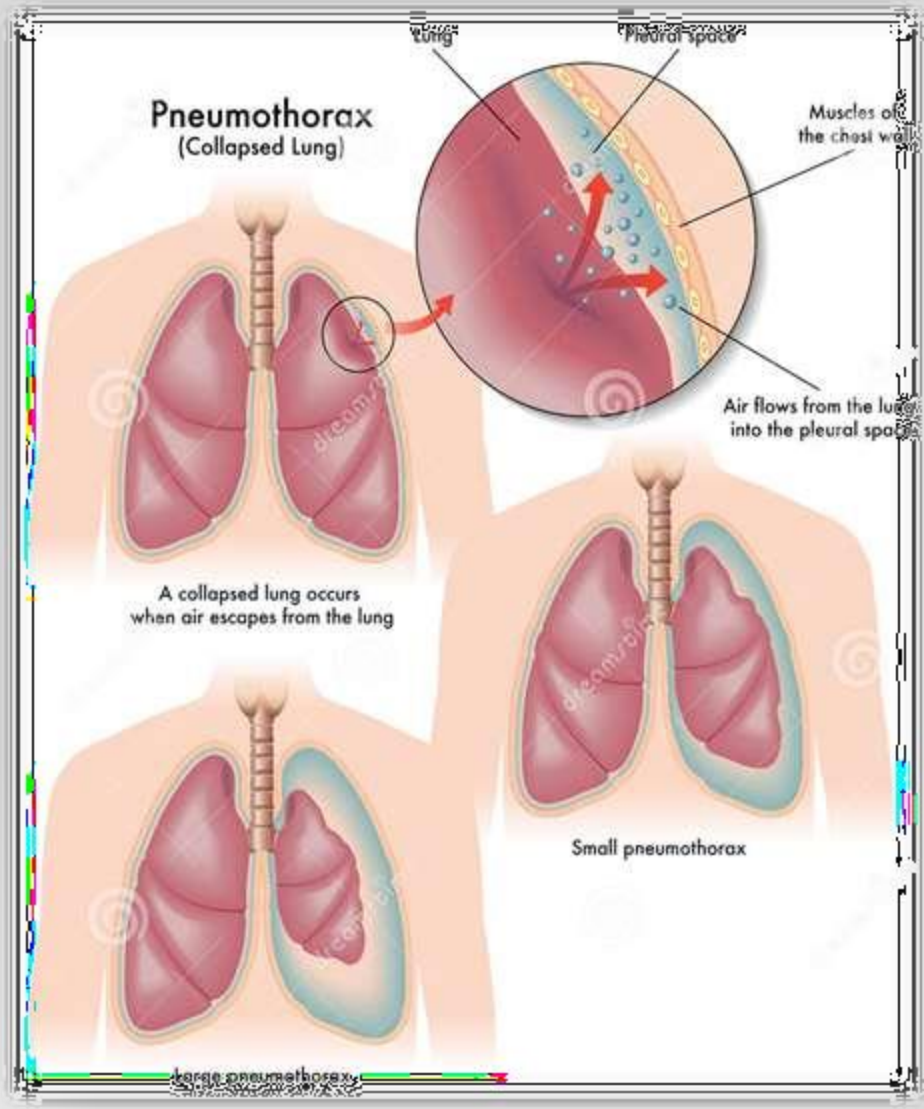
Pathophysiology

- It is often hard to assess whether bullae are the site of leakage, and where the site of rupture of the visceral pleura is
- Smoking causes a 9-fold increase in the relative risk of a pneumothorax in females
- A 22-fold increase in male smokers
- With a dose-response relationship between the number of cigarettes smoked per day and occurrence of PSP

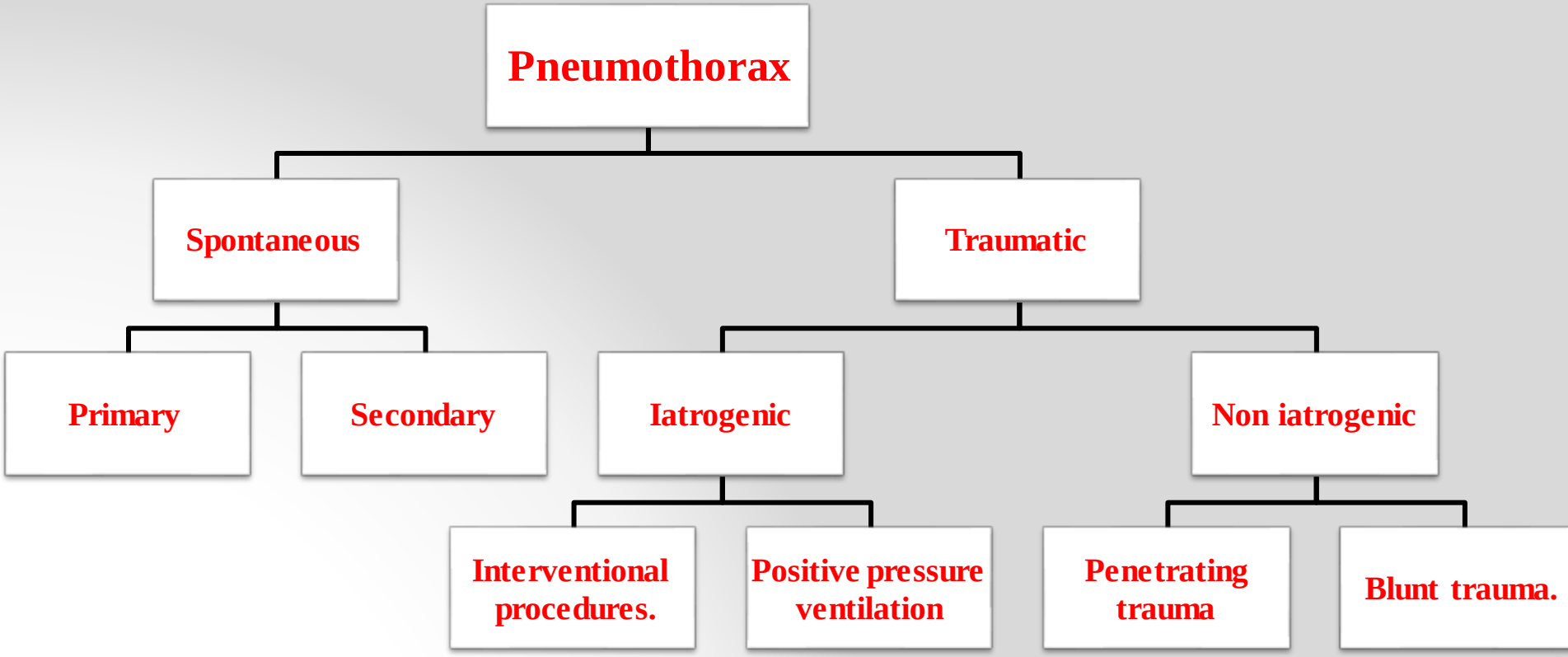
Mechanism

- In normal people, the pressure in pleural space is negative during the entire respiratory cycle.
- Two opposite forces result in negative pressure in pleural space(outward pull of the chest wall and elastic recoil of the lung)
- The negative pressure will be disappeared if any communication develops .

- When a communication develops between an alveolus or other intrapulmonary air space and pleural space, air will flow into the pleural space until there is no longer a pressure difference or the communication is sealed

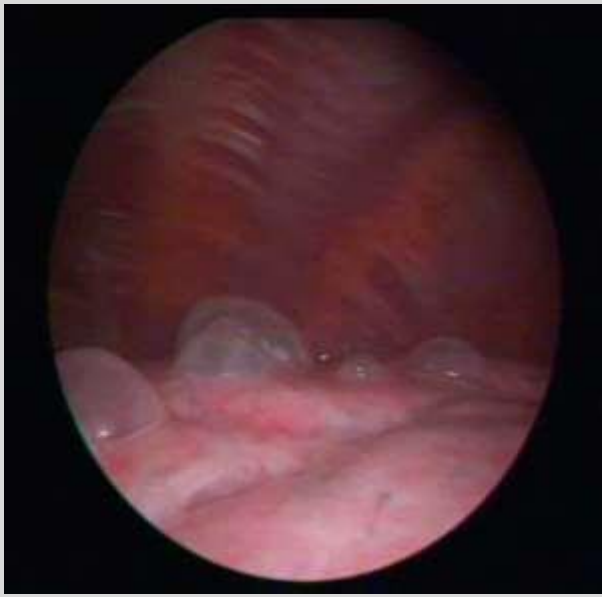


Etiology


Pneumothorax
Spontaneous
Traumatic
Primary
Secondary
Iatrogenic
Non iatrogenic
Interventional procedures.
Positive pressure ventilation
Penetrating trauma
Blunt trauma.

Primary spontaneous pneumothorax

- It occurs in young healthy individuals without underlying lung disease.
- It is due to rupture of apical sub-pleural bleb or bullae



Predisposing factors:

- Smoking.
- Tall, thin male.
- Airway inflammation (distal)
- Structural abnormalities of bronchial
- Genetic contribution

Secondary spontaneous pneumothorax

Most common cause.

- TB
- Asthma
- COPD
- Suppurative pneumonia
- Cystic fibrosis

Rare cause

- ILD
- Eosinophilic granuloma
- Sarcoidosis
- Lymphangioleiomyomatosis
- AIDS.
- Primary lung carcinoma
- Complication of chemotherapy
- Connective tissue disease
- Scleroderma
- Marfans syndrome
- Histiocytosis- x
- Rheumatoid disease
- Pulmonary infarct
- Wegener's granulomatosis…

Clinical manifestation

Dyspnea

Chest pain (pleuritic)

Uncommon manifestation

Cough

Hemoptysis

Orthopnea

Cyanosis

Mod tachycardia

Traumatic pneumothorax

Accidental trauma:(non-iatrogenic)

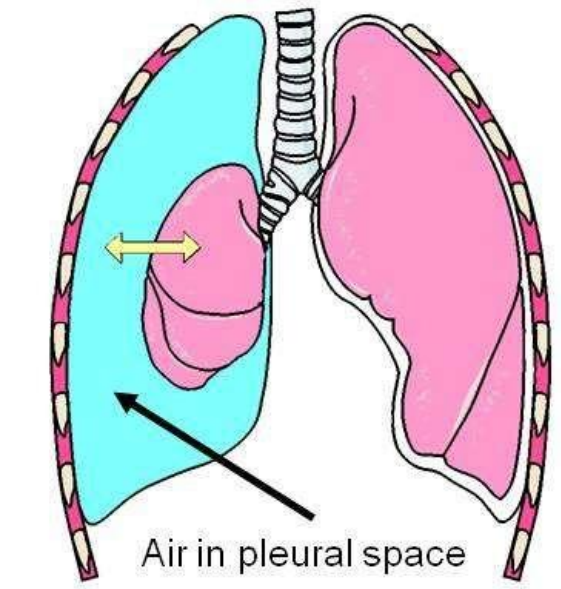
Blunt trauma: with fracture ribs.
Penetrating trauma: stab wound or gun shot injury.

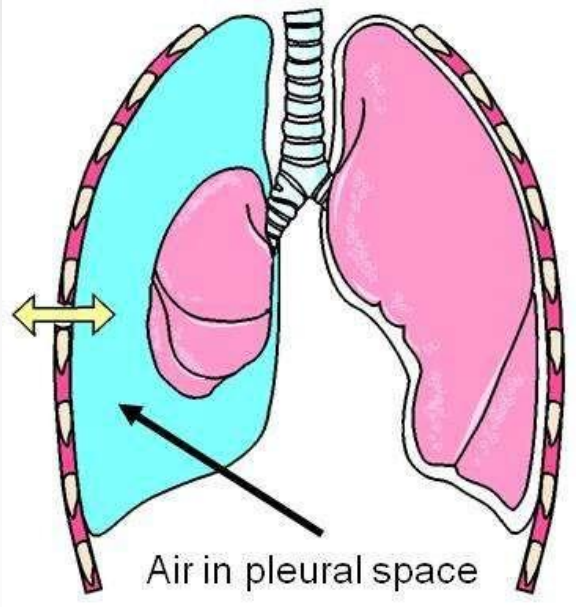
Iatrogenic :
Positive pressure ventilation:
Alveolar rupture → interstitial emphysema
→pneumothorax.(B/L PNX)
Interventional procedures:
Biopsy, thoraco-centesis, **CVP** line,trachestomy etc..

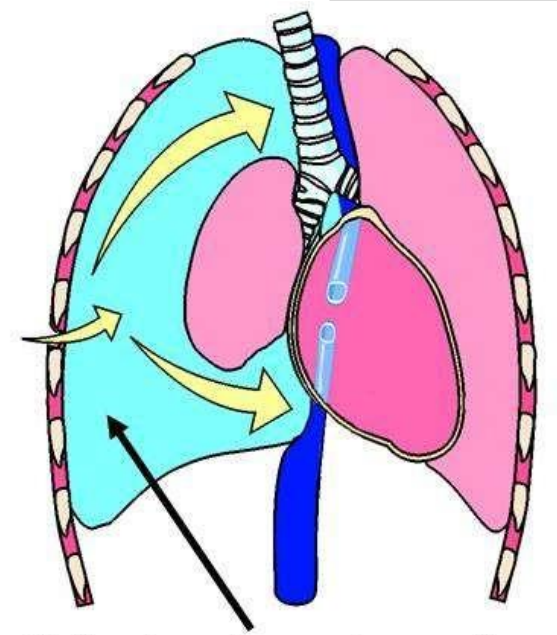
Clinical type of PNX

Pneumothorax

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







Closed pneumothorax	Open pneumothorax	Tension pneumothorax
The pleural tear Is **sealed**	The pleural tear is **open**	The pleural tear act as a **ball & valve** mechanism
The pleural cavity pressure is < the atmospheric pressure	The pleural cavity pressure is = the atmospheric pressure	The pleural cavity pressure is > the atmospheric pressure

Clinical manifestation

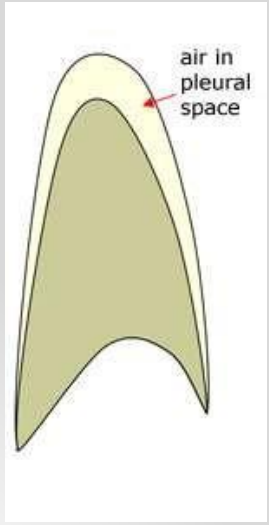
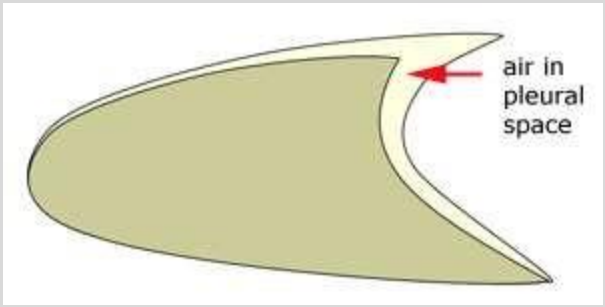
- Tension pneumothorax
  - RAPIDLY PROGRESSIVE DYSPNIA.
  - Cyanosis
  - Marked tachycardia
  - Hypotension

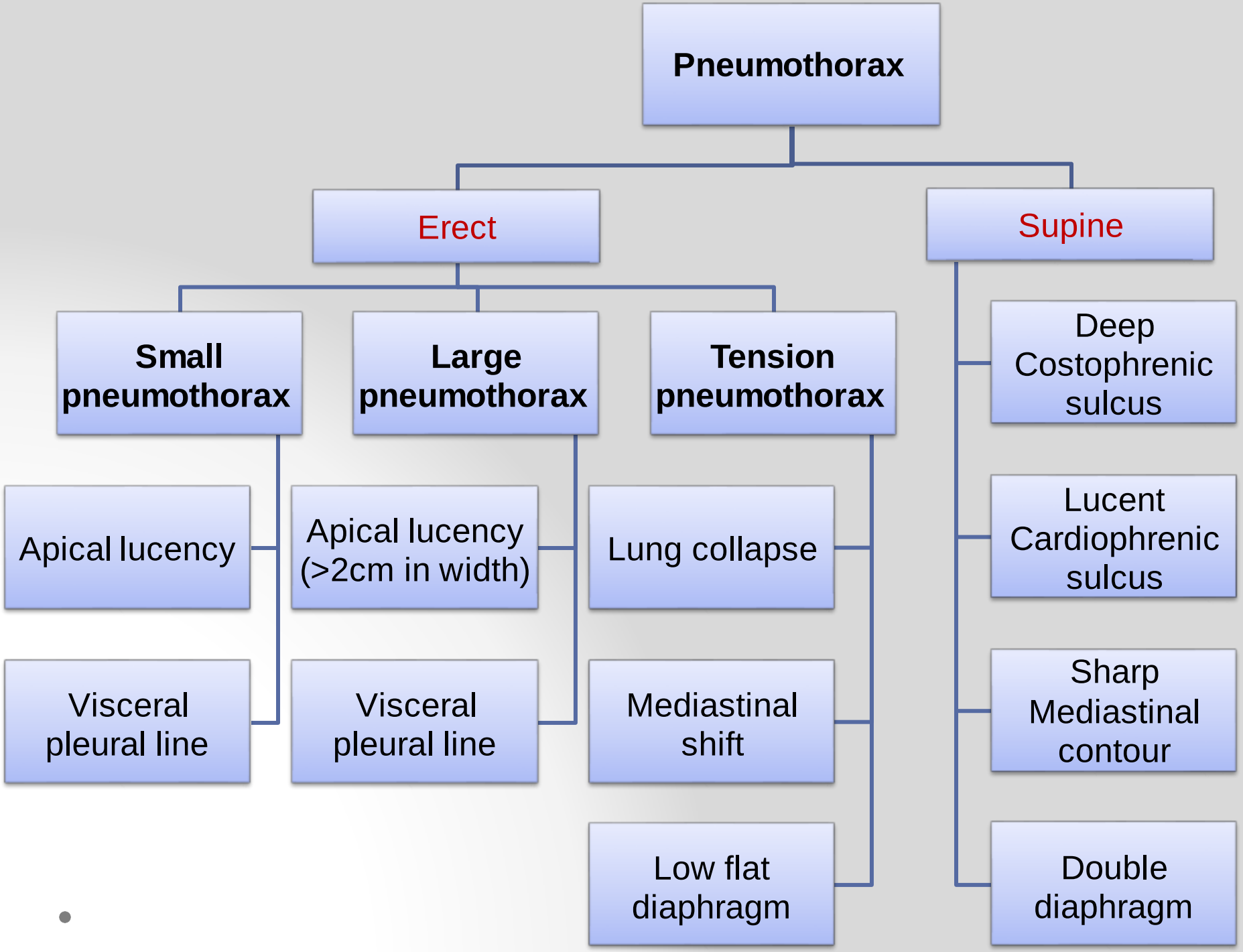
- Patient who suddenly deteriorate clinically, be suspected in the patient with
  - Mechanical ventilation (b/l PNX)
  - Cardiopulmonary resuscitation

Physical examination

- Depend on *size* of pneumothorax
- The *vital signs* usually normal
- Unilateral Chest *movements*
- The *trachea* may be shifted toward the contralateral side if the pneumothorax is large
- Tactile fremitus is absent
- The *percussion* note is hyperresonant
- The *breath sounds* are reduced or absent on the affected side
- The lower edge of *the liver* may be shifted inferiorly with a right-side pneumothorax

Investigations and Diagnosis

Pneumothorax in **erect** position	Pneumothorax in **supine** position
Air in apicolateral pleural space  	Air in anteromedial pleural space.  


Pneumothorax
Erect
Supine
Small pneumothorax
Large pneumothorax
Tension pneumothorax
Deep Costophrenic sulcus
Apical lucency
Apical lucency (>2cm in width)
Lung collapse
Lucent Cardiophrenic sulcus
Visceral pleural line
Visceral pleural line
Mediastinal shift
Sharp Mediastinal contour
Low flat diaphragm
Double diaphragm

Quantification of the size

24

Quantification of the size

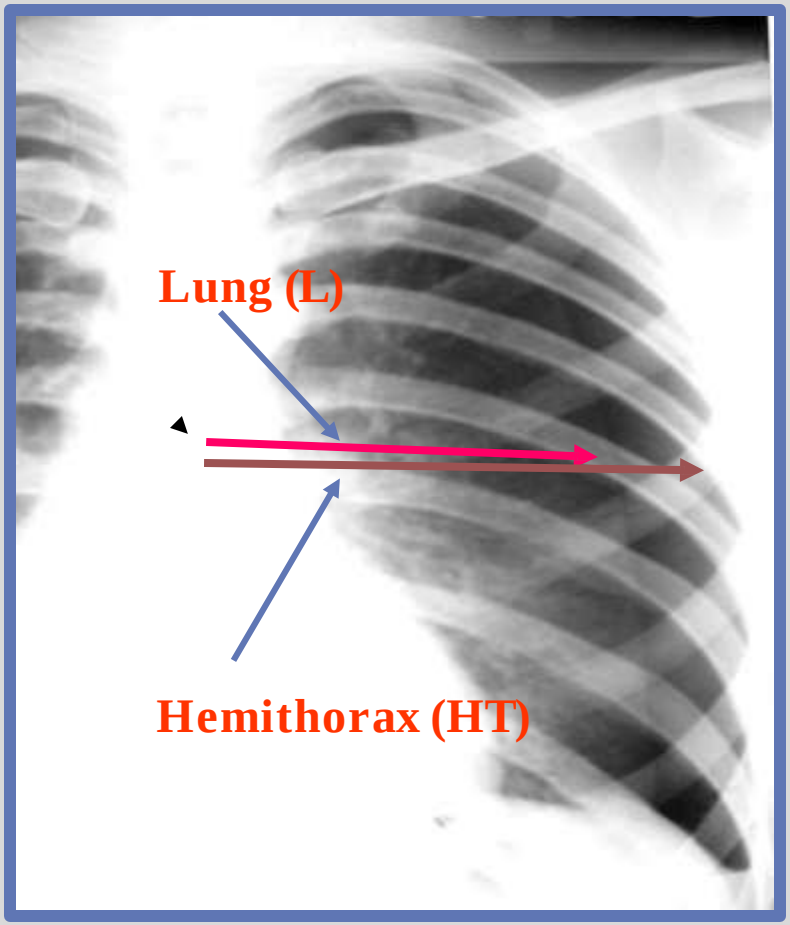
The simple method to estimate the size

Small, a visible rim of < 2 cm between the lung margin and the chest wall

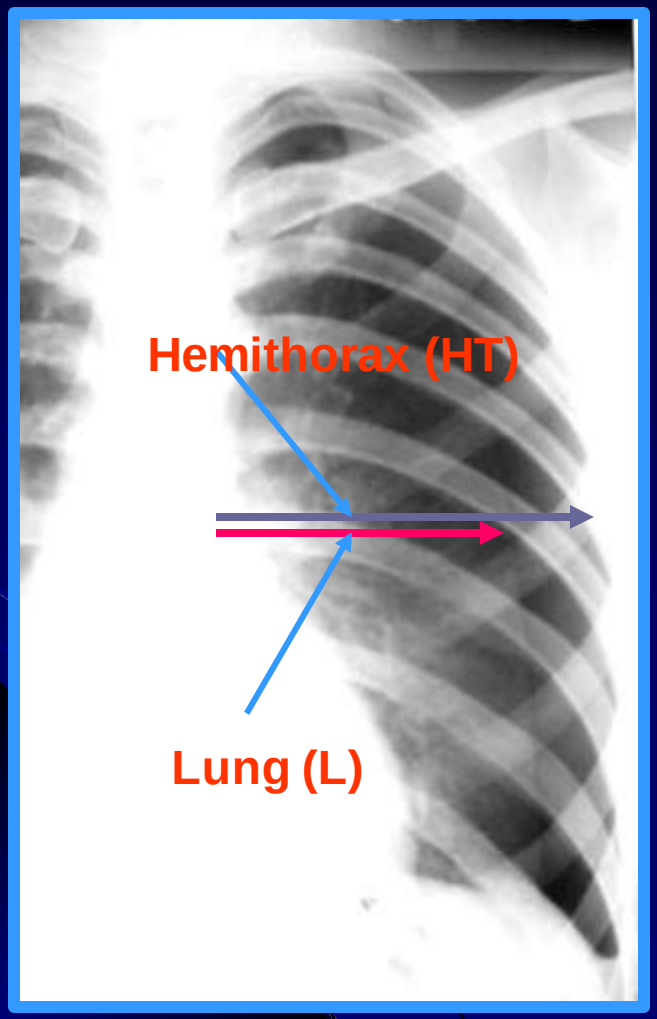
Large, a visible rim of ≥2 cm between the lung margin and chest wall

Light index

Measure transverse Diameters of lung and Compare it with diameter hemithorax



Estimation of pneumothorax volume



- Light equation

  pneumothorax% = $(1 - L^3/HT^3) \times 100$

- Kircher equation

$$\text{pneumothorax\%} = \frac{\text{Thorax area} - \text{lung area}}{\text{Thorax area}} \times 100$$

- Collins equation

  $4.2+[4.7\times(A+B+C)]$

Plane chest X-ray film

- A pneumothorax of 2 cm on the PA chest radiograph occupies about 49% of the hemithorax volume
  - Lung is 8 cm, hemithorax is 10 cm in diameter
- Equation

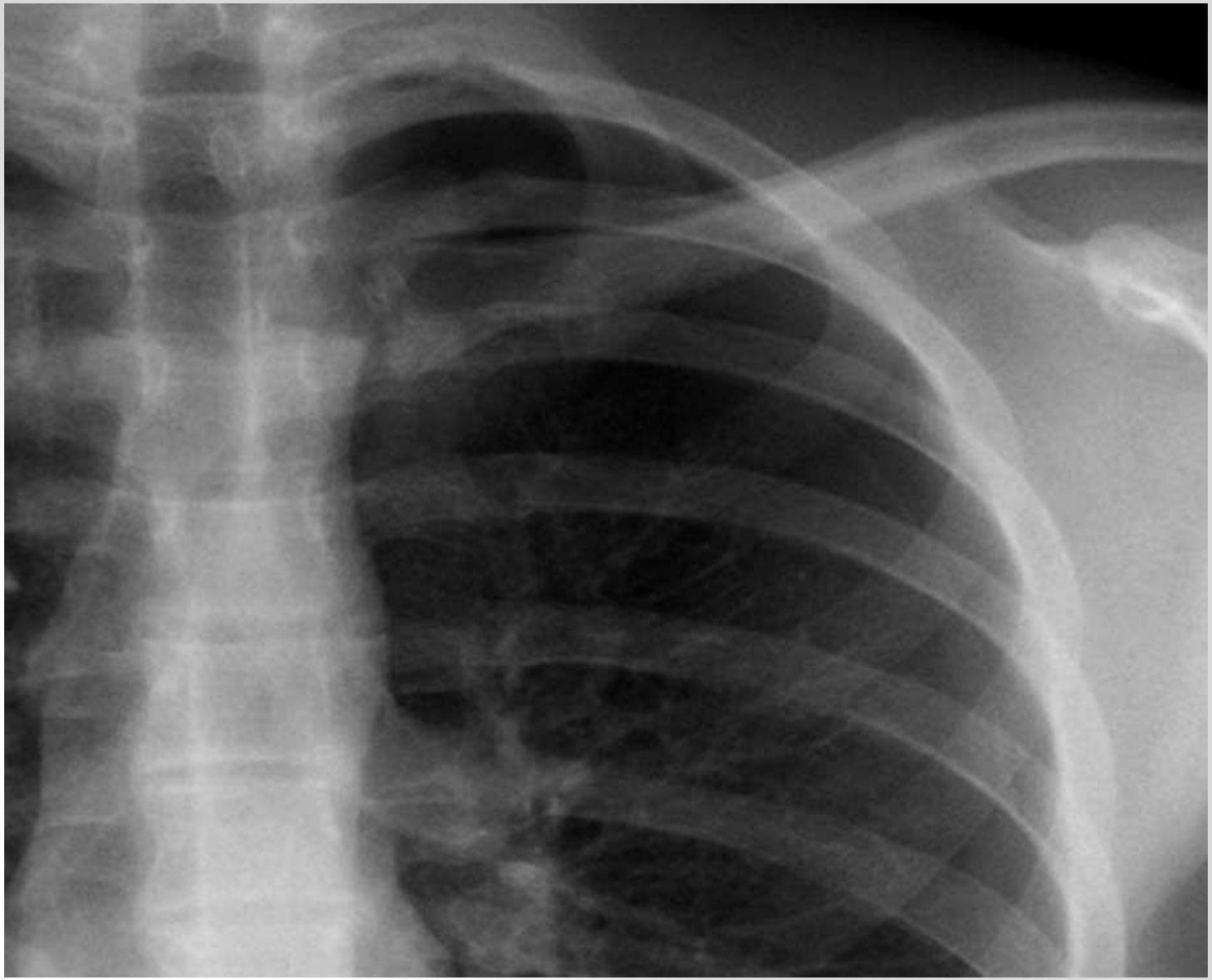
  Volume of pneumothorax = $(HT^3 – L^3) \div HT^3$

  $= (10^3 – 8^3) \div 10^3$

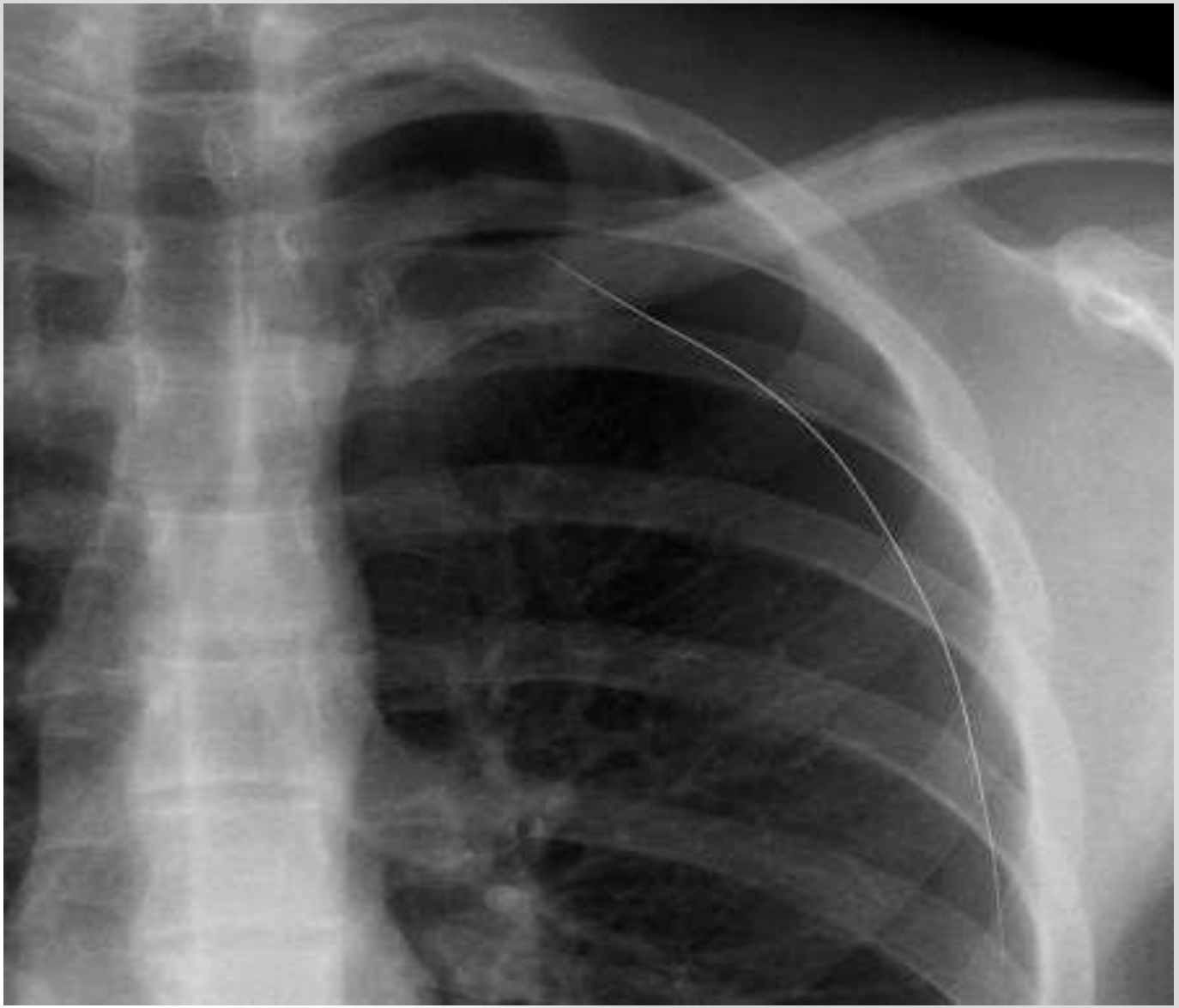
  $= (1000 – 512) \div 1000$

  $= 0.49$

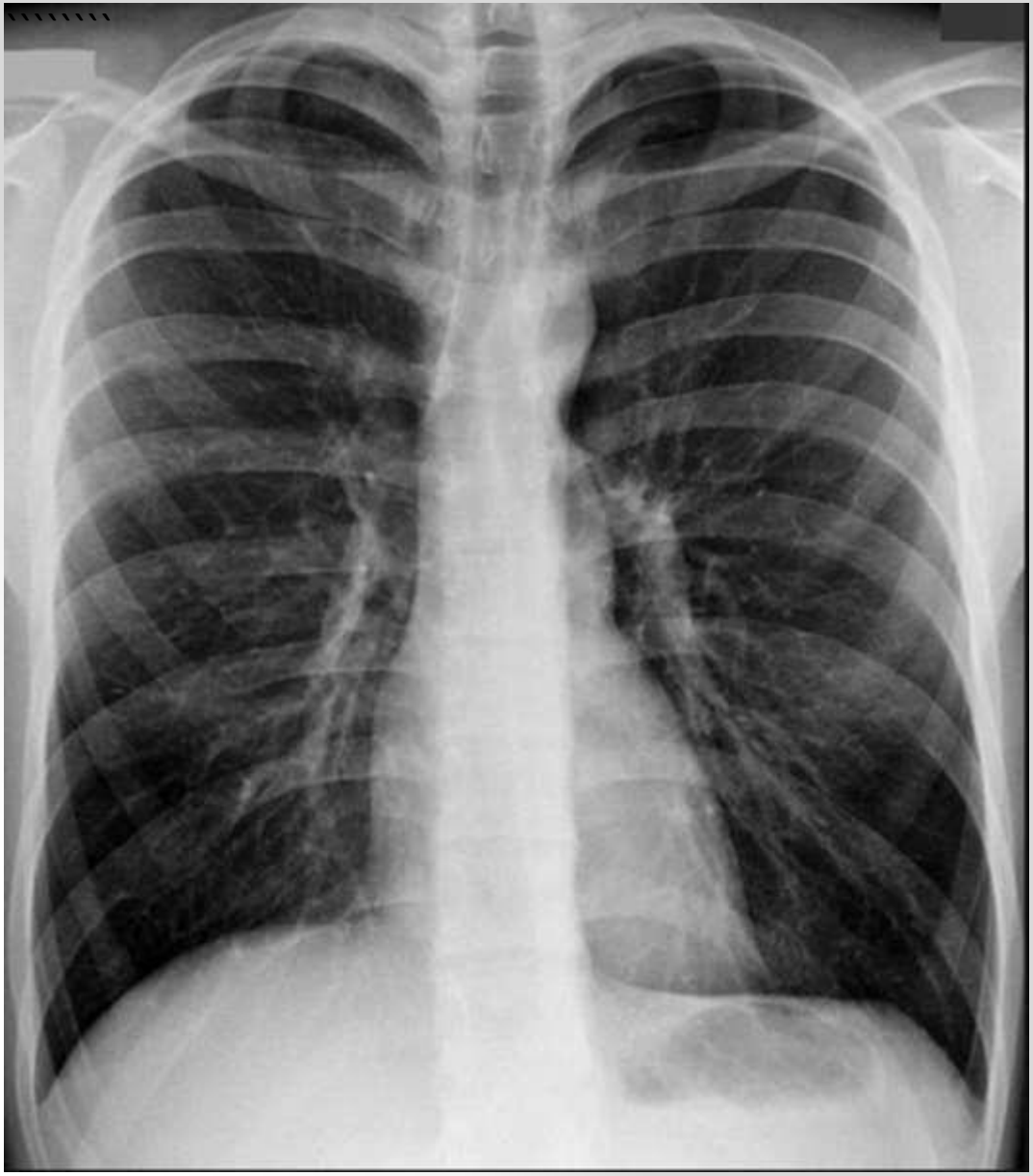
Small pneumothorax



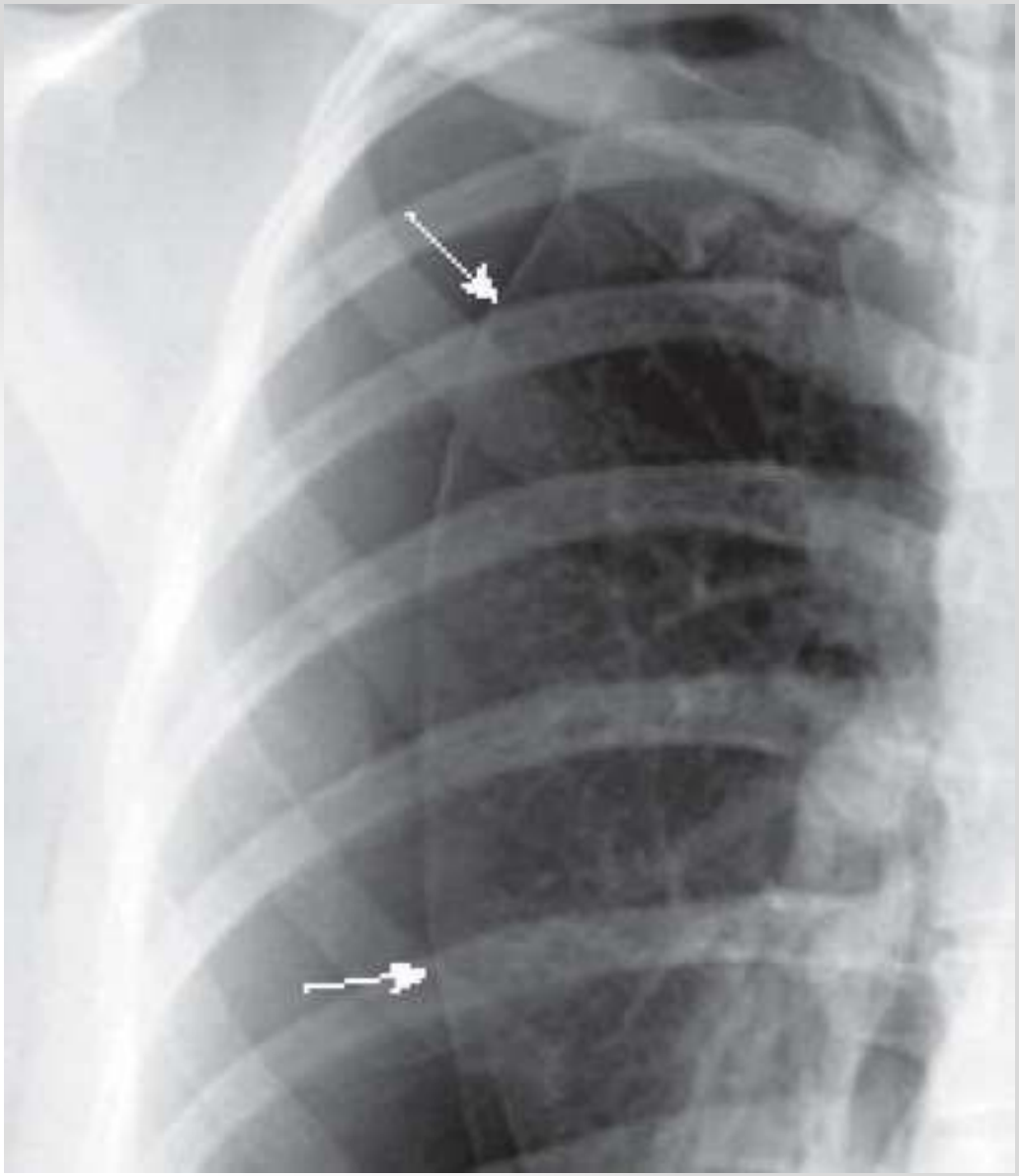
Small pneumothorax



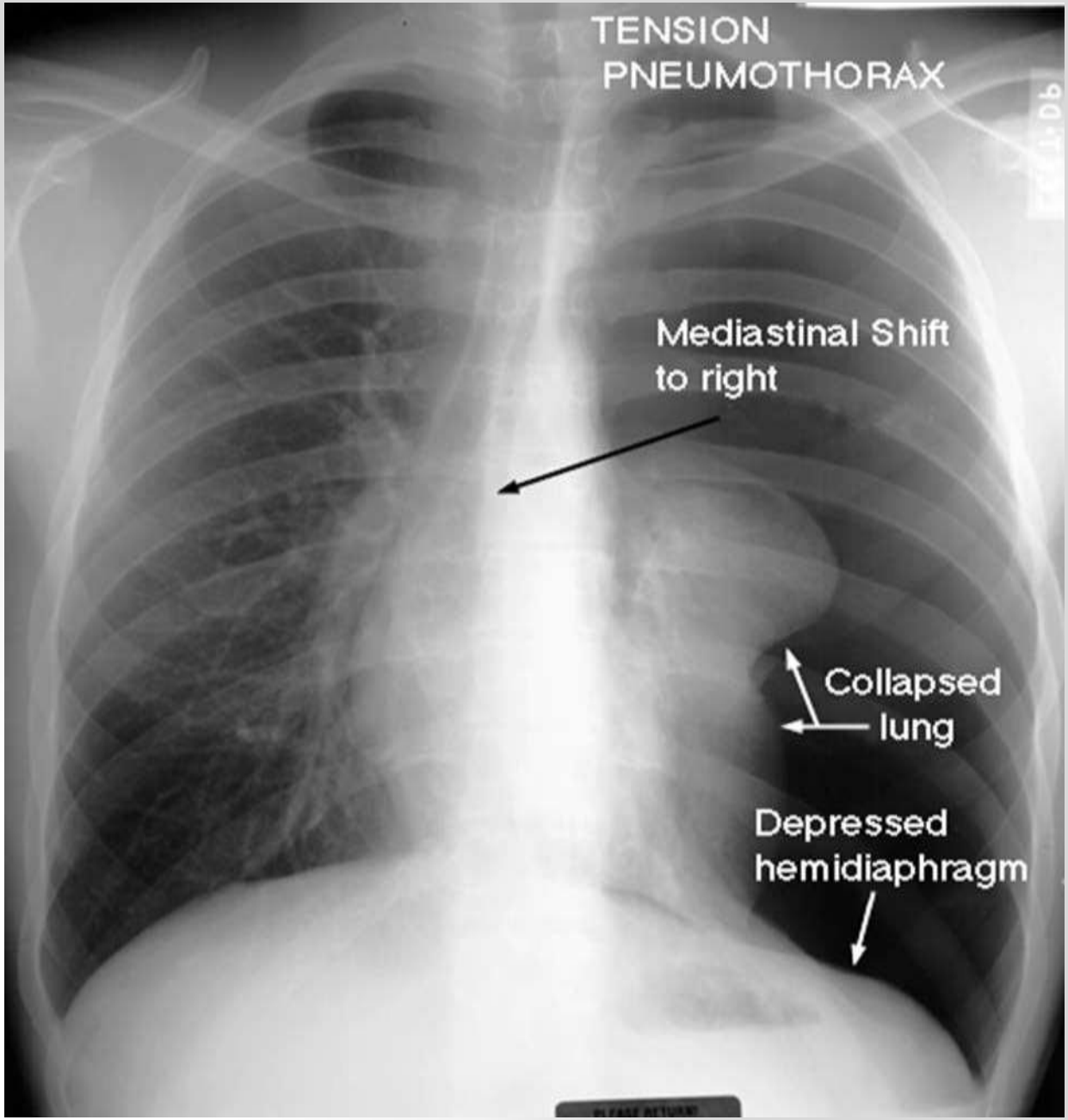
LARGE PNEUMOTHORAX



Visceral pleural line

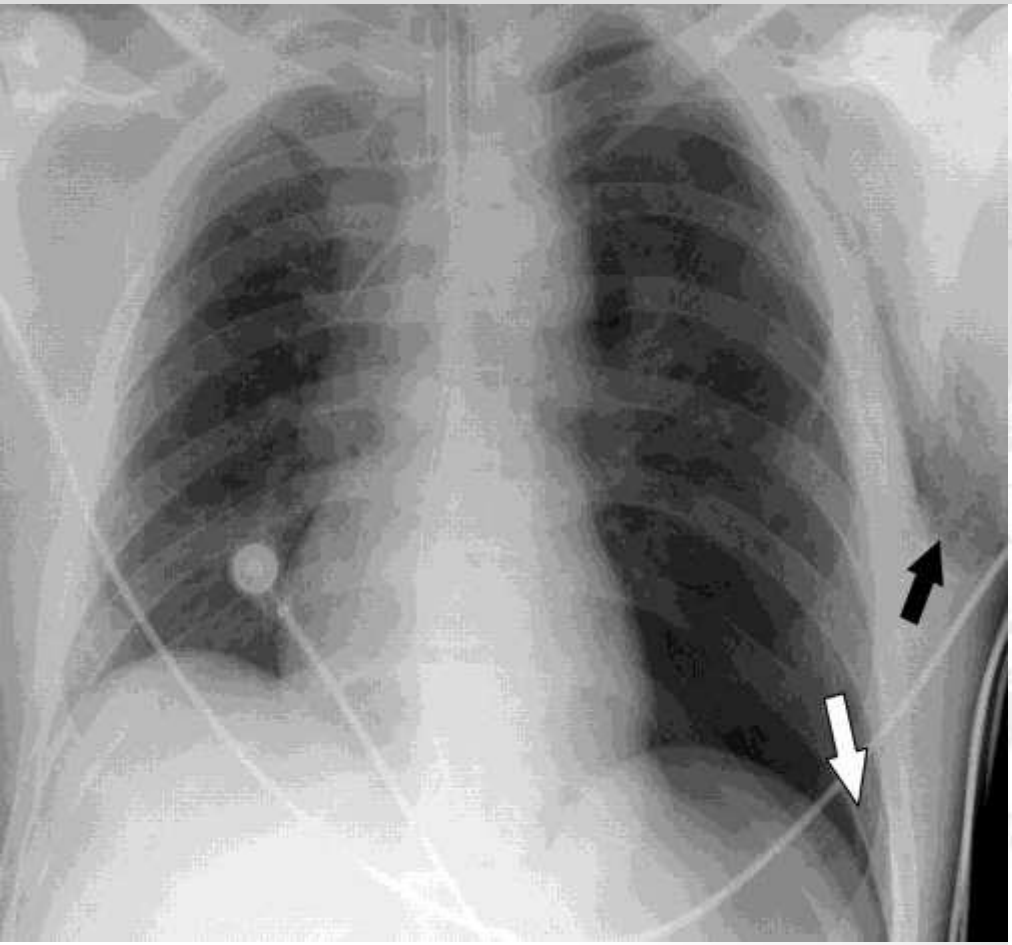


Tension pneumothorax


TENSION
PNEUMOTHORAX
Mediastinal Shift
to right
Collapsed
lung
Depressed
hemidiaphragm

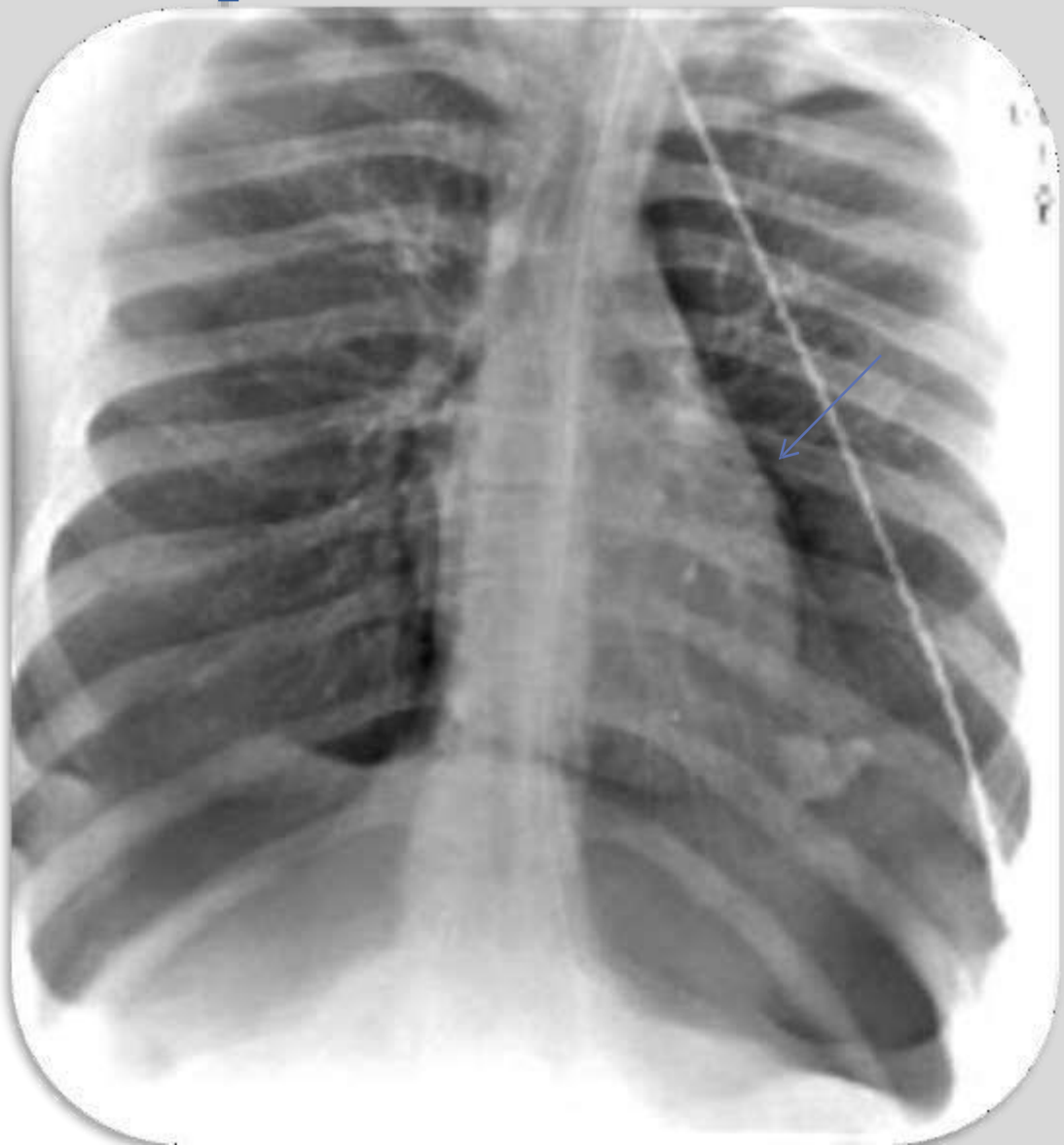
Signs of pneumothorax in supine position

Deep costophrenic sulcus

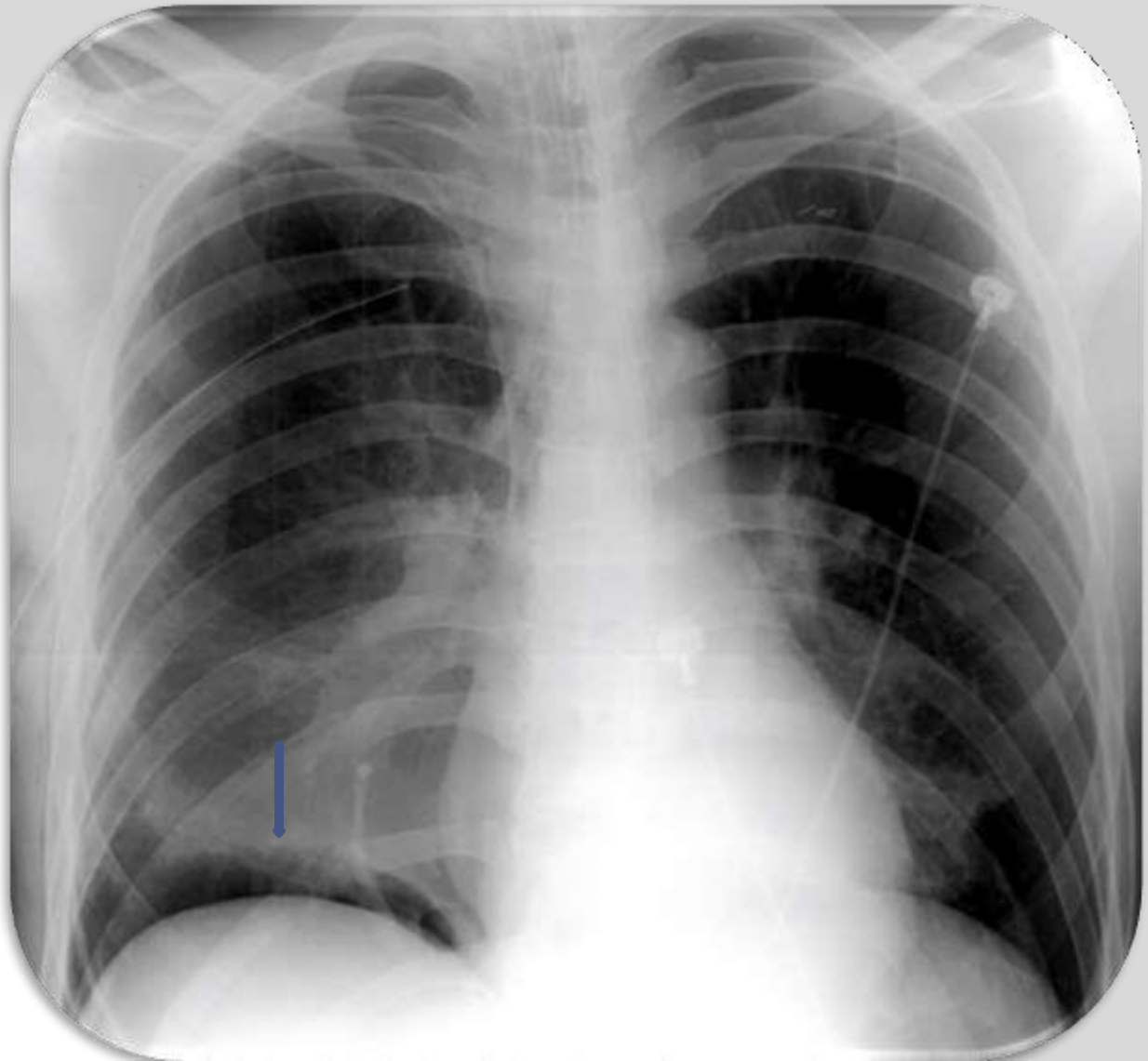


Lucent cardiophrenic sulcus

Sharp mediastinal contour



Double diaphragm sign subpulmonic pneumothorax



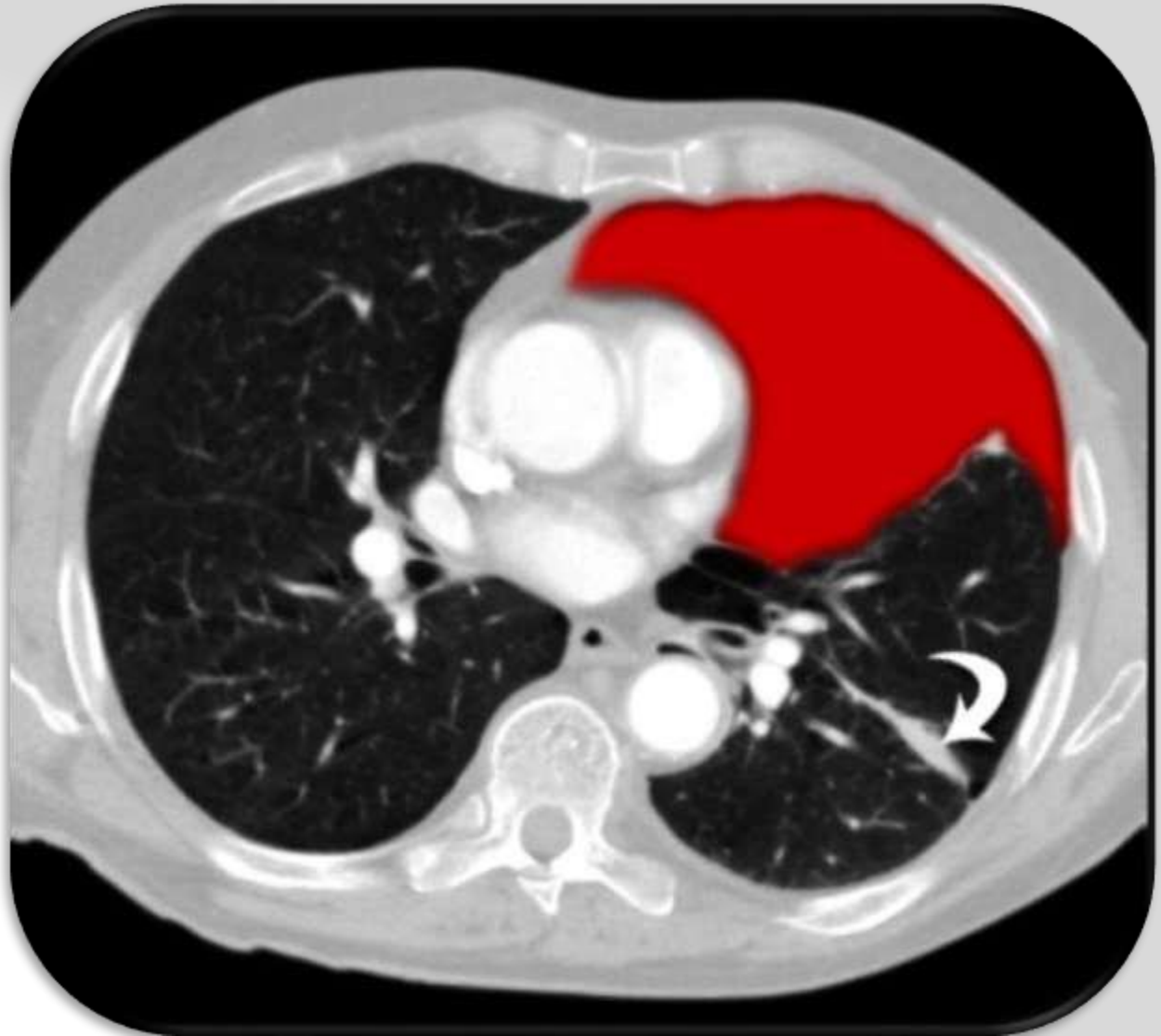
CT scanning

- It is recommended in *difficult cases* such as patients in whom the lungs are obscured by overlying surgical emphysema

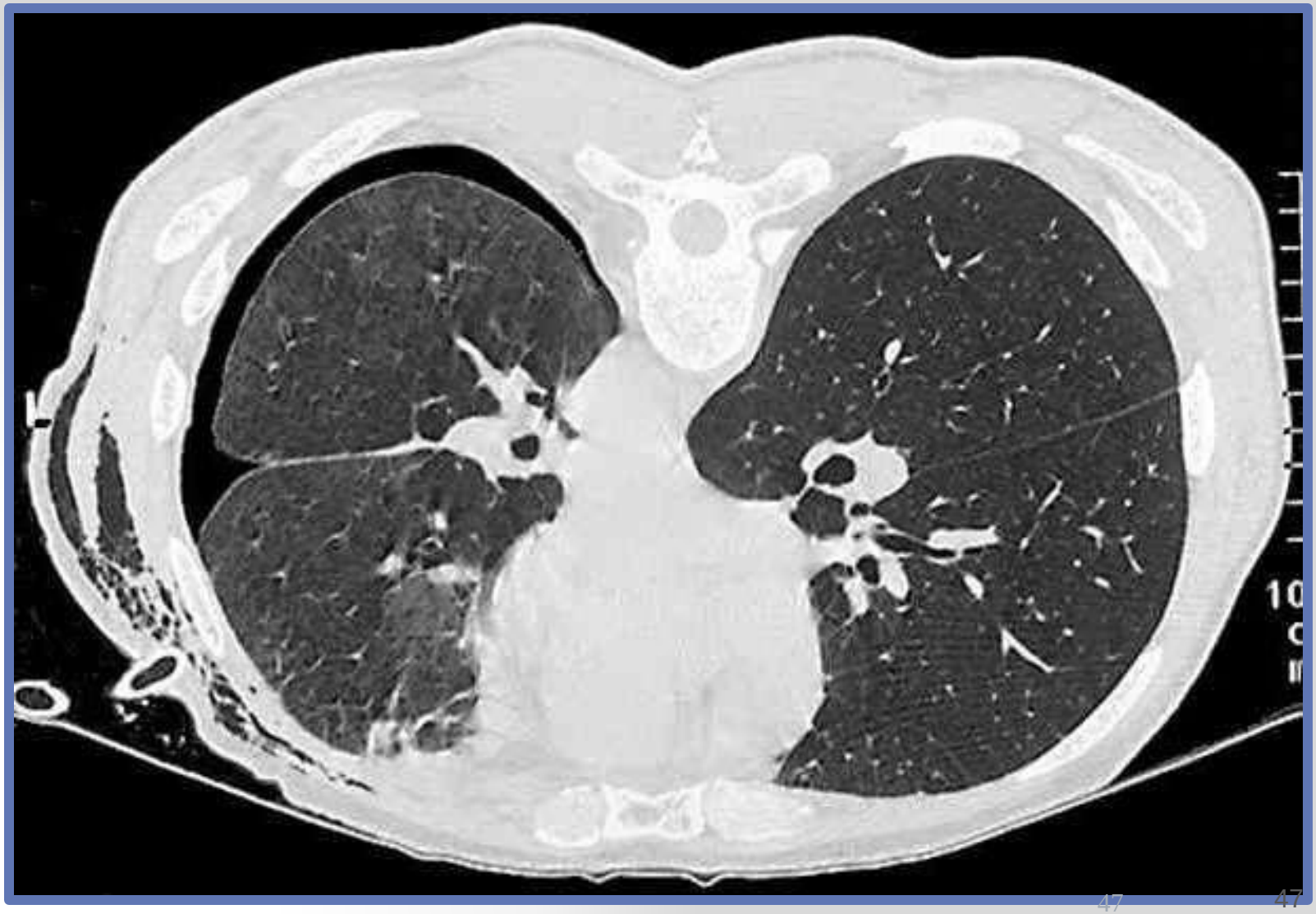
- *To differentiate* a pneumothorax from suspected bulla in complex cystic lung disease

CT can diagnose easily pneumothroax

CT can diagnose easily pneumothroax

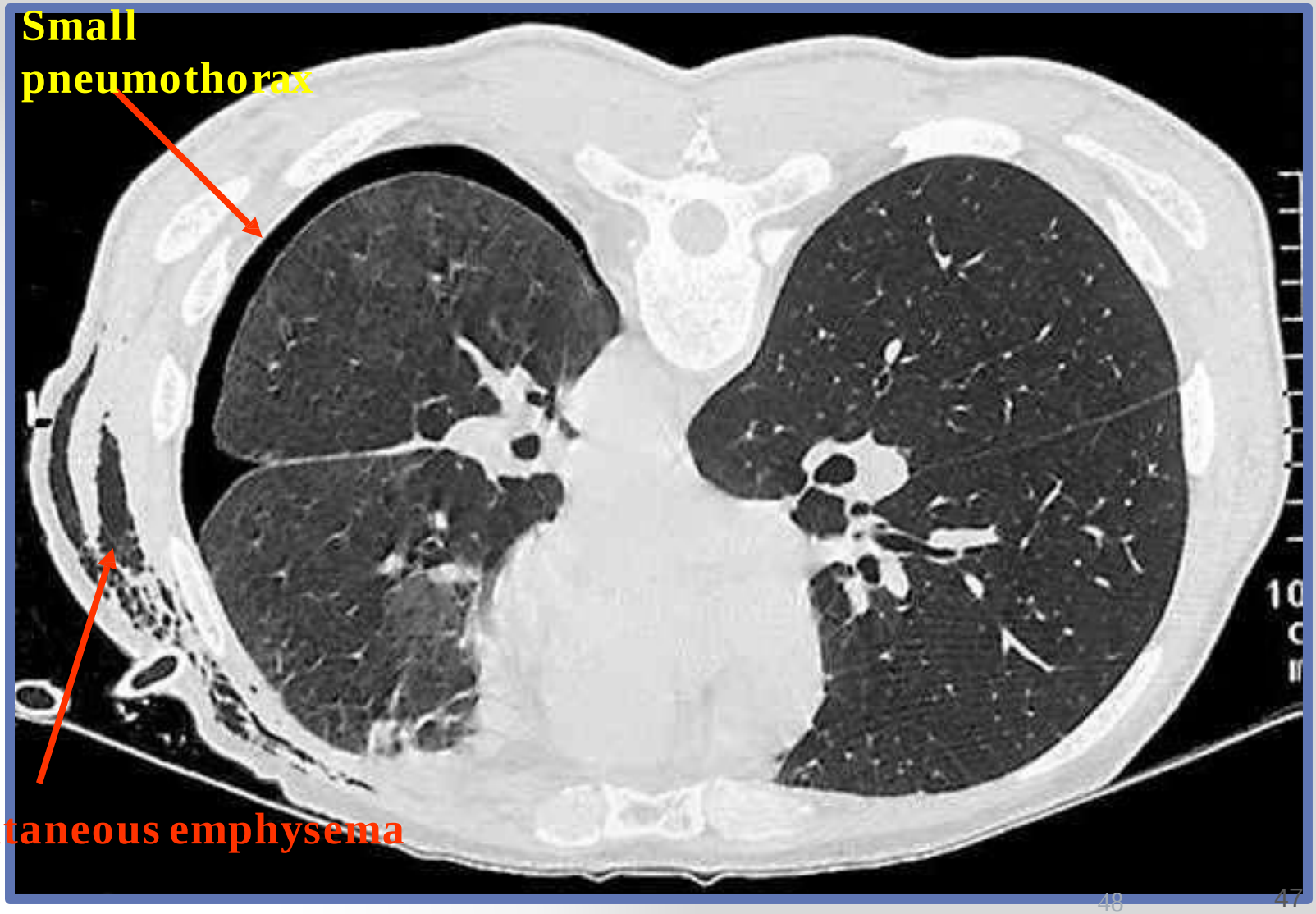


CT scanning



47

CT scanning



U/S in pneumothorax

- Ultrasound found to be more sensitive than CXR in diagnosis of pneumothorax.

U/S signs of pneumothorax

- Loss of lung sliding.
- Loss of comet tails.
- loss of seashore sign (M mode).
- Stratosphere sign or bar code sign(M mode).

MANAGMENT

- **Goals**
  - To promote lung expansion
  - To eliminate the pathogenesis/cause
  - To decrease pneumothorax recurrence
- **Treatment options according to**
  - Classification of pneumothorax
  - Pathogenesis
  - The extension of lung collapse
  - Severity of disease
  - Complication and concomitant underlying diseases

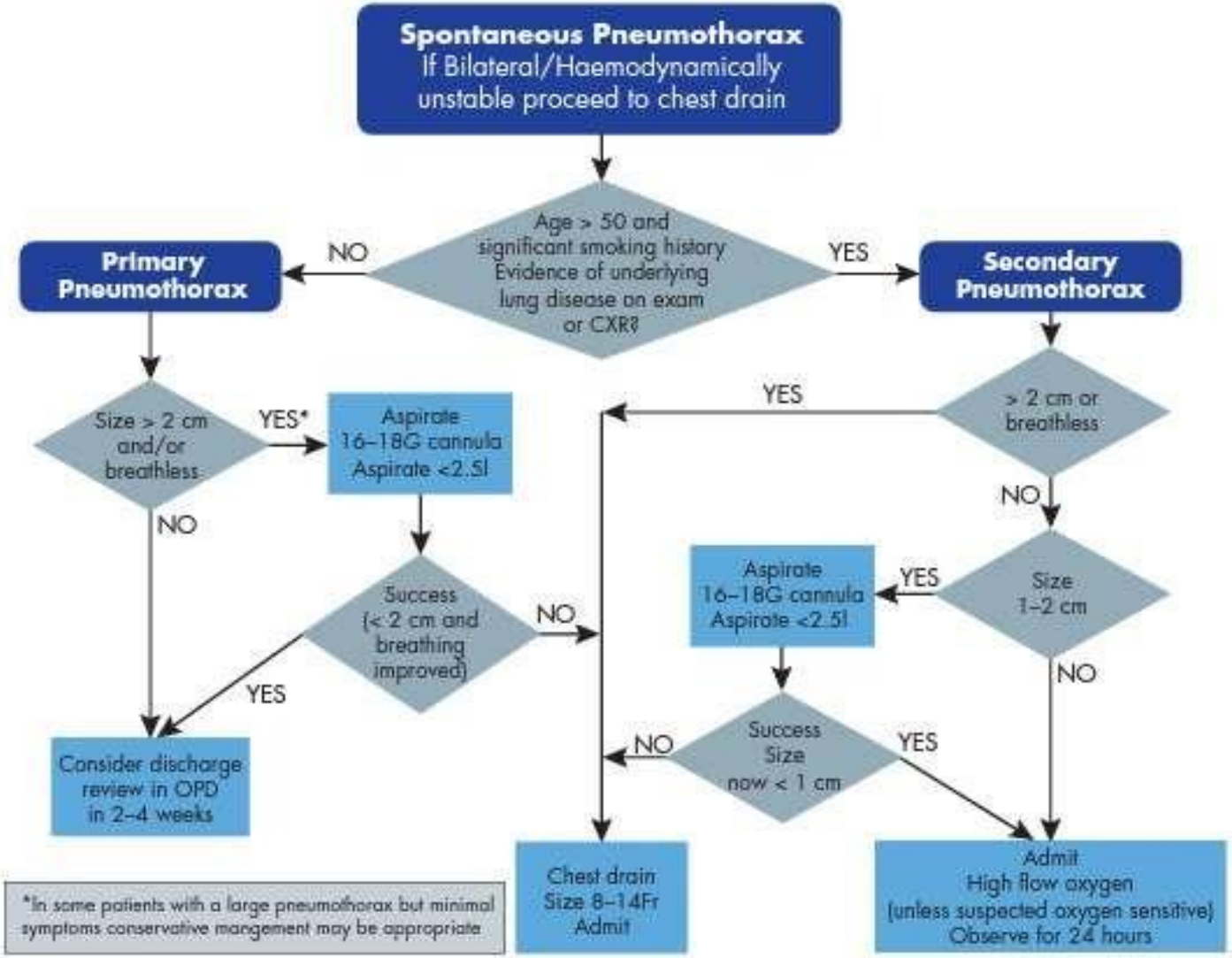


Figure 55.6 British Thoracic Society (BTS) guidelines on management of spontaneous pneumothorax (2010) (adapted from www.bts.org.uk).

O2 TREATMENT-- PSP or SSP

- **Inhalation of high concentration of {10 l/m} oxygen** may reduce the total pressure of gases in pleural capillaries by *reducing the partial pressure of nitrogen*
- This should increase the pressure gradient between the pleural capillaries and the pleural cavity
- Thereby increasing absorption of air from the pleural cavity

- The rate of resolution/reabsorption of spontaneous pneumothorax is 1.25 – 1.8% of volume of hemithorax every 24 hours (ABOUT 50 DAYS TO TAKE if 40% pnx)

- The addition of high flow oxygen therapy has been shown to result in a *4-fold* increase in the rate of pneumothorax reabsorption during the periods of oxygen supplementation

Simple aspiration

- Simple aspiration is recommended as ***first line*** treatment for all PSP requiring intervention
- Simple aspiration is less likely to succeed in secondary pneumothoraces and in this situation, is only recommended as an initial treatment in ***small*** (<2 cm) pneumothoraces in minimally breathless patients under the age of ***50 years***
- Patients should be admitted to hospital and observed for at least 24 hours before discharge.

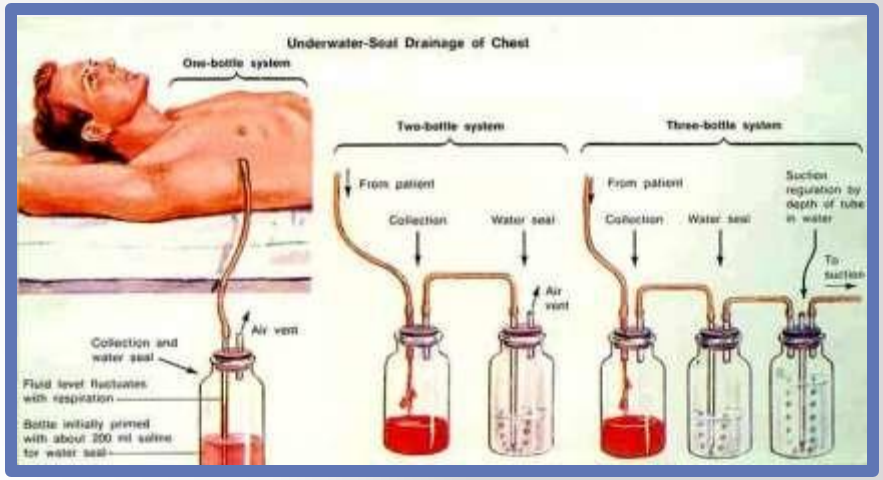
Catheter aspiration

- Repeated aspiration is reasonable for primary pneumothorax when the first aspiration has been unsuccessful
- A volume of < 2.5 L has been aspirated on the first attempt

- The aspiration can be done by needle or catheter

Intercostal tube drainage

- INDICATIONS
  - Tension pneumothorax
  - Severe dyspnea
  - Large/complete pneumothorax
  - Intermittent positive pressure ventilation pneumothorax
  - Recurrent pneumothorax
  - Bilateral pneumothorax
  - Presence of pleural fluid
  - Simple aspiration or catheter aspiration drainage is unsuccessful in controlling symptoms



Intercostal tube drainage

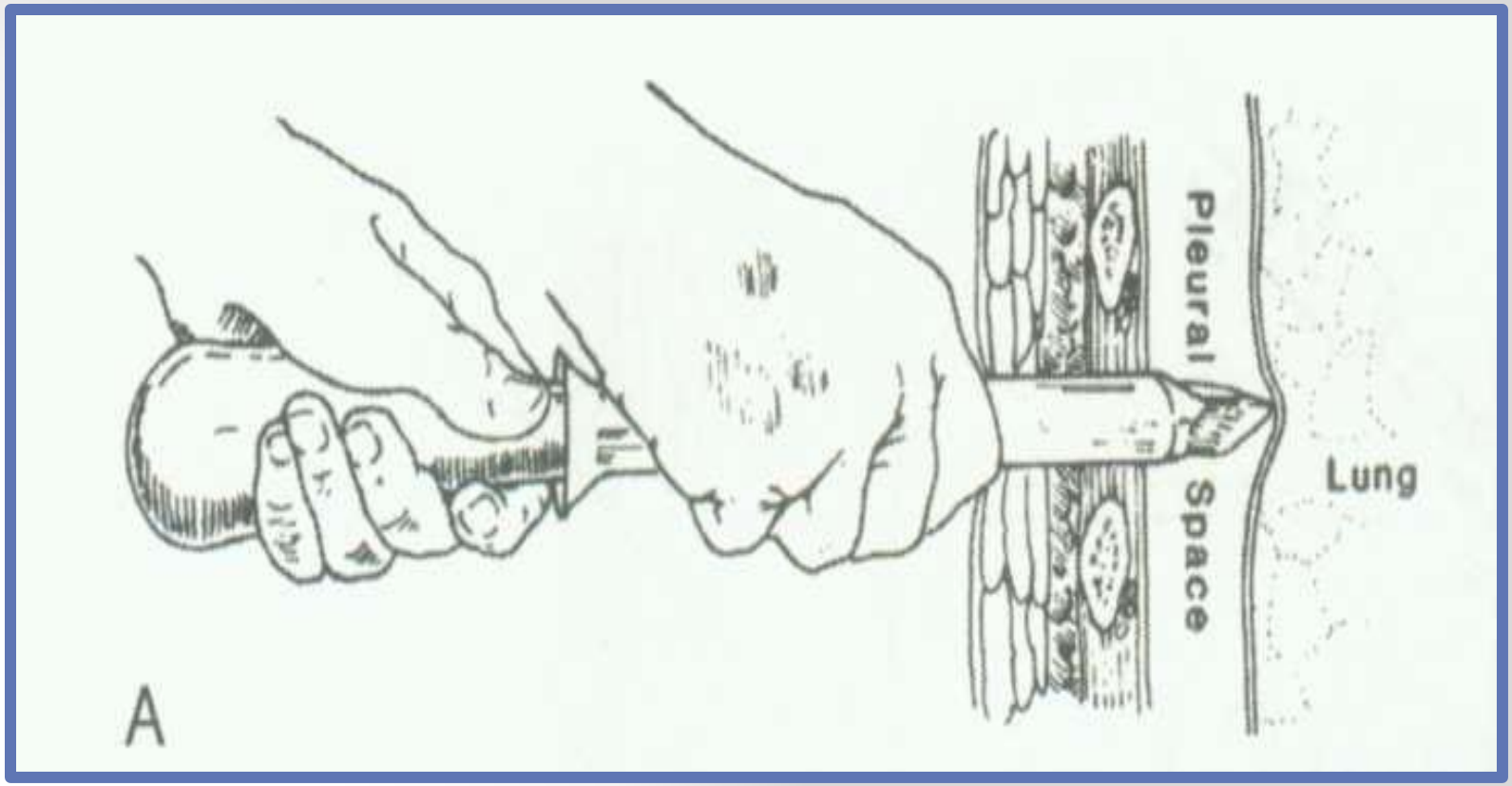
- A common site of chest tube insertion is in the 2nd ICS in mid-clavicular line.

An alternative site now commonly used is midaxillary line of 4th and 5th intercostal space for cosmetic reason and also for when pleural effusion.

73

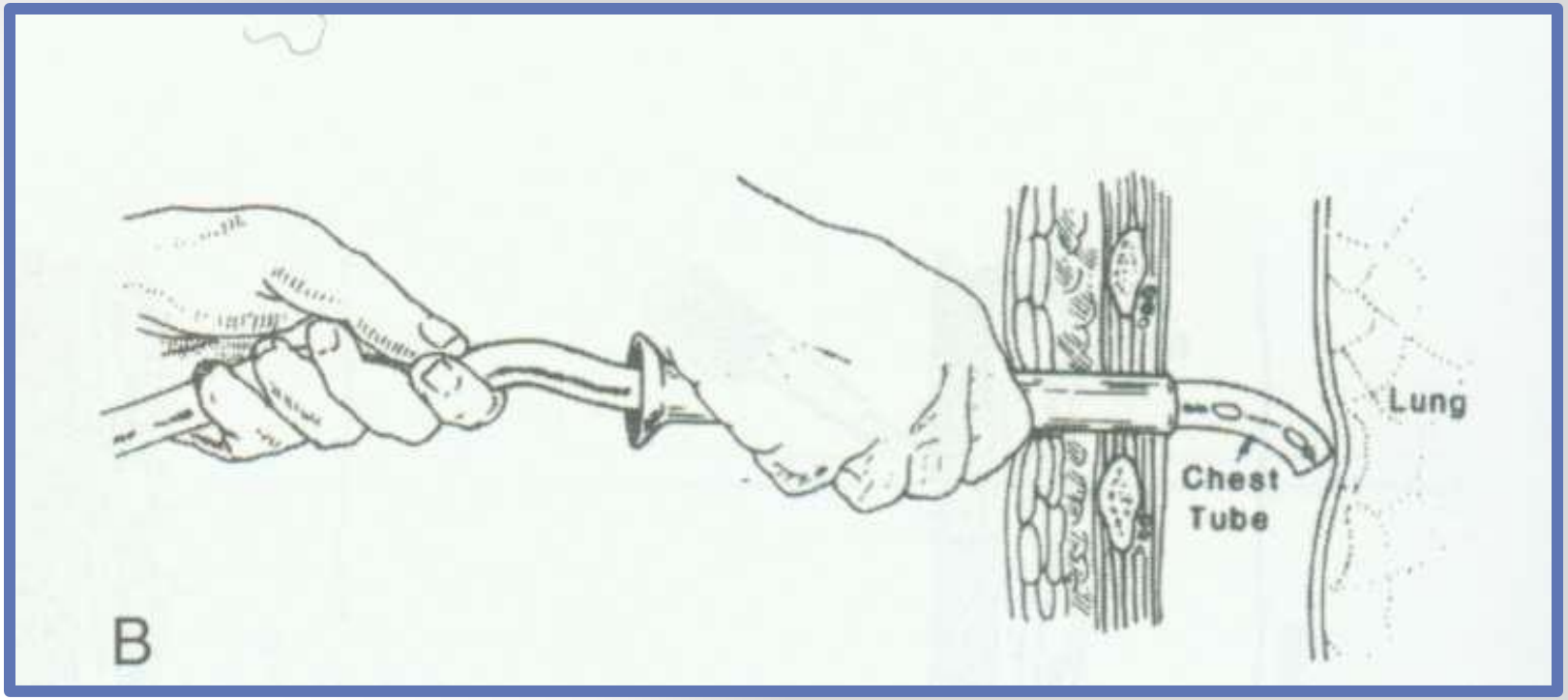
Trocar tube thoracostomy

- Insertion of trocar into the pleural space.



Trocar tube thoracostomy

- Insertion of the chest tube through the trocar



Observation of drainage

- **No bubble released**
  - The lung re-expansion
  - The chest tube is obstructed by secretion or blood clot
  - The chest tube shift to chest wall, the hole of the chest tube is located in the chest wall

- If the lung re expanded, removing the chest tube 24 hours after re expansion.

- Otherwise, the chest tube will be inserted again or regulated the position.

Complications of intercostal tube drainage

- Penetration of major organs
  - Lung, stomach, spleen, liver, heart and great vessels
  - It occurs more commonly when a sharp metal trocar is inappropriately applied
- Pleural infection
  - Empyema, the rate of 1%
- Surgical emphysema
  - Subcutaneous emphysema

Chemical pleurodesis

- Goals
  - To prevent pneumothorax recurrence
  - To produce inflammation of pleura and adhesions
- Indications
  - Persist air leak and repeated pneumothorax
  - Bilateral pneumothorax
  - Complicated with bullae
  - Lung dysfunction, not tolerate to operation

Chemical pleurodesis

- **Sclerosing agents**
  - Tetracycline
  - Doxycycline
  - Talc
  - Erythromycin
  - 10% povidine iodine

- The instillation of sclerosing agents into the pleural space lead to an aseptic inflammation with dense adhesions.

Chemical pleurodesis

- **Methods**
  - Via chest tube or by surgical mean
  - Administration of intrapleural local anaesthesia, 200 – 300 mg lidocaine intrapleurally injection
  - Agents diluted by 60 – 100 ml saline
  - Injected to pleural space
  - Clamp the tube 4hours
  - Drainage again
  - Observed by chest X-ray film, if air of pleural space is absorbed, remove the chest tube
  - If pneumothorax still exist, repeated pleurodesis.

Chemical pleurodesis

- **Side effect**
  - Chest pain
  - Fever
  - Dyspnea
  - Acute respiratory distress syndrome
  - Acute respiratory failure

82

Surgical treatment

- **Indications**
  - No response to medical treatment
  - Persistant air leak
  - Hemopneumothorax
  - Bilateral pneumothoraces
  - Recurrent pneumothorax
  - Tension pneumothorax failed to drainage
  - Thickened pleura making lung unable to reexpand
  - Multiple blebs or bullae

Complications of pneumothorax

- Recurrence of spontaneous pneumothorax
- Tension pneumothorax
- Hydropneumothorax
- Encysted pneumothorax
- Failure of expansion of the collapsed lung
- Re-expansion pulmonary edema
- Broncho-pleural fistula
- Pneumomediastinum

Recurrence of spontaneous pneumothorax

- **50%** on the same side.
- **15%** on the contralateral side.

More common in

- secondary spontaneous pneumothorax.

Tension pneumothorax

- It is life threatening condition.
- The pleural pressure is more than the atmospheric pressure.

Radiological manifestations of large pneumothorax

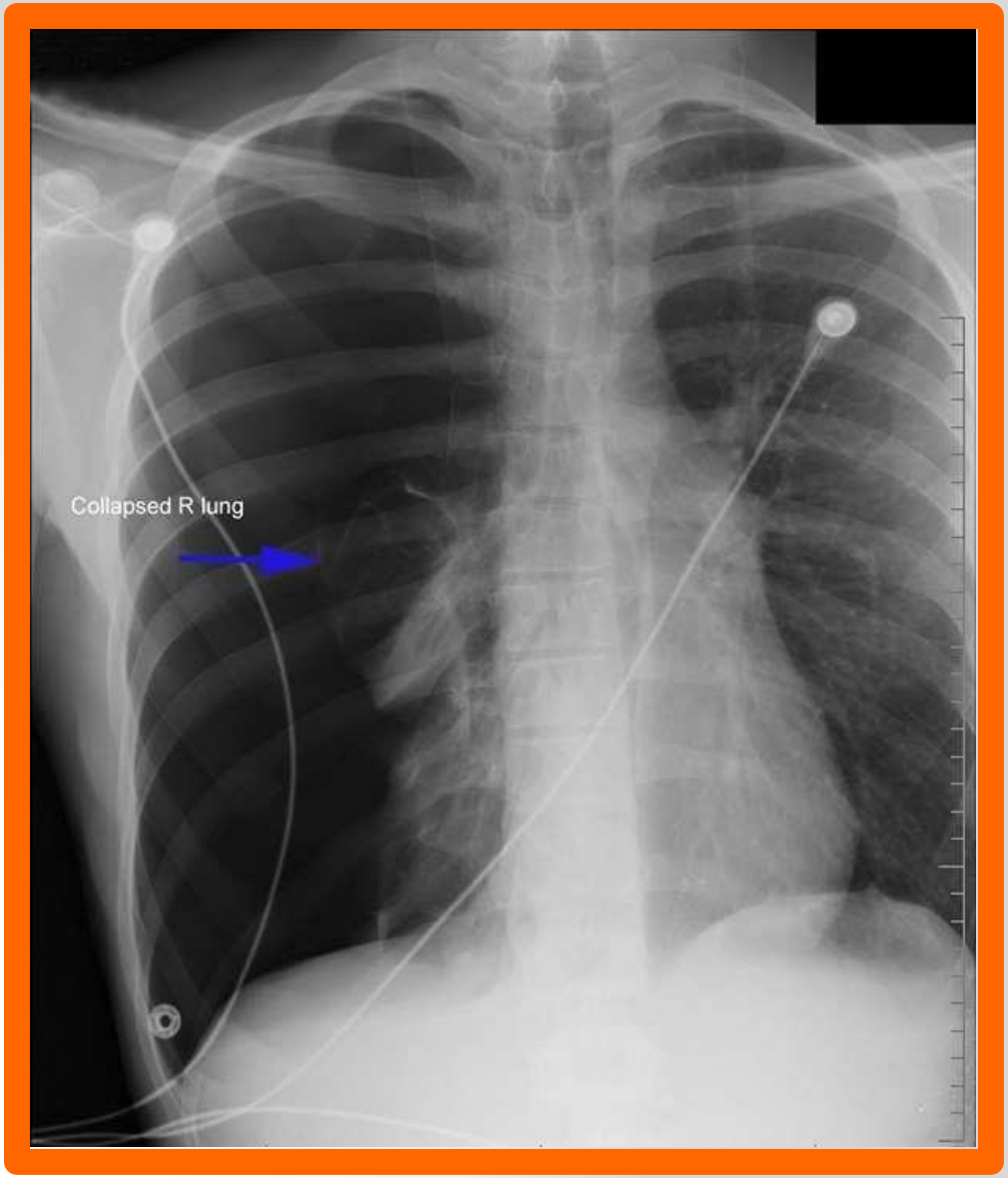
- Mediastinal shift,
- Flattening of the hemidiaphragm &
- Lung collapse.

Associated with **clinical manifestations of rapidly progressive breathlessness and circulatory collapse** (tachycardia, hypotension & sweating).

It is more common with

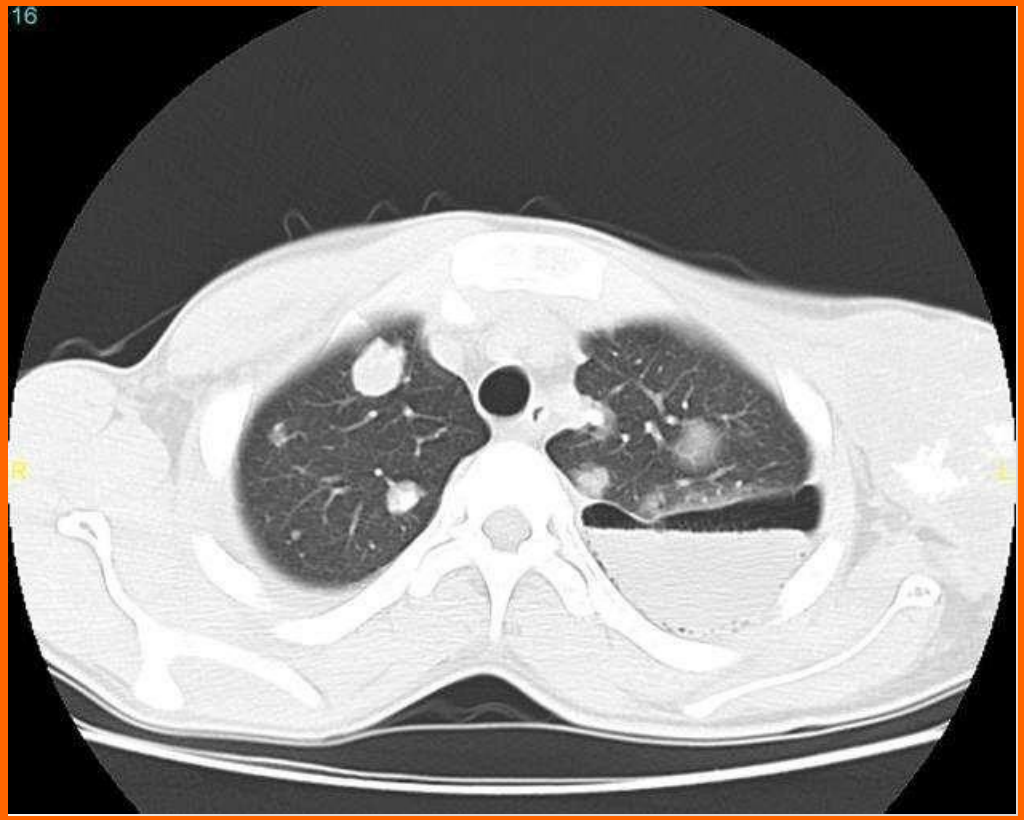
- Positive pressure ventilation &
- Traumatic pneumothorax.

Tension pneumothorax



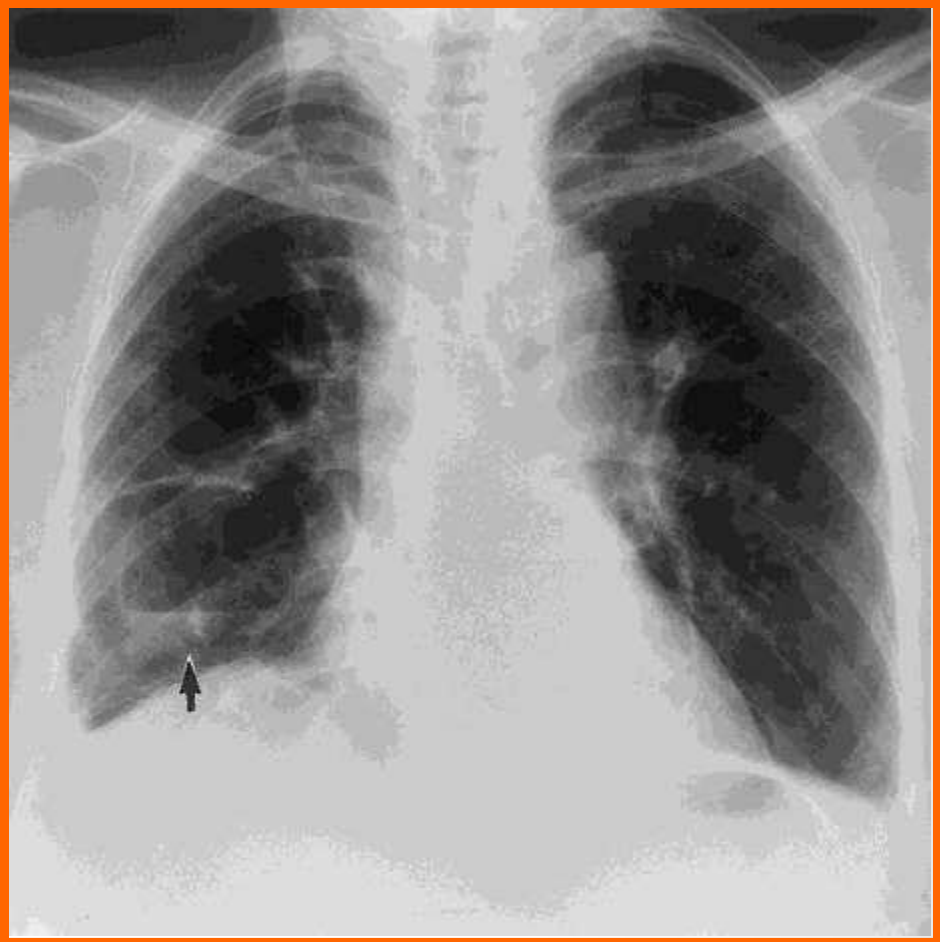
Hydropneumothorax

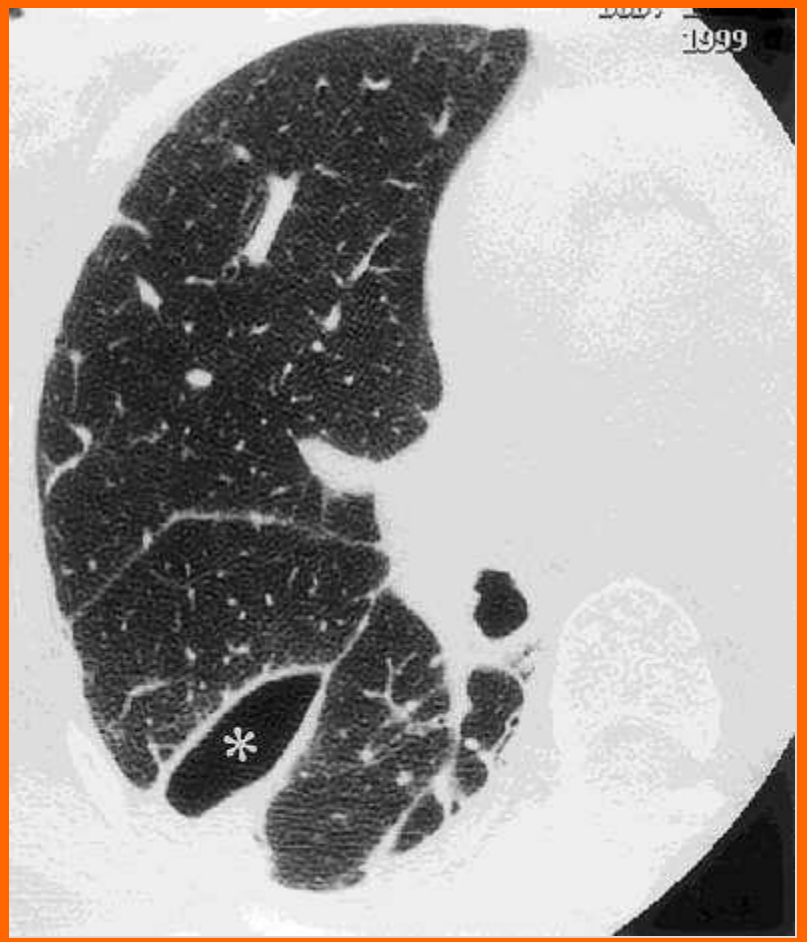
- Due to rupture of pleural adhesions.
- Bronchopleural fistula.



Encysted pneumothorax

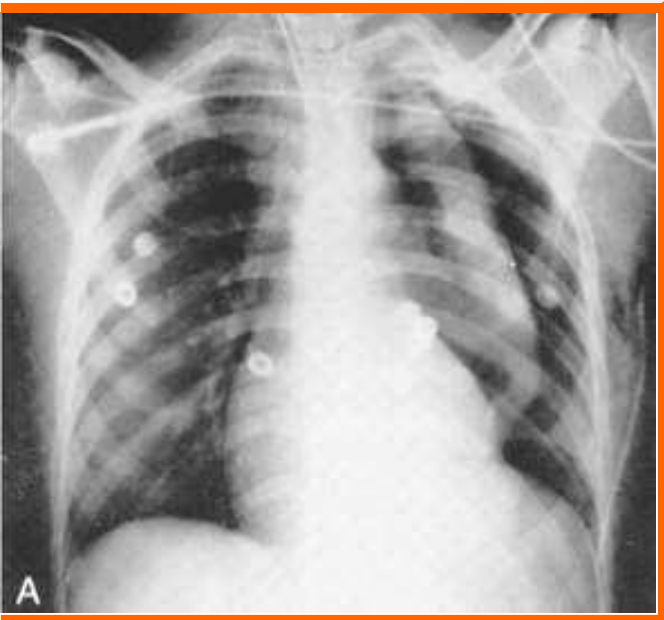
- Due to pleural adhesions.

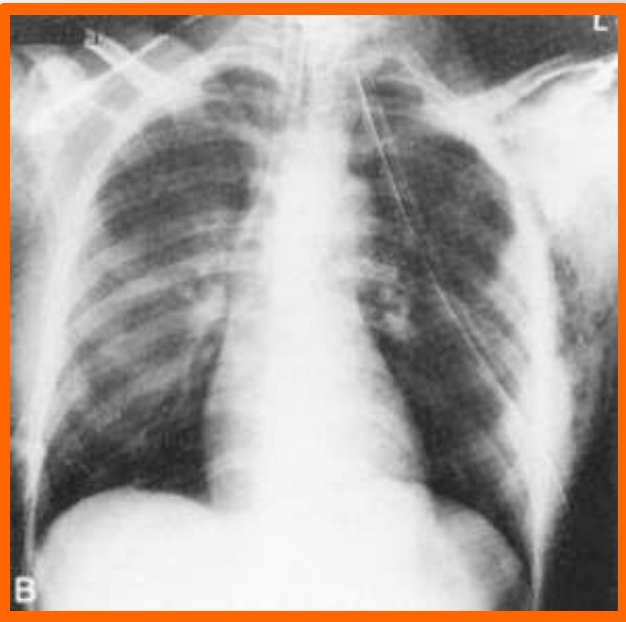


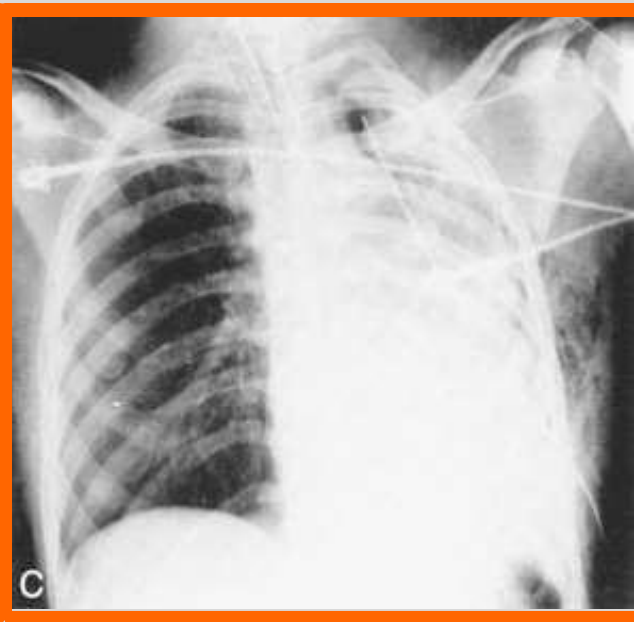


Failure of re-expansion of the collapsed lung

- Due to pleural adhesions.
- Or tracheobronchial injury.







Mediastinal and subcutaneous emphysema

- Alveoli rupture, the air enter into pulmonary interstitial, and then goes into mediastinal and subcutaneous tissues.
- After aspiration or intercostal chest tube insertion, the air enters the subcutaneous by the needle hole or incision – surgical emphysema
- Physical exam – crepitus is present.

Subcutaneous emphysema

THANK YOU