

جامعة
الملك سعود
King Saud University



Presentation and Management of Common Thoracic Diseases



Surgery Team
MED 433



Objectives :

1. Assessment
2. Bronchogenic carcinoma
3. Assessment for pulmonary resection.
4. Metastatic disease
5. Other lung tumours
6. Mesothelioma
7. Mediastinum
8. Pneumothorax
9. Emphysema
10. Interstitial lung disease

Sources : Slides, Raslan's Notebook, Principles & Practice of Surgery by: O. James Garden

Color Index : Slides & Raslan's | Textbook | Doctor's Notes | Extra Explanation

Thoracic

Overview

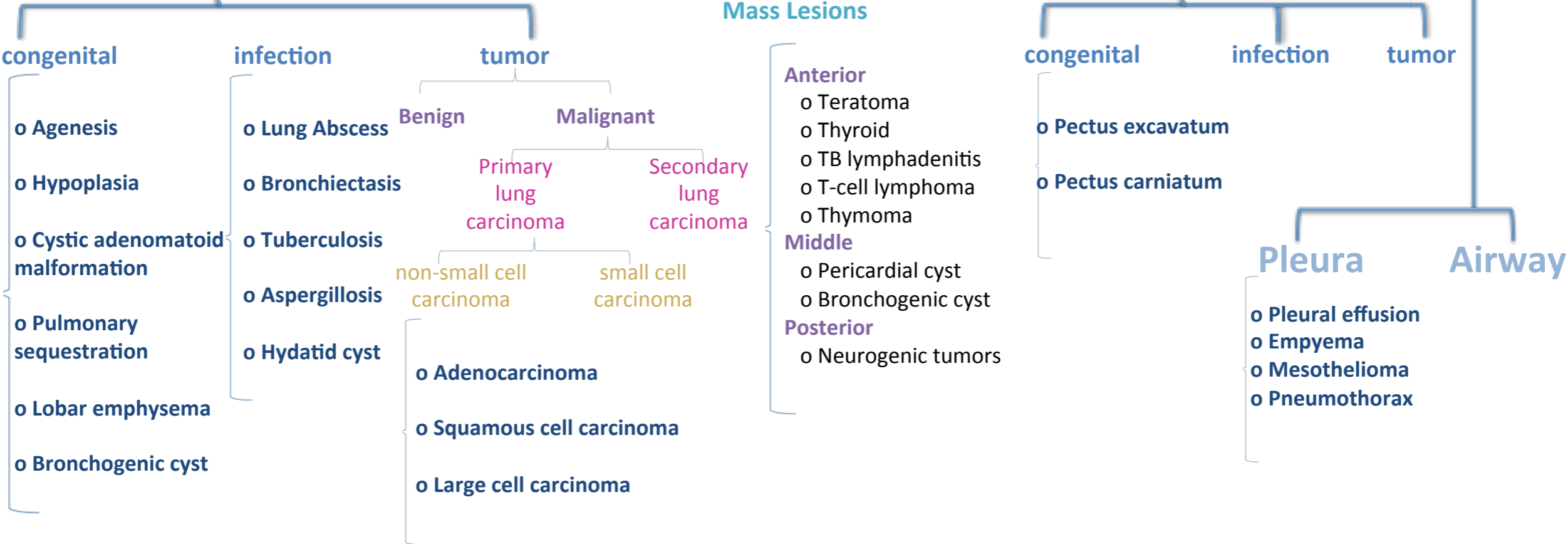
Trauma

Surgery

Lungs

Mediastinum

Chest



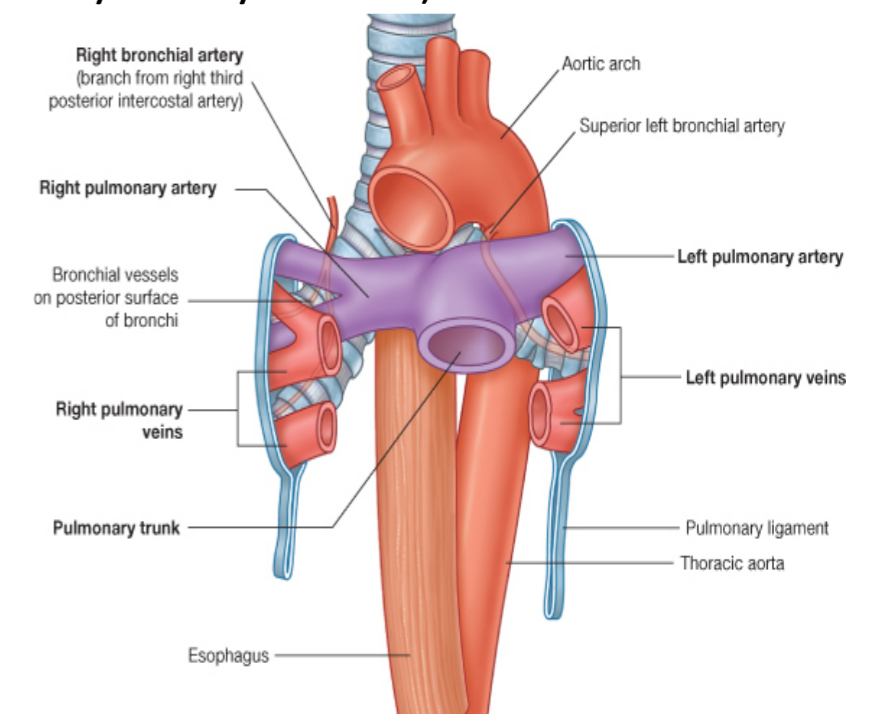
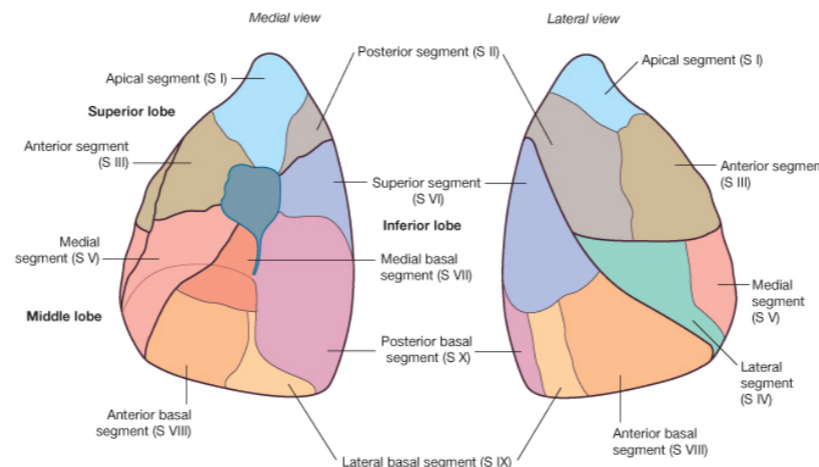
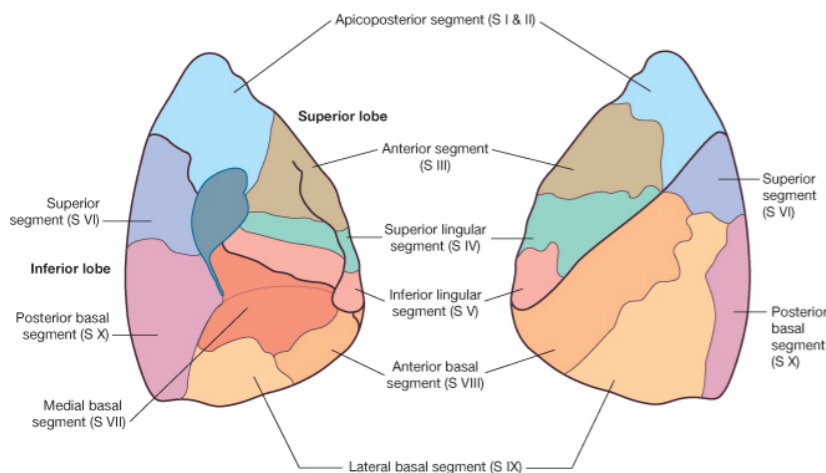
Structure and Development of the Lungs

(This is just a review, you can skip it if you're confident with what you remember)

★ **Embryology:** Bronchial system & Alveolar system.

★ **Lung Anatomy:**

- Right primary bronchus is shorter, wider, and more vertical than the left primary bronchus. Therefore, **when foreign bodies are aspirated, they often lodge in the right main bronchus.**
- **Lobes and fissures:**
 - The right lung is divided into 3 lobes by the oblique and horizontal fissures.
 - The left lung is divided into 2 lobes by the oblique fissure.
- **Segments.**
 - Each of the tertiary bronchi serves a specific bronchopulmonary segments. There are 10 segments in the right lung and 8-10 segments on the left and each have their own artery. Each segment is a discrete anatomical and functional unit, so a segment can be surgically removed without affecting the function of the other segments.
- **Blood supply:**
 - Lungs **don't** receive any vascular supply from the pulmonary vessels (pulmonary artery or vein).
 - Blood is delivered to lung tissue via **the bronchiole arteries.**
 - Vessels evolve from aortic arch, travel along the bronchial tree.



Structure and Development of the Lungs

(This is just a review, you can skip it if you're confident with what you remember)

★ Cont.. Lung Anatomy:

• Airways:

- ✓ Trachea, primary bronchi, secondary bronchi, tertiary bronchi out to 25 generations.
- ✓ All comprised of hyaline cartilage.

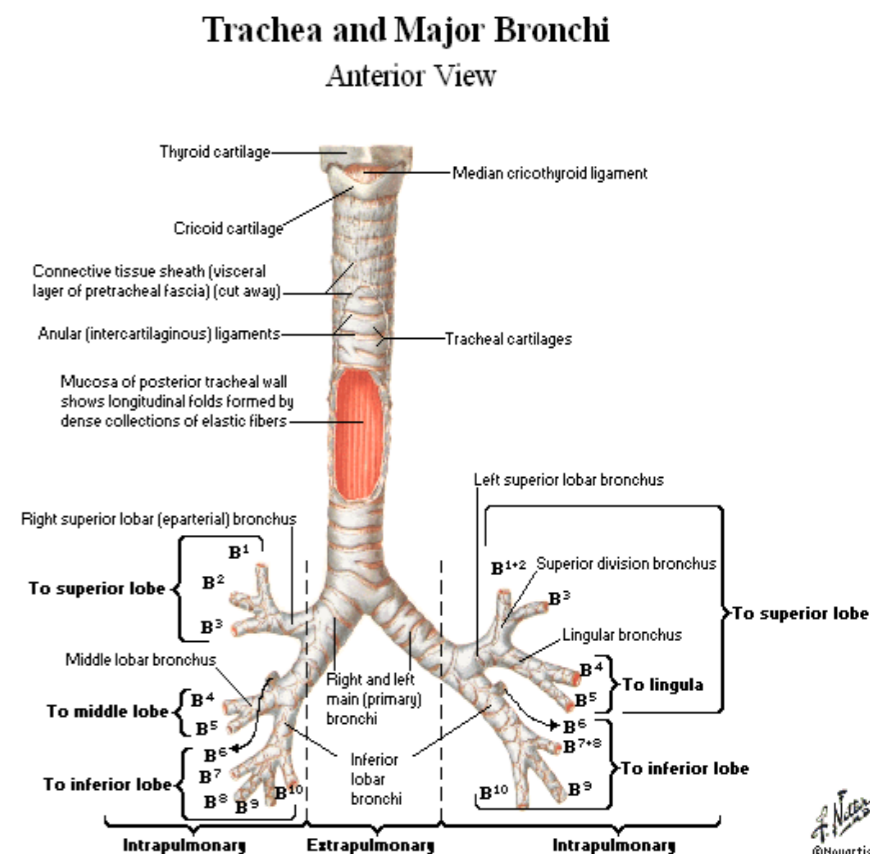
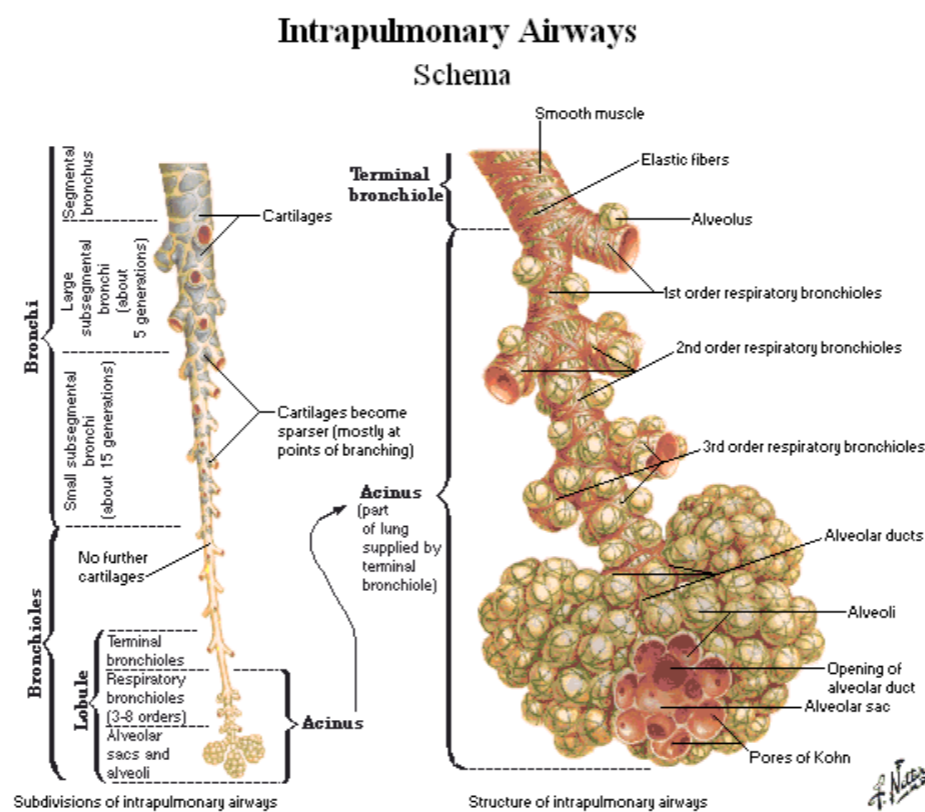
★ Trachea:

- Begins where larynx ends (about C6).
- 10 cm long, half in neck, half in mediastinum.
- 20 U-shaped rings of hyaline cartilage, keeps lumen intact but not as brittle as bone.
- Lined with epithelium and cilia, which work to keep foreign bodies/irritants away from lungs.

★ Bronchioles:

- First level of airway surrounded by smooth muscle; therefore can change diameter as in broncho-constriction and broncho-dilation.
- Terminal bronchioles.
- Respiratory bronchioles.
- 3-8 orders.

★ Alveoli.



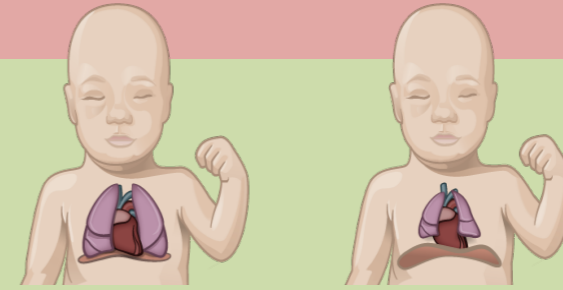
1st : Congenital Lung Diseases

1 Agenesis

Absence of the lungs.

Healthy Baby

Baby With Pulmonary Hypoplasia



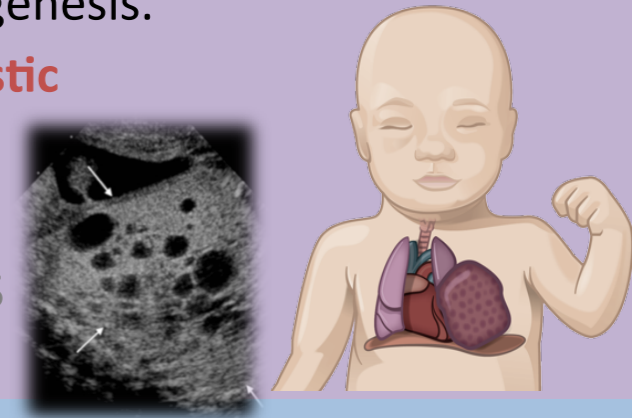
2 Hypoplasia

Incomplete development of the lungs →

3 Congenital Cystic Adenomatoid Malformation (CCAM)

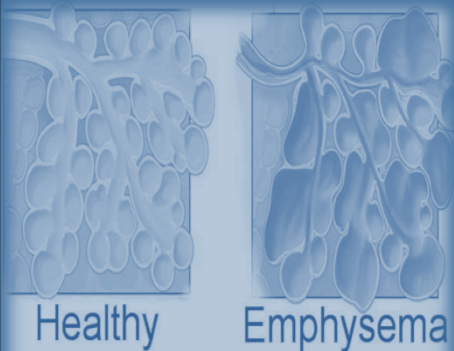
- A cystic area within the lung that stems from abnormal embryogenesis.
- Usually an entire lobe of lung is **replaced by non-functioning cystic** area of abnormal lung tissue.

• **Presenting Clinical Features:** respiratory distress and **recurrent respiratory infections**. The usual appearance of CCAM on CXR & US is a mass containing air-filled cysts (**Swiss cheese pattern**)



4 Lobar Emphysema

- Over-inflation of a pulmonary lobe (replacement of a whole lobe **by bullae**), which may compress the other remaining normal lobes.
- Air enters the lungs but cannot leave easily causing **respiratory function to decrease**.
- **Treated** surgically (lobectomy) in serious cases to allow normal lung to inflate.
- **Diagnosed by:** respiratory symptoms and CXR, which shows over-inflation of the affected lobe (radiolucency).
- **Medical Treatment:** with bronchodilators and steroids may improve symptoms but transplantation is the only definitive cure. This is only an option for younger patients, and it should be postponed for as long as possible.
- **Lung volume reduction surgery:** aims to improve lung function by excising parts of the worst-affected areas, typically the upper lobes, thereby improving diaphragmatic and chest wall function. The procedure may be performed either as a videothoracoscopic operation or through a median sternotomy.
- The clinical improvement only lasts for a few years, as lung function continues to fall, reflecting the progressive nature of emphysema. The operative mortality is high, reflecting the generally very poor condition of these patients.



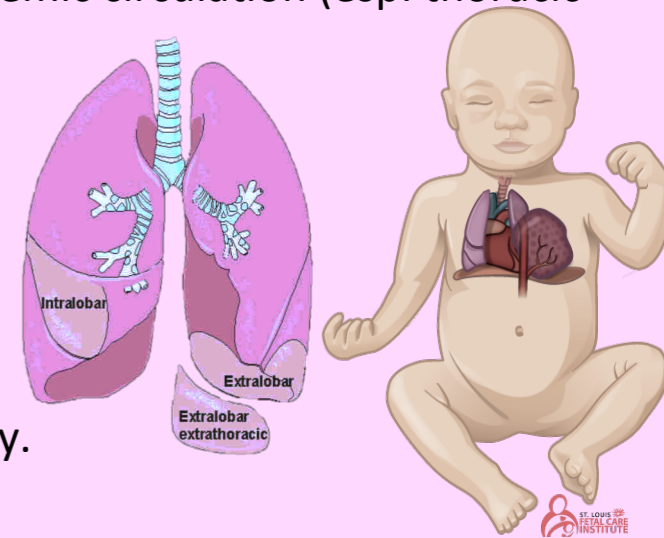
Healthy

Emphysema

1st : Congenital Lung Diseases

Pulmonary Sequestration

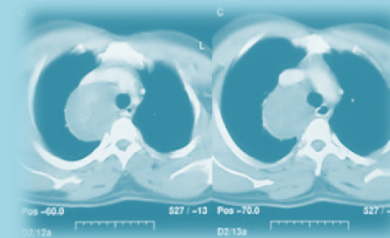
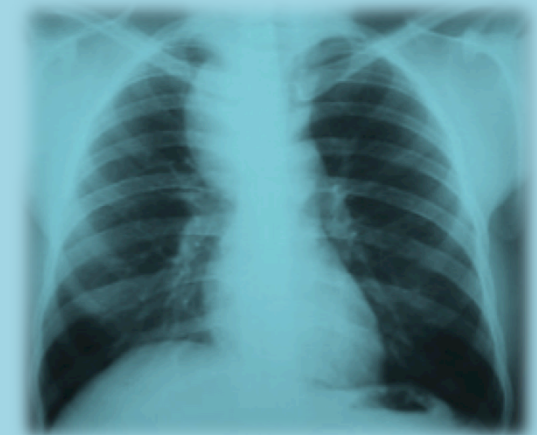
- It consists of a nonfunctioning mass of normal lung tissue that lacks normal communication with the airways, and often receives its own arterial blood supply from the systemic circulation (esp. thoracic aorta).
- Most of the time it is located in the **left lower lobe**.
- Treated surgically to prevent infections.
- Classified anatomically into intralobar and extralobar.
- Usually presents in adolescence or late childhood as **repetitive chest infections** that fails to respond to medical treatment.
- It appears on CXR as an opaque mass. Diagnosed by MRI/arteriography.



Bronchogenic Cysts


- **They can be located:**
 - 1- In the mediastinum: most commonly attached to trachea or below the carina (**paratracheal** or **subcarinal**)
 - 2- within the lung parenchyma (**intraparenchymal**)
- **Clinical features:**
 - They consist of semi-solid cartilaginous that secretes **cheese like material**, which is **prone to infections**. It may also result in **hemorrhage** and compression of the surrounding structures (i.e. trachea, aorta, and esophagus) patient then complains of SOB, stridor, cough and dysphagia.
 - Could be **asymptomatic** found accidentally on CXE as a smooth opacity.
 - They may **transform to malignant adenocarcinoma**.
- **Treatment:**

Surgical excision is done to confirm diagnosis, avoid complications such as malignancy, rupture, infection, and compression on vital organs.



2nd : Infectious Lung Diseases

1) Lung Abscess

Causes	Clinical features	Investigations	Treatment
<p>As a complication of pneumonia, bronchial obstruction (by tumor or inhaled foreign bodies (esp. in children) bacteremia, and septic emboli.</p>	<p>✦ Copious production of foul smelling sputum.</p> <ul style="list-style-type: none"> • Gradual onset • Productive cough • High fever • Night sweats • Weight loss & lethargy • Chest pain (pleuritic) 	<p>1-CXR (air-fluid level) 2- CT scan</p> 	<ul style="list-style-type: none"> • Antibiotics • Drainage: internal and external • Pulmonary resection (surgical treatment) <ul style="list-style-type: none"> ✓ Indications: <ol style="list-style-type: none"> 1. Failure of medical treatment 2. Giant abscess (>6 cm) 3. Hemorrhage (patient presents with hemoptysis) 4. Inability to rule out carcinoma (e.g. a 65 y/o very ill smoker can have lung cancer superimposed by abscess) 5. Rupture with resulting empyema ✓ Type of resections: <ul style="list-style-type: none"> - Lobectomy (main) or bilobectomy (2 lobes) - Pneumonectomy - (look at the CXR →)



Empyema: a collection of pus within the pleural cavity.

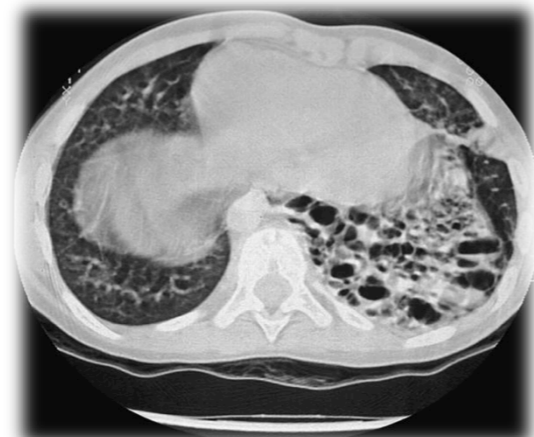
- In the initial phase, the infected fluid is thin and may be completely evacuated by a **low intercostal drain**. The empyema quickly becomes thick and loculated as a result of the deposition of fibrin, and at this stage formal **surgical drainage** is required.
- The collection is typically placed **posteriorly towards the base of the pleural cavity** and causes a **D-shaped shadow** on the chest film. Drainage in this phase may be achieved by **videothoracoscopic** techniques or by **excising a 2 cm segment** of rib over the lowest part of the empyema and suctioning and curetting the cavity clean. As dense fibrosis surrounds an empyema, drainage creates a fixed cavity.
- In elderly or unfit patients, a simple open tube drain is left in situ for many months, during which the cavity gradually shrinks and finally obliterates. In younger patients, **open formal thoracotomy** with decortication allows the fibrous cavity to be excised and any cortex over the lung removed. This **returns more lung function** to the patient and **avoids prolonged open drainage**, so that **recovery is more rapid**.



2nd : Infectious Lung Diseases

2) Bronchiectasis

Definition & Causes	Clinical Features & It's Types	Investigations	Treatment
<p>✧ Definition: Bronchial dilatation, usually affecting the lower lobes</p> <p>✧ Causes:</p> <ul style="list-style-type: none"> • Congenital (i.e. cystic fibrosis and immotile cilia syndrome) • Infection (repeated pulmonary infections and childhood infections) • Obstruction (by tumors/ inhalation of foreign bodies) 	<p>✧ Clinical Features:</p> <ul style="list-style-type: none"> • Cough mostly in morning with copious amounts of sputum • Dyspnea • Hemoptysis (50%) • Clubbing (Because it is a chronic disease) <p>✧ Types:</p> <ol style="list-style-type: none"> 1. Cystic 2. Cylindrical 3. mixed. 	<ol style="list-style-type: none"> 1. Bronchogram (invasive) 2. CT scan (more accurate) 3. Bronchoscopy (not commonly used nowadays) 4. CXR (cystic formation) 	<ul style="list-style-type: none"> • Medical: <ul style="list-style-type: none"> ✓ Resolve most cases (bronchodilators, antibiotics, and physiotherapy with postural drainage) • Surgical Indications: <ul style="list-style-type: none"> ✓ Failure of medical treatment ✓ Cystic dilatation (not cylindrical which is treated medically) ✓ Localized disease ✓ Not perfused (assessed by V/Q scan), most of cystic bronchiectasis are not perfused whereas most of cylindrical are perfused. <p>Cystic? Localized? Non-perfused? > Surgical Cylindrical? Bilateral? Perfused? > Medical</p>



✧ **Immotile Cilia Syndrome:**

1. Bilateral.
2. Lung transplant is needed in old age

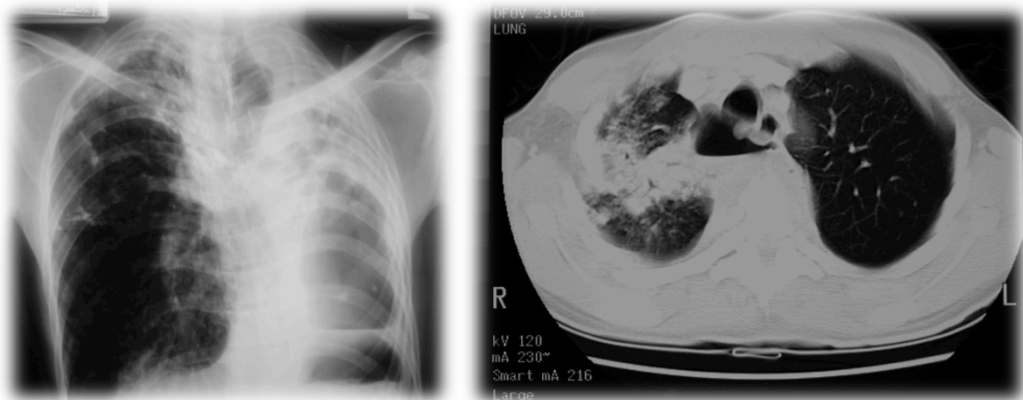
✧ Development of childhood vaccinations has reduced the incidence of bronchiectasis due to whooping cough, measles, and TB.

Case: a child inhales a foreign body bronchial tree obstruction (> right main bronchus) mom explains that her child was ok 6 months ago but now he has been getting repetitive chest infections/SOB/wheezing. **Suspect foreign body inhalation bronchiectasis.**

2nd : Infectious Lung Diseases

3) Tuberculosis

Causes	Investigations	Treatment
<ul style="list-style-type: none"> • Pulmonary • Extra-pulmonary (empyema, mediastinal lymph adenopathy) <p>✧ Epidemiology : 30,000 new cases occur annually in USA</p>	<ol style="list-style-type: none"> 1. CXR (apical scarring more in apex) 2. AFB sputum culture (if positive confirms TB) 3. Tuberculin skin test (latent TB) 4. Bronchoscopy 5. Chest CT scan (infiltration, abscess formation, lymph nodes) 6. Mediastinoscopy (caseating granuloma) 	<ul style="list-style-type: none"> ✧ Medical: <ul style="list-style-type: none"> ○ Effective in most cases ✧ Surgical indications: <ul style="list-style-type: none"> ○ Failure of medical treatment ○ Destroyed lobe or lung ○ Pulmonary hemorrhage ○ Persistent open cavity with positive sputum ○ Persistent broncho-pulmonary fistula



Trachea is deviated to the left side, it's either:

- **Pushed:** massive pneumothorax, hemothorax, plural effusion.
- **Pulled:** lung collapsed, destroyed lung, post-lobectomy, malignancy, no ventilation.

★ Left Bronchus Syndrome:

- Chronic condition that leads to **unilateral** post TB lung destruction as a result of untreated/resistant TB.
- Fibrosis → loss of space → loss of ventilation on left side → left lung is smaller, infective, and bronchioectatic pulling the trachea towards it.
- ✓ Don't operate on active open TB b/c of the risk of spread of infection. Manage them medically first for 4 weeks before surgery.

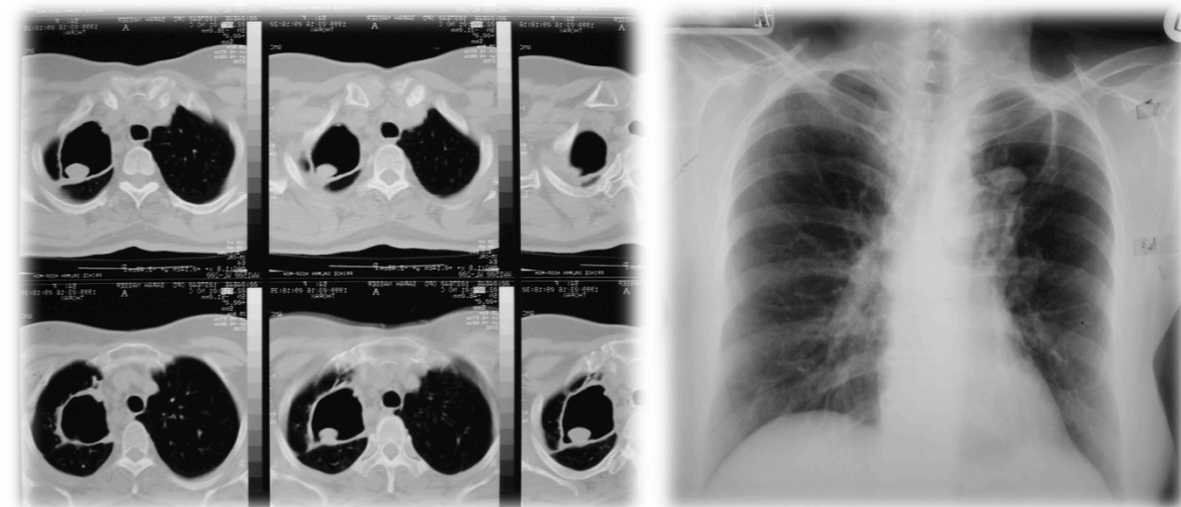
2nd : Infectious Lung Diseases

4) Aspergillosis

Causes & Mode Of Transmisson	Forms	Clinical Features	Investigations	Treatment
<p>✧ Causes: Aspergillus Fumigatus & Aspergillus Niger</p> <p>✧ Mode of Transmisson:</p> <ol style="list-style-type: none"> Inhalation of airborne conidia. Contaminated water (during showering). Nosocomial infections (hospital fabrics and plastics) . Espieclly in immuno-comprimsed individuals 	<ul style="list-style-type: none"> Allergic (allergic bronchopulmonary aspergillosis) Saprophytic aspergilloma* / mycetoma Invasive 	<p>Aspergilloma/Mycetoma:</p> <ul style="list-style-type: none"> Comes with a warning sign of hemoptysis At this stage, the doctor must act quickly because morbidity and mortality are very high in these patients Hemoptysis (patient with preexisting disease) Chronic productive cough Sometimes found accidentally on CXR 	<ol style="list-style-type: none"> Skin test Sputum (fungal culture) Biopsy (invasive) CXR (radiolucent) CT scan (cavity with aspergilloma complex and air crescent sign, DDx TB) 	<ul style="list-style-type: none"> ★ Medical: (Anti-fungal) ★ Surgical Indications: <ul style="list-style-type: none"> A significant aspergilloma (with serious clinical features) Hemoptysis Types of resection: depends on the affected side: <ul style="list-style-type: none"> ✓ Segmentectomy ✓ Lobectomy (mainly) ✓ Pneumonectomy

***Saprophytic Aspergillosis :**

Characterized by Asp infection without tissue invasion. The most common underlying causes are **TB and sarcoidosis**, HIV, uncontrolled diabetes.



2nd : Infectious Lung Diseases

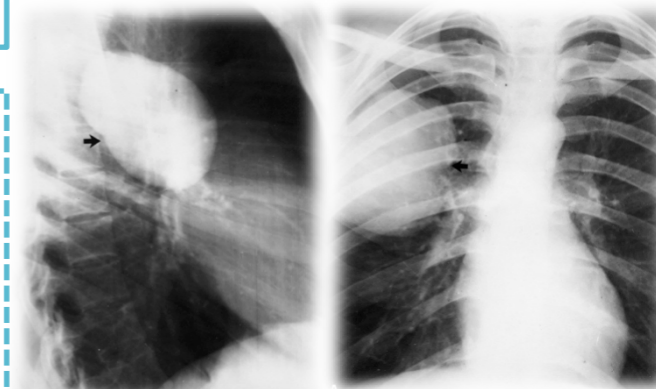
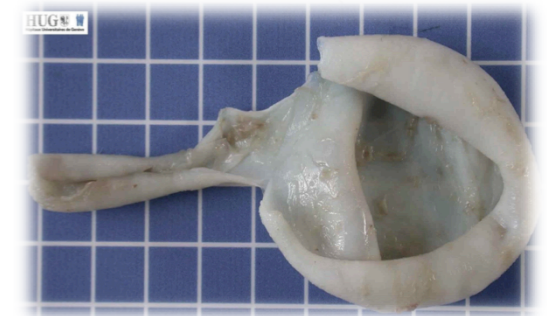
5) Hydatid Cyst

Definition	Clinical Presentation	Diagnosis	Treatment
<p>Parasitic infestation by: Echinococcus Granulosus (tapeworm)</p> <ul style="list-style-type: none"> - Dog (definitive host) → sheep (intermediate host) → human by eating raw sheep liver → enteric system → portal system → liver → IVC → heart & lungs → systemic. - The liver is the most common organ involved, followed by the lungs (brain, bones, kidneys can also be involved) 	<ul style="list-style-type: none"> • Asymptomatic: (accidentally found) • Symptomatic: Symptoms are the result of compression by the cyst (e.g. dyspnea) 	<ol style="list-style-type: none"> 1. Skin test (Casoni's reaction) 2. CXR 3. CT scan (a chronic cyst will appear calcified on CT) 4. High echino-coccus titers and other serologic tests 5. Routine blood work (nonspecific) 	<ul style="list-style-type: none"> • Radical surgical excision (cyst resection or partial affected organ resection) coupled with chemotherapy using albendazole and/or mebendazole before and after surgery. • If multiple cysts are present in multiple organs surgery becomes impractical and chemotherapy is indicated.

★ Hydatid Cyst Layers:

1. **The outer pericyst**, composed of host cells that are formed as a reaction to the parasite (false layer).
 2. **The middle laminated membrane** (external layer of cyst)
 3. **The inner germinal layer** of cyst where the scolices are produced and contained.
- 2+3 form the true wall of the cyst.

- Surgeon must be careful when doing this procedure, because each cyst contains millions of scolex (highly infective) so if ruptured it'll spill millions of scolex into surrounding cavities which leads to the formation of new cysts!
- Injection of scoliodal agents such as **hypertonic 20% saline** is used during surgery to kill scolex.
- Rupture of the cyst depends on **the size of feeding bronchus**, if it was big a small cyst can get ruptured, but if the feeding bronchus was small, the cyst won't rupture.



3rd : Lung Tumors

Benign or Malignant (Primary or Secondary)

A) Primary Lung Carcinoma:

Incidence:



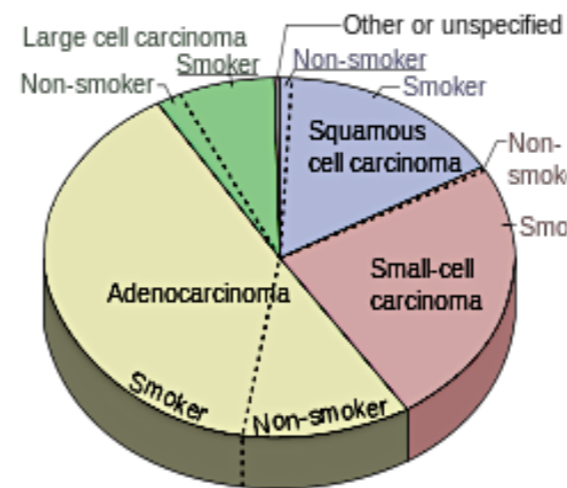
Worldwide, lung cancer is the most common cause of cancer death.

Risk factor:



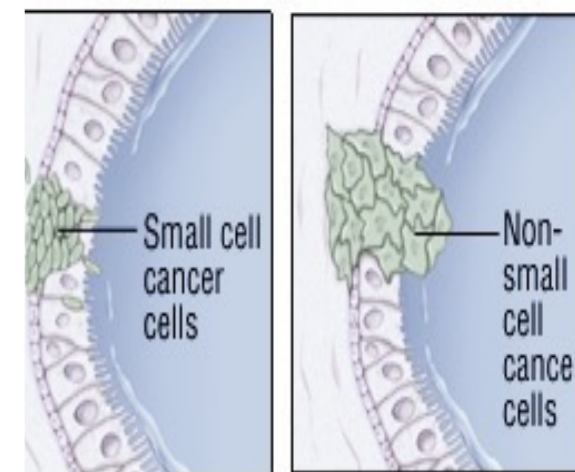
- **Smoking** (most important)
 - Passive smoke exposure
- **Others:**
 - radiation
 - industrial chemicals
 - diet
 - genetic factors asbestos
 - Radon gas exposure

Pathology:



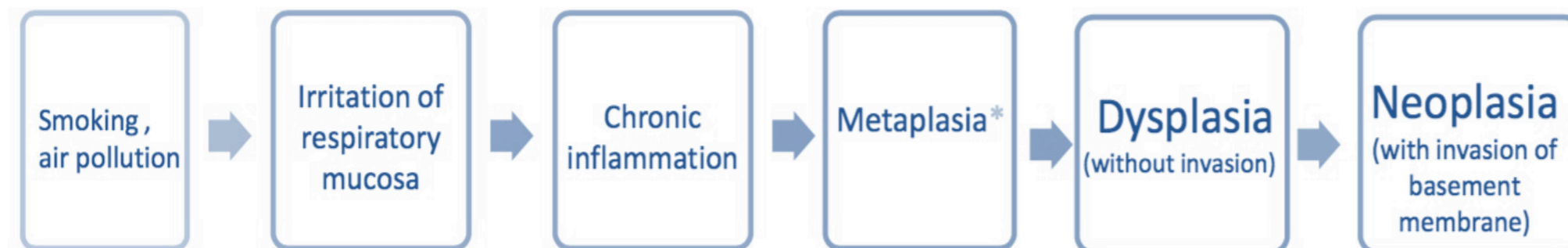
- **1- Non-small Cell Carcinoma**
 - Adenocarcinoma
 - Squamous cell carcinoma
 - Large cell carcinoma
- **2- Small Cell Carcinoma**

Classification:



- must differentiate between SCLC & NSLC because treatment approach is completely different.
- details in the Next slide

★ Pathogenesis (Extra Information)



3rd : Lung Tumors



Two types of cancer share a "s"entral location:

- Small cell
- Squamous cell

A) Primary Lung Carcinoma:

	Non-Small Cell Lung Carcinoma (NSCLC)			Small Cell Lung Carcinoma (SCLC)
General	<ul style="list-style-type: none"> • Epithelial origin • 75-80% 			<ul style="list-style-type: none"> • Neuroendocrine origin • 20-25%
Sub Types	1) Adenocarcinoma (40%) (most common) <ul style="list-style-type: none"> • Peripherally located • Not linked to smoking. • More common in women • It has a mutated gene called EGFR 	2) Squamous Cell Carcinoma (30%) <ul style="list-style-type: none"> • Centrally located (near to the hilum) • strong association with smoking 	3) Large Cell Carcinoma (9%) <ul style="list-style-type: none"> • Peripherally located. 	<ul style="list-style-type: none"> • Centrally located • Very Poor prognosis : 2–4 months from diagnosis to death. (Because it's Highly malignant) • Patient usually presents with systemic disease (e.g. large Mediastinal Lymph Adenopathy) • Mostly discovered late when tumor has already metastasized
Clinical Features	Metastasizes more frequently to the CNS.	Para-neoplastic syndrome: Hypercalcemia (Because This tumor produce PTH -related peptide)	Diagnosis Of Exclusion	Para-neoplastic syndrome: which happen in it are caused by abnormal secretion of two hormones: <ol style="list-style-type: none"> 1. ACTH = High corticosteroid = Cushing's syndrome (Most common Para-neoplastic syndrome) 2. ADH = Hyponatremia
Treatment	<ul style="list-style-type: none"> • Early: Surgery +/- adjuvant chemotherapy (Chemotherapy after the surgery) • Intermediate: Neoadjuvant chemotherapy (Chemotherapy before the surgery to downsize the tumor) + surgery. • Late/metastasis: NON-surgical (chemo/radiotherapy + palliative management). 			<ul style="list-style-type: none"> • Chemotherapy (treatment of choice) • Radiotherapy • NON-surgical: (< 5% candidates for surgery) (because tumor is usually discovered late, when metastasis is extensive and the patient develops systemic symptoms with massive mediastinal lymphadenopathy)

3rd : Lung Tumors

A) Primary Lung Carcinoma

★ Clinical Features:



Chronic cough is the most common symptom of lung cancer.



★ Syndromes Associated with Lung Cancer:

- **Horner's syndrome:**

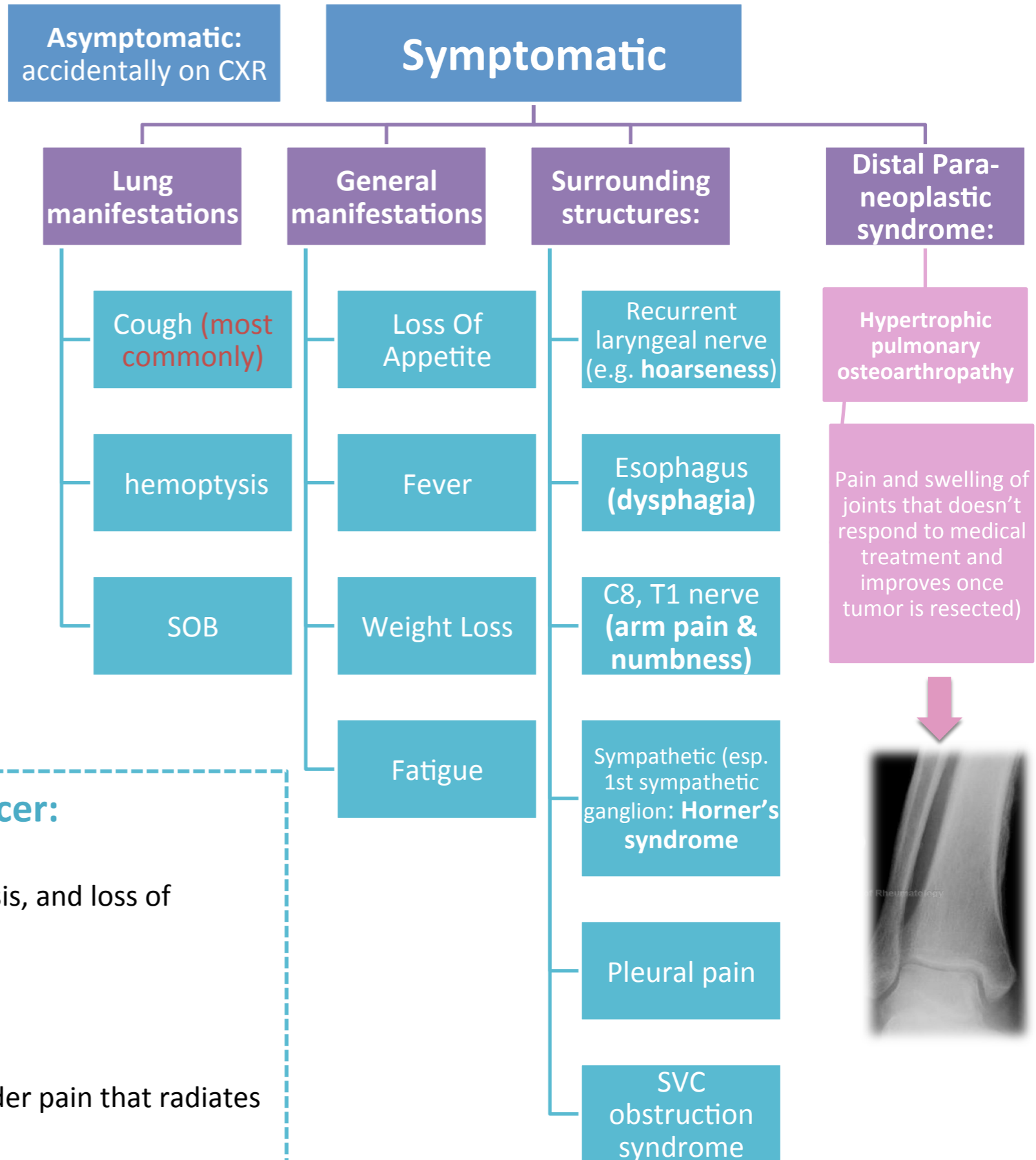
Characterized by the classic triad of miosis partial ptosis, and loss of hemifacial sweating (i.e., anhidrosis).

- **SVC obstruction syndrome:**

SOB most common symptom and facial/arm swelling.

- **Pancoast tumor:**

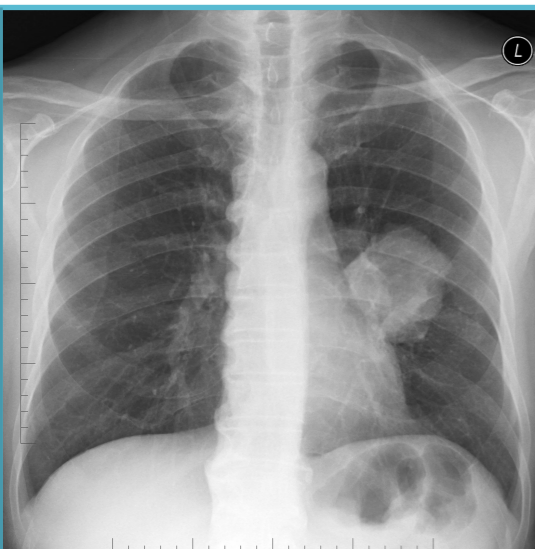
Superior sulcus tumor injury of C8 & T1 causing shoulder pain that radiates to arm.



3rd : Lung Tumors

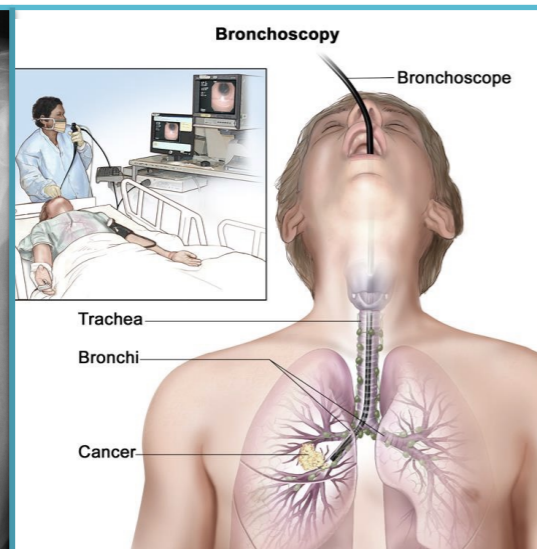
A) Primary Lung Carcinoma

★ Investigations:



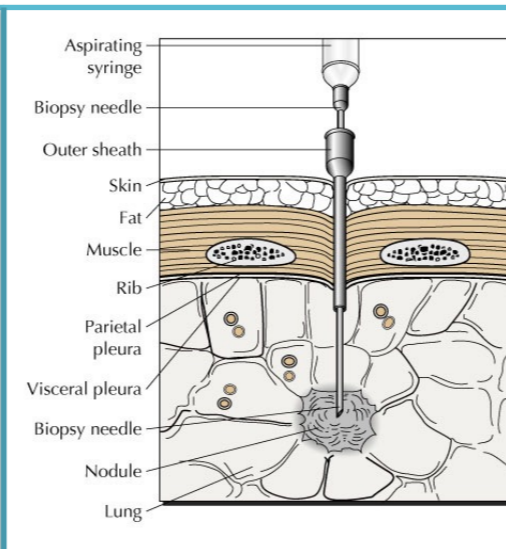
CXR

- find a previous CXR (of the patient) for comparison, if lesion is stable for **more than 2 years**, it is most likely **benign**



Bronchoscopy

- Method of choice of centrally located masses (**squamous cell and small cell**).



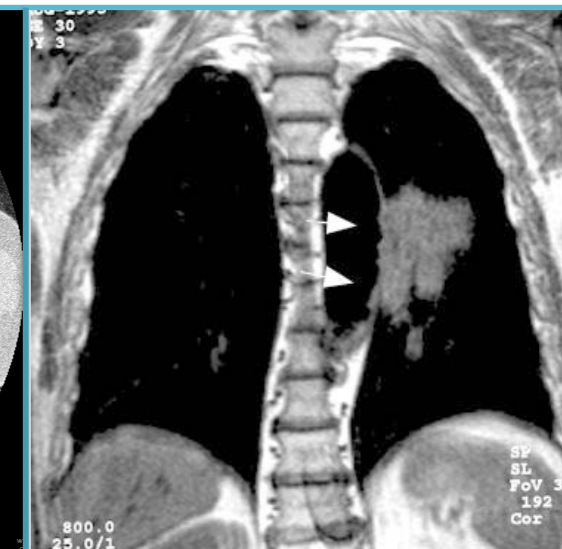
Transthoracic Needle Aspiration

- CT guided
- Method of choice for **peripherally located nodules**



CT scan

- Best modality for staging **extent of metastasis**



MRI

- poor modality in staging, its helpful to **rule out involvement of major structures** in the apex: brachial plexus, vertebral column, and spinal cord e.g. superior sulcus tumor

 **From Surgical Recall:**
Cancer arises more often in which lung? Right > left & upper lobes > lower lobes

3rd : Lung Tumors

A) Primary Lung Carcinoma

★ Staging :

New International Revised Stage Grouping

Stage 0	TIS
Stage IA	T1, NO, MO
Stage IB	T2, NO, MO
Stage IIA	T1, N1, MO
Stage IIB	T2, N1, MO
	T3, NO, MO
Stage IIIA	T1-3, N2, MO
	T3, N1, MO
Stage IIIB	T4, Any N, MO
	Any T, N3, MO
Stage IV	Any T, Any N, M1

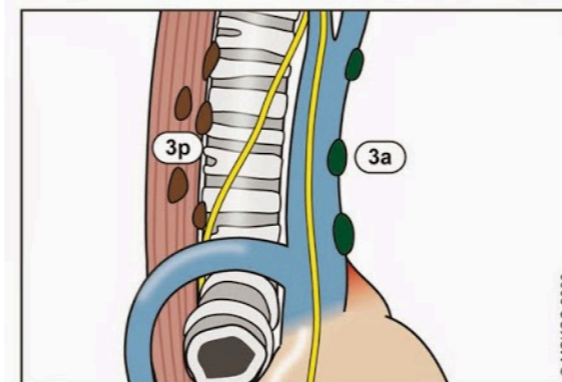
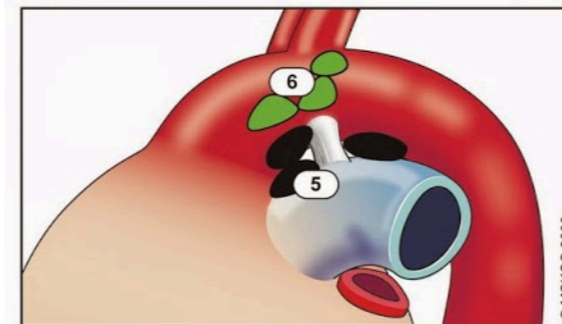
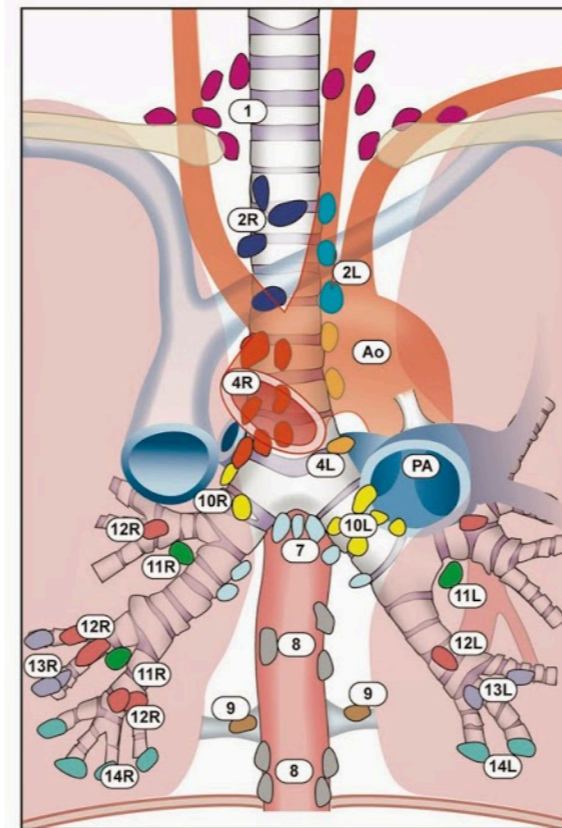
❖ Lymph node staging:

- **N1**: inside the lung
- **N2**: outside the lung toward mediastinum hilum
- **N3**: supraclavicular or to the other side

★ Management:

Depends on:

- ★ **Stage** (tumor size, LN involvement, metastasis to liver, bone, and brain) done by CT.
- ★ **Cell Type**
- ★ **Patient Physical Fitness** (tumor might be of an early stage but the patient has other comorbidities)



Supraclavicular zone

- 1 Low cervical, supraclavicular, and sternal notch nodes

Superior Mediastinal Nodes

Upper zone

- 2R Upper Paratracheal (right)
- 2L Upper Paratracheal (left)
- 3a Pre-vascular
- 3p Retrotracheal
- 4R Lower Paratracheal (right)
- 4L Lower Paratracheal (left)

Aortic Nodes

AP zone

- 5 Subaortic
- 6 Para-aortic (ascending aorta or phrenic)

Inferior Mediastinal Nodes

Subcarinal zone

- 7 Subcarinal

Lower zone

- 8 Paraesophageal (below carina)
- 9 Pulmonary ligament

N₁ Nodes

Hilar/Interlobar zone

- 10 Hilar
- 11 Interlobar

Peripheral zone

- 12 Lobar
- 13 Segmental
- 14 Subsegmental

Regional Lymph Nodes (N)

- NX** Regional lymph nodes cannot be assessed
- N0** No regional lymph node metastases
- N1** Metastasis in ipsilateral peribronchial and/or ipsilateral hilar lymph nodes and intrapulmonary nodes, including involvement by direct extension
- N2** Metastasis in ipsilateral mediastinal and/or subcarinal lymph node(s)
- N3** Metastasis in contralateral mediastinal, contralateral hilar, ipsilateral or contralateral scalene, or supraclavicular lymph node(s)

ILLUSTRATION
The IASLC lymph node map shown with the proposed amalgamation of lymph into zones.
(© Memorial Sloan-Kettering Cancer Center, 2009.)

3rd : Lung Tumors

B) Secondary Lung Carcinoma

- Neoplasms that have **spread** from a primary lesion in **another organ**.
- Secondary lung tumors appear as solitary lung nodules (**well-margined**, single mass <3 cm, intraparenchymal opacity)

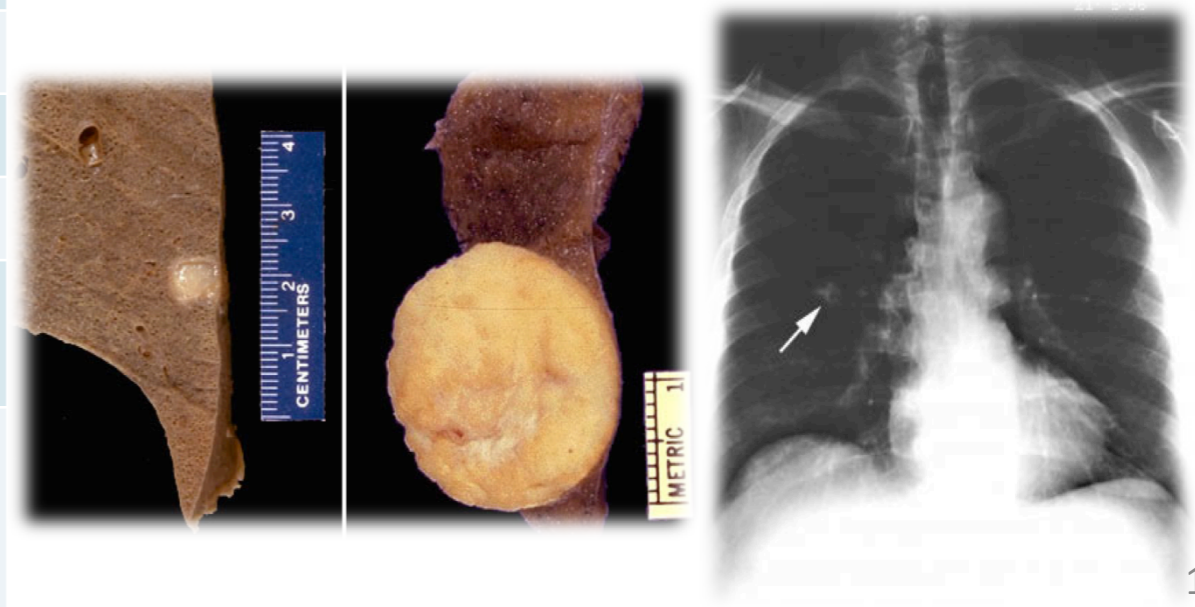
★ Solitary Lung Nodule DDX: (coin lesions)

- **Primary Carcinoma**
- **Tuberculous Granuloma**
- **Mixed tumor**
- **°2 Carcinoma (metastatic)**
- **Miscellaneous**

★ Hamartoma –Carcinoid:

- Hamartomas are the **most common type** of benign lung tumors, accounting for 75% of all benign lung tumors and most of them are asymptomatic.
- ✧ **Age:** hamartomas occur primarily in **adults >50 y/o**
- ✧ **Sex:** **Males** 3 times more likely than females
- ✧ **X-ray** (usually peripherally located)
 - ✓ **Size:** usually small <4cm in diameter, rounded
 - ✓ **Time:** grows slowly
 - ✓ **Calcification:** sometimes with varying patterns

Benign Solitary Pulmonary Nodules	Malignant Solitary Pulmonary Nodules
Age < 50	Age >50
Nonsmoker	Smoker
Size < 2 cm	Size > 3cm
No Growth Over 2 Year Period	Steady Growth
Circular And Regular Shaped	Irregular Nodule Or Speculated Margins
Central Laminated/Concentric Calc	Stippled/Eccentric Calc.



✧ Assessment

(This was not mentioned in the lecture, yet is required from Dr. Adnan's objectives)

Table 22.2 Common thoracic surgical investigations

Investigation	Yield
ECG Resting	Rhythm; conduction abnormalities; atrial and ventricular hypertrophy; established ischaemic changes; evidence of previous myocardial infarction
Chest X-ray Posterior-anterior and lateral	Preliminary assessment of location of lesion; malignant involvement of phrenic nerve or ribs; presence of additional lesions or effusion; presence of pneumothorax or mediastinal air
Thoracic CT	Further refine radiological assessment of mass lesions as above; review mediastinum for enlarged nodes in bronchogenic carcinoma; inspect bronchi for dilatations in suspected bronchiectasis; determine areas of greatest disease in interstitial lung disease; locate intrathoracic collections; map out distribution of bullous/ emphysematous lung disease
PET CT	Identify further disease elsewhere through metabolic uptake of ¹⁸ F-fluorodeoxyglucose not identified by conventional CT
Upper abdominal CT	Exclude or confirm liver abnormalities; identify adrenal metastases
Upper abdominal ultrasound	Determine probable nature of cystic hepatic lesions; provide guidance for biopsy of hepatic or adrenal lesions; review diaphragm motion in cases of suspected diaphragmatic rupture or phrenic nerve paralysis
MRI	Useful for assessing relationship of tumour to adjacent neural structures, e.g. detecting possible intraspinal extension of paravertebral neurogenic tumours or involvement of brachial plexus by superior sulcus (Pancoast) tumours
Isotope scans Bone Lung	Search for skeletal metastases; review chest wall for possible direct invasion by carcinoma Identify areas of low uptake indicative of impaired perfusion or ventilation
Pulmonary function tests FEV ₁ FVC CO transfer	Forced expiratory volume in 1 second; provides a measure of airway obstruction Forced vital capacity; indicates presence of restriction of ventilation Measures the diffusion capacity of the patient's lungs
Walking test	Measures distance walked by the patient in a set time period (4 mins) and the perceived exercise level achieved as assessed by the final heart rate; useful as an indicator of functional status in patients with poor FEV ₁ , as they may not comply well with the methodology of formal respiratory testing and hence underachieve
Arterial blood gas	Useful in demonstrating patients with CO ₂ retention who should be excluded from surgical consideration

4th : Mediastinum

★ Anatomy:

✓ Boundaries:

- **Superior:** thoracic inlet
- **Inferior:** diaphragm
- **Anterior:** sternum & costal cartilages
- **Posterior:** thoracic spine
- **Lateral:** mediastinal pleura

✓ Access:

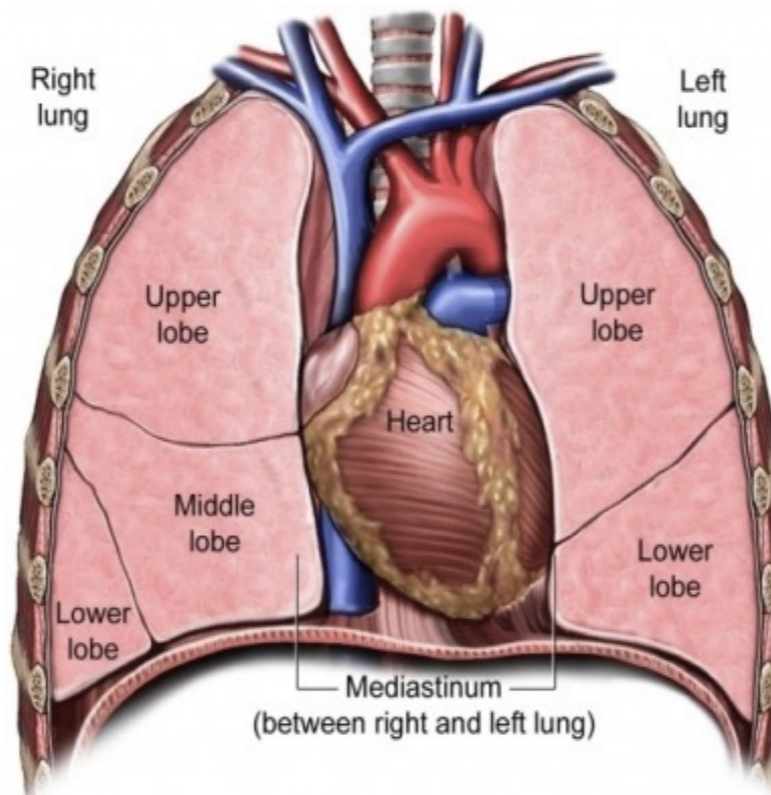
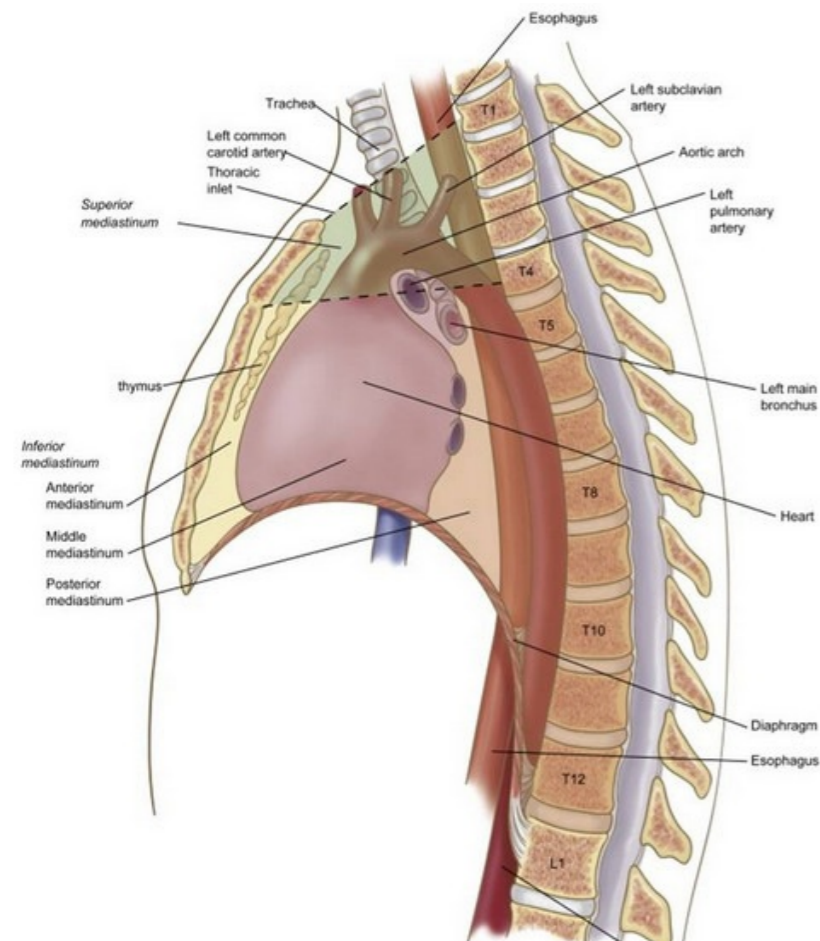
- Mediastenscopy
- Mediastenotomy

Mediastinal Mass Lesions:

1) Anterior
Mediastinum
(5 T's)

2) Middle
Mediastinum
(Cyst)

3) Posterior
Mediastinum
(Neurogenic)



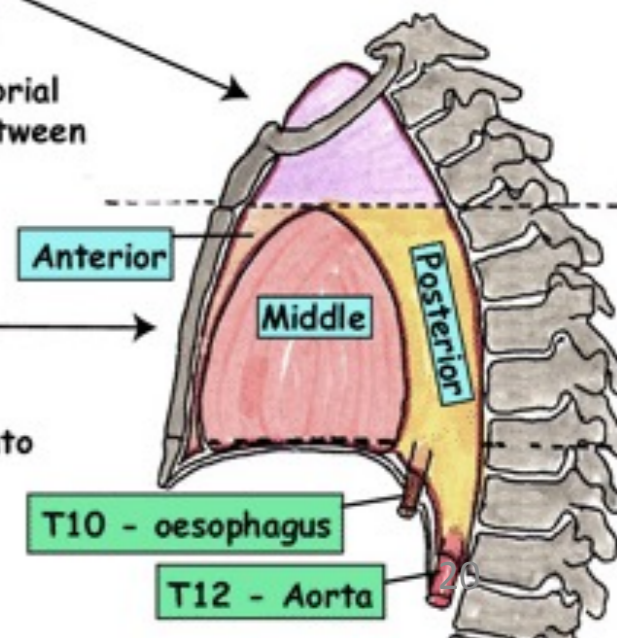
DIVISIONS OF THE MEDIASTINUM

Superior mediastinum

From 1st rib to a line joining the sternomanubrial junction to the disc between T4 and T5

Inferior mediastinum

All below the superior mediastinum. Divided into three



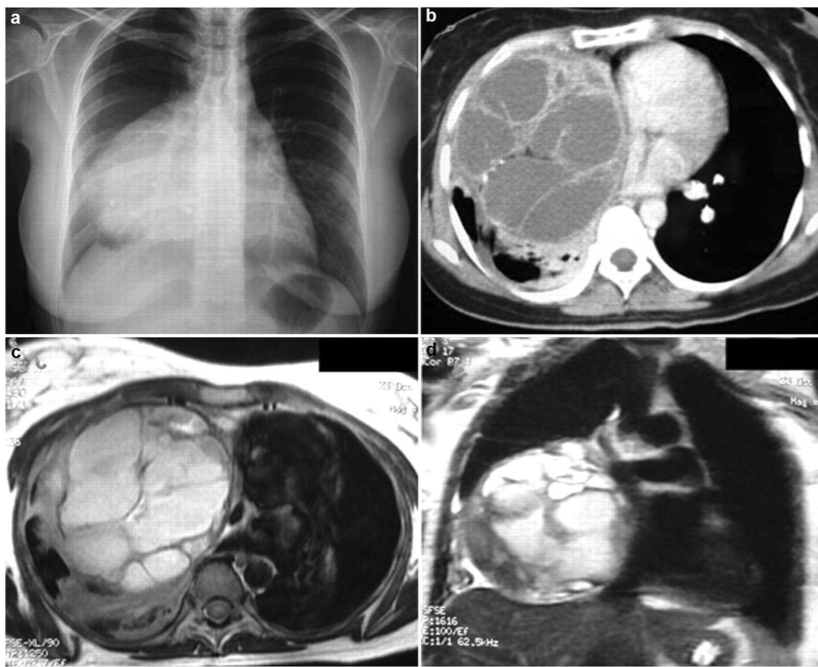
★ Mediastinal Mass Lesions:

1) Anterior Mediastinum

5Ts

1. **Teratoma**
2. **Thyroid** (retrosternal goiter) “goiter means an enlarged thyroid”
3. **TB lymphadenitis** “most common form of extra pulmonary manifestation of TB in children”
4. **T-cell lymphoma**
5. **Thymoma**

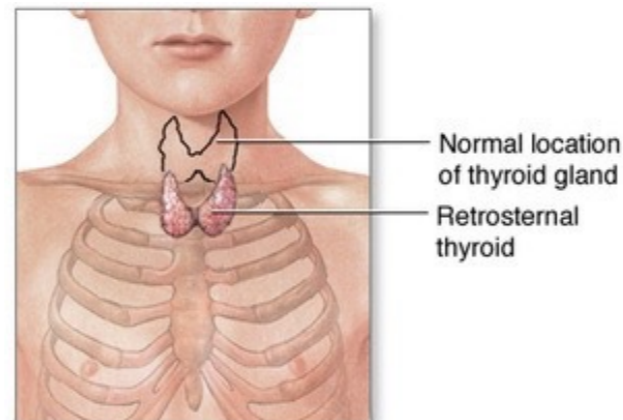
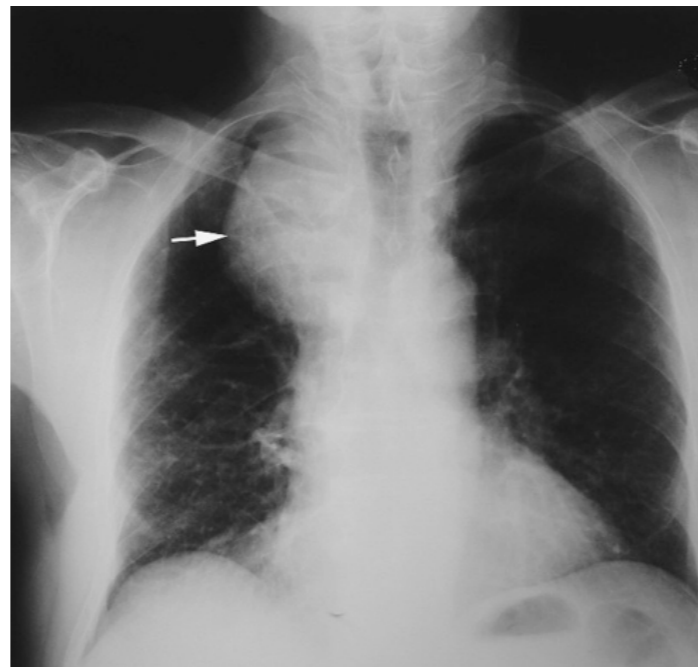
1- Teratoma



Giant Mediastinal Teratoma

- (a) Chest X-ray showing a large mass
(b) Chest CT-scan revealing a giant multilocular lesion located in the upper and middle mediastinum with regular borders.
(c) Chest MRI (transverse section)
(d) Chest MRI (coronary section).

2- Retrosternal Goiter



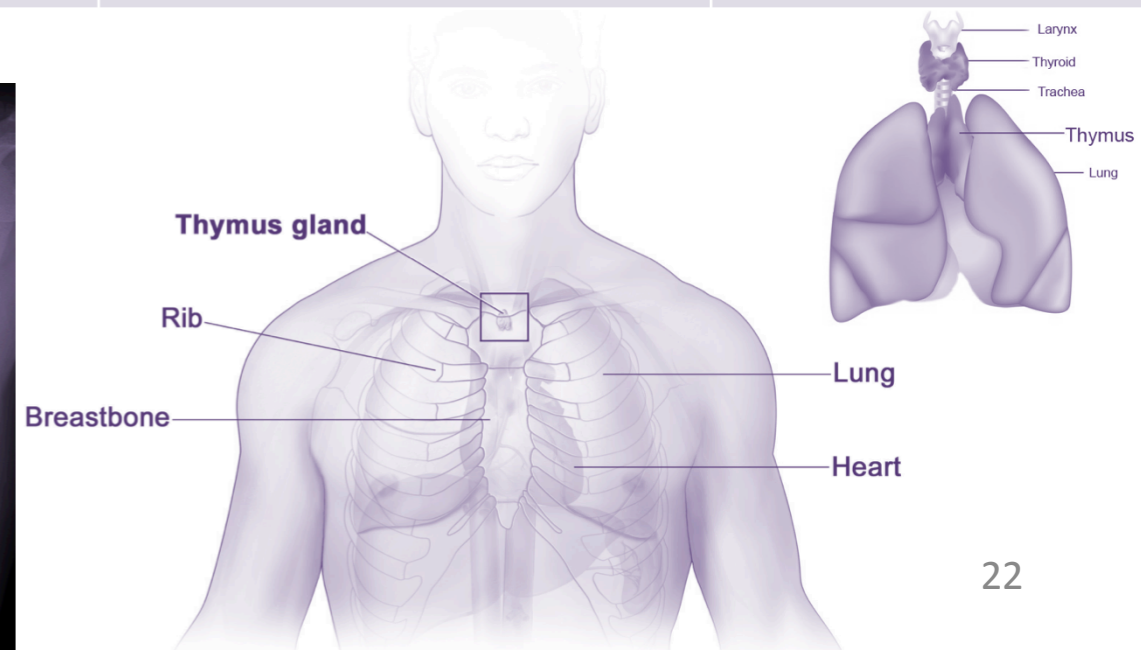
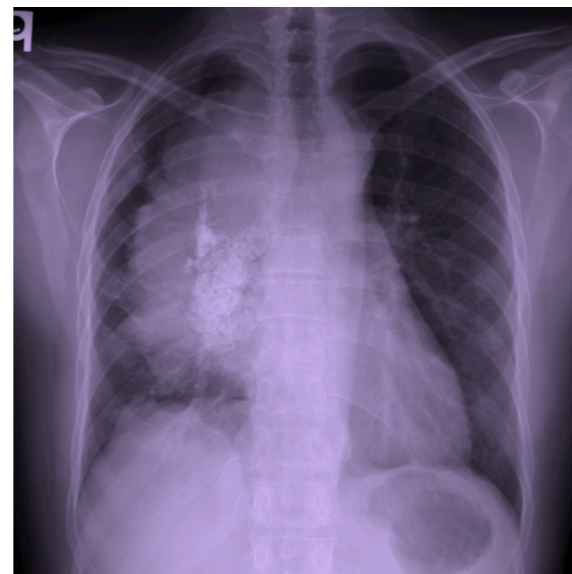
4- T-cell Lymphoma



5- Thymoma

Incidence	Pathology	Clinical Features & Investigations	Treatment
<ul style="list-style-type: none"> The most common tumor of anterior mediastinum Peak 40-60 y/o M: F (1:1) equally affected 	<p>❖ Classification:</p> <ol style="list-style-type: none"> Epithelial Lymphocytic Lymphoepithelial Spindle cell <p>o Benign Vs. malignant</p> <p>No clear histologic distinction between benign and malignant thymomas exists. Malignancy is determined by the invasiveness. Malignant thymoma can invade the vasculature, lymphatics, and adjacent structures within the mediastinum.</p> <p>o Stages: I, II, III, IV :</p> <p>Stage I: only in the thymus and the capsule that surrounds the thymus. Stage II: spread into fat surrounding the thymus or into the mediastinal pleura. Stage III: spread to other organs near the thymus, or into the pericardium. Stage IVA: spread more extensively into the pleura or pericardium. Stage IVB: spread to organs further away from the thymus, or through the vessels or lymph.</p>	<p>★ Clinical Features:</p> <ul style="list-style-type: none"> ✓ Asymptomatic ✓ Symptomatic • Mass effects : SVC syndrome, dysphagia, and cough. • Systemic effect : associated autoimmune disorders, most commonly myasthenia gravis 40-50%. <p>★ Investigations:</p> <p><u>For all cases:</u></p> <ul style="list-style-type: none"> • CXR • CT scan (can be indicative of malignancy) • Biopsy <p><u>For selected cases:</u></p> <ul style="list-style-type: none"> • Bronchoscopy • Esophagoscopy • Angiogram 	<ul style="list-style-type: none"> ✓ Benign: complete excision ✓ Malignant: Complete excision if possible <p>If non-resectable: (i.e. invasive and large) → neoadjuvant chemotherapy and/or radiotherapy may be used to decrease the size and improve resectability or incomplete resection.</p>

Masaoka stage	Criteria
I	Encapsulated tumor
IIA	Microscopic capsular invasion
IIB	Macroscopic invasion into fatty tissue
III	Invasion into great vessels, pericardium, or lung
IVA	Pleural and/or pericardial dissemination
IVB	Lymphatic or hematogenous metastases



★ Mediastinal Mass Lesions:

2) Middle Mediastinum

- **Cysts**

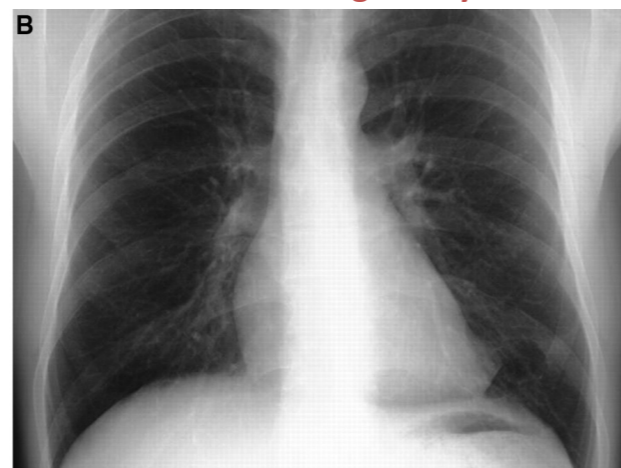
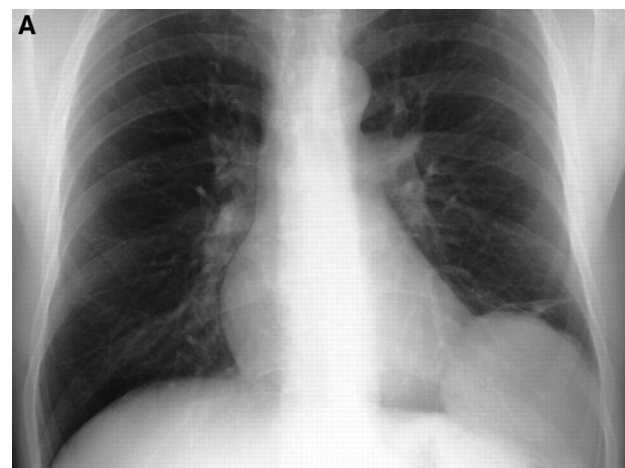
1. **Pericardial cyst** : uncommon benign congenital anomaly. most patients are asymptomatic and discovered incidentally although occasionally patients may present with chest pain and dyspnoea.
2. **Bronchogenic cyst**



Substantial **bronchogenic cyst**



Pediatric **bronchogenic cyst**

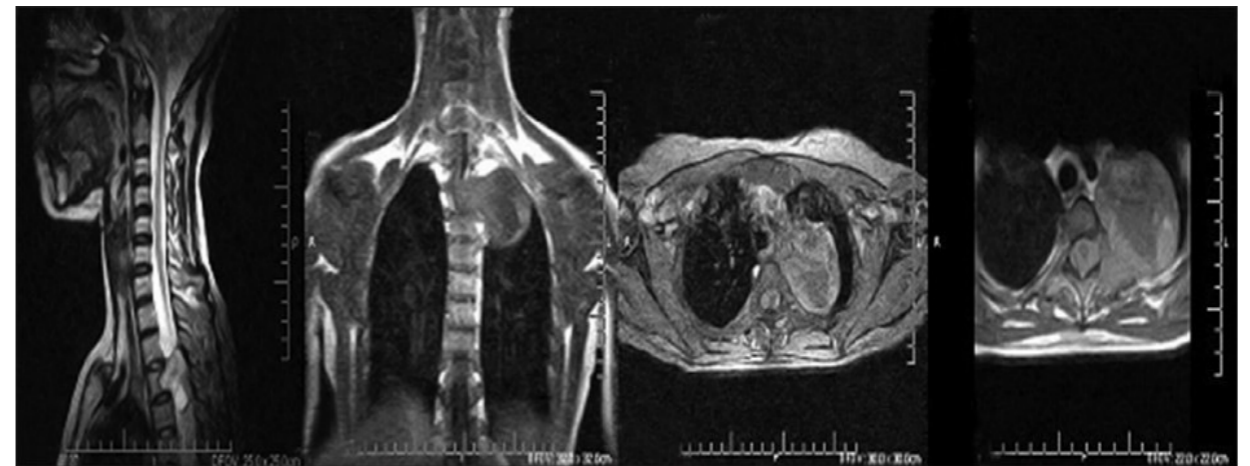


A, Radiograph showing the **pericardial cyst** in the left cardiophrenic angle; B, radiograph after percutaneous aspiration of the pericardial cyst, demonstrating complete evacuation of the cyst.

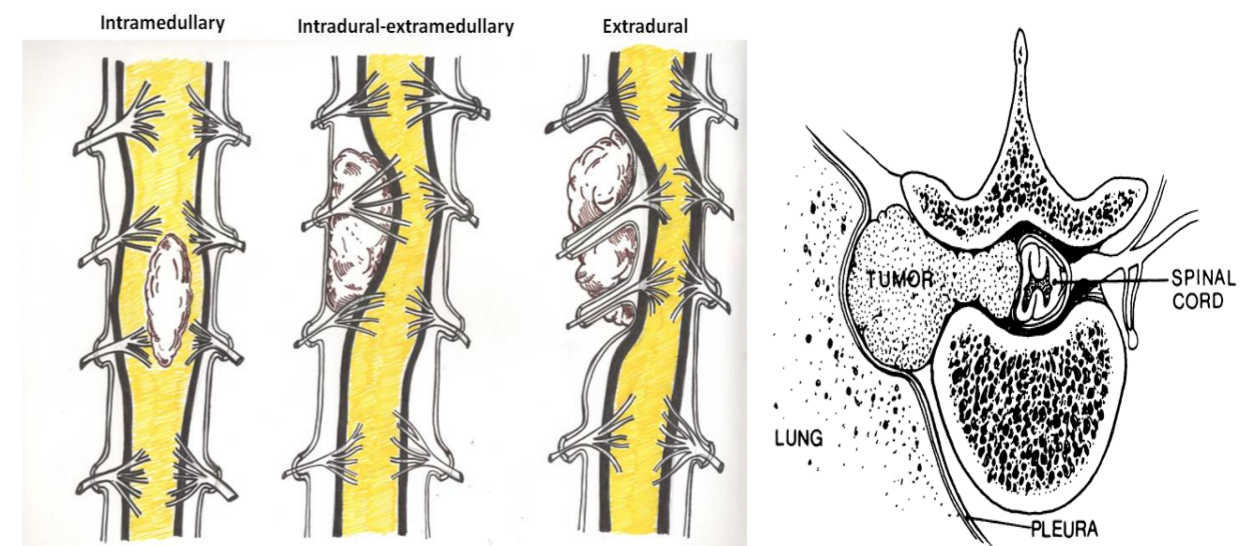
3) Posterior Mediastinum

- **Neurogenic tumors**

- ✧ E.g.:
- Dumbbell tumor of neurofibroma
- paravertebral mass....



TYPE OF TUMOURS



Dumbbell Tumor Of Neurofibroma

5th : Chest

1- Chest Wall :

★ Deformities:

- **Pectus excavatum:** caved-in or sunken appearance of the chest
- **Pectus carniatum:** protrusion of the sternum & ribs (pigeon chest)

- ★ **Infections** (e.g. abscess, empyema, costochondritis...)

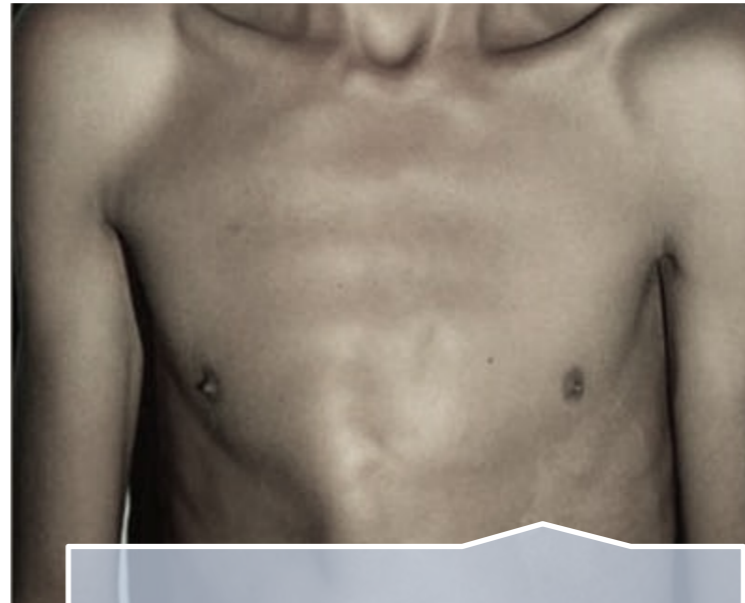
★ Chest Wall Tumor:

- **Benign:**
 - ✓ **soft tissue:** Haemangioma
 - ✓ **skeletal (ribcage):** Fibrous dysplasia
- **Malignant:** most common malignant lesions are metastases.

★ Thoracic Outlet Syndrome

Compression of the neurovascular structures traversing the thoracic outlet, namely:

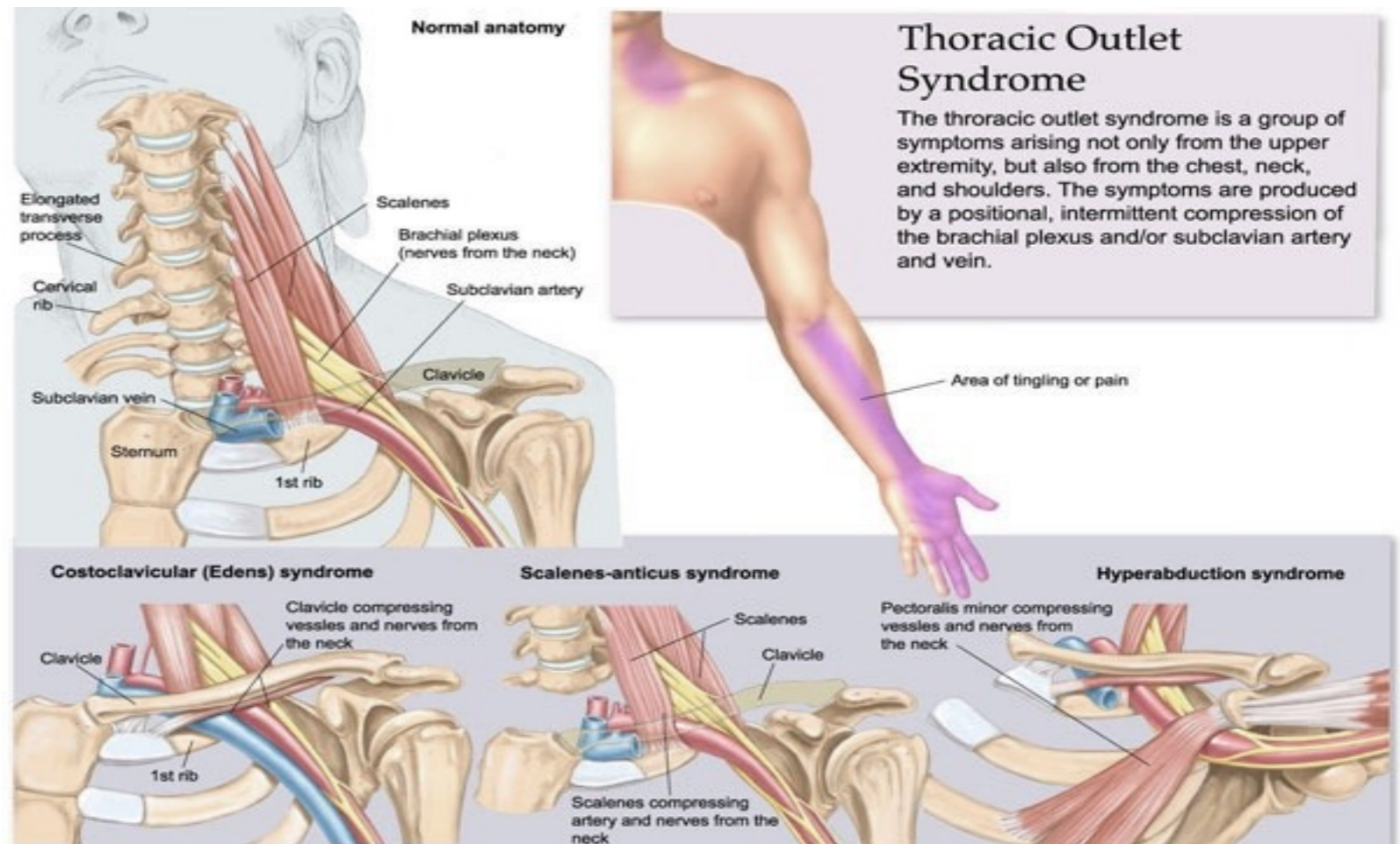
1. Subclavian artery (“arterial TOS”)
2. Subclavian vein (“venous TOS”)
3. Brachial plexus (“neurogenic TOS”)



Pectus Carniatum



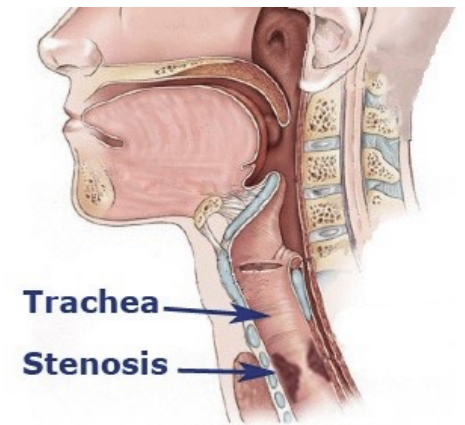
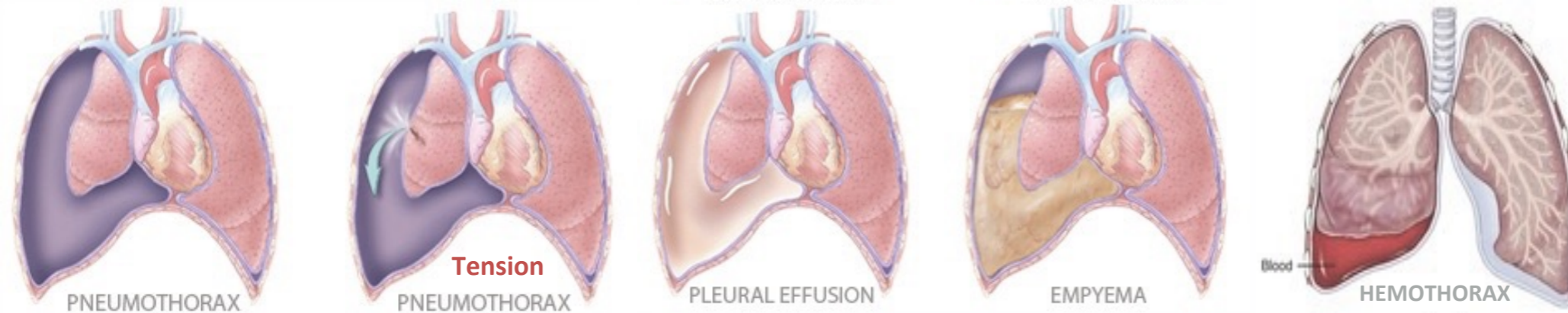
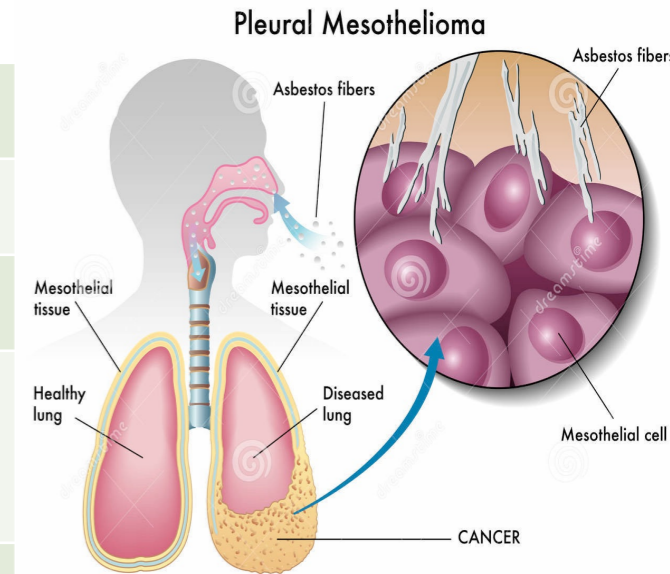
Pectus Excavatum



5th : Chest

2- Pleura:

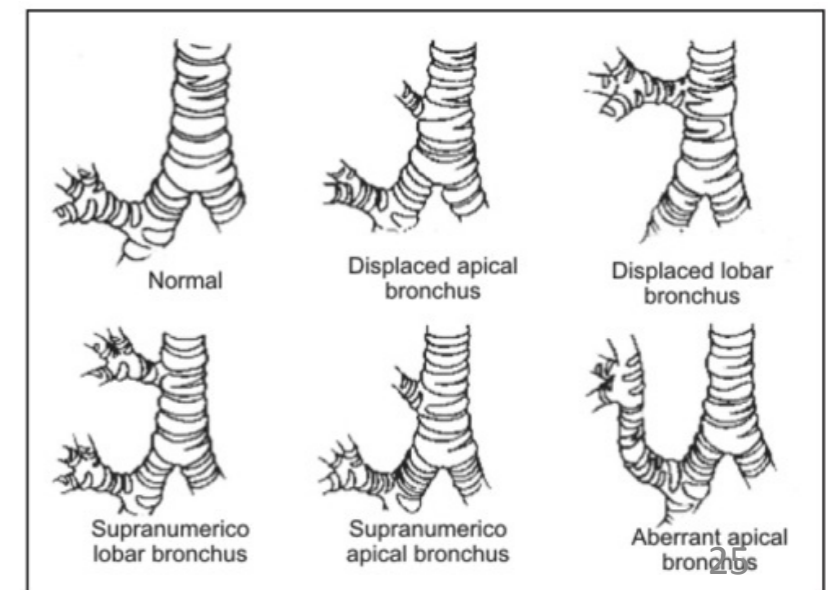
Pleural Effusion	collection of fluid in the pleural cavity .
Empyema	collection of pus in the pleural cavity .
Mesothelioma	rare cancer, usually caused by asbestos exposure.
Hemothorax	<ul style="list-style-type: none"> • Accumulation of blood in pleural cavity, Cause is mostly trauma. • Appears as radio-opacity on CXR.
Pneumothorax	air in the normally airless pleural space (see the upcoming slides)



3- Airways :

★ **Congenital Tracheal Anomalies**

★ **Tracheal stenosis:** narrowing of the trachea caused by an injury or birth defect.



6th: Trauma (Traumatic Thoracic Injuries)

Blunt Trauma



Penetrating Trauma



★ Mechanism Of Injury :

1- Blunt Trauma:

- Most are managed **non-operatively** (simple interventions) like intubation and ventilation and chest tube insertion.
- Diagnosis require additional investigations such as CT scanning.

2- Penetrating Trauma:

- more likely to **require operation**, and complex investigations are required infrequently.
- Patients with **penetrating** trauma may deteriorate rapidly, and recover much faster than patients with blunt injury.

Primary Survey

aim is to identify and treat immediately life-threatening conditions

1. (Tension) Pneumothorax
2. Massive Hemothorax
3. Flail Chest *

Secondary Survey

aim is to identify all injuries, planning further investigation & treatment.

1. Simple Pneumothorax
2. Simple Hemothorax
3. Rib Fractures Most common blunt thoracic injuries



Flail chest (complicated Fracture): when three or more ribs are broken in at least two places, front and back. The key sign of flail chest is '*paradoxical movement*', which means the natural movement of the ribcage during breathing is in reverse. For example, the injured area of ribcage sinks in when the person inhales, instead of lifting outwards.

★ Pneumothorax

Presence of **air** or **gas** in the **pleural cavity**, which may causes lung to collapse.

★ Classification:

1. Spontaneous Pneumothorax : (non-traumatic)

caused by a rupture of a cyst or a small sac (bleb) on the surface of the lung.

- ✓ **primary** typically occurs in young (15-35years) individuals with essentially normal lungs with few apical *bullae* “air or gas sacs that are present in the lungs”.
- ✓ **Secondary** as a result of **underlying lung diseases**, including [cystic fibrosis, **chronic obstructive pulmonary disease (COPD)**, lung cancer, asthma, and infections] develops in elderly patients (55-75years) or it can be caused iatrogenic (pleural biopsy, tracheostomy,etc.)

2. Traumatic Pneumothorax

occur due to **traumatic injury** (penetrating or blunt chest trauma) (external chest wound or internal air leakage)

A. Tension Pneumothorax

life threatening condition. the most common type of pneumothorax, caused by leakage of air from lungs due either “traumatic puncture wound” or “spontaneous leakage”

B. Open Pneumothorax

often associated with a “sucking wound” where air moves in and out of a chest wound with respiration. air leakage may follow oesophageal perforation or anatomic breakdown, as air can enter pleural cavity via the mouth.

★ Signs & Symptoms :

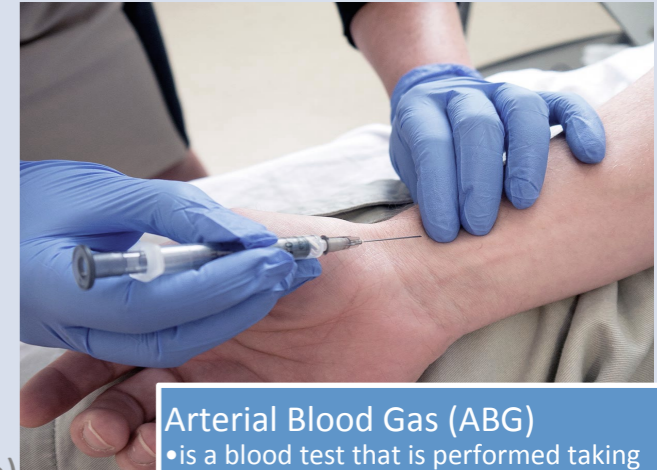
Primary Spontaneous Pneumothorax	Tension pneumothorax
No clinical signs or symptoms until a bleb ruptures and causes pneumothorax > acute onset of chest pain and shortness of breath, particularly with secondary spontaneous pneumothorax	<ul style="list-style-type: none"> • Hypotension • hypoxia • chest pain • dyspnea
Iatrogenic Pneumothorax:	
similar to spontaneous pneumothorax, depending on patient’s age, presence of underlying lung disease, and extent of pneumothorax	

The lungs normally inflate by increasing the size of the chest cavity, resulting in a negative (vacuum) pressure in the pleural space (the area within the chest cavity but outside the lungs). If air enters the pleural space either by a hole in the lung or the chest wall, the pressure in the pleural space equals the pressure outside the body. Thus, the vacuum is lost and the lung collapses.



Diagnosis & Investigations

- Examination of patients may reveal **diaphoresis and cyanosis** (in the case of tension pneumothorax).
- Findings on auscultation vary depending on the extent of the pneumothorax.
- ✧ **Respiratory findings** may include the following:
 - o Respiratory distress
 - o Distant or absent breath sounds
 - o Adventitious lung sounds: Ipsilateral crackles, wheezes
 - o Tachypnea
 - o Asymmetric lung expansion
- ✧ **Cardiovascular findings** may include the following:
 - o Tachycardia
 - o Pulsus paradoxus
 - o Hypotension (a key sign of tension pneumothorax)
 - o Jugular venous distention (may be absent if hypotension is severe)
- ◆ **Investigations** :
 - o **Arterial blood gas (ABG)** useful in evaluating hypoxia and hypercarbia and respiratory acidosis.
 - o Chest radiography: Anteroposterior and/or lateral decubitus films
 - o Chest ultrasonography



Arterial Blood Gas (ABG)
 • is a blood test that is performed taking blood from an artery, rather than a vein.

1. Hypotension and tachycardia
2. Distended neck veins
3. Shift of trachea away
4. Decreased breath sounds on affected side
5. Hyperresonance

Diagnosis: clinically (no time for CXR!)

1. Sudden ipsilateral chest pain
2. Dyspnea and cough
3. Decreased breath sounds over affected side
4. Hyperresonance over the chest
5. Decreased tactile fremitus
6. Mediastinal shift toward side of pneumothorax

Diagnosis: CXR

Management

- medical therapeutic options includes the following:
- ✓ Watchful waiting, with or without supplemental oxygen
 - ✓ Simple aspiration
 - ✓ **Tube drainage**, with or without medical pleurodesis



Chest Tube

Medical EMERGENCY!

- If tension isn't relieved patient is likely to die from hemodynamic compromise.
- Immediately decompress the pleural space via large-bore needle or chest tube

★ Primary Spontaneous Pneumothorax:

- If small and patient is asymptomatic:

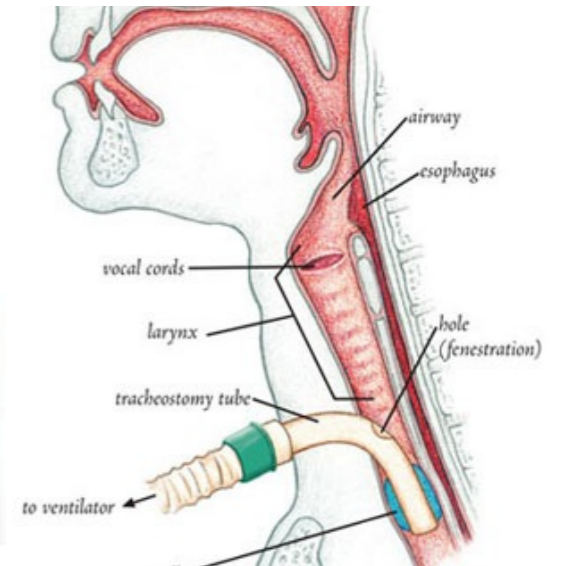
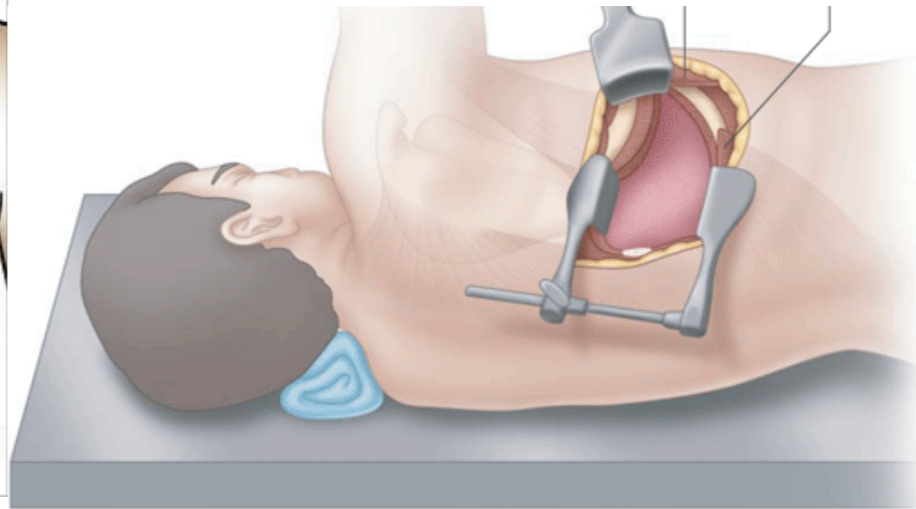
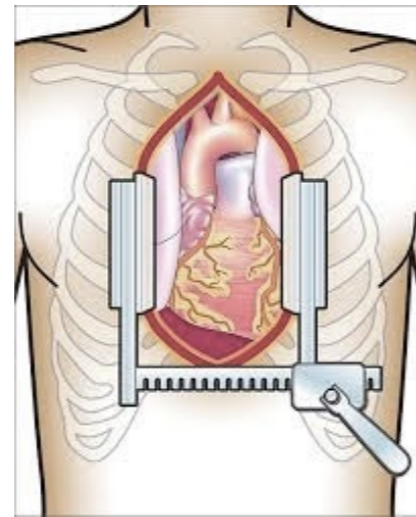
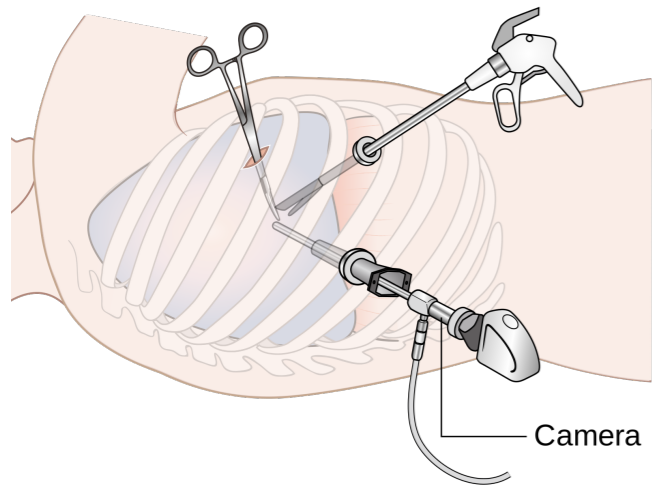
1. Observation (should resolve spontaneously in 10 days) reassess with CXR
2. Small chest tube may benefit some patients

- If larger and/or patient is symptomatic :

1. Administration of supplemental oxygen
2. **Chest tube** insertion to allow air to be released

★ Secondary Spontaneous Pneumothorax **Chest tube drainage**

✂ Surgery



Thoracoscopy

Sternotomy

Thoracotomy

Tracheostomy

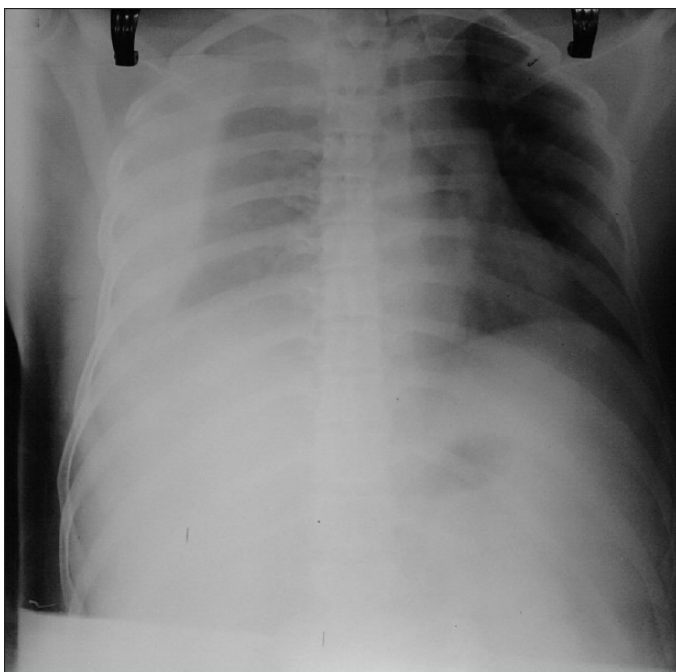


Figure 1: Chest X-ray, hemothorax

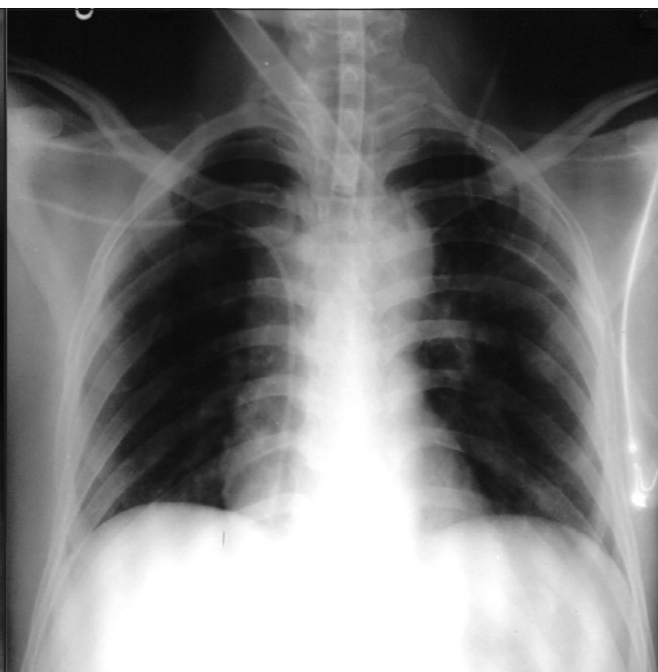


Figure 2: Chest X-ray with catheter in situ

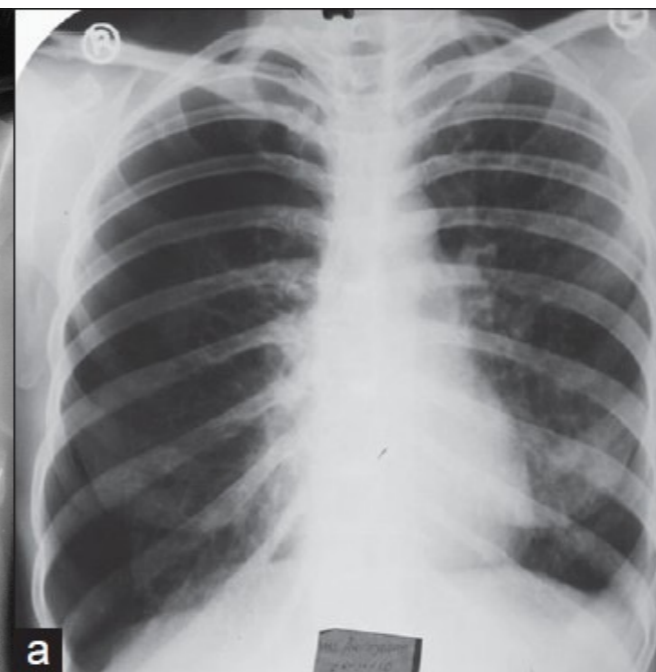


Figure 1: Chest X-ray, pneumothorax.

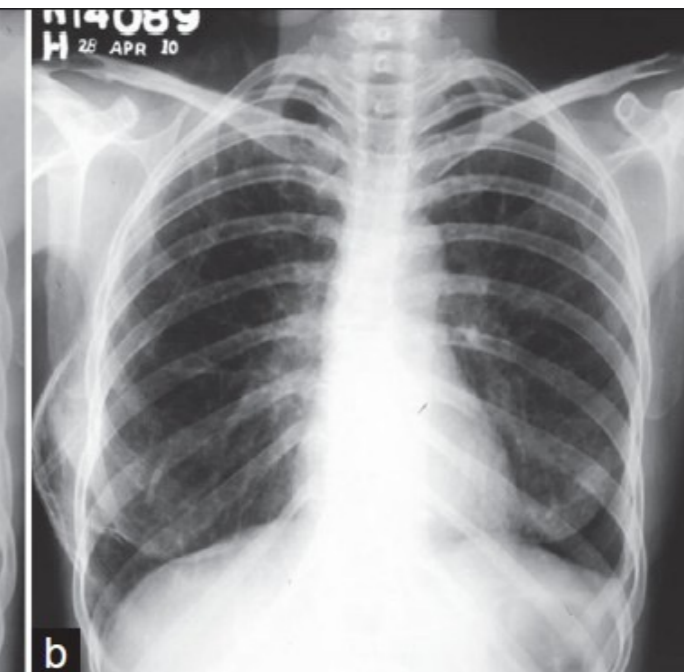


Figure 2: Chest X-ray with intercostal tube in situ and fully expanded right lung

✧ Summary

- 1- Agenesis :
- 2- Hypoplasia :
- 3- Congenital Cystic Adenomatoid Malformation :
 - **Presenting with** : respiratory distress and **recurrent respiratory infections**.
 - The usual appearance of CCAM on CXR & US is **Swiss cheese pattern**
- 4- Lobar Emphysema : replacement of a whole lobe **by bullae**
 - **Diagnosed by**: respiratory symptoms and CXR, which shows over-inflation of the affected lobe (radiolucency).
- 5- Pulmonary Sequestration: **Present in** : adolescence or late childhood as **repetitive chest infections** that fails to respond to medical treatment.
 - Treated surgically to prevent infections.
- 6- Bronchogenic Cyst : **Location**: 1-In the mediastinum(**paratracheal** or **subcarinal**) 2- within the lung parenchyma
 - patient complains of **SOB, stridor, cough and dysphagia**. (If complicated)

Congenital Lung diseases

- 1- Lung Abscess:
 - production of foul smelling sputum.
 - CXR: air fluid level. **Indications of surgical treatment**
 - **Treatment**: Antibiotics , Drainage: internal and external, **Pulmonary resection** (surgical treatment)
- 2- Bronchiectasis :
 - Present with : cough mostly in the morning. Hemoptysis.
 - Treatment : **Medical** (Resolve most cases) , **Surgical indications**
- 3- Tuberculosis : indications of surgery
- 4- Aspergillosis :
 - Especially in immuno-compromised individuals
 - Diagnosis : signs Hemoptysis. CT: Air-crescent
- 5- Hydatid cyst :
 - **Parasitic infestation by**: Echinococcus granulosus.
 - Liver is the most common organ affected followed by the lungs.
 - If multiple cysts are present in **multiple organs** surgery becomes impractical and **chemotherapy** is indicated

Infectious Lung Diseases

✧ Summary

<ul style="list-style-type: none"> • Benign • Malignant : primary & secondary lung carcinoma <p>1st: Primary lung carcinoma: most important risk factor is smoking</p> <p>1- NSCLC (Adenocarcinoma - squamous cell carcinoma - large cell carcinoma) 2- SCLC</p> <p>Differentiation between the two types is very important because the treatment approach is completely different for each type</p> <ul style="list-style-type: none"> ✧ Management depends on 1- stage 2-cell type 3-patient physical fitness ✧ Clinical features : 1- asymptomatic (accidentally on CXR) 2- Symptomatic : lung & general manifestations, surrounding structures, distal Para-neoplastic syndrome{PTH (hypercalcemia) , ADH (hyponatremia), ACTH (Cushing's syndrome), Hypertrophic pulmonary osteoarthropathy} <p>2nd : Secondary lung carcinoma: appear as solitary lung nodules</p>	<h2>Lung Tumors</h2>		
<p>mass lesions:</p> <ul style="list-style-type: none"> o Anterior mediastinum(5 T's) : Teratoma, Thyroid (retrosternal goiter), TB lymphadenitis, T-cell lymphoma, Thymoma o Middle Mediastinum(Cyst) : Pericardial cyst , Bronchogenic cyst o Posterior mediastinum: Neurogenic tumors (e.g. dumbbell tumor of neurofibroma) 	<h2>Mediastinum</h2>		
<p>Airways</p> <p>Congenital tracheal anomalies</p> <p>Tracheal stenosis:</p>	<p>Pleura</p> <p>Pleural effusion(fluid)</p> <p>Empyema(pus)</p> <p>Mesothelioma(rare cancer)</p> <p>Hemothorax(blood)</p> <p>Pneumothorax(air)</p>	<p>Chest Wall</p> <p>Deformities:</p> <p>Pectus excavatum: caved-in</p> <p>Pectus carniatum: (pigeon chest)</p> <p>Infections : (e.g. abscess, empyema, costochondritis...)</p> <p>Chest wall tumor: >benign, most common malignant lesions are metastases.</p>	<h2>Chest</h2>
<ul style="list-style-type: none"> ○ RTA (road traffic accidents) ○ Fracture ribs (simple/complicated) ○ Flail chest ○ Haemothorax ○ Pneumothorax ○ Lung contusion and Acute respiratory distress syndrome (ARDS) 			<h2>Trauma</h2>
<p>Sternotomy (sternum) Thoracotomy (ribs) Thoracoscopy (cam) tracheostomy (tube)</p>			<h2>Surgery</h2>

Thank You..

Done By :

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Sara Habis

Revised By:

Amjad Abalkhail



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