Radiology/ Dr. Abeer – Lecture 1: Chest Imaging Techniques I

A. Plain chest radiography:

- Routine study (PA= frontal) ± optional addition of Lat. View.
- Expiratory and supine film (hase base, ↑ cardiac shadow)
- Though CXR is the most commonly x-ray examination performed, it’s the most difficult to interpret.
- We have to follow problem oriented approach:
  (Ask about the abnormality and clinical finding)

How to read a CXR

1- Diaphragm
   - Upper surface should be clearly visualized from one costophrenic angle to another except at Ht. and mediastinum.
   - Rt. hemidiaphragm is 2.5 cm higher than Lt.

2- Heart
   - Position 1/3 to the Rt.
   - Size (C/T ratio < 50%).
   - Shape

3- Mediastinum:
   - Tracheal position (midline from medial ends of clavicle)
   - Outline (should clearly seen except at contact with Ht & diaph.)
   - Rt. Border (Rt. Sup. Border either straight; or slightly curved and emerge with Rt. Cardiac border, Lt. border is ill-defined above aortic nuckle.
   - Thymus seen in young children “sail shaped”.

4- Hilar region:
   - Pul. A, pul. V, main bronchi & hilar LN (normally too small to cast shadow).
   - Lt. hilum is slightly higher than Rt.
   - Check size and density.

5- Lung
   - Only marking seen (Bl. vessel, large br. Wall seen end on & inter lobar fissure (two layers of pleura) :
     - Determine lobar anatomy
     - Azygous F. seen in 1% of PA.
     - Horiz. F. only seen in frontal, form Rt.h-6th rib.
     - Oblique F. seen only in lat. View.
   - PA to assess zonal anatomy, Lat (↑ lucency downward dorsal spine)
     “Don’t mistake breast, nipple (5th ant. rib space), and hair for pulm. shadow”

6- Thoracic cage;
   - Bone (sternum, ribs, spine, clavicle and shoulder j)
   - Soft tissue (mastectomy)

Assess technique:

- Exposure factor
- Position of patient.
B. CT indications:
- Presence, extent & nature (med. LN enlargement in Ca & Lymphoma, diff. vascular from non-vascular, fat and wide mediastinum).
- Pulm. And pleural masses (shape, outline, wall and calcification)
- Bronchiectasis (presence, extent and severity)
- Clinical suspicion of intrathoracic path. + normal CXR (MG, pul. 2nd.)
- Pul. Embolism (Ct pulm. Angiography)
- Diffuse pul. Disease (Dx and extent)

Technical factors:
- 5-10 mm.
- ± IVCM.
- Lung, medias. And bone window & normal interpretation (BV, pleura and bronchi)

C. MRI
- Limited role in (lung, pleura and media).
- Ht and aorta
- Helpful in:
  - Sup. Sulcus T. (chest wall, spinal extension)
  - Neural t. (intraspinal extent)

D. US:
- Peripheral pleural lesion (effusion, mass)
- Dx biopsy
- Not central b., US waves will absorbe by air.
- Any mass in contact with chest wall.

E. Radionuclide lung scan:
- Ventilation (xenon-133, Xenon-127, Crypton-81m)
- Perfusion scan (99mTc)
- Pulm. Embolism (major indication)

F. PET:
- F-flourodeoxyglucose (FDG)
- Take-up (Ca. lung, 2ndary, active lymphatic tissue)
- Dx or staging Ca and lymphoma.
- Solitary mass (sensitive but cannot diff. neoplasm from inflammatory)

G. Pulmonary angiography: (DSA)
- Main indication prior to intervention
- Pulm. CT-angiography (Dx embolism, Dx congenital AVM)
Radiology/ Dr. Abeer – Lecture 2: Chest Imaging Techniques II

Disease of chest with normal CXR
2. Small lesions (<1cm, hidden areas as ribs, clavicles, behind H. & Diaph.)
3. Pulmonary emboli without infarction.
4. Infectious (atypical pneumonia, Miliary TB.)
5. Diffuse pulmonary dis.
6. Pleural abnormalities (Dry pleuricy, small pleural effusion)
7. Mediastinal masses.

Abnormal chest radiography

a) Silhouette sign:
   - Invaluable sign for localization of disease from CXR.
   - It means loss of cardiac, mediastinal (aorta), and diaphragmatic border when intra-thoracic lesion touching that border.

It has two important applications:
✓ Localization of lesion.
✓ Give Dx (consolidation, collapse), wedge shaped or lens shaped opacity has fade out margin so indicating dis. By silhouetting the cardiac or diaphragmatic border.

b) Radiological signs of lung diseases:
Categorize any abnormal intrapulmonary shadow in to one of the following:
   a. Air space filling shadow {transudative (pulm. oedema) or exudative (infection, infarction or hemorrhagic)}
   b. Collapse
   c. 3-Spherical shadow
   d. Linear shadow
   e. Wide spread small shadows

Signs of air-space filling
1. Ill-defined borders of pulmonary lesion except when it becomes in contact with fissure.
2. Air bronchogram.

Pulmonary oedema
a) Interstitial
   ➢ Septal lines
   ➢ Thickening of the fissures
   ➢ Pleural effusion.

b) Alveolar:
   ➢ all have interstitial
   ➢ Acute always
   ➢ Almost always bilateral, it involve all lobes
   ➢ Has appearance of batwings; maximal density close to hila & fade out peripherally.

Causes:
✓ Cardiogenic: acute H.F, MS, over transfusion.
✓ Non Cardiogenic: ARDS, Mandalson`s synd., inhalation of noxious gas
   pulmonary shadows become uniform over a period of days & eventually affect all parts equally
* Cardiogenic oedema appear & disappear radiologically within 24hr which virtually dx for cardiogenic oedema.
**Pulmonary consolidation:**

a) Lobar consolidation (strep. Pneumonia) which is virtually dx of bacterial pneumonia:
   - Homogenous opacity.
   - Air bronchogram.
   - Silhouette sign.

b) Patchy consolidation: One or more of ill-defined shadows:
   - Pneumonia
   - Infarction
   - Contusion
   - Immunological disorders.

**Cavitation (abscess formation) within consolidation: occur due to bacterial or fungal.**

This only recognized by communication with the bronchial tree (air fluid level).

**Pulmonary collapse**

**Definition:** Loss of volume of a lobe or lung.

**Causes**

I. **Bronchial obstruction:** The commoner cause of lobar collapse:
   1. Bronchial wall lesions:
      - I CA.
      - Rarely other bronchial tumours, carcinoids
      - Rarely endobronchial TB.
   2. Intraluminal occlusion:
      - mucus plugging: POP, Asthma, Unconscious, Artificial ventilation
      - Inhaled FB
   3. Invasion or compression by adjacent mass
      - Malignant tumour
      - Enlarged LN

II. **Pneumothorax or Pleural Effusion.**

NB: Sometimes it’s difficult to say that collapse is due to pleural effusion or whether both of them due to same process; ex. CA bronchus.

**Radiological Signs of Lobar Collapse:**

1- The Shadow of the collapsed lobe; consolidation almost invariably accompanies lobar collapse.

2- Displacement of the structures (Fissure, mediastinum & diaphragm).

3- Silhouette sign; it helps to Dx collapse & which lobe is collapsed.
   - Anteriorly located lobes (upper & middle), causing obliteration of the portions of the mediastinal & heart outline.
   - Lower lobes collapse, will obscure the outline of the adjacent diaphragm & descending aorta.

4- Indirect signs:
   - Compensatory emphysema: I.e. compensatory expansion of the unobstructed lobe(s) on the side of collapse.

5- Collapse of the whole lung → opaque hemithorax + substancial mediastinal & tracheal shift.

CT shows lobar collapse very well, but rarely necessary simply to dx collapse.

“Please; have a look to the .ppt file, for the x-rays as they cannot be printed”

“ 2 ”
Spherical pulmonary shadows (lung mass, lung nodule)

**Causes:**
1. Bronchial CA \ bronchial carcinoid.
2. Benign tumours of the lung; hamartoma (most common).
3. Infective granuloma; tuberculoma & fungal granuloma.
4. Metastasis.
5. Lung abscess.
6. Rarely rounded pneumonia.

Except for the abscess & pneumonia, others found incidentally in the CXR.

> 40 y + smoker → bronchial CA is the major consideration, but not if less than 30 y.

To decide the nature of the lesion, look for the following features:

1. Comparison with previous films (Growth Rate):
   - If the growth rate 18 month or more → benign tumor or inactive granuloma, if < 18 month → CA bronchial or metastasis.

2. Calcification:
   - Substantial Calcification, virtually rules out the dx of a malignant lesion.
   - Common in hamartoma, tuberculoma & fungal granuloma.
   - Uniform calcification, concentric ring calcification, popcorn calcification; whether seen on CXR or CT → bronchial CA can be excluded from the DDX.

3. Involvement of the adjacent chest wall:
   - Rib destruction → virtually dx of invasion by CA.
   - Pan Coast’s tumour → invade chest wall & ribs.
   - CT or bone scan for demonstration of bone invasion & on the top PET/CT.

4) Shape:
   - Irregular, lobulated, infiltrative, notched outline, even in small portion of around lesion → DX of primary CA should be considered.

5) Cavitation:
   - Center of mass → necrosis & coughed up → air seen within the mass → air- fluid level.
   - It’s almost always indicates significant lesion.
   - Very common (lung abscess), relatively common (Primary CA) & occasionally in metastasis (seq. cell CA).
   - Not occur → inactive granuloma & benign lesion.
   - S.T. very difficult to distinguish between lung abscess & cavitatory neoplasm; especially if walls are thin & smooth.
   - Irregular outer or inner walls → mostly CA.

6. Size:
   - > 4 cm + no calcification → nearly always; (Primary CA), lung abscess (cavitation), or rarely round pneumonia (clinical features).

7. Other lesion: Metastasis is the commonest cause.
Multiple pulmonary nodules:

1. Metastasis.
2. Hydatid cysts.
3. Abscess.
4. Fungal granuloma or tuberculomas.
5. Collagen vascular disease.

Line or band-like shadows:

All line shadows within the lung are abnormal except fissures & the walls of the large central bronchi.

1) Septal lines:
- Pulmonary septa; connective tissue planes containing lymph vessels; normally invisible; only thickened septa are visible:
  a. Kerley A lines: radiating towards the hila, not branching thinner than B.V. mid & upper zones.
  b. Kerley B lines: horizontal; not more than 2 cm & at the periphery, reaching the lung edge.

Causes:
- Pul. Odema.
- Lymphangitis CA.

2) Pleural pulmonary scars:
- Previous infection & infarction.
- Reaching the pleura + pleural thickening.

3) Linear (discoid) atelectasis:
- Due to hypoventilation: post-operative or post traumatic

4) Pleural edge in pneumothorax:
- || to the chest wall, no B.V. beyond it.

“Lots of illustrative x-rays are present in the PowerPoint file; Look at them please”
The pleura:

**Pleural effusion**: Transudate, exudate, blood, pus → same radiological appearance.

Early pleural effusion is seen by U/S.

A. **Free pleural effusion, assume two basic shapes:**
   1. Obliterates the costo phrenic angle, & then surrounds the lung, higher laterally than medially (meniscus sign).
   2. Sub pulmonary effusion → apparent elevation of the diaphragm & it will not run up the chest wall but, will take the shape of diaphragm.

   ✓ C.T. → Homogenous fluid density between the lung & chest wall, & in the dependent portion of the chest.
   ✓ N.B.: differentiate between Pleural effusion & ascites by collection of fluid outside diaphragm effusion while ascites seen posterior to diaphragm cover bare area.
   ✓ U\S: Dx & control of Pleural fluid aspiration

B. **Loculated Pleural effusion:**
   due to pleural adhesion & it’s a particular feature of empyema.
   1. Inter lobar fissure.
   2. Lateral chest wall.
   3. Sub pulmonary.
   ❖ N.B. loculated effusion may simulate lung tumor on CXR → C.T or U\S (near diaphragm or chest wall).

**Causes of pleural effusion:**

1) Infection:
   • Pneumonia → small pleural effusion.
   • Pneumonia + loculated effusion → empyema.
   • TB → effusion (may be → the only abnormally & may be large.
   • Subphrenic abscess → always cause effusion.

2) Malignant neoplasm → either pleural secondary deposits, which are usually not seen by CXR, occasionally seen as nodular thickening by U\S, CT, or MRI.
   ✓ Usually large.
   ✓ Or (primary CA) ex. CA bronchus or mesothelioma then other signs of primary T. seen.

3) Cardiac failure:
   ✓ Acute LVF → small bilateral pleural effusion.
   ✓ Long standing congestive failure → large bilateral, more at Rt. + change shape &\ or size of the Ht + pul. Oedema + pul. Venous Hypertension.

4) Pul. Infarction → small pleural effusion.

5) Collagen vascular disease → unilateral or bilateral.

6) Nephrotic syndrome, renal failure.

❖ Pleural thickening (fibrosis) → blunting of the costo phrenic angle, due to infection or hemorrhage
❖ Along lateral chest walls + calcification → asbestos exposure.
N.B. small pleural effusion difficult to differentiate from pleural thickening by CXR → U\S or CT.
**Pleural tumours**
- 2\textsuperscript{nd} deposits most common
- Primary mesothelioma $\rightarrow$ relatively uncommon.
- Pleural effusion that obscure the tumour. (CXR)
- Lobulated mass, based on pleura. (CXR)

**Pleural calcification:** Pleural irregular plaques of calcification &\ or pleural thickening.
- It’s either old haematoma or old empyema (usually T.B).
- *Bilateral pleural calcification with thickening often caused by asbestos exposure.*

**Pneumothorax:**
DX by CXR:
1. Pleural line forming the lung edge separated from the chest wall, mediastinum or diaphragm by air.
2. Absence of vessels shadows outside this line $\rightarrow$ this alone is insufficient evidence to DX as in emphysematous bullae.
   - Small Pneumothorax may be dx on expiratory film.
3. After DX of Pneumothorax $\rightarrow$ if it’s tension or not & this by:
   - Mediastinal shift.
   - Flat or inversion of the diaphragm.

**Causes of Pneumothorax:**
1. Majority occur in young people due to rupture of small blebs or bullae at the lung periphery.
2. Emphysema.
3. Trauma.
5. Pneumocystis carinii pneumonia.
6. Metastases (rarely).
   - Hydropneumothrax or Haemopneumothrax.

“ Lots of illustrative x-rays are present in the PowerPoint file; Look at them please ”
The Mediastinum:
For descriptive purpose; the mediastinum is divided into anterior, middle & posterior division. If mediastinal mass is diagnosed on frontal CXR → lateral CXR.

The value of CT & MRI over CXR:
- Cross sectional image
- Differentiate fat, various soft tissue & blood vessels.

In chest CT is superior to MRI except in:
1. Aneurysms & vascular anomalies, which need no CM.
2. Posterior mediastinum mass, it’s relation to spinal canal.

Mediastinal Masses in CXR:
1. Intrathorax thyroid goiters the most common cause of superior med. Widening.
   CXR Dx: mass extended from sup. Med. to neck.
   Almost invariably compress or displace trachea
2. Enlarged LN: the next common or frequent cause of med. Widening; could occur in any one of three compartments.
   DX CXR: lobulated outline.
   Multiple locations.
   DX: pressure erosion or deformity of adjacent ribs & thoracic spine.
5. Calcification occurs in many conditions but not in malignant lymphadenopathy.
   Calcification may have characteristics app.: (1) Aneurysm of aorta. (2) Egg shell.
6. H.H.; usually easy to dx on plain x-ray due to air or fluid level (best on lateral CXR).
7. Rt. cardiophrenic angle; nearly all benign: (Fat pad, pericardial cyst, hernia through foramen of Morgagni.

Pneumo mediastinum:
Provided air has not tracked into mediastinum from neck root, adjacent chest wall, or retroperitoneum, then comes from:
- Tear esophagus
- Tear bronchi
- Tear lung

Spontaneous or trauma (Endoscopy, FB)
Linear streaks of transradiancy extended to the neck root.

Hilar Enlargement:
1. Enlarged pulmonary arteries:
   A. Branching pattern.
   B. Usually bilateral + Ht size + enlarged MPA.
2. Enlarged hilar LN.:
   A. Lobulated outline.
   B. Unilateral or bilateral.
   C. Adjacent bronchi are normal or slightly narrowed.
**Unilateral enlargement of hilar LN**
- Metastasis; CA bronchus.
- Malignant lymphoma.
- Infection: TB (commonest cause of unilateral hilar LN enlargement \ child) or histoplasmosis.

**Bilateral enlargement of hilar LN:**
- sarcoidosis (Commonest symmetrical, enlarged LN, Rt. Paratrachel).
- Malignant lymphoma.
- Infection TB & fungal.

3. CA bronchus:
   - Hilar mass + lobar collapse \ consolidation or narrowing of adjacent bronchus is visible → DX of CA bronchus is virtual.

**Diaphragm:**

**Unilateral elevation:**
1) Loss of volume of the ipsilateral lung.
3) Subphrenic abscess.
4) Apparent elevation sub Pul. Effusion.
5) Marked elevation + no other visible abnormally → paralysis or eventration.

- Diaphragm paralysis due to disorder of phrenic nerve due CA bronchus, which showed paradoxical movement U\S or fluoroscopy during inspiration.
- Eventration of the diaphragm: congenital condition in which the mussels replaced by thin membranous sheet, except in neonatal period its symptom- less. When the whole hemi diaphragm is involved; it’s almost always the Lt - side, also show either no or paradoxical movement & if involve part of one hemi diaphragm → hump

**Chest wall:**
Should be examined for soft tissue swelling; and rib abnormally.
Oblique view should be obtained if rib abnormally is suspected because ribs are foreshortened in frontal view.

Soft T. swelling:
- #
- Infection.
- Neoplasm.

S.T. soft Tissue swelling is more obvious than the rib lesion → oblique or CT.

**Bacterial pneumonia:**
Common feature of all pneumonias is cellular exudate within the alveoli.
Pneumo coccal Pn. → Complete resolution.
TB. klebsiella, staph, anaerobic → cavitation .

The basic radiological features of Pn. are :
1. One or more areas of consolidations.
2. Consolidation may be accompanied by loss of volume of the affected lobe, particularly in child.
3. Cavitation.

- Pn. May be secondary to bronchial obstruction (major bronchus), CA being a common cause of obstruction.
Bronchial obstruction should always be considered in any Pt. presenting with consolidation of one or two lobes supplied by common bronchus (Rt Mid. & lower lobes), particularly if it associated with volume loss.

**CXR:**
- Ill-defined shadow, ranging from small to large with air bronchogram; involve one or more lobes → lobar pneumonia.
- The common infect. organism → lobar pneumonia → strept. pneumonia, while in pneumo coccal pneumonia → dense lobar consolidation + no loss of volume + pleural effusion.
- Patchy consolidations involve one or more lobes → broncho Pn. Staph., G negative bact. anaerobic bact., mycoplasma Pn.
- S.T. Difficult to differentiate Pn. From Pul. odema, or Pul. Infarction by CXR so depend on clinical feature.

**Viral & Mycoplasma Pneumonia (Atypical Pn.):**
Radiological abnormality may persist for many weeks after clinical recovery.

**CXR**
1. Wide spread ill-defined consolidation.
2. Loss of clarity of the vascular markings.
3. & \ or pleural effusion.

**DDx** Pul. Odema.

**Lung Abscess:**
Localized suppurative lesion of lung parenchyma.

Causes:
1. Aspiration of food or secretion; usually occur in the apical segment of lower lobes or posterior segment of upper lobes.
2. Infection beyond obstructing lesion.
3. Infected emboli.

**CXR \ Lung abscess**
1. Homogenous spherical shadow.
2. Central lucency within shadow (air).
3. Fluid level within shadow.

**DDx:** cavitary CA, cavitation with wegener’s granuloma.

**Pulmonary T.B.:**
1. Primary → 1\textsuperscript{st} infection with mycobacterium tuberculosis usually in child.
2. Post primary: reinfection in adult after developing relative immunity following the primary infection.

**Primary T.B.**

**CXR:**
1. Ghon focus: areas of consolidation develop at the lung periphery in the upper or mid zone.
2. Enlarged hilar LN.
   → Primary complex.
3. Pleural effusion; more often is the only abnormally.

Most of primary TB cases, the primary complex whether treated or not → heal with calcification which often remains visible throughout life.
Spread of infection:

a) Bronchial tree → bronchial Pn.
   - CXR patchy or lobar consolidation; involve one or more lobes + bilateral + freq. cavitation.

b) Blood → miliary T.B.
   - CXR → Miliary shadows + primary focus + pleural effusion.

Post primary T.B.

1. Usually confined to the upper posterior portions of the chest; apical & posterior segments of upper lobes & the apical segment of lower lobes.
2. Multiple small areas of consolidation & are often bilateral.
3. Occasionally lower or middle lobe broncho pneumonia
5. Healing by fibrosis + calcification, which may be seen with continuing activity.
6. Mediastinal & hilar LN, is a predominant or sole feature in non-Caucasians, not clear whether primary or post primary tuberculous.
7. Post primary T.B. may spread: (bronchopneumonia; Miliary T.B.)
8. Pleural effusions are frequent & often permanent pleural thickening which may calcify.
9. Tuberculoma: tuberculosis granuloma, most of them are inactive but viable bacilli may present even in calcified lesion.

CXR: spherical mass, < 3 cm with sharp defined margin, & partly calcified.

★ Mycetoma: fungal bull with old T.B. cavity due to colonization of the fungal aspergillus fumigatus. Mycetoma lies freely with the cavity & air seen between ball & the cavity. & usually surrounded by often evidence of old T.B. (fibrosis + calcification).

Is the disease active? By comparison of serial films over prolonged period are available. Valuable dx signs of activity:

1. Development of new lesions on serial films.
2. Cavitation.

N.B.: 
1. Present of calcification doesn’t exclude activity
2. The better defined the shadow & the greater the calcification → less likely to be active while ill-defined shadows → active.

Fungal & parasite

Fungal:
Aspergillus fumigatus: (Mycetoma; broncho Pn. (immunity); allergic broncho-Pul. Aspergillosis

Parasite; H.C.
- Echinococcus granulosus
- Single or multiple spherical shadows + very well-defined border.
- Rupture → abscess.

* Pneumonia in immune compromised patient → atypical Pn. Due to opportunistic infection: T.B., fungi, pneumocystis carinii.

Pneumocystis carinii → uniform wide spread Pul. Shadow in Pt. with AIDS.

DDx T.B. & Kaposi's sarcoma.

“ Lots of illustrative x-rays are present in the PowerPoint file; Look at them please ”

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Radiology/ Dr. Abeer – Lecture 6: Chest Imaging Techniques VI

**Sarcoidosis:**
Non-caseating granuloma disease, affecting many organs; lung, liver, spleen, LN, skin & bone. Radiological manifestations largely confined to the chest
A. Hilar (symmetrical & bilateral) & other mediastinal enlarged LN (Rt _ paratracheal).
   *DDx* lymphoma; the differentiating point is that in sarcoidosis LN enlargement never predominant in anterior mediastinal.
B. Reticulo nodular pulmonary shadowing: (10 % of Pt.). Mainly at upper & mid zone.

**Diffuse Pul. Fibrosis ; causes:**
1. Idiopathic Pul. Fibrosis or idiopathic fibrosing alveolitis.
2. Extrinsic allergic alveolitis.
4. Pneumoconiosis.
5. Sarcoidosis.
6. Drug - induced fibrosis.

**CXR:** haze shadow (base) → loss of clarity of B.V. → Ground glass.
Later: ill-defined nodular + connecting lines → honey comb app.
Marked decreased in lung vol.
- Pul. Fibrosis + substantial post or hilar mediastinal LN → sarcoidosis.
- Pul. Fibrosis + conglomerate masses in the mid & upper zones → pneumoconiosis.
- Pul. Fibrosis + bilateral pleural thickening + calcification → asbestosis.
- Pul. Fibrosis + past or present pleural effusion → Rh. Arthritis.

**Collagen vascular diseases:**

**Rheumatoid lung:**
- Pul. Fibrosis; DDx cryptogenic or idiopathic fibrosis alveolitis .
- Pleural effusion (most common finding).
- Rh. Nodular < 3 cm; &\ or cavitation → resolve.

**Asbestosis:**
1. Pleural thickening + calcification.
3. Malignant mesothelioma + CA bronchus.
Diseases of airways:

1. **Asthma**: usually normal CXR, S.T. air trapping the main purpose of CXR:
   b. Associated pneumonia.
   c. Exclude other causes of acute dyspnoea ex. Pul. Odema, pneumothorax, rarely tracheal obst.

2. **Bronchiolitis**: young children:
   - CXR: a. normal, b. hyperinflation of lung → low diaphragm & \ or areas of consolidation

3. **Acute bronchitis** → normal CXR unless complicated by pneumonia.

4. **Chronic obstructive airway diseases**:
   a. **Chronic bronchitis**: → normal
      → complications: Pn.; Emphysema; corpulmonale
   b. **Emphysema**:
      - CXR:
        i. Increased lung volume:
           - Over inflation (mid diaphragm below 7th rib anterior end or 12th rib posterior).
           - Flat diaphragm.
           - Elongated & narrowed Ht shadow.
        ii. Attenuation of the vessels:
           - ↓ Size & \ or bullae formation.
           - ↓ Number
   c. **Bronchiectasis**: causes:
      i. Childhood: Pul. Infection
      ii. Cystic fibrosis.
      iii. Long standing bronchial obst.
   - CXR;
     a) Dilated bronchi:
        * cyst
        * tubular shadows & \ or fluid level.
     b) Persistent consolidation.
     c) Volume loss is almost invariable.
     d) May be normal CXR.

**Cystic fibrosis**:
✓ Inherited disorder of the exocrine glands → secretion of viscid mucus → blocked small airways + secondary infection.
✓ High NaCl in sweat is Dx.
❖ CXR :
   1. Bronchiectasis maximum in upper zone.
   2. Small ill- defined consolidation maximum in upper zone & \ or cavitation.
   3. Evidence of airways obstruction: flat diaphragm; narrowed vertical Ht.
**Respiratory distress in new born:**

1) **Hyaline membrane disease:**
   - Premature infant
   - Deficiency of surfactant → alveoli collapse → no gas exchange.
   - **CXR:**
     a. *Mild:* Granular opacities, air bronchogram
     b. *Moderate:* Confluent opacities, air bronchogram

2) **Meconium aspiration:**
   - **CXR:**
     b. Air bronchogram is not obvious feature.
     c. Air way obstruction → low diaphragm.

**N.B. complication of therapy:** Pneumothorax, collapse, pneumo mediastinal

**Adult respiratory distress syndrome** = non cardiogenic Pul. Odema.

**Causes:**
1. Sever trauma.
2. Septicemia.
3. Hypotension.
4. Fat embolism.

**Pathophysiology:** extravasation of protienaceous fluid from Pul. capillaries to Pul. Interstitium & alveoli.

- **CXR:**
  - Normal up to 12 - 24 hour.
  - Wide spread Pul. Shadowing (similar to cardiogenic Pul. Odema).
  - More wide spread & more uniform over the ensuring 24 - 48 hours.

**Complication of therapy:** Pneumothorax, Pneumo mediastinal

**Pulmonary emboli & infarction:**
- From DVT \ legs & pelvis.
- Bed ridden: major surgery; Ht - disease.

- **CXR:**
  i. Normal even with massive Pul. Embolism.
  ii. Wedge shaped pleural based consolidation + pleural effusion.
  iii. Linear atelectasis.

**Radionuclide lung scan**

**CT Pul. Angiography**
Chest trauma:

A. Rib fracture:
   ✓ Often invisible in the standard projections, esp. if below the diaphragm.
   ✓ Extra pleural soft tissue swelling → may guide towards the site of fracture.
   ✓ Frequently are multiple & result in flail segment
   ✓ Often bloody pleural effusion accompanies rib fracture.

B. Pneumothorax:
   ❖ Occurs due to lung injury:
      • Direct injury
      • Sharp edge of fractured rib
   ❖ Air - fluid level is common finding in such situation due to associated hemorrhage (Haemo Pneumothorax).

C. Surgical emphysema of the chest wall, due to injury of lung, presence of pneumo mediastinal in absence of surgical emphysema of the chest wall, → unusual phenomenon of rupture bronchus.

D. Pulmonary contusion: localized traumatic alveolar heamorrhage & odema may occur + \ - rib fracture → Pul. Consolidation shadow.

E. ARDS:
   ✓ May occur after any sever trauma to any part of the body.
   ✓ Fat embolism is a specific subtype of ARDS.

F. Rupture diaphragm:
   • Direct injury or abd. compression
   • Lt. > Rt.
   • Herniation of stomach, S.I
   • CXR: invisible; ruptured hemi diaphragm + stomach gas & small intestine above the presumed position.
   • Ba meal & follow through may be needed to establish the Dx.
   • Tear of diaphragm itself seen only by U/S, but sometime difficult even by expert hand

G. Rupture of aorta: due to rapid deceleration injury; at site of ligamentum arteriosum.
   CXR: mediastinal widening with is nonspecific.
   DSA or CT angiography is indicated in patients in whom chest CT showed hemorrhage within mediastinum because mediastinal hemorrhage could be due venous bleeding, which doesn’t require emergency surgery & this can cause mediastinal widening.

H. Rupture of tracheobronchial tree: only in major chest trauma.
   CXR: pneumo mediastinal or Pneumothorax that dosen’t response to chest tube suction . Main complication: subsequent broncho-stenosis.
**CA bronchus:** One of the most common primary malignant tumours, clear association with cigarette smoking.

**Radiological signs of central tumour:**
1. Tumour itself → hilar mass & \ or narrowing of adjacent major bronchus.
2. Collapse consolidation of the lung beyond the tumour.

**Radiological signs of peripheral tumour:**
1. The peripheral tumour → solitary pulmonary nodule.
2. < 1cm unable be seen by CXR, but few mm could be seen by CT.
3. Rounded shadow, with irregular border or lobulated, or notched or infiltrated edge.
   ❖ Cavitation usually occur seq. cell CA, usually thick & irregular walls but thin-walled smooth cavities could occur with CA.

**Spread of CA bronchus:**
Mainly by (chest & upper abd. CT.)
1. Lymphatic spread → hilar & mediastinal LN enlargement:
   ✓ Mainly to hilar & Rt-Para tracheal, sub carinal LN.
   ✓ Enlarged LN not necessarily mean metastasis, but reactive hyperplasia to tumour or associated infection, or could be due to previous granulomatous infection, sarcoidosis, coal workers pneumoconiosis.
   ✓ LN < 1cm → normal.
   ✓ LN 1- 2 cm → require biopsy prior to surgical resection of primary tumour.
   ✓ LN > 2cm → almost invariably contain metastasis CA.
2. Pleural effusion:
   ✓ Malignant involve of pleura.
   ✓ Secondary to associated lung infection.
   ✓ Coincidental as Ht failure.
3. Mediastinal invasion:
   ✓ **CXR:** widening mediastium & elevation of hemi diaphragm (phrenic nerve involvement)
   ✓ **CT** will accurately show mediastinal widening.
4. Invasion of chest wall:
   ✓ **CXR:** rib destruction adjacent to Pul. Shadow → virtually dx of CA bronchus with chest wall invasion.
   ✓ **CT:** can show rib destruction which not visible at CXR.
   ✓ **MRI** has particular role in pan coast T.
5. Blood Spread (distant meta; adrenal, liver, brain, lung, skin).

**Lymphangitis carcinomatasis:**
Due to block of pulmonary lymphatic by CA tissue.
❖ **CXR:** similar to interstitial pulmonary odema (Septal lines, loss of clarity of B.V. & peri bronchus thickening) + normal Ht size + hilar LN enlarged .the clinical history very important as in Pul. Odema; sudden SOB, while in lymph. CA slowly ↑ SOB over the preceding weeks or months.
❖ **CA lung, breast, abdomen (pancreas, colon)**
Metastatic neoplasm:
1. Pulmonary metastasis:
   • Multiple + variable size + well defined spherical shadows, though irregular outline could be seen
   • CXR >= 1cm, CT 3 - 6 mm.
3. Rib metastasis:
   • CA bronchus, breast, thyroid, kidney & prostate all except breast & prostate are exclusively osteolytic.
   • See the upper cortex of the rib, & not the lower because these are ill-defined even in normal.
   & see at the edge of the chest.
   • Look for soft tissue swelling.

Lymphoma:
   a. Hilar & mediastinal LN enlarged.
   b. Pleural effusion.
   e. Pleural masses are rare.
   f. a. & e. → Intra thoracic malignant lymphoma.

Mammography:
X-ray examination of the breast.
Normal mammography shows the ductal & connective tissue on background of fat.
With an increasing age, the glandular tissue will decrease & the CA becomes easier to detect.

Cardinal signs of CA:
   ✓ Mass with irregular or spiculated border.
   ✓ Malignant micro calcification: clustered, fine linear or irregular calcification.
   ✓ Distorted breast stroma & skin thickening.

Benign masses: spherical well defined border, with larger courser & often ring-like calcification

U/S: diff. solid & cystic masses. & if solid (benign or malig.)

Breast screening.

" Lots of illustrative x-rays are present in the PowerPoint file; Look at them please "

" 6 "