Chest Radiography
Diagnostic value and interpretation

Imaging modalities
- Conventional X-ray & Tomography
- Computed tomography
- Radionuclide imaging
- Magnetic resonance imaging
- Angiography conventional, CT, MRI
- Interventional techniques

Value of chest radiograph
- Simple
- Low cost
- Sensitive
- Excellent resolution

Criteria of optimal chest X-ray
- Positioning
- Tube – Film distance
- Inspiration
- Adequate penetration

Frontal X-ray Chest
- Adequate penetration of the chest by selecting the suitable dose of radiation is required to obtain a good radiograph.
- The thoracic disc spaces should be barely visible through the heart but not the bony details of the spine = optimal exposure.
- Penetration should be sufficient so that broncho-vascular structures can be seen through the heart.
**Lateral X-ray Chest**
Proper penetration and inspiration is insured by observing that the spine appears to be darken as you move caudally. This is due to more air in lung in the lower lobes and less chest wall.

![Normal](image1)

![Lesion](image2)

Lesion in the left lower lobe projected on the spine in the lateral view with consequent more opacity superimposed on the lower dorsal spine

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**How to interpret a Chest X-Ray ?!**

- Ensure optimal quality radiograph
- Patient Data and previous films should be available
- Then evaluate the followings:
  - Lung parenchyma
  - Mediastinum
  - Pleura and chest wall
  - Cardiac shadow
  - Chest tubes

**Radiographic signs and terminology**

- 6 radiographic tumor are commonly used
- Silhouette sign
- Air bronchogram
- Nodule
- Mass
- Patchy opacity
- Cavitary lesion
- Infiltrations
Nodule = well defined lesion less than 3 cm in diameter
Mass = well defined lesion more than 3 cm in diameter
Patch = ill-defined lesion showing air bronchogram
Cavity = well defined lesion containing air either totally or partially

Air bronchogram:
Patent bronchi containing air on the background of opacified lung = consolidation = replacement of air in the alveoli by one of the following materials:
- Fluid in cases of pulmonary edema
- Exudate in cases of pneumonia
- Blood in cases of hemorrhagic pulmonary diseases
- Tumor cells in cases of alveolar cell carcinoma
- Proteins in cases of alveolar proteinosis

Silhouette sign
When there is an opacity in the lung adjacent to the cardiac border, if the cardiac border is masked by the opacity = silhouette +ve which means that the opacity is located anteriorly because the heart is an anterior structure.
If the opacity did not affect the definition of the cardiac border = silhouette –ve which means that the opacity is posteriorly located.
How to interpret the chest X-rays?

Try to discriminate between:
Focal lung lesion = single or multiple pulmonary lesions with clear lung in between
Diffuse lung parenchyma = most of the lung parenchyma in both sides is infiltrated by lesions

4 types of focal lesions
- Nodules
- Masses
- Patches
- Cavities

Nodules 3cm or less  6 common
- Tuberculoma
- Hamartoma
- Bronchogenic carcinoma.
- Metastases
- AVM [arteriovenous malformation]
- Hydatid cyst

Multiple pulmonary metastatic deposits
**NB** Nodule with smooth edge and internal calcification = benign nodule eg Tuberculoma and hamartoma

**NB** Nodule with speculated margin (irregular margin) = malignant lesion (bronchogenic carcinoma)

- Tuberculoma is usually single less than 3cm with smooth edge and may calcify,
- Hamartoma usually single, less than 3cm smooth edge, calcification are seen in 15%” Popcorn
• A nodule with vascular pedicle = nodule connected to the hilum of the lung by two lines representing the feeding artery and the draining vein = arteriovenous malformation = AVM
• A nodule that is containing water density is diagnostic of hydatid cyst

In this chest X-ray a suspected AVM is seen in the right lung base. Before the era of MDCT we used to introduce a catheter via the femoral vein → right atrium → right ventricle → pulmonary artery then we injected contrast material delineating the AVM and its feeding artery and draining vein as seen in the pulmonary angiogram.
The nodule seen in the chest X-ray is called indeterminate nodule because we do not know enough data about the edge, its content, calcification... So CT is needed to verify these information.

The CT scan of the same case showed a nodule with speculated margin diagnostic of bronchogenic carcinoma. Arrows in the same image point to metastatic deposits from the same lesion.

**Peripheral bronchogenic carcinoma**
- Solitary peripheral subpleural nodule of cases
- Upper lobe distribution in 70% of cases
- Speculated margin due to demoplastic reaction

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**Pulmonary mass** = well defined lesion more than 3cm in diameter

**Diagnostic possibilities include:**
- Bronchogenic Carcinoma
- Hydatid Cyst
- Metastatic deposit

CT is needed to show the contents of the lesion.
If cystic consider hydatid cyst.
If solid consider the other 2 possibilities which are either bronchogenic carcinoma or solitary metastatic deposit.
If the patient is known to have primary malignancy.
(Breast cancer, RCC...) then consider the possibility of a deposit. If not, then a solid mass in the lung of an adult should be considered as bronchogenic carcinoma until proved otherwise [whatever the appearance of the lesion smooth, lobulated, speculated and even if it contains calcium]

**NB** In cases of multiple pulmonary masses or nodules consider hydatid cysts and metastatic deposits. If the lesions are cystic in CT scan, then consider hydatid cysts. If solid, the diagnosis is metastatic deposits even in absence of a known primary malignancy.

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**Pulmonary patch** = ill-defined lesion with air bronchogram inside.

Pneumonia and infarction are patchy lesions showing air bronchogram.

Air bronchogram = air filled bronchi passing through opaque lung parenchyma, this indicates that the lesion is

- Pulmonary lesion
- Alveolar pathology
- Consolidation
**Pneumonia and infarction**

- The differentiation between pneumonia and infarction is based on the clinical findings rather than X ray or CT appearances.
- Both lesions almost have similar appearance in X rays and CT scan.
- One of the helpful CT findings is the detection of an embolus in the pulmonary artery, then the opacity in the ipsilateral lung will represent an infarct.
- Pleural effusion is present in both conditions.

![CT scan showing a filling defect (arrow) in the Rt pulmonary artery representing an embolus with bilateral pleural effusion more on the right side.](image1)

![CT scan showing a large left lung opacity with air Bronchogram which can present a pneumonic consolidation or an infarct.](image2)
Cavities
A cavity is a lesion that is partially or totally contains air
The differential diagnosis of a pulmonary cavity depends upon:
- Wall thickness
- Cavity contents:
  - Air
  - Air + fluid level
  - Air + soft tissue mass
  - Look for the table showing differential diagnosis

Thick – walled cavity containing air only

Cavitary neoplasm: A thick wall cavity with irregular inner margin in the right upper lobe

Chronic lung abscess: A thick wall cavity with smooth inner margin in the right lung base

Thin – walled cavity containing air only

Pneumatocele: thin wall cavity in the center of the right lower lung lobe

Emphysematous bullae: thin wall cavities that are peripherally located near the chest wall
A cavity with air-fluid level

Ruptured hydatid cyst with wavy air-fluid level. Arrow points to one of the daughter cysts floating on the fluid surface.

A cavity with air fluid level may represent an abscess or a ruptured hydatid cyst.
The surface of the fluid level in the abscess is straight.
The surface of the fluid level in the ruptured hydatid cyst is wavy due to the floating daughter cysts on the fluid surface.

A cavity with a mass inside:
Diagnostic possibilities include:
- Fungal ball
- Rupture hydatid cyst
- Necrotic tumor
- Blood clots

The most common intracavitary soft tissue mass is the fungal ball developing in a chronic lung cavity usually called mycetoma or asperigilloma.
**Cavitary Lesions**

**Contents**
- Air fluid level
  - Surface of the fluid level
    - Straight Abscess
    - Wavy Ruptured hydatid cyst
  - Air only
    - Wall thickness
      - Thick
        - Central in the lung Pneumatocele
      - Thin
        - Site
          - Peripheral near the chest wall Emphysematous bulla
          - Peripheral near the chest wall Chronic lung abscess
          - Peripheral near the chest wall Breakdown in a bronchogenic carcinoma
      - Site
        - Peripheral near the chest wall Emphysematous bulla
        - Peripheral near the chest wall Chronic lung abscess
        - Peripheral near the chest wall Breakdown in a bronchogenic carcinoma
- Inner margin of the cavity
  - Smooth
  - Irregular
    - Chronic lung abscess
    - Breakdown in a bronchogenic carcinoma