

# 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.

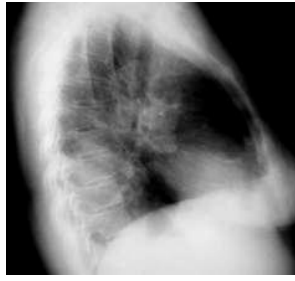


### **Lateral X-ray Chest**

Proper penetration and inspiration is insured by observing that the spine appears to be darkened as you move caudally. This is due to more air in lung in the lower lobes and less chest wall.



Normal



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



### **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



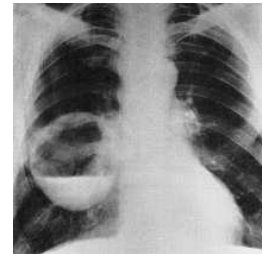
Rt lower lobe pulmonary nodule



Rt lower lobe mass



Middle lobe patch



Rt lower lobe cavitory lesion

**Nodule** = well defined lesion less than 3 cm in diameter

**Mass** = well defined lesion more than 3cm 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 back ground 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



Silhouette +ve

## 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



Focal lung lesion



Diffuse lung pathology

## 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)



Malignant nodule  
[speculated margin with no calcifications]

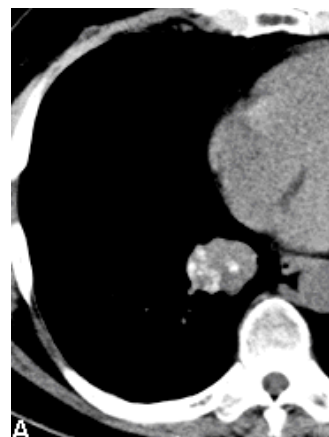


Benign nodule  
[smooth margin + matrix calcifications]

- ◆ 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"



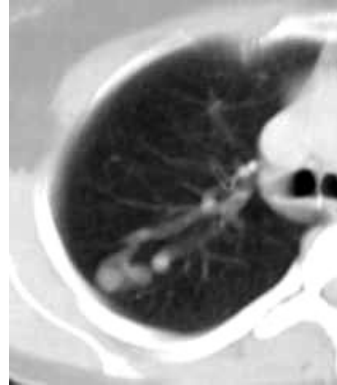
Tuberculoma



Hamartoma



Bilateral hydatid cysts



AVM

- ◆ 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

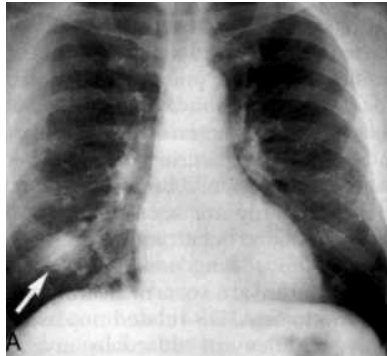


Chest X- ray



Pulmonary angiogram

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

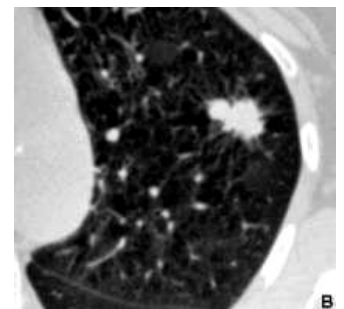


The nodule seen in the chest X ray is called indeterminate nodule because we do not know enough data about the edge, its content, calcification,.. So CT is needed to verify these information

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



Left sided peripheral bronchogenic carcinoma

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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



Pulmonary mass in the Rt lung base

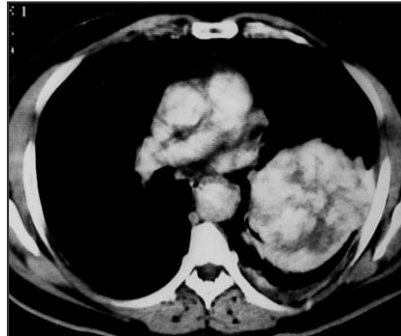
(Breast cancer, RCC,..) then consider the possibility of a deposit. If not, then a solid mass in the lung of an adult should be considered as bronchogenic carcinoma until proved otherwise [whatever the appearance of the lesion smooth, lobulated, speculated and even if it contains calcium]

**NB** In cases of multiple pulmonary masses or nodules consider hydatid cysts and metastatic deposits

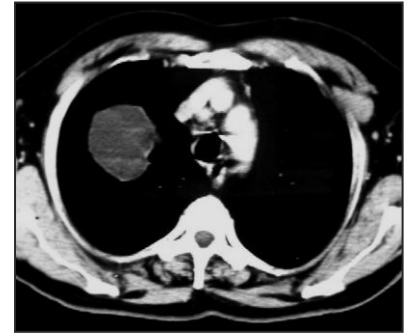
If the lesions are cystic in CT scan, then consider hydatid cysts. If solid, the diagnosis is metastatic deposits even in absence of a known primary malignancy



Multiple pulmonary masses



Bronchogenic carcinoma:  
Left lung solid mass with  
central calcification



Hydatid cyst: cystic lesion  
with water contents in the  
right lung

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

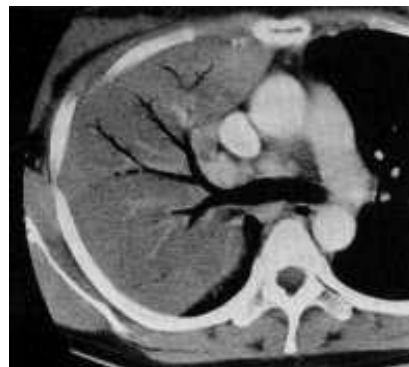
Pneumonia and infarction are patchy lesions showing air bronchogram

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

- ◆ Pulmonary lesion
- ◆ Alveolar pathology
- ◆ Consolidation



X- ray of consolidation  
with air bronchogram

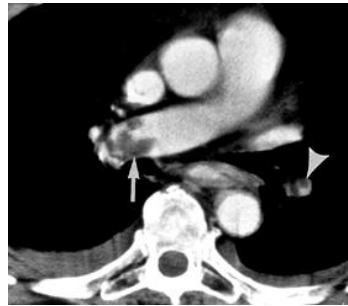


CT of consolidation with  
air bronchogram



## **Pneumonia and infarction**

- The differentiation between pneumonia and Infarction is based on the clinical findings rather than X ray or CT appearances
- Both lesion almost have similar appearance in X rays and CT scan
- One of the helpful CT finding 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.



CT scan showing a large left lung opacity with air Bronchogram which can present a pneumonic consolidation or an infarct

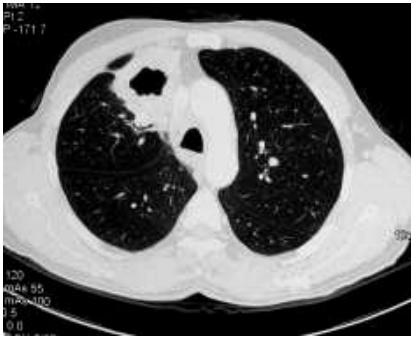
## Cavities

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

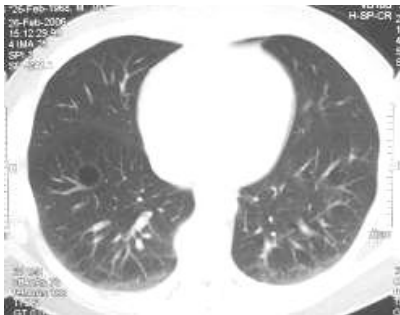


Cavitary neoplasm: A thick wall cavity with irregular inner margin in the right upper lobe



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

