

Respiratory System

Methods of investigations:

1. Plain films (Chest X-Ray).
2. CT scanning.
3. Ultrasound.
4. Radionuclide studies.--- Perfusion & ventilation scans.
5. Pulmonary angiography---- Conventional & CT angiography.
6. Needle guided aspiration.
7. Others (MRI, fluoroscopy, , bronchography, Ba studies----etc)

Computed tomography:(CT)

Advantages ??

1. Compared to conventional radiograph the range of density recorded is increased approximately to 10-fold. (conventional radiograph—4 basic densities). (wide window range).
2. Absorption values (Hounsfield Units--- HU)
3. Sectional images----- compared to 2-dimensional conventional X-Ray.
4. CT is usually performed in axial planes, reconstructions in other planes is also possible.
5. High-Resolution CT (HRCT) ? . CT angiography ?

Disadvantages ??

High radiation dose (CT of the thorax capable of giving an effective dose 50—500 times higher than a conventional chest radiograph).

Indications of CT in chest disease ?

1. Showing the presence & extent of mediastinal masses & other mediastinal abnormalities,,,,, Can differential vascular mass (like aneurysm) from solid mass.
2. Presence & extent of chest wall & pleural pathology.
3. Ascertaining the solitary nature of a pulmonary nodule or detection of other unsuspected nodules
4. Contributing to the staging of lung cancer prior to treatment & monitoring of response. e.g. demonstrate enlarged lymph node.
5. Localizing a mass prior to biopsy----- CT guided biopsy .

6. Can confirm the extent & severity of diffuse pulmonary parenchymal pathology.---
- HRCT.
7. Demonstrating the presence of disease when plain radiograph is normal. e.g.
detecting pulmonary metastases or demonstrating thymic tumors in patients with
myasthenia gravis.
8. Diagnosing pulmonary emboli using the technique CT pulmonary angiography.

Ultrasound of the thorax :

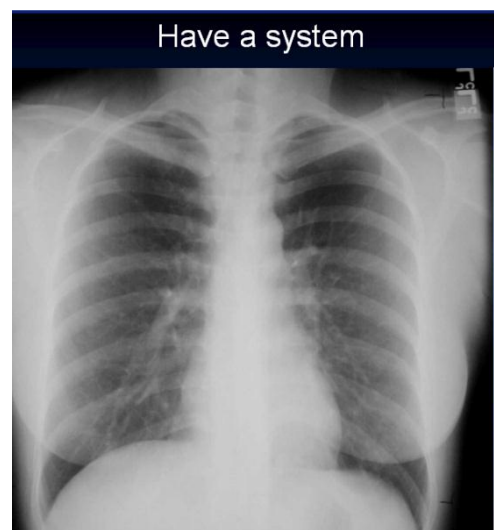
- ☐ Demonstration of process in contact with the chest wall, notably pleural effusion & pleural masses.
- ☐ Guiding a needle to sample /drain /biopsy / aspirate pleural fluid or masses in contact with chest wall.

Chest Radiograph (Chest X-Ray):

- Is the most requested radiological examination.
- The standard view is (Postero -Anterior " PA" view), lateral view should not be undertaken routinely.
- Additional views :
 - ☐ AP/supine.
 - ☐ Oblique.
 - ☐ Decubitus.
 - ☐ Lordotic / Apical .
 - ☐ Portable / Mobile radiograph .
- **Request form :** " name, age, sex, date, clinical informations , examination requested -views & provisional diagnosis " .

How to take a chest X-Ray ?

- Normal anatomical landmarks:



Viewing of the PA film : (interpretations Of PA chest film)

- 1 - Film labeling (side marks).
- 2 - Technical quality of the film.
- 3 - Structural & tissue components of the film.

1. Film labeling (side marks).

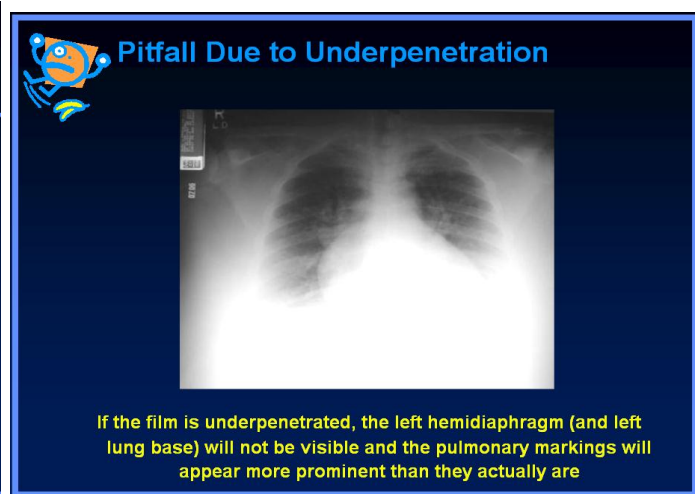
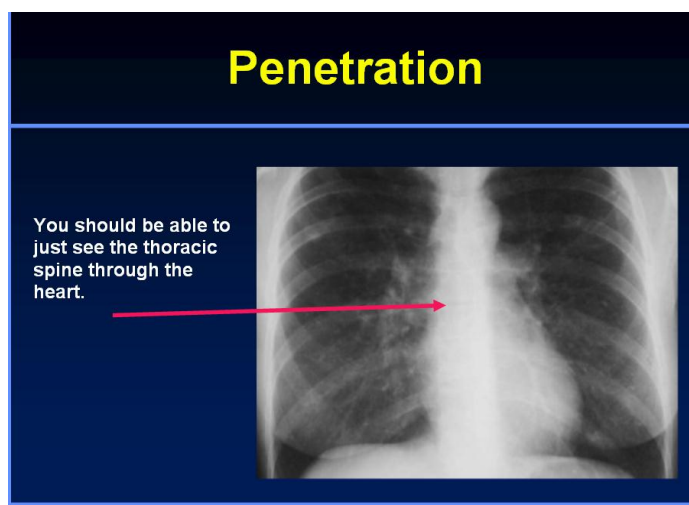
- Name .
- Date.
- Side (R----L).
- Additional marks (e.g. view , examiner & hospital name----etc.)

2. Technical quality of the film :

Factors to evaluate ?

- Penetration.
- Inspiration.
- Rotation.
- Angulations.
- Magnification (AP versus PA)
- Radiographic technique (Body habitus).

Penetration

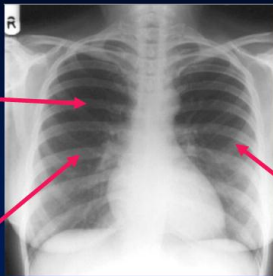


Inspiration

- About 10 posterior or 6 anterior ribs visible is an excellent inspiration.
- In many hospitalized patients 9 posterior or 5 anterior ribs is an adequate inspiration.
- At least 8-9 posterior ribs in difficult situations

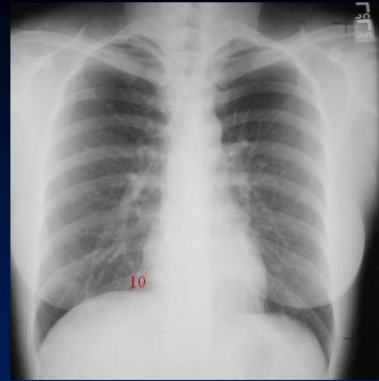
Anterior vs. Posterior Ribs

Posterior ribs are those that are most apparent on the chest x-ray. They run more or less horizontally.



Anterior ribs will be visible but are harder to see. They run more or less at a 45 degree angle downward toward the feet.

How to tell the difference between the anterior and the posterior ribs



Ten posterior ribs showing is an excellent inspiration



Pitfall Due to Poor Inspiration



About 8 posterior ribs are showing

Poor inspiration will crowd lung markings and make it appear as though the patient has airspace disease

Same patient



About 8 posterior ribs are showing



9-10 posterior ribs are showing

Better inspiration and the "disease" at the lung bases has cleared

Short of breath

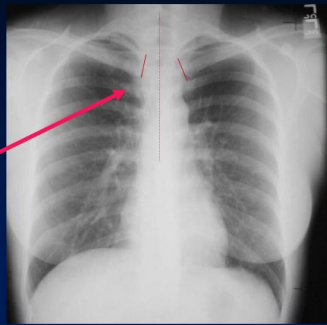


One minute later

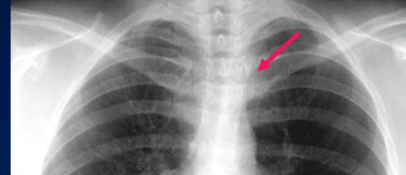
Rotation

Rotation

If the spinous process of the vertebral body is equidistant from the medial ends of each clavicle, there is no rotation

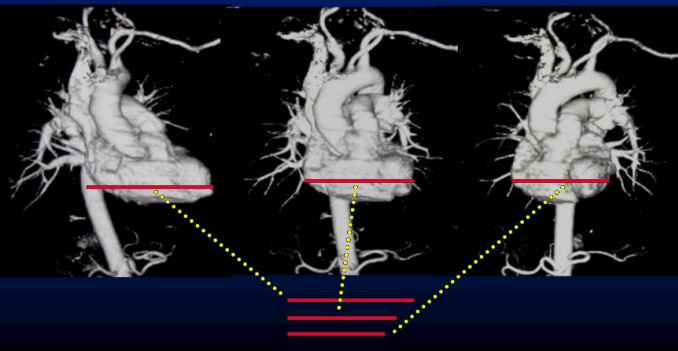


If spinous process appears closer to the right clavicle (red arrow), the patient is rotated toward their own left side ▲

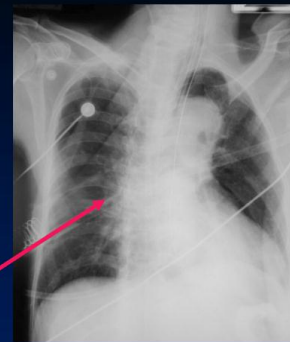


If spinous process appears closer to the left clavicle (red arrow), the patient is rotated toward their own right side ▲

Effect of obliquity on heart size



Pitfall Due to Marked Rotation



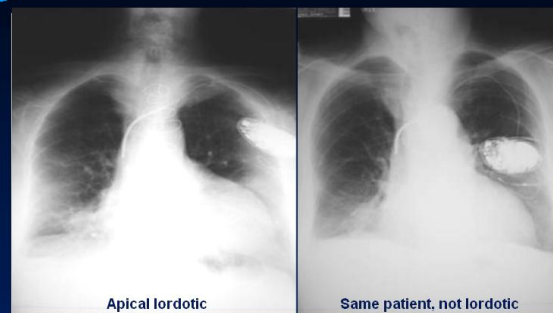
Severe rotation may make the pulmonary arteries appear larger on the side farther from the film

Angulation

Angulation

- If the x-ray beam is angled toward the head (mostly because the patient is semi-recumbent), the film so obtained is called an "apical lordotic" view
- Anterior structures (like the clavicles) will be projected higher on the film than posterior structures

Pitfall Due to Angulation

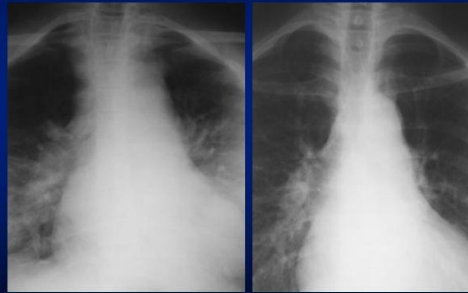


A film which is apical lordotic (beam is angled up toward head) will have an unusually shaped heart and the sharp border of the left hemidiaphragm will be absent

Technical Factors

- **Positioning**

- straight vs oblique
- PA vs AP
- erect vs supine
- lordotic vs kyphotic



Effect on mediastinal contour

AP versus PA Magnifications

AP versus PA The Effect of Magnification

- In a PA film, the heart is closer to the film and thus less magnified
 - The standard chest x-ray is a PA film
- In an AP film, the heart is farther from the film and is more magnified
 - Portable chest x-rays are almost always done AP

AP versus PA The Effect of Magnification



AP portable film makes the heart look larger than it does...



On this PA film done on the same patient an hour later

Body habitus - Radiographic technique

Technical Factors

Body habitus

Radiographic technique:

Is it really different?

Changing technique can make disease look better or worse.



Important Points

- The factors to evaluate the quality of a chest x-ray are:
 - Penetration – see spine through the heart
 - Inspiration – at least 8-9 posterior ribs
 - Rotation – spinous process between clavicles
 - Angulation – clavicle over 3rd rib

What is technically wrong with each of the following images?

What is most wrong with this image (check any that apply)?



- ☒ Penetration
- ☒ Inspiration
- ☒ Rotation
- ☒ Angulation

Go back

Go ahead

Correct

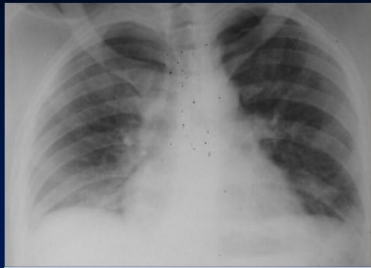


The image is apical lordotic-look at the high position of the clavicles. It is also underpenetrated. You can't tell if its rotated and the degree of inspiration is adequate.

Go back

Go ahead

What is wrong with this image (check any that apply)?



- ☒ Penetration
- ☒ Inspiration
- ☒ Rotation
- ☒ Angulation

Go back

Go ahead

Correct



The patient has taken a poor inspiration. He is also rotated toward his own right. It is slightly underpenetrated and he is not angulated.

Go back

Go ahead

What is wrong with this image (check any that apply)?



- ☒ Penetration
- ☒ Inspiration
- ☒ Rotation
- ☒ Angulation

Go back

Go ahead

Correct

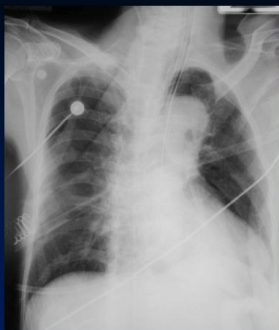


The film is underpenetrated. You can't see the heart through the spine. The degree of inspiration is probably adequate. Rotation can not be evaluated and there is a slight amount of angulation. Incidentally, there is a large bronchogenic ca in the left lung.

Go back

Go ahead

What is wrong with this image (check any that apply)?



- ☒ Penetration
- ☒ Inspiration
- ☒ Rotation
- ☒ Angulation

Go back

Go ahead

Correct



The primary technical problem here is the patient is rotated considerably toward her own left side. Notice how the hemidiaphragm appears elevated on the side to which the patient is rotated (red arrow).

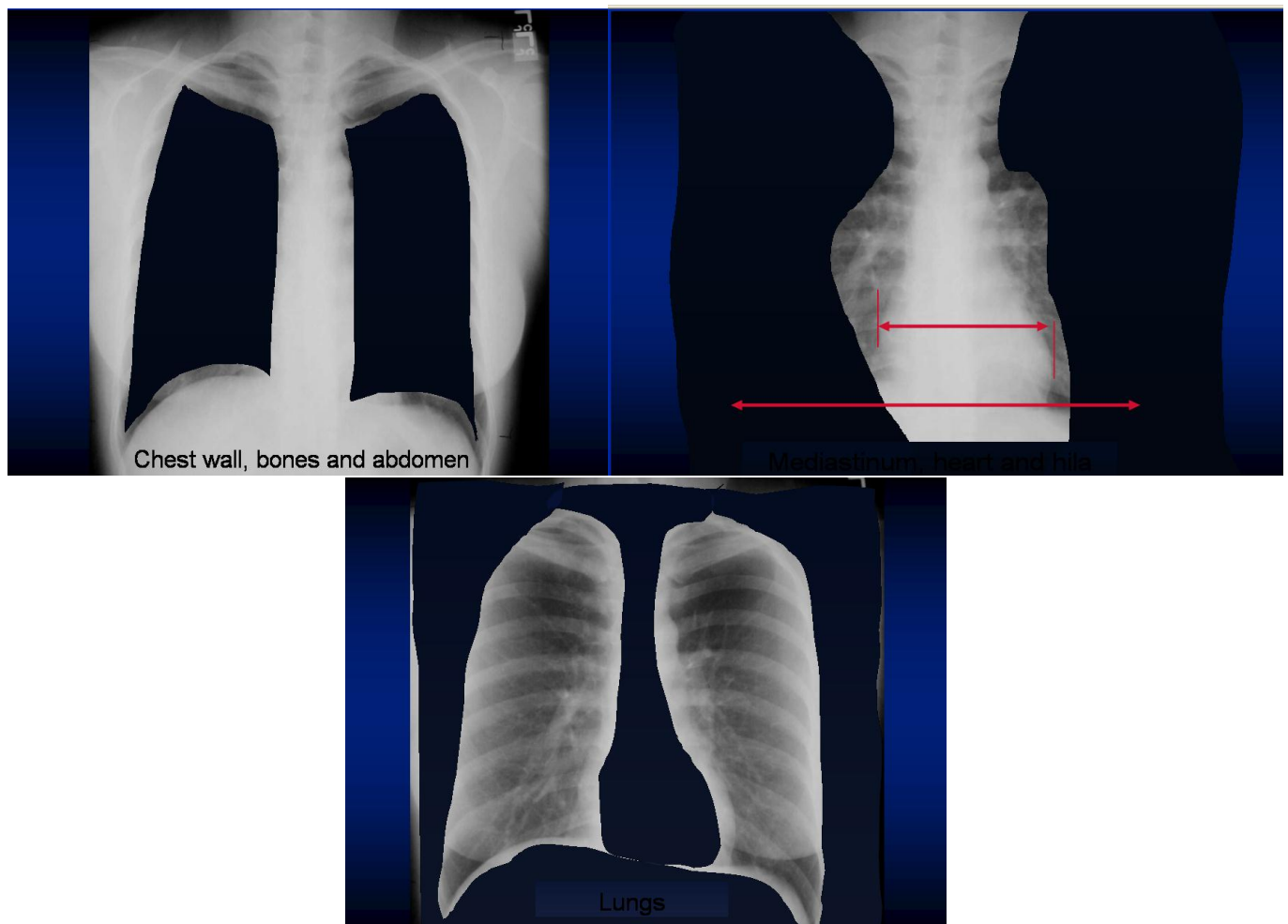
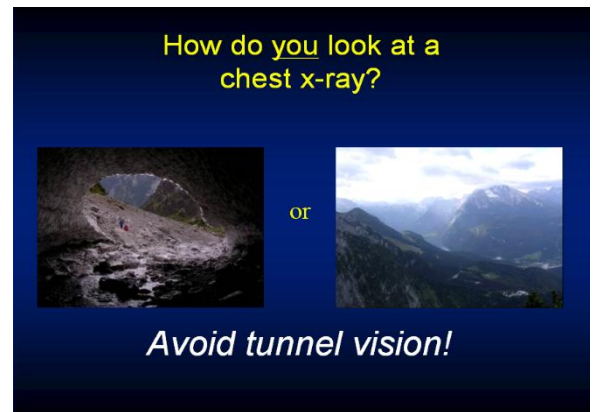
Go back

Go ahead

3- Structural & tissue components of the film .

1. Haphazard.
2. Systematic :
 - inner to outer
 - outer to inner
 - according to various tissue components.

Note if a pathology present describe it 1st .



Viewing of lateral film: (interpretation of lateral chest film)

1. The clear spaces (retrosternal & retrocardiac).
2. Vertebral translucency.
3. Diaphragm outline.
4. Sternum .

5. Complex hilar & mediastinal structures.(major vessels, heart)

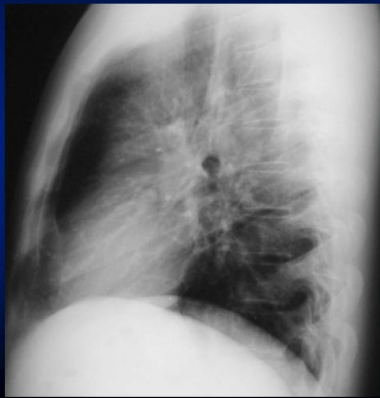
6. Trachea .

7. Fissure outlines .

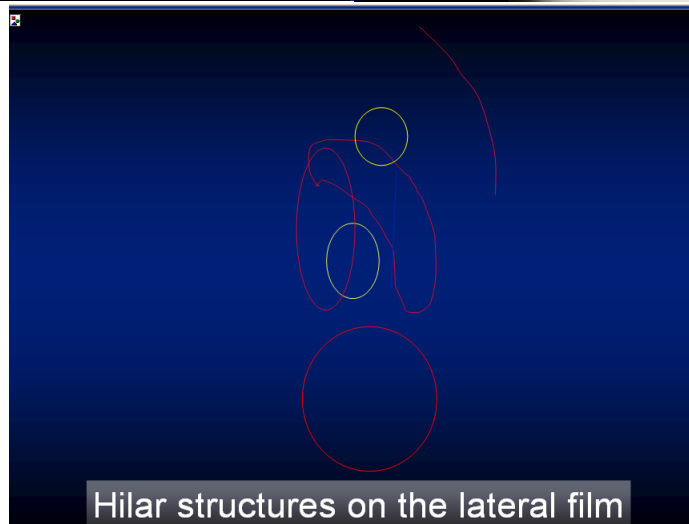
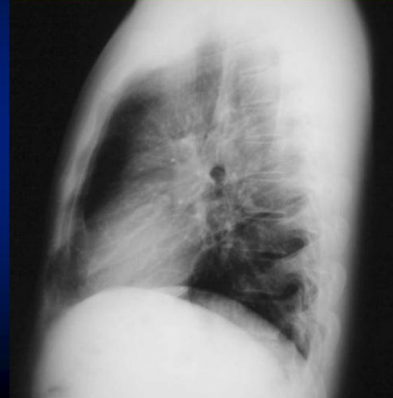
The Lateral Chest Film

Our best friend!

- Find abnormalities hidden on the frontal film
- Confirm abnormalities suspected from frontal film
- Don't be afraid to look at it!



Looking at the lateral CXR



Hilar structures on the lateral film

Diseases of the chest with a normal chest radiograph

1. Obstructive air ways diseases :Asthma & acute bronchitis may produce over inflation of the lungs, but in many cases the chest film is normal.
2. Small lesions :Its usually impossible to see solitary lung masses or consolidations of less than 1 cm in diameter
3. Pulmonary emboli without infarction, the chest radiograph is often normal.
4. Infections :Most patients with acute bacterial pneumonia present with recognizable consolidations, but in other infections, notably pneumocystic carinii pneumonia, obvious pulmonary consolidation may only develop after the onset of symptoms.

5. Diffuse lung diseases . May be responsible for substantial alternation in lung function test before any clear-cut abnormalities are evident on the chest radiograph.
6. Pleural abnormalities. Dry pleurisy does not produce any radiological findings and small amounts of pleural fluid may be impossible to recognize on standard PA and lateral chest films.
7. mediastinal masses. Plain chest radiograph is very insensitive for the diagnoses of mediastinal masses, lymph node enlargements,& mediastinal fluid collections.

