

432 Radiology Team



(5): Comprehensive Review of Chest Imaging Interpretation Skills

* Many thanks to 431 team for their helpful notes *



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COLOR GUIDE: • Females' Notes • Males' Notes • Important • Additional • 431 team

Objectives

1. Introduce the basic technical factors affecting image quality.
2. Recognize different terms “imaging vocabulary” utilized in interpretation.
3. Develop Interpretation Skills “Where to look & What to look for”.
4. Define the chest pattern of abnormality seen on the CXR.

Chest X-Ray Techniques

Introduction:

What is a good chest x-ray?

1. CXR with adequate **EXPOSURE**.
2. CXR with proper **POSITIONING**.
3. CXR with adequate **INSPIRATION**.

The basic technical factors affecting image quality:

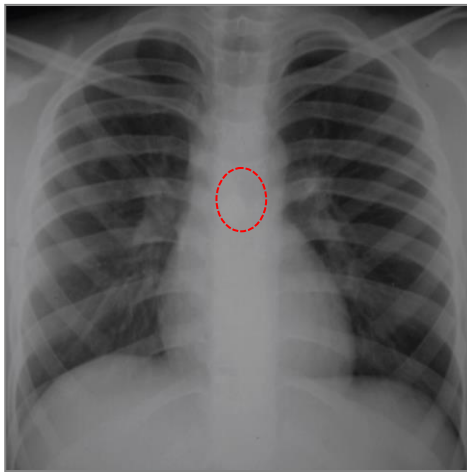
1. Exposure: "Exposure factor: The amount of x-ray photons that we will allow to expose the area we want to see" This is an x-ray of a patient who came to the ER with respiratory distress:

Note:

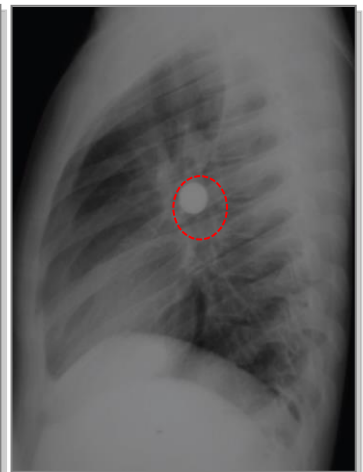
It is preferred to use PA for CXR because we can estimate the cardiac size on the PA better than the AP. NO magnification of the heart in PA.. Also the scapulae and clavicles' shadows will cover the lung in AP.



Inadequate exposure



Adequate exposure (Here we can see a foreign body in the esophagus)



* To say I have an adequate exposure I should see the structures through the cardiac shadow. (i.e. the spine should be visible)



Under exposure



Adequate exposure (I can see the heart, the vascular marking through the heart, and the spine through the heart)



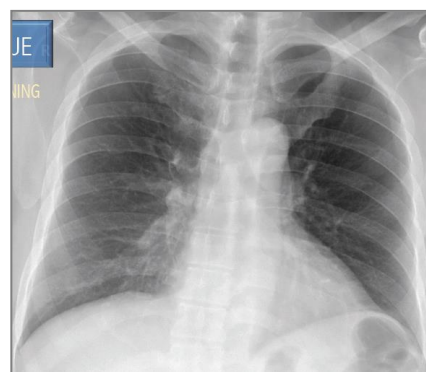
Over exposure (Over penetrated) (Burned Chest)

2. Positioning:

The lungs are air-containing structures, so they should be black in the x-ray.

In this x-ray we can see that the left lung is more black, which means there's more air there!

This can be a pathological condition (pneumothorax, emphysema) however it can also appear like that if the **patient is rotating**.



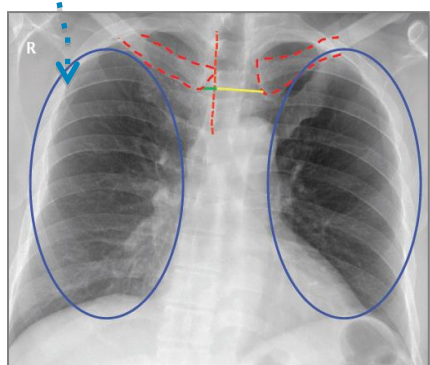
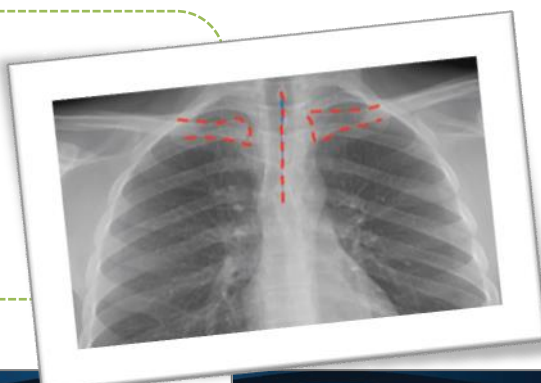
The lungs are asymmetrical (not equal in blackening)

How can we evaluate the central positioning

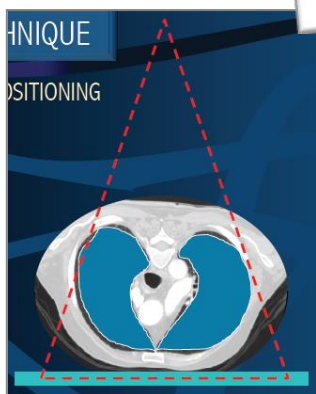
We measure from the medial end of the clavicles to the midline (spinous processes).

Left = Right → Patient is well centralized.

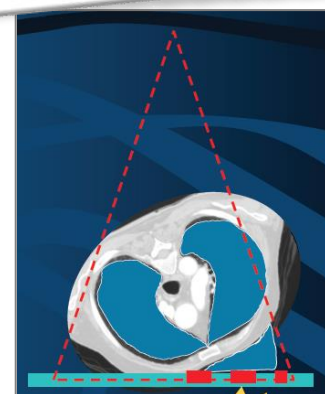
Left ≠ Right → Patient is rotated.



The right clavicle end is touching the midline, unlike the left one!



Uniform exposure. Centralized.



The gap is filled with air so the side away would be blacker; false impression of pathology.

3. Inspiration:

To assess the inspiratory effort of CXR, we ask the pt. to take a deep breath and then expose the lungs (we want the lungs to be well-aerated).

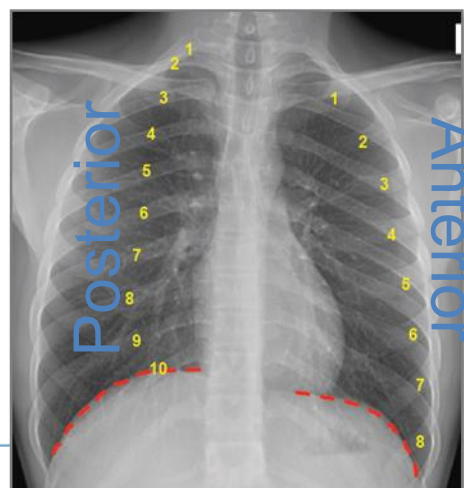
How can we evaluate inspiratory effort

We outline the dome of the diaphragm and then count the ribs above it either posterior or anterior.

Anterior → incline inferiorly toward the midline.

Posterior → horizontal or incline laterally.

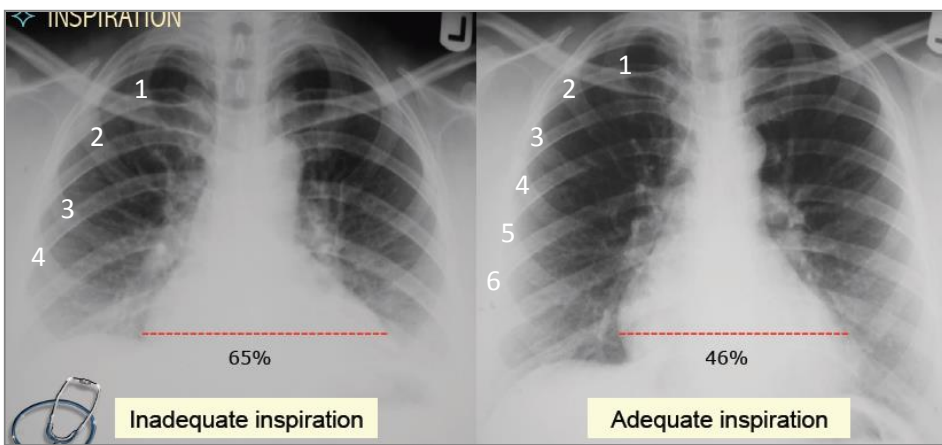
Normally: Ant. = 6-8 ribs Post. = 9-10 ribs.



Case: Patient came to the ER with coughing and shortness of breath.

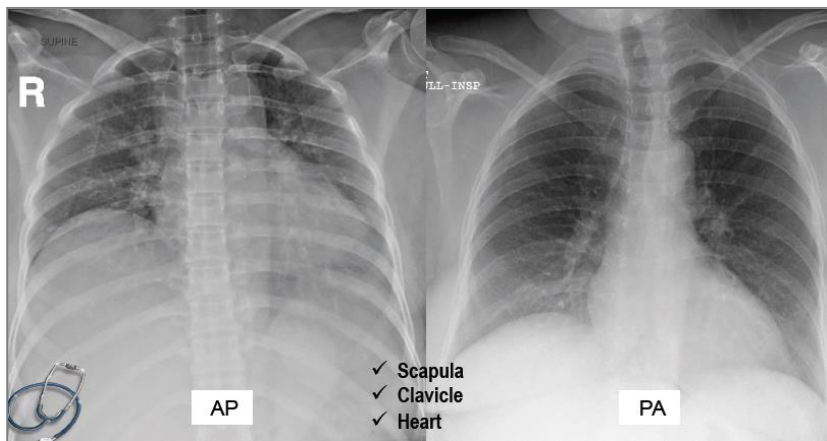
DDx: Pulmonary edema due to heart failure. His CXR: ???????????? :| ???

The ant. ribs above the dome are 4
 The heart looks bigger
 The margin of pulmonary artery looks hazy



The ant. ribs above the dome are 6
 The heart looks normal
 The margin of pulmonary artery looks sharp

Inadequate inspiration gives the impression of congested lungs!



Note:
 To assess if the heart is normal or abnormal:
 We measure the transverse diameter of the heart.
 If it's <50% → normal.
 >50% → enlarged heart

?

Some situations where x-ray should be taken at any possible position +/- inspiration:

- In the ICU the patient can't stand for an x-ray so I have to accept having an AP x-ray rather than PA while the patient is in a supine position.
- The x-ray of a patient with poor inspiratory effort will give the impression of early congestive failure; however, his presentation may not be compatible with such finding!

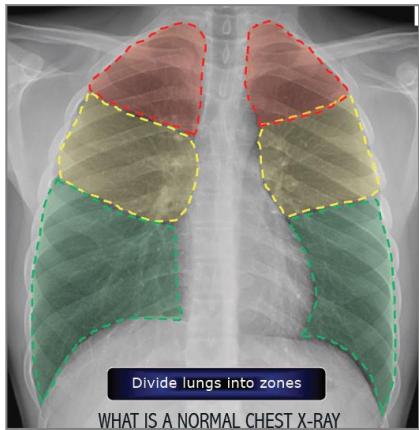
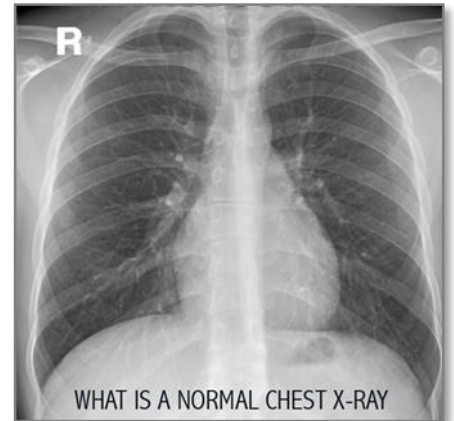
In those patients I will evaluate the lung for a **major pathology** only not a subtle one

Normal CXR:

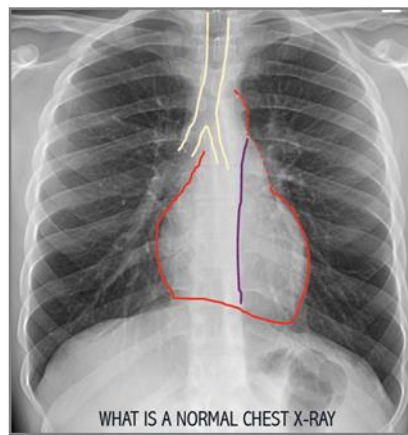
A normal CXR should show:

- **Symmetrical translucency** in both lungs.
- **White branching** structure (Vascular diffusion).
- **Homogeneous density** in the heart.

Remember!
Vessels are always white (visible in normal lungs.)
Bronchi are always black (invisible).

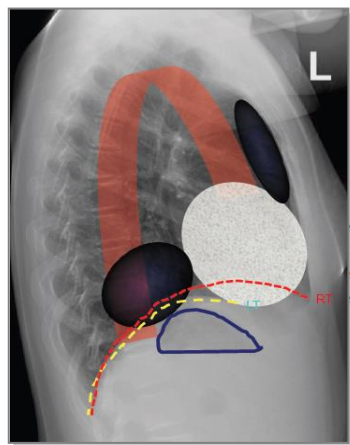


The lungs should be divided to three zones; to compare the right and left.



Note:

The heart on the left side has three curvatures (left atrium and left ventricle) while on the right side it has one (right atrium only).
** The most anterior chamber of the heart: right ventricle.*
** The most posterior: left atrium.*



Lateral CXR

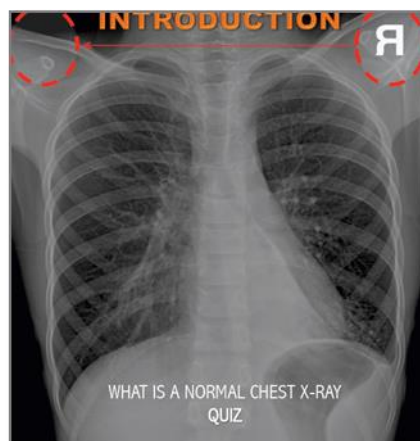
There's left and right diaphragm; left is only seen in the posterior two-third because the heart is sitting on it.

Gastric air bubble under diaphragm.

Two areas should look translucent normally

The lung should look blacker inferior????

- The problem is technical, the R (indicating right) should be on the other side
- This patient has Dextrocardia.
- Another finding is that the heart doesn't have homogeneous density
 → **May suggest collapse of the lower lobe.**

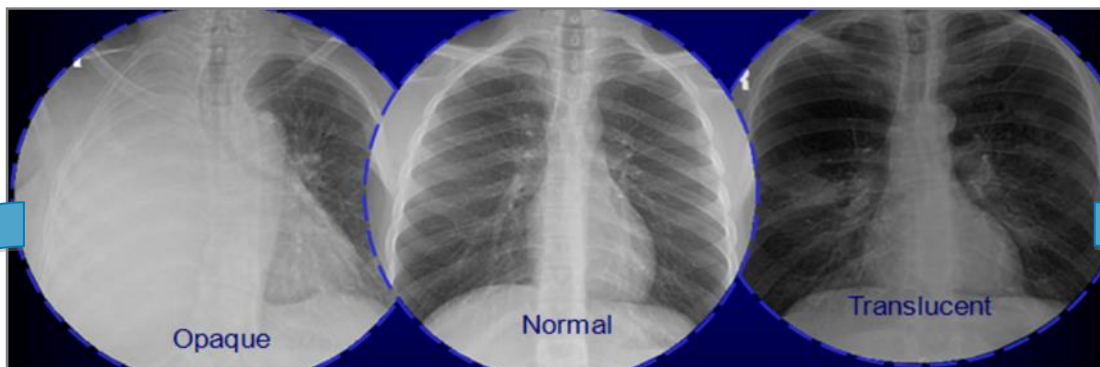


The correct image

Important Terms

1. Opaque Vs. Translucent (transparent).
2. Alveolar Vs. Interstitial.
3. Airbronchogram.
4. Silhouette Sign.

Opaque Vs. Translucent (Transparent)



DDx for Increased Density (Opaque):

- Chest wall: Mass lesion •
- Pleural: Pleural effusion •
- Lung: Consolidation/Collapse •
- Ageneis/pneumonectomy •
- Outside: Diaphragmatic Hernia •
- Congenital(total)abscess. •

DDx for Translucent (Transparent):

- Technique •
- Chest Wall (Mastectomy) •
- Pneumothorax •
- Emphysema •
- Hyperinflation of lung tissue. •
- Absent of soft tissue muscles. •

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1. Opaque:

- Condensed structured (thick structured) → e.g. bone
- The x-ray beam will hit that structure and will reflux back → won't pass through that structure → It will appear as white.

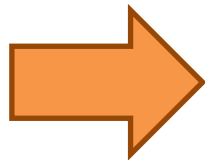
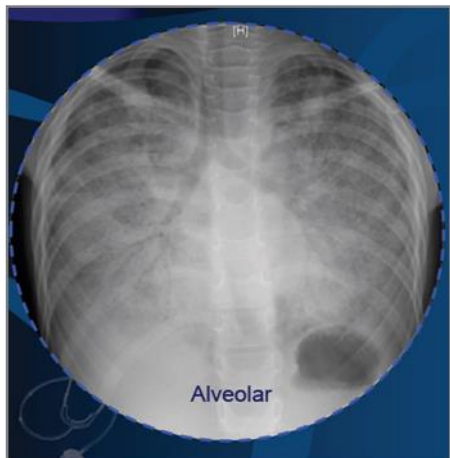
2. Translucent (transparent):

- Structures that contain air → e.g. lungs, bronchial tree, colon or bubbles within the abdomen.
- X-ray beam will transfer though that structure easily because of the presence of the air → Therefore, it will appear as black.
- Normal Lungs are always translucent (because they are filled with air).
- The more amount of x-ray interacting with the film, the darker it will appear.

3. Gray:

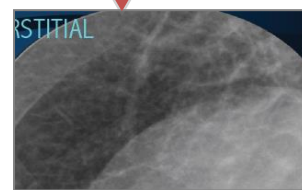
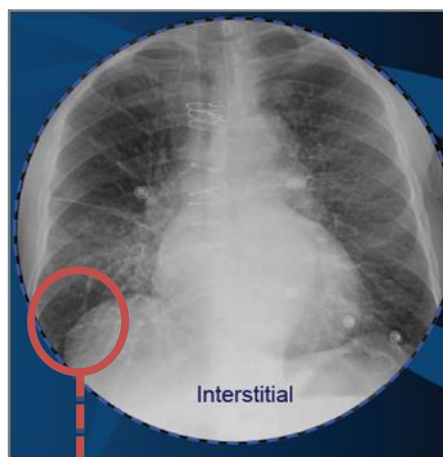
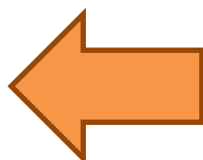
- Soft tissue → e.g. breast, muscles and heart.
- Have different thickness → therefore, you will see different densities gradients in between white and black (gray).

Alveolar Vs. Interstitial



- ❖ Alveolar
 - Pneumonia
 - Pulmonary edema
 - Pulmonary Hemorrhage
 - Alveolar cell carcinoma

interstitial
 Interstitial Pulmonary edema
 Interstitial Pneumonitis IPF
 Lymphangitis Carcinomatosis
 (Lymphatic spread of malignancy within the lung)



Reticulation "white lines"

* You should only see blood vessels lines that appears from hilum branching to periphery; but if something wrong happened to the interstitium there would be exaggerated white lines (linear densities.)

Pathology:

- ❖ Alveolar:
 - Obliterate ==> white (opaque) lung.
 - Called air space or alveolar sac diseases.
 - Examples: pneumonia, pulmonary edema, presence of blood in the lungs and presence of malignant cells.
 - If fluids entered the alveoli in cases such as CHF or the alveoli are filled with transudative or exudative fluids due to infections.
- ❖ Interstitial:
 - Thickening of the interstitial septa in between the alveolar sacs. (Lung appears black, with exaggerated interlacing reticular shadows)
 - Examples: early stage of pulmonary edema, interstitial edema, interstitial pulmonary fibrosis, lymphangitis carcinomatosis, idiopathic pulmonary fibrosis (IPF).

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Airbronchogram

(Alveolar or Airspace disease)

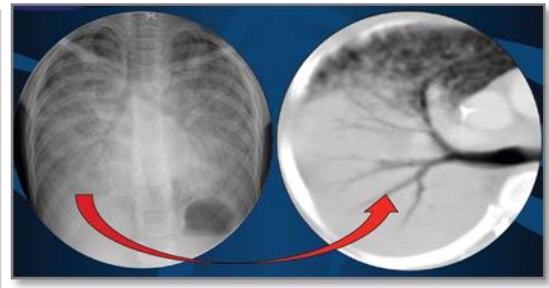
Airbronchogram: Drawing of the bronchial tree by air; you can't find it in normal lungs.



Normal lung should look black with black bronchial tree



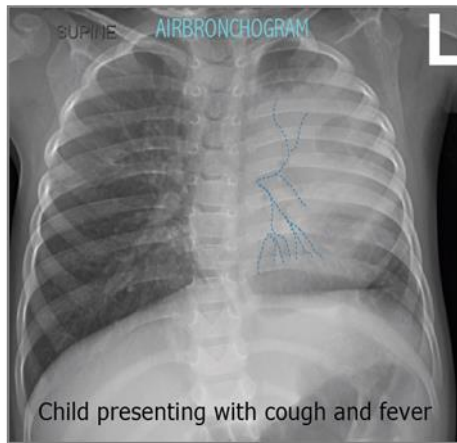
The air within the alveolar sacs is replaced with fluid so **the lung appears white**. (Airbronchogram)



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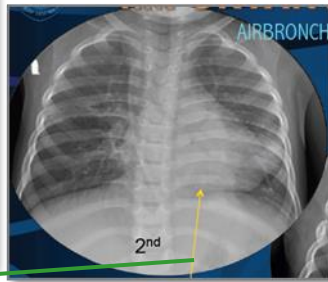
Note:

- o Whenever you see airbronchogram: it is lung parenchymal pathology with edema, hemorrhage or infection.
- o Note that the absence of airbronchogram indicate that the disease could be chest wall.

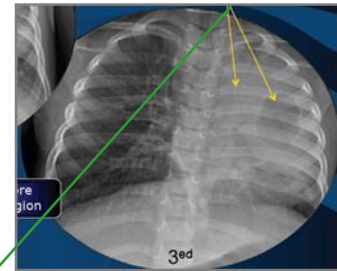


Case: Child presented with cough and fever.

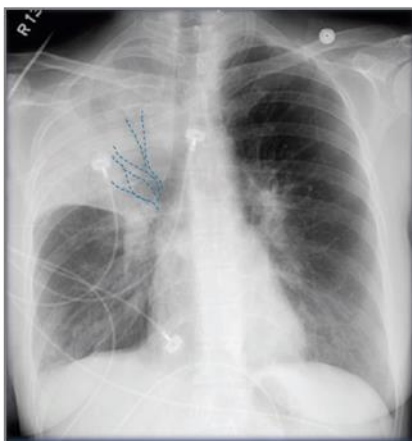
There are black lines (airbronchogram) it means consolidation not pleural space or chest wall.



Consolidation become more obvious in retro-cardiac region



Air-bronchogram is more clear here with development of cavitation



There's whitening in the upper zone with black branching (airbronchogram)

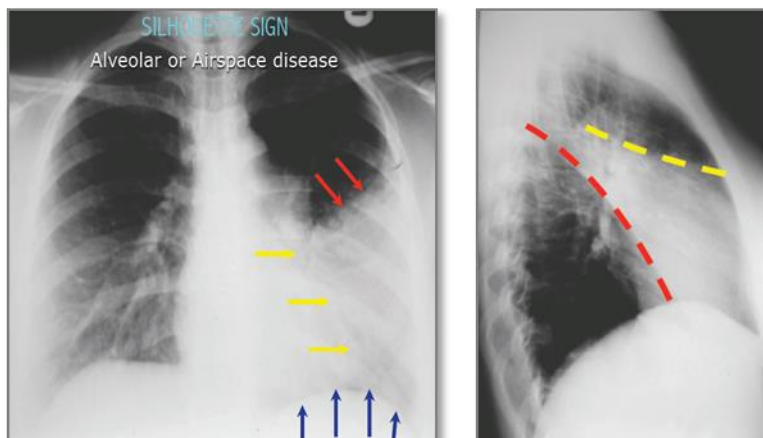
Two scenarios:

- Patient presents with cough and fever → Pneumonia.
- Patient comes after trauma (road traffic accident) with no cough nor fever → Blood within alveolar sacs.

Silhouette Sign

(Alveolar or Airspace disease)

Silhouette sign: If two objects of the same radiographic density touch each other, the edge or the margin between them disappears.



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- In the radiograph: left lung: 1. Obliterated heart line 2. Diaphragm line is clear. So it's **consolidation**, not pleural effusion (In case of pleural effusion, fluid will be in the **base of the lung so it will also obliterate the diaphragm**)
- If the white shadow obliterates the cardiac border, it's adjacent to the heart. If it obliterates the hemidiaphragm, it's adjacent to the hemidiaphragm.
- This helps in: Localizing the pathology.

Interpretation:

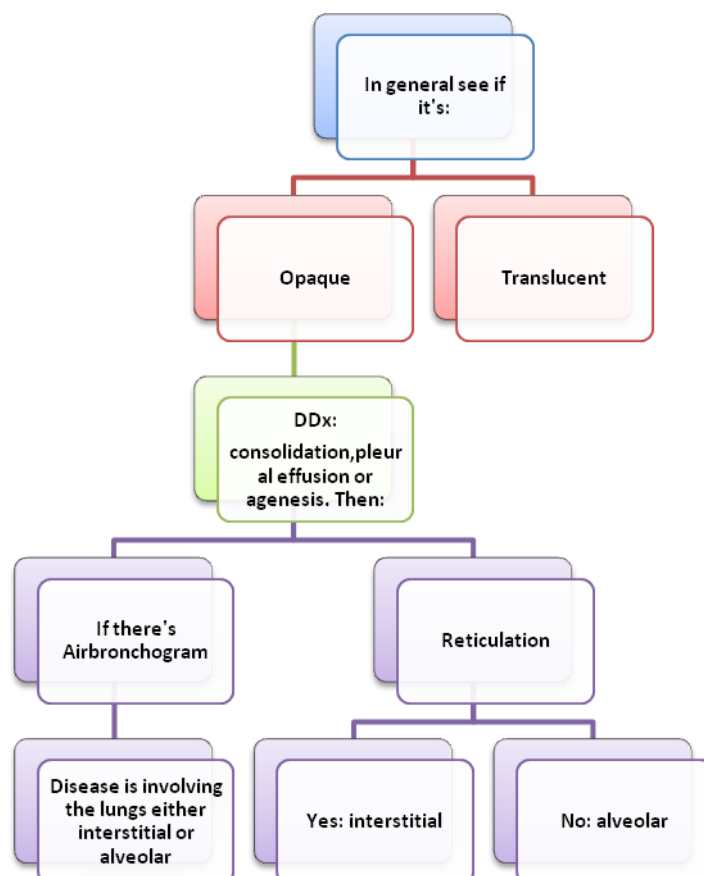
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- In radiology, the original normal image is not given for comparison. Also, no one will tell you the number of abnormalities in each radiograph.
- The original or normal radiograph of a person of a certain age and sex is a mental image that must be developed.
- The best way to build up this mental picture is to understand the anatomy of that region and its variations.
- The best way to interpret the findings is to use a consistent system in analyzing the radiograph.

SUMMARY

1. The basic technical factors affecting image quality:
 - * Exposure. * Positioning. * Inspiration.
2. To say I have an adequate exposure I should see the structures through the cardiac shadow.
3. To evaluate the central positioning we measure from the medial end of the clavicles to the midline (spinous processes).
4. To evaluate inspiratory effort we outline the dome of the diaphragm and then count the ribs above it either posterior or anterior. Normally: Ant. = 6-8 ribs. Post. = 9-10 ribs.
5. A normal CXR should show:
 - Symmetrical translucency in both lungs.
 - White branching structure (Vascular diffusion).
 - Homogeneous density in the heart.
6. Important Terms:
 - Opaque Vs. Translucent (transparent).
 - Alveolar Vs. Interstitial.
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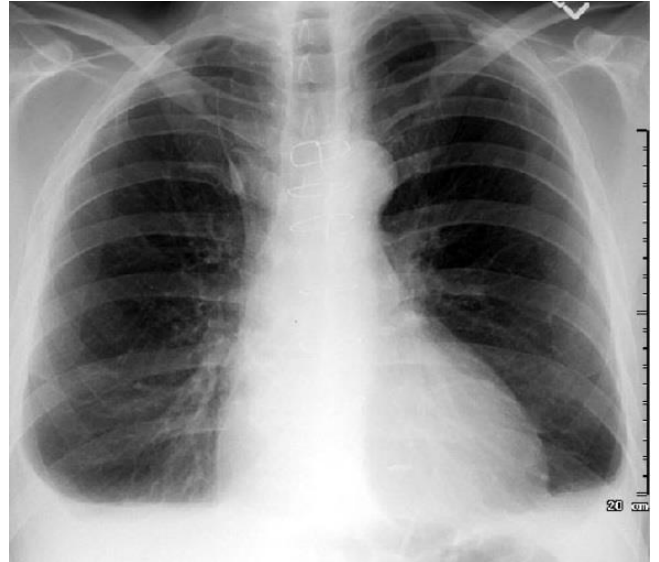
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Questions

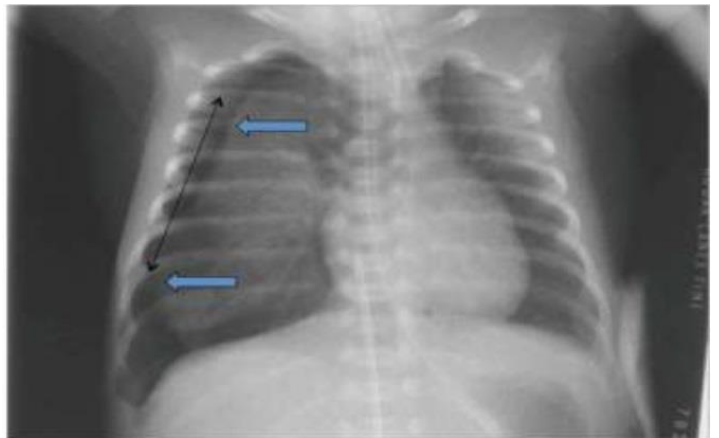
1) A 28 yo male presented to the ER with chest pain and SOB (Shortness of breath)?

- a. Pneumonia.
- b. Lower lobe pneumonia.
- c. Bilateral pleural effusion.
- d. Lower atelectasia.



2) What's the most likely diagnosis for the following CXR?

- a. Interstitial fibrosis.
- b. Cardiac tamponade.
- c. Pneumothorax.
- d. Pulmonary edema.



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Answers:

1st Questions:C

2nd Questions:C