Basic Chest X-ray Interpretation: Programme 1

The Chest X-ray is the most frequently requested radiological investigation and so it's important to be familiar with them. It is often also the most difficult investigation to interpret. I will start by going through the normal chest x-ray and then move on to the more commonly encountered pathologies.

It is important to develop a routine that you go through each time you are presented with a chest x-ray so that you do not miss subtle abnormalities or multiple pathologies. The following is my own routine but feel free to adapt or change the order as you prefer.

Having confirmed the patient's details I start by looking at the main airways, lungs, heart, hila, bones and soft tissues, and finally the so called hidden areas - the apices, behind the heart and under the hemidiaphragms. I'll now go through these in more detail with reference to the following normal radiograph.

I start with the trachea which is essentially midline but descends slightly to the right and splits at the carina to form the left and right main bronchi. I then look at the lungs comparing left with right. All that one normally sees in the lungs is the white vascular markings of the pulmonary vessels on the background of the black air. Remember to check the costophrenic angles* which should form sharp acute angles. The iaphragm and heart borders should be seen as clear crisp lines. As I will come onto later, any loss of clarity of the heart borders or hemi-diaphragms may be a sign of pathology.
Next the heart. Approximately 2/3 of the heart lies in the left chest on 1/3 in the right. The width of the heart should be less than half of the width of the chest on an inspiratory PA projection radiograph. If this so called cardiothoracic ratio is greater than 50%, this is a sign of cardiomegaly. The heart border on the right is due to the right atrium and on the left the left ventricle. As we move up we can see the aortic knuckle* and descending aorta on the left and the SVC on the right.

![Chest X-ray diagram](image)

The hila are made up of the proximal pulmonary arteries and veins and main bronchi. Lymph nodes are also present here but are normally too small to be seen on chest radiograph. However they can become visible when pathologically enlarged. The left hilum* is usually about 1cm higher than the right* and should NEVER be below it. If it is, this implies that either the right hilum has been pulled up or the left hilum has been pulled down. I will come back to this when discussing lobar collapse. The bones and soft tissues can be easily overlooked if one is not careful and may give useful information. For example the loss of a breast shadow due to a previous mastectomy might explain why one lung looks darker than the other and will also make one look particularly carefully for bone, lung and pleural metastases. Or rib fractures could explain the presence of a pneumothorax for instance.

Finally the hidden areas – so called because they are areas where pathology is easily missed if not carefully looked for and therefore important to carefully scrutinise. Namely the apices, behind the heart and under the hemi-diaphragms.

### Basic Routine

- Patient identifier and markers
- Airways
- Lungs
- Heart
- Hila
- Bones and soft tissues
- Hidden areas
A quick reminder regarding the lung lobes. There are three lobes on the right but only two lobes on the left with the lingula being the equivalent of the right middle lobe on the left but unlike on the right there is no fissure separating it from the left upper lobe and so it is considered part of it. *Note on the diagram of the lateral chest how high the lower lobes extend posteriorly and also that they extend inferiorly below the level of the diaphragm. Due to the overlap of the lobes when looking at a frontal radiograph it is often very difficult to state with confidence in which lobe an abnormality lies. For this reason it is easier to describe the location of an abnormality by splitting the lungs into upper, mid and lower zones.

Technical Factors
I'll now go through a few points regarding technical factors as these can be important and seem to be favourite questions of examiners although I don't think you need to get too concerned with them.

Projection
The standard chest x-ray is PA posteroanterior that is with the x-ray beam fired from behind the patient onto a film placed in front. If patients are too unwell to stand for a PA film, an AP anteroposterior projection is used with the x-ray beam exposed from in front onto a film placed behind the patient. This has the advantage that the patient can be lying down or sitting when the x-ray is taken but has the disadvantage that it does produce a degree of magnification of the heart and mediastinum and therefore one should be cautious about interpreting these structures.
Rotation
This is assessed by measuring the distance between the medial ends of the clavicles and the nearest spinous process lying in between them. If the patient is straight the spinous process should be equidistant between the medial ends of clavicles. If there is asymmetry, then the patient is rotated. This may be important because it can cause one hilum to look more prominent than the other and can also make one lung appear more white than the other.

Penetration
The radiographer taking the radiograph changes the amount of x-rays used to produce the radiograph depending on the size of the patient. Ideally the vertebral bodies should only just be visible though the heart shadow. If they are seen too clearly, the film is overpenetrated which will make the lungs look falsely black and you may miss low density lesions. If the vertebral bodies cannot be seen, the film is under penetrated which will make the lungs look falsely white.
Finally Inspiration – The midpoint of the right hemidiaphragm should lie between the 5th and 7th ribs anteriorly. If fewer ribs are visible, the patient has taken a poor inspiration. This will make the heart look larger and the lung bases whiter and so once again should be interpreted with caution. If more ribs are visible, the lungs are hyperinflated.

If we go back to the example of the normal x-ray I have used, we can see it was taken in the standard PA projection. Looking at the medial ends of the clavicles, there is some asymmetry with the gap between the spinous process and the left clavicle being smaller than the gap on the right and so the patient is a little rotated. Assessing the penetration, the vertebral bodies and their disc spaces are easily seen through the cardiac shadow and so the film is slightly overpenetrated.

The mid point of the right hemidiaphragm is at the level of the 7th rib anteriorly and so this is a good inspiratory film.
The Silhouette Sign

I will finish this first tutorial by going over a very important concept in chest radiology, namely the silhouette sign. An intrathoracic lesion touching a border of the heart, aorta, or diaphragm will obliterate that border on the radiograph. An intrathoracic lesion not anatomically in contact with a border of one of these structures will not obliterate that border. The loss of the silhouette of any of these borders by adjacent disease is known as the silhouette sign.

This is highlighted by looking at the following two x-rays both of which show soft tissue density lesions (tumours) projected over the region of the left hilum. In the first radiograph, the left heart border is still seen through the shadow of the mass. From this we can deduce that the mass is not in contact with the heart border and must therefore lie either in front of or more likely behind the heart.

In contrast, in the second radiograph the left heart border can no longer be seen because the mass is in contact with the heart border and as they are both of a similar soft tissue density the heart border is lost.

The concept of the silhouette sign is therefore helpful in working out the location of an abnormality. It is also useful in highlighting areas of subtle abnormality. The heart borders and diaphragms should have clear sharp outlines as they are surrounded by air. If this clarity is lost, it implies something with a similar density is abutting that structure – for example this may be an area of consolidation, collapsed lung or perhaps a mass.
In the next example, the normally crisp right heart border has been lost. In this case due to an area of consolidation. Once again we can quite accurately state the location of the consolidation as being in the right middle lobe as it is this lobe that abuts the right heart border.

So in summary, we have looked at a routine to use each time we are presented with a chest radiograph, considered some of the technical factors which you should be aware of but not get too concerned with and discussed the important concept of the silhouette sign and some of its uses.