How to look at a chest X-ray

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1.1 Basic interpretation is easy

Basic interpretation of the chest X-ray is easy. It is simply a black and white film and any abnormalities can be classified into:

1. Too white.
2. Too black.
3. Too large.
4. In the wrong place.

To gain the most information from an X-ray, and avoid inevitable panic when you see an abnormality, adopt the following procedure:

1. Check the name and the date.
2. If you are using a picture-archiving system, see whether previous X-rays are on the system for comparison. The patient may have had previous X-rays which are stored on film. If you cannot access previous films, look for old radiology reports, which may be helpful.
3. Check the technical quality of the film. (Explained in Chapter 1.2.)
4. Scan the film thoroughly and mentally list any abnormalities you find. Always complete this stage. The temptation is to stop when you find the first abnormality but, if you do this you may get so engrossed in determining what it is that you will forget to look at the rest of the film. Chapter 1.3 explains how to scan a film.
5. When you have found the abnormalities, work out where they are. Decide whether the lesion is in the chest wall, pleura, within the lung or mediastinum. Chapter 2 explains how to localize lesions within the lung and the heart, Chapter 8 the mediastinum and Chapter 9 the ribs.
6. Mentally describe the abnormality. Which category does it fall into:
   I. Too white.
   II. Too black.
   III. Too large.
   IV. In the wrong place.

Chapters 4 to 11 will take you through how to interpret your findings.
7. Always ensure that the film is reported on by a radiologist. Basic interpretation of the chest X-ray is easy, but more subtle signs require the trained eye of a radiologist. Seeking a radiologist’s opinion can often expedite a diagnosis or the radiologist may suggest further imaging.

8. Finally, do not forget the patient. It is possible and, indeed, quite common for a very sick patient to have a normal chest X-ray.
The next four X-rays are examples of how the technical quality of a film can affect its appearance and potentially lead to misinterpretation. Above is an AP film which shows how the scapulae are projected over the thorax and the heart appears large. Compare this to the film opposite which is a standard PA projection showing how the scapulae no longer overlie the thorax and the heart size now appears normal.
Films on pages 6 and 7 show the effects of respiration. The above film is taken with a poor inspiration, and page 7 with a good inspiration. Note how the lung bases look whiter, and the heart size appears larger.
Technical quality continued

[Image of an X-ray of a chest with the letter 'L' indicating left side]
Always check the technical quality of any film before interpreting it further. To do this you need to examine in turn the projection, orientation, rotation, penetration and degree of inspiration. Problems with any of these can make interpretation difficult and unless you check the technical quality carefully you may misinterpret the film.

**Projection**
Look to see if the film is anteroposterior (AP) or posteroanterior (PA). The projection is defined by the direction of the X-ray beam in relation to the patient. In an AP X-ray the X-ray machine is in front of the patient and the X-ray film at the back. In a PA film the beam is fired from behind the patient and the film placed in front. The standard chest X-ray is PA but many emergency X-rays are AP because these can be taken more easily with the patient in bed. AP films are marked AP by the radiographer and PA films are often not marked since this is the standard projection. If you are not sure then look at the scapulae. If the scapulae overlie the lung fields then the film is AP. If they do not it is most likely PA. If the X-ray is AP you need to be cautious about interpretation of the heart size which will appear magnified on an AP film because the heart is anterior. The shape of the mediastinum can also be distorted. An AP film can be taken with the patient sitting or lying. The film should be marked erect or supine by the radiographer. It is important to note this since the appearance of a supine X-ray can be very different to that of an erect one.

**Orientation**
Check the left/right markings. Do not assume that the heart is always on the left. Dextrocardia is a possibility but more commonly the mediastinum can be pushed or pulled to the right by lung pathology. Radiographers always safeguard against this by marking the film left and right. Always check these markings when you first look at the film but remember the radiographer can sometimes make mistakes – if there is any doubt re-examine the patient.

**Rotation**
Identify the medial ends of the clavicles and select one of the vertebral spinous processes that falls between them. The medial ends of the clavicles should be equidistant from the spinous process. If one clavicle is nearer than the other then the patient is rotated and the lung on that side will appear whiter.
A patient with a thoracic scoliosis may appear to have a rotated film. Check whether the spinous processes on the vertebral column are aligned. If they are it is more likely that the patient is rotated.

**Penetration**

To check the penetration, look at the lower part of the cardiac shadow. The vertebral bodies should only just be visible through the cardiac shadow at this point. If they are too clearly visible then the film is over penetrated and you may miss low-density lesions. If you cannot see them at all then the film is under penetrated and the lung fields will appear falsely white. When comparing X-rays it is important to check that the level of penetration is similar.

**Degree of inspiration**

To judge the degree of inspiration, count the number of ribs above the diaphragm. The midpoint of the right hemidiaphragm should be between the 5th and 7th ribs anteriorly. The anterior end of the 6th rib should be above the diaphragm as should the posterior end of the 10th rib. If more ribs are visible the patient is hyperinflated. If fewer are visible the patient has not managed a full intake of breath, perhaps due to pain, exhaustion or disease. It is important to note this, as a poor inspiration will make the heart look larger, give the appearance of basal shadowing and cause the trachea to appear deviated to the right. Remember also that patients are all different shapes! Some are broad with relatively short chests and some are tall with long chests. To assess whether the patient has failed to take a deep breath in or simply has a short chest it can be useful to compare the current X-ray with previous ones. If the number of ribs above the diaphragm has changed then it is likely to be due to changes in the degree of inspiration.
1.3 Scanning the PA film

The PA film
If you are looking at a printed film find a decent viewing box with a functioning light that does not flicker. If possible lower the ambient lighting.

If you are using a workstation or computer screen the amount you will see will depend on the resolution of the screen. Make sure you are using a suitable screen and turn down the ambient lighting. You may wish to use an alternative screen if the image is not clear enough. At a workstation the contrast and brightness of the image can be altered to bring out subtle abnormalities; for example, inverting black and white can help make detection of rib abnormalities easier.

If looking at a printed film, in order to recognize areas that are too white or too black you need to survey the X-ray from a distance (about 4 ft/1.2 m) and then repeat this close up.

1. **Lung fields.** These should be of equal transradiancy and one should not be any whiter or darker than the other. Try to identify the horizontal fissure (1) (this may be difficult to see) and check its position. It should run from the hilum to the 6th rib in the axillary line. If it is displaced then this may be a sign of lung collapse.

An important sign of many lung diseases is loss of volume of that lung and so you need to determine whether either of the lung fields is smaller than it should be. This is difficult since the presence of the heart makes the left lung field smaller. As you see more and more chest X-rays, however, you will gain an appreciation of how the two lung fields should compare in size and therefore be able to detect when one is smaller than it should be.

Look for any discrete or generalized shadows. These are described in Chapter 4 – The white lung field. Remember that the shadows that appear to be in the lung can represent abnormalities anywhere from the patient’s clothing and jewellery inwards.

2. **Look at the hilum.** The left hilum (2) should be higher than right (3) although the difference should be less than 2.5 cm. Compare the shape and density of the hila. They should be concave in shape and look similar to each other. Chapter 6 describes how to interpret hilar abnormalities.

3. **Look at the heart.** Check that the heart is of a normal shape and that the maximum diameter is less than half of the transthoracic diameter at the broadest part of the chest. Check that there are no abnormally dense areas of the heart shadow. Chapter 7 takes you through interpretation of the abnormal heart shadow.

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4. **Check the rest of the mediastinum.** The edge of the mediastinum should be clear although some fuzziness is acceptable at the angle between the heart and the diaphragm. A fuzzy edge to any other part of the mediastinum suggests a problem with the neighbouring lung (either collapse or consolidation) dealt with in Chapter 4. Interpretation of the widened mediastinum is dealt with in Chapter 8.

Look also at the right side of the trachea. The white edge of the trachea (4) should be less than 2–3 mm wide on an erect film. (See Chapter 8 for interpretation.)

5. **Look at the diaphragms.** The right diaphragm (5) should be higher than the left (6) and this can be remembered by thinking of the heart pushing the left diaphragm down. The difference should be less than 3 cm. The outline of the diaphragm should be smooth. The highest point of the right diaphragm should be in the middle of the right lung field and the highest point of the left diaphragm slightly more lateral.

6. **Look specifically at the costophrenic angles (7).** They should be well-defined acute angles.

7. **Look at the trachea (8).** This should be central but deviates slightly to the right around the aortic knuckle (9). If the trachea has been shifted it suggests a problem within the mediastinum or pathology within one of the lungs.

8. **Look at the bones.** Step closer to the X-ray and look at the ribs, scapulae and vertebrae. Follow the edges of each individual bone to look for fractures. Look for areas of blackness within each bone and compare the density of the bones which should be the same on both sides. Sometimes turning the image on its side can make rib fractures easier to see.

9. **Soft tissues.** Look for any enlargement of soft tissue areas.

10. **Look at the area under the diaphragm.** Look for air under the diaphragm or obviously dilated loops of bowel. Remember that abdominal pathology can occasionally present with chest symptoms.
1.4 How to look at the lateral film

Lateral film
A lateral chest X-ray can be taken with either the right or left side of the patient against the film. Do not worry about which way it has been taken since for all but the most subtle signs it makes little difference. It is useful to get into the habit of always looking at the film the same way and we suggest looking at the film with the vertebral column on the right and the front of the chest on the left. Once you have done this:

1. Check the name and the date.

2. Identify the diaphragms. The right hemidiaphragm (1) can be seen to stretch across the whole thorax and can be clearly seen passing through the heart border. The left (2) seems to disappear when it reaches the posterior border of the heart.

Another method of identifying the diaphragms is to look at the gastric air bubble (3). Look again at the PA film and work out the distance between the gastric air bubble (which falls under the left diaphragm) and the top of the left diaphragm. Make a note of this. Now go back to the lateral. The diaphragm that is the same distance above the gastric air bubble is the left diaphragm.

You can now set about interpreting the film. As with the PA step back from the film and adopt the following process:

1. Compare the appearance of the lung fields in front of and above the heart to those behind. They should be of equal density. Check that there are no discrete lesions in either field.

2. Look carefully at the retrosternal space (4), which should be the blackest part of the film. An anterior mediastinum mass will obliterate this space turning it white.

3. Check the position of the horizontal fissure (5). This is a faint white line which should pass horizontally from the midpoint of the hilum to the anterior chest wall. If the line is not horizontal the fissure is displaced. Check the position of the oblique fissure (6) which should pass obliquely downwards from the T4/T5 vertebrae, through the hilum, ending at the anterior third of the diaphragm.

4. Check the density of the hila (7). A hilar mass may make the hila whiter than usual.

5. Check the appearance of the diaphragms. Occasionally a pleural effusion is more obvious on a lateral film. Its presence would cause a blunting of the costophrenic angle either anteriorly or posteriorly.
6. Look at the vertebral bodies. These should get more translucent (darker) as one moves caudally. Check that they are all the same shape, size and density. Look for collapse of a vertebra or for vertebrae that are significantly lighter or darker than the others, which may indicate bone disease. Consolidation in the posterior costophrenic sulcus can also make the vertebral bodies appear abnormally white.