In the previous tutorial we looked at the different causes and appearances of increased shadowing in the lungs. I will start this tutorial by briefly looking at the causes of black lungs.

**Chronic Obstructive Pulmonary Disease (COPD)**

The most common cause of black lungs is COPD. The increased blackness is due to the formation of bullae which are large, thin walled, cystic air spaces formed by the breakdown of alveoli and a decrease in the number and size of the lung markings peripherally also known as peripheral pruning. The other sign to look for in COPD is hyperexpansion of the lungs with associated flattening of the diaphragms.

In this example the lungs generally appear darker than normal and there is marked hyperexpansion of the chest with flattening of the diaphragms. There is also a paucity of body fat which is a common finding in emphysema.

**Pneumothorax**

The other reasonably common cause of increased blackness is a pneumothorax when air has entered into the pleural space. Look for a lung edge with an area without lung markings between the chest wall and the lung edge. They can be quite subtle and so it is important to look carefully at the upper zones which is where air will accumulate initially.

At the other end of the scale is the potentially fatal condition of a tension pneumothorax where there is the accumulation of air under pressure in the pleural space. This condition develops when injured tissue forms a 1-way valve, allowing air to enter the pleural space and preventing the air from escaping naturally. Arising from numerous causes, this condition rapidly progresses to respiratory insufficiency, cardiovascular collapse, and, ultimately, death if unrecognized and untreated.
Radiologically, the findings can include ipsilateral lung collapse at the hilum, tracheal and mediastinal deviation to the contralateral side, and widened intercostal spaces on the affected side. Additionally the hemidiaphragm may be depressed.

The first example shows a moderate sized left pneumothorax with no signs of tension.

The second example is of a tension pneumothorax and demonstrates the classic features:

I've now covered lung and pleural abnormalities. I'll move on to abnormalities of the heart, hila, and hidden areas.
The Heart
I will not discuss the heart other than to emphasise the size which should be less than 50% of the total transverse diameter of the chest. There are many causes for an increase in heart size but most commonly this is associated with cardiac failure and/or pericardial effusions.

This x-ray shows a grossly enlarged heart in a patient who has undergone valve replacement and who has a dual chamber cardiac pacemaker.

![Artificial heart valve](image)

The Hila
You will recall that the hila are made up of the main bronchi, pulmonary vessels and lymph nodes which are normally not visible unless pathologically enlarged. The main hilar abnormalities therefore involve either enlargement of the pulmonary arteries as in pulmonary hypertension or more commonly enlarged lymph nodes.

Hilar lymphadenopathy can be either unilateral or bilateral and these have slightly different differential diagnoses associated with them. The common causes of bilateral hilar lymphadenopathy include sarcoidosis, lymphoma, metastases and less commonly infection. The common causes of unilateral hilar lymphadenopathy include infection such as TB and metastatic spread for example from a primary bronchial malignancy. Signs of hilar lymphadenopathy include an increase in size and density of the hilum and loss of the normal concave shape the hilum. The first example shows bilateral enlarged hila with bulging, convex lobulated borders consistent with lymphadenopathy.

![Bilateral Hilar Lymphadenopathy](image)
In the second example the right hilum appears normal but the left hilum once again is enlarged and has a bulging border in keeping with unilateral hilar lymphadenopathy. It is always important to look for other signs on the radiograph to explain the lymphadenopathy and in this case a large soft tissue mass is seen in the left lower zone which is a primary malignancy.

Hidden Areas
The importance of carefully scrutinising the hidden areas cannot be overemphasised as these are the areas in which abnormalities are commonly overlooked. If you take away one thing from these tutorials this perhaps should be it. Usually the hidden areas are considered to be the apices, behind the heart, and under the hemidiaphragms.

Apical abnormalities might include for example a small tumour, pneumothorax or area of tuberculosis. Behind the heart one can see masses, areas of consolidation or a hiatus hernia to name a few examples. Under the diaphragms look for free air from a perforated abdominal viscus, subdiaphragmatic collections and remember that the lower lobes of the lungs descend below the level of the diaphragm and so lung pathology can also be seen.

The following x-ray shows a crescent of free air under the right hemidiaphragm from a perforated duodenum.
The next x-ray shows a raised right diaphragm with a pocket of air as well as an air fluid level beneath it. Normally the area below the right hemidiaphragm is white due to the liver. These findings are therefore consistent with a subdiaphragmatic collection or abscess.

The next radiograph shows a circular retrocardiac shadow with an air fluid level within it which is a hiatus hernia.

And finally in this radiograph of a baby there is an area of increased air space shadowing behind the heart with a few air bronchograms within it consistent with a pneumonia.
Heart Failure

To finish this tutorial I’m going to go through the appearances of the radiograph in heart failure and chronic tuberculosis as they show a combination of a number of the abnormalities mentioned previously which hopefully should be a useful recap.

The first x-ray shows a patient who is obviously unwell with an oxygen mask. It is an AP film which makes it difficult to comment on the size of the heart.

There is dense air space shadowing in a bilateral perihilar distribution, sometimes referred to as bat’s wing distribution. Note the air bronchograms within the shadowing which is the hallmark of consolidation. There is blunting of the right costophrenic angle consistent with a small pleural effusion. The left CP angle is unfortunately missed off on this film. These appearances are in keeping with acute left ventricular failure.

In the next x-ray even allowing for the AP projection the heart appears enlarged and the patient has a cardiac pacemaker. There is a combination of diffuse bilateral reticular interstitial shadowing and more confluent dense air space shadowing predominantly in a perihilar and lower zone distribution.
You will recall that one of the differentials for interstitial shadowing is pulmonary oedema and this often precedes the air space shadowing that occurs with more florid pulmonary oedema. A special type of interstitial shadowing known as Kerley B lines are also demonstrated in this x-ray and are commonly seen in pulmonary oedema. These are thin horizontal lines up to a couple of centimetres long which are found laterally in the lung bases and extend to the pleura. Finally, there are small bilateral pleural effusions, once again in keeping with pulmonary oedema or left ventricular failure.

**Chronic Changes Due to Tuberculosis**
The final radiograph shows some of the chronic changes due to previous tuberculosis.

There is marked loss of lung volume in the upper lobes bilaterally due to fibrosis. We know this because both hila are markedly elevated. There is pleural thickening in both apices but particularly on the right side.
There is blunting of the left costophrenic angle which is probably due to a small pleural effusion. In fact if you look carefully you can make out air fluid levels in this area which is due to recent attempted needle aspiration of the effusion and a resulting small hydropneumothorax – ie fluid and air within the pleural space.

Air- fluid level

Hopefully by now you should feel a little more confident about tackling chest x-rays. Remember to use a systematic routine when looking at the film and don’t forget the hidden areas. If there are abnormalities try to decide which structures are involved and if there are areas of increased opacification, decide broadly what type of pattern you are dealing with as this will help to narrow the list of differential diagnoses.