Interpreting the chest radiograph

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Abstract

A methodical system for looking at every chest radiograph is suggested. Readers are encouraged to decide whether an opacity on a chest radiograph is due to pleural, alveolar or interstitial pathology and then to consider the cause. Lung and pleural masses are considered and contrasted and the features of asbestos exposure listed. Special consideration is given to the problems of interpretation of the chest radiograph in the intensive care unit (ICU), and the various appearances of lines and tubes are outlined.

Keywords Alveolar; chest X-ray; interstitial; lines; pleural

Royal College of Anaesthetists CPD matrix: 3G00

Learning objectives

After reading this article you should be able to:

- systematically review a chest X-ray
- understand the differences between alveolar, interstitial and pleural shadows
- understand the particular features of chest X-rays of patients in the intensive care unit

A system for looking at the chest X-ray

Identification

Check name, side marker and whether the film is posteroanterior (PA) or anteroposterior (AP).

Film quality

This indicates how precise is the information you can expect from the film.

Penetration: a good film allows the localization of one or two thoracic disc spaces.

Inspiration: following good inspiration the diaphragm is normally at or near the level of the posterior 10th rib. The right diaphragm is usually higher than the left.

AP or PA, supine or erect: the radiographer should mark how the film has been taken. AP films have the scapula and magnified heart projected over the lung fields and heart size cannot be assessed. Most portable, and all supine, films are AP. Supine films show less of the lung fields and the mediastinum appears wide: it is pointless trying to decide if a patient has an aortic dissection on a supine film. Interpretation of a film of a patient with a marked kyphosis suffers from similar difficulties.

Centring: allows for rotation before evaluating mediastinal and tracheal shift by examining the relationship between the medial ends of the clavicle and the posterior spinous process. The side to which the patient is rotated usually becomes more translucent (black). But there are exceptions and marked degrees of rotation are required to produce significant changes in radiographic density (Figure 1).

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Conflicts of interest: none.

Bones

Start checking from the outside (i.e. humeri, shoulders and clavicles). Note if there are any secondaries, fractures or arthritis. Is the spine straight? Look through the heart to where the ribs meet the spine. Check the lateral chest wall and the anterior end of each rib. Compare the two sides all the time. Many prefer to examine each rib as a whole, but it is possible to miss one unless care is taken.

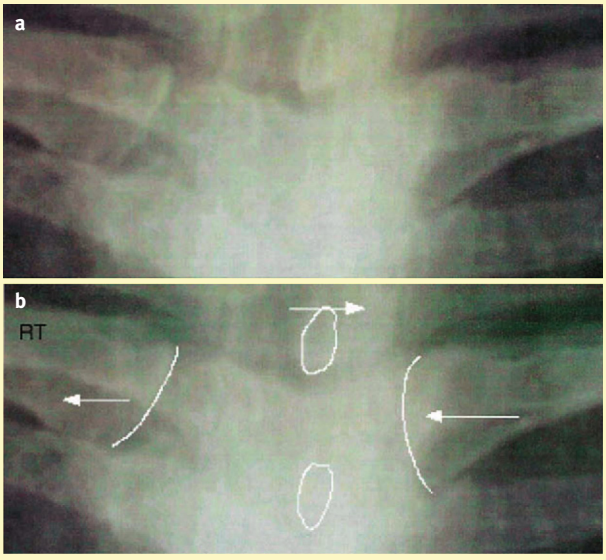
Soft tissues

Briefly examine the muscles of the chest wall and note any surgical emphysema. The trachea should be central or it may be pushed slightly to the right of the midline in patients with aortic dilatation. Note the size, shape and position of the mediastinum and hila. Note any discrepancy of height in the diaphragm and examine the area below.

Mediastinum

Cardiac shadow (Figure 2): on a PA film the maximum width of the heart shadow compared with the maximum width of the

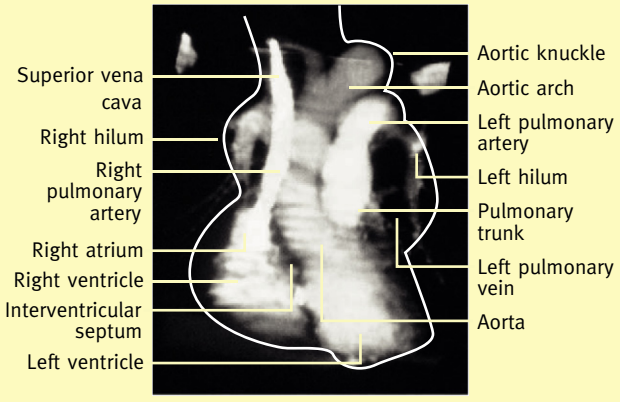
Evaluating rotation



(a) Patient rotated towards their right. **(b)** The medial ends of the clavicles and the spinous processes are outlined with their apparent direction of movement. The mediastinum and trachea, being anterior structures, move in the same direction as the clavicles.

Figure 1

Cardiac shadow



A three-dimensional computed tomography cardiac angiogram showing the approximate outline of the cardiac shadow. The anterior portions of the right atrium and right ventricle have been removed.

Figure 2

combined lung fields approximates the cardiothoracic (CT) ratio. It is normally below 50% but can be up to 60% in elderly patients. The true CT ratio is the sum of maximum distances from the centre of the heart shadow to each heart edge over the maximum external bony thoracic wall.

Assessment of chamber size is best done by echocardiography but the classic chest radiograph signs of left atrial enlargement are accurate (double right heart border, infilling of the concavity between the aortic knuckle and the pulmonary artery and splaying of the carina).

The hila are central mediastinal structures and the hilum on the side to which rotation has occurred may become obscured by the heart shadow. The anatomy of the pulmonary vessels is such that the left hilum is the higher. If this is reversed or even if they are at the same level there is likely to be some collapse somewhere.

The diaphragm

The diaphragm is normally at the level of the 10th posterior rib but this is variable and its height depends on several factors, including the radiographic technique. It is a thin structure (3 mm) and if it appears to be thicker than this then any gas apparently delineating its lower surface is probably in the gut rather than due to a pneumoperitoneum.

Lung fields

Compare the two sides by mentally dividing them into six parts (i.e. right and left upper mid and lower zones). Go back to the difficult areas: apices, costophrenic angles, hila and through the heart. There is a lot of lung behind the heart. Note the position and thickness of the horizontal fissure which normally extends out from the centre of the right hilum and is very thin. Low flat diaphragms may indicate emphysema, but can also be produced by a massive breath in.

The two sides should be of similar density. The basal arteries should look notably thicker and longer than those to the upper zones. Bronchial walls, if seen at all, should be thin and restricted to the perihilar regions. Any measurable thickness indicates peribronchial thickening.

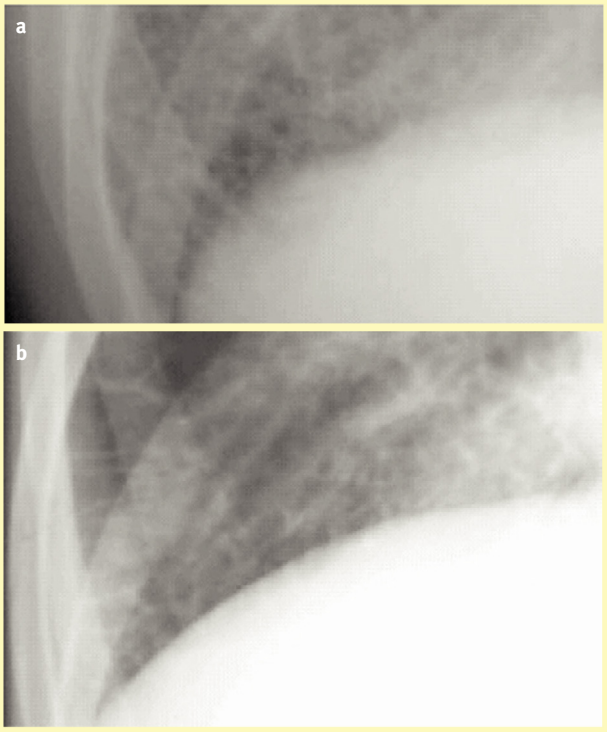
Compared with computed tomography, only gross cases of vascular redistribution, plethora, air trapping and bronchiectasis can be diagnosed with certainty on the chest X-ray. Remember that patients with pulmonary emboli can have normal chest radiographs.

Abnormal lung shadows

Disease in the different anatomical divisions of the lung gives rise to specific appearances and distinction can usually be made between interstitial shadows, air space or alveolar shadowing (often called consolidation) and pleural abnormalities. All of these often coexist, for example in pneumonia, left ventricular failure and acute lung injury (ALI) or adult respiratory distress syndrome (ARDS), but one type of shadowing usually dominates. Having decided which of these you are looking at, it is then necessary to match up the clinical history with the type and distribution of the shadowing.

Interstitial disease is identified by lines and dots with variable distribution on the radiograph (Figure 3). Chronic obstructive pulmonary disease (COPD) causes peribronchial thickening, left ventricular failure tends to thicken the peripheral interstitium (Kerley B lines) as well as causing peribronchial thickening. Malignant involvement (lymphangitis carcinomatosa) tends to

Interstitial shadowing



Two patients with interstitial shadowing. **(a)** Fibrosing alveolitis with the typical shaggy diaphragm. **(b)** Interstitial pulmonary oedema showing Kerley B lines. Note the relatively sharp diaphragm.

Figure 3