CHEST RADIOGRAPHS—I

D W Hodgkinson, B R O'Driscoll, P A Driscoll, D A Nicholson

Chest radiographs are commonly requested and taken in accident and emergency departments and in many emergency situations in hospital. This article details the types of urgent chest radiograph available and provides a systematic method for interpreting films. The next article will describe the common emergency conditions requiring chest radiographs and the relevant radiological signs.

Important anatomical considerations

The plain chest radiograph allows assessment of the heart, lungs, mediastinum, and chest wall. You need to be familiar with the main anatomical features seen on posteroanterior and lateral chest radiographs together with common normal variations.

FIG 1—Normal posteroanterior chest radiograph with line diagram.

1) Trachea
2) Aortic knuckle
3) Left atrium
4) Left pulmonary artery
5) Left atrial appendage
6) Left ventricle
7) Left hemidiaphragm
8) Right cardiophrenic angle
9) Right costophrenic angle
10) Right ventricle
11) Right atrium
12) Right hilum
13) Superior vena cava
14) Right first rib

FIG 2—Normal lateral chest radiograph with corresponding line diagram.

1) Trachea
2) Ascending aorta
3) Horizontal fissure
4) Oblique fissure
5) Hilar density
6) Diaphragms (right usually higher)
7) Descending thoracic aorta
8) Bones of dorsal spine are seen clearly on most films
9) Anterior cardiac window
10) Posterior cardiac window
Types of view

Potential pitfalls of the anteroposterior film
Cardiomegaly
Wide mediastinum
High diaphragms
Vague lower zone shadowing due to poor inspiration
Rotation artefacts
In the supine film
Upper lobe blood diversion may be normal
Small pneumothorax may be missed (air collects anteriorly)
Pleural effusion (fluid collects posteriorly giving appearance of diffuse shadowing)

Though most patients require only one good quality film, other specialised views will be needed to identify some abnormalities.

Posteroanterior view—This film is taken in the radiology department. The patient stands with his or her anterior chest against the film cassette and the exposure is taken in full inspiration with the x-ray source located 2 metres behind the patient. It is used for all cases unless the patient requires ongoing assessment, resuscitation, treatment, or monitoring.

Anteroposterior view—This view is usually requested for seriously ill patients with a life threatening condition that requires assessment, monitoring, or treatment in a resuscitation area. The film cassette is placed behind the patient, who sits or lies on the bed or trolley. A portable x-ray machine is used. Non-essential medical and nursing staff leave the immediate area during exposure. There are several potential pitfalls that should be remembered when requesting and interpreting this film.

Lateral chest film—This view is rarely helpful in the emergency situation. It can, however, reveal abnormalities that are obscured by the heart or are hidden in the costophrenic recess in the posteroanterior film. It can also help localise an abnormality which has been identified in the posteroanterior or anteroposterior view. Remember that an extrathoracic foreign body may appear to be intrathoracic in a posteroanterior or anteroposterior view.

Lateral decubitus film—This is a posteroanterior chest film taken with the patient lying on his or her side (usually the abnormal side down). It can identify a small pleural effusion and differentiate this from pleural thickening. A subpulmonary haemothorax may become apparent with this view when the only abnormality seen in the posteroanterior film is a raised hemidiaphragm.

Sternal view—This is used to assess patients with suspected fractured sternum.

Rib views are rarely indicated because rib fractures are diagnosed on the clinical features. Remember that rib fractures may be associated with more important and serious chest injuries. Absence of rib fractures in a posteroanterior film does not exclude their presence or, more importantly, a serious intrathoracic injury.
Expiration films may be used to show a small pneumothorax, but it is not necessary to request this view routinely because most pneumothoraces will be apparent in the posteroanterior inspiration film. Expiration films are occasionally requested to help establish a diagnosis of inhaled foreign body, when “gas trapping” may be seen.

Apical lordotic view—This is an oblique view that can show details of the lung apex which are usually hidden behind the clavicle and upper ribs. This technique is seldom indicated in the emergency situation.

**System of radiological assessment**

First check the name and age of the patient together with the date on the radiograph.

**Check the adequacy and technical quality of the film**

Note the following:

- **Projection and exposure**—Look at the mid-thoracic intervertebral discs; they should be clearly visible.
- **Posture**—Supine or erect.
- **Rotation**—Look at the spinous processes of the upper thoracic vertebrae. They should be central. Then inspect the medial end of both clavicles to ensure they are equidistant from the central spinous process.
- **Degree of inspiration**—This affects the appearance of the lower zone vessels. They appear more prominent with poor inspiration. The right hemidiaphragm should reach the anterior end of the right sixth or seventh rib or the ninth rib posteriorly on full inspiration.

**Check for any medical equipment**

The position and presence of any invasive medical equipment (for example, endotracheal tubes, central venous cannulas) must be assessed. The tip of the endotracheal tube should lie about 2 cm above the carina.

**Check the mediastinum**

The mediastinum can be divided into upper, middle (hila), and lower (heart). The mediastinum should be central and its silhouette sharp. A double outline suggests pneumomediastinum. Further assessment depends on a knowledge of the normal anatomy and relative sizes of the mediastinal organs.

Start your inspection in the upper mediastinum on the left side. As you descend this border is interrupted by normal structures such as the aortic knuckle. Continue down the left border to the cardiophrenic angle, which should be acute and clear. Then follow the right border from the cardiophrenic angle back up to the upper mediastinum.

Next check the hila. These shadows are made up of pulmonary arteries and veins. The left hilum is usually 2 cm higher than the right. The heart is positioned with about one third of its diameter to the right and two thirds to the left of the spine processes. A low diaphragm will cause a right shift and a high diaphragm a left shift. The diaphragm’s full diameter should be less than half of the internal thoracic diameter at its widest point.
Check the diaphragms
Examine the diaphragms specifically. Look for clear cardiophrenic and costophrenic angles. In 95% of normal subjects the right diaphragm is higher than the left by up to 3 cm.

The outline of the diaphragms is smoothly arcuate with the highest point medial to the midline of the hemithorax. Lateral peaking, particularly on the right, suggests a subpulmonary effusion or haemothorax in the appropriate clinical setting. Loss of clarity of the margin of the left diaphragm may indicate collapse or consolidation of the left lower lobe.

Check the transradiance of both lungs
Both lungs should be equal. Check them more specifically for fissures, vessels, and abnormal opacities. Look at the position, configuration, and thickness of fissures. Any fissure wider than hairline is considered abnormally thickened. The oblique fissure is normally seen in only the lateral view.

Both arteries and veins are visible, but it is not helpful to distinguish between them. They extend outwards from the mediastinum and disappear 2 cm or less from the lung margin. Carefully examine the apex of each lung field as apical lung lesions are commonly missed.

Check the bones
Examine the posterior and anterior aspects of the ribs in detail, looking particularly for fractures and metastatic bone disease. Trace out laterally and anteriorly each rib from the posterior costochondral joint to where the rib joins the costochondral cartilage at the mid-clavicular line.

Check both the upper and lower borders of the rib. Then assess the clavicles and scapulae. Remember that information on both shoulder joints and the thoracic spine can be obtained from the chest film, but for proper assessment the appropriate special views must be obtained.
Check the extrathoracic soft tissues

Start at the top with the supraclavicular areas. Note any surgical emphysema, which is often seen in the cervical region. Continue down the lateral wall of the chest on each side. The assessment must include the breast shadows. Finally, check under the diaphragms for abnormal structures or free gas.

Fig 9—Left haemopneumothorax and surgical emphysema extending up the left of the chest. The collapsed lung appears as an area of increased density obliterating the normal cardiac silhouette with increased transradiancy of the left upper and mid- zones.

Fig 10—Common mistakes.

1) Wrong patient or wrong date
2) Small apical pneumothorax overlooked
3) Callus around old rib fracture misdiagnosed as pulmonary or pleural mass or rib tumour
4) Medial part of scapula may overlie lung field and be mistaken for a pneumothorax or pleural mass
5) Skin lesions (for example, a lipoma or sebaceous cyst) may be mistaken for an intrathoracic lesion
6) Prominent pulmonary arteries in emphysematous patients (due to pulmonary hypertension) may be mistaken for hilar tumour or nodes
7) Extraneous objects such as buttons or contents of pockets may be mistaken for intrathoracic lesions
8) Scoliosis or kyphosis may be overlooked. These make radiographs difficult to interpret as they commonly cause rotation and distortion of other chest structures
9) Costotransverse articulations (especially of upper ribs) may be mistaken for a fracture of the posterior rib
10) Lytic or sclerotic lesions of ribs are commonly overlooked
11) Large peripheral bullae may be mistaken for a pneumothorax
12) Scarring from old pleurisy or from thoracic surgery may cause blunting of the costophrenic angles and may be mistaken for an effusion. (The history and clinical signs should resolve this but if in doubt get a lateral decubitus view or an ultrasound scan)

D W Hodgkinson is senior registrar in emergency medicine, B R O‘Driscoll is consultant in respiratory medicine, P A Driscoll is senior lecturer in emergency medicine, and D A Nicholson is consultant radiologist, Hope Hospital, Salford. The line drawings were prepared by Mary Harrison, medical illustrator. The ABC of Emergency Radiology has been edited by David Nicholson and Peter Driscoll.