Chest radiography is the most frequently used radiological chest imaging technique and also one of the most challenging. The technical aspects of this imaging modality are studied extensively. New approaches to image acquisition and display have been introduced in the past decade. As a general rule, establishing the presence of a lung disease process on the radiograph should constitute the first step in radiological diagnosis of chest disease.

**Basic radiographic techniques**

Diagnostic accuracy in chest disease is partly related to the quality of the radiographic images themselves. Several variables such as patient position, patient respiration and film exposure factors must be taken into account to ensure image quality (table 1). Positioning of the patient must be such that the X-ray beam is properly centred, the patient’s body not rotated and the scapulas rotated so that they are projected away from the lungs. Patient respiration must be fully suspended, preferably at total lung capacity. Film exposure factors should be such that faint visualisation of the thoracic spine and the intervertebral disks on the postero–anterior (PA) radiograph is possible and that lung markings behind the heart are clearly visible. Exposure should be as short as possible, consistent with the production of adequate contrast. A high-kilo voltage technique appropriate to the film speed should be used.

**Projections**

**PA and lateral projection** The most satisfactory routine radiographic views for evaluating the chest are the PA and lateral projections with the patient standing (fig. 1). The combination of these two projections provides very good three-dimensional information. In patients who are too ill to stand up, antero–posterior (AP) upright or supine projections offer alternative but considerably less satisfactory views. The AP projection is of inferior quality because of the shorter focal-film distance, the greater magnification of the heart, and often the restricted ability of these patients to suspend respiration or achieve full inspiration. Based on a review of the literature and recommendations of the American College of Radiology and the American Thoracic Society, recommendations on the use of chest radiographs are summarised in table 2.

**Lateral decubitus projection** For the lateral decubitus projection, the patient lies on one side and the X-ray beam is oriented
horizontally. This technique is particularly helpful for the identification of small pleural effusions. <100 mL of fluid may be identified on well-exposed radiographs in this position. Radiography in the lateral decubitus position is also useful to demonstrate a change in position of an air–fluid level in a cavity or a freely moving intracavitary loose body (e.g. fungus ball in aspergilloma).

**Lordotic projection** The lordotic projection can be made in AP or PA projection. For this projection, the patient stands erect and the X-ray tube is angled 15° cephalad. The main advantage of this modification is its reproducibility. The lordotic projection can be used: 1) for improving visibility of the lung apices, superior mediastinum and thoracic inlet, and 2) for identifying the minor fissure in suspected cases of atelectasis of the right middle lobe.

**Oblique projection** Oblique studies are sometimes useful in locating a pleural or chest wall disease process (e.g. pleural plaque); however, in most situations, computed tomography is preferred.

**Inspiratory–expiratory radiography**

Comparison of radiographs exposed in full inspiration and maximal expiration may supply useful information in two specific situations. The first indication is the evaluation of air trapping, either focal or general. With air trapping, diaphragmatic excursion is reduced symmetrically and lung density changes little between expiratory and inspiratory radiographs. The second indication is when a pneumothorax is suspected and when the visceral pleural line is not visible on the standard inspiratory radiograph or the findings are equivocal. In these situations, a film taken in full expiration may show the line more clearly.

**Bedside radiography**

Chest radiography, performed at the bedside with portable apparatus, is one of the most frequently performed radiological examinations; however, this technique is also the examination with the most variation in image quality. The amount of diagnostic information provided by chest examinations done with portable apparatus is high, and many abnormalities are detected. These examinations are useful 76–94% of the time. However, poor image quality and day-to-day variations in film density interfere with the detection of interval changes in patients with pulmonary diseases. The need to improve the image quality of this examination has long been recognised, but it is a difficult problem to solve.

**Digital chest radiography**

There have been many remarkable advances in conventional thoracic imaging over the past decade. Perhaps the most remarkable is the rapid conversion from film-based to digital radiographic systems. Digital radiography (DR) is the common name for different technologies that are characterised by a direct readout matrix that covers the whole exposure.
Figure 1. Postero-anterior chest radiograph. Normal lungs are visible as black fields (air) (*) with superposition of multiple white linear structures (vessels and walls of airways). The lunghili consist of bronchi (main stem (1) and lobar bronchi) and vascular structures (pulmonary arteries (2) and pulmonary veins). A normal pleura is not visible on a chest radiograph. In the mediastinum we can visualise the trachea (3) as a translucent tube on the midline, the aortic arch (4), the pulmonary trunk (5), the left border or the heart formed by the left ventricle (6) and the right border of the heart formed by right atrium (7). A normal heart has a normal cardiothoracic index: (a+b)/maximal diameter of the chest (c) must be less than 0.5. The bony components of the chest visible on the frontal view are: the ribs (+), the manubrium sternum (8), the claviculae (9), the scapulae (10) and the vertebral bodies on the midline. The diaphragm (11) is sharply delineated and also the costophrenic angles (12) must be sharp and free. b) Lateral chest radiograph. The lateral chest film can be used to localise better the findings on the frontal view. Numbers and symbols are as for a).

Table 2. Recommendations for the use of chest radiography

<table>
<thead>
<tr>
<th>Indications</th>
<th>No indications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signs and symptoms related to the respiratory and cardiovascular system</td>
<td>Routine screening of unselected populations</td>
</tr>
<tr>
<td>Follow-up of previously diagnosed thoracic disease for evaluation of improvement resolution, or progression</td>
<td>Routine prenatal chest radiographs for the detection of unsuspected disease</td>
</tr>
<tr>
<td>Staging of intrathoracic and extrathoracic tumours</td>
<td>Routine radiographs solely because of hospital admission</td>
</tr>
<tr>
<td>Pre-operative assessment of patients scheduled for intrathoracic surgery</td>
<td>Mandated radiographs for employment</td>
</tr>
<tr>
<td>Pre-operative evaluation of patients who have cardiac or respiratory symptoms or patients who have a significant potential for thoracic pathology that may lead to increased peri-operative morbidity or mortality</td>
<td>Repeated radiograph examinations after admission to a long-term facility</td>
</tr>
<tr>
<td>Monitoring of patients who have life support devices and patients who have undergone cardiac or thoracic surgery or other interventional procedures</td>
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area. Conversion of X-ray intensity into electrical signals can either be direct (selenium-based systems) or indirect (scintillator/photodiode systems). Advantages of DR systems are a high image quality and the potential for dose reduction. This technique is now the preferred imaging modality for bedside chest imaging because of its more consistent image quality. DR is rapidly replacing film-based chest units for in-department PA and lateral examinations. The final aim is to realise a completely integrated digital radiology department throughout the hospital connected to a large digital image archiving system. This concept, referred to as picture archiving and communication systems (PACS), represents the logical culmination of the extensive research that is continuing in this area.

**Chest fluoroscopy**

Chest fluoroscopy was a popular procedure a generation ago. Patients were examined fluoroscopically in various projections, and multiple spot radiographs were obtained with barium in the oesophagus. Examinations to evaluate pericardial effusion also were frequent. Overall diminution in cardiac pulsation and greater pulsation of the posterior cardiac wall in the lateral projection were thought to be signs of effusion. Other indications for fluoroscopy included the investigation of foreign bodies determined by air trapping and appropriate mediastinal shift and the evaluation of diaphragmatic paralysis. This evaluation of diaphragmatic paralysis is still an indication for fluoroscopy today.

**References**

- American College of Radiology. ACR Standard for the Performance of Pediatric and Adult Chest Radiography. Reston, American College of Radiology, 1997; p. 27.