Interpreting the chest radiograph

Donna-Marie Rigby

Linda Hacking

Abstract

Presented is an approach to a chest radiograph, paying particular attention to features commonly seen in the intensive care unit (ICU) with regards to iatrogenic lines and tubes, together with common pathologies that may be encountered. This is accompanied by helpful images to use as an aide memoire when reviewing ICU chest x-rays. Pitfalls in interpreting these often complex x-rays are also discussed.

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
- evaluate chest X-ray lines and tube in patients on the ICU
- categorize interstitial, alveolar and pleural disease based on their appearance
- be aware of pitfalls when interpreting x-rays in the ICU setting

Developing your system[1] (Figure 1)

Identification: patient demographics, side marker and projection

A must when reviewing a radiograph is to check that you have the right patient and the correct date and time the imaging was performed. Check the film is orientated correctly (left and right) and be mindful of its projection (posteroanterior [PA] or anteroposterior [AP]) in order to draw the correct conclusions.

Film quality: coverage, rotation, exposure

It is essential to ensure relevant anatomy is included, from the apices to just below the diaphragm. Ideally, the film should be well centred, with equal distance from the spinous process to the medial borders of the clavicles. Any rotation will alter the interpretation of the mediastinal contours and the lungs. Ensure you can see vertebrae centrally to ensure the exposure is correct, maximizing the pathology that can be identified.

Lines and tubes: systematic review of all foreign objects on the film

This is of relevance to your patients in the ICU, paying particular attention to any lines or tubes. By reviewing these first, this will allow any immediate repositioning to be undertaken. This is discussed in more detail later.

Mediastinum and heart

Trace out the cardiac borders and be alert to any missing or enlarged border. Missing borders indicate an adjacent similar density (soft tissue or fluid) that prevents the air in the lungs outlining the heart and creating a silhouette. Any enlargement should alert you to pathology, of which the causes are extensive, however commonly due to cardiomegaly, mediastinal lymph nodes, pericardial effusions and adjacent lung tumours.

Lungs and pleural spaces

Cast your eyes over the lungs as a whole to get an overview. Then work systematically from top to bottom, reviewing the upper, middle and lower thirds to locate any pathology. Once each lung has been reviewed in this manner, compare right to left to allow for any additional differences to be spotted swiftly. Finally trace around the periphery of the lungs, adjacent to the chest wall to detect pneumothoraces, pleural effusions, pleural calcification and pleural malignancies.

Diaphragm

Follow the diaphragm from right to left, noting its position and review the area below for any evidence of free air to suggest intra-abdominal pathology such as a perforated hollow viscus.

Bones

The bones can be overwhelming without a system. So, review the clavicles and shoulders followed by the right-sided ribs in pairs and then the left. Trace out the ribs from posterior to anterior, using two fingers to guide your eyes, therefore never overlooking a missing rib or bony abnormality.

Soft tissues and peripheries of the film

Finally, scan your eyes around the edges of the film as you never know what you might pick up that has previously been overlooked: a mastectomy, axillary clips, subcutaneous emphysema, soft tissue nodules, neck masses, missing bones and so on. This may then prompt a further review of the chest X-ray to discover more pathology or clues to a diagnosis.

A final note on developing your system is that you should routinely review the patients previous x-rays together with their reports as these often add valuable information and assist in forming your diagnosis and differentials.

Analysing lines and tubes

Endotracheal tubes (ET) and tracheostomies

ET tubes should lie approximately 4 cm above the carina (the bifurcation of the trachea into right and left main bronchi) allowing for alterations in the patients position and hence maintaining adequate ventilation (Figure 2).

Donna-Marie Rigby *MBChB FRCR is an ST4 Radiology Trainee in the North West Deanery, currently at Royal Bolton Hospital, UK. Conflicts of interest: none declared.*

Linda Hacking *MBChB FRCR FAcadMED PG Cert (Med ed) is a Consultant Radiologist at Blackpool Victoria Hospital and Honorary Clinical Senior Lecturer at the University of Liverpool, UK. Conflicts of interest: none declared.*

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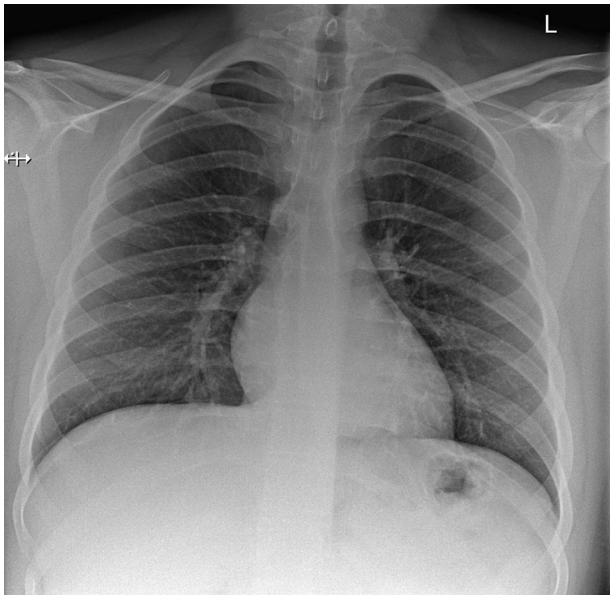

Figure 1 Normal chest X-ray. It is useful to have a normal chest X-ray as a reference when looking at ICU X-rays as this allows the eye to detect abnormalities more easily.

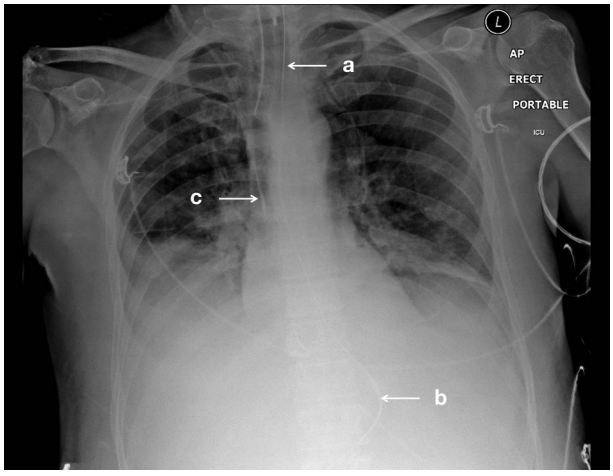

Figure 2 AP portable chest X-ray of a sick patient in ICU. Note the positions of the (**a**) ET tube, (**b**) NG tube and (**c**) internal jugular line.

Tracheostomy tubes are also increasingly seen in intensive care patients and their appearance and position should again be instantly recognizable (Figure 3).

Nasogastric (NG) tubes

An NG tube should follow the course of the oesophagus just to the left of the midline, and the tip lies below the diaphragm in the stomach, usually slightly to the left. However, this varies with patient posture, rotation and orientation of the stomach (Figure 2).

Central lines: internal jugular and subclavian

A central line should have the tip projected over the superior vena cava and follow the normal anatomical course of the vessel it has been inserted into. The internal jugular should run its course parallel to the neck, and the subclavian along the third rib

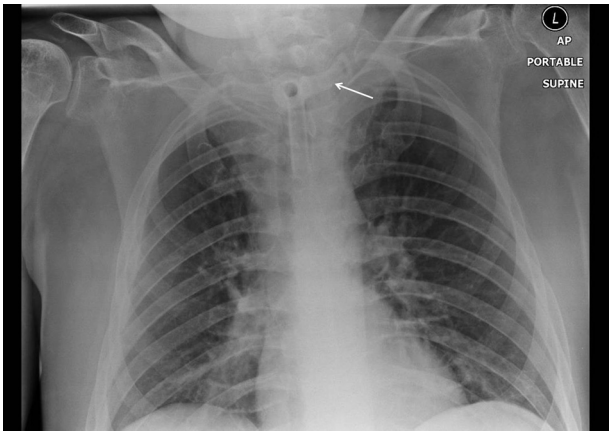

Figure 3 AP chest X-ray of a recovering patient on the ICU with a tracheostomy in situ. Note the external strap to secure the airway, projected over the patient's neck.

space parallel to the clavicle. Always check for an inadvertent pneumothorax or a particularly low course (into the atria and beyond) (Figure 2). If the lines or tubes take an unexpected course it is worth liaising with your local radiologist for advice on whether the patient may have an anatomical variant to explain the appearances or whether they will require line replacement.

Cardiac devices

These come in a variety of shapes and sizes, including internal cardiac defibrillators (ICD), permanent pacemakers (PPM), loop recorders and newer devices such as wireless pacemakers and MR compatible devices. Make a note of any such device before requesting any magnetic resonance imaging (MRI) and review the patient's pacemaker notes to ensure compatibility (Figure 4).

Pleural catheters

One of the more familiar catheters noted on a radiograph is the pleural drain, in particular in trauma and postoperative

Figure 4 On this thoracic spine X-ray you will see a small device over the cardiac shadow. This is the classic location of a lead-less pacemaker, directly implanted in the patient's heart. Nowadays, these are increasing in popularity and also more likely to be MRI safe.

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