

Abdominal x rays made easy: normal radiographs

Understanding x ray films is something that all clinical students should get to grips with. Starting out as a doctor, you will not need to be an expert but you will need to know the basics. **Ian Bickle** and **Barry Kelly** present the first part of a new series on interpreting plain abdominal radiographs

The abdominal radiograph is one of the most commonly requested images, and all medical students should have a knowledge of common radiological interpretations. This article covers the radiology of normal findings. Subsequent parts of the series will cover abnormal intraluminal gas, abnormal extraluminal gas, calcification, bone and soft tissue abnormalities, and iatrogenic, accidental, and incidental objects.

The standard abdominal radiograph (AXR) taken is a supine projection: x rays are passed from front to back (anteroposterior projection) of a patient lying down on his or her back. In some circumstances an erect AXR is requested: its advantage over a supine film is the visualisation of air-fluid levels. A decubitus film (patient lying on his or her side) is also of use in certain situations.

Although an AXR is a plain radiograph, it has a radiation dose equivalent to 50 posteroanterior chest x rays or six months of standard background radiation.

As with any plain radiograph, only five main densities are seen, four of which are natural: black for gas, white for calcified structures, grey representing a host of soft tissue with a slightly darker grey for fat (as it absorbs slightly fewer x rays). Metallic objects are seen as an intense bright white. The clarity of outlines of structures depends, therefore, on the differences between these densities. On the chest radiograph, this is easily shown by the contrast between lung and ribs—black air against the white calcium containing bones. These differences are much less apparent on the AXR as most structures are of similar density—mainly soft tissue.

Technical features

It is important, as with any image, that the technical details of an AXR are assessed. The date the film was taken and the name, age, and sex of the patient are all worth noting. This ensures you are interpreting the correct film with the correct clinical information and it also may aid your interpretation. You would be a little concerned if you saw what appeared to be a calcified fibroid on an AXR when holding the notes of Mr John Brown.

Next ask what type of AXR is it: supine,



Figure 1. Normal film

erect, or decubitus? Unless specifically labelled the film is taken to be supine.

The best way to appreciate normality is to look at as many films as possible, with an awareness of anatomy in mind (fig 1).

Intraluminal gas

Begin by looking at the amount and distribution of gas in the bowels (intraluminal gas). There is considerable normal variation in distribution of bowel gas. On the erect



Figure 2. Rectal gas film

AXR, the gastric gas bubble in the left upper quadrant of the film is a normal finding. Gas is also normally seen within the

large bowel, most notably the transverse colon and rectum (fig 2).

Important characteristics of bowel loops to bear in mind are their size and distribution (where they are situated in relation to other structures). Normal small bowel should measure less than 3 cm in diameter, whereas normal colon should measure less than 5 cm in diameter. The diameter of the caecum may be



Figure 3. Valvulae conniventes

greater, but if it is greater than 9 cm it is abnormal. Large bowel should lie at the periphery of the film, with small bowel distributed centrally. Small and large bowel can also be distinguished, most easily when dilated, by their different mucosal markings. Small bowel has valvulae conniventes that transverse the full width of the bowel; large bowel has haustra that cross only part of the bowel wall (figs 3 and 4). These features are important in the next part of this series, which considers abnormal intraluminal gas. Occasionally, fluid levels in the small bowel are a normal finding. Valvulae conniventes and haustra films

Faecal matter in the bowel gives a "mottled" appearance (fig 5). This is seen as a mixture of grey densities representing a gas-liquid-solid mixture.

Extraluminal gas

Gas outside the bowel lumen is invariably abnormal. The largest volume of gas you might see is likely to be under the right diaphragm: this occurs after a viscus has



Figure 4. Haustra films



Figure 5. Faecal mottling

Presenting the AXR

This is the supine abdominal radiograph of a 42 year old women taken yesterday. It is technically satisfactory. The amount and distribution of gas within the bowel is normal. There is no bowel dilatation. There is no evidence of extraluminal air. Soft tissue outlines of the psoas muscles and kidneys are seen. The kidneys are normal in size and shape. There are no apparent bony lesions or abnormal calcification. Incidentally, sterilisation clips can be seen within the pelvis indicating previous gynaecological intervention.

been perforated. This gas within the peritoneal cavity is termed pneumoperitoneum.

Gas in the right upper quadrant within the biliary tree is a “normal” finding after sphincterotomy or biliary surgery, but it can indicate the presence of a fistula between the biliary tree and the gut.

Beware of gas in the portal vein, as this can look very similar to biliary air. Gas in the portal vein is always pathological and frequently fatal. It occurs in ischaemic states, such as toxic megacolon, and it may be accompanied by gas within the bowel wall (intramural gas).

Calcification

Calcium is visible in a variety of structures, both normal and abnormal, and becomes more common with advancing age. However, review the following areas in particular for evidence of calcification: cartilage of ribs, blood vessels (chiefly the aortoiliac and splanchnic arteries), pancreas, kidneys, the right upper abdominal quadrant for gall-bladder calculi, and the pelvis, which may contain a variety of calcified structures,

Places to look for abnormal extraluminal gas

- Under the diaphragm
- In the biliary system
- Within the bowel wall

most commonly phleboliths. Part 4 of this series is dedicated to calcification on AXR.



Figure 6. Gastric pseudotumour

Soft tissues and bone

A review of the soft tissues entails evaluating the outlines of the major abdominal organs. Observing these structures is made easier by the “fatty” rim (peritoneal fat lines) surrounding them. In fact, the loss of these fat planes may indicate an ongoing pathological process, such as peritonitis. Look at the size and position of the liver and spleen. Look at the position and size of the kidneys, lateral to the midline in the region of the T12-L2 vertebrae (a useful way of identifying vertebrae: the lowest one to give off a rib is T12 and serves as a reference point). The renal outline is usually three to three and a half vertebral bodies in length. Also, look for the clear outline of the psoas muscle shadow(s). Finally, try to identify the outline of the bladder, seen more clearly if full, within the pelvis. The

Key to densities in AXRs

- Black—gas
- White—calcified structures
- Grey—soft tissues
- Darker grey—fat
- Intense white—metallic objects

appearance of what looks like a soft tissue mass in the region of the stomach is more often than not actually a gastric pseudotumour. This is a normal finding on the supine film and represents gastric fluid lying within the fundus (fig 6).

The assessment of bones entails evaluating the spine and pelvis for evidence of bony pathology. Osteoarthritis frequently affects the vertebral bodies, as well as the femoral and the acetabular components of the hip joint. Paget’s disease may also be identified, commonly along the iliopectineal lines of the pelvis. Your bone survey should also check for fractures, especially subtle femoral neck fractures in elderly people. The spine and pelvis are also common locations for metastatic deposits. In the spine this is classically seen as “the absent pedicle.”

Artefacts

You should be able to identify “man made” structures correctly. These may be iatrogenic (put there by health professionals), accidental (put there by the patient or other), or projectional (lying in front of or behind the abdomen but spuriously projected within it on the AXR). Examples of iatrogenic structures would be surgical clips, an interuterine contraceptive device, renal or biliary stent, an endoluminal aortic stent, or inferior vena cava filter. Accidental findings include bullets or a per rectum object. Projectional findings include pyjama buttons, coins in pockets, or body piercings (see part 6 of the series).

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Next month: Abnormal intraluminal gas

Review points

- Technical specifics of the radiograph
- Amount and distribution of gas
- Extraluminal gas
- Calcification
- Soft tissue outlines and bony structures
- Iatrogenic, accidental, and incidental objects