Plain abdominal x-ray

We have many ways of getting images of the abdomen with ultrasound, CT and MRI but the plain abdominal x-ray is the one that is most readily available in the emergency situation when a patient presents with acute abdominal pain.

X-rays should never be requested without due consideration. They expend resources and expose the patient to ionizing radiation. They are an adjunct to history and examination.

Value and limitations Criticisms of requests for abdominal films[1]often quote a low number of cases in which the diagnosis or management was changed by the x-ray. A survey[2]found that there were abnormalities in 66% of films but the surgical registrar altered his diagnosis in only 7% and his management in 4% with the interpretation that "The investigation was of immediate clinical value in only 4% of the patients, and its use could probably be limited without detriment to patients." This is unfair and does not mean that 96% were a waste of time and radiation. It is often reassuring to have confirmation of a clinical diagnosis. A negative result is a retrospective assessment but it is not easy to be so sure before the investigation and surprises do occur.

Erect abdominal x-rays are requested to look for fluid levels in obstruction or ileus. Air under the diaphragm may be seen in an erect picture if the bowel has been perforated although a CXR is more usual to look for that sign. Abdominal x-ray is of no value in haematemesis. Avoiding erect pictures where unnecessary and avoiding plain films for haematemesis will reduce the level of unnecessary films[3]

Renal colic If a patient presents with loin pain the possibility of renal colic is high. A KUB picture is requested. This is a large film that is designed to take in the kidneys, ureters and bladder. About 90% of renal stones are radio-opaque. Uric acid stones especially may be missed. False positives may occur from phleboliths that are commonest in the pelvic veins and false negatives from small stones. On the right calcification may represent gallstones but only a minority of gallstones are radio-opaque. The presence of gallstones does not confirm biliary colic as the cause of pain as gallstones become more frequent with age and are often asymptomatic[4]Doctors in A&E tend to be poor at identifying stones on plain films and if urinalysis is negative the diagnosis is unlikely to be renal colic[5]

Intestinal obstruction Erect and supine films are used to confirm the diagnosis. Obstruction of the small bowel shows ladder-like series of small bowel loops but this also occurs with an obstruction of the proximal colon. Fluid levels in the bowel can be seen in upright views. Distended loops may be absent if obstruction is at the upper jejunum. Obstruction of the large bowel is more gradual in onset than small bowel obstruction. The colon is in the more peripheral part of the film and distension may be very marked. Fluid levels will also be seen in paralytic ileus when bowel sounds will be reduced or absent rather than loud and tinkling as in obstruction. In an erect film a fluid level in the stomach is normal as may be a level in the caecum. Multiple fluid levels and distension of the bowel is abnormal.

Perforation of the intestine If the bowel has been perforated and a significant amount of gas has been released it will show as a translucency under the diaphragm on an erect film. Gas will also be found under the diaphragm for some time after laparotomy or laparoscopy.

Appendicitis An appendicolith may be apparent in an inflamed appendix in 15% of cases but as a diagnostic point in the management of appendicitis the plain x-ray it is of very limited value[6]although it may be of value in infants[7]

Intussusception Intussusception occurs in adults and children. A plain abdominal radiography may show some characteristic gas patterns[8]. A sensitivity and specificity of 90% adds to this rather difficult diagnosis but ultrasound is vastly superior[9]

Body packers An increasing problem is people who swallow drugs, usually in condoms, to evade detection. There may be signs that the drugs are leaking but the carrier is unwilling to disclose the fact for fear of a long prison term, even if his life is at risk. A plain abdominal x-ray will show 90% of cases but there will be false positives in 3%[10]. Hence a positive result is likely to be true but a negative result does not exclude the clinical suspicion adequately and an ultrasound examination may be considered.

Systematic approach to viewing films There are many valid routines. This is just one.

- As always, start by identifying the name on the film and the date. If there are previous films use them for comparison.
- What is the projection of the film? Is if PA or AP? Most are PA.
- Is the view Supine, Erect or Lateral Decubitus? Are there erect and supine films? If so decide which is which.
- Confirm that an adequate area has been covered, especially for a KUB. An abdominal film should include the lower anterior ribs.
- Check exposure. If the spine is visible most structures to be seen will be visible. Under-penetration is not usually a problem. Overexposure (dark areas) should be viewed with a bright light.
- Artefacts may be immediately obvious. Piercing of the umbilicus is very popular, especially in young women but genital piercing is not infrequent. Metallic objects are obvious. There may be clips or materials from previous surgery. Occasionally a retained surgical instrument is seen. Swabs contain a radio-opaque band.

Solid organs, hollow organs and bones can be classified as:

- Visible or not visible
- Normal in size, enlarged, or too small
- Distorted or displaced
- Abnormally calcified
- Containing abnormal gas, fluid, or discrete calculi

Bones Look in a specific order and keep to your regime.

- Lower Rib Cage
- Lumbar Spine
- Sacrum
- Pelvis
- Hip Joints

Check bones for:

- Cortical Outline

- Joint and Disc Space
- Trabecular Pattern
- General Bone Density
- Lysis, Fracture, Sclerosis
- Epiphyseal Lines

Solid organs

- Liver – There is soft tissue density in the right upper quadrant that displaces any bowel from this area.
- Spleen - Soft tissue mass in the left upper quadrant about the size of a fist. It may be clear or obscured but usually is not seen at all.
- Kidneys – A shadow may be visible. The left kidney is higher than the right. The upper poles tilt medially. They should be about 3 vertebrae in size.
- Psoas Muscles - Form straight lines extending infero-laterally from the lumbar spine to the lesser trochanter of the femur.
- Bladder - If the bladder is full, it will appear as a soft tissue density in the pelvis.
- Uterus - Sits on top of and may indent the bladder. It is often not seen on plain films.
- Prostate - Sits deep in the pelvis. Usually only seen if calcified.

Hollow organs

- Stomach - When supine, air in stomach will rise anteriorly and fluid will pool posteriorly.
- Small Bowel - Gas will be seen in polygonal shapes due to peristalsis. Normal small bowel is 2.5 to 3.0 cm in diameter. Valvulae may be seen crossing the entire lumen. Often little small bowel is seen on a plain film.
- Appendix - Occasionally an appendicolith is seen. Less commonly barium from an old study, or ingested foreign bodies appear in the appendix.
- Colon - Start in the right iliac fossa with the caecum that may show fluid levels. Follow it up to the hepatic flexure, over to the splenic flexure, and down into the pelvis. It may be filled with air or faeces. Shape may altered by redundant bowel. The colon is in the periphery of the abdomen.

Normal Calcification

- Costal cartilage
- Mesenteric lymph nodes
- Pelvic vein phleboliths
- Prostate gland

Abnormal calcification *Calcium indicates pathology in*

- Pancreas
- Renal parenchymal tissue

- Blood vessels and vascular aneurysms
- Gallbladder fibroids (leiomyoma)

Calcium is the pathology in

- Biliary calculi
- Renal calculi
- Appendicolith
- Bladder calculi
- Teratoma

Costal cartilages may be calcified, especially in the elderly. It can look dramatic but is benign.

Mesenteric lymph nodes may calcify and be confused with ureteric calculi. They are usually oval in shape. The line of the ureter is along the transverse processes of the lumbar vertebrae. Phleboliths from calcified pelvic veins may appear like bladder stones. Calcification may appear in the ageing prostate, low down in the pelvic brim. Prostate calcification may also occur in malignancy but it is not diagnostic.

The pancreas lies at the level of the T9 to T 12 vertebrae. Calcification occurs in chronic pancreatitis and may show the whole outline of the gland.

Between the levels of T12 and L2, nephrocalcinosis may be seen. Calcification of the renal parenchyma indicates pathology including hyperparathyroidism, renal tubular acidosis, and medullary sponge kidney.

Calcification of blood vessels usually affects the arteries and can be quite striking. The whole vessel may be outlined by calcium. Extensive calcification may indicate widespread atheroma, especially in diabetes.

Abdominal aortic aneurysms are usually below the 2nd lumbar vertebra. Calcification may make them obvious and can give a rough indication of the internal diameter. Abdominal ultrasound is required for accurate assessment, and to determine the need for surgery or follow up.

Uterine fibroids can become calcified.

Gallstones are visible in only 10 to 20% of cases. Ultrasound is vastly superior but plain abdominal x-ray is often the initial investigation in patients with abdominal pain. The gallbladder may become calcified after repeated episodes of cholecystitis. This is called a porcelain gallbladder and 11% will become malignant[11].

Renal calculi tend to obstruct at certain sites, especially the pelviureteric junction, brim of the pelvis, and vesicoureteric junctions.

In the pelvic region bladder calculi may occasionally be seen. Bladder stones are usually quite large and often multiple. Calcification of a bladder tumour may also occur. Schistosomiasis may produce calcification of the bladder wall.

Sometimes ovarian teratoma may show a tooth. This is of passing interest although such an ovarian tumour can undergo torsion.

BestBETS

1. Role of plain abdominal radiograph in the diagnosis of intussusception

Clinical bottom line
Plain abdominal radiography adds little to the management of patients with suspected intussusception

2. Abdominal radiography in 'Body Packers'.

Clinical bottom line
A single abdominal radiograph is insufficiently sensitive to rule-out abdominal drug carriage. However, specificity is high and a positive finding is diagnostic.

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