Everyday Practice

Abdominal radiograph: Archaic modality or still clinically relevant?

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INTRODUCTION

The plain abdominal radiograph is one of the most commonly requested investigation in the emergency room. Traditionally, it was the initial investigation done to evaluate any abdominal pathology. Although there has been a paradigm shift towards the use of ultrasonography and computed tomography in any abdominal emergency, the role of a conventional abdominal radiograph cannot be underestimated. The plain radiograph is most useful in patients who have considerable abdominal tenderness and in those with clinical suspicion of bowel obstruction, perforation or ischaemia, or urinary calculi.[1] It still has a major role in ruling out bowel obstruction or a large perforation.

The standard abdominal radiograph is an anterior–posterior view, taken with the patient in the supine position and with her/his breath held in expiration. The area from the xiphisternum to the lower border of the symphisis pubis must be included. A gonadal shield must be used if it does not hamper the clinical objective of the investigation. The role of an erect abdominal film is debatable.[2] Although this supplemental view may be omitted to reduce the time and cost of examination, we routinely perform this view to improve the degree of confidence with which a diagnosis of obstruction can be made. For detection of a pneumoperitoneum, an erect chest radiograph is more sensitive than an abdominal film.[3] A left lateral decubitus view (taken with the patient in the left lateral position for 10 minutes and a horizontal X-ray beam) is also highly sensitive in demonstrating small amounts of extraluminal air. Once a radiograph has been taken, we need to look at the bowel gas pattern, organ shadows, extraluminal air, calcifications and soft tissue masses.

ABNORMAL BOWEL GAS PATTERNS

Bowel gas is normally visible on an abdominal radiograph, particularly in those segments of a hollow viscus that are placed anteriorly. Gas in the stomach is seen in the left hypochondrium. The gas in the small bowel is located in the central abdomen. The gas filled ascending and descending colon are seen along the lateral walls of the abdomen. The transverse colon gas lies just below the stomach and rectal air is seen in the midline in the pelvis. The small bowel loops have a smaller diameter (<3 cm), are closely spaced and have complete mucosal folds (valvulae conniventes). The colon has a larger diameter (>5 cm), is widely placed and has incomplete haustral folds. An air–fluid level may be seen in the stomach and one or two levels may be seen in the small intestine (in the right lower quadrant) and should not be considered abnormal.[4]

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Small intestinal obstruction

The radiographic picture of small bowel obstruction depends on the site and duration of obstruction, frequency of vomiting and the use of nasogastric suction. With complete obstruction of the bowel, air and secretions accumulate in the proximal loop resulting in its dilatation. The luminal contents of the distal loop and colon are emptied by normal peristaltic motion. Sequential radiographs taken over 12–24 hours are more sensitive than a single film in depicting intestinal obstruction.[5] The most common cause of intestinal obstruction is postoperative adhesions, responsible for 60% of cases. The radiograph may occasionally establish the cause of obstruction, particularly in cases of obstructed hernia, gallstone ileus and intussusception.

Intestinal obstruction is suspected in a patient presenting with colicky abdominal pain, distension and vomiting. Failure to pass flatus and constipation occur in the later stages. Examination reveals a tympanic abdomen with increased tinkling bowel sounds. The presence of abdominal tenderness suggests complicated obstruction. Abdominal radiographs show dilated small bowel loops proximal to the obstruction, with a luminal diameter >3 cm (Fig. 1A).[6] No gas is seen in the colon. Multiple air–fluid levels are visualized depending on the site of obstruction (Fig. 1B). The presence of air–fluid levels at differential heights and a fluid level length >2.5 cm are suggestive of complete obstruction.[7] These two findings together have positive and negative predictive values of 86% and 83%, respectively. In addition, an erect film may show the characteristic 'string of pearls' sign, which corresponds to the beads of air trapped between mucosal folds (Fig. 2). The presence

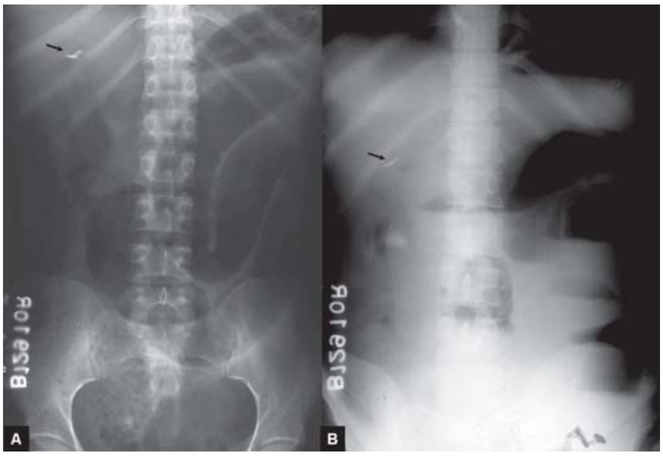

FIG 1. Plain radiograph, supine (A) and erect (B), of a patient with acute abdomen showing dilated jejunal loops with multiple air–fluid levels, producing step-ladder appearance suggestive of small bowel obstruction. A post-cholecystectomy clip is also seen (arrow).

of this sign is highly suggestive of mechanical obstruction, as it is not seen in paralytic ileus. Visualization of an enterolith (Fig. 3) may suggest chronic or recurrent obstruction. In doubtful cases, a barium follow through study can be done.

Obstructed hernia is another common cause of bowel obstruction. An obstructed hernia must be suspected in the absence of a history of surgery. Clinically, an obstructed hernia is irreducible and is associated with pain. In case of an obstructed inguinal hernia, a plain radiograph may show bowel loops below the level of the pubic symphysis with features of obstruction in the bowel proximal to the hernia (Fig. 4).

Intussusception is more common in children with the ileocolic variety being the most common. While in children usually no cause is found, adults often have a lesion at the lead point. Clinically, the condition is associated with pain, vomiting and blood in the stools. An abdominal radiograph may be normal or may show evidence of obstruction. The 'crescent sign' (a crescent of gas around the intusussceptum; Fig. 5A) and 'target sign' (two circles of fat density, when seen enface), often located in the right hypochondrium, may be suggestive.[8] It is important to look for the presence of pneumoperitoneum as it is a contraindication to an enema. Confirmation is done by barium enema, ultrasound or CT scan (Fig. 5B).

Gallstone ileus, seen in <1% of patients with cholelithiasis, should be suspected in a patient with acute cholecystitis who has more prolonged vomiting than in the previous episodes. The radiograph shows air in the biliary tree or gall bladder (in one-third of cases) along with features of obstruction.[8] The obstructing calculus, mostly located in the terminal ileum (Fig. 6), is seen on the radiograph in one-third of cases. A radiographic diagnosis is often missed as typical features are seen in only one-third of cases.[9] Ultrasonography may show the absence of a stone in the gall bladder in a patient known to have cholelithiasis.

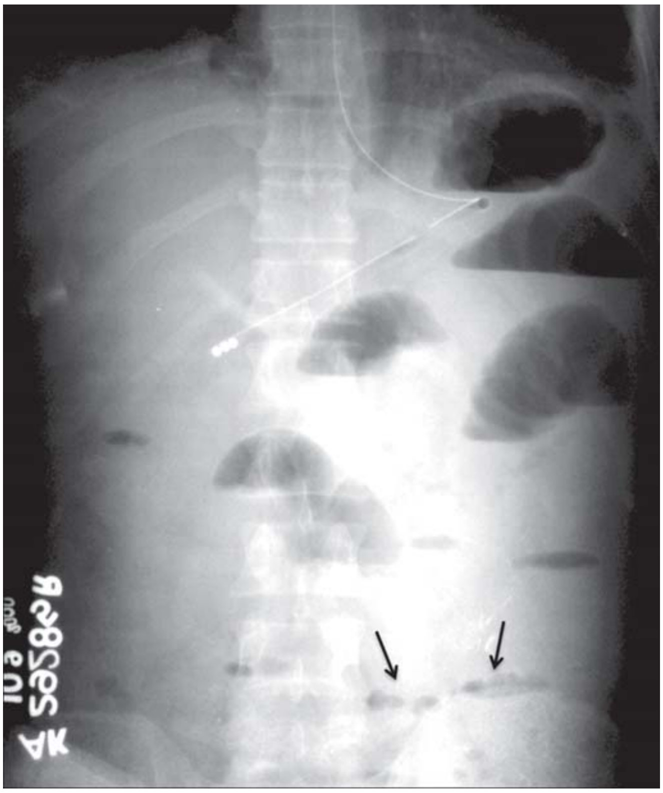

FIG 2. Plain abdominal radiograph (erect) of a patient with small bowel obstruction shows the typical appearance of 'string of pearls' sign (arrows).

FIG 3. Plain abdominal radiograph of a patient with subacute intestinal obstruction showing multiple calcified enteroliths, having a similar shape (arrows).

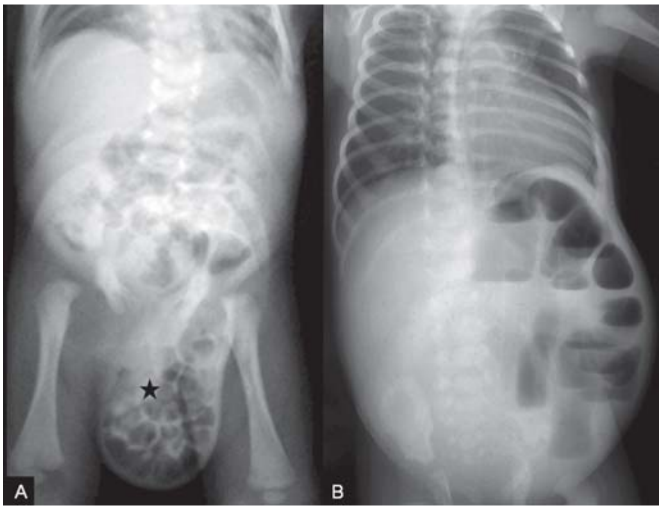

FIG 4. Plain radiographs, supine (A) and erect (B) views, of a 6-month-old child with abdominal distension, vomiting and scrotal swelling depict herniated small bowel loops in the scrotum (star) with dilated proximal small bowel loops showing air–fluid levels suggestive of an obstructed inguinal hernia.

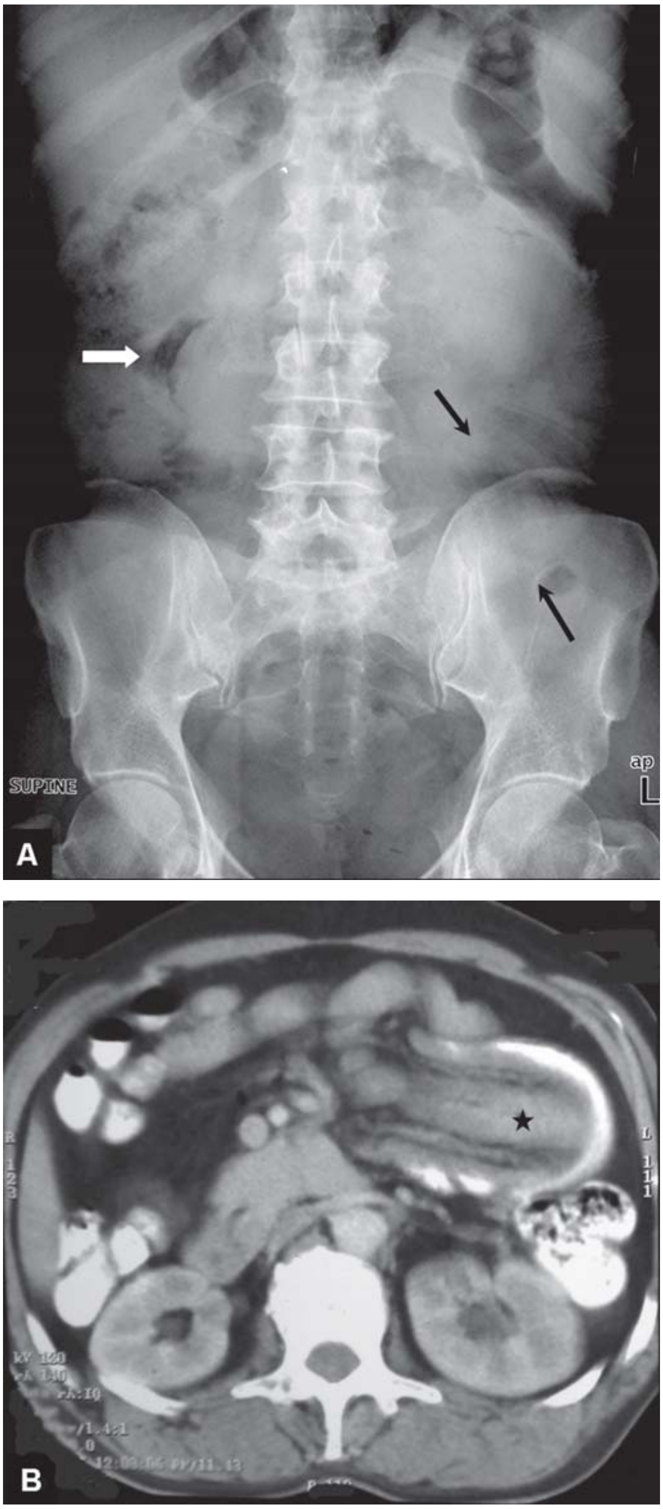

FIG 5. Plain radiograph (A) of a 23-year-old man with pain abdomen showing a dilated loop of intestine with mucosal folds in the left lumbar region (black arrow), which extends to a crescent of air at the lead point (white arrow). The CT scan (B) shows the characteristic 'sausage-shaped' appearance (star) due to the presence of mesenteric fat around the intussusceptum confirming intussusception.

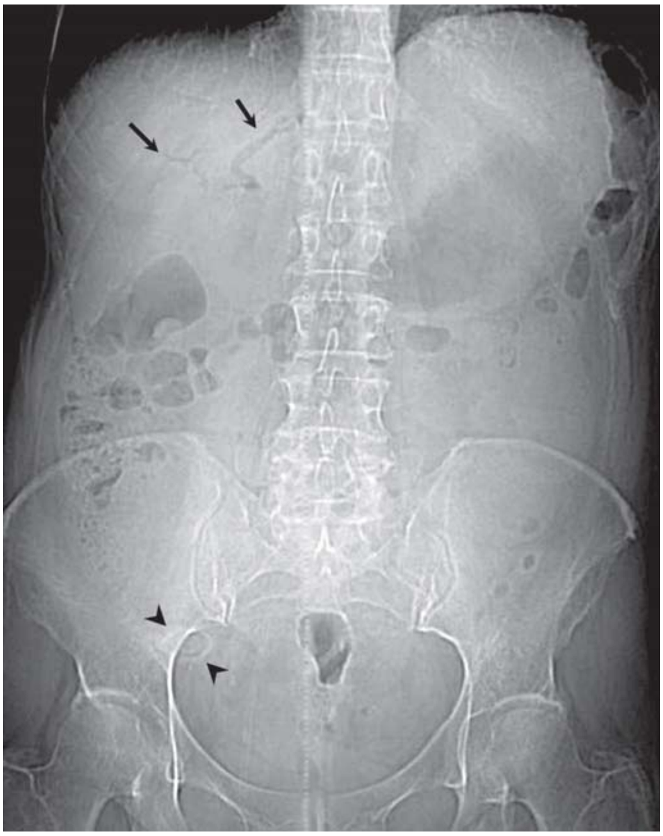

FIG 6. CT scanogram of a patient with gallstone disease done to evaluate fever of unknown origin shows pneumobilia (arrows) with a laminated calculus in the right hemipelvis (arrow head). No evidence of intestinal obstruction was noted which may happen with smaller calculi.

As mentioned above, plain radiograph has a sensitivity and specificity of just over 80%. The sensitivity can be improved if the radiographs are correlated with the presence or absence of bowel sounds.[5] A contrast-enhanced CT scan is the next line of investigation as it not only confirms the presence of obstruction, but frequently also identifies the cause. It has an accuracy of 95% for the diagnosis of obstruction. Ischaemic changes in the bowel are also identified. If no cause is found, adhesions may be the causative factor.[10]

Large bowel obstruction

Colonic obstruction is commonly seen in the sigmoid colon, which has a narrower calibre and more solid faeces. Carcinoma is the most common cause of obstruction and is commonly seen with tumours of the left side of the colon. Other causes include volvulus, hernia and diverticulitis.

Obstruction of the large bowel is characteristically seen on a plain radiograph as dilated, gas-filled colonic loops proximal to the obstruction with little or no gas seen distally (Fig. 7). In patients with a competent ileocaecal valve, the dilatation may become severe and may lead to caecal perforation (especially if the diameter is >10 cm).[11] In patients with an incompetent ileocaecal valve, there is reflux of gas into the distal small bowel and differentiation from a distal small bowel obstruction becomes difficult. Plain radiograph has a sensitivity of 84% and specificity of 72% in the diagnosis of large bowel obstruction.[12] A single contrast barium enema is highly sensitive (96%) and specific (98%) in the diagnosis of obstruction and identifying its cause.[5,12] The features that help in differentiating small and large bowel obstruction are listed in Table I.

TABLE I. Radiographic features of small and large bowel obstruction

Feature	Small bowel obstruction	Large bowel obstruction
Distribution of loops	Central	Peripheral
Luminal diameter	3–5 cm	Usually >5 cm
Number of loops	Many	Few
Mucosal folds	Valvulae conniventes (thin, complete, closely arranged)	Haustrae (thicker, incomplete, widely spaced)

FIG 7. Plain radiograph of a patient with abdominal distension and pain shows a grossly dilated caecum and ascending colon due to obstruction at the level of the transverse colon. Dilated small bowel loops are also seen in the left lumbar region. CT scan (not shown) showed a mass in the transverse colon, which on biopsy, was an adenocarcinoma.

Adynamic ileus

This is a condition of the bowel (small or large) which refers to non-obstructive dilatation of the intestine. Patients present with abdominal distension, usually without pain. The bowel loops show no peristaltic motion and are distended with swallowed air. This can be generalized or localized.

Generalized ileus is most commonly seen in the postoperative period. There is commensurate dilatation of both the small and large bowel, and rectum without any transition point (Fig. 8; *cf*. mechanical obstruction). These patients usually do not present to the emergency room. Clinically, no bowel sounds are heard in contrast to obstruction. It can also be seen in patients with electrolyte imbalance, blunt abdominal trauma, peritonitis and sepsis.[13] *Localized ileus* is seen when there is dilatation of one or two loops of bowel (called 'sentinel loops'). This is commonly seen when there is inflammation in an adjacent organ, viz. acute appendicitis (Fig. 9), acute cholecystitis, acute pancreatitis and diverticulitis. The presence of a localized area of tenderness, reduced or absent bowel sounds with dilated loops in that area on radiographs suggests the diagnosis.

Volvulus

Volvulus is an uncommon condition in which a loop of bowel is twisted on its mesentery that is fixed. This is particularly common with bowel loops which have a long and redundant mesentery (viz. sigmoid colon) and a narrow fixed mesenteric root.[14] The condition may occur intermittently and if the twist is >360°, it may not reduce spontaneously. The consequences of a volvulus are two-fold. First, there is obstruction of the bowel and second, development of vascular compromise of the twisted loop, leading to gangrene, perforation and sepsis. The clinical diagnosis of

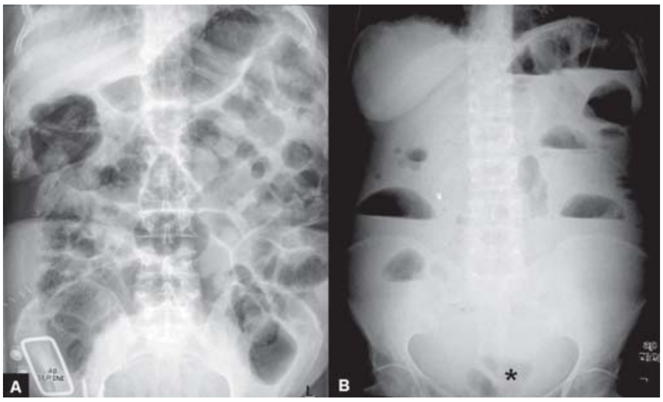

FIG 8. Plain radiographs, supine (A) and erect (B) of a postoperative patient shows commensurate dilatation of the small and large bowel loops with no zone of transition, with air–fluid levels suggestive of paralytic ileus. Rectal air is also seen (star).

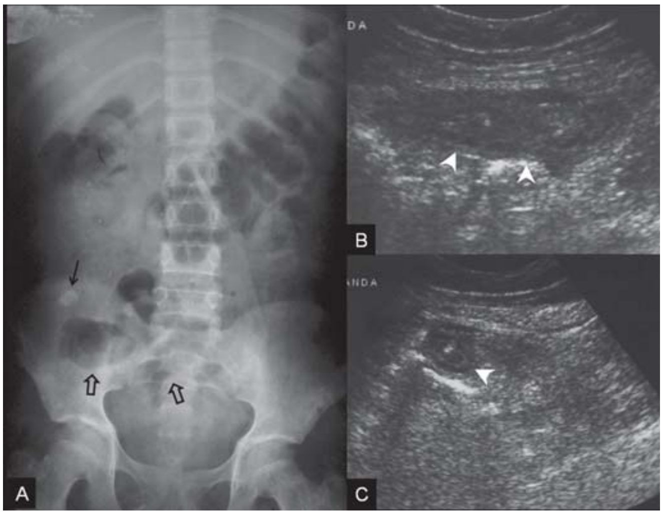

FIG 9. Plain radiograph (A) of a patient with right iliac fossa pain and vomiting shows an appendicolith (arrow) and focal dilatation of distal ileal loops (block arrows). Ultrasonography (B and C) showed a dilated appendix (arrow heads) with positive probe tenderness suggestive of acute appendicitis. The dilated distal ileal loops suggest localized paralytic ileus—the sentinel loop.

volvulus is difficult as patients present with pain and abdominal distension and imaging, including an abdominal radiograph is imperative.

Caecal volvulus is less common than sigmoid volvulus, but accounts for 2%–3% of all colonic obstructions.[5] It occurs more commonly in patients who have a mobile caecum. It is also associated with adhesions, pregnancy and colonoscopy.[15] Plain radiographs, diagnostic in 50%–75% of patients, show gas-filled, dilated caecum ectopically located in the mid-abdomen or left hypochondrium.[5,16] A gas-filled caecum may be kidney or coffee-bean shaped. A single large air–fluid level may be seen on an erect film. The gas may reflux into the distal ileum in case of an incompetent ileocaecal valve and mimic small bowel obstruction. Barium enema shows typical 'beaking' (a beak-like appearance) at the site of the volvulus.

Sigmoid volvulus is the most common type of colonic volvulus. The predisposing factors are chronic constipation, high fibre diet and prolonged bed rest.[17] The patients present with non-specific acute abdominal pain and distension. The plain radiograph is diagnostic in up to 75% of the patients[5] and typically shows an inverted 'U' shaped dilated air–filled ahaustral bowel loop, with its apex lying in the upper abdomen (Fig. 10). No rectal gas is seen. Another important feature is inferior convergence of the two loops, usually on the left side of the pelvis.[16,18] Other features include dilated loops overlapping the descending colon or liver and an air–fluid ratio >2:1. The presence of three signs—apex of the loop under the left hemidiaphragm, inferior convergence to the left and left flank overlap sign—together has a specificity of 100%.

Gastric volvulus may show a distended air-filled stomach but often does not show diagnostic features on plain radiograph. A barium study and CT scan are required for accurate diagnosis.

FIG 10. Plain radiograph of a patient with acute pain abdomen and distension shows an inverted 'U' shaped, dilated sigmoid colon with loops converging towards the pelvis which is diagnostic of a sigmoid volvulus.

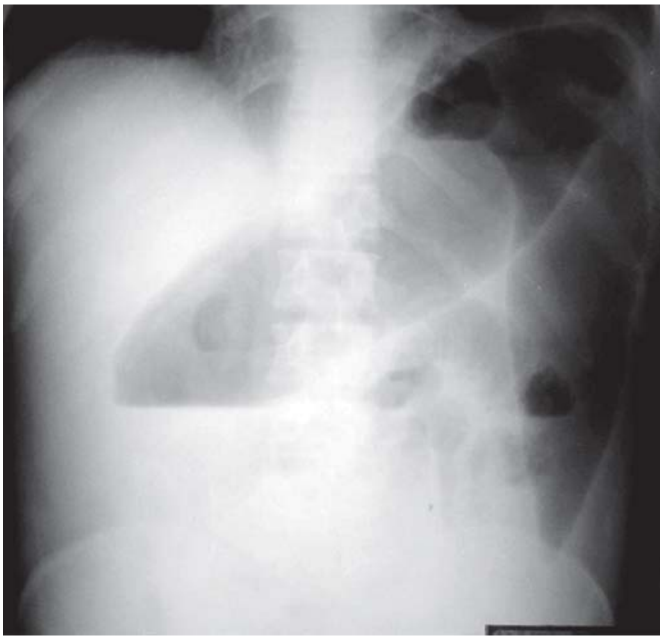

FIG 11. Plain abdominal radiograph of a patient of ulcerative colitis presenting with acute pain abdomen showing grossly dilated ahaustral transverse colon suggestive of toxic megacolon.

Closed loop obstruction

This occurs when a loop of bowel is obstructed at two points. This is commonly seen with hernia, volvulus and adhesions. The involved bowel loop may be grossly dilated and air-filled. If it is filled with fluid, it is seen as a soft tissue mass (pseudotumour). Vascular compromise developing due to strangulation results in bowel wall ischaemia leading to mucosal oedema. A radiological diagnosis is often difficult.

Toxic megacolon

This is a potentially fulminant condition characterized by acute inflammation and dilatation of the colon.[19] It is caused by a variety of conditions, classically by ulcerative colitis. Other causes include granulomatous colitis, pseudomembranous colitis, ischaemic colitis and amoebiasis. The patient presents with high grade fever and has tachycardia and hypotension. The plain X-ray shows dilated ascending and transverse colon, with a diameter of >6 cm (Fig. 11). There is loss of haustrations and the mucosa may show irregularity due to pseudopolyps. A perforation may occur resulting in pneumoperitoneum. The diagnosis must be based on a combination of clinical findings and radiographic appearances so that barium enema, which has the risk of perforation, can be judiciously avoided.

EXTRALUMINAL AIR

Pneumoperitoneum

The presence of free intraperitoneal air in a patient with acute abdomen suggests bowel perforation. Intraperitoneal air usually resolves in 3–7 days after abdominal surgery although small amounts of gas may be detected up to 4 weeks later.[20] Demonstration of pneumoperitoneum is better with an erect chest radiograph than with an abdominal radiograph (Fig. 12).[2] The reasons for this are that the X-ray beam is more parallel to the diaphragm when a chest radiograph is taken. Also, the radiation exposure for a chest film is lower, allowing better visualization of air under the diaphragm (Fig. 12). A left lateral decubitus film is sensitive in detecting even 1 ml of intraperitoneal air (Fig. 13). An erect radiograph typically shows air under the diaphragm. For all these views, the patient must be placed in this position for at least 10 minutes to allow air to move in to the non-dependent position. In sick patients, a supine film may show features of pneumoperitoneum in up to 56%.[21] Most of the features of pneumoperitoneum seen on supine film (when erect film is not possible) require larger amounts of air to be present in the peritoneal cavity (Table II).[22] Demonstration of pneumoperitoneum on a plain radiograph is an indication for immediate surgery. However, when clinical suspicion is high and the radiograph does not show free air, a CT scan, which is very sensitive for picking up pneumoperitoneum, is required.

Pneumobilia

The presence of gas in the biliary tree suggests a communication between the bowel and the bile duct. The causes include an incompetent sphincter of Oddi (post-sphincterotomy and passage of calculus), surgical biliary–enteric anastomosis, gallstone ileus, perforation of a peptic ulcer and trauma.[23] Although of no significance when detected incidentally, pneumobilia in patients with acute abdomen most often suggests gallstone ileus (with features of bowel obstruction), perforated duodenal ulcer, biliary ascaris or rarely, recent passage of calculus (dilated biliary ducts). Knowledge of pneumobilia is also essential to differentiate it from the ominous portal vein gas. The radiograph shows linear, tubular and branching air lucencies over the liver density (Fig. 6). It occupies the central portion of the liver, due to the direction of flow of bile from the periphery to the centre (*cf.* portal vein gas). A CT scan is diagnostic.

Portal vein gas

This is visualized as thin, branching air lucencies, extending up to the periphery of the liver. In severe cases, air may enter the main portal vein. The most important cause of portal vein gas is ischaemia or infarction of the bowel and has a grave prognosis.[24] This finding needs to be looked for in patients with an acute abdomen as it indicates gangrene of the bowel—a surgical emergency. Occasionally, portal vein gas may be seen in benign conditions such as overdistension of the stomach, double-contrast barium enema and post-liver transplantation. In doubtful cases, ultrasonography, which is the most sensitive imaging technique, can be done to detect echogenic moving gas bubbles.

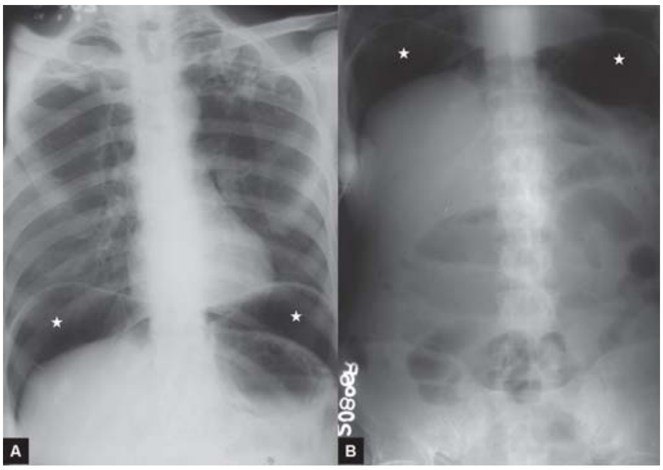

FIG 12. Chest (A) and abdominal (B) X-rays of a patient with tubercular ileal perforation. Air is noted under the diaphragm suggestive of pneumoperitoneum (star). Note that due to lower exposure factors, the outline of the diaphragm is better visualized on the chest film, which is the radiograph of choice to detect free intraperitoneal air. The upper zone of the left lung shows evidence of old pulmonary tuberculosis.

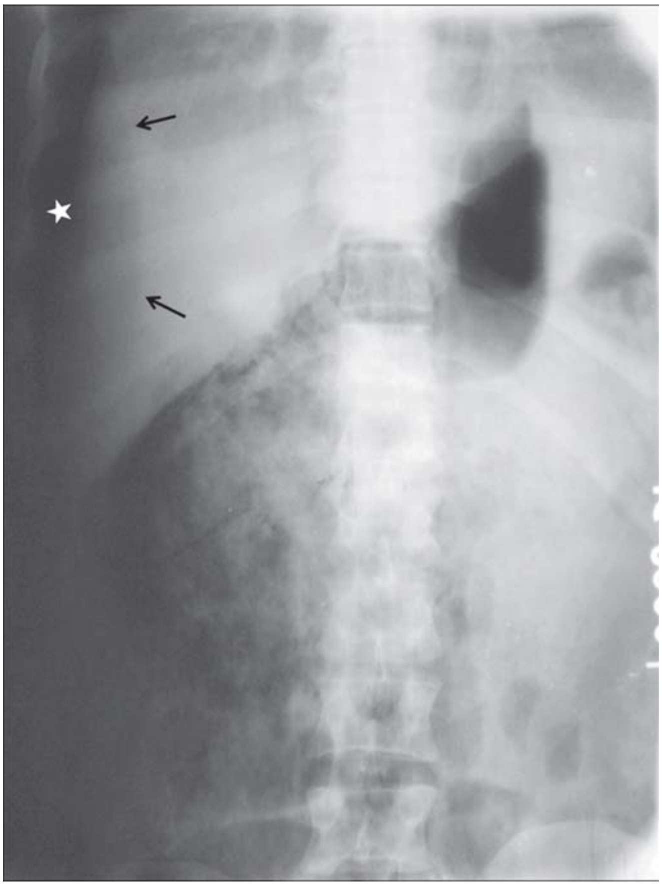

FIG 13. Lateral decubitus radiograph of a patient of polytrauma shows free intraperitoneal air around the liver (star) with a fluid level (arrows) suggesting haemo-pneumoperitoneum and bowel injury.

TABLE II. Radiographic signs of pneumoperitoneum seen on a supine film

Appearances/signs	Description
Rigler/serosal sign	Gas on both sides of the bowel wall outlining it clearly
Cupola sign	Air under the diaphragm allowing visualization of its undersurface
Falciform ligament sign	Outlining of the falciform ligament by free air
Inverted V sign	Outlining of the lateral umbilical ligaments in the lower abdomen by free air
Football sign	Huge amounts of air filling the peritoneal cavity, giving 'American football' appearance; common in infants
Air in Morrison pouch	Linear or triangular collection of gas in the right upper quadrant (loculated air pocket)
Air in lesser sac	Air pocket above the lesser curvature of stomach

Pneumatosis intestinalis (intramural air)

This indicates presence of air in the wall of the intestine. It is caused by a wide variety of causes, ranging from benign to fulminant gastrointestinal diseases.[25] This is of two types: primary and secondary. Primary disease, also called pneumatosis cystoides intestinalis, is rare and frequently involves the left colon.[26] The condition is benign and typically shows multiple intramural air-filled cysts, seen as grape-like clusters on the radiograph. These usually resolve spontaneously. The secondary type is the most common and is associated with bowel necrosis, mucosal inflammatory conditions and obstructive pulmonary disease.[25] Radiographically, it is seen as linear streaks or bubbles of air within the bowel wall. The clinical importance of identifying intramural air is in patients with acute abdomen where it suggests bowel infarction. Here, it may be associated with dilated bowel loops with a nodular mucosa and porto-mesenteric venous gas. CT scan accurately demonstrates these features. The radiological appearance of benign and fulminant causes look similar and a combination of clinical, radiological and laboratory findings are needed for a proper diagnosis.

Pneumoretroperitoneum

The sources of air in the retroperitoneum include perforation of retroperitoneal parts of hollow viscera such as duodenum, ascending and descending colon, and rectum.[27] In patients with an acute abdomen it suggests perforation of a hollow viscus. A plain radiograph shows linear collections of gas along the renal outlines, psoas muscle and medial to the diaphragmatic crura (Fig. 14). Appearance of these findings in a patient with acute pain abdomen after instrumentation (endoscopic retrograde cholangiopancreaticography, colonoscopy or barium enema) indicates perforation—a complication of these procedures.

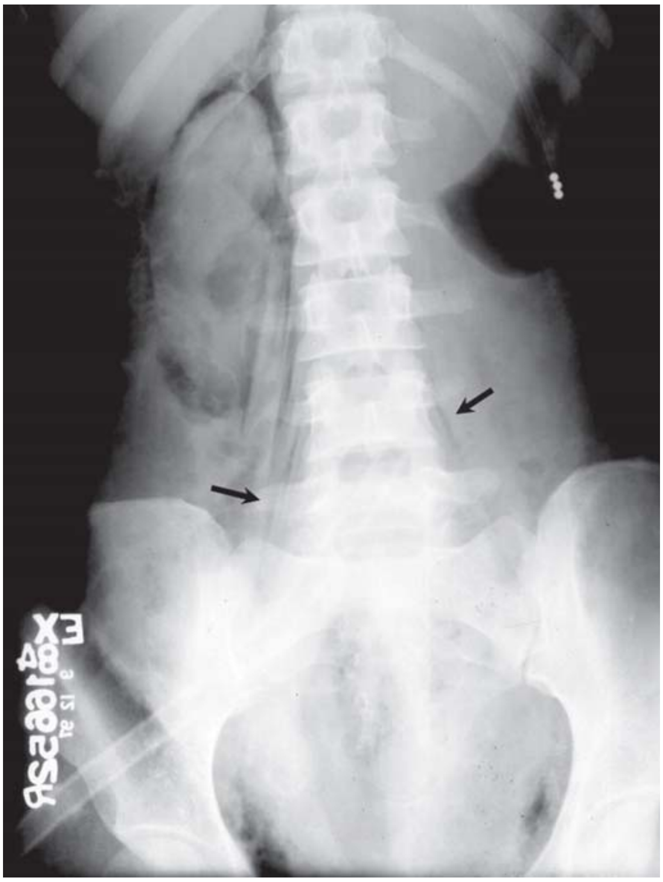

FIG 14. Plain abdominal radiograph of a patient with duodenal ulcer perforation shows air around the right kidney and extending along both psoas muscles (arrows) suggestive of pneumoretroperitoneum.

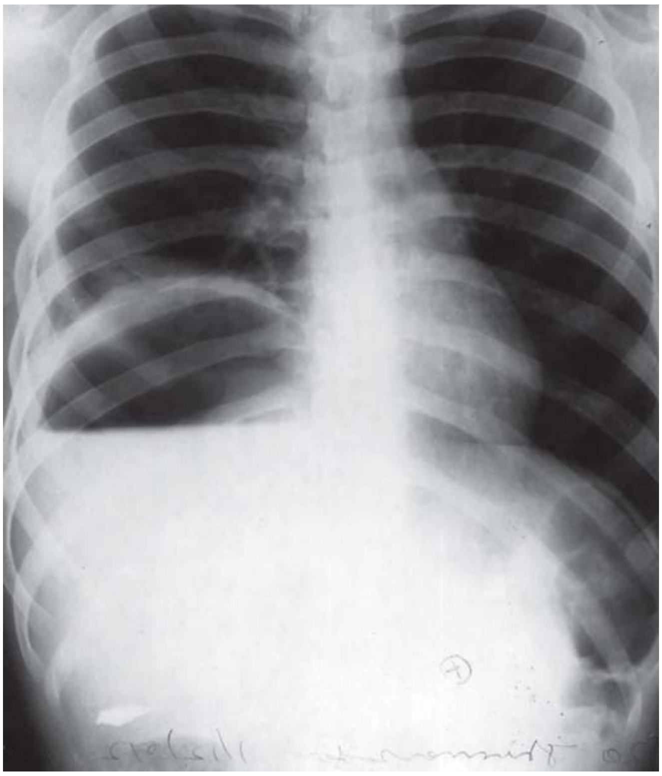

FIG 15. Chest radiograph of a patient who had high grade fever on postoperative day 4 of abdominal surgery showing an elevated right hemidiaphragm with a large air–fluid level suggestive of a subphrenic abscess.

MISCELLANEOUS CONDITIONS

An *intra-abdominal abscess* may show mottled lucencies within a soft tissue mass, mass effect on adjacent structures and air–fluid level. Subphrenic abscess, seen usually in postoperative patients shows an elevated hemidiaphragm, with more lateral tenting and an air–fluid level in 60% of patients (Fig. 15). Although CT scan is the imaging modality of choice, a radiograph may be positive in up to half the cases.[28]

Bezoars are intragastric masses which are formed from ingested materials. They are of three types: phytobezoars (vegetable or fruit products), trichobezoar (hair) and lactobezoar (milk products).[29] These are often associated with abnormal gastric motility or gastric surgery (vagotomy, hemigastrectomy). The radiograph shows a mottled mass in the stomach taking its shape, separated from its wall by a rim of air (Fig. 16).

Gossypiboma is a term used to indicate cotton-based foreign bodies that are accidentally left behind following surgery.[30] The patients are often asymptomatic but secondary infection of the sponge may result in the formation of an abscess, fistula or obstruction. Radiographic detection, although difficult, may show presence of mottled lucencies (Fig. 17). A CT scan is required for a diagnosis and shows soft-tissue density containing air bubbles.[30] In chronic cases, a thick fibrous capsule may be seen.

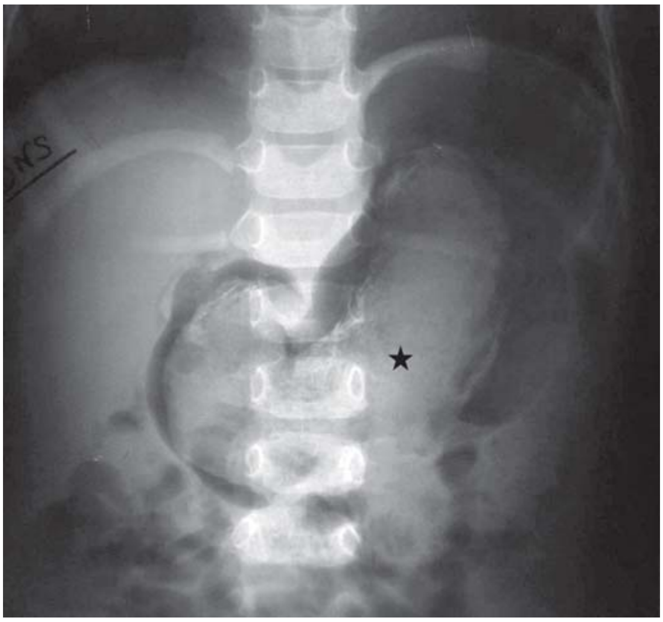

FIG 16. Plain radiograph of a patient of anorexia nervosa showing a soft tissue opacity (star) within the stomach, taking its shape which is suggestive of bezoar.

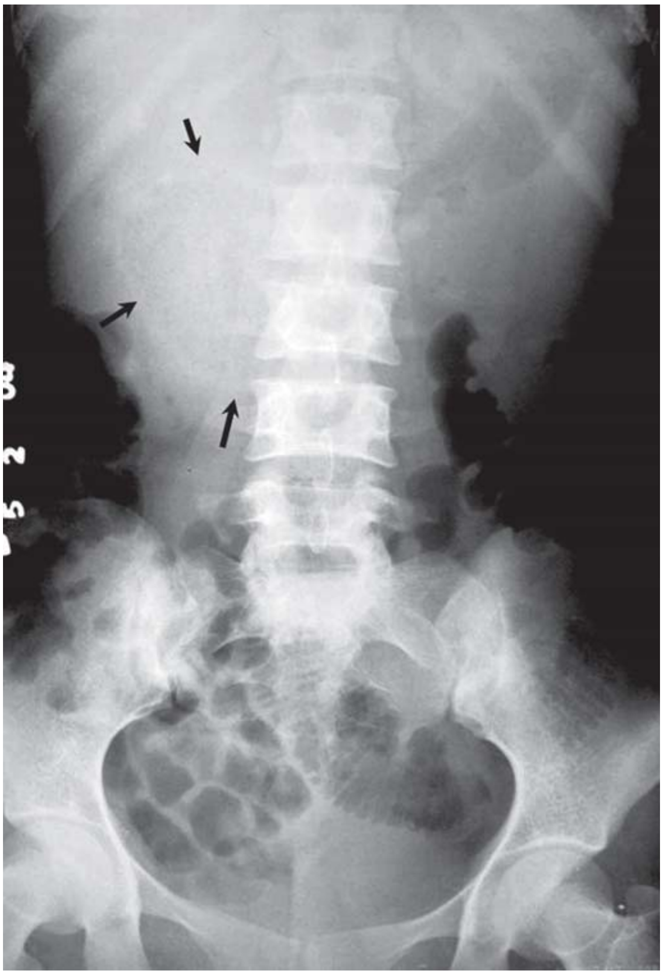

FIG 17. Plain radiograph of a patient operated for intestinal obstruction one month back showing an area of mottled air lucency (arrows) in the right lumbar region. This was confirmed as a retained sponge on CT scan (not shown).

Tumours such as gastrointestinal stromal tumours or cavitating lymphomas may manifest as a large, irregular walled, extraluminal air cavity, which may or may not communicate with the lumen of the bowel.

CALCIFICATION

Calcification is one of the important signs seen on a plain abdominal radiograph which provides clues to the diagnosis. The location and the morphology of calcification may either provide an unequivocal diagnosis or suggest the subsequent line of imaging. The various morphological forms of calcification include concretions, conduit wall calcification, rim-like calcification and solid mass calcification.[5]

Concretions are solid precipitates containing a central nidus. These are seen within normal structures such as the genitourinary (renal calculi) and gastrointestinal (gallstones) tracts (enteroliths [Fig. 3] and phleboliths).

The major role of a plain radiograph is in the detection of renal calculi—about 90% of these are radiopaque (Fig. 18). They usually contain uric acid, xanthine or cystine. An abdominal radiograph is the initial imaging modality in a patient presenting with a renal colic or haematuria. Intravenous urography (IVU) is done to confirm the location of the calculi and to demonstrate obstruction. However, non-contrast CT scan is required for detection of small stones, and may also demonstrate obstruction obviating the need for an IVU.[31]

Gallstones are uncommonly seen on a plain radiograph as about 15% are calcified (Fig. 6), and ultrasonography is the first-line investigation. Enteroliths typically have a laminated

FIG 18. Plain radiograph of a patient with left renal colic showing multiple radio-opaque densities over the left renal area suggestive of renal calculi (arrows).

appearance and are seen in patients who have clinical features of chronic partial obstruction. Phleboliths, which are calcified thrombi seen in veins, are often seen in the pelvis and have a central lucency.

Conduit wall calcification includes calcification of the wall of normal structures such as the ureter, urethra, vas deferens, pancreatic duct, bile duct and blood vessels. Aortic and iliac arterial calcification is commonly seen, especially in elderly patients and those with diabetes. It is seen as two parallel calcified lines coursing along the vessels or a circle of radiopacity if seen enface.

Rim calcification is seen in the walls of cystic lesions or aneurysms. The radiograph shows a thin, smooth, curvilinear opacity, which may be complete or incomplete. The examples include aortic or renal artery aneurysm calcification, hydatid cysts (Figs 19 and 20), benign ovarian cysts, dermoid cysts (Fig. 21), cystic renal or pancreatic tumours, perinephric haematomas and porcelain gall bladder.

Solid calcification is seen in a variety of pathological conditions. It can occur either within abdominal organs or may be tumour calcification. Within the solid organs, they can be granulomas [liver, spleen, adrenal (Fig. 22)], chronic abscesses (Fig. 23) or haematomas, calcified metastases and chronic pancreatitis (Fig. 24). In addition, mesenteric lymph nodes calcify and appear as mobile, mottled radiopacities (Fig. 25). The kidneys show characteristic calcifications in tuberculosis (Fig. 26), thick peripheral rim of calcification in renal cortical necrosis and calcification along the tips of medullary pyramids in medullary sponge kidney. Uterine leiomyomas are among the common tumours which calcify. Other tumours producing calcification include teratomas which show tooth-like structures (Fig. 27), renal cell carcinomas (Fig. 28), ovarian carcinomas and adrenal carcinomas.

Barring a few conditions such as renal calculi and chronic calcific pancreatitis, plain films are not used for the diagnosis of calcified lesions. Most of these calcifications are demonstrated

FIG 19. Abdominal radiograph of a patient presenting with acute abdomen, incidentally showing rim calcification (arrow) in the right upper quadrant suggestive of a hydatid cyst of the liver.

FIG 20. Radiograph of the pelvis of a patient, done for evaluation of low backache, shows typical wall calcification of a cystic lesion. Surgical excision revealed it to be a hydatid cyst.

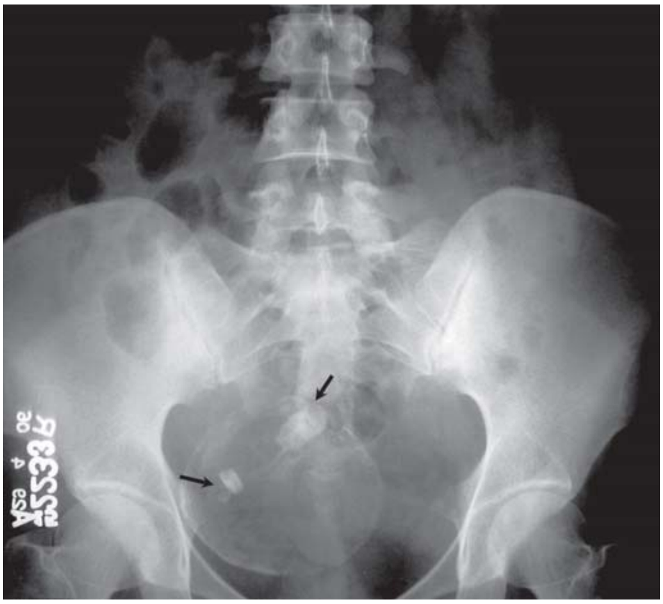

FIG 21. Plain radiograph of the pelvis of a woman presenting with lower abdominal pain shows cystic calcification with tooth-like structures (arrows) within the lesion. This appearance is diagnostic for a dermoid cyst.

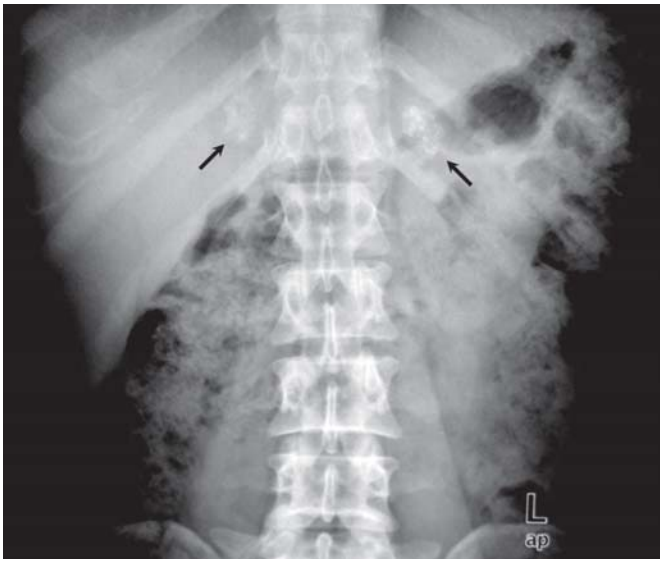

FIG 22. Plain radiograph of a patient with Addison disease showing calcification in bilateral adrenal glands (arrows). This appearance may be seen in tuberculosis or histoplasmosis.

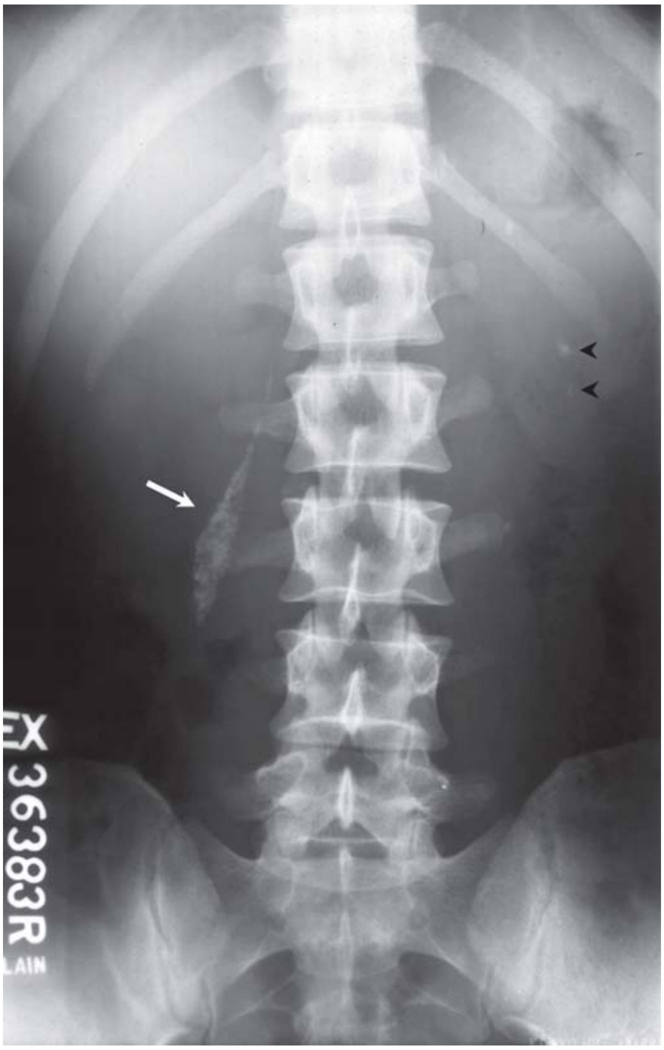

FIG 23. Plain radiograph of a patient with a healed right psoas abscess showing calcification in the psoas muscle (arrow). Incidental left renal cacluli are also seen (arrow heads).

FIG 24. Plain radiograph of a patient presenting with recurrent episodes of epigastric pain for 1 year showing extensive calcification along the orientation of the pancreas, which is diagnostic of chronic calcific pancreatitis.

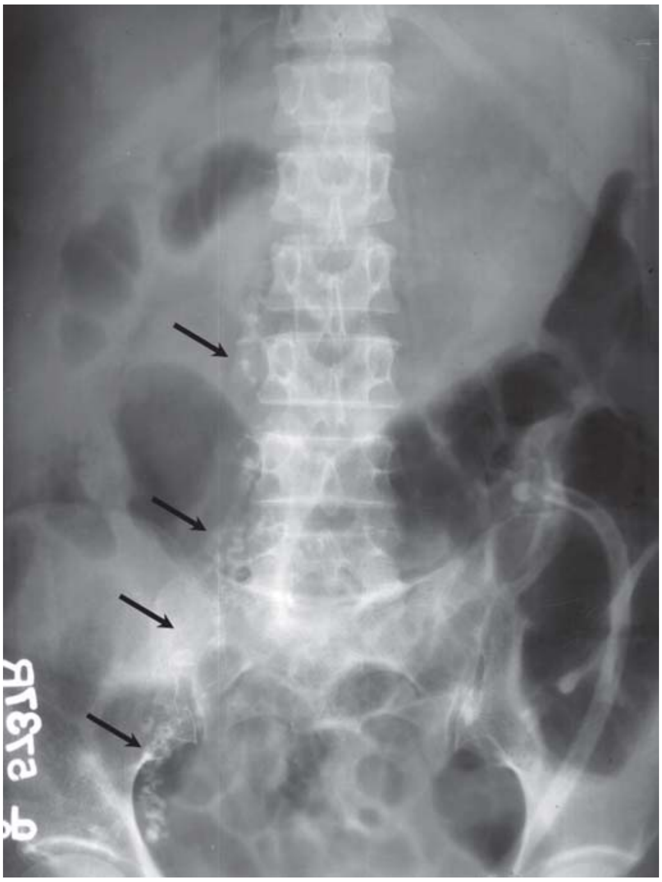

FIG 25. Plain radiograph of the abdomen of a patient with left iliac fossa abscess showing typical lymph nodal calcification in the retroperitoneum and right iliac region (arrows). A Malecot catheter inserted to drain the abscess is seen in the left iliac region.

FIG 26. Plain radiograph of a patient with a long history of backache and low grade fever shows a completely calcified right kidney (putty kidney) diagnostic for end stage of renal tuberculosis.

FIG 27. Plain radiograph of a 1-year-old boy done for evaluation of abdominal distension shows a large soft tissue mass, displacing bowel loops to the left and large areas of calcification, some of which have a tooth-like appearance (arrows). This is suggestive of a retroperitoneal teratoma, an entity which is better diagnosed using ultrasound or CT.

FIG 28. Abdominal radiograph of a patient presenting with renal colic shows irregular tumour-like calcification in the left lumbar region (arrows). In addition, calculi are seen in the region of the renal pelvis (star) and lower ureter (arrow head). CT (not shown) revealed a left renal cell carcinoma.

incidentally when the radiograph is done for other conditions. A knowledge of the appearances of calcifications is important to plan further management, if required.

ABDOMINAL MASSES

Fat-containing masses have a low density on a radiograph. The presence of fat in a large mass can be suggested when there is displacement of intra-abdominal structures by a lesion having a disproportionately low density. The common examples are mature teratoma (Fig. 29), dermoid cyst, a large lipoma and well differentiated liposarcoma.

Soft tissue masses, when sufficiently large, can be seen on a plain abdominal radiograph. Depending on the location of the mass, the organ of origin can be determined. Large retroperitoneal tumours displace the kidneys and obliterate the psoas and renal outlines. Tumours may also cause abnormal contours or size of various intra-abdominal organs. Large liver masses cause elevation of the hemidiaphragm, displacement of the transverse colon, kidney and duodenum inferiorly and the stomach to the left. Splenomegaly displaces the stomach medially as will pancreatic tumours or pseudocysts. Pelvic masses displace bowel loops superiorly.

Although some possible suggestions can be made, most findings are non-specific and a radiograph has a low yield and is not used for primary diagnosis. They are mostly detected incidentally and ultrasonography and CT scan are necessary for better assessment.

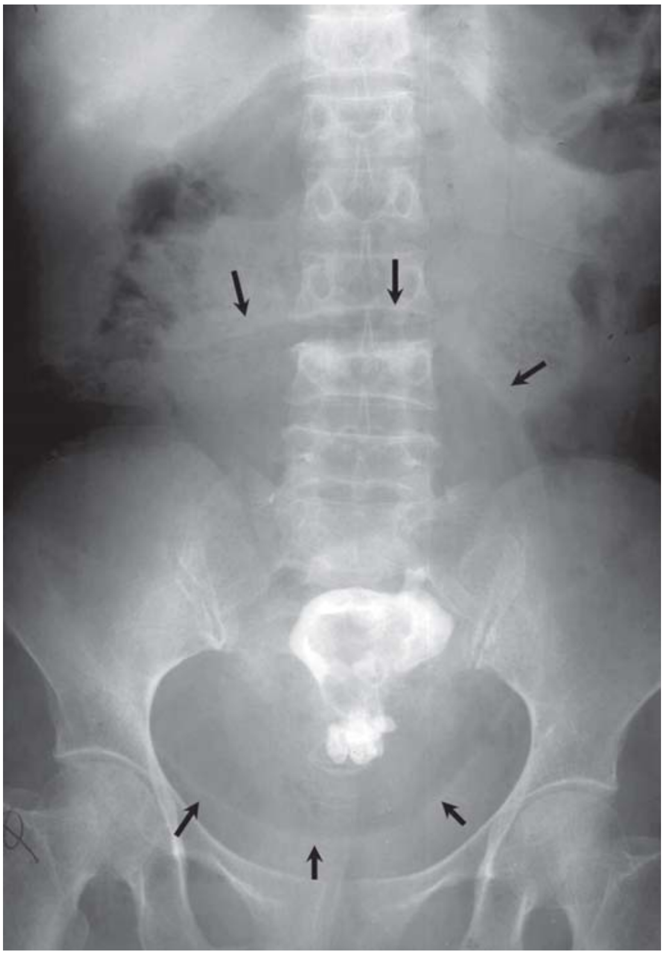

FIG 29. Radiograph of a patient presenting with abdominal lump shows a large predominantly lucent mass in the lower abdomen and pelvis (arrows) displacing the bowel loops and containing tooth-like structures and an ossified area suggestive of a mature teratoma.

CONCLUSION

It is vital to understand the value and limitations of plain films before requesting one. An abdominal radiograph has an important role in diagnosing intestinal obstruction, perforation and urinary calculi. Its yield can be improved if plain films are requested to answer a specific clinical question. A complete knowledge of the normal and abnormal appearances on plain radiographs is essential to triage patients into an appropriate imaging algorithm as well as for patient care and management.

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