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ABDOMINAL IMAGING

REVIEW

Abdominal and pelvic radiographs of medical devices and materials—Part 1: gastrointestinal and vascular devices and materials

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ABSTRACT
When compared with chest radiographs, medical devices of the abdomen and pelvis are less frequently seen. However, with recent advances in technology the interpreting radiologists are seeing more medical objects on these radiographs. The identification of these devices and materials are crucial for not only enabling the radiologist to understand the underlying background pathology but also for evaluating any related complications. An online survey of literature showed our review article to be the most detailed. In this first part of our two-part series, we discuss about the various gastrointestinal and vascular devices and materials seen on abdominal and pelvic radiographs.

When compared with chest radiographs, abdominal/ pelvic radiographs (AXRs) are less frequently performed and hence fewer lines, tubes, devices, and materials are encountered. Most of these medical devices are used for monitoring or managing diseases of the gastrointestinal and genitourinary system, while some devices such as the inferior vena cava (IVC) filters and extracorporeal membrane oxygenation (ECMO) are used for management of systemic conditions. Just as with chest radiographs, it is important for radiologists to identify these devices, to evaluate for their accurate placement and to look for any equipment related complications (1). As per our knowledge, a review of the available online literature showed our pictorial essay to be the most comprehensive work so far related to radiographic evaluation of devices of abdomen and pelvis. In this first part of our two-part series pictorial article, we discuss in detail about the various gastrointestinal and vascular devices and materials seen on abdominal and pelvic radiographs.

Gastrointestinal devices and materials

Gastrointestinal tubes

Nasogastric (NG) tubes

NG tubes are used for suction of stomach contents, infusion of medication and for feeding. NG suction tubes generally have a thin metallic marker along their length, with a short gap at the level of the most proximal side hole (Fig. 1). NG feeding tubes are often uniformly mildly radiopaque and some have metallic weights near the tip. An ideal position for a suction tube would be with its tip in the stomach distal to the gastric cardia or at least 10 cm caudal to the gastroesophageal junction (2, 3). NG tube misplacement is the most common complication, and can lead to pulmonary perforation, pneumonia, and pneumothorax (4).

*Dobhoff or Keofeed tube*s are flexible narrow bore tubes that enable administering enteral nutrition or medication. Unlike NG tubes, these tubes cannot be used for suctioning. Due to their narrow bore (measuring 4 mm), they are better tolerated by the patients, in addition, these tubes allow post-pyloric feeding. The distal end of some of these tubes have metallic ends comprising of metal wrapped in silicon, and as a result, the gold standard for confirming an accurate placement is radiography (5).

Sengstaken-Blakemore (SB) tube is an esophagogastric tamponade tube used as a temporary measure for stopping or slowing bleeding from the esophagus and stomach. Its

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use has also been validated for the immediate control of esophageal variceal related bleeding prior to definitive shunt surgery. The tube maybe inserted through the nasal or oral route. Confirmation of placement of the tube within the stomach is required and done by abdominal radiography, following which the tube's gastric balloon is inflated. A repeat abdominal radiograph is obtained to confirm that the inflated gastric balloon remains fully inflated in the stomach (6). The role of the radiologist is to confirm the tube's accurate position in the stomach and to look for tube malposition related complications such as esophageal perforation.

Gastrostomy tubes

Gastrostomy is the favorable route for nutritional support in patients with prolonged impairment of oral intake requiring long-term enteral feeding. A gastrostomy tube can be placed surgically (surgical gastrostomy), endoscopically (percutaneous endoscopic gastrostomy [PEG]) (Fig. 2a), and radiologically (percutaneous radiological gastrostomy [PRG]) (7). Complications associated with gastrostomy tube placements that need to be looked out for on radiographs include pneumoperitoneum (Fig. 2b), gastrostomy tube prolapse (into the duodenum with/without obstruction, into the distal ileum), gastric pneumatosis, extraluminal position of the gastrostomy tube, and lost gastrostomy tube (tube migration) (Fig. 3) (8).

Jejunostomy tubes

Like gastrostomy tubes, jejunostomy tubes can be inserted surgically, endoscopically, and with imaging assistance. Indications for jejunostomy tube insertion over gastrotomy tubes include prior gastric surgery, gastric outlet obstruction, gastric ulcers or fistula, among others. Complications that can be identified on radiographs related to the tube placement are cellulitis around tube insertion site, ileus (focal or generalized), pneumoperitoneum (Fig. 4) (9), malpositioned tube (Fig. 5), tube kinking/coiling, small bowel obstruction, and bowel edema (10).

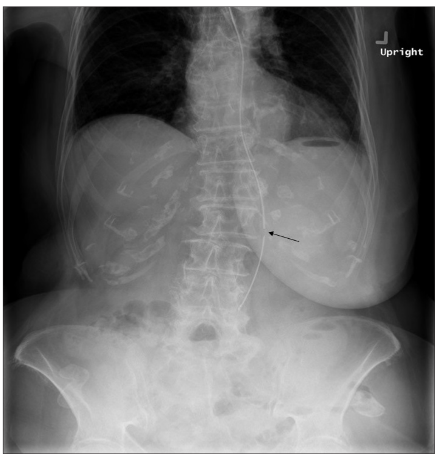

Figure 1. AXR shows a satisfactorily positioned NG tube with its most proximal side hole *(arrow)* ideally positioned in the gastric body.

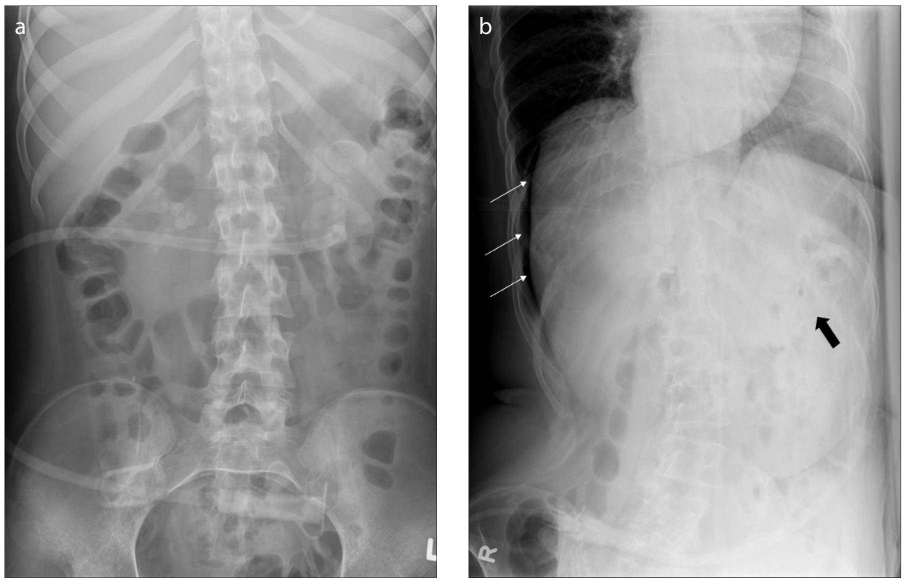

Figure 2. a, b. Supine AXR **(a)** shows a normally positioned percutaneous endoscopic gastrostomy (PEG) tube. Cross lateral AXR **(b)** showing pneumoperitoneum *(thin arrows)* as a complication following PEG tube *(thick arrow)* insertion.

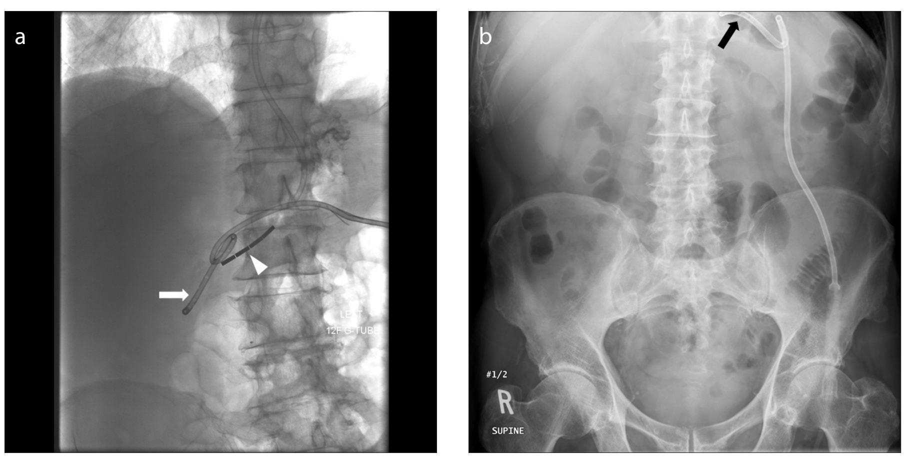

Figure 3. a, b. Fluoroscopic image **(a)** shows gastrostomy tube placement *(white arrow)* with its tip in the gastric pylorus/proximal duodenum. In addition, a Keofeed tube (**a,** *arrowhead)* is also noted with its weighted tip in the gastric pylorus. AXR **(b)** taken 2 days later shows that the gastrostomy tube has dislodged *(black arrow)*.

Main points

- Abdominal and pelvic radiographs are useful for identifying medical devices, evaluating their accurate placement, and spotting complications following their immediate placement or on follow-up imaging.
- Complications that can be evaluated on radiographs related to gastrointestinal devices include pneumoperitoneum, tube kinking/migration and malposition.
- Complications that can be evaluated on radiographs related to vascular devices include catheter fragmentation and embolization, kinking, migration; retained guidewire fragments, migrated coils/ stents/ inferior vena cava filters and other unintentionally retained vascular devices.

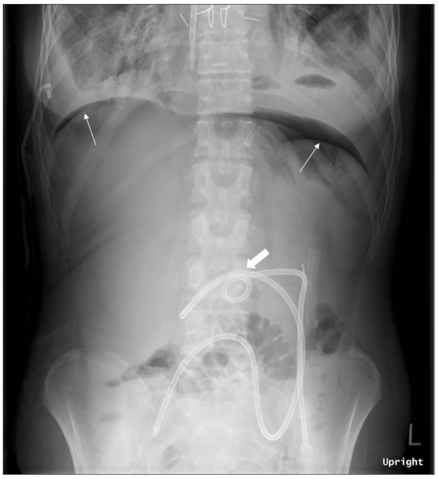

Figure 4. AXR shows pneumoperitoneum *(thin arrows)* following insertion of a GJ tube *(thick arrow)*.

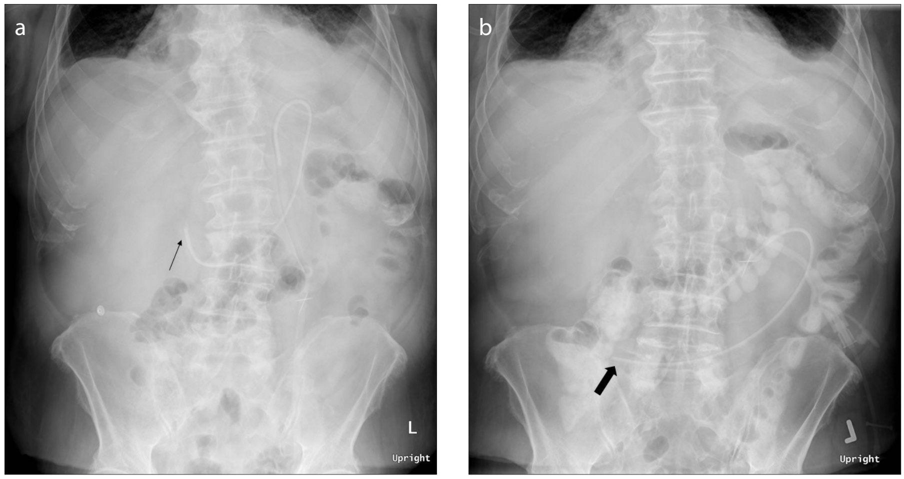

Figure 5. a, b. AXR **(a)** shows a malpositioned GJ tube with its tip in the duodenum *(thin arrow)*. AXR **(b)** taken following repositioning of the tube, now shows its tip in the jejunum *(thick arrow)*.

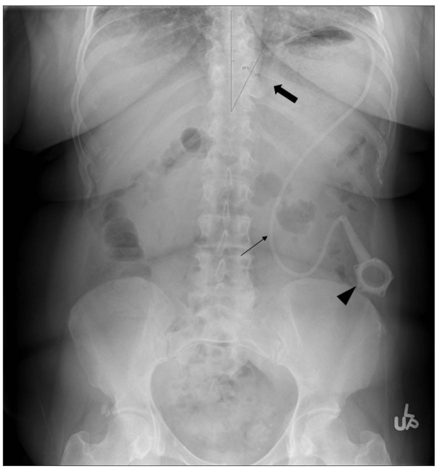

Figure 6. AXR shows an accurately positioned LAP-BAND (Allergan) system with its ϕ angle measuring 27°. Note its various parts: the adjustable gastric band *(thick arrow)*, connector tube *(thin arrow)* and its subcutaneous port *(arrowhead)*.

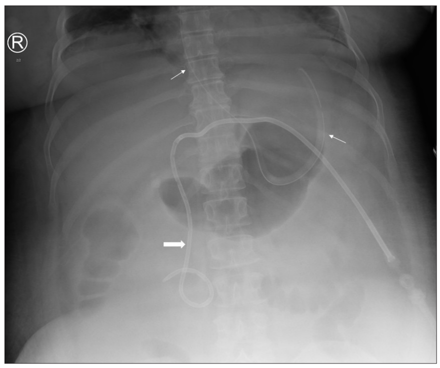

Figure 7. AXR shows a percutaneous biliary drainage (PTBD)/ internal-external drainage catheter *(thick arrow)*. Additionally, a feeding catheter *(thin arrows)* can also be seen.

Laparoscopic adjustable gastric banding (LAGB)

LAGB is a bariatric surgical procedure widely used for morbid obesity. A LAGB system comprises of three components: a radiopaque silicon band with an inflatable inner surface, a reservoir port and a connector tubing that links the port with the band.

A normally positioned LAGB (Fig. 6) on an AXR is defined in terms of the phi (φ) angle. The φ angle is the angle formed between a vertical line drawn along the spinal column and a line drawn along the long axis of the band, and a normal φ angle should be between 4° and 58° (when imagined in terms of the hands of a clock, the ends of the band should point towards the 2 and 8 o'clock positions) (11). The gastric band should also be located about 5 cm distal to the left hemidiaphragm and have a rectangular appearance as its anterior and posterior margins are superimposed on an AXR. Complications related to LAGB that may be identified on AXRs include band malposition, band slippage, intragastric erosion, gastric perforation, tube disconnection. Band malposition (perigastric fat or distal stomach) can be identified as it will have an abnormal lie and an abnormal φ angle. Band slippage (herniation of distal stomach proximally from below the band) may occur anteriorly or posteriorly. An anterior band slippage will have a φ angle >58°. An additional finding would be an eccentric pouch dilatation with an air-fluid level. Posterior band slippage is comparatively rare and can present on an AXR with the band facing *en face*, alternatively described as the "O sign" (which is characteristic of band slippage, where the band assumes an O shape on an AXR). Gastric erosion may be suspected when the band shows an abnormal position and when compared to prior AXRs, the band shows progressive migration over time to the abnormal position (12).

Percutaneous biliary drainage (PTBD) catheter/ internal-external drainage catheter

PTBD (Fig. 7) is an efficient technique for bile drainage in biliary obstruction and allows access for placement of plastic endoprostheses or metallic stents. Procedure related complications are usually seen immediately or within 48 hours and include tenderness, fever, hemorrhage, fever, hemobilia and sepsis, all of which can be fatal. PTBD catheter related complications that may be identified on AXRs are migration, malposition, and catheter fracture. A fractured PTBD catheter requires urgent management, and a percutaneous approach is preferred for retrieval over an endoscopic retrograde cholangiopancreatography approach used for dislodging plastic stents (13).

Stoma

An abdominal stoma is a surgical procedure performed as a part of management for benign or malignant pathologies. Stomas may be temporary or permanent, with the most common being ileostomy and colostomy. Common complications of stoma that may be visualized on radiographs include parastomal hernia (Fig. 8) and prolapse with or without complicating bowel obstruction (14).

Titanium tacks for hernia mesh fixation

Laparoscopic ventral and incisional hernia repairs with lightweight mesh have gained popularity over recent years and

Figure 8. AXR shows a colostomy *(thin arrows)* with prolapsed large bowel *(thick arrow)*.

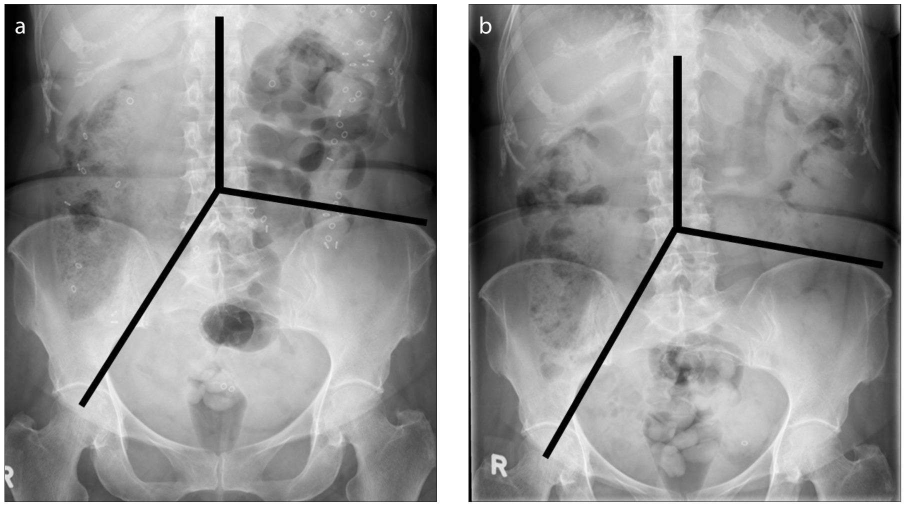

Figure 10. a, b. AXR **(a)** shows colonic transit of the stool markers. AXR **(b)** taken on day 7 shows near total evacuation of the markers except for a single marker in the sigmoid colon.

Figure 9. AXR shows titanium tacks placed for hernia mesh fixation.

are considered the first choice due to its ability to integrate into the abdominal wall. Various mesh fixation methods that are employed include titanium tacks, absorbable tacks, and fibrin glue. Of these, titanium helicoidal tacks (Fig. 9) are considered the gold standard for hernia mesh fixation. Complications associated with these titanium tacks that have been reported include postoperative pain, adhesion formation, bowel perforation, and tack migration (15).

Fecal/stool markers

Colonic motility disorders commonly present with constipation or diarrhea. Assessment of colonic transit time provides information about colonic motility, which in turn allows the severity of the pathology and the therapeutic response to be assessed. Radiopaque markers can be used to assess colonic transit time, the other options being colonic scintigraphy and the more recent video capsule endoscopy. The markers are usually ingested in a capsule containing 20–50 plastic rings. The two kind of radiopaque markers currently available are the Sitzmarks® (Konsyl Pharmaceuticals) and the Kolomark™ (M.I.Tech.), the latter more commonly used in Korea. The advantage with radiopaque marker testing is that it is simple, inexpensive, reliable and reproducible. The disadvantage is that it requires good patient compliance, radiation exposure and does not measure the physiological transit of a meal.

There are two techniques for measuring colonic transit time using radiopaque markers, the single capsule technique and the multicapsule technique. In the former technique, a single capsule containing multiple markers is ingested on a specific day, followed by serial AXRs that are repeated until all markers are defecated or a single AXR taken on day 5 (120 hours later). The disadvantage being that it is time consuming and involves greater radiation exposure. The multicapsule technique involves ingestion of a capsule a day for 3 days, followed by AXRs on day 4 and 7 or only on day 7.

Interpretation is based on identifying the markers in three regions (right, left and rectosigmoid) defined by bony landmarks and gaseous outlines (Fig. 10). In the single capsule technique using a single AXR on day 5, delayed transit is defined as retention of >20% of the markers. Most western studies have shown that the mean colon transit time was 30–40 hours, with the upper limit being 70 hours in mixed populations. Some studies have even shown that the patient sex, age, diet and menstrual cycle can affect the colonic transit time (16).

PillCam patency capsule (PC)

The PC is a self-dissolving dummy capsule given before video capsule endoscopy (VCE) in patients with known or suspected risk factors for gastrointestinal stenosis to minimize the risk of VCE retention. The PC is made of barium sulphate and lactose anhydrous. It consists of a small radiofrequency identification (RFID) tag, detectable by an extracorporeal RFID scanner. Thirty hours post ingestion, a built in timer opens two tiny holes in the surface of the PC, allowing the digestive juice to enter the PC and causing it to dissolve, thereby preventing potential small bowel obstruction. VCE retention is unlikely upon excretion of the PC within 30 hours, excretion in an undamaged state or radiological projection to the colon. Only a few cases of continued retaining of the PC (Fig. 11) or temporary intestinal obstruction have been documented (17).

Wireless capsule endoscopy (WCE) or video capsule endoscopy

WCE is a minimally invasive diagnostic technique for diagnosing small intestinal disease, especially in the work up of obscure gastrointestinal bleeding. The WCE allows visualization of the gastrointestinal tract by transmitting wireless images from a disposable endoscopic capsule to a data recorder that is worn by the patient. The endoscopic capsule is disposable and used only once. It comprises of a camera, light source, batteries and a transmitter. The capsule has a battery life of approximately 8 hours, sufficient

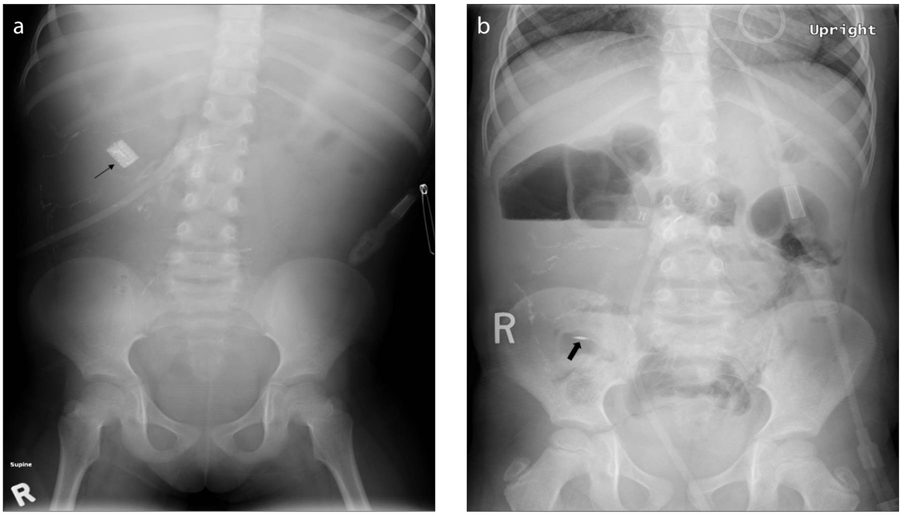

Figure 11. a, b. AXR **(a)** shows a PillCam patency capsule *(thin arrow)* on initial swallow. AXR **(b)** taken 2 months later shows that the electronic (RFID tag) component of the capsule has been retained *(thick arrow)* in the caecum/ ascending colon.

Figure 12. AXR shows a stuck WCE in the sigmoid colon.

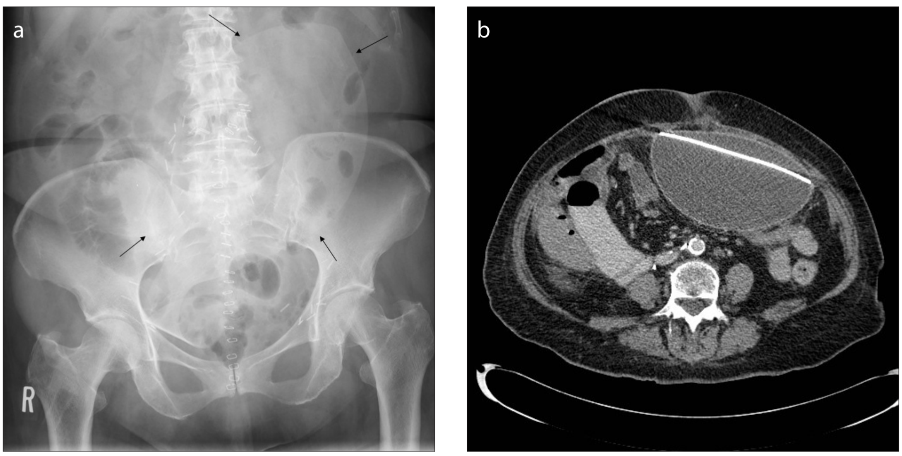

Figure 13. a, b. AXR **(a)** shows a retained Fish viscera retainer *(thin arrows)*. Axial CT **(b)** confirms the retained Fish viscera retainer.

enough to evaluate the small intestine as it passes through. In majority of the cases, it should be expelled naturally by 72 hours. On an AXR, the capsule appears as a rectangular metallic density resembling a lantern. Following capsule ingestion, serial radiographs should demonstrate movement of the capsule through the gastrointestinal tract (18). Capsule retention (Fig. 12) is an established complication of WCE with an incidence of 0%–21% and is suspected when serial radiographs show a constant position of the capsule. The most common site for capsule retention is the small intestine, followed by the esophagus, colon and stomach. The commonest causes for retention are diverticulum, stricture, ulcer, and tumors. Once a capsule retention has been established the radiologist needs to inform the surgeon for surgical or endoscopic removal of the capsule (19). Retained endoscopic capsules are dangerous and contraindicated to magnetic resonance imaging (MRI) due to the potential risk for migration and bowel perforation (20).

“Fish” viscera retainer

The “Fish” viscera retainer is a latex-free rubber medical device used by surgeons to separate the omentum and viscera during the peritoneal cavity closure. The fish is inserted when the surgery has finished and just prior to the closure of the abdominal wall, in order to prevent accidental puncture to the bowel during closure of the peritoneum and fascia. The body of the device is flat and ovoid or elliptical in shape and it has a narrow waist connected to a small tail with a retainer ring that stays outside of the patient’s body. The fish can easily fold due to its high elasticity, and therefore, can be removed just before the final stiches in the fascia, through a small hole by pulling the retainer ring. As the retainer ring always lies outside the patient’s body, it also signals that the fish retractor is within the patient’s body. Imaging plays a crucial role in identifying an accidentally retained viscera retainer (Fig. 13). Due to its rubber texture, the device appears as a faintly radiopaque elliptical or ovoid structure on an AXR. The device can be better identified and assessed by reformatted computed tomography (CT) (21).

Fiducial markers

External beam radiation therapies such as stereotactic body radiotherapy (SBRT) and proton beam therapy involve the delivery of a precise dose of radiation to a tumor while sparing the normal adjacent tissues. However, its utility has been hampered by the movement of intraabdominal organs during respiration. Fiducial markers (Fig. 14) are cylindrical medical devices measuring 0.8×3 mm and are made of gold, thereby making them biocompatible and radiographically visible. Once the fiducial markers have been percutaneously inserted near the tumor, these markers maintain a fixed relationship with lesion and prior to SBRT enables real-time tracking of the respiratory motion, thereby enabling accurate dose delivery during free breathing. The markers are placed superiorly, inferiorly, medially and laterally or if allowed as per the anatomy. Fiducial marker migration is a recognized complication, especially with liver tumors, and markers placed in the liver

Figure 14. AXR shows fiducial markers *(thick arrow)* and a rectal stent *(thin arrow)* placed in a patient with history of hepatocellular carcinoma with metastases to the rectum.

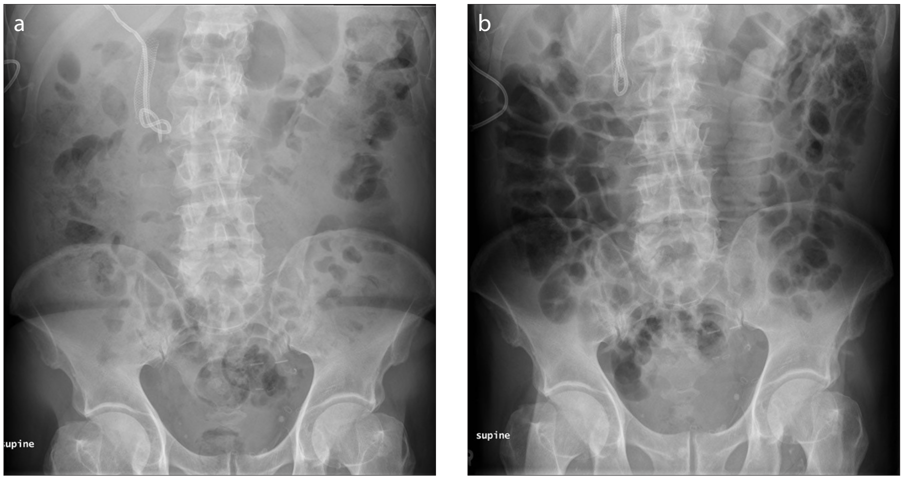

Figure 17. a, b. AXR **(a)** shows an internal external biliary drain placed through a CBD stent *(thin arrows)* with its tip in the duodenum. Follow-up AXR **(b)** shows that the internal-external biliary drain has migrated proximally and is now coiled upon itself in the CBD stent.

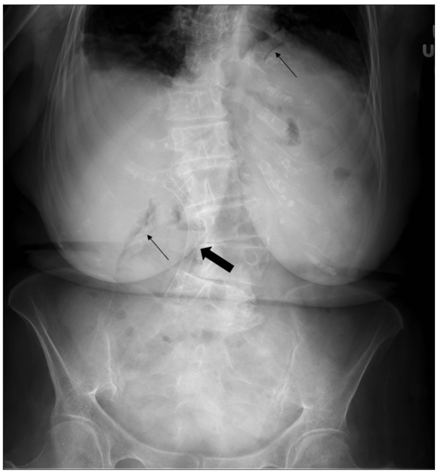

Figure 15. AXR shows pneumoperitoneum *(thin arrows)* following a CBD stent *(thick arrow)* placement.

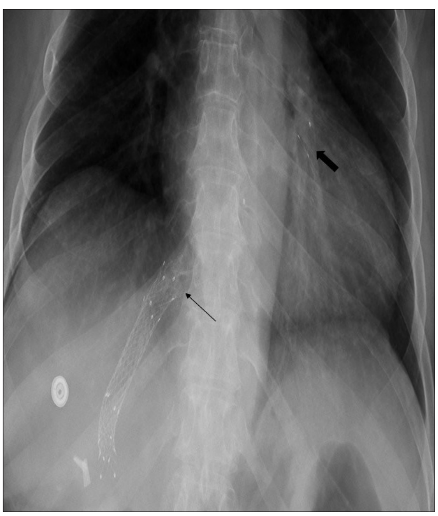

Figure 16. AXR shows a TIPS stent that has migrated cranially with a part of it in the right atrium *(thin arrow)* and a fractured fragment that migrated into the lower lobe inter lobar branch of the left pulmonary artery *(thick arrow)*.

have been known to migrate into the right atrium via the hepatic vein and IVC (22).

Stents

Endoprosthetic stents can be used for benign and malignant pathologies in the biliary tree, genitourinary tract as well as for treatment of atherosclerotic diseases of the vascular system following angioplasty. Plastic stents appear as thin, straight or curved tubes with a continuous wall and are typically used in the biliary tract and pancreatic duct. Metallic stents tend to be larger and have a typical reticular wall (mesh) that can be easily recognized. In addition to its various application in the biliary, genitourinary and vascular system, metallic stents are also used for transjugular intrahepatic portosystemic shunt (TIPS), which is the preferred method of therapy for managing patients with refractory bleeding from esophageal and gastric varices, whereby a self-expanding metallic stent is deployed to form a bridge between the main portal vein and one of the hepatic veins. The checklist while evaluating a radiograph containing a stent include identifying the stent type, its purpose, location, patency, and integrity and to look for any complications such as pneumoperitoneum (Fig. 15), stent fracture (Fig. 16), stent migration (Fig. 17), stent misplacement, and stent collapse (23).

Vascular devices and materials

The increased demand and utilization of vascular devices and materials has led to an increased number of procedure related complications including unintentionally retained vascular devices (uRVDs). The various predisposing factors for uRVDs, tips to identify them on a radiograph, the role of the radiologist while assessing a radiograph containing these devices and their potential mimickers have been elaborated in detail in the Table (24). In addition to the above mentioned stents, which can also be used in vessels, below are some of the various vascular devices and materials that can be seen and evaluated on radiographs.

Endoclips

Endoclips (Fig. 18), also known as hemostatic clips, are surgical tools placed endoscopically for closure of tissue defects, managing gastrointestinal bleed, anchoring of tubes and stents, and for marking internal bowel anatomy for future surgery or monitoring. Although most endoclip models are made of nonferromagnetic materials, these devices have the theoretical potential for detachment from the bowel wall during MRI and can inadvertently lead to tissue damage and hemorrhage. As a result, screening is recommended at some centers prior to an MRI examination (25). Endoclips generally detach within 2 weeks, but there are cases where endoclips have been retained for even up to 2 years (26). Therefore, radiologists need to recognize an endoclip, as dedicated radiographs are one of the accepted screening tools (25,26).

Standard endoclips are not efficient for closure of large gastrointestinal perforations (≥10 mm) due to its insufficient tensile force and limited jaw size. The "Bear Claw" or Over-The-Scope Clip (OTSC®, Ovesco Endoscopy GmbH), (Fig. 19) is a device made for this purpose having a strong grasp without

Table. Predisposing factors for unintentionally retained vascular devices (uRVDs), tips to identify them, the role of the radiologist and uRVD mimickers

Predisposing factors for uRVDs:
1. Technical factors:
- Inappropriate methods for placing and removal of devices
- Inappropriate supervision of trainees performing placement and removal of devices
- Manufacturing defects in the devices
2. Patient factors:
- Unstable or uncooperative patient
- Variant anatomy
- Uncontrolled patient motion
Tips to identifying uRVDs:
- Take into account all the medical and procedural histories
- Use routine windowing and magnification of images to aid in the detection of uRVDs
The role of the radiologist:
- Diagnosis of a uRVD is best made at the time of the procedure. If a uRVD is identified on the postprocedural imaging, the finding needs to be immediately and directly communicated with the patient's physician/ surgeon
- The finding of a uRVD should be documented in the radiology report, including the name of the surgeon/ physician contacted, along with the date and time of notification
- The US Food and Drug Administration (FDA) recommends discussing with the patient regarding the risks and benefits of removing versus leaving behind the uRVD. Discussion should include the size, location and composition of the device; potential complications if left behind, and the future procedures or treatments that the patient should avoid if the device is left behind
- In case of manufacturing defects, as per FDA recommendation, the device should be saved, and the manufacturer should be notified of the device fault. In addition, all deaths or serious injuries resulting from the defective device(s) should be reported
Mimickers of retained vascular devices:
- Some examples include overlying jewellery, electrocardiography lines, surgical masks, artifacts from the radiograph cassette, postsurgical changes in a patient, and intravenous contrast jet through a peripherally inserted central venous catheter

Ref (24): Whang G, Lekht I, Krane R, Peters G, Palmer SL. Unintentionally retained vascular devices: improving recognition and removal. Diagn Interv Radiol 2017; 23:238–244.

Figure 18. AXR shows an endoclip *(arrow)* placed in a patient following gastroscopy.

causing tissue injury. Various indications for OTSC include closure of iatrogenic gastrointestinal defects, visceral perforation and hemorrhage. Rarely, the OTSC like other endoclips can also fall off with recurrence of symptoms (27).

Embolization devices and materials

Embolization coils

Embolization coils (Fig. 20) are permanent embolic agents that come in a variety of shapes and sizes. In general, they are easy to see, control, and deploy. They are typically used for occlusion of larger vessels and cause complete occlusion equivalent to surgical ligation. Coils cause vessel occlusion by inducing thrombosis. Potential complications of coil embolization include occlusion of nontarget vessels and coil migration. Coils are generally made of steel or platinum. Although more expensive, platinum coils are more malleable and radiopaque and are easier to see under fluoroscopy compared with similarly sized and shaped steel coils (28).

Cyanoacrylate glue

Cyanoacrylate glue (Fig. 21) is mainly used for embolization of cerebral arteriovenous malformations (AVMs) but may be used in the peripheral circulation for embolization of arterial pseudoaneurysms, endoleaks, vascular tumors and lymphatic pathologies. Cyanoacrylate glue deposition is unpredictable, and complications including nontarget embolization, venous migration, microcatheter blockage, and catheter retention do occur (28).

Amplatzer vascular plug (AVP)

The AVP (Fig. 22) comprises of a disk made of nitinol mesh attached to a polytetrafluoroethylene coated delivery wire with micro screw made of stainless steel. An AVP has a platinum marker band at its end enabling it to be visualized on a radiograph. The device acts as an embolic agent by stimulating clot formation. Advantages of AVPs over embolization coils include minimal risk of migration, and enabling occlusion of a large diameter vessel with a single device. Potential complications that are rare but may be identified on radiographs are device detachment and device migration (Fig. 23) (29).

Inferior vena cava (IVC) filter

IVC filter placement is a therapeutic option for management of venous thromboembolism. IVC filter related complications that may be seen on AXRs include IVC filter tilt, incomplete opening of the filter, malposition, IVC perforation, filter fracture and migration. IVC filter tilting is defined as an angulation of the filter >15° in relation to the long axis of the IVC. An excessive tilting reduces the filter's ability to trap thrombus effectively. An ideally placed IVC filter would be in the infrarenal IVC with its superior aspect/apex at or immediately inferior to the level of the renal veins. Suprarenal IVC filter placement is indicated for renal vein thrombosis. Documented sites for filter malposition include the renal veins, right atrium, iliac veins and the aorta, which can not only reduce the filter's efficiency of reducing pulmonary embolism but also cause damage to these vessels. An IVC filter perforation (Fig. 24) is diagnosed when the filter's strut or anchor extends >3 mm outside the wall of the IVC, which is usually diagnosed by CT or venography or on autopsy. The filter can perforate the IVC and extend into adjacent structures such as the psoas muscle, lumbar veins, gonadal veins, abdominal aorta and vertebral body, which can cause complications such as bowel perforation, volvulus, arterial hemorrhage and gastrointestinal bleeding. IVC filter fracture is defined as either breakage or separation of the filter structure. Risk factors for filter fracture include placement in an ectatic IVC or over the renal ostia and close to vertebral osteophyte (16). Filter migration is defined as a movement of the filter by ≥2 cm from its deployed position. Filter migration into the cardiopulmonary system can cause fatal complications and requires urgent intervention (30, 31).

Figure 19. AXR shows a Bear Claw /Over-The-Scope Clip (OTSC) *(arrow)* in a patient who developed gastrocutaneous fistula from previous PEG site.

Figure 20. AXR shows an embolization coil *(thick arrow)* and vascular endograft stent *(thin arrow)* in the right common iliac artery.

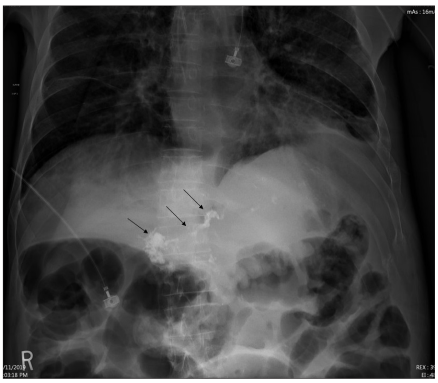

Figure 21. AXR shows cyanoacrylate glue *(arrows)* that was injected at the site of a jejunal varix.

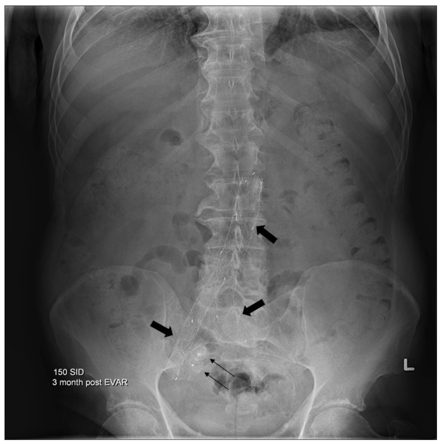

Figure 22. AXR shows two Amplatzer vascular plugs in the right common iliac artery *(thin arrows)* and an aortobiiliac vascular endograft *(thick arrows)*.

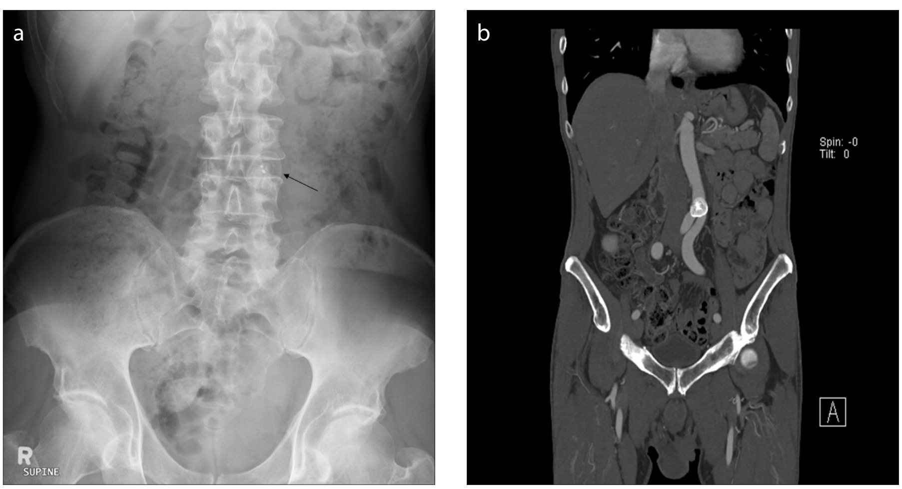

Figure 23. a, b. AXR **(a)** shows an atrial septal defect (ASD) amplatzer occluder device *(arrow)* that embolized distally into the abdominal aorta just above the level of the aortic bifurcation. CT angiogram **(b)** confirmed the embolized Amplatzer occluder device in the distal abdominal aorta just above the level of its bifurcation.

Femoral venous/ arterial catheter

Femoral central venous catheters are placed for various purposes some which include administering drugs, monitoring central venous pressure (CVP), total parenteral nutrition, renal replacement therapy, among others. Complications related to catheter placement can be immediate or delayed. Immediate complications include vascular, cardiac, pulmonary and placement complications. Radiographs are useful for identifying delayed complications such as catheter fracture, kinking (Fig. 25), or migration. Radiographs are also useful in cases complicated by preexisting central venous devices, e.g., catheter and wire entanglement with IVC filter or catheter entanglement with other preexisting multiple catheters (32).

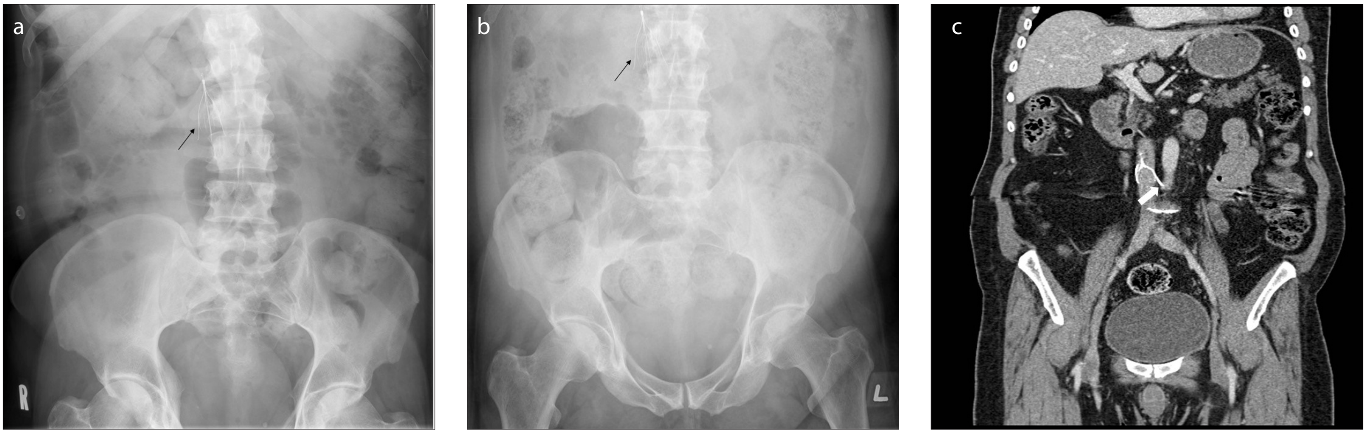

Figure 24. a–c. AXR **(a)** taken following an IVC filter placement *(thin arrow)*. Follow-up AXR **(b)** taken a few years later shows that the IVC filter has changed position *(thin arrow)*, with one of its struts now more medially oriented. Coronal CT **(c)** showed that one of the filter's strut had perforated the IVC and was abutting the aorta *(thick arrow)*.

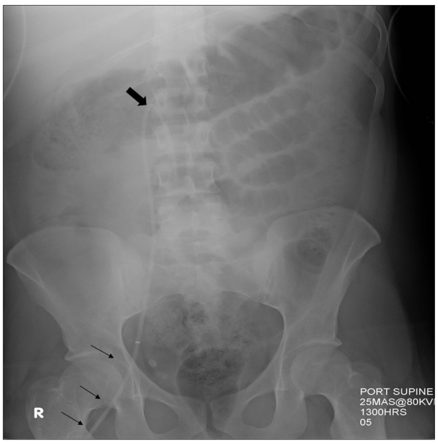

Figure 25. AXR shows a kinked femoral venous catheter at its distal end *(thick arrow)*, the femoral arterial catheter *(thin arrows)* is normal in position and appearance.

Conclusion

A variety of tubes, lines, materials and devices maybe seen on the abdominal and pelvic radiographs of patients in a hospital. A thorough evaluation of these radiographs is important. Radiologists need to recognize these medical materials, and to assess them for accurate placement and to look for abnormal radiographic presentations, which would enable them to inform the relevant physician/ surgeon in a timely manner and help avoid potential consequences.

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Conflict of interest disclosure

The authors declared no conflicts of interest.

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