**Imaging of bowel obstruction and perforation**

by Dr Steven R Yule, MBChB  
MRCP FRCR  
Consultant radiologist,  
Aberdeen Royal Infirmary  
e-mail: syule@nhs.net

**Introduction**

Small bowel obstruction represents 20% of acute surgical admissions. The old surgical saying “never let the sun set on an obstructed bowel” reflected the limitations of imaging in detecting bowel strangulation (vascular compromise due to obstruction), and therefore the ability to predict which patients needed urgent surgery and which could be given a trial of conservative management. If untreated, strangulated obstruction carries a 100% mortality rate. If surgery is performed within 36 hours, the mortality decreases to 8%.

Imaging is used to make the diagnosis, identify the site, cause and severity of bowel obstruction, and radiographers and radiologists play an essential role in this process.

**Small bowel obstruction (SBO)**

The traditional abdominal x-ray is diagnostic in 50-60% of cases, especially in high grade obstruction. Comparatively, CT is 95% accurate, yields much more information (regarding site, cause, etc) and guides patient management. CT should be performed with IV contrast to demonstrate vascular supply, bowel wall enhancement and extra-intestinal findings, but does not require oral contrast. Giving (positive) oral contrast is time-consuming, impairs the ability to assess bowel wall enhancement, and can cause patient discomfort due to nausea and vomiting. Bowel content, particularly in SBO, acts as a useful neutral contrast agent.

Diagnosing SBO on CT depends on identification of dilated small bowel loops (>2.5cm) and the presence of a transition point where loops change in calibre from dilated to non-dilated, or collapsed. Multiplanar reconstructions are helpful, but require thin slice CT acquisition.

Pathological small bowel dilatation also occurs in paralytic ileus (which is usually a response to peritonitis), but in this condition there is no transition point or collapsed loops. If present, the ‘small bowel faeces sign’ can be useful in localising the point of obstruction. This sign is due to an accumulation of gas and particulate matter within a dilated small bowel loop immediately upstream from the transition point. SBO may be due to luminal, intrinsic or extrinsic pathology. The majority (two thirds) are caused by adhesions, which may be seen as angulation or kinking of a loop at the transition point, but is generally a diagnosis of exclusion. Other common causes include malignancy, Crohn’s disease and hernias (table 1).

SBO can be simple, of closed loop type or strangulated (closed loop obstruction with intestinal ischaemia). High grade obstruction is generally associated with more dilatation and the presence of a clear transition point, compared with low grade obstruction. In the case of low grade obstruction, further imaging with a ‘volume challenge’ examination such as barium or CT enteroclysis may be necessary.

**Small bowel obstruction**

- **Intrinsic**
  - Inflammatory (eg Crohn’s, TB)
  - Malignancy (eg GIST, adenocarcinoma, lymphoma, metastatic)
  - Vascular (eg radiation, ischaemia)
  - Haematoma
  - Intussusception

- **Extrinsic**
  - Adhesions
  - Hernias
  - Endometriosis
  - Carcinomatosis

**TABLE 1**

Causes of small bowel obstruction (common causes highlighted in red).

MRI is an accurate technique for SBO, but is generally not first line because of restricted access and limitations in scanning acutely unwell patients. Ultrasound can give helpful information, for example a lack of peristalsis suggests paralytic ileus rather than SBO, which tends to have increased peristalsis, at least in the early stages.

**Closed loop obstruction (CLO)**

This is a specific type of obstruction where two points along the course of the bowel are obstructed at a single location (figure 1). This is usually due to adhesions, a mesenteric twist or an internal hernia. It is important to recognise CLO because the risk of strangulation and bowel infarction is high, carrying a mortality of 10-35%. The appearance on CT depends on the length of affected segment and orientation of the loop. A short closed segment orientated within the imaging plane forms a ‘U’ or ‘C’-shaped loop. A radial array of dilated loops with mesenteric vessels converging to a central point is another feature of CLO.

**FIGURE 1**

Diagram showing two points along the course of the bowel obstructed at a single location (A - adhesions, V - volvulus).

**Strangulation**

Strangulation is a term used to describe vascular compromise of affected bowel, for example as a result of closed loop obstruction. This results in bowel ischaemia and infarction and is a surgical emergency. On CT a specific finding is lack of bowel wall enhancement. This is better appreciated when patients are not given oral contrast. Non-specific features include thickening and increased density of affected bowel wall, a halo or ‘target sign’, fluid and haemorrhage in the mesentery which appears ‘hazy’, ascites, pneumatisos (gas within the bowel wall) and gas within the portal vein (figure 2).
**FIGURE 2**
Strangulated bowel obstruction due to an internal hernia in the lesser sac in a 50-year-old woman. Contrast-enhanced CT scan shows bowel wall thickening with poor enhancement of the strangulated bowel segment (arrows) in the lesser sac. Regional mesenteric vascular engorgement and haziness are also seen. Reproduced with permission from RadioGraphics.

**Large bowel obstruction (LBO)**

A plain abdominal x-ray may allow a specific diagnosis, such as colonic volvulus. If LBO is suspected, further imaging with CT or occasionally contrast enema is generally required. The first task is to distinguish obstruction from pseudo-obstruction. Patients with pseudo-obstruction nearly all have an underlying predisposing condition such as trauma, post-operative state, infection, cardiac disease, etc. Pseudo-obstruction is characterised by a loss of peristalsis and results in the accumulation of gas and fluid in the colon. The colon may become massively dilated and if not decompresed the patient risks perforation and death. Particular care should be taken to distinguish low rectal obstruction from pseudo-obstruction.

CT is unrivalled at detecting and characterising the cause of LBO, with a sensitivity of 96% and specificity of 93%. A single portal venous phase is sufficient, with thin sections (1-2mm) and reformats. Oral and rectal contrast are not routinely required. CT features of LBO include large bowel dilatation, with colonic diameter >5.5cm and caecal diameter >10cm.

As in SBO, the diagnosis of LBO requires identification of a transition point. LBO may have a benign or malignant cause. Features such as length of stricture, symmetry of bowel wall thickening, local inflammation and abscess, and presence of nodes or metastatic disease should be assessed. A short, irregular stricture with enlarged local nodes is more suggestive of a malignant cause, but luminal examination and biopsy is usually required for confirmation. The commonest causes of LBO are colorectal cancer (60%), sigmoid volvulus (10-15%) and diverticulitis (10%).

**Volvulus**

This is an equivalent term in the large bowel to closed loop obstruction in the small bowel. Volvulus affects mobile intraperitoneal segments, with the commonest types being sigmoid and caecal volvulus, accounting for nearly 2/3 and 1/3 of cases respectively.

Volvulus can rarely affect other segments (transverse colon 2-4%, splenic flexure 1%). Risk factors for volvulus include malrotation, mobile segments, pregnancy, adhesions, constipation and laxative use.

**Bowel perforation**

Plain x-rays have a sensitivity for free intraperitoneal gas of 50-70%, but cannot detect pockets of gas less than 1ml. Contrast studies still have a role in detection of site and severity of perforation, but CT is commonly used as it detects the site of perforation in the majority of cases. CT technique includes oral or rectal contrast and IV contrast.

The features of perforation include extraluminal gas or contrast, a bowel wall defect, localised bowel thickening, abscess, phlegmon or foreign body. The site and amount of free gas can be helpful, for example a large amount in the lesser sac and around the ligamentum teres is typical of gastro-duodenal perforation. Perforated diverticulitis generally leads to a small volume of free gas, commonly in the retroperitoneum.

Small retroperitoneal perforations generally remain regional. However, if the origin is in the pelvis, this will often spread to both sides of the abdomen (pararerenal spaces). If the origin is above the pelvis this tends to remain unilateral. A combination of intra and extra-peritoneal gas suggests an extra-peritoneal source. It should be recognised that free gas can occur without perforation. Causes include gastric distension, scleroderma, pneumatosis cystoides intestinalis, free gas from the thorax, and via the female genital tract.

Causes of upper gastro-intestinal perforation include peptic ulceration, malignancy and iatrogenic. Small bowel perforation is rare, with causes including ischaemia, Crohn’s disease, obstruction and foreign body (figure 3).

**FIGURE 3**
Foreign body perforation. Patient experienced epigastric pain several hours after eating fish. Coronal reconstruction CT shows foreign body (fishbone, black arrow) which has perforated through the duodenum (D) with an associated liver abscess (white arrow).

Causes of large bowel perforation include diverticulitis, malignancy, trauma, ischaemia, inflammatory bowel disease and iatrogenic.

With respect to iatrogenic perforations, the perforation rate at colonoscopy is quoted at 0.06%, barium enema between 0.02-0.24% and CT colonography (CTC) at 0.036%. A study of 11,870 CTC cases found seven perforations (all in the rectum or sigmoid), with risk factors including older age in combination with pathology (such as sigmoid colon within an inguinal hernia, diverticulosis and obstructing colorectal cancer).

Perforation remains an infrequent complication of various types of colonic imaging. Early recognition and active management of iatrogenic perforation minimises an adverse outcome.

**Conclusions**

- Bowel obstruction is common and clinical diagnosis unreliable;
- Use plain x-rays first;
- CT with IV contrast next;
- Oral contrast is not generally required in suspected obstruction;
- Look for a transition point and the cause;
- Ask yourself “Is this a closed loop obstruction?”;
- Look for signs of strangulation;
- Recognise the urgency of closed loop/volvulus/strangulation;
- Bowel perforation – look for clues regarding the site and cause.
References