Computed tomography (CT) imaging review of small bowel obstruction

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Learning objectives

To illustrate Multidetector CT imaging features of the important causes of small bowel obstruction (SBO). In this poster we will review the essential role of the multidetector CT in diagnosis and management of SBO and discuss the important imaging findings of the main causes of this clinical condition.

Background

Effective treatment of this common clinical syndrome depends on accurate and timely diagnosis. The diagnosis is based on a combination of clinical background, patient's medical history, physical examination and the results of laboratory and triage examinations such as plain abdominal radiography.

Radiologists play an essential role in clinical decision making in cases of SBO by assisting the clinicians to make the management decision. This is achieved by addressing the presence, severity, location and the cause of SBO and detecting the presence or absence of strangulation.

Owing to its unique capabilities, multidetector CT is now considered the modality of choice for determining which patients would benefit from conservative management with close follow-up and which patients would need immediate surgical intervention.

Therefore familiarity with the CT appearances of different causes of SBO by radiologists is of paramount importance in providing the critical information to the clinicians.

Imaging findings OR Procedure details

Dilated small bowel loops (>2.5 cm in diameter) proximally and normal-calibre or collapsed loops distally are the main criteria for diagnosing SBO on CT.
Causes of Small bowel Obstruction can be classified into three major categories:

1. Extrinsic etiologies

2. Intramural etiologies

3. Intraluminal etiologies

A. Extrinsic Etiologies:

**Adhesions**- Adhesions are the most common cause of SBO, accounting for about two thirds of the cases. The majority of adhesions form following abdominal surgery with about 10-15% secondary to prior or concurrent inflammation. A small minority of adhesions are thought to be congenital.

Since adhesion bands are not usually seen on CT, the diagnosis of adhesive small bowel obstruction is primarily one of exclusion. The presence of an abrupt change in the calibre of the bowel without any apparent cause at the transition point in combination with a history of abdominal surgery usually suggests the diagnosis (Fig 1,2,3 and 4). The accuracy of CT in diagnosing adhesions has been found to be around 70% to 95%.

A closed loop obstruction occurs when the obstructed bowel loop is not decompressed caudally and the obstructed bowel loop is at risk of vascular compromise and ischemia. Most closed loop obstructions are caused by adhesions (75%). This type of obstruction may be associated with a U-shaped distended loop of small bowel and the loop may be fixed and does not change position over time. An increasing amount of fluid is incarcerated within the closed loop, and the coffee bean sign (a gas-filled loop) or a pseudo-tumor (fluid-filled loop) may be seen (Fig 5,6 and 7).

**Hernias**- Hernias were the most common cause of SBO before the laparotomy era. However even in developing countries, the scenario is changing.

Hernias are classified as external or internal.

An external hernia results from a defect in the abdominal or pelvic wall due to previous surgery or congenital weakness. This usually occurs at predictable sites of weakness where there is only fascia and peritoneum between the viscera and skin (Fig 8,9, 10 and 11).
The internal hernias are less common and usually occur at sites of mesenteric and omental weakness and beneath adhesive or congenital bands.

Pre-operative diagnosis of an internal hernia is almost always radiologic whereas external hernias in most cases are diagnosed with clinical examination.

Incarceration, obstruction and strangulation are the main complications of hernias.

Dilatation of small bowel proximal to the hernia indicates obstruction at the entry site while dilatation of the loops with the hernia suggests obstruction at the outflow loop. Strangulation has similar radiographic findings to adhesive obstruction.

B. Intramural Etiologies:

**Inflammatory Conditions** - Crohn’s disease is the most common inflammatory condition causing small bowel obstruction and SBO is the most frequent indication for surgery in patients with Crohn’s disease. It can occur in the acute or chronic phases of the disease and is characterized on CT by bowel luminal narrowing caused by edema, spasm, inflammation, fibrosis, post-operative complications or a superimposed carcinoma. Distinguishing between these conditions is essential for optimal management of the patients (Fig 12 and 13).

**Primary tumours** - Primary neoplasms of small bowel are rare and constitute less than 2% of gastrointestinal malignancies. When presenting as SBO, they are usually at an advanced stage and appear as irregular, asymmetric marked circumferential mural thickening at the transition point (Fig 14 and 15). Involvement of the cecum with malignant tumours can also result in SBO via infiltration of the ileocecal valve.

**Vascular Causes** - Critical involvement of the arterial or venous vascular supply to the bowel usually produces bowel ischemia, which subsequently causes wall thickening and SBO. Thrombosis or occlusion of the mesenteric vessels and mural thickening with asymmetric wall enhancement can be seen in the affected loops on CT (Fig 16).

**Radiation Enteropathy** - Obstruction secondary to radiation enteropathy occurs due to a combination of serositis, adhesions, mural fibrosis and dysmotility. The changes often occur in a radiation portal usually in pelvic loops of ileum 6-12 months after radiation therapy.
CT shows thickening of the bowel wall and small bowel folds with associated submucosal edema which causes narrowing of the lumen. There may also be abnormal enhancement of the thickened bowel wall. Dilatation of the proximal small bowel loops with angulation of the diseased loops of ileum in the pelvis and retraction of the mesentery suggest SBO.

**Hematomas**-Intramural small bowel hematoma may occur secondary to blunt abdominal trauma, anticoagulant therapy or iatrogenic intervention. Most hematomas resolve without sequelae with conservative management. However they may cause luminal narrowing and SBO due wall thickening or stricture formation secondary to small bowel ischemia or healing of hematoma.

**Intraluminal Causes of SBO**

**Gallstone Ileus**- Gallstone-induced SBO usually occurs in elderly patients especially women. When a large gallstone migrates through a biliary-enteric fistula and enters the small bowel, it may lodge in the narrowest segment of the small bowel (typically the terminal ileum at or near the ileocecal valve) and cause obstruction (Fig 17). CT findings are pathognomonic, corresponding to the classic triad of an ectopic gallstone, pneumobilia, and SBO.

**Bezoar**-SBO secondary to a bezoar is rare. The patients often have undergone a partial gasterectomy or gastroenterostomy which prevent adequate digestion of vegetable fibers, which become impacted, causing obstruction. At CT, a bezoar appears as an intraluminal mass with an ovoid shape and a mottled gas pattern.

**Intussusception**-Intussusception accounts for less than 5% of SBOs. Various extrinsic, intrinsic and intraluminal processes can cause small bowel intussusception. On CT, a bowel-within-bowel configuration (a pair of concentric soft tissue rings with and eccentric area of fat inside the outer ring) is pathognomonic for intussusception (Fig 18 and 19). A leading mass as the cause of the intussusception may be identified.
Fig. 1: Axial CT image demonstrates sudden change in the caliber of small bowel loop just to the left of midline. No obstructing cause is identified. Adhesion was confirmed at surgery.
Fig. 2: Coronal CT image in the same patient demonstrates the point of small bowel obstruction to the left of midline. No obstructing cause is identified. Adhesion was confirmed at surgery.
Fig. 3: Axial CT image in a patient with previous colectomy and ileostomy demonstrates high-grade small bowel obstruction due to adhesions, at the site of ileostomy.
Fig. 4: Saggital CT section in the same patient demonstrating high-grade small bowel obstruction due to adhesions at the site of ileostomy.
Fig. 5: Axial CT images in a patient with Closed-loop obstruction demonstrate small bowel obstruction due to adhesion just to the right of midline. Also mural thickening of distal ileum and free intraperitoneal fluid are seen. The terminal ileum beyond the obstructed ileum is collapsed.
Fig. 6: Axial CT images in a patient with Closed-loop obstruction demonstrate small bowel obstruction due to adhesion just to the right of midline. Also mural thickening of distal ileum and free intraperitoneal fluid are seen. The terminal ileum beyond the obstructed ileum is collapsed.
Fig. 7: Axial CT images in a patient with Closed-loop obstruction demonstrate small bowel obstruction due to adhesion just to the right of midline. Also mural thickening of distal ileum and free intraperitoneal fluid are seen. The terminal ileum beyond the obstructed ileum is collapsed.
Fig. 8: Axial and Sagittal CT images in a patient with high-grade obstruction secondary to an incarcerated right femoral hernia.
Fig. 9: Axial and Sagittal CT images in a patient with high-grade obstruction secondary to an incarcerated right femoral hernia.
Fig. 10: Axial CT section demonstrating an obstructing umbilical hernia.
**Fig. 11:** Axial CT section demonstrates obstructing parastomal hernia in this patient with previous total colectomy and ileostomy.
Fig. 12: Axial CT section demonstrates mural thickening and enhancement in terminal ileum in a patient high grade small bowel obstruction secondary to active Crohn’s disease. Also note fistulation between terminal ileum and a distal ileal loop.
**Fig. 13:** Coronal CT section demonstrating high grade small bowel obstruction secondary to active terminal ileal Crohn's disease.
**Fig. 14:** Coronal CT section demonstrates significant segmental mural thickening of distal ileum. Lymphoma was diagnosed at histology.
**Fig. 15:** Axial CT section in the same patient with significant mural thickening of distal ileum.
Fig. 16: Axial CT section demonstrates small bowel mesenteric twist causing small bowel obstruction.
Fig. 17: Axial CT section demonstrates an obstructing intraluminal gallstone in a distal ileal loop.
**Fig. 18:** Coronal CT section demonstrates a jejuno-jejunal intussusception. No lead point was identified in this patient.
Fig. 19: Axial CT section in the same patient demonstrating jejuno-jejunal intussusception
Conclusion

Today there is increasing evidence that some cases of small bowel obstruction resolve with conservative management. Accurate imaging by allowing confident diagnosis or exclusion of small bowel ischemia can help the clinicians make the most appropriate management decision for the patients. In this context, the role of multidetector CT as the modality of choice for imaging SBO is a critical one. Therefore familiarity with CT imaging findings in different cases of SBO allows tailoring an individualized treatment plan for each patient which is essential for their optimal management.

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