

Case Report

Early diagnosis of bowel obstruction and strangulation by computed tomography in emergency department

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BACKGROUND: Closed loop bowel obstruction is a specific type of mechanical obstruction with a high risk of strangulation and bowel infarction, especially in the small bowel. It is associated with a high mortality rate. Hence, it is important for emergency physicians to identify the presence of strangulation, while making the diagnosis of closed loop small bowel obstruction.

METHODS: We reported three patients with strangulated closed loop small bowel obstruction associated with severe abdominal pain, who had been treated at the emergency department. Urgent computerized tomography was performed in the patients.

RESULTS: Two patients were discharged with stable conditions, and one patient died after hemodialysis.

CONCLUSION: Urgent computerized tomography of the abdomen serves as an important diagnostic tool in view of its ability to detect the site, level and cause of obstruction along with the distinctive CT appearance of closed loop small bowel obstruction and signs of ischemia. Early definitive diagnosis will guide subsequent management and improve outcomes.

KEY WORDS: Closed loop small bowel obstruction; Computed tomography; Ischemia; Strangulation

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INTRODUCTION

Closed loop bowel obstruction is a specific type of mechanical obstruction in which a segment of the bowel is obstructed at two points along its course at a single location, thus forming a closed loop. Usually this is due to adhesions, a twist of mesentery or internal hernias. In the large bowel, it is known as volvulus. In the small bowel, it is known as small bowel closed loop obstruction. Especially in the small bowel, the risk of strangulation and bowel infarction is high with a mortality rate of 10%–35%.^[1]

We reported 3 patients with strangulated closed loop small bowel obstruction associated with severe abdominal pain who had been treated at the emergency department. These patients showed the need for urgent abdominal computed tomography (CT) and the distinctive appearance of closed loop small bowel obstruction and signs of ischemia on emergency CT.

CASE REPORT

Case 1

A 48-year-old Chinese man presented to the emergency department because of sudden onset of severe, continuous left lower abdominal pain and a single episode of vomiting. He had no history of abdominal surgery or any other medical problems. Immediate examination revealed left iliac fossa tenderness but no distention, guarding or signs of peritonitis. Bowel sounds were normal and per-rectal examination showed empty rectum with no bleeding or malaena. Ultrasonography showed no free intra-peritoneal fluid, hydronephrosis or hyperechoic shadows compatible with renal calculi. Laboratory studies showed an elevated white blood cell count of 11.4×10^9 per liter with lymphocytic predominance (neutrophil: lymphocyte 25:62), suggesting a connective tissue disorder or lymphoma

which can potentially lead to intestinal obstruction. Other blood tests showed nothing abnormal. Plain abdominal radiography showed no distention of bowel loops or signs of intestinal obstruction (Figure 1A). In view of ongoing severe abdominal pain, CT scan of the abdomen and pelvis revealed a few small bowel loops in the left iliac fossa, showing beak sign (Figure 1B), slightly decreased mural enhancement, marked corresponding mesenteric fat stranding and vascular congestion associated with a small amount of low density free peritoneal fluid (Figure 1C). These findings were suspicious for a closed loop intestinal obstruction with evolving mesenteric and bowel ischemia. Also, there was a slightly dilated and fluid filled bowel loop across the mid abdomen proximal to the suspected closed loop intestinal obstruction. Other organs showed no obvious abnormality and major visceral branches including mesenteric vessels showed no evidence of occlusion. Emergency exploratory laparotomy showed a 5 cm bruised (subserosal hematoma) but viable loop of the small bowel about 40 cm from the DJ flexure and no obvious congenital band. There was suspicion of vasculitis

or malrotation as a cause for small bowel obstruction. The patient was discharged in a stable condition after 6 days.

Case 2

A 72-year-old Chinese man presented to the emergency department for colicky abdominal pain and vomiting for two days. He had a history of non-ST elevation myocardial infarction and a perforated duodenal diverticulum for which he had undergone duodenal repair and gastrojejunostomy. He was tender over the right iliac fossa with associated guarding on palpation. His blood tests were normal. Plain abdominal X-ray showed multiple loops of the slightly distended small bowel but no intestinal obstruction (Figure 2A). Emergency CT scan showed a distended segment of the small bowel in the right abdomen with tapered proximal and distal margins, suspicious for a closed loop obstruction. There was a small bowel loop around a central mesenteric whirl (Figure 2B) with a U-shaped configuration and converging bowel loops with "rat-tailing" (Figure 2C). A marked edema was observed at the distended segment

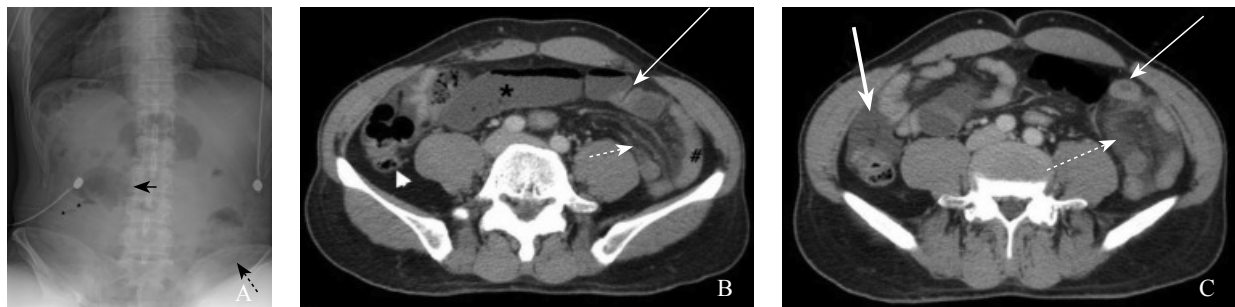


Figure 1. CT scan of the case 1. A: Plain abdominal radiograph showing distention of a short segment of the small bowel (arrow) and a few air-fluid levels (*), suggesting obstruction of the small bowel. The cecum (long dashed arrow) is of normal caliber and shows normal fecal densities. Plain radiograph signs are not specific at this stage, and further evaluation with CT is indicated. B: CT scan showing a narrow transition point forming a "beak sign" (long white arrow). There are the proximal dilated small bowel loop (*) and the normal caliber more distal small bowel (#). There is some stranding in the small bowel mesentery (thin dashed arrow). The cecum (white arrowhead) is normal. C: CT slice just inferior to Figure 1B reveals mural edema (thin arrow) of the small bowel and free peritoneal fluid (thick arrow). There is a significant stranding of the small bowel mesentery (thin dashed arrow).

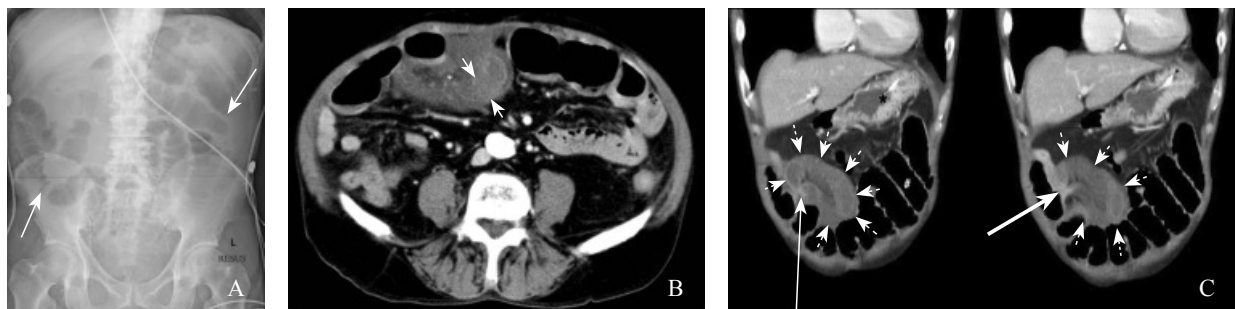


Figure 2. CT scan of the case 2. A: Plain abdominal radiograph showed multiple loops of slightly distended small bowel (thin arrow) but no intestinal obstruction and focal narrowing of the small bowel (thick arrow). B: Axial CT scan showing the center of the twist point (*) with a markedly thickened small bowel loop (arrows) leading to it. C: Coronal reformatted CT scan images better demonstrate a closed loop of the small bowel which forms a U-shaped configuration (dashed arrows). There is the tapering or "rat-tailing" (long thin arrow) of the small bowel at the thickened twist point (thick arrow). The more proximal jejunal loops are dilated (#). There is a nasogastric tube in the stomach (*).

with areas of poor enhancement suspicious for necrosis. The patient underwent emergency laparotomy and small bowel volvulus was found operatively. He was subjected to a resection of the small bowel and an end-to-end anastomosis. The condition of the patient was stable on the day of discharge.

Case 3

A 85-year-old woman with end-stage renal failure on continuous ambulatory peritoneal dialysis was transferred from another hospital with a diagnosis of peritoneal dialysis peritonitis. She had a two-day history of abdominal pain with a few episodes of diarrhea and vomiting but clear dialysate effluent during peritoneal dialysis. There was generalized tenderness with guarding over her abdomen on examination. She had an elevated white blood cell count of 20.1×10^9 per liter with neutrophilia. Plain abdominal radiograph showed distended bowel loops with mural thickening (Figure 3A). CT scan of the abdomen revealed non-enhancement of the bowel wall with distended loops (Figure 3B) and also a stagnation of small bowel contents resulting in "small bowel feces sign" (Figure 3C) and mesenteric congestion (Figure 3D). Emergency laparotomy showed a 125-cm ischemic segment of the jejunum. Omental adhesion caused a small window leading to internal herniation of the small bowel through the window with turbid fluid in the abdomen. The ischemic bowel was resected. The patient developed fast atrial fibrillation and then underwent a second look laparotomy the next day showing two segments of the gangrenous small bowel, turbid fluid, and a pulseless superior mesenteric artery. A family

meeting was arranged to discuss the poor outcome and then the family agreed for comfort care and not for further operation or resuscitation. Hemodialysis was stopped and the patient died the next day.

DISCUSSION

Mechanical small bowel obstruction (SBO) is one of the most frequently encountered surgical conditions, and accounts for approximately 12%–20% of all patients presenting with an acute abdomen.^[2–4] Intra-abdominal adhesion, related to prior abdominal surgery, is the etiologic factor in up to 75% of cases of SBO.^[5] Patients with intestinal malrotation are also at increased risk of SBO, although this is mostly diagnosed in the pediatric population. Internal hernias, accounting for 0.2%–0.9% of all hernias, are rare. History and physical examination of such patients should focus on prior abdominal operations suggestive of adhesions, presence of intra-abdominal cancer, inflammatory bowel disease, vasculitis occurring in systemic lupus erythematosus and polyarteritis nodosa, and the presence of inguinal or femoral hernias.

Clinical differentiation between simple and strangulating obstruction is often difficult, even by an experienced physician.^[6,7] The classical signs of strangulating obstruction are fever, tachycardia, continuous abdominal pain, peritoneal signs, leukocytosis and metabolic acidosis. But these signs alone or in combination have a very low sensitivity and specificity. Currently, clinical information obtained from history and physical examination can be supplemented with recent advances in imaging techniques.

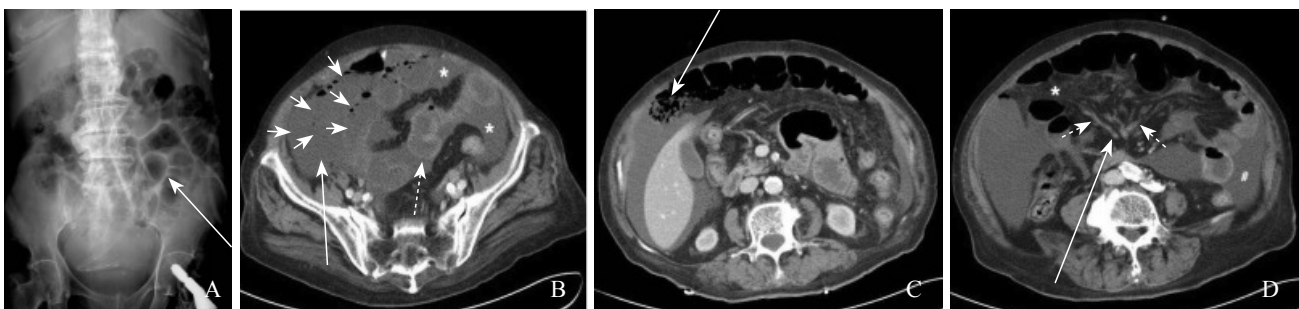


Figure 3. CT scan of the case 3. A: Plain abdominal radiograph showing distended bowel loops with mural thickening (arrow) and a Tenckhoff catheter in-situ; B: The axial CT scan shows a very abnormal segment of the small bowel (long white arrow), which is infarcted. There is no enhancement with contrast and the small bowel walls (multiple thin arrows) are barely perceptible. There is significant free fluid in the peritoneal cavity (*). Compared this to the clearly visible and enhancing bowel wall, more distally (dashed arrow), which is edematous but not infarcted. There may be gas within the bowel wall itself i.e. pneumatosis intestinalis or free gas due to perforation (not shown); C: CT scan demonstrating a "small bowel feces sign" (arrow). This is not actually fecal material, but has an appearance similar to the mixed solid densities and gas lucencies which are normally seen in the large bowel (cecum in Figure 1B and 1C) but not normally visible in the small bowel. This is due to a stagnation of small bowel motility owing to obstruction; D: CT scan showing an area of mesenteric congestion (long arrow). The small bowel mesentery shows thickened veins (small arrows) and fat stranding, which refers to areas of increased density within the normally black (lucent) fat (*). Again, significant free fluid (#) can be seen.

Plain abdominal radiography (PAR) is a rapid and convenient examination in the initial evaluation of abdominal pain in an emergency setting because of its widespread availability and low cost. Use of PAR in evaluation of patients with clinically suspected SBO has a sensitivity of 69% and a specificity of 57%.^[8] Other studies have also reported a sensitivity of 63%–77% and a specificity of 50%–78%.^[9,10] A recent study^[11] of patients with abdominal pain treated at an emergency department revealed a sensitivity of 82% and a specificity of 96.4% in plain abdominal radiography for small bowel obstruction. The possibility of selection bias cannot be ruled out in this study in view of its retrospective design.

It is important for the emergency physicians to identify the presence of strangulation in addition to making the diagnosis of closed loop obstruction of the small bowel. Strangulation, which is most commonly seen in the setting of closed loop obstruction, occurs as a result of obstruction of blood flow to the bowel, leading to vascular compromise. This compromise to the arterial blood flow results in ischemia, and finally infarction, and it is associated with a mortality rate of up to 35%.^[1] Urgent evaluation of small bowel ischemia is important in view of its implications on morbidity and mortality secondary to delayed diagnosis.

Several studies^[8,12–18] have demonstrated the accuracy of CT in confirming the diagnosis and also revealing the site, level and cause of SBO, with a sensitivity of 94%–100% and a specificity of 90%–95%. A review of the literature also supported the use of CT as a sensitive and specific test for SBO.^[19]

CT findings of closed loop SBO depend on the length of bowel segment forming the closed loop and orientation of the loop in relation to the imaging plane. A short closed loop oriented within the plane of imaging will appear as a U- or C-shaped loop of the bowel. Another appearance is that of a radial array of distended small bowel loops with the stretched mesenteric vessels converging to a central point of the site of torsion. If the closed loop is longer and oriented perpendicular to the imaging plane, it will be seen as a clump of bowel loops. The "beak sign" seen at the site of torsion appears as a fusiform tapering. The "whirl sign" occurs as a result of the tightly twisted mesentery.^[1,12]

The diagnosis of small bowel ischemia in the presence of obstruction is more challenging, with sensitivities ranging from 75% to 100% and specificities from 61% to 93%.^[20,21] Decreased enhancement of the bowel wall after administration of intravenous contrast is the most specific sign of ischemic bowel. The other useful finding is the "small bowel feces sign" which is defined as gas

and solid material within a distended small bowel loop that simulates the appearance of feces. It is very useful as it is seen at the transition zone from normal to obstructed bowel, and thus facilitates identification of the point and cause of SBO. Other findings suggestive of ischemia and risk of strangulation, but not independently sensitive and specific, include bowel wall thickening, mesenteric edema with fat stranding appearance, ascites, mesenteric vascular congestion, intramural pneumatosis, and portal venous gas.^[1,22]

CT scan also provides a global evaluation of the abdomen and this is especially relevant in the emergency department when evaluating a patient with acute abdomen when multiple etiologies are being considered in the differential diagnosis.^[10,17] Thrombus can be seen in the mesenteric artery or vein in central occlusion on CT performed after intravascular contrast administration. Multiple organ infarcts can be seen in global hypoperfusion. Multisegmental mural edema and focal areas of transient ischemia occurs as a result of mesenteric vasculitis.

The other advantage of CT in SBO in an emergency department is the rapidity. Helical CT scanning allows thin slice contiguous images to be obtained without increasing radiation exposure. The rapidity of scanning allows several acquisitions to be obtained during different phases of a single intravenous contrast bolus. There is emphasis on the use of only intravenous contrast to look for abnormal bowel wall enhancement when small bowel ischemia is suspected. Oral contrast should not be given as it will make the patient more uncomfortable and induce vomiting as there is preexisting bowel distention. Bowel content serves as a contrast agent and oral contrast will also hamper the ability to assess the enhancement of the bowel wall.^[1,22]

The limitation of CT scan is its low sensitivity for detecting partial SBO. Enteroclysis (small bowel enema) is regarded as one of the most accurate radiographic tests for the diagnosis of SBO, with a sensitivity and specificity being approximately 100%. But it is labor intensive, time consuming and hence not suitable in the emergency setting.^[11] Magnetic resonance imaging has also shown to be equally sensitive as CT in locating and evaluating the cause of obstruction. But the inability to detect viability of the bowel, poor definition of mass lesions and inflammation and lack of availability in all emergency departments limit its use.^[5]

Patients with PAR finding of small bowel obstruction and peritonitis on physical examination or clinical markers (fever, tachycardia, continuous pain, leukocytosis

and metabolic acidosis) should undergo exploration. All patients with inconclusive plain films for bowel obstruction or suspicion for strangulated SBO should undergo an abdominal CT scan. Patients with multiple signs on CT suggesting strangulation should be operated on early.^[5] Studies have shown that 31%–43% of patients with uncomplicated SBO will resolve without requiring any form of bowel resection.^[23]

In conclusion, the diagnosis of SBO is based on presenting history, previous medical background, physical examination and laboratory findings. Plain abdominal radiography can be performed as an initial imaging modality in suspected SBO. However, urgent computerized tomography of the abdomen in the emergency department serves as an important diagnostic tool in view of its ability to detect the site, level and cause of obstruction along with the distinctive CT appearance of closed loop obstruction of the small bowel and signs of ischemia. Early definitive diagnosis will guide subsequent management and improve outcomes.

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