Strangulated small bowel obstruction caused by adhesion of the tip of appendix to the ileum

Akitoshi Inoue, MD／Akira Furukawa, MD, PhD*／Shinichi Ohta, MD, PhD
Keiko Mochizuki, MD**／Yoshihiro Tsutamoto, MD, PhD**／Kiyoshi Murata, MD, PhD

Department of Radiology, Shiga Universitiy of Medical Science
*Department of Radiological Science, Tokyo Metropolitan University
**Department of Surgery, Toyosato Hospital

Abstract *Adhesion resulting from past abdominal surgeries account for the vast majority of small bowel obstruction cases. We report a rare case of strangulated ileal obstruction caused by an appendiceal adhesion to the ileum in which an aperture was formed that permitted herniation of ileal loops. CT demonstrated distended small bowel loops and collapsed cecum and ascending colon, which indicated small bowel obstruction. During laparoscopic surgery, the tip of the appendix was found to adhere to the ileum at 80 cm proximal to the ileo-cecal valve, forming an aperture that permitted herniation of the distal ileum, which resulted in a closed-loop ileal obstruction. Adhesion of the appendix as a cause of bowel obstruction and strangulation is rare, but physicians should be familiar with this pathological condition.*

Keywords ; *Intestinal Obstruction, Appendix, Hernia, Multidetector-Row Computed Tomography*

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Address reprint request to Akitoshi Inoue, Department of Radiology, Shiga Universitiy of Medical Science, 520-2192 Seta Tsukinowa-cho, Otsu-city, Shiga, Japan

Introduction

Small bowel obstruction (SBO) is a common clinical condition accounting for approximately 20% of surgical admissions for acute non-traumatic abdominal pain [1]. The most common cause is adhesions which account for up to 70% of SBO cases in developed countries, and 80% of patients with adhesion-related SBO have a history of prior abdominal surgery. Bowel obstruction caused by adhesions resulting from previous appendicitis is extremely rare, and therefore, it is typically not suspected. We report a rare case of strangulated ileal obstruction caused by an appendiceal adhesion to the ileum in which an aperture was formed that permitted herniation of ileal loops. The diagnosis of bowel obstruction and strangulation by MDCT is also reviewed.

Case report

A 61-year-old woman with a 9-h history of right lower abdominal pain presented to our hospital as a general outpatient. She had a medical history of subarachnoid hemorrhage at 50 years of age and gastric cancer treated by endoscopic submucosal

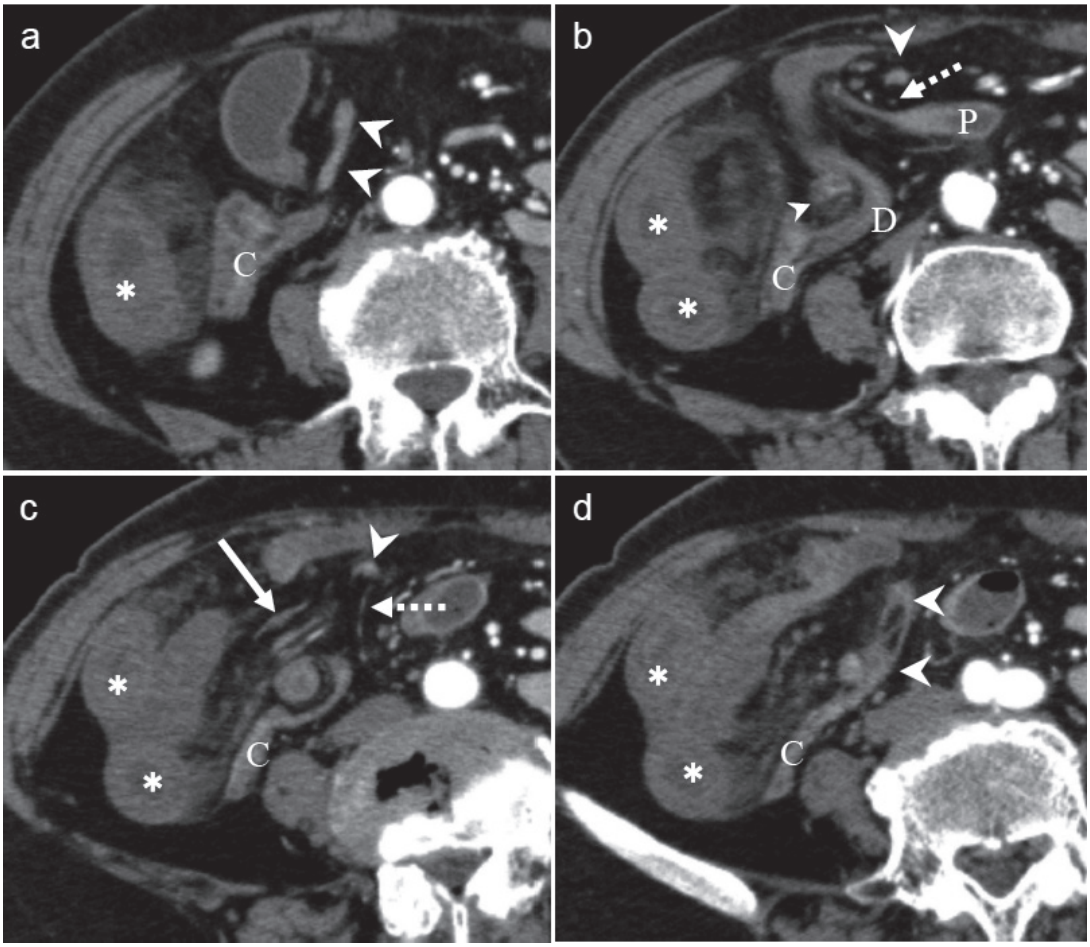

Figure 1 Axial CT image shows a thickened-wall, small bowel loop with mesenteric edema in the right lower abdomen (a-d: asterisk). The cecum (a-d: C) is displaced medially by the small bowel loop. The appendix adheres to the ileum and forms the aperture (a-d: arrow head). The appendiceal artery, which is located in the mesoappendix, is also observed near the appendix (b and c: broken arrow). Proximal (b: P) and distal transition points (b: D) and the ileal artery (c: arrow) in the appendiceal loop.

dissection at 57 years of age. Physical examination revealed tenderness and a mass in her right lower abdomen, but indicators of peritonitis, such as Blumberg's sign, were not present. Blood test results were as follows: white blood cell count, 10.1 × 10^3/μL; hemoglobin level, 13.2 g/dL; platelet count, 23.3 × 10^4 /μl; C-reactive protein level, 0.3 mg/dL; and creatine kinase level, 78 IU/L.

Abdominal radiographs showed distended small bowel loops with air-fluid levels in the left upper abdomen that were consistent with SBO. In addition, a gas-free area was observed in the right lower abdomen. SBO, in particular, a closed-loop obstruction, was suspected; therefore, computed tomography with and without contrast was immediately performed. Images were obtained using a Toshiba Aquilion 16 (120 kv, 200 mAs, helical pitch 15, FOV 230, slice thickness 1 mm).

Contrast-enhanced images were obtained at 35 and 70 s after a bolus injection of 100 mL of iohexol (300 mgI/mL) at a speed of 3.0 mL/s. CT findings included distended small bowel loops and collapsed cecum and ascending colon, which indicated SBO. In addition, contrast-enhanced CT images of the ileal loops in the right lower abdomen showed thickened walls and a halo or target stratification. Infiltration of the contrast into the mesentery associated with these ileal loops and engorgement of their draining mesenteric veins were also observed. Although these ileal loops were not prominently distended, transition points were identified at both ends of the loops that were situated closely together, a finding that is characteristic of a closed-loop obstruction. Small amount of ascites was also observed in the pelvic region (Fig.1, 2). Based on these findings, a diagnosis of strangulating closed-loop ileal obstruction was made.

CT imaging additionally showed that the cecum was collapsed and medially displaced by the closed loops. An internal hernia, such as pericecal hernia, was considered as a differential diagnosis but was ruled out because the ileum and mesentery, including mesenteric vessels, passed thorough an aperture that was formed by the ileum, appendix, and mesoappendix, including the appendiceal artery (Fig.1, 2). However, the relationship of the appendix to the strangulating ileal obstruction was not identified in the initial CT image interpretation.

Because the closed loops demonstrated a stratified pattern of enhancement, the ischemic bowel was regarded as potentially reversible without transmural infarction. In addition, the physical examination and

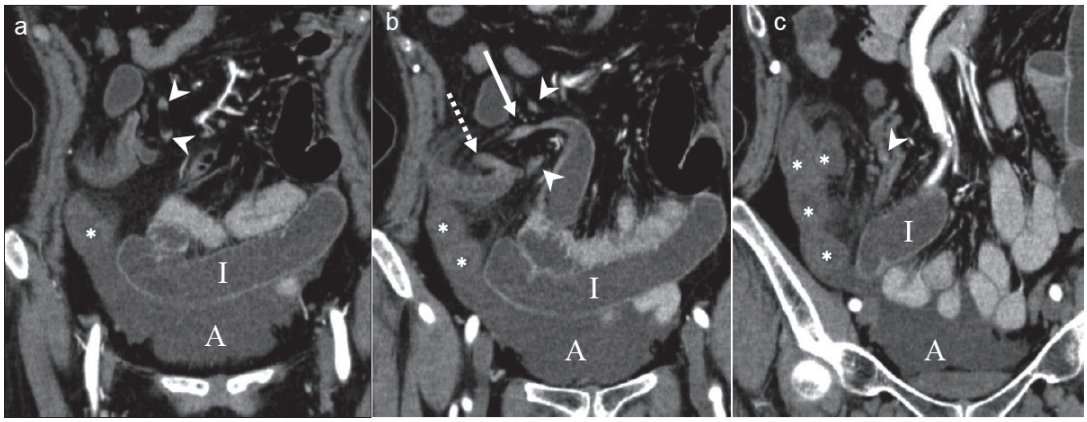

Figure 2 Coronal CT image shows a thickened-wall small bowel loop with mesenteric edema in the right lower abdomen (a-c: asterisk) and ascites (A) in the pelvic cavity. The appendix adheres to the ileum, making the aperture (a-c: arrow head). The dilated oral side ileum (I) is observed. Proximal (b: solid arrow) and distal transition points (b: broken arrow) are observed in the appendiceal loop (b: arrow head).

laboratory data were relatively unremarkable and there was no indication of peritonitis; therefore, the surgeon elected to perform laparoscopic surgery. During laparoscopic surgery, the tip of the appendix was found to adhere to the ileum at 80 cm proximal to the ileo-cecal valve, forming an aperture that permitted herniation of the distal ileum, which resulted in a closed-loop ileal obstruction (Fig.3). The herniated ileal loops were dark red in color, and hemorrhagic ascites were also observed. Figure 4 shows the positioning of the strangulated intestine in relation to the aperture formed by the appendiceal adhesion to the ileum.

The adhesion between the appendix and ileum was removed, and the strangulated loops were released. After the synechiotomy, the color of the involved ileum improved, the artery supplying the region began to pulsate, and bowel peristalsis resumed. Based on these observations, the strangulated ileum was judged to be viable with no transmural necrosis; therefore, only appendectomy was performed without ileectomy. No peritoneal recesses or defects were observed, and internal hernia was ruled out. Histopathological examination revealed abundant lymphoid follicles, mild neutrophilic infiltration, and chronic inflammatory changes in the appendix. Additionally, a hematoma was found in the distal appendix that extended from the muscular to the subserosal layer (Fig.5).

The patient's recovery from laparoscopic surgery was uneventful, and she was discharged from the hospital 14 days postoperatively.

Discussion

Most patients with SBO are initially treated conservatively; however, approximately 10% of SBO cases are complicated with intestinal strangulation that requires correct early diagnosis and timely management [2]. Delay in appropriate surgery may lead to sepsis and multiple organ failure caused by bowel necrosis or perforation, which increases the risk of death. The mortality rate of strangulating SBO is greater than that of simple SBO and increases to 8%–25% when not managed

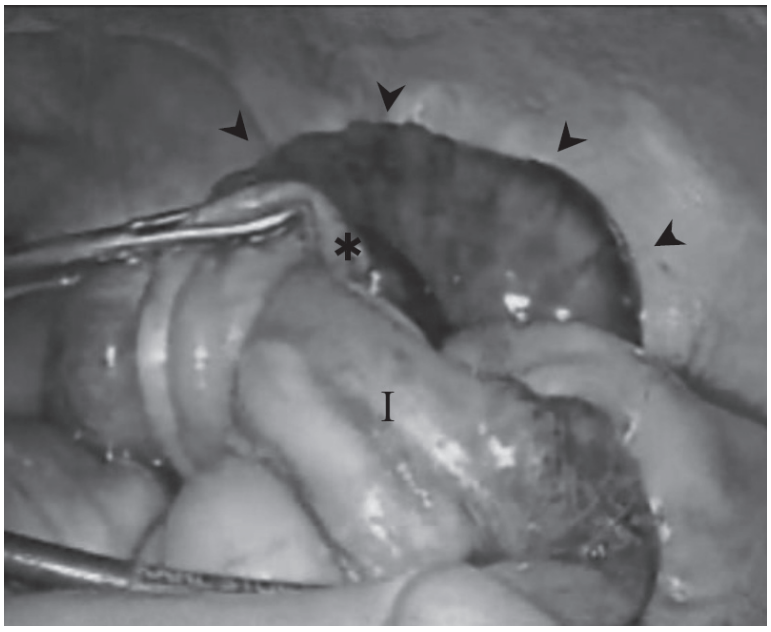

Figure 3 Laparoscopy shows that the tip of the appendix (asterisk) is adherent to the ileum wall (I). The strangulated ileum (arrow head) passes through into the aperture formed because of the adhesion.

appropriately [3].

CT plays an extremely important role in diagnosis of strangulating SBO. The sensitivity of CT in diagnosing strangulation is as high as 83%–100%, and the specificity is 61%–93% [4]. The reported accuracy of CT in the diagnosis of high-grade obstructions is 95%, with a sensitivity of 90%–94% and a specificity of 96% [5].

Causes of SBO are various and can be extrinsic, intrinsic, or intraluminal [6]. Adhesions resulting from past abdominal surgeries account for the vast majority of SBO cases. Because the adhesive band itself is not visible on CT, diagnosis is based on exclusion of other causes. External hernias [incidence: 2%–8% [6]], and tumors are the second and third most common causes of SBO, respectively, and their presence are mostly indicated on CT images. Internal hernias are rare, but are considered as possible causes of SBO in patients with no previous history of surgery when a suck-like mass or cluster of dilated small bowel loops displacing adjacent organs or vessels are visible on CT [5, 7]. The etiology of SBO can be determined on CT by close analysis of the transition zone between the dilated and collapsed loops with a reported diagnostic accuracy of 73%–95% [7].

Adhesion of the appendix from acute or previous appendicitis as a cause of bowel obstruction and strangulation is extremely rare and was not suspected in this case. In this case, inflammation in the appendix and a hematoma in the distal appendix were revealed by histopathological examination. The following scenario was proposed to explain the development of this patient's strangulating SBO: the tip of the appendix adhered to the ileum because of inflammation and formed the aperture. The ileal loops then herniated through the aperture and was strangulated. Finally, the stretching of the appendix by the dilated ileal loops induced hemorrhage in the muscular and subserosal layer of the distal appendix.

There have been only a limited number of case reports on such conditions [8-10]. These reports described various scenarios regarding the role of the appendix in the development of SBO.

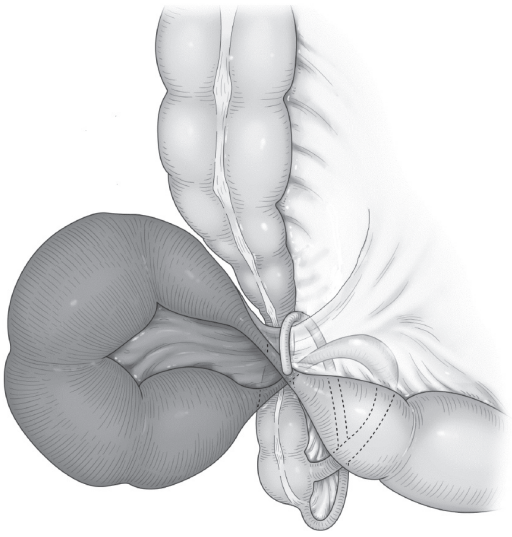

Figure 4 Illustration of the intestinal position in this case.
The tip of the appendix adheres to the ileum at 80 cm proximal to the ileo-cecal valve to form an aperture for the distal ileum to herniate and create a closed-loop ileal obstruction.

SBO in this setting can be caused by extrinsic compression, traction of the small bowel trapped in an appendicular mass or abscess, by strangulation of the bowel loops due to the appendix wrapping around the mesentery of the affected loops, or by a mechanism of internal herniation through an aperture created by adhesion of the base of the appendix to the cecum, ileum, or peritoneum. It is clinically very important to differentiate these relatively rare causes of bowel obstruction from an adynamic ileus stemming from localized peritonitis associated with acute appendicitis by precise interpretation of CT images as discussed above. Key findings indicative of bowel obstruction are collapse of the ascending colon and presence of an ileal closed loop. In addition, this condition may be observed in patients without acute appendicitis where appendiceal adhesion from previous inflammation causes strangulation. The recent trend toward conservative management for acute appendicitis may increase the number of strangulating obstructions that occur with this rare mechanism. In our case, by a retrospective review of CT images with the results from surgery, adhesion of the appendiceal tip to the distal ileum in addition to the presence of closed ileal loop obstruction in the right lower abdomen can be recognized. The knowledge of a relation between SBO and strangulation related to acute appendicitis and appendiceal adhesion might have been helpful to make a correct preoperative diagnosis in our case.

In conclusion, in cases where bowel distention is observed in the right lower abdomen on CT images, physicians should be careful not to exclude this rare but dangerous cause of bowel obstruction and strangulation.

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All authors have no conflict of interest.

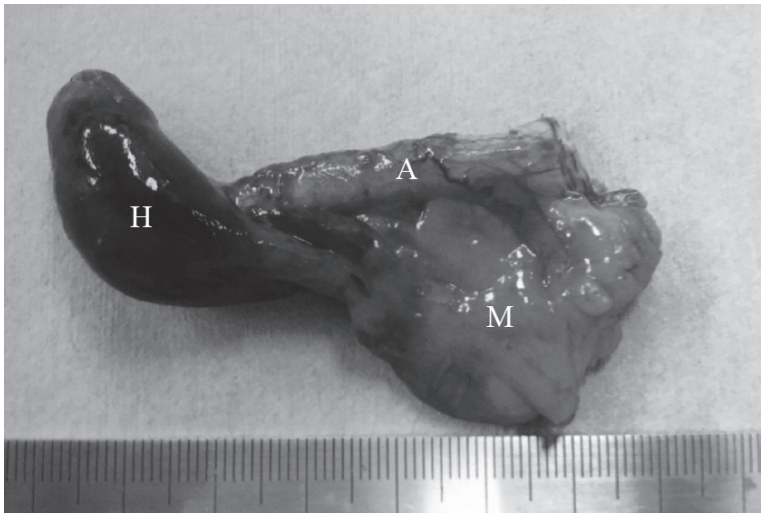

Figure 5 Resected specimen showing a submucosal hematoma in the distal appendix.A: appendix, H: hematoma, M: mesoappendix

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