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Case Report

A case of strangulated bowel obstruction in which transabdominal ultrasound was useful for preoperative diagnosis ☆,☆☆

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ABSTRACT

A 74-year-old man presented to the emergency department with the chief complaint of abdominal pain. A computed tomography scan showed paralytic ileus. An ileostomy tube was placed, but the symptoms of bowel obstruction did not improve. Two days after admission, the patient's renal function deteriorated. Transabdominal ultrasound (TUS) showed linear high-intensity echoes consistent with a fibrotic band and microbubbles suggestive of circulatory disturbance in the dilated intestinal tract. Subsequent contrast-enhanced ultrasound revealed circulatory disturbance of the small bowel wall. Emergency surgery was performed under the diagnosis of strangulated ileus. Intraoperative examination revealed that the terminal ileum was strangulated by a fibrotic band from the retroperitoneum, which was confirmed by TUS. The fibrotic band was resected, the strangulation was released, and ileocecal resection was performed. Postoperatively, intestinal peristalsis was rapidly restored. TUS was able to depict the fibrotic band, which could not be detected by a computed tomography scan, allowing the patient to undergo immediate surgical treatment. We herein report this case of strangulated bowel obstruction in which TUS and contrast-enhanced ultrasound were useful in preoperative assessment of the patient's condition.

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Introduction

Strangulated bowel obstruction is associated with disturbance of blood flow. This type of bowel obstruction accounts for approximately 10% of all bowel obstructions and is not an uncommon condition [1]. Strangulated bowel obstruction is a progressive disease that requires careful attention because incorrect initial treatment can lead to intestinal necrosis, septic shock, and death. It is important to correctly diagnose the presence or absence of impaired bowel circulation because the treatment outcome depends on the duration of time from the onset of the disease [2]. Although some blood tests show statistically significant variations in the diagnosis of strangulated ileus, the specificity of these tests is not high. They show abnormal values less frequently, or they may also show many abnormal values in other types of simple ileus [3,4]. Strangulation is difficult to predict using blood tests alone, and additional examinations should be performed before the patient's condition becomes severe.

We herein report a case of strangulated bowel obstruction in which transabdominal ultrasound (TUS) and subsequent contrast-enhanced ultrasound (CEUS) were useful in preoperative assessment of the patient's condition.

Case report

A 74-year-old man visited a previous physician with the chief complaint of abdominal pain. The patient was diagnosed with constipation and prescribed laxatives, but the abdominal pain did not improve. He was transferred to our hospital the next day and admitted with a diagnosis of paralytic ileus. Physical examination revealed no abnormalities: the patient was conscious and had a blood pressure of 154/91 mmHg, pulse rate of 72 beats/min, respiratory rate of 20 breaths/min, SpO₂ of 99% on room air, and body temperature of 36.6°C. His abdomen was flat, soft, and distended throughout with tenderness but without muscular defense or Blumberg's sign.

Blood tests revealed a high white blood cell count [9560 cells/ μ L (reference range: 3300-8600 cells/ μ L)], the creatinine concentration [1.59 mg/dL (reference range: 0.65-1.07 mg/dL)], and a mildly elevated C-reactive protein concentration [0.19 mg/dL (reference range: \leq 0.14 mg/dL)]. Liver function indices [aspartate aminotransferase, 13 U/L (reference range: 13-30 U/L); alanine aminotransferase, 19 U/L (reference range: 10-42 U/L)] were normal.

A contrast-enhanced computed tomography (CT) scan showed that the entire small bowel was dilated with an air-fluid level, but there were no obvious signs of obstruction (Fig. 1). The dilated small bowel wall was almost uniformly contrast-enhanced without obvious ischemia. A small accumulation of ascitic fluid was present. However, the symptoms of intestinal obstruction did not improve, and 2 days after admission, deterioration of renal function was observed.

TUS showed linear high-intensity echoes consistent with a fibrotic band and microbubbles suggestive of circulatory disturbance in the dilated intestinal tract on the right side of the umbilical region, which was thought to be the starting point of the obstruction (Fig. 2). On subsequent CEUS, the mucosal surface of the dilated bowel exhibited contrast, but only faintly, suggesting a possible circulatory disturbance caused by blood stasis secondary to the fibrotic band (Fig. 3). Based on the above findings, strangulated bowel obstruction due to the fibrotic band was diagnosed and the patient underwent emergency surgery.

The abdomen was opened through an upper midline incision. The small intestine was dilated throughout. As confirmed by preoperative ultrasonography, the end of the ileum was strangulated by a retroperitoneal cord (Fig. 4). The fibrotic band was dissected and the strangulation was released. Ileal resection was performed because of necrosis of the intestinal tract extending approximately 2 cm at the end of the ileum. Functional reconstruction was performed and the operation was completed.

Recovery of intestinal peristalsis was achieved promptly after surgery, and the patient resumed eating on day 2. He developed aspiration pneumonia but was discharged 48 days after surgery.

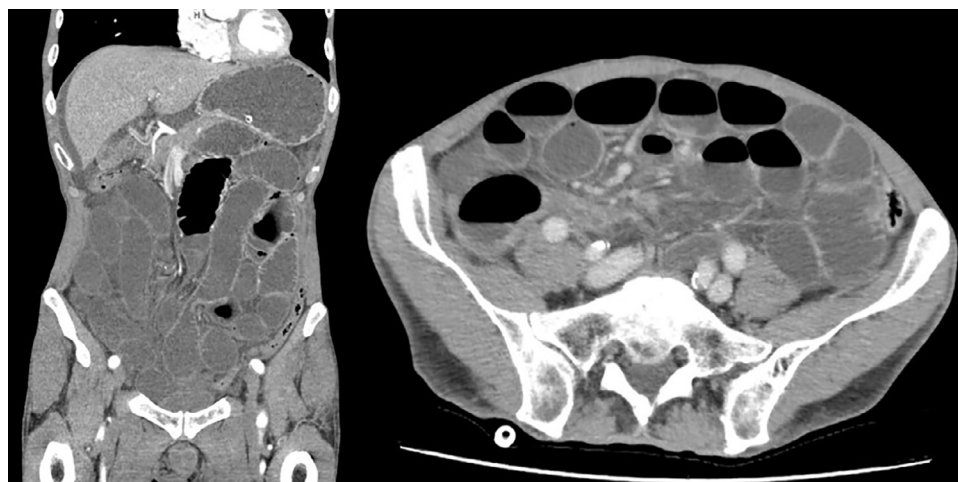


Fig. 1 – CT scan showed that the entire small bowel was dilated with an air-fluid level, but there were no obvious signs of obstruction.

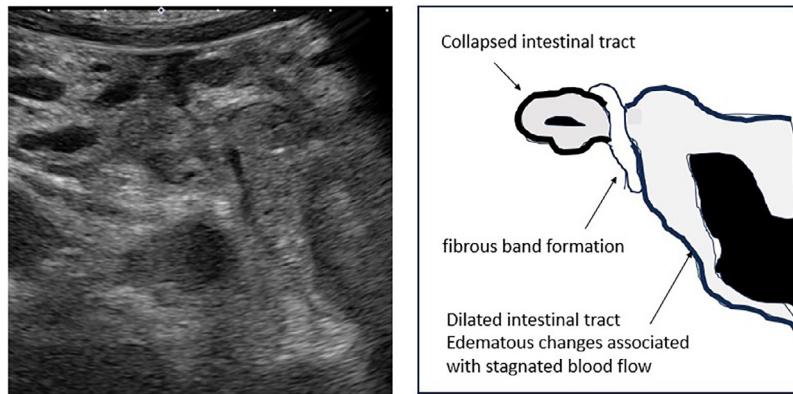


Fig. 2 – CEUS showed a fibrous band and strangulated ileus.

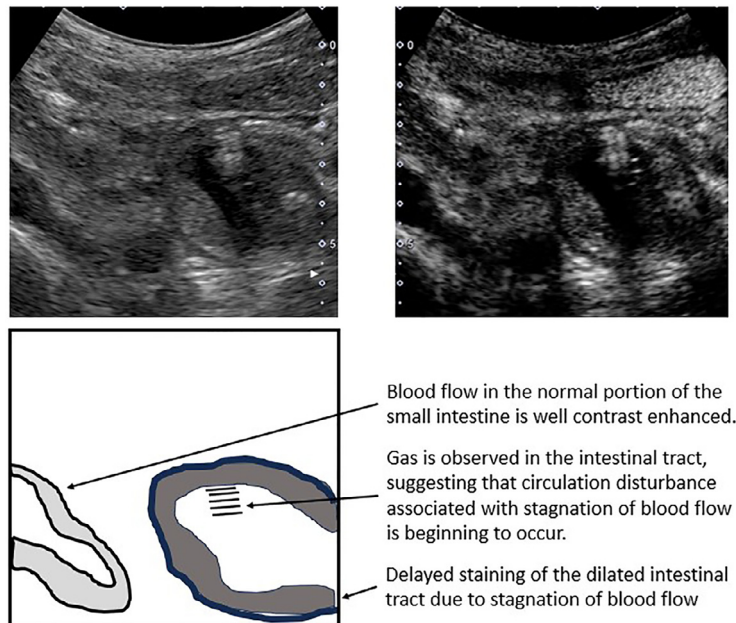


Fig. 3 – CEUS suggested a possible circulatory disorder of the mucosal surface due to blood stasis from the fibrotic band.

Discussion

The prognosis of patients with strangulated bowel obstruction is highly dependent on the appropriate decision to perform either surgery or conservative management in the early stages of the disease. However, Hikida et al. [5] reported that it is difficult to make such a decision based on clinical examination alone. In our case, only the white blood cell count was elevated; other laboratory values suggestive of ischemia, such as creatine phosphokinase and lactate, were normal.

Contrast-enhanced CT is considered the gold standard for imaging diagnosis of strangulated bowel obstruction [6]. Some reports have suggested that the well-known CT findings of strangulated bowel obstruction, such as the appearance of ascites and Kerckring's opacity, are useful in strangulated bowel obstruction that has already developed necrosis but not in

early-onset cases [7]. Contrast enhancement of the bowel wall on CT is considered an important finding of strangulated bowel obstruction [6,8]. However, in a study by Chou et al. [6], 17% of 42 patients with contrast enhancement on CT died. Strangulated bowel obstruction should be diagnosed as early as possible before contrast enhancement on CT is observed.

The basic pathophysiology of strangulated bowel obstruction is hemorrhagic infarction due to impaired venous return, and CT images of early-stage strangulated bowel obstruction show simple ileus-like findings. Therefore, the diagnosis of early-stage strangulated bowel obstruction requires identification of changes in the intestinal tract and mesentery due to circulatory disturbances such as congestion or obstruction.

In this regard, compared with other morphological examination methods, the microbubbles in the dilated intestine detected by TUS prompt consideration of the possibility of circulatory disturbance. Subsequent CEUS is very useful for

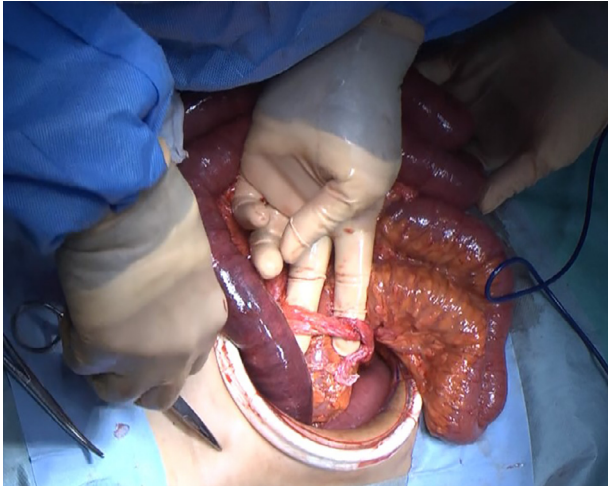


Fig. 4 – A fibrous cord was observed and the small intestine on the oral side was congested.

diagnosis because it can be used to evaluate blood flow in real time, providing a dynamic image of the microcirculation and helping to determine the presence or absence of hemorrhage or ischemia. Good results have been reported in several papers on CEUS for mesenteric ischemia [9–11]. In addition, compared with CT, CEUS does not use radiation, is minimally invasive, and has excellent real-time performance. Furthermore, contrast-enhanced CT and magnetic resonance imaging cannot be performed in patients with renal dysfunction or contrast allergy, whereas CEUS can be performed in such patients [12].

Although CEUS is considered useful, it also has several areas with room for improvement. First, in the high-echo band of the submucosa, it is sometimes difficult to separate the tissue signal from the ultrasound contrast agent, and care must be taken when evaluating still images. Second, high frequencies are often used to detect acute intestinal ischemia, and the resonance of the ultrasound contrast agent bubbles may make examination difficult; therefore, care must be taken in setting the mechanical index value and gain. Third, because there is no objective indicator of flow velocity, the determination of blood flow congestion and other abnormalities must be based on the examiner's subjective impression. Caution is required especially when determining the presence of early strangulated bowel obstruction. Although CEUS has been suggested to be useful, its diagnostic accuracy and universality require further investigation.

Conclusion

We experienced a case of strangulated bowel obstruction due to a fibrotic band in which both TUS and CEUS were useful for preoperative assessment of the patient's condition, allowing for prompt surgical treatment.

Compliance with Ethical Standards

This article does not contain any studies involving human participants performed by any of the authors.

Patient consent

Written informed consent was obtained from the patient for the publication of this case report and any accompanying images.

REFERENCES

- [1] Onda M, Takahashi H, Furukawa K, Tanaka N, Moriyama Y. Nationwide investigation of 21,899 cases of intestinal obstruction. *J Abdom Emerg Med* 2000;20:629–36.
- [2] Yamada T, Kan H, Matsumoto S, Koizumi M, Suzuki H, Uchida E. Diagnosis and treatment of strangulated ileus; importance of early diagnosis. *Surgery* 2012;74:250–4.
- [3] Kawase H, Uemura S, Senmaru N, Yuasa N. Diagnostic accuracy and treatment outcome of strangulated intestinal obstruction. *J Abdom Emerg Med* 2015;35:543–8.
- [4] Kawasaki M, Kurumi Y, Naitoh H, Yamamoto H, Endo Y, Mekata E, et al. A study of diagnosis and management of mechanical small bowel obstruction. *J Jpn Surg Assoc* 2007;68:1369–76.
- [5] Hikida S, Mizote H, Hosokawa T, Katsuki N, Kaibara A, Hashimoto M, et al. Postoperative ileus-surgical indication and operative timing-Progress in Acute abdominal. *Medicine (Baltimore)* 1993;13:367–71.
- [6] Chou CK, Wu RH, Mak CW, Lin MP. Clinical significance of poor CT enhancement of the thickened small-bowel wall in patients with acute abdominal pain. *AJR Am J Roentgenol* 2006;186:491–8.
- [7] Yamada T, Kan H, Matsumoto S, Koizumi M, Shinji S, Matsueda A, et al. Early diagnosis for bowel strangulation by using contrast enhanced CT. *J Abdom Emerg Med* 2015;35:403–7.
- [8] Geffroy Y, Boulay-Coletta I, Jules MC, Nakache S, Taourel P, Zins M. Increased unenhanced bowel-wall attenuation at multidetector CT is highly specific for ischemia. *Radiology* 2014;270:159–67.
- [9] Giannetti A, Bisconti M, Randisi P, Cortese B, Minacci C, Stumpo M. Contrast-enhanced sonography in the diagnosis of acute mesenteric ischemia: case report. *J Clin Ultrasound* 2010;38:156–60.
- [10] Braden B, Iggne A, Hocke M, Palmer RM, Dietrich C. Diagnostic value and clinical utility of contrast enhanced ultrasound in intestinal diseases. *Dig Liver Dis* 2010;42:667–74.
- [11] Hata J, Kamada T, Haruma K, Kusunoki H. Evaluation of bowel ischemia with contrast-enhanced US: initial experience. *Radiology* 2005;236:712–15.
- [12] Odo M, Tokuda K, Shimana A, Hori H, Tsunouchi H, Katafuchi S. Is ultrasound study unnecessary for the diagnosis of strangulated ileus? *J Abdom Emerg Med* 2015;35:39–396.