



BRIEF REPORT

## A case report of inverted Meckel's diverticulum resected by single-balloon enteroscopy

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### Introduction

Meckel's diverticulum (MD), which usually occurs in the distal ileum, is the most common congenital malformation of the gastrointestinal tract [1]. MD is generally asymptomatic; however, ~2%–6% of affected patients develop complications [2] such as bleeding, obstruction, or perforation. Intestinal hemorrhage is the most common complication, accounting for ~30% of all complications [3]. Laparoscopic surgery is usually recommended for MD with hemorrhagic complications. Inverted MD is very rare. MD was reportedly found by double-balloon enteroscopy and surgical treatment was performed. Double-balloon enteroscopy has unique advantages in the diagnosis and treatment of MD-associated bleeding. It not only allows direct, repeated, and clear observation of the small intestine, but the scope can also enter the diverticulum for observation of the internal conditions and acquisition of biopsy specimens to clarify the diagnosis. In the present case, we used single-balloon enteroscopy to identify an inverted MD with massive hemorrhage and performed treatment via whole-layer ileum resection under enteroscopy. This method reduces both pain and the occurrence of post-operative complications such as intestinal adhesion and obstruction. It has high clinical application value and can serve as the first-choice treatment.

### Case report

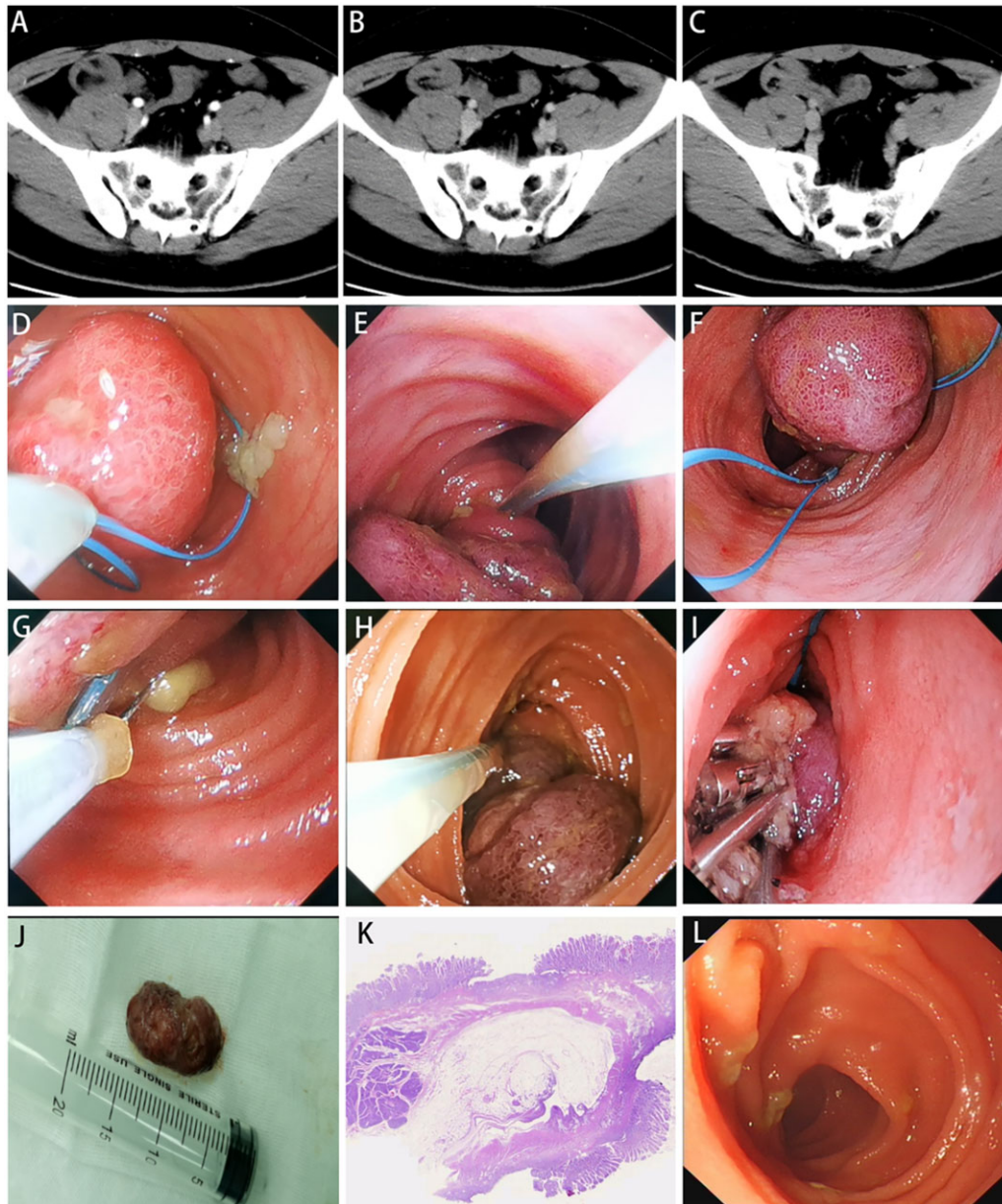
A 21-year-old man was hospitalized because of a 1-day history of hematochezia. His vital signs were stable and his shock index

was 0.6. Continuous hematochezia caused his hemoglobin concentration to decrease from 141 to 91 g/L. Conventional esophagogastroduodenoscopy showed no abnormalities. Colonoscopy revealed many blood clots and bloody water; however, no bleeding lesion was found after washing. Enhanced abdominal computed tomography showed a soft tissue shadow in the distal ileum, and a concentric circle sign and a curved strip-like shadow with fat density were observed in the image. A mesenteric shadow was also seen in some sections (Figure 1A–C). Perianal single-balloon enteroscopy revealed a polypoidal lesion of ~5.0 × 2.5 cm in the ileum 80 cm away from the ileocecal valve with the typical small intestinal villus structure and ulceration at the head. Bleeding of an inverted MD was considered according to the above endoscopic findings. We then resected the lesion by enteroscopy. First, two nylon cords were used to ligate the bottom of the diverticulum to prevent bleeding. A snare was then used to cut between the two nylon cords. Three metallic clips were used to close the center of the wound and another five Harmony metal clips were applied to completely close the wound and thus avoid perforation (Figure 1D–I). The endoscopically excised mass lesion of the terminal ileum measured 4 cm in its greatest dimension (Figure 1J). Post-operative pathologic examination of the specimen showed the full thickness of the small intestinal, multiple ulcerations, and reparative granulation tissue. Notably, heterotopic pancreatic tissue was also found (Figure 1K), which was the main cause of bleeding. After 10 days of observation, the patient was discharged with no complications. No recurrence of gastrointestinal bleeding was found and re-examination by single-balloon enteroscopy 6 months

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**Figure 1.** Clinical data of a case report of inverted Meckel's diverticulum (MD) resected by single-balloon enteroscopy. (A)–(C) Enhanced abdominal computed tomography. A soft tissue shadow in the distal ileum, a concentric circle sign, and a curved strip-like shadow with fat density were observed. (D)–(I) Resection of inverted MD via single-balloon enteroscopy. First, two nylon cords were used to ligate the bottom of the diverticulum to prevent bleeding (D–F). A snare was then used to cut between the two nylon cords (G, H). Three metallic clips were used to close the center of the wound and another five Harmony metal clips were applied to completely close the wound and thus avoid perforation (I). (J) The endoscopically excised mass lesion in the terminal ileum measures 4 cm in its greatest dimension. (K) Histological sections (hematoxylin and eosin staining) of heterotopic pancreatic tissue. (L) Enteroscopic image at the 6-month re-examination.

after discharge showed that the wound had healed well (Figure 1L).

### Discussion and conclusion

Balloon-assisted enteroscopy (BAE) is being increasingly more widely used in the clinical setting. It can facilitate partial or even total enteroscopy of the small intestine and effectively improve the diagnostic rate of small bowel diseases, and it has become the preferred method for the diagnosis of small bowel diseases [4]. The diagnostic rate of small intestinal hemorrhagic diseases can be as high as 70%–95% using this technique [5, 6]. Double-balloon enteroscopy was developed before single-

balloon enteroscopy. Because most MDs are within 100 cm of the ileocecal valve, identification of MDs is easier using transanal enteroscopy. Single-balloon enteroscopy is simpler than double-balloon enteroscopy; thus, it may become an effective diagnostic and therapeutic tool for MD.

According to literature reports, 15.5% of MD contains ectopic tissue. The most common such tissue is gastric mucosa, accounting for 62.4%; others include pancreatic tissue (16.1%), jejunal mucosa, and Brunner's glands [7]. Hydrochloric acid or protease secreted by ectopic tissue can corrode adjacent intestinal mucosa and blood vessels, causing inflammation, erosion, ulceration, and bleeding [8]. BAE has the advantages of intuition, accuracy, safety, and effectiveness. It not only has high

diagnostic value for adult MD, but can also facilitate endoscopic injection, coagulation, clamping of bleeding vessels, and even removal of MD, thus avoiding emergency surgery [9]. Fukushima *et al.* [10] suggested that for adult patients who have suspected MD with stable vital signs, transanal BAE should be performed after multi-slice spiral computed tomography. Compared with laparoscopic treatment of MD with bleeding, BAE has the advantages of less trauma, more rapid recovery, and a shorter hospital stay. Patients with MD that was removed by single-balloon enteroscopy in our center recovered with a fluid diet for 3 days and were discharged smoothly without complications after 7 days. This hospitalization time was significantly shorter than that required for laparoscopic treatment. Additionally, re-examination by transanal enteroscopy after 1 year showed good recovery of the post-operative wound. Endoscopic treatment is expected to become an alternative to surgery. However, few relevant reports have been published and its long-term effect is not clear. Therefore, further research is needed.

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## Conflict of Interest

None declared.

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