Meckel’s Diverticulum Bleeding Missed by the First but Detected by the Second Capsule Endoscopy

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Abstract: A 13-year-old boy was admitted to our hospital because of bloody stools. Although a Meckel’s diverticulum (MD) was suspected, capsule endoscopy (CE) revealed no remarkable findings. Seven months later, he was admitted again because of rebleeding. CE was performed again and revealed an elevated lesion and fresh blood in the ileum. A single balloon endoscopic examination revealed a diverticulum with an elevated lesion in it. Histologic findings showed ectopic gastric mucosa, thus we diagnosed this patient as having MD. Although CE is useful for the examination of obscure gastrointestinal bleeding, a single CE is not enough to diagnose MD bleeding. The timing in performing CE and the evaluation of other modalities would be valuable for patients suspected of having MD.

Keywords: Meckel’s diverticulum, capsule endoscopy, ectopic gastric mucosa.

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Introduction

Meckel’s diverticulum (MD) is a congenital anomaly of the gastrointestinal tract. It is a vestigial remnant of the Vitello-intestinal duct of the fetus, located about 100 cm proximal to the ileocecal valve [1]. MD seems to be found in 2% of the total population [2], and is usually asymptomatic. When symptomatic, it may present with hemorrhage in association with ectopic gastric and/or pancreatic mucosa, intestinal obstruction, intussusceptions, or inflammation [3]. The most frequent symptoms are stomachache (68%) and hemorrhage (31%) [4].

Capsule endoscopy (CE), used for the detection of gastrointestinal diseases, has such advantages as non-invasiveness, high detection rates and few complications. Its diagnostic rate of lesions of obscure gastrointestinal bleeding (OGIB) is 58%, which is superior to double balloon endoscopy (DBE) [5]. Nakamura et al recommended that CE should be performed for an initial diagnosis of OGIB because of its high rate of detection of suspicious small-intestinal lesions [6], but the use of CE for detection of MD is not usual.

We report the case of a 13-year-old boy with bleeding of MD that was not detected by the first CE but was detected by a second CE 7 months later.

Case Report

A 13-year-old-boy was admitted to a local hospital
because of bright red loose stools. Although he had the same symptom 3 years and 5 years before that, he had not gone to a hospital because it improved spontaneously. His overall physical status was good (blood pressure 106/56 mmHg, heart rate 95/min). Blood tests showed red blood cell (RBC) count: 307×10^4 /µl, hemoglobin (Hb): 9.0 g/dl, total serum protein (TP): 6.4 g/dl, serum albumin (Alb): 3.8 g/dl, Fe: 53 µg/dl, and ferritin: 50 ng/ml (Table 1). Colonoscopy and upper gastrointestinal endoscopy revealed no lesions. The patient was transferred to the pediatrics department of our hospital for further examination. 99mTcO4 scintigraphy revealed a quite pale accumulation that was not sufficient for a definitive diagnosis of MD (Figure 1). Because there was no abdominal pain or melena after admission, the parents wanted him to be discharged on day four after hospitalization. CE (Endo Capsule; Olympus Medical Systems Corp. Tokyo, Japan) and small bowel series carried out after discharge showed no remarkable findings. The patient did not want to undergo a more detailed examination.

Seven months later, he was admitted our hospital again because of bright red stools. On clinical examination, his overall physical status was good, but he had slight tachycardia (blood pressure 110/60 mmHg, heart rate 104/min). Blood tests showed RBC: 217×10^4 /µl, Hb: 5.2 g/dl, TP: 5.7 g/dl, Alb: 3.7 g/dl, Fe: 12 µg/dl, and ferritin: 8 ng/ml (Table 2). Contrast enhanced computed tomography (CECT) and CE were performed on day 1. Although the CECT showed no source of bleeding, the CE revealed a smooth surface elevated lesion and fresh blood near a lesion in the ileum (Figure 2). Endoscopic examination via the anal route was carried out using a single balloon endoscope (SBE) system (Olympus Medical Systems Corp. Tokyo, Japan). We found a diverticulum at about 70 cm on the oral side from the Bauhin’s valve with a reddish elevated lesion in it (Figure 3A). The surface was smooth and a small, round, regular pit was observed. An ulcer resembling a fundus mucosa of the stomach was observed near the elevated lesion, and we performed a biopsy from the lesion (Figure 3B).

We carried out a water-soluble gastrointestinal contrast media (Gastrografin®) from the endoscopy, which revealed a diverticulum of about 50 mm in length (Figure 4). As the histologic findings from the elevated lesion showed a fundic gland (Figure 5), we diagnosed the patient as having MD. The patient underwent surgical resection. A 50×40-mm diverticulum approximately 90 cm distal to the Bauhin’s valve was confirmed (Figure 6). Laparoscopic diverticulectomy was performed. The resected specimen confirmed the presence of an elevated lesion of 10×10-mm at the bottom of the diverticulum and an ulcer scar beside the lesion (Figure 7A). Microscopic section revealed a fundic gland mucosa at the site of the elevated lesion and UL-Ⅲ ulceration (Figure 7B). The patient has not had a recurrence of the symptom since the surgery.

| Table 1. Blood test at the first hospitalization |
|-----------------------------------------------|
| Hematology                                    |
| WBC   | 3,000 /µl    | ALT | 6 U/l |
| Neutro| 39.4%        | LDH | 160 U/l |
| Eosino| 6.4%         | ALP | 644 U/l |
| Baso  | 0.3%         | γGTP| 8 U/l |
| Mono  | 7.8%         | BUN | 7 mg/dl  |
| Lympho| 46.1%        | Cre | 0.54 mg/dl |
| RBC   | 307×10^4 /µl | Ferritin | 50 ng/ml |
| Hb    | 9.0 g/dl     |
| Plt   | 22.1×10^4 /µl|
| MCV   | 84.0 fl      | CRP | 0.09 mg/dl |
| MCH   | 29.3 pg      | Fe  | 53 µg/dl  |
| MCHC  | 34.9 g/dl    |

Biochemistry Coagulation

| TP   | 6.4 g/dl | PT% | 63.0% |
| Alb  | 3.8 g/dl | PT-INR | 1.19 |
| T-bil| 0.5 mg/dl| APTT | 39.5 Sec |
| AST  | 21 U/l | Fibrinogen | 236 mg/dl |

WBC: white blood cell, Neutro: neutrophil, Eosino: eosinophils, Baso: basophil, Mono: monocyte, Lympho: lymphocyte, RBC: red blood cell, Hb: hemoglobin, Plt: platelet, MCV: mean corpuscular volume, MCH: mean corpuscular hemoglobin, MCHC: mean corpuscular hemoglobin concentration, TP: total serum protein, Alb: serum albumin, T-bil: total bilirubin, AST: aspartate aminotransferase, ALT: alanine aminotransferase, LDH: lactate dehydrogenase, ALP: alkaline phosphatase, γGTP: gamma glutamyl transpeptidase, BUN: blood urea nitrogen, Cre:creatinine, CRP: C-reactive protein, Fe: serum iron, PT%: prothrombin time%, PT-INR: prothrombin time-international normalized ratio, APTT: activated partial thromboplastin time
Table 2. Blood test at the second hospitalization

| Hematology         | Coagulation   |
|--------------------|--------------|
| WBC 4,100 /µl     | TP 5.7 g/dl  |
| Neuto 52.0%       | PT% 72.4%    |
| Eosino 1.7%       | Alb 3.7 g/dl |
| Baso 6.6%         | T-bil 0.4 mg/dl |
| Mono 6.6%         | AST 19 U/l   |
| Lympho 39.5%      | Fibrinogen 153 mg/dl |
| RBC 217×10⁴ /µl |             |
| Hb 5.2 g/dl       |             |
| Plt 28.4×10⁴ /µl |             |
| MCV 73.3 fl/µl    |             |
| MCH 24.0 pg       |             |
| MCHC 32.7 g/dl    |             |

WBC: white blood cell, Neuto: neutrophil, Eosino: eosinophils, Baso: basophil, Mono: monocyte, Lympho: lymphocyte, RBC: red blood cell, Hb: hemoglobin, Plt: platelet, MCV: mean corpuscular volume, MCH: mean corpuscular hemoglobin, MCHC: mean corpuscular hemoglobin concentration, TP: total serum protein, Alb: serum albumin, T-bil: total bilirubin, AST: aspartate aminotransferase, ALT: alanine aminotransferase, LDH: lactate dehydrogenase, ALP: alkaline phosphatase, γGTP: gamma glutamyl transpeptidase, BUN: blood urea nitrogen, Cre: creatinine, CRP: C-reactive protein, Fe: serum iron, PT%: prothrombin time%, PT-INR: prothrombin time-international normalized ratio, APTT: activated partial thromboplastin time.

Figure 1. ⁹⁹ᵐ-TcO₄ scintigraphy. We detected a slight accumulation of technetium (arrow).

Figure 2. Capsule endoscopy (CE). A: There were smooth surface elevated lesion and B: fresh blood near the lesion in the ileum.

Figure 3. Single balloon endoscopy (SBE). A: There was a diverticulum at about 70 cm on the oral side from the Bauhin’s valve with a reddish elevated lesion and ulcer. B: The surface was smooth and a small round regular pit resembling a fundus mucosa of the stomach was observed (arrow).

Figure 4. Small bowel follow through examination. There was a 50 mm length diverticulum (arrow).
Discussion

Most cases of MD are asymptomatic, so it is difficult to find. We often discover it during an operation for such as unidentified gastrointestinal (GI) bleeding and bowel obstruction. Although there are several diagnostic methods for MD, it is difficult to diagnose preoperatively. It has been reported that only about 6% of cases of MD can be diagnosed preoperatively [7]. $^{99m}$TcO4 scintigraphy, a diagnostic procedure for detecting ectopic gastric mucosa, has a sensitivity of 85% and a specificity of 95% in children [8]. False-negative results occur, however, because of the existence of MD without gastric mucosa. In certain instances, ectopic mucosa may fall off at bleeding. In our case, $^{99m}$TcO4 was accumulated, but it was faint, and not enough for a definite diagnosis. Because ectopic gastric mucosa was found in a portion of the elevated lesion, it might have been too small to accumulate much $^{99m}$TcO4.

In barium studies, MD appears as a blind-ending pouch at the site of the anti-mesenteric side of the distal ileum. MD is not often seen in routine barium studies because of its small ostium, filling with intestinal contents, and peristalsis with rapid emptying. The barium study performed on our patient at the first admission was not diagnostic for the anomaly. We reviewed the radiological image from the barium study after the operation, but could not point out an MD, apparently because the barium study was not completed to the point where the barium had filled into the ascending colon. The barium moved very slowly, and the radiologist could not complete the study because they were mindful of the radiological dosage for such a young child.

Figure 5. Histological finding. A fundic gland tissue was in the depths, and the outer layer was covered with lacunar epithelium. There was no malignant finding, but a finding of ectopic gastric mucosa ($\times$100).

Figure 6. Laparoscopic diverticulectomy. A 50×40-mm diverticulum approximately 90cm distal to the Bauhin’s valve was confirmed (arrow).

Figure 7. Excised specimen. There was A: a 10×10-mm elevated lesion (arrow) at the bottom of the diverticulum and B: an ulcer scar beside the lesion (arrow).

Figure 8. Course of capsule endoscopy (CE) which we inferred. In the first CE, the capsule had passed the ostium of the diverticulum (arrow 1). In the second CE, the capsule entered into the diverticulum, then after stagnating it returned again into the small bowel (arrow 2).
Capsule endoscopy (CE) is a non-invasive modality for detection of OGIB. CE was first described in 2000 [9], and it has been used for detection of gastrointestinal diseases because of its advantages such as noninvasiveness, high detection rates, and few complications. We can anticipate the approximate position of lesions in the intestine by CE, so it can indicate the nearest DBE route. However, the detection rate of MD by CE is not high enough. CE moves only passively by intestinal peristalsis; as a result, we may often not notice a lesion if the CE does not enter into the diverticulum.

The image of MD is described as a polypoid form lesion [2], stenotic structure of ileum [10], ulcer, or double lumen [11]. Researchers have compared the diagnostic value of balloon endoscopy (BE) and CE in such gastrointestinal diseases as OGIB [12]. CE is lower than assisted enteroscopy in the detection rate of MD (35.7%: 85.0%), because of its lack of air insufflation and active manipulation [6].

In our case, despite taking into account the MD, we performed CE after the 99mTcO4 scintigraphy because of the low invasiveness of CE, and because the patient was a child. At the first admission, CE could not detect the diverticulum, ulcer, or the exposed vessel to be a bleeding point, but at the second admission, CE revealed a smooth surface elevated lesion and fresh blood near the lesion in the ileum. We think that there are two reasons why we could not detect the lesion by the first CE. One, the first CE was performed three weeks after bleeding, whereas the second CE was carried out on the next day of bleeding. Esaki et al suggested that the diagnosis rate rises by performing CE within one week from the last day of bleeding [13]. Performing CE as soon as possible may help to increase the diagnostic rate. Secondly, it is also possible that the capsule passed the ostium of the diverticulum at the first CE, and at the second CE the capsule entered into the diverticulum, then after stagnating, it returned again into the small bowel (Figure 8).

The diagnosis rate of MD by the CE is not very high. It might be possible to detect MD by repeating CE, but it is important to use other modalities, too. CE retention in the diverticulum also remains a major concern. In our case, CE did not become incarcerated because the diverticular lumen was wide enough. Although reported cases are rare [10, 14, 15], we should always understand the risk of incarceration in MD.

Additionally, SBE revealed an elevated lesion with the surface of a small round pit that resembled fundus mucosa, and we could diagnose the ectopic gastric mucosa by biopsy. There are several case reports of histologically diagnosing ectopic gastric mucosa in MD before an operation [16–18]. A preoperative diagnosis of MD can be performed more reliably by combining BE with biopsy forceps.

The usual causes of small intestinal bleeding are neoplastic, vascular disease, diverticulum, circulatory disturbance, inflammation, drug inducement, infectivity, heredity, polyps, etc., but the causes of small intestinal bleeding in young people (under 40 years) are inflammatory bowel disease, MD, Dieulafoy’s lesions, neoplasia, and polyposis syndrome [19]. In our case, the patient had repeated hematochezia, but did not have symptoms such as fever, stomachache, epistaxis or arthralgia. Considering his age, life history, family history, medication history and medical history, we assumed that circulatory disturbance, inflammation, drug inducement, infectivity and heredity were also negative. We certainly suspected MD, but could not detect any evidence of MD by CECT, barium study, nor by the first CE. Vascular disease was negative in the second CE, so we suspected neoplasia, polyp, or inverted MD. Finally, we were able to detect the diverticulum and ectopic gastric mucosa by biopsy, which led to a definitive diagnosis.

In conclusion, the detection rate of MD is not high, although CE is a useful tool to investigate OGIB. A single CE is not always enough to diagnose MD bleeding. Reexamination by CE, particularly performing it as soon as possible after bleeding, or other modalities such as CECT, 99mTcO4 scintigraphy and BE, would be valuable for patients suspected of having MD.

Conflict of Interest
The authors declare that there is no conflict of interest.

References
1. Fukushima M, Kawanami C, Inoue S, Okada A, Imai Y & T Inokuma (2014): A case series of Meckel’s diver-
ticulum: usefulness of double-balloon enteroscopy for diagnosis. BMC Gastroenterol 14: 155
2. Xinias I, Mavroudi A, Fotoulaki M, Tsikopoulos G, Kalampakas A & Imvrios G (2012): Wireless capsule endoscopy detects Meckel’s diverticulum in a child with unexplained intestinal blood loss. Case Rep Gastroenterol 6(3): 650–659
3. Rashid OM, Ku JK, Nagahashi M, Yamada A & Takabe K (2012): Inverted Meckel’s diverticulum as a cause of occult lower gastrointestinal hemorrhage. World J Gastroenterol 18(42): 6155–6159
4. Yamaguchi M, Takeuchi S & Awazu S (1978): Meckel’s diverticulum: investigation of 600 patients in Japanese literature. Am J Surg 136(2): 247–249
5. Ohmiya N, Yano T, Yamamoto H et al (2007): Diagnosis and treatment of obscure GI bleeding at double balloon endoscopy. Gastrointest Endosc 66 (3 Suppl): S72–S77
6. Nakamura M, Niwa Y, Ohmiya N et al (2006): Preliminary comparison of capsule endoscopy and double-balloon enteroscopy in patients with suspected small-bowel bleeding. Endoscopy 38(1): 59–66
7. Murruste M, Rajaste G & Kase K (2014): Torsion of Meckel’s diverticulum as a cause of small bowel obstruction: a case report. World J Gastrointest Surg 6(10): 204–207
8. Daneman A, Lobo E, Alton DJ & Shuckett B (1998): The value of sonography, CT and air enema for detection of complicated Meckel diverticulum in children with nonspecific clinical presentation. Pediatr Radiol 28(12): 928–932
9. Iddan G, Meron G, Glukhovsky A & Swain P (2000): Wireless capsule endoscopy. Nature 405(6785): 417
10. Tanaka Y, Motomura Y, Akahoshi, K et al (2010): Capsule endoscopic detection of bleeding Meckel’s diverticulum, with capsule retention in the diverticulum. Endoscopy 42 Suppl 2: E199–E200
11. Mavrogenis G, Coumaros D, Bellocq JP & Leroy J (2011): Detection of a polypoid lesion inside a Meckel’s diverticulum using wireless capsule endoscopy. Endoscopy 43 Suppl 2 UCTN: E115–E116
12. Ohmiya N, Taguchi A, Mabuchi N et al (2005): Usefulness of double-balloon enteroscopy (DBE) for diagnosis and treatment of small intestinal diseases. Gastrointest Endosc 61(5): AB177
13. Esaki M, Matsumoto T, Yada S et al (2010): Factors associated with the clinical impact of capsule endoscopy in patients with overt obscure gastrointestinal bleeding. Dig Dis Sci 55(8): 2294–2301
14. Ling CR, Wang MJ & Zhuang W (2017): Capsule retention for 7.5 years in Meckel’s diverticulum. Dig Endosc 29(3): 386–387
15. Giday SA, Pickett-Blakely OE, Buscaglia JM & Mullin GE (2009): Capsule retention in a patient with small-bowel diverticulosis. Gastrointest Endosc 69(2): 384–386
16. Mukai R, Handa O, Fukui A et al (2017): A case of inverted meckel’s diverticulum. Gastroenterol Endosc 59(9): 2416–2421
17. Doi Y, Kimura N, Sakata M, Yoshimizu N, Simamura K & Masuda M (2018): A case of intussusception due to inverted Meckel’s diverticulum preoperatively diagnosed and resected by single port laparoscopic surgery. J Jpn Surg Assoc 79(11): 2291–2295 (in Japanese)
18. Takagaki K, Osawa S, Ito T et al (2016): Inverted Meckel’s diverticulum preoperatively diagnosed using double-balloon enteroscopy. World J Gastroenterol 22(17): 4416–4420
19. Gerson LB, Fidler JL, Cave DR & Leighton JA (2015): ACG Clinical Guideline: diagnosis and management of small bowel bleeding. Am J Gastroenterol 110(9): 1265–1287; quiz 1288