Barium impaction therapy with balloon occlusion for deep colonic diverticular bleeding: a three-case series

Authors
Mikinori Koga, Chika Kusano, Takuji Gotoda, Sho Suzuki, Takemasa Sato, Masakatsu Fukuzawa, Takao Itoi, Fuminori Moriyasu

Institution
Department of Gastroenterology and Hepatology, Tokyo Medical University, Tokyo, Japan

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Corresponding author
Chika Kusano, MD PhD
Department of Gastroenterology and Hepatology
Tokyo Medical University
6-7-1 Nishishinjuku
Shinjuku-ku
Tokyo 160-0023
Japan
Fax: +81-3-53816654
ckusano2007@yahoo.co.jp

Background and aims: In hemostasis for colonic diverticular bleeding, the incidence of recurrent bleeding is higher in deep colonic diverticulum than in shallow. We aimed to improve and evaluate barium impaction therapy using an enteroscopic overtube with balloon.

Patients and method: We performed barium impaction therapy in three patients with a diagnosis of deep colonic diverticular bleeding. The tip of the overtube was inserted to reach the cecum using the conventional method. After deflating the colon, the enteroscope was removed. The balloon in the tube was inflated, followed by barium filling via the tube. Sufficient pressure was applied by ensuring no regurgitation into the small intestine side. The entire colon was continuously filled with barium in stages.

Results: Post-treatment bleeding was controllable without adverse events in all three patients.

Conclusion: This novel barium impaction therapy using an enteroscopic overtube with balloon was effectively performed without adverse events.

Introduction
Colonic diverticular bleeding is among the most common diseases with lower gastrointestinal bleeding [1]. Endoscopic hemostasis [2], interventional radiology [3], and surgical treatment [4] are reportedly effective for controlling colonic diverticular bleeding. However, achieving hemostasis is often difficult with these methods when the bleeding source is uncertain. Barium impaction therapy was reported to be an effective alternative [5]. However, with this method, which does not require identification of a diverticulum responsible for bleeding, it is often difficult to apply pressure to the deep colon (right-sided colon). The deep colon is filled with barium by changing body positions. Therefore, the internal intestinal pressure required for the impaction to achieve hemostasis may not be produced. We report a novel technique using an enteroscopic overtube with balloon, which allows sufficient barium filling while applying pressure to the diverticulum.

Patients
Among patients who visited our hospital with the chief complaint of bloody stools and who were diagnosed as having colonic diverticular bleeding from the deep colon by exclusion, three with poorly controlled bleeding during hospitalization were administered a novel technique (Table 1). For diagnosis, upper and lower gastrointestinal endoscopy and contrast-enhanced computed tomography (CT) were concurrently performed. Diverticular bleeding from the deep colon was diagnosed by exclusion in patients meeting all of the following criteria: lower gastrointestinal endoscopy revealing divertica and fresh clots in the deep colon, failure to confirm bleeding from a responsible diverticulum and to provide definitive diagnosis, detection of brown stools in the small intestine to exclude small intestinal bleeding, and indication of the absence of mucosal lesions that could cause bleeding, such as angiectasis, inflammation, and ulcers of the colonic mucosa. The upper gastrointestinal endoscopy excluded upper gastrointestinal bleeding, and contrast-enhanced CT could not identify the responsible blood vessel. Deep colonic diverticular bleeding was considered if spontaneous hemostasis had been achieved before observation. Moreover, in these three patients, neither endoscopic treatment nor interventional radiology was performed because the bleeding source was difficult to identify with endoscopy and contrast-enhanced CT.
Methods

All three patients had achieved spontaneous hemostasis at the time of this study. The treatment was performed to prevent recurrence bleeding.

An enteroscope (SIF TYPE Q260, OLYMPUS, Tokyo, Japan) with an overtube (single-use splinting tube, OLYMPUS) (Fig. 1) was inserted, and the scope was removed when the tube reached the cecum (Fig. 2a).

An enema catheter (double balloon enema catheter with 3-pipe isolation check valve; Kaigen Pharma Co., Ltd., Osaka, Japan) was connected to an overtube, and the balloon was initially inflated around the midpoint between the cecum and the hepatic flexure to close the colon cavity. High-density barium 200 w/v% was then injected (Fig. 2b). The intestinal tract was filled with barium and was sufficiently pressurized for 3 minutes without regurgitation into the small intestine side. The balloon was subsequently inflated at sites equally dividing the total colon into eight parts, with filling and maintaining being repeated in stages, eventually filling the entire colon (Fig. 2c, Fig. 2d, Fig. 2e).

Results

In all three patients, the entire colon could be filled with a total volume of barium of about 1200 mL to 1500 mL without adverse events such as perforation. Abdominal radiography on the day following treatment showed barium remnants in the diverticulum (Fig. 3). All three patients had favorable courses with control of bleeding after treatment. Barium in the intestinal tract outside the diverticulum was excreted without additional laxatives, with no ileus symptoms, diverticulitis, or appendicitis.

Table 1 Demographic and clinical data for patients undergoing therapeutic barium enema for diverticular bleeding.

| Case no. | Age, years | Sex | Comorbidity | Medication | Location of diverticulum |
|----------|------------|-----|-------------|------------|-------------------------|
| 1        | 80         | M   | Prostatic cancer AP HT | L-Asp | AC, SC |
| 2        | 78         | F   | RA HT HL | NSAIDs | TO |
| 3        | 64         | M   | MR (post MVR operation) HT HL | NSAIDS L-Asp | AC/SC |

Table 2 Previous reports on therapeutic barium enema for diverticular bleeding.

| Author/s (year) [Reference] | n | Location | Concentration of barium used, w/v% | Successful cases | Recurrent bleeding |
|-----------------------------|---|----------|-----------------------------------|-----------------|-------------------|
| Adams (1970) [10]           | 28| NR       | 20                                | 26              | 9                 |
| Chorost et al. (2001) [9]   | 1 | TO       | 20                                | 1               | 0                 |
| Koperna et al. (2001) [11]  | 63| NR       | NR                                | 53              | 10                |
| Matsuhashi et al. (2003) [8]| 1 | TO       | 200 (with 1 mg of epinephrine)    | 1               | 0                 |
| Iwamoto et al. (2008) [12]  | 4 | TO, AC, SC(2 cases) | 200                        | 4               | 0                 |
| Fujimoto et al. (2011) [16] | 11| NR       | 60                                | 11              | 6                 |
| Niikura et al. (2013) [13]  | 1 | AC       | 200                               | 1               | 0                 |
| Nagata et al. (2015) [5]    | 27| Right-sided: 7 cases Left-sided: 5 cases Bilateral colon: 15 cases | 200             | 27              | 5                 |
| Our cases (2015)            | 3 | AC, SC TO AC, SC | 200                        | 3               | 0                 |

Fig. 1 Overtube (single-use splinting tube, OLYMPUS, Tokyo, Japan).
Discussion

Cases of colonic diverticulosis are increasing annually [6], resulting in more cases with diverticular diseases [7]. The endoscopic identification rate of diverticular bleeding sources was reported-ly 38%, the hemostasis rate 88%, and the recurrent bleeding rate 22% [8].

Several reports have described the usefulness of barium impaction therapy, which is an option for patients whose bleeding source cannot be identified (● Table 2) [2,8–13]. However, recurrent bleeding rates with barium impaction therapy and endoscopic treatment were similar [14]. The rate of recurrent bleeding from deep colonic diverticulum is higher than with endoscopic treatment. One explanation is the difficulty in applying pressure to the deep colon with the conventional method of barium impaction via the rectum. Although there is no clear evidence of the hemostatic mechanism of barium impaction, various effects have been reported, such as a tamponade action, direct blood clotting, mucosal protection, and exposed blood vessel clotting [2,12,15].

Regarding the concentration of barium, previous studies used concentrations ranging from 20 w/v% to 200 w/v% [2,5,8–13]. We used a concentration of 200 w/v% in this study, although we were uncertain about whether a higher concentration barium impaction could provide better results because there were no studies on this issue. Further studies investigating the hemostatic mechanism of barium impaction as well as the optimal concentration for the treatment are required.

In contrast to the conventional method, pressure is directly applied to the deep colon via barium filling under balloon occlusion. The tamponade effect of barium is apparently enhanced, thereby increasing the hemostasis effect. The disadvantages include possible increased risk of perforation due to pressurization. We adjusted the barium injection pressure so that barium did not pass back through the ileoceleal valve into the small intestine, as regurgitation of barium into the small intestine side might lead to decreased pressure in the large intestine. These three patients re-
The limitation of this novel technique is no evidence of its therapeutic effects in this case series, which describes only three cases. Although this technique may significantly increase the risk of complications in comparison to the conventional method, it should provide more benefits than risks through its therapeutic effects on hemostasis and long-term prevention of recurrence. Further studies are needed to improve the method and establish evidence of treatment effectiveness. A prospective comparative study is required to validate long-term recurrence prevention rates and the safety of this novel barium impaction therapy technique.

AP, angina pectoris; HT, hypertension; RA, rheumatoid arthritis; HL, hyperlipidemia; MR, mitral regurgitation; MVR, mitral valve replacement; HU, hyperuricemia; NSAIDs, nonsteroidal anti-inflammatory drugs; L-Asp, low-dose aspirin; TO, throughout the colon; AC, ascending colon; SC, sigmoid colon.

Competing interests: None.

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