JGH Open Open Access An open access journal of gastroenterology and hepatology

JGHF Journal of Gastroenterology and Hepatology Foundation

doi:10.1002/jgh3.13099

ORIGINAL ARTICLE

Usefulness of a long hood for the detection of bleeding sites in colonic diverticular hemorrhage: A randomized controlled trial

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Key words
colonic diverticular hemorrhage, colorectal diverticulosis, long hood, stigmata of recent hemorrhage.

Accepted for publication 8 May 2024.

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Declaration of conflict of interest: None.

Abstract

Background and Aim: The use of a hood at the tip of a colonoscope enables aspiration, inversion of the diverticulum, and observation of the inside of the diverticulum. In most previous studies, a short hood was used; however, observation of the diverticulum is often inadequate. Long food is promising by previous research, but it was a retrospective study using propensity matching and has some limitations. We compared the identification rate of stigmata of recent hemorrhage (SRH) between the long and standard hoods in cases of suspected colonic diverticular hemorrhage (CDH) to confirm the usefulness of long hood by prospective randomized controlled trial.

Methods: Eighty patients (42 in the long hood group [L group] and 38 in the short hood group [S group]) who visited the Saitama Medical University Hospital and Tokai University Hachioji Hospital between December 2018 and July 2021 with a chief complaint of bloody stool and suspected CDH, based on the clinical course and imaging studies, were included. Patients were randomly assigned to the L or S group.

Results: Regarding patient background, age was significantly higher in the L group; however, no significant differences were found in medical history or history of antithrombotic medication or nonsteroidal anti-inflammatory drug use. Identification rate of SRH was significantly higher in the L group (58.5%, 24/42 patients) than in the S group (26.3%, 10/38 patients) ($P < 0.05$). All patients were treated using the clip method, and the rate of rebleeding within 1 month was not significantly different between the two groups.

Conclusion: A long hood was more useful compared with a short hood in identifying SRH of CDH (UMIN000034603).

Introduction

The increasing incidence of colorectal diverticulosis is directly tied to the advancing age of the Japanese population.[1] Although many patients remain asymptomatic, the increasing prevalence of diverticulosis has led to the development of diverticular hemorrhage and diverticulitis, which are the main complications of the disease.[2] In Japan, colonic diverticular hemorrhage (CDH) is reported to occur in 0.46 per 1000 patients per year among those with colonic diverticulosis.[1] Aspirin and nonsteroidal anti-inflammatory drugs (NSAIDs) have been reported as risk factors for bleeding.[3]

European Society of Gastrointestinal Endoscopy (ESGE) Guideline recommends that upper gastrointestinal endoscopy be performed in patients presenting with acute lower gastrointestinal bleeding and hemodynamic instability unless computed tomography angiography has already been performed, showing a definitive bleeding source in the lower gastrointestinal tract.[4] On the other hand, colonoscopy has been shown to be useful in the diagnosis and treatment of CDH,[5,6] and in particular, active bleeding, non-bleeding visible blood vessels, or adherent clots that induce active bleeding or non-bleeding visible vessel by removal are referred to as stigmata of recent hemorrhage (SRH). The identification of SRH is clinically important because it is considered a source of bleeding.[7] The early rebleeding rate in SRH-positive cases is high, ranging from 53 to 66%, and hemostatic treatment is recommended.[8]

However, it is sometimes difficult to identify the bleeding site in cases with multiple diverticula. Extravasation on contrast-enhanced computed tomography (CT) is considered a useful tool for identification, and the identification rate during colonoscopy

in patients with negative extravasation is reported to be as low as 20–31%, whereas the rate is as high as 60–68% in positive cases.[9,10] The usefulness of pretreatment with oral bowel cleansers and attachment of a hood to the tip of the colonoscope has also been reported.[11] The use of a hood enables aspiration, inversion of the diverticulum, and observation of the inside of the diverticulum.[11] In most previous studies, a short hood was used. In the process of inverting the diverticulum, the diverticulum and tip of the colonoscope come into contact with each other, the visual field is not maintained, and observation of the diverticulum is often inadequate. Akutsu et al.[12] have reported the usefulness of a long hood, which improves visualization due to suctioning of diverticular mucosa into the cup of the hood and enables endoscopic detachable snare ligation. Kobayashi et al.[13] have reported that long cap-assisted colonoscopy is superior for the diagnosis of acute hematochezia, especially CDH compared with short cap-assisted colonoscopy retrospectively. Long food is promising by these previous researches, but it was a retrospective study using propensity matching and has some limitations. Thus, this study was designed to confirm it by prospective study by comparing the SRH identification rate of the long and standard hoods in cases of suspected CDH.

Methods

Patients. Eighty patients who visited the Saitama Medical University Hospital and Tokai University Hachioji Hospital between December 2018 and July 2021 with a chief complaint of bloody stool without abdominal pain and suspected CDH, based on the clinical course, medical history, and imaging studies, were included. Contrast-enhanced CT was performed in patients without renal dysfunction or allergy to the contrast media, and the presence of extravasation was evaluated. On the other hand, plane CT was performed with renal dysfunction or allergy to the contrast media. The diagnosis of CDH contained both definitive and presumptive CDH.[14] Definitive CDH was defined as a diverticulum with SRH identified by colonoscopy. On the other hand, presumptive CDH included diverticulum without SRH and very little possibility of bleeding source except for colonic diverticulum determined by colonoscopy, and CT visualization of contrast medium extravasation localized to the diverticulum. Patients aged 20 years or older were included; those with intestinal obstruction, stenosis, active inflammatory bowel disease, postprocedure bleeding, acute hemorrhagic rectal ulcer suspected, or colonic diverticulitis were excluded. Patients were randomly assigned to two groups by block randomization using computerized randomization lists: the L group with a long hood (MAJ663; Olympus Medical Systems, tip protrusion length: 12 mm) and the S group with a standard short hood (D-201-12 704, Olympus Medical Systems, tip protrusion length: 4 mm).

Colonoscopy. The colonoscopes used in this study were PCF-Q260I and PCF-H290I with the EVIS LUCERA ELITE series (Olympus Medical Systems, Tokyo, Japan) and EC-L600ZP7 with the LASEREO 7000 system (Fujifilm Co., Tokyo, Japan). Colonoscopy was performed within 24 h after the patient's arrival at the hospital, and pretreatment with oral bowel lavage solution MoviPrep (EA Pharma Co., Tokyo, Japan) was used, except for cases with poor vital signs or a short waiting time before the examination. The degree of bowel cleansing was evaluated based on the Boston Bowel Preparation Scale.[15] The colon was divided into three regions: right colon, transverse colon, and left colon. The degree of cleansing in each region was classified from 0 to 3 points, and the total score of the three regions was used for evaluation. Scopolamine butylbromide (10 mg) or glucagon (0.5 mg) was administered in the absence of contraindications, and midazolam (1–3 mg) was used for conscious sedation only when the patient complained of abdominal discomfort or pain. In the L group, the diverticulum was observed by inversion whenever possible even in the absence of hemorrhage. SRH was defined as active bleeding, non-bleeding visible vessel, or adherent clots with active bleeding or non-bleeding visible vessel by removal. Endoscopic hemostasis using hemoclips was performed if an SRH was observed (Fig. 1). In cases of difficulty in endoscopic hemostasis, embolization using interventional radiology (IVR) or surgery was performed. All colonoscopies were performed by 16 endoscopists, 10 of whom were experts with an experience of 1000 or more colonoscopies, and 6 were trainees with an experience of less than 1000 colonoscopies. Trainees performed colonoscopy under the supervision of trainers.

Rebleeding was defined as a significant amount of fresh bleeding or wine-colored stools after hematochezia,[6,11,16–19] and rebleeding within 1 month was evaluated between the two groups. The patients who visited the hospital within 1 month after discharge were evaluated for rebleeding. If bleeding occurred again, colonoscopy was performed immediately.

Endpoints. The primary endpoint was the identification rate of SRH, and the secondary endpoints were the cecal intubation

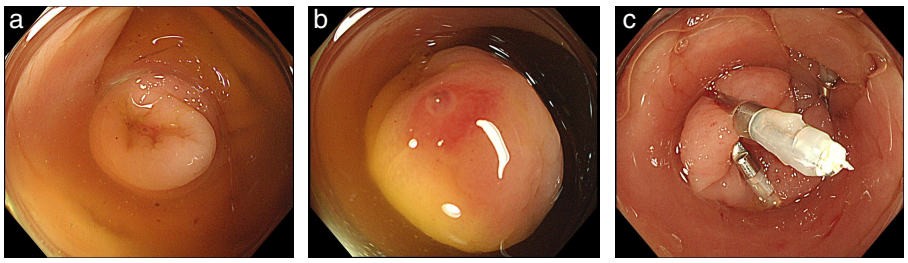

Figure 1 (a) The tip of the hood is pressed against the diverticulum. (b) The bottom of the diverticula can be aspirated into the hood, and the vessel can be observed. (c) The inverted position is maintained, and hemoclipping is performed.

rate, cecal intubation time, bleeding site, rate of endoscopic hemostasis, and rebleeding within 1 month.

The study protocol was in accordance with the tenets of the revised Declaration of Helsinki (1989) and approved by the institutional review boards of our institutions. Written informed consent was obtained from all the patients. This study is registered with the University Hospital Medical Information Network Clinical Trials Registry (UMIN000034603).

Sample size calculation and statistical analysis. The identification rate of SRH in a retrospective observational study conducted at our hospital was 70% using the long hood. The calculated sample size was set to 36 cases in each group, based on the identification rate of SRH (assuming 75%) and the sample size required when $\alpha = 0.05$ and $1 - \beta = 0.80$. Considering an exclusion or withdrawal rate, the sample size was set to 80 patients in total.

Statistical analysis was performed using protocol analysis. The χ^2 test, Student's *t*-test, and Mann–Whitney *U* test were used for statistical analysis, and a *P*-value <0.05 was considered significant. All analyses were performed using the SPSS software version 26 (IBM Corp., Armonk, NY, USA).

Results

Patients were allocated to the L group (42 patients) and S group (38 patients), and no patients were excluded. Table 1 shows the patients' background. There were no significant differences in medical history, antithrombotic medication, vital signs at presentation, or hemoglobin level; the age in the L group was significantly higher than that in the S group (77.6 *vs* 71.7 years; $P < 0.05$).

Contrast-enhanced CT of the abdomen was performed in approximately 75% of patients in both groups, of whom nine (28.1%) in group L and six (23.0%) in group S had positive extravasation. Oral bowel cleansing solution was administered to all but two patients in the L group and one in the S group. There was no significant difference between both groups in the degree of cleansing, the cecal intubation rate, and the mean cecum intubation time (Table 2). No adverse events were observed during the examination.

In patients with sigmoid colon diverticulum, the cecal intubation rate and mean cecal intubation time were 93.5% and 10.9 ± 6.2 min in the L group and 95.8% and 10.9 ± 7.2 min in the S group, respectively, with no significant difference between the two groups. The mean cecal intubation time was 7.7 ± 2.7 min in the L group and 9.8 ± 5.5 min in the S group, with no significant difference between the two groups (Table 2).

The identification rate of SRH was significantly higher in the L group (58.5%, 24 of 42 patients) than in the S group (26.3%, 10 of 38 patients) (Table 3). The ascending colon was the most common site of bleeding, followed by the sigmoid colon, with no significant difference between the two groups. Among patients who underwent contrast-enhanced CT, the identification rate of SRH in patients with positive extravasation was

Table 1 Patient background

	L-group ($n = 42$)	S-group ($n = 38$)	*P*-value
Age, mean ± SD	77.6 ± 9.6	71.7 ± 10.5	<0.05
Sex (male)	30 (71.4)	27 (71.0)	0.97
Medical history			
Diabetes mellitus	5 (11.9)	8 (21.0)	0.26
Hypertension	23 (54.7)	14 (36.8)	0.10
History of abdominal surgery	10 (23.8)	7 (18.4)	0.55
Ischemic heart disease	2 (4.7)	4 (10.5)	0.32
Arrhythmia	6 (14.2)	3 (7.8)	0.36
Cerebrovascular disease	11 (26.1)	4 (10.5)	0.07
Chronic kidney disease	5 (11.9)	5 (13.1)	0.86
Medication history			
NSAIDs	4 (9.5)	3 (7.8)	0.79
Aspirin	8 (19.0)	5 (13.1)	0.47
Antiplatelet agents other than aspirin	13 (30.9)	9 (23.6)	
Anticoagulant	7 (16.6)	4 (10.5)	0.42
Antithrombotic agent	17 (40.4)	12 (31.5)	0.40
Vital signs on arrival at the hospital			
Systolic blood pressure (mmHg), mean ± SD	132.3 ± 20.9	132.1 ± 27.6	0.80
Diastolic blood pressure (mmHg), mean ± SD	74.9 ± 15.5	78.2 ± 15.5	0.23
Pulse rate (bpm), mean ± SD	88.4 ± 17.4	87.9 ± 22.7	0.55
Hemoglobin (g/dL), mean ± SD	11.1 ± 2.1	11.6 ± 2.3	0.55
Contrast CT	32 (76.1)	26 (74.2)	0.84
Extravasation	9 (28.1)	6 (23.0)	0.66
Bowel preparation	40 (95.2)	37 (97.4)	0.62
Degree of cleansing	6.8 ± 2.2	7.0 ± 2.1	0.72

Data are presented as *n* (%).

CT, computed tomography; NSAIDs, nonsteroidal anti-inflammatory drugs.

Table 2 Cecal intubation rate and cecal intubation time

	L-group ($n = 42$)	S-group ($n = 38$)	*P*-value
Cecal intubation rate			
Total	40 (95.2)	36 (94.7)	0.84
History of abdominal surgery	10/10 (100.0)	7/7 (100.0)	1.0
Cases with sigmoid colon diverticulum	29/31 (93.5)	23/24 (95.8)	0.71
Cecum intubation time (min), mean ± SD			
Total	10.4 ± 6.2	11.2 ± 6.8	0.57
History of abdominal surgery	7.7 ± 2.7	9.8 ± 5.5	0.58
Cases with sigmoid colon diverticulum	10.9 ± 6.2	10.9 ± 7.2	0.70

Data are presented as *n* (%).

Table 3 Stigmata of recent hemorrhage

	L-group ($n = 42$)	S-group ($n = 38$)	*P*-value
Total	24 (58.5)	10 (26.3)	0.005
Active bleeding	2	3	0.10
Non-bleeding visible vessel	1	1	0.51
Adherent clots	21	6	0.07
Site			
Cecum	1	1	0.51
Ascending colon	11	4	0.75
Transverse colon	2	0	0.34
Descending colon	1	1	0.51
Sigmoid colon	8	3	0.84
Rectum	1	1	0.51

Data are presented as *n* (%).

Table 4 Site of bleeding in cases undergoing contrast-enhanced computed tomography

	L-group	S-group	*P*-value
Cases with positive extravasation	9/32 (28.1)	6/26 (23.0)	
SRH(+)	5/9 (55.5)	5/6 (83.3)	0.26
Cases with negative extravasation	23/32 (71.8)	20/26 (76.9)	
SRH(+)	17/23 (73.9)	1/20 (5.0)	<0.05

Data are presented as *n* (%).
SRH, stigmata of recent hemorrhage.

five of nine (55.5%) in the L group and five of six (83.3%) in the S group, with no significant difference between the two groups (Table 4). In contrast, the identification rate of SRH in patients with negative extravasation was significantly higher in the L group (17 of 23 patients (73.9%), and 1 of 20 patients (5.0%) in the S group). Of the 34 SRH-positive cases, endoscopic hemostasis was confirmed by hemoclipping in 33 cases; however, it was difficult in one case in the S group, and hemostasis was performed by IVR.

Rebleeding within 1 month after endoscopic hemostasis occurred in 4 of 24 patients (16.7%) in the L group and 3 of 10 patients (30.0%) in the S group, with no significant difference between the two groups ($P = 0.39$). In contrast, in cases where hemostasis was not performed, rebleeding occurred in 2 of 18 cases (11.1%) in the L group and 4 of 28 cases (14.3%) in the S group, with no significant difference between the two groups ($P = 0.56$). One patient in the L group experienced rebleeding on day 3 after initial hemostasis, and surgery was performed due to difficulty in endoscopic hemostasis. The rebleeding rates with and without hemostasis were not significantly different between the two groups. In addition, short-term early rebleeding within 7 days was comparable between the two groups: three cases in the L group and two cases in the S group, with no significant difference between the two groups.

Discussion

The identification rate of SRH, accompanied by adherent clots with active bleeding or non-bleeding visible vessel by removal, was significantly higher in the L group than in the S group. The identification rate of SRH has been reported to be 8–31%,[12,13,15,16] and it has been reported that the identification rate increases when the hood is attached.[11] The usefulness of hemostasis using a long hood has been reported by Akutsu et al.[12] and

Kobayashi et al.[13] The bottom of the diverticulum can be observed by inverting the diverticulum with a long hood due to suction. It is assumed that a long hood will provide a high identification rate of SRH because the bottom of the diverticulum can be seen, and an adherent clot can be detected even in the absence of active bleeding. However, in some cases, the diverticulum cannot be reversed because of small diverticulum or adhesions.[12] On contrast-enhanced CT, which is considered useful in identifying the site of bleeding, the rate of identification of the bleeding site in patients with negative extravasation was significantly higher in the L group than in the S group. Previous reports have shown that the identification rate of bleeding sites in extravasation-negative cases is 20–31%,[4] suggesting the usefulness of long hoods in negative cases in this study. It has been reported that early detection and hemostasis of SRH reduce the rebleeding rate,[16] and identification of SRH may be beneficial in improving the success rate of endoscopic hemostasis and reducing the rebleeding rate.

As to patient backgrounds, there were significant differences in age between two groups. The small sample size could have been the cause. In cases with a history of abdominal surgery or multiple diverticula of the sigmoid colon, abdominal adhesions may influence the maneuverability of the colonoscope. Further, there have been cases of difficult insertion due to pain. However, there was no significant difference in the cecal intubation time or cecal intubation rate in patients with a history of abdominal surgery or multiple diverticula of the sigmoid colon, suggesting that a long hood may not be a contraindication in these cases. In contrast, 95% of the cases were pretreated with oral bowel lavage solution, but in cases where pretreatment was not performed, clots and residuals may enter the hood, resulting in poor visual field; therefore, it is necessary to select patients with oral bowel lavage solution.

Although the identification rate of SRH was higher in the L group, there was no significant difference in rebleeding within 7 days or 1 month between the two groups, indicating that the higher identification rate of SRH did not contribute to a lower rebleeding rate. In general, it has been reported that in the hemoclipping method, direct hemoclipping of vessels at the bottom of the diverticula has a lower rebleeding rate than the suture method for diverticula opening.[17,18] In small diverticula or adhesion of diverticula that cannot be reversed, the suture method may be selected for endoscopic hemostasis. In this study, the ratio of the direct hemoclipping and suture methods was not investigated between both groups. The usefulness of endoscopic band ligation as a method of hemostasis for CDH has further been reported,[19] and it offers the advantages of lower early and late rebleeding rates, reduced need for IVR, and a shorter length of hospital stay. However, adverse events such as perforation and diverticulitis have been reported. Further studies are required to identify better hemostasis methods after the identification of SRH.

This study had several limitations. This study was conducted at two institutions, and the sample size of 80 cases was small. Double-blinding was not feasible because both hoods could be seen during colonoscopy. Although there was no significant difference in the cecal intubation rate between the two groups, cecal intubation was difficult in some cases. In the near future, further study is warranted to confirm these results in multicenter trials with a larger sample size.

In conclusion, a long hood may be useful for identifying SRH in patients with suspected diverticular hemorrhage. In particular, the results suggest that a long hood may be more useful in patients without extravasation on contrast-enhanced CT.

References

1 Manabe N, Haruma K, Nakajima A *et al*. Characteristics of colonic diverticulitis and factors associated with complications: a Japanese multicenter, retrospective, cross-sectional study. *Dis. Colon Rectum*. 2015; **58**: 1174–81.

2 Nagata N, Niikura R, Aoki T *et al*. Increase in colonic diverticulosis and diverticular hemorrhage in an aging society: lessons from a 9-year colonoscopic study of 28,192 patients in Japan. *Int. J. Colorectal Dis.* 2014; **29**: 379–85.

3 Yuhara H, Corley DA, Nakahara F *et al*. Aspirin and non-aspirin NSAIDs increase risk of colonic diverticular bleeding: a systematic review and meta-analysis. *J. Gastroenterol.* 2014; **49**: 992–1000.

4 Konstantions T, Paraskevas G, Ian G *et al*. Diagnosis and management of acute lower gastrointestinal bleeding: European Society of Gastrointestinal Endoscopy (ESGE) Guideline. *Endoscopy*. 2021; **53**: 850–68.

5 Strate LL, Syngal S. Predictors of utilization of early colonoscopy vs. radiography for severe lower intestinal bleeding. *Gastrointest. Endosc.* 2005; **61**: 46–52.

6 Nagata N, Kobayashi K, Yamauchi A *et al*. Identifying bleeding etiologies by endoscopy affected outcomes in 10,342 cases with hematochezia: CODE BLUE-J Study. *Am. J. Gastroenterol.* 2021; **116**: 2222–34.

7 Jensen DM, Machicado GA, Jutabha R. Urgent colonoscopy for the diagnosis and treatment of severe diverticular hemorrhage. *N. Engl. J. Med.* 2000; **342**: 78–82.

8 Jensen DM, Ohning GV, Kovacs TO *et al*. Natural history of definitive diverticular hemorrhage based on stigmata of recent hemorrhage and colonoscopic Doppler blood flow monitoring for risk stratification and definitive hemostasis. *Gastrointest. Endosc.* 2016; **83**: 416–23.

9 Nakatsu S, Yasuda H, Maehata T *et al*. Urgent computed tomography for determining the optimal timing of colonoscopy in patients with acute lower gastrointestinal bleeding. *Intern. Med.* 2015; **54**: 553–8.

10 Sugiyama T, Hirata Y, Kojima Y *et al*. Efficacy of contrast-enhanced computed tomography for the treatment strategy of colonic diverticular bleeding. *Intern. Med.* 2015; **54**: 2961–7.

11 Niikura R, Nagata N, Aoki T *et al*. Predictors for identification of stigmata of recent hemorrhage on colonic diverticula in lower gastrointestinal bleeding. *J. Clin. Gastroenterol.* 2015; **49**: e24–30.

12 Akutsu D, Narasaka T, Wakayama M *et al*. Endoscopic detachable snare ligation: a new treatment method for colonic diverticular hemorrhage. *Endoscopy*. 2015; **47**: 1039–42.

13 Kobayashi K, Akiyama S, Narasaka T, Wakayama M *et al*. Multicenter propensity score-matched analysis comparing short versus long cap-assisted colonoscopy for acute hematochezia. *JGH Open*. 2023; **7**: 487–96.

14 Nagata N, Ishii N, Manabe N *et al*. Guidelines for colonic diverticular bleeding and colonic diverticulitis: Japan Gastroenterological Association. *Digestion*. 2019; **99**: 1–26.

15 Lai EJ, Calderwood AH, Doros G, Fix OK, Jacobson BC. The Boston preparation scale: a valid and reliable instrument for colonoscopy-oriented research. *Gastrointest. Endosc.* 2009; **69**: 620–5.

16 Gobinet-Suguro M, Nagata N, Kobayashi K *et al*. Treatment strategies for reducing early and late recurrence of colonic diverticular

bleeding based on stigmata of recent hemorrhage: a large multicenter study. *Gastrointest. Endosc.* 2022; **95**: E1210–22.
17 Ishii N, Hirata N, Omata F *et al*. Location in the ascending colon is a predictor of refractory colonic diverticular hemorrhage after endoscopic clipping. *Gastrointest. Endosc.* 2012; **76**: 1175–81.
18 Kishino T, Nagata N, Kobayashi K *et al*. Endoscopic direct clipping versus indirect clipping for colonic diverticular bleeding: a large multicenter cohort study. *United European Gastroenterol. J.* 2022; **10**: 93–103.
19 Kobayashi K, Nagata N, Furumoto Y *et al*. Effectiveness and adverse events of endoscopic clipping versus band ligation for colonic diverticular hemorrhage: a large-scale multicenter cohort study. *Endoscopy*. 2022; **54**: 735–44.