Surg Endosc (2011) 25:3574–3578
DOI 10.1007/s00464-011-1760-8

Enodoscopic band ligation (EBL) is superior to endoscopic clipping for the treatment of colonic diverticular hemorrhage

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Received: 15 February 2011 / Accepted: 30 April 2011 / Published online: 3 June 2011

Abstract
Background Recently, endoscopic band ligation (EBL) has been used to treat colonic diverticular hemorrhage, but the number of EBL cases treated to date has been limited. This study aimed to evaluate the clinical outcomes of EBL in the treatment of colonic diverticular hemorrhage compared with those of endoclips.
Methods At St. Luke's International Hospital in Tokyo, 66 patients were treated with EBL or endoclips from January 2004 to October 2010. Early rebleeding was defined as clinical evidence of recurrent bleeding within 30 days after initial treatment. Patients' demographics, rate of early rebleeding, and complications were retrospectively evaluated.
Results Of the 66 patients, 18 were treated with EBL. The initial success rate for hemostasis with EBL was 100% with no complications. Early rebleeding was observed in one patient (6%), for whom eversion of a bleeding diverticulum in the sigmoid colon could not be obtained and early loss of the O-band occurred. However, the patient could be retreated with EBL. On the other hand, complete eversion could be obtained for all 10 patients with right-sided diverticula, and no early rebleeding occurred. Endoclips were used to treat 48 patients. Although the initial success rate for hemostasis was 100% without any complications, the rate of early rebleeding was 33% (16 patients), which was significantly higher than the rate for the EBL-treated group ($P = 0.018$).
Conclusions According to the findings, EBL should be considered safe, effective, and superior to endoclips for the treatment of colonic diverticular hemorrhage. The EBL procedure should be attempted as the initial therapy especially for the right-sided disease.

Keywords Colonic diverticular hemorrhage · Endoscopic treatment · Endoscopic band ligation · Endoscopic clipping · Lower gastrointestinal bleeding

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Introduction

Diverticular hemorrhage accounts for approximately 20–48% of lower gastrointestinal bleeding (LGIB) and is the most commonly identifiable cause of LGIB [1–3]. Colonic diverticulosis has been increasing in Japan because of increasing low-fiber diets. Concomitantly, the incidence of diverticular hemorrhage is increasing due to regular use of antiplatelet agents and nonsteroidal antiinflammatory drugs (NSAIDs) [4, 5]. Diverticular hemorrhage has a less severe course than upper gastrointestinal bleeding and stops spontaneously in 70–80% of cases [1, 6]. However, rebleeding occurs for approximately 25% of these patients, with some requiring medical intervention [1, 6–8].

Several investigators have proposed that urgent colonoscopy is useful for the initial evaluation of LGIB, and endoscopic therapies have been used in the treatment of colonic diverticular hemorrhage for immediate hemostasis and prevention of further hemorrhage [2, 9–19]. Endoscopic hemostasis with endoclips rather than coagulation therapy is sometimes used to treat colonic diverticular hemorrhage. The endoclip approach offers the theoretical

advantage of causing less injury to adjacent tissues [12–14].

Recently, endoscopic band ligation (EBL) also has been used in the treatment of colonic diverticular hemorrhage. The EBL procedure achieves successful immediate hemostasis without procedural complications in cases of even massive bleeding [16–19]. However, the number of cases treated with either endoclips or EBL to date has been limited [12–14, 16–19]. In the current study, we retrospectively evaluated the safety and efficacy of EBL versus endoclips for the treatment of colonic diverticular hemorrhage.

Methods

Study population

A retrospective review of all patients who underwent colonoscopy for acute LGIB from January 2004 to October 2010 at St. Luke's International Hospital in Tokyo, Japan was performed. Colonoscopy was performed for evaluation of acute LGIB in 418 patients.

First, postpolypectomy bleeding, colorectal cancer, ischemic colitis, angiodysplasia, and incidental diverticulosis with bleeding originating from lesions other than the diverticula [11] were excluded from the study. Of the 418 patients, 189 had a diagnosis of presumptive or definite diverticular hemorrhage [11], and 120 had presumptive colonic diverticular hemorrhage, in which diverticula had no evidence of bleeding, yet no other major colonic lesions or bleeding sites were identified on the colonoscopy.

Definite colonic diverticular hemorrhage was evident in 69 patients, with stigmata of recent hemorrhage (SRH) observed. Defined as a densely adherent clot despite vigorous irrigation, a nonbleeding visible vessel, or active bleeding visualized on colonoscopy, SRH allowed for unequivocal identification of a specific diverticulum as the source of bleeding [11, 20]. In the first session, three of these patients were treated with transcatheter arterial embolization (TAE) instead of endoscopic therapy, and 66 patients were treated with endoscopic clipping or EBL. Those patients not followed up at our institution were contacted by telephone to investigate whether they had rebleeding after the initial episode. This study was approved by the ethics committee of St. Luke's International Hospital, and written informed consent was obtained from all the patients enrolled in the study.

Colonoscopic examinations

All the patients received standard supportive medical care for LGIB, including hemodynamic monitoring and fluid resuscitation. Packed red blood cells were transfused to correct severe anemia if necessary. Bowel preparation with polyethylene glycol or glycerin enema was performed before colonoscopic examinations. All the patients underwent colonoscopy using water-jet scopes (PCF-Q260 JI or GIF-Q260 J: Olympus Optical Company Ltd, Tokyo, Japan), and a water-jet system was used for vigorous irrigation.

Endoscopic hemostasis with endoscopic band ligation

After the site of bleeding had been marked with endoclips, the colonoscope was removed and subsequently reinserted after attachment of a band-ligator device (MD-48710 EVL Devices; Sumitomo Bakelite Company Ltd., Tokyo, Japan). The bleeding diverticulum was pulled via suction into the cup of the endoscopic ligator, and the elastic O-ring was released (Fig. 1A, B).

Endoscopic hemostasis with endoclips

When the hemorrhage source was located at the neck of the diverticulum, endoclips (HX-610-135 EZ CLIP; Olympus Optical Company Ltd.) were placed directly onto the vessel if technically feasible. When direct placement of endoclips

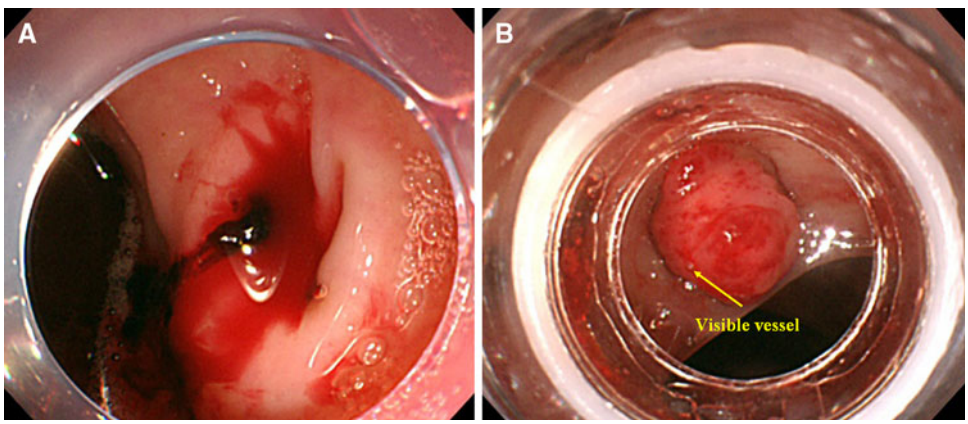

Fig. 1 **A** Endoscopic view of active bleeding from a diverticulum. **B** After endoscopic band ligation (EBL) therapy, immediate hemostasis was obtained

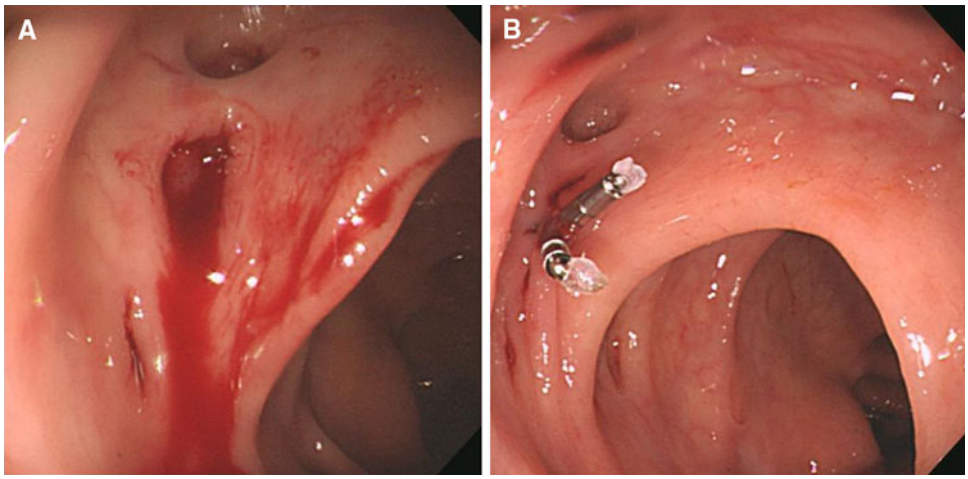

Fig. 2 **A** Endoscopic view of active bleeding from a diverticulum. **B** After closure of the diverticulum in zipper fashion with endoclips, immediate hemostasis was obtained

onto the vessel could not be performed, the diverticulum was closed in a zipper fashion (Fig. 2A, B).

Further treatment for rebleeding after initial endoscopic treatment

Early rebleeding was defined as rebleeding observed by endoscopy within 30 days after initial treatment that needed further treatment by endoscopy, TAE, or surgery. If rebleeding after initial endoscopic treatment occurred, repeat endoscopic intervention was attempted first. If diverticular rebleeding could not be controlled with endoscopic retreatment, as in cases of massive rebleeding from previously treated diverticula, poor endoscopic view, or hemodynamic instability, TAE or colectomy was performed based on the clinical judgment of the attending gastroenterologist.

Statistical analysis

Demographics of the patients, location of bleeding diverticula (cecum, ascending colon, transverse colon, descending colon, or sigmoid colon), location of a bleeding site within the diverticulum (dome or neck), procedural time, rate of rebleeding, and complications were retrospectively evaluated. The results are expressed as medians (range) for continuous variables and proportions for categorical variables. The nonparametric Mann–Whitney *U* test was applied for continuous and Fisher's exact test for categorical variables. Statistical significance was defined as a *P* value less than 0.05.

Results

The clinical outcomes of EBL and endoclips for the treatment of colonic diverticular hemorrhage are presented in Table 1

Bleeding sites were variously represented throughout the colon, with 10 cases (56%) in the EBL-treated group and 32 cases (75%) in the endoclip-treated group located in the right colon (ascending colon and transverse colon). Initial therapy successfully achieved immediate hemostasis without any procedural complications in both groups.

One patient (6%) in the EBL-treated group had early rebleeding, for which complete eversion of the banded diverticulum was not performed. The patient experienced recurrent hematochezia 1 day after the initial EBL. Urgent repeat colonoscopy showed loss of the O-ring from the sigmoid diverticulum. As a result, rebleeding was observed, and EBL was subsequently repeated. Complete eversion of the diverticulum was obtained with retreatment, and immediate hemostasis was successfully achieved without any procedural complications. No further bleeding occurred after repeat therapy, and neither surgical nor angiographic therapy was required.

On the other hand, 16 patients (33%) in the endoclip-treated group experienced early rebleeding, with 13 cases located in the right colon. Although nine patients were managed conservatively or by endoscopic retreatment, TAE or colectomy was performed for seven patients because of uncontrollable hemorrhage from the previously treated diverticula. The rate of early rebleeding was significantly higher in the endoclip-treated group than in the EBL-treated group ($P = 0.018$). The age of the patients, the rate for usage of anticoagulant or antiplatelet agents, the hematocrit at admission, the shock index, the location of hemorrhage, and the procedural time were not significantly different between the two groups.

Discussion

Diverticular hemorrhage is a common cause of severe hematochezia, and patients with endoscopic stigmata of

Table 1 Clinical characteristics and outcomes of endoscopic band ligation (EBL) versus endoclips for the treatment of colonic diverticular hemorrhage

	EBL ($n = 18$)	Endoclips ($n = 48$)	P value
Age (years)	59 (40–87)	63 (29–91)	0.77
Usage of anticoagulant or antiplatelet agents (%)	38.9 (7/18)	31.3 (15/48)	0.38
Hematocrit at admission % (range)	38.6 (29.3–49.3)	36.5 (23.9–45.4)	0.10
Shock index (range)	0.68 (0.50–0.85)	0.64 (0.38–1.32)	0.92
Procedural time: min (range)	42.5 (18–70)	49 (18–129)	0.13
Location of hemorrhage (right colon:left colon)	10:8	32:16	0.87
Stigmata of hemorrhage (AB:NBVV:DAC)	7:4:7	22:17:9	
Bleeding point in diverticula (dome:neck:uncomfirmed)	7:6:5	9:16:23	
Complications	0	0	
Early rebleeding (%)	5.6 (1/18)	33.3 (16/48)	0.018
Right colon:left colon	0:1	13:3	
TAE or surgery needed (%)	0 (0/1)	43.8 (7/16)	

AB active bleeding; *NBVV* nonbleeding visible vessels; *DAC* densely adherent clot; *TAE* transcatheter arterial embolization

recent bleeding such as adherent clots, visible vessels, or active bleeding are at higher risk for early recurrence of hemorrhage than those for whom these findings are absent or diverticular ulceration alone is found [11, 20]. Traditional methods of therapy for diverticular hemorrhage are medical management, angiographic intervention, and surgery. In addition, several reports describe successful endoscopic therapy using epinephrine injection, contact thermal therapy, and endoclips [2, 10–15].

Jensen et al. [11] reported that contact coagulation with a multipolar electrocautery probe and injection of epinephrine was a safe and effective endoscopic hemostatic method. However, Bloomfeld et al. [15] reported a much higher rate of early rebleeding after endoscopic hemostasis with bipolar coagulation and a much higher epinephrine injection rate (5 of 13 patients). Moreover, perforation after application of bipolar coagulation in the treatment of colonic angiodysplasia was observed because the wall of the colon is especially thin in the right colon [21].

Although the pathogenesis and pathology of angiodysplasia differs from those of colonic diverticula, contact coagulation may pose a risk of perforation, especially for hemorrhage sources located at the dome of the diverticulum, which lacks a muscular layer. Similarly, hemostasis with endoclips is sometimes considered difficult because of poor endoscopic visualization due to massive bleeding, a diagonal endoscopic view of the bleeding source, or instability of the endoscope [18]. Therefore, safer and more effective methods are needed for therapy of diverticular hemorrhage.

Recently, EBL has been applied to the therapy for colonoscopic diverticular hemorrhage [16–19]. In our study, as in previous studies, EBL achieved successful immediate hemostasis without any procedural complications in all cases, even in those with massive bleeding. Farrell et al. [17] reported that ligated diverticula, despite a lack of muscularis propria or serosa, demonstrated no evidence of perforation in vivo or ex vivo. Therefore, EBL is considered a safe endoscopic treatment, even when adjacent colon walls are thin.

Early rebleeding occurred in one patient, for whom complete eversion of the bleeding sigmoid diverticulum was not achieved during initial therapy. On the other hand, complete eversion could be obtained for all 10 patients with right-sided diverticula, and no early rebleeding occurred. Eversion of the bleeding diverticulum was considered important to prevent rebleeding due to early loss of the O-ring and to achieve complete hemostasis.

In this study, the rate of early rebleeding in the endoclip-treated group was higher than in previous reports. Many lesions were treated with endoclip closure in a zipper fashion (37 of 48 cases). This suggests that endoclip-zippering around the diverticular neck may be a suboptimal technique for occlusion of the immediate source of hemorrhage and the underlying culprit artery.

In Western countries, diverticulosis is located predominantly in the left colon, whereas in Asia, including Japan, right-sided diverticulosis is more common [4, 22] and tends to present with more massive bleeding [8, 23]. In a series by Tan et al. [8], all the patients who rebled within 30 days after superselective embolization had right-sided diverticula, which were associated with more massive hemorrhage and rebleeding than left-sided diverticula. It is postulated that this is due to the thinner colonic wall in the right colon, with the result that vessels are more vulnerable to injury and bleeding [23]. Early rebleeding did not occur in any of the 10 right-sided diverticular hemorrhage cases in the EBL-treated group, although a large number of right-sided cases (13 of 32 cases) rebled in the endoclip-treated group.

Although the number of colonic diverticular hemorrhage cases treated with endoscopy was not large in our study, EBL is considered superior to endoclips in the treatment of colonic diverticular hemorrhage and should be attempted as the initial therapy, especially for the right-sided disease.

Acknowledgments The authors thank Dr. Gautam Deshpande for refining their manuscript.

Disclosures Authors have no conflicts of interest or financial ties to disclose.

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