Comparison of long-term outcomes between endoscopic band ligation and endoscopic clipping for colonic diverticular hemorrhage

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Introduction

Incidence of colonic diverticular hemorrhages is rising due to increasing comorbidities, such as hypertension and arteriosclerosis, and regular use of antiplatelet agents or nonsteroidal anti-inflammatory drugs [1 – 6]. Colonic diverticular hemorrhage is the most common cause of lower gastrointestinal bleeding (LGIB) [7 – 9], and is seen to resolve spontaneously in 70% to 90% of cases [7, 10 – 12]. However, endoscopic treatment, surgery, or transarterial embolization (TAE) may be required in cases with severe or continuous bleeding [12 – 16].

Colonoscopy is useful for diagnosis of colonic diverticular hemorrhage, and endoscopic treatments for hemostasis include epinephrine injection, contact thermal therapy, and endoscopic clipping (EC) [12, 17 – 22]. Recently, endoscopic band ligation (EBL) has also been performed to achieve hemostasis [23 – 28]. We previously reported that EBL was a safe and effective endoscopic treatment for colonic diverticular hemorrhage, and that resolution of the colonic diverticulum may prevent late rebleeding (rebleeding more than 30 days after EBL) occurred in five of these 11 cases.

Results: Rebleeding occurred in 21 patients in the EBL group and in 26 patients in the EC group. The cumulative incidence of rebleeding at 1, 12, 24, and 36 months after first treatments was 14%, 23%, 26%, and 41% in the EBL group and 38%, 49%, 59%, and 68% in the EC group, respectively. Time-to-event analysis revealed statistically significant data (Log-rank test, \(P=0.0036\)). Scar formation with fold convergence at the previously banded site was observed in 11 of 24 patients who underwent follow-up colonoscopy (46%). However, late rebleeding (rebleeding more than 30 days after EBL) occurred in five of these 11 cases.

Conclusions: EBL was superior to EC in the treatment of colonic diverticular hemorrhage. However, the risk of rebleeding was not avoided even after the diverticula had been resolved using EBL.
May 2009, and EBL from June 2009 to November 2014. A study flow diagram is presented in Fig. 1. Only cases of colonic diverticular hemorrhage were included, and all cases of bleeding (polypectomy bleeding, colorectal cancer, ischemic colitis, vascular ectasia, and ileal diverticular bleeding) were excluded. Presumptive diverticular hemorrhage was ruled out where the stigmata of recent hemorrhage (SRH) were absent in the colonoscopy, because it is essential for unequivocal identification of specific diverticula as the bleeding source. Sources were classified, using colonoscopy, into active bleeding (AB), non-bleeding visible vessel (NBVV), or adherent clots (AC) [12]. A total of 163 patients were diagnosed with definite colonic diverticular hemorrhage with SRH. Patients treated with TAE, surgery, or epinephrine injection therapy as first-line therapy were excluded. A total of 154 patients with definite diverticular hemorrhage were successfully treated with EBL or EC as first-line treatment. Patients who were followed up for less than 1 year after initial endoscopic treatments (EBL or EC) at St. Luke’s International Hospital were excluded, resulting in a final sample of 61 patients in the EBL group and 39 patients in the EC group.

**Treatment methods**
Colonoscopy was performed after bowel preparation with polyethylene glycol, in both the EBL and the EC groups. However, patients with hemodynamic instability did not undergo bowel preparation. Endoscopic treatments were performed by well-trained endoscopists and a trainee under the supervision of experts.

The EBL method was performed as follows [25–28]: Once the diverticula were identified with SRH, they were marked with hemoclips and the endoscope was removed. It was then reinserted after a band-ligation device (MD-48710 EVL Device, Sumitomo Bakelite Co., Tokyo, Japan) was attached to its tip. When the endoscope head reached the target point, the bleeding diverticula were suctioned into the band-ligator cup. Thereafter, the O-ring was released and a visible vessel was observed on the banded diverticulum. Tattooing was not performed at the bleeding point. If EBL was not successful, other endoscopic treatments, such as endoscopic clipping or epinephrine injection therapy, were performed.

EC was performed as previously reported [22], i.e., by direct placement of hemoclips (HX-600-090L, HX-600-135, HX-610-090L, or HX-610-135; Olympus Medical Systems, Tokyo, Japan), if feasible, on the targeted vessel. When direct placement was considered difficult because of the dome location or massive hemorrhage, indirect placement (closing with multiple hemoclips in a zipper fashion) was performed.

**Follow-up after endoscopic treatments**
After endoscopic treatment, patients were followed up on an outpatient basis at St. Luke’s International Hospital. Continuous massive hematochezia after endoscopic treatments was considered as rebleeding. In such situations, a repeat colonoscopy was performed to retreat the diverticula, or to rule out other bleeding lesions, such as colonic neoplasms or vascular ectasia. If required, additional treatments were administered based on the judgment of the attending gastroenterologists.

In the EBL group, follow-up colonoscopy was performed after the procedure to confirm the disappearance of the banded diverticula, except in patients with severe comorbid conditions such as cardiovascular disease. A convergence of folds at the site of the previously banded diverticula, seen on follow-up colonoscopy, was considered as the disappearance of the diverticula with SRH.
However, the presence or absence of the previously banded diverticula could not be confirmed in all cases because tattooing was not performed near the bleeding point. In such cases, we recorded the results as unknown. This study was approved by the ethics committee of our hospital, and written informed consent was obtained from all patients. The patients who were not followed up at St. Luke’s International Hospital were contacted by telephone to confirm the presence or absence of massive hematochezia after endoscopic treatments.

**Statistical analysis**

Statistical analysis was performed using JMP version 9 (SAS Institute Inc., USA). Patients’ ages and follow-up periods after initial treatment were reported as mean [standard deviation (SD)] and median [range], respectively. Student’s t-test or a Mann-Whitney U-test were used for continuous variables, and the Fisher’s exact test was used for categorical variables. A \( P \) value less than 0.05 was considered statistically significant. Time-to-event analysis of rebleeding was analyzed using the Kaplan-Meier method.

**Table 1** Characteristics of patients with definite diverticular hemorrhage treated with EBL or EC.

<table>
<thead>
<tr>
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<th>EBL (n=61)</th>
<th>EC (n=39)</th>
<th>( P ) value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male, n (%)</td>
<td>44 (72)</td>
<td>29 (74)</td>
<td>0.81</td>
</tr>
<tr>
<td>Age, mean (SD)</td>
<td>67 (13)</td>
<td>64 (13)</td>
<td>0.32</td>
</tr>
<tr>
<td>Antiplatelet agent, n (%)</td>
<td>18 (30)</td>
<td>13 (33)</td>
<td>0.69</td>
</tr>
<tr>
<td>NSAIDs, n (%)</td>
<td>4 (7)</td>
<td>3 (8)</td>
<td>0.83</td>
</tr>
<tr>
<td>Hypertension, n (%)</td>
<td>33 (55)</td>
<td>19 (49)</td>
<td>(&lt; 0.001^1)</td>
</tr>
<tr>
<td>Right colon, n (%)</td>
<td>45 (74)</td>
<td>28 (72)</td>
<td>0.25</td>
</tr>
<tr>
<td>AB : NBVV + AC, n (%)</td>
<td>25 (41) : 36 (59)</td>
<td>16 (41) : 23 (59)</td>
<td>1.00</td>
</tr>
<tr>
<td>Follow-up periods, median (range) (months)</td>
<td>30 (12 – 65 )</td>
<td>65 (12 – 111)</td>
<td>(&lt; 0.001^1)</td>
</tr>
</tbody>
</table>

NSAIDs, non-steroidal anti-inflammatory drugs; AB, active bleeding; NBVV, non-bleeding visible vessel; AC, adherent clot. 

\(^1\) A \( P \) value less than 0.05 was considered statistically significant.
Recent advancements in endoscopic hemostatic methods have included the use of epinephrine injection, contact thermal therapy, and/or epinephrine injection. Therefore, EC has become the most common treatment for colonic diverticular hemorrhage. However, the risk of rebleeding could not be avoided, even after resolution of the diverticula using EBL.

**Competing interests:** None

**References**


**Long-term outcomes of EBL or EC for diverticular hemorrhage**

The Kaplan-Meier test estimates of rebleeding in each group are presented in Fig. 5. In the EBL group, the cumulative incidence of rebleeding at 1, 12, 24, and 36 months were 14%, 23%, 26%, and 41%, respectively. In the EC group, the cumulative incidence of rebleeding at 1, 12, 24, and 36 months were 38%, 49%, 59%, and 68%, respectively. The time-to-event analysis revealed statistically significant data (Log-rank test, P=0.0036). A follow-up colonoscopy was performed in 24 out of 61 EBL cases (39%). Scar formation with fold convergence at the previously banded site, which was considered as complete resolution of the diverticula, was observed in 11 cases (46%). However, late rebleeding occurred in 5 out of 11 cases.

**Discussion**

Recently, endoscopic hemostatic methods such as epinephrine injection, contact thermal therapy, EC, and EBL [12–17] have become the most common treatments for colonic diverticular hemorrhage. In our retrospective cohort study, we investigated long-term follow-up results with EBL and EC for treatment of colonic diverticular hemorrhage.

The walls of the colon are thin, and the absence of a muscular layer in the colonic diverticula implies a risk of perforation during contact thermal therapy and/or epinephrine injection. Therefore, EC is sometimes preferred over contact coagulation therapy for treatment of colonic diverticular hemorrhage, because it provides immediate mechanical hemostasis and causes less injury to the colonic tissues [18–22]. However, direct placement of hemoclips on the targeted vessel is difficult, particularly in cases of dome location, massive hemorrhage, or small diverticular orifices [20–22]. Moreover, the colonic diverticular anatomy sometimes precludes indirect placement of hemoclips at the diverticula for occlusion of either the SRH or the underlying artery [29], and bleeding from right-sided diverticulosis (commonly seen in eastern countries) is more severe than that from left-sided diverticulosis [30]. High rates of rebleeding after EC were seen in the current study in which 29 patients (74%) were treated using the initial method and 28 bleeding diverticula (72%) were located in the right colon.

Recently, EBL has been performed to treat colonic diverticular hemorrhage with the band-ligator device that is widely used for esophageal varices [25–28]. In the current study, the rate of rebleeding was significantly lower in the EBL group than in the EC group. By occluding SRH and underlying arteries using EBL, higher hemostatic effects and lower rebleeding rates may be obtained, and late bleeding from the “same” diverticula could be prevented by resolution of the banded diverticula.

However, late rebleeding occurred in five cases where the follow-up colonoscopy showed resolution of the banded diverticula. These results imply that late rebleeding occurred from different diverticula, implying that it cannot be prevented even after resolution of the previously banded diverticula.

The main limitation of this study was the difference in the follow-up periods between the EBL and EC groups. In our institution, until May 2009, colonic diverticular hemorrhage had been treated mainly with EC; in June 2009, it was replaced by EBL. Therefore, rebleeding after initial treatments were compared between the groups using the Kaplan-Meier method.

In conclusion, although the current study was retrospective and the number of patients followed up long term was limited, EBL was considered superior to EC in treatment of colonic diverticular hemorrhage. However, the risk of rebleeding could not be avoided, even after resolution of the diverticula using EBL.
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