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Prophylactic Clipping May Not Eliminate Delayed Hemorrhage in Colonoscopic Polypectomies

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ABSTRACT

To prevent delayed hemorrhage after the endoscopic resection of colonic polyps, many endoscopists have used prophylactic clipping with hemoclips without any general standards of application, because the effects of clipping have not been fully examined. We retrospectively investigated delayed hemorrhage in patients who underwent resection of colonic polyps in our hospital from January 1995 through December 1999 either without prophylactic clipping (nonclipping group) or with prophylactic clipping (clipping group) to every excision. The incidence of delayed hemorrhage did not differ significantly between the nonclipping (1.2% of polyps, 2.5% of patients) and clipping groups (1.4% of polyps, 2.7% of patients). In addition, the incidence of delayed hemorrhage did not differ significantly with the resection method, the number of resected polyps per patient, the location, morphologic type, or size of the resected polyps and did not affect the timing of hemorrhage or decreases in serum hemoglobin levels. Delayed hemorrhage occurred from well-closed postprocedural mucosal defects and from mucosal injuries produced by dislodged prophylactic clips. These results suggest that prophylactic clipping does not eliminate delayed hemorrhage and that clips may become dislodged and produce an effect opposite to that intended.

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Key words : colonic polyp, polypectomy, delayed hemorrhage, prophylactic clipping

INTRODUCTION

Hemorrhage is the most frequent complication in endoscopic resection, such as hot-biopsy, snare polypectomy, and endoscopic mucosal resection (EMR), of colonic polyps. The incidence of major hemorrhage, which causes hemodynamic alteration, after colonoscopic polypectomy is estimated to be 0.2% to 2.6%[1-6]. Hemorrhage may occur immediately or hours to a few weeks after polypectomy ; the reported incidence of severe delayed hemorrhage ranges from 0.2% to 1.6%. Both immediate and delayed hemorrhage can usually be treated endoscopically[7,8]. Recent advances in equipment and techniques have made colonoscopic resection safer, and outpatient procedures have become common. Delayed hemorrhage, however, may require hospitalization, and interventional radiologic or surgical treatment is still required when insertion of a colonoscope is difficult. Nevertheless, no prophylactic procedures have been established to prevent delayed hemorrhage after endoscopic resection of colonic polyps.

Hemoclips are used to treat gastrointestinal hemorrhage and may provide hemostasis with a lower risk of complications, such as perforation, than do other hemostatic procedures[9,10]. Hemoclips are also effec-

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tive for treating both immediate and delayed postprocedural colonic hemorrhage[7]. Recent reports from Japan suggest that prophylactic clipping with hemoclips is useful to prevent delayed hemorrhage after endoscopic resection of gastrointestinal polyps[6,7,11,12]. Therefore, many endoscopists in Japan use prophylactic clipping after endoscopic resection of colonic polyps, especially if a large mucosal defect is produced, the polyp is pedunculated with a thick stalk, several polyps are resected simultaneously, the patient has an underlying disease increasing the risk of hemorrhage, or insertion of a colonoscope is difficult[6]. However, whether prophylactic clipping effectively prevents delayed hemorrhage has not been fully investigated. Prophylactic clipping is usually performed at the endoscopist's discretion without any general standards of application. Moreover, a recent report has suggested that prophylactic hemoclip placement does not eliminate the possibility of delayed hemorrhage and, in fact, increases the incidence of delayed hemorrhage[6].

We have used prophylactic clipping with hemoclips after endoscopic resection of colonic polyps since 1997. However, in several of our patients delayed hemorrhage occurred despite prophylactic clipping. In the present study, we reviewed cases of delayed hemorrhage in detail and examined the effects of prophylactic clipping to prevent delayed hemorrhage.

SUBJECTS AND METHODS

Subjects

Patients underwent endoscopic resection of colonic polyps at the Daisan Hospital of Jikei University School of Medicine from January 1995 through December 1999. To avoid the possible effect of the endoscopist's discretion in placing prophylactic hemoclips, we investigated cases of delayed hemorrhage in two groups of patients: those in whom prophylactic clipping was used for every excision (clipping group) and those in whom prophylactic clipping was not used (nonclipping group) in the resection of colonic polyps without any other prophylactic procedures.

Colonoscopic procedures

Colonoscopy was performed either as an inpatient or outpatient procedure. Patients were prepared with oral magnesium citrate and a polyethylene glycol electrolyte lavage solution. Colonoscopic procedures were performed in an endoscopy unit by experienced endoscopists, using intravenous sedation with flunitrazepam and pethidine hydrochloride. Videoendoscopes (CF200I or CF240I; Olympus, Tokyo, Japan) and a wire snare (CE0197; TeleMed Systems, Inc., Marlborough, MA, USA) were used with an electrosurgical output device (PSD-10, Olympus) at a blended current combining coagulation (30 W) and cutting current (30 W). EMR followed a submucosal injection of saline. Patients were excluded from this study if total colonoscopy to the cecum was not done. Patients receiving anticoagulant therapy were excluded if the anticoagulants were not suspended for at least 1 week before and after colonoscopic procedures. The morphologic types of polyps were defined according to the classification of the Japanese Society for Cancer of the Colon and Rectum as sessile, semipedunculated, and pedunculated[13].

Prophylactic clipping was performed with hemoclips (MD850, Olympus) and a clip-application device (HX-5QR-1, Olympus) as described previously[12,14]. Briefly, mucosal defects formed by polypectomies or EMRs of sessile and semipedunculated polyps were closed with hemoclips, which gather the peripheral mucosa. The number of hemoclips placed ranged from 1 to 10, depending on the size of the mucosal defects. The stalks of pedunculated polyps were always ligated before excision with 1 to 4 transversely placed hemoclips, depending on the size of the stalks. The resected end of the remaining stalk was closed by additional clipping, if possible.

Observation of delayed hemorrhage

When hemorrhage occurred before the patient was discharged from the endoscopy unit, it was considered immediate postprocedural hemorrhage and excluded from analysis. Hemorrhage that occurred after discharge from the endoscopy unit was consid-

ered delayed hemorrhage. Delayed hemorrhage was suspected when hematochezia occurred in hours or days after the colonoscopic procedure and the site of hemorrhage was detected with colonoscopy, as described by Parra-Blanco et al.[7]. When spurting or oozing was detected with colonoscopy, the hemorrhage was defined as active. When an adherent clot, red spot, or visible vessel was detected, hemorrhage was defined as inactive. Hemostasis was secured by further clipping to the bleeding point at colonoscopy. Serum hemoglobin levels were measured when delayed hemorrhage was diagnosed.

Histologic examinations

The resected polyps were fixed with 10% neutral buffered formalin, and serial sections of polyps were cut and stained with hematoxylin and eosin with standard procedures for light microscopy. The size of the resected polyps was measured before fixation in formalin. The diameters of transected submucosal vessels in the polyps were measured with light microscopy and an image analysis system.

Analysis

The timing and types of hemorrhage and decreases in serum hemoglobin levels were reviewed in the two patient groups. The incidences of delayed hemorrhage were also analyzed according to the resection method, the number of polyps resected during the same procedure, and the location, and the morphologic type and size of resected polyps. To analyze whether the risk of hemorrhage is related to vessel size, the maximum diameters of transected submucosal vessels in resected polyps were examined in cases of delayed hemorrhage. In addition, we tried to determine the causes of delayed hemorrhage after the placement of prophylactic hemoclips by examining the sites of hemorrhage at follow-up colonoscopy in these cases. Student's t-test was used to compare quantitative variables between the two groups. Fisher's exact probability test was used to compare the incidences of delayed hemorrhage. Statistical significance was indicated by a P value less than 0.05.

Results

During the study period, 437 patients had 846 colonic polyps resected in the clipping group and 474 patients had 982 polyps resected in the nonclipping group (Table 1). There were no significant differences between the two groups in the distributions of age, sex, patient status at colonoscopic resection, and previous colonoscopic polypectomies ($P>0.05$ by Student's t-test and Fisher's exact probability test).

Summary of delayed hemorrhage in the two groups

Delayed hemorrhage occurred in 12 patients in each group. There were no differences between the groups in distributions of age, sex, patient status at colonoscopic resection, current anticoagulant therapy, the timing and types of hemorrhage, or decreases in serum hemoglobin level ($P>0.05$ by Student's t-test and Fisher's exact probability test, Table 2). The details of individual cases in the nonclipping and clipping groups are shown in Tables 3 and 4, respectively. Contrary to our expectations, hemorrhage

Table 1. Characteristics of the two patient groups.

	Nonclipping group	Clipping group
Number of patients	474	437
Age (yr, mean±S.D.)	62.7±10.7	61.3±11.3
Male sex (%)	66.0	69.8
Inpatient (%)	72.2	68.4
Previous polypectomy (%)	9.7	11.4
Number of resected polyps	982	846

Table 2. Summary of delayed hemorrhage in the two groups.

	Nonclipping group ($n=12$)	Clipping group ($n=12$)
Age (yr)*	59.8±9.4	60.3±9.9
Male sex (%)	91.7	83.3
Inpatient (%)	75.0	75.0
Current anticoagulant therapy (%)	0	0
Delay of hemorrhage (day)*	3.4±1.6	2.9±2.1
Active hemorrhage (%)	50.0	66.7
Decrease in hemoglobin level (mg/dl)*	1.8±1.2	2.4±1.5

*Data are means±S.D.

Table 3. Details of the cases with delayed hemorrhage in the nonclipping group.

Case	Age (yr)	Sex	Morphologic type	Size (mm)	Location	Resection method	Delay (day)	Type of hemorrhage	Decrease in hemoglobin (mg/dl)
1	64	M	Sessile	4	Sigmoid	Hot biopsy	1	Adherent clot	0.3
2	53	M	Sessile	5	Ascending	Snare polypectomy	5	Adherent clot	0.6
3	57	M	Sessile	5	Transverse	Snare polypectomy	3	Oozing	1.4
4	62	M	Sessile	9	Cecum	EMR	3	Oozing	2.6
5	59	M	Sessile	9	Rectum	EMR	3	Oozing	3.7
6	76	M	Sessile	10	Sigmoid	EMR	3	Oozing	4.3
7	61	M	Semipedunculated	10	Rectum	Snare polypectomy	6	Oozing	1.5
8	59	F	Semipedunculated	9	Rectum	Snare polypectomy	1	Adherent clot	1.3
9	43	M	Semipedunculated	10	Sigmoid	Snare polypectomy	3	Adherent clot	2.0
10	74	M	Semipedunculated	13	Sigmoid	EMR	5	Oozing	1.7
11	62	M	Pedunculated	8	Sigmoid	Snare polypectomy	3	Visible vessel	1.1
12	48	M	Pedunculated	10	Descending	Snare polypectomy	5	Visible vessel	0.5

Table 4. Details of the cases with delayed hemorrhage in the clipping group.

Case	Age (yr)	Sex	Morphologic type	Size (mm)	Location	Resection method	Delay (day)	Type of hemorrhage	Decrease in hemoglobin (mg/dl)
1	61	F	Sessile	7	Sigmoid	EMR	1	Adherent clot	1.5
2	58	M	Sessile	7	Rectum	EMR	1	Oozing	1.5
3	42	M	Semipedunculated	6	Rectum	EMR	1	Oozing	3.7
4	51	M	Semipedunculated	4	Rectum	Snare polypectomy	6	Adherent clot	1.3
5	66	M	Semipedunculated	6	Ascending	Snare polypectomy	1	Oozing	1.6
6	70	M	Semipedunculated	4	Ascending	Snare polypectomy	5	Oozing	4.1
7	56	M	Semipedunculated	5	Transverse	Snare polypectomy	3	Oozing	0.3
8	55	M	Pedunculated	8	Transverse	Snare polypectomy	5	Oozing	2.0
9	54	M	Pedunculated	12	Sigmoid	Snare polypectomy	2	Visible vessel	5.1
10	64	M	Pedunculated	10	Transverse	Snare polypectomy	2	Oozing	3.5
11	66	M	Pedunculated	10	Ascending	Snare polypectomy	1	Oozing	1.0
12	80	F	Pedunculated	12	Cecum	Snare polypectomy	5	Oozing	3.6

associated with a decrease in serum hemoglobin level of more than 3.0 g/dl occurred in more patients in the clipping group (5 patients) than in the nonclipping group (2 patients); however, the mean decreases in serum hemoglobin level did not differ significantly between the clipping group (2.4 ± 1.5 mg/dl) and the nonclipping group (1.8 ± 1.2 mg/dl, $P = 0.24$ by Student's t-test; Table 2). One patient in the clipping group (case 11, Table 4) showed hemodynamic changes, which were due to severe hemorrhage associated with a decrease in hemoglobin level of 5.1 g/dl, 2 days after polypectomy. However, no patients in either group required blood transfusion.

Incidences of delayed hemorrhage in the two groups

The incidence of delayed hemorrhage as a percentage of all polyps did not differ significantly between the nonclipping group (1.2%) and clipping group (1.4%; $P = 0.84$ by Fisher's exact probability test; Table 5). Furthermore, for each resection method, the incidence of delayed hemorrhage did not differ significantly between the two groups (Table 5). The incidence of delayed hemorrhage between the nonclipping group and the clipping group did not differ significantly according to the total number of polyps resected in all patients (2.5% and 2.7%, respectively; $P > 0.99$ by Fisher's exact probability test; Table 6)

Table 5. Incidences of delayed hemorrhage with each resection method.

	Nonclipping group ($n=982$)		Clipping group ($n=846$)	
Snare polypectomy	7/788	(0.89%)	9/661	(1.4%)
EMR	4/101	(4.0)	3/106	(2.8)
Hot biopsy	1/93	(1.1)	0/79	
Total	12/982	(1.2)	12/846	(1.4)

Table 6. Incidences of delayed hemorrhage in the number of resected polyps in each patient at the same procedure.

Number of polyps	Nonclipping group ($n=474$)		Clipping group ($n=437$)	
1	4/221	(1.8 %)	5/231	(2.2 %)
2	3/143	(2.1)	2/122	(1.6)
3	2/48	(4.2)	1/27	(3.7)
4	0/23		3/23	(13)
5	1/19	(5.3)	1/13	(7.7)
6 ～ 10	2/20	(10)	0/17	
Total	12/474	(2.5)	12/437	(2.7)

Table 7. Incidences of delayed hemorrhage in the location of polyps.

	Nonclipping group ($n=982$)		Clipping group ($n=846$)	
Cecum	1/55	(1.8 %)	1/45	(2.2 %)
Ascending	1/150	(0.67)	3/138	(2.2)
Transverse	1/272	(0.37)	3/248	(1.2)
Descending	1/104	(0.96)	0/26	
Sigmoid	5/323	(1.6)	2/271	(0.74)
Rectum	3/78	(3.9)	3/68	(4.4)

Table 8. Incidences of delayed hemorrhage in the morphologic types and size of polyps.

	Size (mm)	Nonclipping group ($n=982$)		Clipping group ($n=846$)	
Sessile	<20	6/474	(1.3%)	2/459	(0.44%)
	20≤	0/4		0 / 6	
Total		6/478	(1.3)	2/465	(0.43)
Semipedunculated	<20	4/301	(1.3)	5/208	(2.4)
	20≤	0/1		0/5	
Total		4/302	(1.3)	5/213	(2.4)
Pedunculated	<20	2/202	(0.99)	5/162	(3.1)
	20≤	0		0/6	
Total		2/202	(0.99)	5/168	(3.0)

Table 9. Maximum diameters of transected submucosal vessels in the polyps with delayed hemorrhage.

	Control polyps* ($n=10$)	Nonclipping group	Clipping group
Sessile			
Range (μm)	39–114	37–229 ($n=6$)	44–116 ($n=2$)
mean±S.D.	65±21	132±82	80±51
Semipedunculated			
Range (μm)	66–153	76–214 ($n=4$)	62–193 ($n=5$)
mean±S.D.	99±24	143±57	110±55
Pedunculated			
Range (μm)	500–1700	800–1300 ($n=2$)	504–1292 ($n=5$)
mean±S.D.	1150±409	1050±354	952±337

*Polyps, 10 mm in diameter, without delayed hemorrhage were selected at random in the nonclipping group.

or the number of polyps resected per patient during the same procedure. Furthermore, the incidence of delayed hemorrhage on the basis of polyp location did not differ significantly between the groups (Table 7).

Because few polyps resected were larger than 2 cm in diameter, our analysis chiefly involves polyps smaller than 2 cm in diameter (Table 8). The incidence of delayed hemorrhage did not differ significantly between the patient groups on the basis of morphologic type. Furthermore, in the nonclipping group, the incidence of delayed hemorrhage did not differ among polyps of different morphologic type. However, the incidence for sessile polyps was slightly lower and the incidences for semipedunculated and pedunculated polyps were slightly higher in the clipping group than in the nonclipping group; as a result, in the clipping group the incidence of delayed hemorrhage for sessile polyps (0.43%) was significantly lower than that for semipedunculated polyps (2.4%, $P=0.03$) or pedunculated polyps (3.0%, $P=0.02$).

Maximum diameters of transected submucosal vessels

Table 9 shows the maximum diameters of transected submucosal vessels observed with light microscopy in the resected polyps of the 12 cases in each group. Vessel diameters in 10 nonhemorrhage polyps of each morphologic type, which were selected at random from polyps 10 mm in diameter in the nonclipping group, are presented as controls. Although the number of polyps was too small for statistical analy-

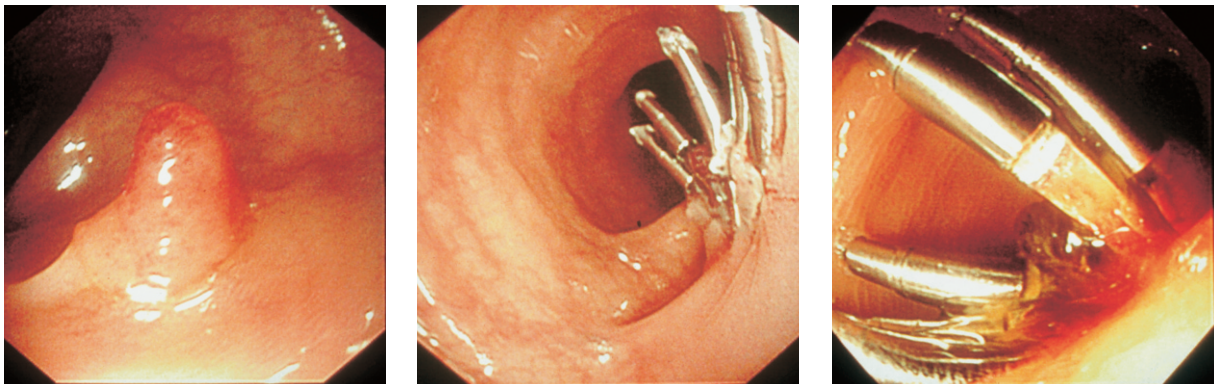

Fig. 1A Fig. 1B Fig. 1C

Fig. 1. Endoscopic photographs of a sessile polyp of case 1 in the clipping group. Photographs are before EMR (A), after the EMR with prophylactic clipping (B), and at follow-up colonoscopy the next day, showing an adherent clot at the well-closed mucosal defect (C).

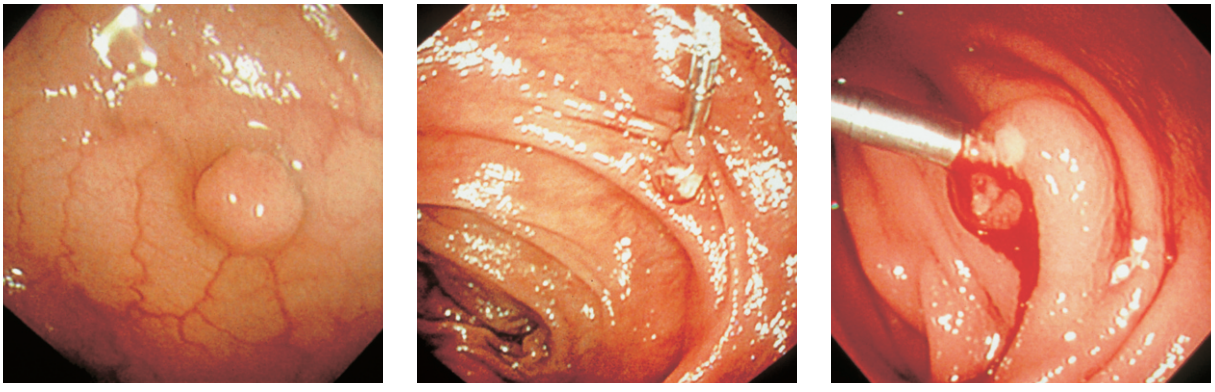

Fig. 2A Fig. 2B Fig. 2C

Fig. 2. Endoscopic photographs of a semipedunculated polyp of case 7 in the clipping group. Photographs are before snare polypectomy (A), after polypectomy with prophylactic clipping (B), and at follow-up colonoscopy 3 days after polypectomy, showing blood oozing from the well-closed postpolypectomy ulcer with edematous change in the surrounding mucosa (C).

sis, the diameters of transected submucosal vessels in the 24 cases with delayed hemorrhage were not larger than those in nonhemorrhage polyps.

Observations at follow-up colonoscopy in the clipping group

Follow-up colonoscopy was performed in the 12 cases and revealed two patterns of hemorrhage (Table 4). In one pattern, observed in cases 1 (Fig. 1) and 7 (Fig. 2), delayed hemorrhage occurred from well-closed postprocedural mucosal defects, which were formed by EMRs or snare polypectomies of sessile and semipedunculated polyps, without prophylactic clips becoming dislodged. Similar findings were obtained in cases 2 and 5. In a second pattern, observed in cases 4, 9, and 10 (Fig. 3, 4, and 5, respectively), delayed hemorrhage occurred, apparently from mucosal injuries produced by clips becoming dislodged. Similar findings were obtained in cases 3, 6, and 11. In these cases of delayed hemorrhage with clip dislodgement, marked edematous swelling was observed at the postprocedural ulcers or remaining stalks. In two other cases (cases 8 and 12), follow-up colonoscopy (including photography) did not clearly show whether the prophylactic clips had become dislodged. Therefore, the type of hemorrhage in these two cases could not be determined.

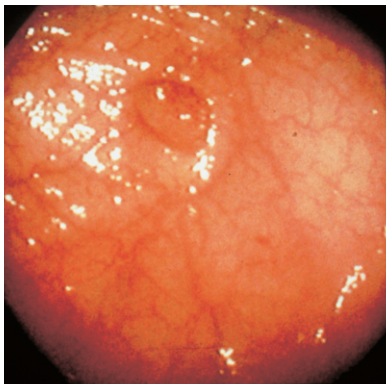

Fig. 3A

Fig. 3B

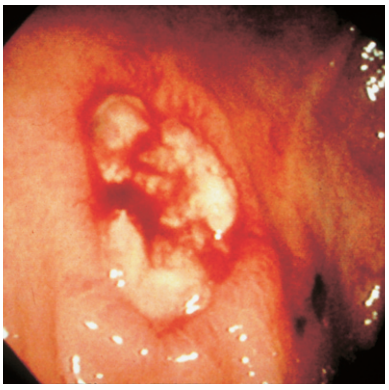

Fig. 3C

Fig. 3. Endoscopic photographs of a semipedunculated polyp of case 4 in the clipping group. Photographs are before snare polypectomy (A), after polypectomy with prophylactic clipping (B), and at follow-up colonoscopy 6 days after polypectomy, showing an adherent clot at a mucosal injury produced by the dislodgement of the prophylactic clip in the edematous ulcer (C).

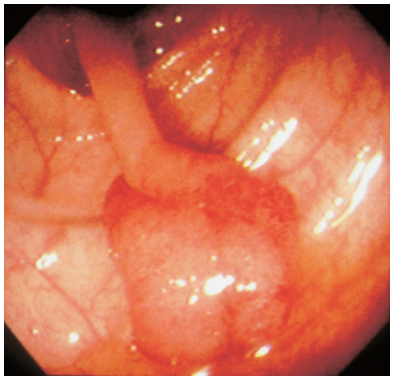

Fig. 4A

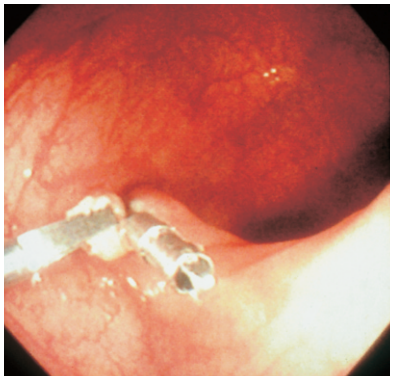

Fig. 4B

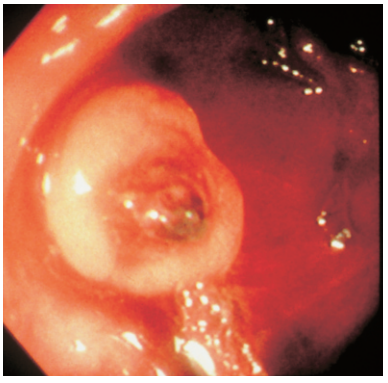

Fig. 4C

Fig. 4. Endoscopic photographs of a pedunculated polyp of case 9 in the clipping group. Photographs are before snare polypectomy (A), after polypectomy with prophylactic clipping to ligate the stalk transversely and to close the resected end (B), and at follow-up colonoscopy 2 days after polypectomy, showing a visible vessel in a mucosal injury, which was produced by dislodgement of a prophylactic clip, at the resected end of the remaining stalk with severe edematous swelling. (C).

In cases without clip dislodgement (cases 1, 2, 5, and 7 in Table 4) the mean decrease in the serum hemoglobin level was 1.2 ± 0.6 g/dl. In contrast, in cases with clip dislodgement (cases 3, 4, 6, 9, 10, and 11) the mean decrease was 3.1 ± 1.6 g/dl; four of these cases (cases 3, 6, 9, and 10) were associated with considerable hemorrhage and a decrease in the serum hemoglobin level of more than 3.0 g/dl.

Discussion

In the present study, prophylactic hemoclip placement did not reduce the incidence or alter the nature of delayed hemorrhage in the endoscopic resection of colonic polyps. The incidences of delayed hemorrhage in patients in whom prophylactic clips were not used (nonclipping group; 1.2% as a percentage of polyps resected and 2.5% as a percentage of patients) did not differ significantly from those in patients in whom clips were used (clipping group; 1.4% and 2.7%, respectively). In addition, the incidence of delayed hemorrhage did not differ significantly between the groups on the basis of resection method, the number of polyps resected during the same proce-

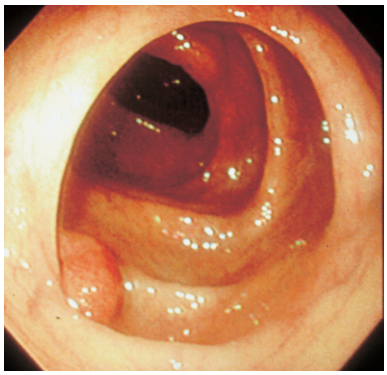

Fig. 5A

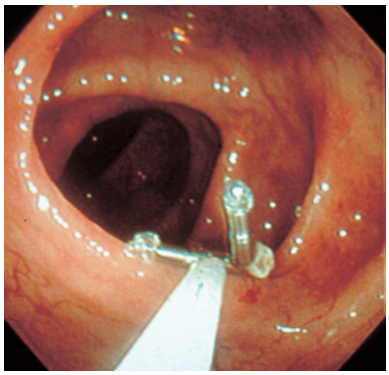

Fig. 5B

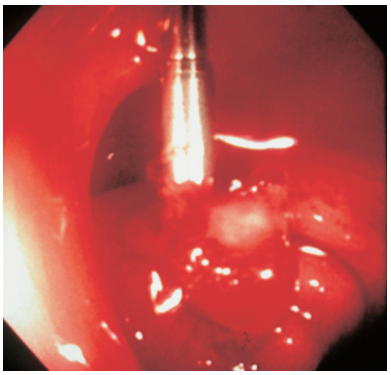

Fig. 5C

Fig. 5. Endoscopic photographs of a pedunculated polyp of case 10 in the clipping group. Photographs are before snare polypectomy (A), after polypectomy with prophylactic clipping to ligate the stalk transversely with two clips (B), and at follow-up colonoscopy 2 days after polypectomy, showing blood oozing from a mucosal injury, which was produced by dislodgement of a prophylactic clip, at the remaining stalk with severe congestion and edema (C).

dure, or the location, morphologic type, or size of resected polyps. Finally, in cases of delayed hemorrhage, the groups did not differ significantly in the timing of hemorrhage, in whether the hemorrhage was active or inactive on follow-up colonoscopy, and in decreases in serum hemoglobin level.

To our knowledge, no previous studies have examined in detail, as has our study, the effect of the prophylactic clipping for preventing delayed hemorrhage after endoscopic resection of colonic polyps. Only one recent report has briefly mentioned the possibility that prophylactic clipping after colonoscopic polypectomy does not eliminate delayed hemorrhage, based on 7 cases (1.2%) of delayed hemorrhage in a series of 565 polypectomies with prophylactic hemoclip placement[6]. Our present results clearly indicate that prophylactic clipping with hemoclips does not prevent delayed hemorrhage in the endoscopic resection of colonic polyps.

The risk of major complications, such as hemorrhage and perforation, is generally considered high when larger sessile polyps are treated with polypectomy or EMR, which produce large mucosal defects[15–17]. However, to our knowledge no previous study has compared the risk of delayed hemorrhage between different morphologic types of colonic polyps in polypectomies or EMRs. In the present study, the incidence of hemorrhage in the nonclipping group did not differ significantly among polyps of different morphologic type. However, the incidence of delayed hemorrhage for sessile polyps was slightly lower and the incidences for semipedunculated and pedunculated polyps were slightly higher in the clipping group than in the nonclipping group; as a result, in the clipping group the incidence of delayed hemorrhage for sessile polyps was significantly lower than that for semipedunculated or pedunculated polyps. Although the incidence of delayed hemorrhage did not differ between the clipping group and the nonclipping group for polyps of each morphologic type, these results indicate that prophylactic clipping might alter the risk of postprocedural delayed hemorrhage in each morphologic type of colonic polyp.

To our knowledge, our study is the first to closely observe delayed hemorrhage with follow-up colonoscopy. We observed two types of delayed hemorrhage with follow-up colonoscopy in the 12 cases of the clipping group. In four cases, delayed hemorrhage occurred from well-closed postprocedural mucosal defects, which were formed by EMRs or snare polypectomies of sessile and semipedunculated polyps, without prophylactic hemoclips becoming dislodged. In contrast, delayed hemorrhage occurred from mucosal injuries caused by clip dislodgement in 6 cases. Although the number of the cases was too small for statistical analysis, the difference in the mean decrease in serum hemoglobin levels between cases of delayed hemorrhage with or without clip

dislodgement (1.2±0.6 g/dl vs. 3.1±1.6 g/dl) suggest that mucosal injuries cause a considerable amount of delayed hemorrhage. In addition, in cases of delayed hemorrhage, the diameters of transected submucosal vessels in resected polyps were not extremely larger to increase the risk of hemorrhage than those in nonhemorrhage polyps. Therefore, we suspect that the mucosal injuries induce hemorrhage and impair the ability of prophylactic clipping to prevent delayed hemorrhage in the endoscopic resection of colonic polyps. The dislodgement of prophylactic clips was associated with the edematous swelling of postprocedural ulcers or remaining stalks. Because hemoclips were developed to stop bleeding from vessels[10,11], they might not be large or strong enough to ligate postprocedural mucosal defects or remaining stalks, which, owing to subsequent edematous swelling, are much thicker than bleeding vessels. Moreover, delayed hemorrhage that occurred from well-closed postprocedural mucosal defects despite prophylactic hemoclips remaining in place implies that prophylactic clipping cannot eliminate the possibility of delayed hemorrhage.

In summary, we have shown that prophylactic clipping with hemoclips does not reduce the incidence of delayed hemorrhage in the endoscopic resection of colonic polyps. In addition, when delayed hemorrhage occurs, prophylactic clipping does not alter the timing of hemorrhage or the mean decrease in serum hemoglobin level. Follow-up colonoscopy demonstrated that delayed hemorrhage occurs from well-closed postprocedural mucosal defects, which are not associated with dislodged prophylactic hemoclips, and that significant hemorrhage can occur from mucosal injuries caused by dislodged prophylactic clips. These results suggest that prophylactic clipping cannot eliminate the possibility of delayed hemorrhage and that prophylactic hemoclips may become dislodged and produce an effect opposite to that intended. A possible limitation of our study is that it included few polyps larger than 2.0 cm in diameter. Thus, further study is required to evaluate the usefulness of prophylactic clipping for the prevention of postprocedural delayed hemorrhage in large colonic polyps.

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