

Clip-assisted endoloop ligation of the mucosal defect after resection of colorectal polyps decreased postprocedural delayed bleeding

Jian-hua Xu, Peng Gao, Min Zhou, Shuang Gao, Zhi-qi Dong, Yu-cui Shen and Qi-sheng Zhang 

Ther Adv Gastroenterol

2022, Vol. 15: 1–9

DOI: 10.1177/
17562848221131132

© The Author(s), 2022.
Article reuse guidelines:
[sagepub.com/journals-
permissions](https://sagepub.com/journals-permissions)

Abstract

Background: Postprocedural delayed bleeding (PDB) remains the most common major complication of colorectal polypectomy. Incomplete clip closure of mucosal defect and unclosed injured blood vessels in gaps between clips may be the risk factors for PDB.

Objectives: To observe whether completely no-gap closure of mucosal defect after polypectomy can reduce PDB occurrence.

Design: Single-center, retrospective case-control study.

Methods: In this study based on historical comparisons of patients in 2 time periods, only the patients with polyps sized between 6 and 15 mm were included. A new clip-assisted endoloop ligation (CAEL, treatment group) method was used between January 2019 and December 2020, and a traditional simple clip closure (SCC, control) was used Between January 2017 and December 2018 to prevent PDB after polypectomy. The rate of PDB of two groups and risk factors for PDB were evaluated.

Results: Totally 4560 patients were included in the study; 2418 patients belong to CAEL group, and 2142 patients belong to SCC group. The overall rate of PDB was significantly lower in CAEL group compared to SCC group (0.6% versus 1.5%, $p < 0.00$). On multivariate logistic analysis, CAEL was a significant independent preventive factor for PDB (odds ratio (OR), 0.092; 95% confidence interval (CI), 0.029–0.3335; $p = 0.000$). Polyps located at rectum (colon versus rectum) represented a significant independent risk factor for PDB (OR, 11.888; 95% CI, 3.343–42.269; $p = 0.001$).

Conclusion: Completely no-gap closure of mucosal defect after polypectomy further reduced the rate of PDB for polyps sized between 6 and 15 mm. CAEL may be a significant independent preventive factor for PDB. Polyps located at the rectum may be a significant independent risk factor for PDB.

Keywords: colorectal polyps, delayed bleeding, endoloop ligation, polypectomy

Received: 28 May 2022; revised manuscript accepted: 20 September 2022.

Introduction

The polypectomy of colorectal polyps reduces the incidence and mortality of colorectal cancer (CRC).¹ Postprocedural delayed bleeding (PDB) is the most common major complication of endoscopic mucosal resection (EMR) and may require

hospitalization, blood transfusion, and repeat colonoscopy.^{2,3} Although some trials^{4–7} demonstrated that prophylactic clip closure of the mucosal defect after EMR for colorectal polyps reduced risk of PDB, other studies^{8–10} showed no benefit from this technique to prevent PDB. The

Correspondence to:
Qi-sheng Zhang
Department of
Gastroenterology,
Shanghai Fourth People's
Hospital Affiliated to Tongji
University, 1279 Sanmen
Road, Shanghai 200434,
China
zhangqish@hotmail.com

Jian-hua Xu
Peng Gao
Min Zhou
Shuang Gao
Zhi-qi Dong
Yu-cui Shen
Department of
Gastroenterology,
Shanghai Fourth People's
Hospital Affiliated to Tongji
University, Shanghai,
China

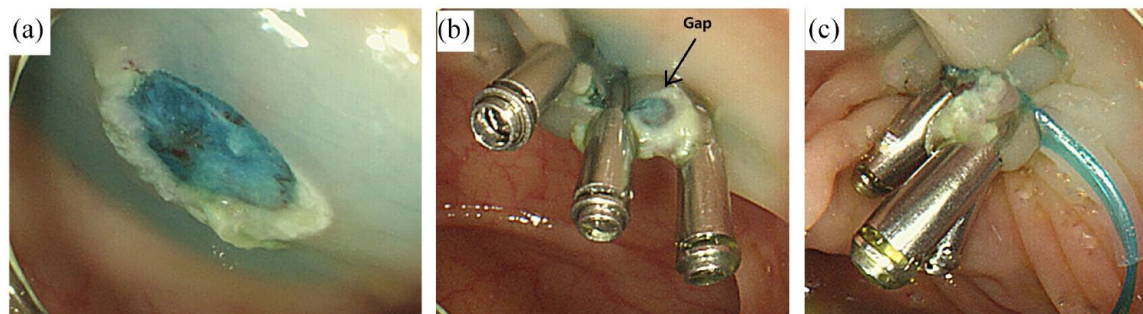


Figure 1. (a) The mucosal defect left after resection of colorectal polyps. (b) Three anchored clips with gap (↓) between clips were placed along the mucosal defect from one end to the other. (c) Mucosal defect was completely ligated and closed with endoloop around the base of the anchored clips.

question is why prophylactic clip placement has succeeded in some patients but failed in others in the prevention of PDB.

There are no guidelines regarding the use of prophylactic clips after EMR to prevent PDB.¹¹ When and how to place clips is decided by individual endoscopists, whose practices may vary widely. So, gaps of different sizes were left between clips that were placed on the mucosal defect. Presumably, those unclosed injured blood vessels in gaps may cause PDB when the patient's blood pressure rises after polypectomy. Until now, how to achieve no-gap closure of mucosal defect and whether no-gap closure of mucosal defect can prevent PDB have not been reported.

Most of the polyps removed by colonoscopy are between 6 and 15 mm in size, and the mucosal defect left after polypectomy can be completely closed easily.^{8,12,13} For larger polyps, some mucosal defects are difficult to be closed completely, which was considered as a possible cause of PDB.⁵ So, since 2019, three senior endoscopists in our hospital have adopted a new method to completely no-gap close the mucosal defect left after polypectomy of polyps sized between 6 and 15 mm. That is, clips were placed on the defects as anchor points, and then the defect was ligated along the base of the anchor points with endoloop^{14,15} to achieve no-gap closure (tentatively named clip-assisted endoloop ligation, CAEL). This retrospective report describes impact of prophylactic CAEL method on PDB in 2418 patients with polyps sized between 6 and 15 mm, and compared with 2142 similar patients who were treated with simple clip closure (SCC) to prevent PDB also.

Patients and methods

Study design

This is a case-control study based on historical comparisons of patients in two time periods; the data of patients were prospectively collected; only the patients with polyps sized between 6 and 15 mm were consecutively included in this study. Informed consent to treatment was obtained for all patients in the study. Our hospital is a referral endoscopic diagnosis and treatment center. We have developed and maintained a detailed database of patients with these lesions and reported several studies related to our experience of resecting these lesions.^{6,16,17} From January 2019, three senior doctors in our hospital began to use CAEL method (Figure 1) to achieve no-gap closure of defect after EMR for polyps sized between 6 and 15 mm (CAEL group). By December 2020, 2418 cases of patients have been treated with this method. During the initial period of the study (since 2014), our hospital has been routinely using SCC method of closing the defect after EMR for patients with similar polyps to prevent PDB. In this study, from January 2017 to December 2018, 2142 consecutive patients treated with SCC were selected as control group.

In this study, patients were excluded if they had blood disease, coagulation dysfunction, or were taking an antiplatelet/anticoagulant. All patients with small polyps (sized between 6 and 9 mm) were managed by outpatient setting. Patients with large polyps (sized between 10 and 15 mm) were also managed in an outpatient setting, except those patients with intraoperative bleeding were admitted to the hospital for observation. All patients were followed up by telephone at least

30 days after colonoscopy to ensure complete capture of complications. All procedures were performed randomly by one of three experienced endoscopists who have more than 10 years of experience in endoscopy and have performed more than 2000 endoscopic examinations and more than 300 polypectomy per year. The study was approved by the Institutional Review Board at Shanghai Fourth People's Hospital and was registered with ClinicalTrials.gov (ChiCTR2200058054). The reporting of this study conforms to the STROBE statement.¹⁸

Instruments and preparations

The procedure was performed by using conventional single accessory channel colonoscopes (CF-Q260AI, CF-H260AI; Olympus Medical Systems, Tokyo, Japan), snares (SnareMaster 10 mm, 20 mm; Olympus Medical Systems), endoloops (Loop-25, Loop-20; LeCamp, Changzhou, China), and clips (Micro-Tech NanJing Co, Ltd, NanJing, China). ERBE ICC 200 electrosurgical generators (ERBE Elektromedizin, Tübingen, Germany) were used in the Endocut mode for all EMR techniques. Bowel preparations were completed with a split-dose regimen of 3 L (1 L the day before and 2 L on the day of colonoscopy) polyethylene glycol solution before colonoscopy. Sedation was administered by an anesthetist with a combination of midazolam, fentanyl, and propofol.

Endoscopic resection and closure of mucosal defect

Conventional EMR procedure was performed for all subjects in this study. Hemostatic forceps was used for the intraprocedural bleeding to achieve endoscopic hemostasis. To close mucosal defect left by EMR, in CAEL group, firstly, clips were placed from the junction between the distal and proximal ends of mucosal defect and normal mucosa. The spacing of clips placed on the defect was 4 mm. With these placed clips as anchor points, the endoloop was opened out, close to the mucosal surface, made to surround the base of the clips, then tightened to ligate and close the mucosal defect (Figure 1). In SCC group, the mucosal defect was closed with simple hemostatic clips, and the spacing between hemostatic clips was 2 mm. The procedure time of this study is defined as time spent from the beginning of polyp

removal to the complete closure of the post-polypectomy defect.

Primary outcome

The primary outcome was PDB, defined as bleeding within 6 h to 30 days after EMR. Overall, PDB was classified as clinically significant or minor bleeding. Clinically significant PDB was defined as massive hematochezia that required endoscopic hemostasis, hospitalization, or a decrease in the hemoglobin level >2 g/dL. Minor PDB was defined as a decrease in hemoglobin level <2 g/dL and self-limiting hematochezia not requiring endoscopic hemostasis. All patients were informed to return to our hospital immediately if they experienced hematochezia or visit an emergency department and contact our hospital.

Statistical analysis

Categorical variables were tested by using chi-square tests of independence and the Fisher exact test, as appropriate. Unpaired two-sample *t* tests were used for continuous variables. $p < 0.05$ was considered statistically significant. All analyses were performed using SPSS for Windows (version 18, SPSS Inc, Chicago, IL, USA). To examine the associations of the patient, polyp characteristics or resection mode with delayed bleeding, odds ratios (ORs), and 95% confidence intervals (CIs) were estimated using univariate and multivariate logistic regression models.

Results

Patients and characteristics of polyps

Totally 4560 consecutive patients aged 27–85 years and underwent a EMR procedure for polyps sized between 6 and 15 mm were included in this study between January 2017 and December 2020; of them, 2418 patients belonged to CAEL group, and 2142 patients belonged to control group. Among all patients, cases with polyps sized between 6 and 9 mm accounted for 57.8% (2635/4560), with polyps sized between 10 and 15 mm accounted for 42.2% (1925/4560), polyps located at colon accounted for 86.5%, at rectum accounted for 13.5%. Bowel preparation of adequate quality was achieved in 95% of the patients based on the Boston Bowel Preparation Scale. Baseline characteristics of patient's demographics

Table 1. Baseline characteristics of patient's demographics and polyp-related factors.

Parameter	CAEL N=2418	Control N=2142	p Value
Age (years)	65.2 ± 10.4	64.8 ± 9.8	0.328
Sex, male, n (%)	1403 (58.0)	1204 (56.2)	0.217
Polyp characteristics, n (%)			
Size			0.197
6–9 mm	1410 (58.3)	1225 (57.2)	
10–15 mm	1008 (41.7)	917 (42.8)	
Location, n (%)			0.108
Colon	2095 (86.6)	1849 (86.3)	
Rectum	323 (13.4)	293 (13.7)	
Histopathology, n (%)			0.242
Adenoma	2016 (83.4)	1788 (83.5)	
Serrated polyps	365 (15.1)	319 (14.9)	
Cancer or HGD	37 (1.5)	35 (1.6)	
Resection, n (%)			0.199
En bloc	2307 (95.4)	2026 (94.6)	
Piecemeal	111 (4.6)	116 (5.4)	

CAEL, clip-assisted endoloop ligation; HGD, high-grade dysplasia.

and polyp-related factors were comparable between two groups (Table 1).

Resection and closure – Methodology and cost comparisons

Among all 2418 patients in CAEL group, en bloc resection was achieved for 2307 (95.4%) cases; as for 2142 patients in SCC group, en bloc resection was achieved for 2026 (94.6%) cases. In CAEL group, after using two to five clips as anchored points, all mucosal defects after EMR were completely ligated and closed with one detachable endoloop. In SCC group, the defects of all patients were completely closed with hemostatic clips. In the SCC group, the average number of clips needed to close a mucosal defect was 5.2 ± 0.8 pieces, and the average total cost was US\$199.16 ± 30.64. In the CAEL group, except

for one endoloop, the average number of clips needed to close a mucosal defect was 3.4 ± 0.6 pieces, and the average cost was US\$193.42 ± 22.98\$. There was no significant difference in the mean procedure time and total medical expenses for patients between the two groups.

Outcomes of PDB

A total of 46 patients developed PDB in this study, including 15 in CAEL group and 31 in SCC group. The overall rate of PDB was significantly lower in CAEL group compared to SCC group (0.6% versus 1.5%, $p < 0.00$) (Table 2). Of all 46 patients with PDB, 8 were considered to be clinically significant bleeding and 38 were considered to be minor bleeding. Although the rate of clinically significant bleeding in CAEL group was lower than that in SCC group (0.1% versus 0.3%, $p = 0.112$), it did not reach statistical significance. However, the rate of minor bleeding in CAEL group was significantly lower than that in the SCC group (0.5% versus 1.2%, $p = 0.020$).

Compared with SCC group, prophylactic CAEL significantly reduced the incidence of PDB for colon polyps (0.47% versus 1.3%, $p = 0.005$), but did not reduce the incidence of PDB for rectal polyps (1.5% versus 2.3%, $p = 0.451$). Additionally, Six PDB cases occurred in the first 48 h; 36 cases occurred between 3 and 7 days post-EMR and 4 cases were in the second week after the resection. For control of delayed bleeding, no patient required a surgical or an angiographic intervention. Further endoscopy was necessary in 17 out of 46 patients (37%). Six patients required transfusions. No serious complications such as perforation or death occurred.

Factors related to PDB

All patients in CAEL and SCC groups were divided into PDB and non-PDB sub-groups. Uni- and multivariate logistic regression analyses were performed to identify factors related to PDB (Table 3). Univariate analysis showed that CAEL was a significant preventive factor for PDB. Furthermore, polyps located at rectum was a significant risk factor for PDB. No significant differences in polyp size, resection mode, and histopathology were seen between PDB and non-PDB groups. On multivariate logistic regression analysis, CAEL was a significant independent preventive factor for PDB (OR, 0.092; 95% CI,

0.029–0.3335; $p=0.000$). The location (colon *versus* rectum) of the tumor (OR, 11.888; 95% CI, 3.343–42.269; $p=0.001$) represented a significant independent risk factor for PDB. The location (colon *versus* rectum) of polyps (OR, 11.888; 95% CI, 3.343–42.269; $p=0.001$) represented a significant independent risk factor for PDB.

Discussion

In this case control study, we demonstrated that completely no-gap closure of mucosal defect after EMR for polyps sized between 6 and 15 mm with CAEL method, significantly reduced the overall rate of PDB compared to prophylactic SCC. Polyps located at the rectum may be a significant

Table 2. Outcomes of PDB.

	CAEL	Control	<i>p</i> Value
Parameter			
Overall PDB, <i>n</i> (%)	15 (0.6)	31 (1.5)	0.005
Clinically significant	2 (0.1)	6 (0.3)	0.112
Minor	13 (0.5)	25 (1.2)	0.020
Location of PDB, <i>n</i> (%)			
Colon	10 (0.47)	24 (1.3)	0.005
Rectum	5 (1.5)	7 (2.3)	0.451
PDB, postprocedural delayed bleeding; CAEL, clip-assisted endoloop ligation.			

Table 3. Factors related to postprocedural delayed bleeding.

	Univariate OR (95% CI)	<i>p</i> Value	Multivariate OR (95% CI)	<i>p</i> Value
Intervention				
Control	1.0		1.0	
CAEL	0.425 (0.229–0.790)	0.000	0.092 (0.029–0.333)	0.000
Size				
6–9 mm	1.0		1.0	
10–15 mm	1.194 (0.626–2.276)	0.591	0.588 (0.261–1.326)	0.201
Location				
Colon	1.0		1.0	
Rectum	2.285 (1.177–4.473)	0.015	11.888 (3.343–42.269)	0.001
Resection				
En bloc	1.0		1.0	
Piecemeal	1.336 (0.411–4.340)	0.630	0.861 (0.115–6.449)	0.884
Histopathology				
Adenoma	1.0		1.0	
Serrate polyps	1.300 (0.631–2.680)	0.476	1.319 (0.355–4.897)	0.679
HGD or cancer	1.321 (0.574–2.985)	0.512	1.352 (0.279–5.324)	0.643
CAEL, clip-assisted endoloop ligation; OR, odds ratio; CI, confidence interval; HGD, high-grade dysplasia.				

independent risk factor for PDB. Prophylactic CAEL method did not reduce the rate of PDB for rectal polyps.

Although some data^{7,19,20} presented in the literature showed no definitive advantages of clipping after EMR for preventing PDB, especially for removal of 6–9 mm polyps. Lots of studies^{5,21–25} showed that clip closure after EMR of large colorectal lesions is cost effective, especially in patients with a high risk of bleeding. Besides, complete closure of mucosal defect showed superior efficacy in preventing PDB compared with partial closure. Our study showed that compared with the traditional SCC method, for patients with polyp size between 6 and 15 mm, the CAEL method of completely closing the defect without gaps further reduced the incidence of PDB to a very low level (1.5% versus 0.6%), which may make it possible to manage such polyp patients with outpatient surgical mode. Because of concerns about the adverse effects of PDB after polypectomy, patients with polyp size of 6–15 mm in China often need to be hospitalized to complete surgical treatment, which increases the medical burden and brings inconvenience to patients.

Clip closure of the mucosal defect after EMR for colorectal polyps has long been considered to reduce the risk of PDB; however, there may be injured blood vessels not closed left in the gaps between clips, which may be a major risk factor involved in PDB. Several studies have demonstrated that some conditions related to injured blood vessels during polypectomy were important risk factors for PDB, such as intraprocedural bleeding,^{2,26} or more visible vessels within the post-EMR defect,²⁷ and a ‘cherry red spot’ in the resection defect.²⁸ Moreover, Lee *et al.*²⁹ reported that prophylactic endoscopic coagulation of visible vessels in the post-EMR defect reduced delayed overall post-EMR bleeding. So, in our study, treated with CAEL method, the injured blood vessels in the gaps between clips were ligated completely, which may be an important reason for the reduction of PDB. When closing the mucosal defect after polypectomy, the spacing of clip placement was 4 and 2 mm in CEAL group and SCC group, respectively. For complete closure of a mucosal defect, the CEAL group used 1.8 clips less and one nylon rope more than the SCC group on average. There was no significant difference in the total medical expenses between the two groups.

In our study, although the mucosal defect after EMR was completely no-gap closed with CAEL method, PDB still occurred. Presumably, the reason may be that although the mucosal surface of defect was completely no-gap closed, the damaged blood vessels in the deep submucosa and muscle layer were not completely closed. It was hypothesized that these vessels might account for clinically significant PDB. Moreover, even if these injured blood vessels were closed with clips and endoloop during polypectomy, delayed bleeding will still occur after the detachment or displacement of the clips and endoloop. Due to the influence of fecal and defecation pressure on the rectum, the clips and endoloop are more likely to shift or fall off, which may be the reason why the rectum is more prone to PDB. In our study, 6 cases of PDB occurred within 48 h after polypectomy and 36 cases occurred 3–7 days after polypectomy. The time of PDB occurrence also indirectly supported this conjecture.

Unexpectedly, in this study we identified that the rate of PDB for rectum polyps was significantly higher than that for colon polyps. Although with CAEL method, the incidence of PDB for colon polyps significantly reduced, it has no significant preventive effect for rectal polyps. Multivariate analysis revealed that the location of polyps in the rectum was a significant independent risk factor for PDB, which was similar with three previous studies.^{29–31} Presumably, PDB occurred more easily in the rectum than the colon because of the following reason: First, the mechanical force during straining to defecate is more likely to cause detachment or displacement of the clips and endoloop. Second, blood vessels are more abundant in the rectum owing to the venous plexus. Third, solid stool is stored for greater periods in the rectum than in the colon; therefore, the surgical area in the rectum is subjected to more mechanical force.

A single-center setting, retrospective study design, and comparison with historical control were major limitations of this study. Nonetheless, the data of patients were prospectively collected from our completely maintained database and all procedures were performed by one of three experienced endoscopists randomly, so the selection bias might not be substantial. In addition, there are still several other limitations: (1) the size of polyps in our study is between 6 and 15 mm.

Using CAEL method, the mucosal defect of these polyps after EMR can be completely closed; however, for polyps larger than 15 mm, complete closure for some postprocedural mucosal defects are difficult or cannot be done. It is uncertain whether CAEL method is effective in preventing PDB for these patients. (2) Compared with the control group, CAEL method reduced the incidence of clinically significant PDB (0.1% *versus* 0.3%), but the difference was not statistically significant. This may be related to the low incidence of clinically significant PDB in the real clinical practice. To answer this question, a larger study sample size is needed. (3) In this study, complete closure of mucosal defects by prophylactic CAEL did not further reduce the incidence of rectal PDB compared with SCC. New methods need to be found to reduce rectal PDB. (4) In this study, we mainly compared the preventive effects of two different operation methods on PDB. When designing the study scheme, we excluded those patients who were taking antiplatelet/anticoagulant to exclude the influence of this confounding factor on the statistical results, which may affect the generalizability of the study result.

Conclusion

In conclusion, completely no-gap closure of mucosal defect after EMR further reduced the rate of PDB for polyps sized between 6 and 15 mm. Polyps located at the rectum may be a significant independent risk factor for PDB. The CAEL method may be a significant independent preventive factor for PDB.

Declarations

Ethics approval and consent to participate

The study was approved by the local institutional ethics committee of Shanghai Fourth People's Hospital (batch number: 2021-04-024, 2 May 2021). Informed consent was waived by the ethics committee, due to the retrospective nature of this study. The reporting of this study conforms to the STROBE statement.

Consent for publication

This publication was approved by all authors.

Author contribution(s)

Jian-hua Xu: Conceptualization; Investigation; Methodology; Supervision.

Peng Gao: Data curation; Investigation; Project administration; Resources; Validation.

Min Zhou: Formal analysis; Investigation; Software; Supervision; Validation; Visualization.

Shuang Gao: Formal analysis; Investigation; Project administration; Validation; Visualization.

Zhi-qi Dong: Data curation; Formal analysis; Project administration; Software; Validation; Visualization.

Yu-cui Shen: Conceptualization; Data curation; Project administration; Resources; Visualization.

Qi-sheng Zhang: Conceptualization; Funding acquisition; Investigation; Methodology; Project administration; Resources; Supervision; Writing – original draft; Writing – review & editing.

Funding

The authors disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: The authors received financial support for this research from the Hongkou District Health and Family Plan Commission, Shanghai, China, grant no.: ZK15-06.

Competing interests

The authors declare that there is no conflict of interest.

Availability of data and materials

The data underlying this article will be shared on reasonable request to the corresponding author.

ORCID iD

Qi-sheng Zhang  <https://orcid.org/0000-0002-3291-0127>

Supplemental material

Supplemental material for this article is available online.

References

1. Dekker E and Rex DK. Advances in CRC prevention: screening and surveillance. *Gastroenterol* 2018; 154: 1970–1984.
2. Park SK, Seo JY, Lee MG, *et al.* Prospective analysis of delayed colorectal post-polypectomy bleeding. *Surg Endosc* 2018; 32: 3282–3289.

3. Kantsevov SV, Bitner M, Mitrakov AA, *et al.* Endoscopic suturing closure of large mucosal defects after endoscopic submucosal dissection is technically feasible, fast, and eliminates the need for hospitalization (with videos). *Gastrointest Endosc* 2014; 79: 503–507.
4. Pohl H, Grimm IS, Moyer MT, *et al.* Clip closure prevents bleeding after endoscopic resection of large colon polyps in a randomized trial. *Gastroenterol* 2019; 157: 977–984.e3.
5. Albéniz E, Álvarez MA, Espinós JC, *et al.* Clip closure after resection of large colorectal lesions with substantial risk of bleeding. *Gastroenterol* 2019; 157: 1213–1221.e4.
6. Zhang QS, Han B, Xu JH, *et al.* Clip closure of defect after endoscopic resection in patients with larger colorectal tumors decreased the adverse events. *Gastrointest Endosc* 2015; 82: 904–909.
7. Spadaccini M, Albéniz E, Pohl H, *et al.* Prophylactic clipping after colorectal endoscopic resection prevents bleeding of large, proximal polyps: meta-analysis of randomized trials. *Gastroenterol* 2020; 159: 148–158.e11.
8. Feagins LA, Smith AD, Kim D, *et al.* Efficacy of prophylactic hemoclips in prevention of delayed post-polypectomy bleeding in patients with large colonic polyps. *Gastroenterol* 2019; 157: 967–976.e1.
9. Nishizawa T, Suzuki H, Goto O, *et al.* Effect of prophylactic clipping in colorectal endoscopic resection: a meta-analysis of randomized controlled studies. *United European Gastroenterol J* 2017; 5: 859–867.
10. Boumitri C, Mir FA, Ashraf I, *et al.* Prophylactic clipping and post-polypectomy bleeding: a meta-analysis and systematic review. *Ann Gastroenterol* 2016; 29: 502–508.
11. Spinzi G, Milano A, Brosolo P, *et al.* The Italian Society for Digestive Endoscopy (SIED) accreditation and quality improving project based on international standards. *Endosc Int Open* 2020; 8: E338–E345.
12. Rex DK. Best practices for resection of diminutive and small polyps in the colorectum. *Gastrointest Endosc Clin N Am* 2019; 29: 603–612.
13. Iwai T, Imai K, Hotta K, *et al.* Endoscopic prediction of advanced histology in diminutive and small colorectal polyps. *J Gastroenterol Hepatol* 2019; 34: 397–403.
14. Wang J, Zhao L, Wang X, *et al.* A novel endoloop system for closure of colonic mucosal defects through a single-channel colonoscope. *Endoscopy* 2017; 49: 803–807.
15. Zhang Y, Wang X, Xiong G, *et al.* Complete defect closure of gastric submucosal tumors with purse-string sutures. *Surg Endosc* 2014; 28: 1844–1851.
16. Zhang Q, Gao P, Han B, *et al.* Polypectomy for complete endoscopic resection of small colorectal polyps. *Gastrointest Endosc* 2018; 87: 733–740.
17. Zhang Q, Shen Y, Xu J, *et al.* Clear colonoscopy as a surveillance tool in the prediction and reduction of advanced neoplasms: a randomized controlled trial. *Surg Endosc* 2021; 35: 4501–4510.
18. Benchimol EI, Smeeth L, Guttman A, *et al.* The reporting of studies conducted using observational routinely-collected health data (RECORD) statement. *PLoS Med* 2015; 12: e1001885.
19. Forbes N, Hilsden RJ, Lethembe BC, *et al.* Prophylactic endoscopic clipping does not prevent delayed postpolypectomy bleeding in routine clinical practice: a propensity score-matched cohort study. *Am J Gastroenterol* 2020; 115: 774–782.
20. Pedersen IB, Rawa-Golebiewska A, Calderwood AH, *et al.* Complete polyp resection with cold snare versus hot snare polypectomy for polyps of 4–9 mm: a randomized controlled trial. *Endoscopy*. Epub ahead of print 10 January 2022. DOI: 10.1055/a-1734-7952.
21. Albéniz E, Enguita-Germán M, Gimeno-García AZ, *et al.* The answer to “When to Clip” after colorectal endoscopic mucosal resection based on a cost-effectiveness analysis. *Am J Gastroenterol* 2021; 116: 311–318.
22. Gangwani MK, Ahuja P, Aziz A, *et al.* Role of prophylactic hemoclip placement in prevention of delayed post-polypectomy bleeding for large colon polyps: a meta-analysis of randomized controlled trials. *Ann Gastroenterol* 2021; 34: 392–398.
23. Chen B, Du L, Luo L, *et al.* Prophylactic clips to reduce delayed polypectomy bleeding after resection of large colorectal polyps: a systematic review and meta-analysis of randomized trials. *Gastrointest Endosc* 2021; 93: 807–815.
24. Yang TC, Wu YH, Lee PC, *et al.* Prophylactic clipping after endoscopic mucosal resection of large nonpedunculated colorectal lesions: a meta-analysis. *J Gastroenterol Hepatol* 2021; 36: 1778–1787.
25. Shah ED, Pohl H, Rex DK, *et al.* Routine prophylactic clip closure is cost saving after endoscopic resection of large colon polyps in a

- medicare population. *Gastroenterol* 2020; 158: 1164–1166.e3.
26. Burgess NG, Metz AJ, Williams SJ, *et al.* Risk factors for intraprocedural and clinically significant delayed bleeding after wide-field endoscopic mucosal resection of large colonic lesions. *Clin Gastroenterol Hepatol* 2014; 12: 651–661.e613.
27. Desomer L, Tate DJ, Bahin FF, *et al.* A systematic description of the post-EMR defect to identify risk factors for clinically significant post-EMR bleeding in the colon. *Gastrointest Endosc* 2019; 89: 614–624.
28. Elliott TR, Tsiamoulos ZP, Thomas-Gibson S, *et al.* Factors associated with delayed bleeding after resection of large nonpedunculated colorectal polyps. *Endoscopy* 2018; 50: 790–799.
29. Lee HS, Jeon SW, Kwon YH, *et al.* Prophylactic endoscopic coagulation to prevent delayed post-EMR bleeding in the colorectum: a prospective randomized controlled trial (with videos). *Gastrointest Endosc* 2019; 90: 813–822.
30. Chiba H, Ohata K, Tachikawa J, *et al.* Delayed bleeding after colorectal endoscopic submucosal dissection: when is emergency colonoscopy needed? *Dig Dis Sci* 2019; 64: 880–887.
31. Ogasawara N, Yoshimine T, Noda H, *et al.* Clinical risk factors for delayed bleeding after endoscopic submucosal dissection for colorectal tumors in Japanese patients. *Eur J Gastroenterol Hepatol* 2016; 28: 1407–1414.

Visit SAGE journals online
[journals.sagepub.com/
home/tag](https://journals.sagepub.com/home/tag)

 SAGE journals