Original Article

Comparison of cold snare polypectomy and endoscopic mucosal resection for 3–10-mm colorectal polyps in end-stage renal disease patients

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Abstract

Background: Patients with end-stage renal disease (ESRD) have a higher incidence of clinically relevant complications, such as bleeding and perforation after polyp resection, compared to patients without underlying diseases. Cold snare polypectomy (CSP) is increasingly used for the removal of small polyps and diminutive polyps due to its shorter procedure time and low risk of bleeding and perforation. However, there have been few studies on the effectiveness and safety of CSP in patients with ESRD. The aim of this study was to compare the efficacy and safety of CSP and endoscopic mucosal resection (EMR) in ESRD patients.

Methods: This study was a retrospective study. We performed propensity score-matched analysis in patients with ESRD who underwent endoscopic resection for 3–10-mm-sized colorectal polyps at Seoul St. Mary's Hospital, from January 2014 to December 2019.

Results: After 1:1 ratio matching, 406 polyps were included: 203 polyps were resected with CSP and 203 polyps with EMR. There was no difference between the CSP group and EMR group in incomplete resection rate (4.43% vs. 1.97%, $P = 0.16$). There were no differences between the CSP and EMR group for immediate bleeding (5.42% vs. 7.88%, $P = 0.32$) and delayed bleeding (0% vs. 0.49%, $P = 1.00$). No perforation occurred in either group.

Conclusions: There were no differences between the CSP and EMR group in terms of efficacy and safety. CSP can be one of the standard methods for the removal of 3–10-mm-sized colorectal polyps in patients with ESRD.

Keywords: Colorectal polyp, Cold snare polypectomy, Endoscopic mucosal resection, End-stage renal disease

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INTRODUCTION

Colorectal cancer (CRC) is a major cause of cancer-related mortality and morbidity worldwide.[1] Colonoscopy reduces the incidence of CRC as the endoscopic removal of precancerous polyps prevents the progression to CRC.[2,3]

Endoscopic mucosal resection (EMR) is commonly used for the removal of polyps with the use of snare and an electrosurgical unit for complete resection and hemostasis.[4-6] However, the use of an electrosurgical unit can cause adverse events such as post-polypectomy bleeding,

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post-polypectomy perforation, and post-polypectomy coagulation syndrome. Horiuchi *et al.*[7] reported that post-polypectomy bleeding is related to injury to vessels in the submucosal layer caused by an electrocautery effect. In that study, the rate of injured arteries in the submucosal layer was 39% after EMR. The researchers speculated that this was a leading cause of post-polypectomy bleeding. Cold snare polypectomy (CSP) has grown in popularity worldwide because of its technical ease and low incidence of adverse events such as post-polypectomy bleeding, perforation, and post-polypectomy coagulation syndrome.[4,8-10] Furthermore, CSP does not require an electrosurgical system and submucosal injector. As a result, CSP has a shorter procedure time and lower cost than EMR. Thus, several clinical guidelines recommend CSP for the removal of small- and diminutive-sized polyps.[4,8] Major adverse events related to polypectomy are bleeding and perforation. Post-polypectomy bleeding and perforation occur in approximately 0.63%–6.12% and 0.01%–0.63% of cases, respectively.[10-12]

Owing to the aging of the population, a growing prevalence of CKD, and increased comorbidities, the prevalence of end-stage renal disease (ESRD) is increasing worldwide.[13] The removal of colorectal polyps in ESRD patients is also expected to increase. ESRD patients have a high risk of post-polypectomy bleeding and perforation.[14,15] Furthermore, ESRD patients usually have several comorbidities and receive multiple medications. Because of this, safe polypectomy is important in ESRD patients. Recently, several studies were conducted to compare CSP with EMR.[6,16-20] However, no prior studies have compared CSP with EMR in ESRD patients. Therefore, the aim of our study was to compare the efficacy and safety of removal of small colorectal polyps (3–10 mm) by CSP and EMR in ESRD patients.

METHODS

Patients

This study was conducted in ESRD patients who underwent CSP or EMR for colorectal polyps at Seoul St. Mary's Hospital, between January 2014 and December 2019. We retrospectively examined 961 colorectal polyps. We only included colorectal polyps that were 3–10 mm in size. ESRD was defined as patients on hemodialysis, patients on peritoneal dialysis, and CKD stage 5 patients scheduled for kidney transplantation or dialysis within 6 months (CKD 5). We excluded pedunculated polyps (Ip) and those less than 3 mm or larger than 10 mm in size. We performed propensity score matching to control and reduce selection bias in the CSP and EMR groups. This study was approved by the Institutional Review Board of the Seoul St. Mary's Hospital (Approval number: KC20RISI0588).

Procedures

All patients underwent bowel preparation with a 4-L of polyethylene glycol (PEG) solution or a 2-L of PEG plus ascorbic acid solution. All procedures were performed by an expert (>1500 colonoscopies performed), endoscopists, and fellowship trainee endoscopists. A high-definition colonoscope (CF-H260AI, CF-H260AL, CF-HQ290I; Olympus, Tokyo, Japan) was used in all procedures. The endoscopic resection methods were selected according to the size, morphology, location of the colorectal polyp, and the endoscopist's preference. In EMR, normal saline with or without a few drops of indigo carmine solution was used for submucosal injection. A 10- or 15-mm oval snare (Optimos®; Taewoong Medical, Gimpo, Korea; SnareMasterÒ; or Olympus, Tokyo, Japan) with forced coagulation or EndocutI of the electrosurgical unit (VIO300D; ErbeElektromedizin GmbH, Tübingen, Germany) was used for resection. CSP was performed by using a 10- or 15-mm oval snare (Optimos®; Taewoong Medical, Gimpo, Korea; SnareMaster®; or Olympus, Tokyo, Japan) without an electrosurgical unit and submucosal injection. The polyps were categorized based on the Paris classification.[21] Protruded and superficial colorectal polyps were classified as type I and type II, respectively. The location of colorectal polyps was divided into the right-side colon (from cecum to the splenic flexure), left-side colon (from splenic flexure to the sigmoid colon), and the rectum. The size of each colorectal polyp was estimated by comparing the fully deployed snare of known size. Each resected specimen was reviewed by expert pathologists according to the routine procedure followed at our institution. Histological classification was conducted based on the World Health Organization classification. Adenomas, sessile serrated lesions (SSLs), and hyperplastic polyps (HPs) were classified as colorectal polyp histology. Incomplete resection was defined in cases in which histological lateral or basal positive margins were detected.

Complications

Immediate bleeding was defined as continuous bleeding over 30 s requiring any form of endoscopic hemostatic procedure (therapeutic clip or electrocoagulation). Delayed bleeding was defined as hematochezia occurring >12 h after colorectal polypectomy that required an endoscopic hemostatic procedure on a post-polypectomy ulcer. Post-polypectomy ulcers showing bleeding signs (spurting, oozing bleeding, exposed vessels, or adherent clots) at the time of endoscopic evaluation were considered as a culprit site of post-polypectomy bleeding. Perforation was defined as a

target sign in the colonic wall requiring immediate endoscopic intervention. All patients were routinely instructed to visit the outpatient department within 2 weeks to check for any signs or symptoms suggesting delayed adverse complications.

Statistics

The Chi-square test or Fisher's exact test was used for analysis of categorical data. Continuous data were compared using the Mann–Whitney U test. Median values are reported with ranges. Bias was minimized by applying nearest neighbor propensity score matching with a caliper width of 0.02 based on the type of ESRD, presence of hypertension, presence of heart failure, use of anticoagulants, identification of the operator, size of the polyp, and morphology of the polyp. Multivariate analyses were performed using the risk factors that were identified as being significant by univariate analysis. If the standardized mean difference was lower than 0.1, the covariate was considered well-balanced. All statistical analyses were performed using SPSS software (SPSS 21.0 version, Chicago, IL, USA). P <0.05 was considered statistically significant.

RESULTS

Baseline characteristics of the subjects

Initially, 961 colorectal polyps 3–10 mm in size were included in the study. However, 98 colorectal polyps were subsequently excluded because these colorectal polyps were larger than 10 mm in size (n = 73) or pedunculated (n = 25) [Figure 1]. Of the remaining 863 colorectal polyps, 458 (53.07%) were treated with CSP and 405 (46.93%) with EMR. The baseline characteristics of the subjects are presented in Table 1. After 1:1 ratio propensity score matching, 203 colorectal polyps were assigned to the CSP group and 203 to the EMR group. The median age was 58 (22–85) and 57 (33–86) in the CSP and EMR groups (P = 0.70), respectively. Males comprised 71.43% and 67.49% of the CSP and EMR groups (P = 0.39), respectively. There were no significant differences between the groups after propensity score matching.

Outcomes

There was no significant difference in the incomplete resection rate (4.43% vs. 1.97%, P = 0.16) between the CSP and EMR groups. The characteristics of the incomplete resection cases are presented in Supplementary Table 1. The median size of colorectal polyps was not significantly different between CSP and EMR groups (6 mm [3–10 mm] vs. 6 mm [3–10 mm], P = 0.90). There was no significant difference in the location, morphology, and histology of colorectal polyps between the CSP group and the EMR group. Immediate bleeding was not significantly different between CSP and EMR groups (5.42% vs. 7.88%, P = 0.32). The characteristics of the immediate bleeding cases are presented in Supplementary Table 2. One case of delayed bleeding occurred in the EMR group. There was no perforation case in either group [Table 2]. The characteristics of the delayed bleeding case are presented in Supplementary Table 3.

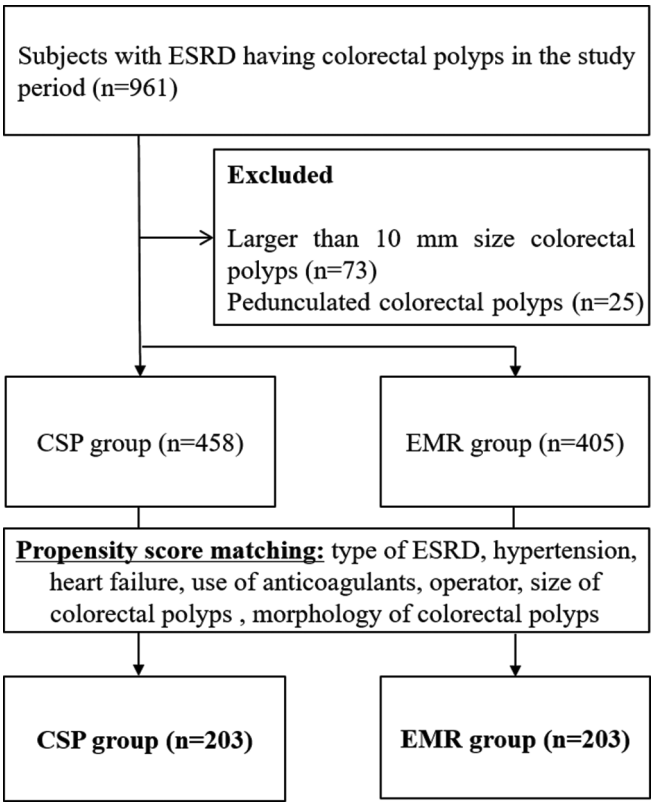

Figure 1: Study flow chart ESRD, end-stage renal disease; CSP, cold snare polypectomy; EMR, endoscopic mucosal resection

Risk factors associated with incomplete resection

The result of univariate analysis conducted to identify the risk factors associated with incomplete resection is presented in Table 3. Only the size of the polyp was significantly associated with incomplete resection (OR: 1.85; 95% CI: 1.30–2.64; P < 0.01). There were no other risk factors associated with incomplete resection.

Risk factors associated with immediate bleeding

The result of univariate and multivariate analysis conducted to identify the risk factors associated with immediate bleeding is presented in Table 4. In the univariate analysis, immediate bleeding was significantly associated with the size of polyp, superficial morphology, and use of antiplatelet medication. However, in the multivariate analysis, size of polyp (OR: 1.47; 95% CI: 1.11–1.95; P < 0.01) and superficial morphology (OR: 3.08; 95% CI: 1.23–7.69; P = 0.02) were significantly associated with immediate bleeding.

Table 1: Baseline characteristics before and after propensity score matching

	Before matching		*P*	SMD	After matching		*P*	SMD
	CSP (*n*=458)	EMR (*n*=405)			CSP (*n*=203)	EMR (*n*=203)		
Age, years (range)	58 (22-85)	56 (29-86)	0.18		58 (22-85)	57 (33-86)	0.70	
Sex, Male	327 (71.40)	286 (70.62)	0.80		145 (71.43)	137 (67.49)	0.39	
Type of ESRD							0.27	0.03
HD	306 (66.81)	242 (59.75)	0.06	0.16	143 (70.44)	135 (66.50)		
PD	80 (17.47)	77 (19.01)			21 (10.34)	32 (15.76)		
CKD 5	72 (15.72)	86 (21.23)			39 (19.21)	36 (17.73)		
Comorbidity								
Hypertension	362 (79.04)	345 (85.19)	0.02	0.16	168 (82.76)	171 (84.24)	0.69	0.04
Diabetes	225 (49.13)	197 (48.64)	0.89	0.16	102 (50.25)	95 (46.80)	0.49	0.04
Cardiovascular disease	40 (8.73)	26 (6.42)	0.20		23 (11.33)	15 (7.39)	0.17	
Heart failure	39 (8.52)	18 (4.44)	0.02		14 (6.90)	12 (5.91)	0.69	
Chronic liver disease	9 (1.97)	7 (1.73)	0.80		2 (0.99)	4 (1.97)	0.69	
Cerebrovascular disease	12 (2.62)	9 (2.22)	0.71		4 (1.97)	3 (1.48)	1.00	
Antiplatelet	149 (32.53)	124 (30.62)	0.55		29 (14.29)	23 (11.33)	0.37	
Anticoagulant	29 (6.33)	9 (2.22)	<0.01	0.20	2 (0.99)	1 (0.49)	1.00	0.06
Operator							0.75	0.03
Trainee	347 (75.76)	227 (56.05)	<0.01	0.42	139 (68.47)	142 (69.95)		
Expert	111 (24.24)	178 (43.95)			64 (31.53)	61 (30.05)		

Values are median or *n* (%). CSP, cold snare polypectomy; EMR, endoscopic mucosal resection; SMD, standardized mean difference; ESRD, end-stage renal disease; HD, hemodialysis; PD, peritoneal dialysis; CKD, chronic kidney disease

DISCUSSION

To the best of our knowledge, this was the first study to compare CSP and EMR in ESRD patients. In this study, we found no significant difference in incomplete resection rate between the CSP and EMR group in ESRD patients (4.43% vs. 1.97%; $P = 0.16$). Several studies in the general population reported that there was no significant difference in incomplete resection rate between the CSP and EMR group, respectively (0.47%–6.41% vs. 1.29%–7.41%).[16-20] This is similar to the incomplete resection rate found in this study. As reported in previous studies, the size of polyp was associated with incomplete resection in this study also.

ESRD patients are at an increased risk of bleeding because of the following conditions: uremic platelet dysfunction, abnormal platelet-endothelium interaction, use of antiplatelet medication, use of anticoagulants, accumulation of medications in the blood leading to poor clearance, heparin use during dialysis, and hemodialysis itself.[22,23]

A recent large national cohort study reported that the rates of post-polypectomy bleeding among patients with ESRD were much higher compared with those without ESRD (bleeding: 5.58% vs. 1.75%; $P < 0.01$).[14] For this reason, safe colon polypectomy was more important in ESRD patients. In the general population, several studies reported that the immediate bleeding rate with CSP and EMR was 1.77%–6.61% and 0%–3.30%, respectively.[17-19,24] In this study, we found more frequent immediate bleeding in ESRD patients than in the general population. We believe that the high risk of bleeding in ESRD patients and the use of antithrombotic agents affected

Table 2: Clinical outcomes of CSP and EMR before and after propensity score matching

	Before matching		*P*	SMD	After matching		*P*	SMD
	CSP (*n*=458)	EMR (*n*=405)			CSP (*n*=203)	EMR (*n*=203)		
Incomplete resection	13 (2.84)	16 (3.95)	0.37		9 (4.43)	4 (1.97)	0.16	
Size, mm (range)	5 (3-10)	6 (3-10)	<0.01	0.99	6 (3-10)	6 (3-10)	0.90	0.02
Location								
Rt. side	259 (56.55)	233 (57.53)	0.25		108 (53.20)	119 (58.62)	0.33	
Lt. side	180 (39.30)	146 (36.05)			87 (42.86)	73 (35.96)		
Rectum	19 (4.15)	26 (6.42)			8 (3.94)	11 (5.42)		
Morphology								
Superficial	101 (22.05)	73 (18.02)	0.14	0.10	28 (13.79)	23 (11.33)	0.45	0.07
Protruded	357 (77.95)	332 (81.98)			175 (86.21)	180 (88.67)		
Histology								
Adenoma	329 (71.83)	305 (75.31)	0.19		147 (72.41)	149 (73.40)	0.51	
Hyperplastic polyp	74 (16.16)	48 (11.85)			33 (16.26)	26 (12.81)		
Sessile serrated lesion	55 (12.01)	52 (12.84)			23 (11.33)	28 (13.79)		
Immediate bleeding	29 (6.33)	38 (9.38)	0.10		11 (5.42)	16 (7.88)	0.32	
Delayed bleeding	3 (0.66)	6 (1.48)	0.32		0	1 (0.49)	1.00	
Perforation	0	0	1.00		0	0	1.00	

Values are median or n (%). CSP, cold snare polypectomy; EMR, endoscopic mucosal resection; SMD, standardized mean difference

Table 3: Risk factors associated with incomplete resection

	Univariate OR (95% CI)	*P*
Age	0.96 (0.91-1.02)	0.18
Method		
EMR	Reference	0.17
CSP	2.31 (0.70-7.62)	
Type of ESRD		
CKD 5	Reference	0.84
HD	1.17 (0.25-5.58)	0.80
PD	0.82 (0.17-3.87)	
Polyp size	1.85 (1.30-2.64)	<0.01
Location		
Rt. side	Reference	0.78
Lt. side	1.19 (0.36-3.96)	0.09
Rectum	4.33 (0.81-23.13)	
Morphology		
Protruded	Reference	0.60
Superficial	0.57 (0.07-4.49)	
Histology		
Adenoma	Reference	0.34
Hyperplastic polyp	1.93 (0.50-7.50)	0.63
Sessile serrated lesion	1.47 (0.30-7.13)	
Operator		
Trainee	Reference	0.54
Expert	0.67 (0.18-2.46)	

OR, odds ratio; CI, confidence interval; EMR, endoscopic mucosal resection; CSP, cold snare polypectomy; ESRD, end-stage renal disease; CKD, chronic kidney disease; HD, Hemodialysis; PD, peritoneal dialysis

these outcomes. Nevertheless, there was no significant difference in immediate bleeding between CSP and EMR groups (5.42% vs. 7.88%; $P = 0.32$). In addition, immediate bleeding could be adequately controlled by endoscopic hemostatic procedures (therapeutic clipping and electrocautery), and there were no cases that required additional therapeutic treatments such as blood transfusions, hospital admission, or embolization. Kim *et al.*[25] reported that old age (≥65 years), cardiovascular disease, chronic kidney disease, use of anticoagulant agents, poor bowel preparation, large polyps (≥1 cm), pedunculated polyps, laterally spreading tumors, polypectomy with cutting mode of the electrosurgical unit current, and the unwanted cutting of the polyp before current application were risk factors for immediate bleeding. In our study, the size of polyp and superficial morphology were associated with immediate bleeding.

In the general population, several studies reported that delayed bleeding rate with EMR and CSP was 0.37%–1.91% and 0%, respectively.[18,24,26] Horiuchi *et al.*[7] also reported that delayed bleeding requiring an endoscopic hemostatic procedure occurred significantly less frequently in the CSP group than in the EMR group, despite continuation of anticoagulants. Delayed bleeding often led to endoscopic hemostatic procedures, hospitalization, blood transfusion, and/or embolization. Therefore, delayed bleeding is clinically significant. In addition, patients with ESRD are more likely to use antithrombotic agents (antiplatelet agents and anticoagulants) than those without underlying diseases, due to comorbidity and dialysis. Several studies have reported that patients who use antithrombotic agents have a higher incidence of bleeding after polypectomy than those who do not use antithrombotic agents.[27,28] However, we had only one case of delayed bleeding in our study [Supplementary Table 3]. Future study is needed to confirm our delayed bleeding in CSP of ESRD patient findings.

Although there was no case of perforation in our study, ESRD patients have a higher risk of post-polypectomy perforation. A recent study reported that a higher rate of post-polypectomy perforation occurred in ESRD patients on hemodialysis compared with non-ESRD patients (0.45% vs. 0.02%; OR: 21.17; 95% CI: 5.05–88.73; $P < 0.01$).[15] Yang *et al.*[14] reported that the rates of post-polypectomy perforation among ESRD patients were significantly higher compared with those among non-ESRD patients (0.28% vs. 0.04%; $P < 0.01$). CSP does not require an electrosurgical unit. As a result, CSP has virtually no risk of perforation. In the general population, several studies reported that the perforation rate with EMR and CSP was less than 1% and 0%, respectively.[29,30]

Table 4: Risk factors associated with immediate bleeding

	Univariate OR (95% CI)	*P*	Multivariate OR (95% CI)	*P*
Age	0.97 (0.93-1.01)	0.08		
Method				
EMR	Reference	0.32		
CSP	0.67 (0.30-1.48)			
Type of ESRD				
CKD 5	Reference	0.57		
HD	1.38 (0.460-4.16)	0.94		
PD	1.07 (0.230-4.97)			
Polyp size	1.48 (1.130-1.95)	<0.01	1.47 (1.11-1.95)	<0.01
Location				
Rt. side	Reference	0.41		
Lt. side	0.69 (0.29-1.66)	0.18		
Rectum	2.47 (0.65-9.38)			
Morphology				
Protruded	Reference	<0.01	Reference	0.02
Superficial	3.29 (1.36-7.97)		3.08 (1.23-7.69)	
Histology				
Adenoma	Reference	0.71		
Hyperplastic polyp	1.21 (0.44-3.36)	0.20		
Sessile serrated lesion	0.26 (0.03-1.20)			
Use of antiplatelet				
No	Reference	0.04	Reference	0.06
Yes	2.60 (1.04-6.49)		2.48 (0.96-6.38)	
Use of anticoagulant				
No	Reference	0.11		
Yes	7.25 (0.64-82.61)			
Operator				
Trainee	Reference	0.57		
Expert	0.77 (0.32-1.88)			

OR, odds ratio; CI, confidence interval; EMR, endoscopic mucosal resection; CSP, cold snare polypectomy; ESRD, end-stage renal disease; CKD, chronic kidney disease; HD, Hemodialysis; PD, peritoneal dialysis

This study has some limitations. First, it is limited by its retrospective design and by allowing the decision to perform CSP or EMR to be at the operator's discretion. However, we minimized selection bias and confounding factors by using a propensity score-matched analysis. Second, follow-up data were not collected; the relationship between incomplete resection and local recurrence has therefore not been evaluated. Further studies are needed to determine whether incomplete resection results in local recurrence more frequently after CSP and EMR. Third, procedure times were not evaluated. However, several studies reported that shorter procedure time is an advantage of CSP. CSP does not require electrosurgical unit preparation, submucosal injection, and electrocautery. As a result, the procedure time can be significantly shortened clinically.[7,20]

Despite these limitations, our study has several strengths. This is the first study to compare CSP with EMR in ESRD patients. We demonstrated that CSP was useful in ESRD patients. In addition, this study has the advantage of being conducted to include experts and trainees. CSP is technically easy and has a low risk of complications and short procedure time. Trainees can conduct CSP safely in ESRD patients.

In conclusion, we demonstrated the efficacy and safety of CSP in ESRD patients. CSP is a viable treatment method for removal of 3–10-mm-sized colorectal polyps in ESRD patients based on the results of this study. In the future, multicenter randomized controlled trials are needed to confirm our results.

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Conflicts of interest

There are no conflicts of interest.

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Supplementary Table 1: Characteristics of incomplete resection cases

Case no.	Method	Age (yrs)	Sex	Type of ESRD	Size (mm)	Location	Morphology	Histology	Operator
1	CSP	59	F	PD	9	Lt. side	Superficial	Adenoma	expert
2	CSP	52	F	CKD 5	7	Rt. side	Protruded	Adenoma	Trainee
3	CSP	62	M	PD	6	Lt. side	Protruded	SSL	Trainee
4	CSP	47	M	HD	8	Rt. side	Protruded	Adenoma	Trainee
5	CSP	43	M	HD	6	Rt. side	Protruded	HP	Trainee
6	CSP	59	M	HD	10	Lt. side	Protruded	Adenoma	Trainee
7	CSP	55	F	HD	6	Rectum	Protruded	Adenoma	Trainee
8	CSP	58	M	HD	7	Rt. side	Protruded	HP	Expert
9	CSP	62	M	CKD 5	8	Lt. side	Protruded	HP	Trainee
10	EMR	52	M	HD	6	Rt. side	Protruded	SSL	Trainee
11	EMR	55	F	HD	7	Rt. side	Protruded	Adenoma	Trainee
12	EMR	56	M	HD	6	Lt. side	Protruded	Adenoma	Expert
13	EMR	37	M	HD	5	Rectum	Protruded	Adenoma	Trainee

ESRD, end-stage renal disease; CSP, cold snare polypectomy; PD, peritoneal dialysis; CKD, chronic kidney disease; SSL, sessile serrated lesion; HD, hemodialysis; HP, hyperplastic polyp; EMR, endoscopic mucosal resection

Supplementary Table 2. Characteristics of immediate bleeding cases

Case no.	Method	Age (yrs)	Sex	Use of Anti platelet	Use of Anti coagulant	Type of ESRD	Size (mm)	Location	Morphology	Operator
1	CSP	59	F	Yes	No	PD	9	Lt. side	Superficial	Expert
2	CSP	50	M	No	No	PD	10	Rt. side	Protruded	Trainee
3	CSP	54	F	Yes	No	HD	6	Rt. side	Superficial	Trainee
4	CSP	59	M	Yes	No	CKD 5	7	Rectum	Superficial	Trainee
5	CSP	52	M	No	No	HD	5	Rt. side	Protruded	Trainee
6	CSP	52	M	No	No	HD	5	Lt. side	Protruded	Trainee
7	CSP	59	M	No	No	HD	10	Lt. side	Protruded	Trainee
8	CSP	60	M	No	No	HD	6	Rt. side	Protruded	Expert
9	CSP	55	F	Yes	No	HD	6	Rectum	Protruded	Trainee
10	CSP	55	F	No	No	HD	6	Rectum	Protruded	Trainee
11	CSP	48	F	No	No	HD	5	Rt. side	Protruded	Trainee
12	EMR	60	F	No	No	HD	4	Rt. side	Superficial	Trainee
13	EMR	59	M	Yes	No	HD	5	Lt. side	Superficial	Trainee
14	EMR	44	F	No	No	PD	10	Rt. side	Superficial	Trainee
15	EMR	58	M	No	No	HD	6	Lt. side	Superficial	Trainee
16	EMR	40	M	Yes	No	HD	7	Rt. side	Superficial	Expert
17	EMR	47	F	No	No	CKD 5	5	Rt. side	Protruded	Trainee
18	EMR	63	M	Yes	No	HD	7	Rt. side	Protruded	Expert
18	EMR	63	M	No	No	HD	6	Rt. side	Protruded	Expert
19	EMR	68	0	No	No	CKD 5	5	Lt. side	Protruded	Trainee
20	EMR	47	0	No	Yes	HD	8	Rt. side	Protruded	Trainee
21	EMR	55	0	No	No	CKD 5	7	Rt. side	Protruded	Trainee
22	EMR	54	0	No	No	HD	5	Rt. side	Protruded	Trainee
23	EMR	47	1	No	No	HD	7	Lt. side	Protruded	Trainee
24	EMR	47	0	No	No	HD	5	Rt. side	Protruded	Expert
25	EMR	57	0	No	No	HD	6	Rt. side	Protruded	Trainee
26	EMR	48	0	No	No	HD	6	Lt. side	Protruded	Expert

ESRD, end-stage renal disease; CSP, cold snare polypectomy; PD, peritoneal dialysis; HD, hemodialysis; CKD, chronic kidney disease; EMR, endoscopic mucosal resection

Supplementary Table 3: Characteristics of delayed bleeding cases

Case no.	Method	Age (yrs)	Sex	Use of Anti platelet	Use of Anti coagulant	Type of ESRD	Size (mm)	Location	Morphology	Operator
1	EMR	71	M	No	No	HD	5	Lt. side	Protruded	Trainee

ESRD, end-stage renal disease; EMR, endoscopic mucosal resection; HD, hemodialysis.