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Authors

Yen, AW
Amato, A
Cadoni, S
et al.

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Underwater polypectomy without submucosal injection for colorectal lesions ≤20mm in size — a multicenter retrospective observational study

Andrew W. Yen, MD[1,2], **Arnaldo Amato, MD**[3], **Sergio Cadoni, MD**[4], **Shai Friedland, MD**[5,6], **Yu-Hsi Hsieh, MD**[7,8], **Joseph W. Leung, MD**[1,2], **Mauro Liggi, MD**[4], **James Sul, MD**[9,10], and **Felix W. Leung, MD**[10,11]

[1]Division of Gastroenterology, Sacramento VAMC, VANCHCS, Mather, CA

[2]University of California Davis School of Medicine, Sacramento, CA, USA

[3]Division of Gastroenterology, Valduce Hospital, Como, Italy

[4]Digestive Endoscopy Unit, S. Barbara Hospital, 09016 Iglesias (CI), Italy

[5]Division of Gastroenterology, Palo Alto VAMC, Palo Alto, CA

[6]Stanford University, Palo Alto, CA, USA

[7]Division of Gastroenterology, Dalin Tzu Chi Hospital, Buddhist Tzu Chi Medical Foundation

[8]Tzu Chi University

[9]Division of Gastroenterology, West Los Angeles VAMC, VAGLAHS, Los Angeles, CA

[10]David Geffen School of Medicine at UCLA, Los Angeles, CA, USA

[11]Division of Gastroenterology, Sepulveda ACC, VAGLAHS, North Hill, CA

Abstract

Background—Underwater polypectomy (UWP) of large (≥20mm) colorectal lesions is well described, but reports of UWP for lesions ≤20mm in size, which account for >95% of polyps encountered in routine clinical practice, are limited. We assessed the feasibility of UWP in routine practice across various sites for colorectal lesions ≤20mm in size.

Methods—A multicenter retrospective study was performed on pooled data from 9 colonoscopists at 3 U.S., 1 Taiwanese and 2 Italian sites. Outcomes related to UWP on lesions ≤20mm in size were analyzed.

Results—In 117 patients, UWP netted 169 lesions. Polypectomy by hot (HSP, 54%) or cold (CSP, 41%) snare, and cold forceps (CFP, 5%) were performed successfully without endoscopic evidence of residual neoplasia or immediate clinically significant adverse events. The majority (74.6%) were tubular adenomas; 60.9% were from the proximal colon. Histopathologic margins

Corresponding author: Sacramento VA Medical Center, Division of Gastroenterology, 10535 Hospital Way, 111/G, Mather, CA 95655, Phone: (916)366-5339, andrew.yen3@va.gov.

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were positive in 4 and unavailable in 26 CSP and 24 HSP specimens. The remainder had negative resection margins on pathologic reports.

Conclusion—UWP for colorectal lesions ≤20mm in routine practice across multiple sites confirms the feasibility and acceptability of this technique. Improvement of resection outcomes by UWP in routine practice deserves further evaluation in a randomized controlled trial.

Keywords

Polypectomy; underwater; water exchange colonoscopy

Introduction

Polypectomy during colonoscopy decreases the incidence of and mortality from colorectal cancer [1]. Safe, effective and complete removal of pre-cancerous lesions contributes to high quality colonoscopy. Removal of polyps during endoscopy has traditionally been performed with the colon fully distended with gas. However, the techniques of water-aided [2] and water-assisted [3] colonoscopy have led to familiarity with use of water instead of air to distend the colon. The increasing use of water as a distending medium during colonoscopy warrants assessment of the feasibility of underwater interventions, including polypectomy.

Underwater polypectomy (UWP) of large (≥20mm) colorectal lesions was first described in a retrospective observational study from a referral-based practice [4]. Similar reports from other referral centers [5–7] and community practice [8] followed, but large polyps account for <5% of colorectal lesions encountered during colonoscopy [9,10] and experience with UWP of lesions ≤20mm in routine practice to date has been limited to a case report [11], small case series [12] and a study with limited number of centers and endoscopists [13], despite the significantly more common occurrence of lesions in this size range. Early observations associated with water exchange (WE) colonoscopy, the simultaneous infusion of clean water and suctioning of turbid effluent and residual stool with gas exclusion, raised interests about further documentation of UWP for lesions of various sizes in routine practice. At a meeting for the endoscopy interest group *International WATERS* (Water-Aided Techniques in Endoscopy and Research Society), members from multiple international sites active in the use of WE endorsed pooling practice data to document feasibility and outcomes of UWP for polyps ≤20mm in size in routine clinical practice.

Materials and Methods

Study design

We performed a multicenter retrospective observational study on data collected from 9 members of *International WATERS* across various practice sites related to UWP of colorectal lesions ≤20mm in size. Eligibility criteria for inclusion were consecutive adult patients (≥18 years old) whose ≤20mm polyps encountered in routine practice were removed underwater from February 2011 to June 2015. The data collecting settings and locations (Table 1) were the usual practice sites of the members of the interest group. In the usual consent for colonoscopy in which water-assisted techniques were used (e.g. water exchange), patients were informed about the possibility of performing interventions (e.g.

biopsy, polypectomy) underwater. De-identified data are reported in accordance with local IRB (Sacramento VAMC, Palo Alto VAMC, West Los Angeles VAMC, Tzu Chi Buddhist Hospital) or Ethical Committee (Valduce Hospital, S. Barbara Hospital) approval and/or standards.

Definitions

UWP was defined as polypectomy performed in a water distended colon with gas exclusion. Feasibility and success of UWP were determined by 1) the ability to completely resect a colorectal lesion without endoscopic evidence of residual neoplasia; 2) the avoidance of salvage techniques to remove or eradicate a polyp such as transition to conventional resection in a gas filled colon or use of ablative therapies for residual neoplasia; 3) absence of clinically significant immediate complications including perforation, immediate post-polypectomy bleeding requiring intervention for hemostasis, unplanned hospital admission or need for additional therapeutic procedures; and 4) the retrieval of the resected specimen for histologic assessment. Per routine practice for resection of diminutive and small polyps, longer term follow up was not systematically performed for each patient.

Procedure

All procedures performed at the 6 sites were completed on an outpatient basis by 9 endoscopists experienced with water-aided colonoscopy. Procedures were performed with or without procedural sedation and colonoscopes used were based on local availability and endoscopist preference. Polyp size was estimated visually by the endoscopist and assessed for suitability of resection, e.g., no suggestion of deep submucosal invasion. At the site of polypectomy, all gas from the segment of bowel was suctioned and replaced by sterile water to distend the lumen for visualization of the field of resection. There was no limit to the amount of water that could be used. Electrosurgical generator settings, snares used and choice of hot or cold resection techniques were based on routine practice patterns by individual endoscopists. Polyps were resected completely underwater until no endoscopic evidence of residual neoplasia remained. Submucosal injection prior to polypectomy was not performed in any case in this series.

De-identified data including patient age, gender, polyp characteristics (location, size, pathology), polypectomy approach (hot snare [HSP] (Figure 1), cold snare [CSP] (Figure 2), cold forceps [CFP]), complications (immediate bleeding, perforation, hospitalization) and, when available, histopathologic margins (clear or involved) were collected.

Statistics

Descriptive statistics were used to present data as frequency counts (n), percentages of total (%) and normally distributed variables are presented as means and standard deviations (SD). For continuous variables, p values for comparison of the group means were obtained using t-test and a value of $p<0.05$ was considered significant.

Results

Table 1 shows data collection settings and locations. Nine members of *International WATERS* from various sites (3 USA, 1 Taiwan, 2 Italy) provided data. UWP was performed on 169 polypoid and non-polypoid lesions in 117 patients (mean age 63.4 years [SD 9.5]; 93 male, 24 female). Ninety-nine (58.6%) polypectomies were performed in patients receiving sedation. Indications for colonoscopy were screening (n=43), surveillance (n=38) and diagnostic (n=36). One-hundred-three (60.9%) polyps were from the proximal colon (cecum=22, ileocecal valve=2, ascending colon=46, hepatic flexure=2, transverse colon=31) and the remaining were from the left colon (descending colon=18, sigmoid=42, rectum=6). HSP (92/169, 54%), CSP (69/169, 41%) and CFP (8/169, 5%) were performed successfully and safely without perforation. All lesions were removed underwater and appeared to be completely removed endoscopically without the need for salvage therapies. After HSP, clipping to control immediate bleeding occurred in 2 (1.2%). One polyp removed by HSP was not retrieved. No other procedural or immediate post-procedural complications were noted. Late complications were not tracked in this retrospective analysis.

Tubular adenomas accounted for 74.6% (126/169) of resected lesions and 4 were tubulovillous adenomas (one with high grade dysplasia). There were 6 sessile serrated polyps (one with high grade dysplasia), 30 hyperplastic polyps and 2 inflammatory polyps (Table 2).

Of the 69 polyps resected by CSP, 56 (81%) were non-polypoid (pathologic size 5.3mm [2.3]) and 13 (19%) were polypoid (pathologic size 5.9mm [3.1]). Of the 92 polyps resected by HSP, 55 (60%) were non-polypoid (pathologic size 11.5mm [6.0]) and 37 (40%) were polypoid (pathologic size 8.8mm [3.1]).

Mean (SD) underwater size (10.3mm [5.4]) was significantly larger than the reported pathological size (8.8mm [5.0]). Mean size of lesions removed by CFP was 4.6mm [0.5]; CSP 6.0mm [1.8]; and HSP 12.9mm [5.9]. Compared with HSP, CSP was applied to significantly smaller lesions (12.9mm [SD 5.9] vs. 6.0 [SD 1.8], p=0.0001).

Of the 69 polyps removed by CSP, margins were histopathologically negative in 43, positive in none, and not reported on pathology in 26. Pathologists across sites variably reported margin involvement and in other cases fragmentation of resected lesions during retrieval and/or processing prevented reliable margin assessment. Thus, margins were clear in at least 62% (43/69) of resections. Of the 91 retrieved polyps removed by HSP, margins were negative in 63, positive in four and not reported in 24. Margins were clear in at least 69% (63/91). Four (4.4%) polyps removed by HSP had positive histopathologic margins (two 10mm polypoid adenomas, one 12mm non-polypoid adenoma, one 20mm non-polypoid tubulovillous adenoma). If only polyps with known margins were considered, 100% of CSP and 94% of HSP had clear margins. The en bloc success rate was not recorded by all endoscopists for lesions in this size range.

Discussion

UWP using hot and cold resection techniques is a novel approach that is feasible and appears effective for removal of the most commonly sized colorectal polyps (≤20mm) encountered in routine clinical practice. No clinically significant procedural adverse events were noted in this series and all but one lesion was successfully retrieved for histopathologic analysis.

The introduction of WE colonoscopy raised questions about the feasibility of UWP. With more widespread use, additional advantages of water-aided colonoscopy emerged. The anecdotal failure to capture an elusive 10mm pedunculated polyp in an air-filled, spastic sigmoid, was overcome by water-filling the colon, and UWP highlighted the merits of this novel approach [11]. The ease of finding magnified polyps underwater during WE insertion [14] and early reports of large polyp removal underwater by hot snare [4–8] attracted further interest. The majority of polyps encountered during colonoscopy, however, are ≤20mm in size [9,10], so interest in outcomes for UWP in routine practice has grown.

Three cases of UWP during insertion WE colonoscopy of smaller sized lesions were initially reported by Ocampo, et al. [12], using HSP and CSP, suggesting the possibility of extending UWP with hot and cold techniques to lesions ≤20mm. The observations also raised interests in documenting the expanded role of UWP regardless of the phase of colonoscopic examination (insertion or withdrawal) and the use of various approaches involving HSP, CSP and CFP on commonly encountered lesions. In the current report, this multicenter series shows that this novel approach can be performed effectively and safely and provides opportunity to further explore potential benefits of the technique in routine practice.

A randomized controlled trial (RCT) from Switzerland reported a polyp miss rate of 7.3% for lesions ≤10mm in size when polypectomy was limited to colonoscope withdrawal. The investigators advised small polyps be removed during insertion and withdrawal [15]. This recommendation generates further interest in UWP associated with WE, where submerged polyps encountered on insertion are more easily identified [14]. The data reported here support the feasibility of UWP during WE insertion, and this practice may have implications for reducing polyp miss rates.

CSP is superior to CFP for reducing the incomplete resection rate of small polyps [16,17], although CFP is often preferred by practicing endoscopists [18]. But reliance on CFP may adversely impact the quality of colonoscopy, e.g., incomplete lesion removal, and limiting its use may be beneficial. Removing polyps in a water-filled lumen may promote use of snares over forceps as polyps tend to “float” upward into the lumen, and capturing lesions in their entirety with a rim of normal mucosa may be easier. The buoyancy of polyps underwater alters their morphology, and flat or sessile lesions reveal their stalks, which may not be easily visible in a gas filled lumen (Figure 3). The data in the current study showed that CSP (41%) was used significantly more frequently by endoscopists compared to CFP (5%), possibly a reflection of the ease of use of this technique in a waterfilled colon, which may help with complete resections.

The importance of complete resection is underscored by results from prior RCTs reporting significant incomplete resection rates of approximately 10% for lesions ≤20mm in a gas-filled colon [19,20]. These studies suggest alternative methods for resection deserve consideration. Although the information in the current study is observational and incomplete, the reported histopathologic margin of resected specimens was deemed clear in at least 62% of polyps removed by CSP and at least 69% of polyps removed by HSP. If analysis is restricted to lesions with known and reported margin information, >94% of specimens had a negative margin pathologically (100% for CSP, 94% for HSP). Given these findings and the need to improve current resection techniques, UWP deserves further evaluation as a new method to improve resection rates in routine clinical practice, particularly in the context of WE colonoscopy. WE colonoscopy has been shown to increase ADR significantly and unequivocally [21–23]. Coupled with a plausible, more complete resection underwater, the combined approach may have a welcomed impact on post-colonoscopy interval cancer by significantly reducing its occurrence, a current glaring drawback of traditional air insufflation colonoscopy and polypectomy performed in a gas filled lumen.

Limitations to this report include its retrospective, observational nature, lack of long term follow up and its small sample size. Given the variation among endoscopists in collecting polyp resection times, this potentially informative variable was not available for analysis. In upcoming prospective studies, a standardized approach will be used to document resection time. The en bloc resection rate would also be an interesting statistic to provide. However, this metric was not clearly recorded by all endoscopists, likely because of the smaller lesion sizes involved in this study, so it cannot be accurately calculated.

We conclude that the effective use across multiple sites in different countries confirms the feasibility and acceptability of UWP for polyps ≤20mm in size in conjunction with WE colonoscopy in non-referral practice. An improvement of resection outcomes by the novel UWP approach in routine clinical practice deserves further evaluation in a randomized controlled trial.

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Acronyms

UWP	underwater polypectomy
WE	water exchange
HSP	hot snare polypectomy
CSP	cold snare polypectomy

CFP	cold forceps polypectomy
SD	standard deviation
RCT	randomized controlled trial

References

1. Zauber AG, Winawer SJ, O'Brien MJ, et al. Colonoscopic polypectomy and long-term prevention of colorectal-cancer deaths. N Engl J Med. 2012;366:687–96. [PubMed: 22356322]
2. Leung FW, Amato A, Ell C, Friedland S, Harker JO, Hsieh YH, Leung JW, Mann SK, Paggi S, Pohl J, Radaelli F, Ramirez FC, Siao-Salera RM, Terruzzi V. Water-aided colonoscopy: a systematic review. Gastrointest Endosc. 2012;76(3):657–666. [PubMed: 22898423]
3. Cadoni S, Leung FW. Water-assisted colonoscopy. Curr Treat Options Gastroenterol. 2017 3;15(1): 135–154. [PubMed: 28205108]
4. Binmoeller KF, Weilert F, Shah J, et al. "Underwater" EMR without submucosal injection for large sessile colorectal polyps (with video). Gastrointest Endosc. 2012 5;75(5):1086–91. [PubMed: 22365184]
5. Curcio G, Granata A, Ligresti D, et al. Underwater colorectal EMR: remodeling endoscopic mucosal resection. Gastrointest Endosc. 2015;81(5):1238–42. [PubMed: 25746979]
6. Uedo N, Nemeth A, Johansson GW, et al. Underwater endoscopic mucosal resection of large colorectal lesions. Endoscopy 2015;47:172–174. [PubMed: 25314326]
7. Schenck RJ, Jahann DA, Patrie JT, et al. Underwater endoscopic mucosal resection is associated with fewer recurrences and earlier curative resections compared to conventional endoscopic mucosal resection for large colorectal polyps. Surg Endosc. DOI 10.1007/s00464-017-5474-4.
8. Amato A, Radaelli F, Spinzi G.Underwater endoscopic mucosal resection: The third way for en bloc resection of colonic lesions? United European Gastroenterol J. 2016; 4(4): 595–598.
9. Iishi H, Tatsuta M, Iseki K, et al. Endoscopic piecemeal resection with submucosal saline injection of large sessile colorectal polyps. Gastrointest Endosc. 2000;51:697–700. [PubMed: 10840302]
10. Regula J, Wronska E, Polkowski M, et al. Argon plasma coagulation after piecemeal polypectomy of sessile colorectal adenomas: long-term follow-up study. Endoscopy. 2003;35:212–218. [PubMed: 12584639]
11. Anderson JM, Goel GA, Cohen H, et al. Water infusion distention during colonoscopy is a safe alternative technique to facilitate polypectomy in a "difficult location". J Interv Gastroenterol. 2013:3(4):137–140.
12. Ocampo LH, Kunkel DC, Yen A, et al. Underwater hot and cold snare polypectomy can be safely executed during water exchange colonoscopy. J Interv Gastroenterol. 2013(3);3:104–106.
13. Siau K, Ishaq S, Cadoni S, et al. Feasibility and outcomes of underwater endoscopic mucosal resection for ≥10 mm colorectal polyps. Surg Endosc. 2017 10.1007/s00464-017-5960-8.
14. Hsieh YH, Leung FW. A nonpolypoid colorectal neoplasm found during insertion phase of colonoscopy with water exchange: case report and literature review. J Interv Gastroenterol. 2015;5(1):38–40.
15. Wildi SM, Schoepfer AM, Vavricka SR, et al. Colorectal polypectomy during insertion and withdrawal or only during withdrawal? A randomized controlled trial. Endoscopy. 2012; 44:1019–23. [PubMed: 22930173]
16. Lee CK, Shim JJ, Jang JY. Cold snare polypectomy vs. Cold forceps polypectomy using double-biopsy technique for removal of diminutive colorectal polyps: a prospective randomized study. Am J Gastroenterol. 2013;108(10):1593–600. [PubMed: 24042189]
17. Kim JS, Lee BI, Choi H, et al. Cold snare polypectomy versus cold forceps polypectomy for diminutive and small colorectal polyps: a randomized controlled trial. Gastrointest Endosc. 2015;81(3):741–7. [PubMed: 25708763]
18. Singh N, Harrison M, Rex DK. A survey of colonoscopic polypectomy practices among clinical gastroenterologists. Gastrointest Endosc. 2004 9;60(3):414–8. [PubMed: 15332033]

19. Gómez V, Badillo RJ, Crook JE, et al. Diminutive colorectal polyp resection comparing hot and cold snare and cold biopsy forceps polypectomy. Results of a pilot randomized, single-center study (with videos). Endosc Int Open. 2015;3(1):E76–E80. [PubMed: 26134778]

20. Pohl H, Srivastava A, Bensen SP, et al. Incomplete polyp resection during colonoscopy-results of the complete adenoma resection (CARE) study. Gastroenterology. 2013 1;144(1):74–80.e1. [PubMed: 23022496]

21. Jia H, Pan Y, Guo X, et al. Water Exchange Method Significantly Improves Adenoma Detection Rate: A Multicenter, Randomized Controlled Trial. Am J Gastroenterol.2017 4;112(4):568–576. [PubMed: 27922025]

22. Hsieh YH, Tseng CW, Hu CT, et al. Prospective multicenter randomized controlled trial demonstrating water exchange (WE), but not water immersion (WI), significantly increases adenoma detection compared with air insufflation (AI) even in propofol sedated patients. GIE. 2017 7;86(1):192–201.

23. Cadoni S, Falt P, Rondonotti E, et al. Water exchange for screening colonoscopy increases adenoma detection rate: a multicenter, double-blinded, randomized controlled trial. Endoscopy. 2017 5;49(5):456–467. [PubMed: 28282689]

Key Summary

What is known:

- Underwater polypectomy without submucosal injection for large (≥20mm) colorectal lesions is well described in referral practices.

What is new:

- Underwater polypectomy without submucosal injection is feasible and effective for colorectal lesions ≤20mm in size encountered in routine clinical practice.

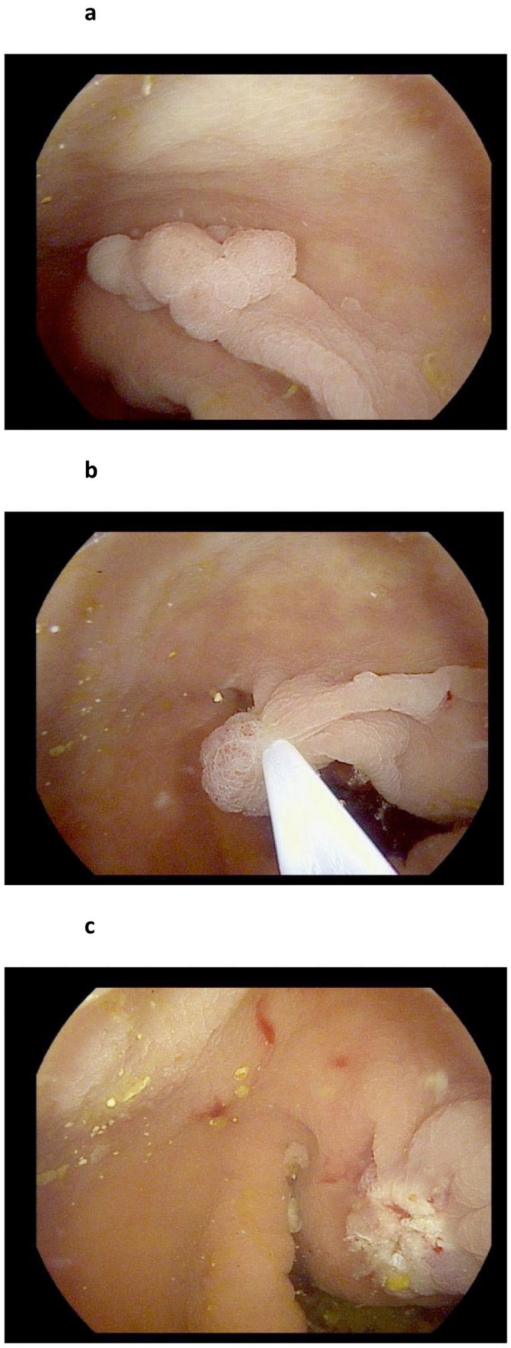

Figure 1.

Figure 1a: Underwater view of a 10 mm sessile granular lesion in the ascending colon.

Figure 1b: Polyp captured and removed by hot snare underwater without submucosal injection.

Figure 1c: Underwater view of polypectomy site.

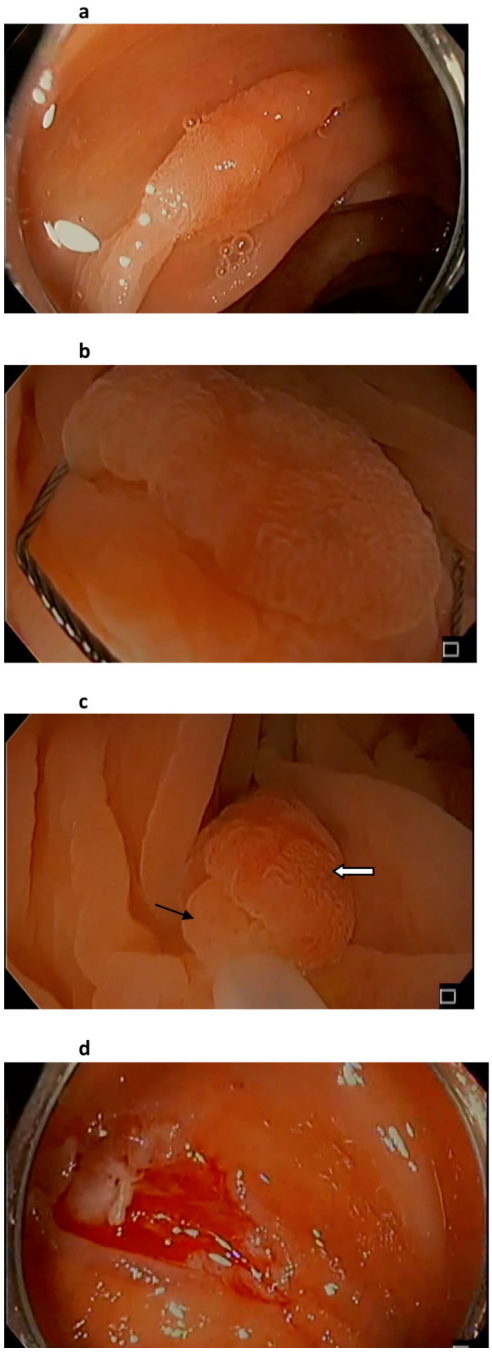

Figure 2.

Figure 2a: 6 mm non-granular lesion in a gas distended colon.

Figure 2b: Ensnaring the lesion underwater with a dedicated cold snare.

Figure 2c: Capturing a rim of normal mucosa (small arrow) around the lesion (big arrow) to achieve complete resection.

Figure 2d: Post-resection site in a gas distended colon.

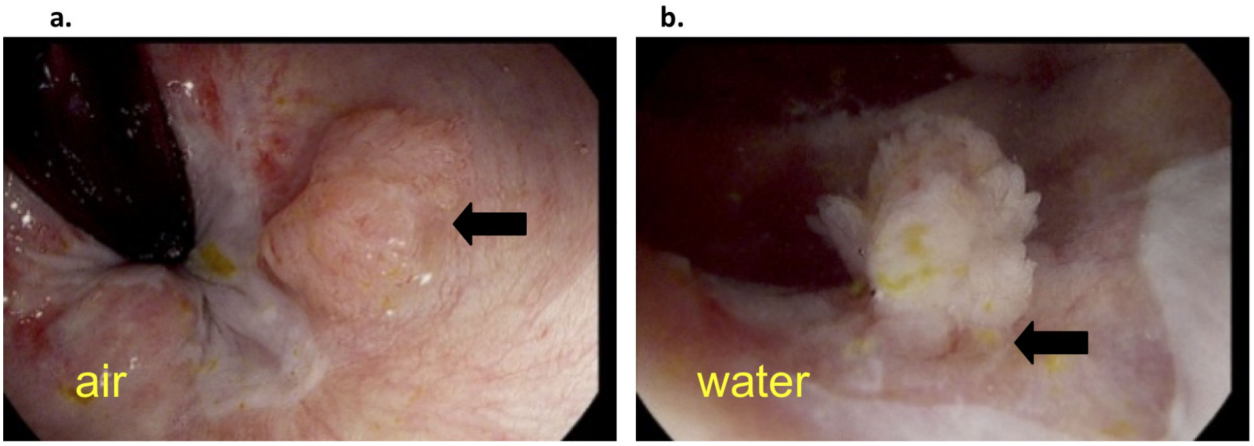

Figure 3:

a. Rectal lesion seen in an air filled lumen (no obvious stalk seen, arrow); b. Underwater view of the same lesion. The lesion (floating in water) becomes polypoid, revealing a very short stalk (arrow).

Table 1:

Data collection settings and locations

Site	Investigators	Settings, Locations	Number of polyps
Sacramento VAMC	AW Yen	VA, United States	98
	JW Leung		
Palo Alto VAMC	S Friedland		
West Los Angeles VAMC	J Sul		
	FW Leung		
Valduce Hospital	A Amato	Community Hospital, Italy	44
S. Barbara Hospital	S Cadoni		
	M Liggi		
Tzu Chi Buddhist Hospital	YH Hsieh	Community Hospital, Taiwan	27

VAMC, Veterans Affairs Medical Center

Table 2:

Details of CFP/CSP/HSP for adenomas/tubulovillous adenomas/sessile serrated polyps/hyperplastic polyps/ inflammatory polyps

	CFP	CSP	HSP	Total
Adenomas	4	48	73	126
Adenomas with high grade dysplasia (HGD)		1		
Tubulovillous adenomas (TVA)			3	4
TVA with HGD			1	
Sessile serrated polyps			5	6
Sessile serrated polyps with HGD			1	
Hyperplastic polyps	4	20	6	30
Inflammatory polyps			2	2
Not retrieved			1	1
Total	8	69	92	169

CFP, cold forceps polypectomy; CSP, cold snare polypectomy; HSP hot snare polypectomy; HGD, high grade dysplasia; TVA, tubulovillous adenoma