Polypectomy for Diminutive and Small Colorectal Polyps

Melissa Zarandi-Nowroozi, MD, Roupen Djinbachian, MD, Daniel von Renteln, MD*

KEYWORDS

• Colorectal polyp • Colorectal cancer • Snare polypectomy
• Cold snare polypectomy • Hot snare polypectomy • Postpolypectomy bleeding
• Resect and discard • Diagnose and leave

KEY POINTS

- Diminutive and small colorectal polyps are frequently encountered during colonoscopy. Removing them contributes to colorectal cancer prevention.
- Cold snare polypectomy is recommended for the resection of diminutive and small polyps because studies report shorter procedure times, and a comparable safety profile and similar incomplete resection rates to hot snare polypectomy.
- Current guidelines recommend discontinuing dual antiplatelet therapy (leaving aspirin monotherapy), warfarin, and direct anticoagulant agents before polypectomy for diminutive and small polyps, although recent studies report low postpolypectomy bleeding rates in patients on continuous therapy.
- Optical diagnosis using real-time endoscopic assessment of the histology of diminutive colorectal polyps is a paradigm shift in the assessment and management of diminutive polyps, which with the development of technology, such as artificial intelligence, might help replace histopathology assessment and reduce colonoscopy-associated costs.

INTRODUCTION

Colorectal cancer is the third most common cancer and the second leading cause of cancer death globally.[1–10] Carcinogenesis arises from a multistep process involving the accumulation of genetic, histologic, and morphologic changes within a colorectal polyp.

The main objective of polypectomy is the successful removal of all neoplastic tissue and the subsequent reduction in colorectal cancer incidence. Polypectomy techniques are described based on whether they are completed with or without cautery,

Funded by: CANADALETR
Department of Medicine, Division of Gastroenterology, Montreal University Hospital (CHUM) and Montreal University Hospital Research Center (CRCHUM), 900 Rue Saint-Denis, Montréal, QC H2X 0A9, Canada
* Corresponding author.
E-mail address: renteln@gmx.net

Gastrointest Endoscopy Clin N Am 32 (2022) 241–257
https://doi.org/10.1016/j.giec.2021.12.009
giendo.theclinics.com

Abbreviations	
ADR	Adenoma detection rate
AGA	American Gastroenterological Association
ASGE	American Society for Gastrointestinal Endoscopy
CSP	Cold snare polypectomy
CFP	Cold forceps polypectomy
DOACs	Direct oral anticoagulants
ESGE	European Society of Gastrointestinal Endoscopy
HFP	Hot forceps polypectomy
HSP	Hot snare polypectomy
IPB	Intraprocedural bleeding
JSGE	Japanese Society of Gastroenterology
KSGE	Korean Society of Gastrointestinal Endoscopy
PIVI	Preservation and Incorporation of Valuable Endoscopic Innovations
PPB	Postprocedural bleeding
PDR	Polyp detection rate
RCT	Randomized control trial

submucosal injections, en bloc, or piecemeal. The inherent characteristics of the encountered polyp, such as its size and morphology, dictate the polypectomy approach used. Two major techniques are available for diminutive and small lesions: biopsy-forceps polypectomy and snare polypectomy. Both procedures are performed with the presence or absence of electrocoagulation, distinguishing them as hot or cold.

FORCEPS POLYPECTOMY

Hot Forceps Polypectomy

Hot forceps polypectomy involves the use of a high-frequency current to simultaneously biopsy and electrocoagulate tissue. Jumbo forceps may also be used and are more effective in lesion removal because of their larger size. This technique has been forsaken by many endoscopists because it is often incapable of removing the entire lesion and confers an increased risk of polypectomy syndrome, perforation, and delayed bleeding. Impaired histologic evaluation of the biopsy specimen has also played a role in the loss in popularity of this procedure.

Cold Forceps Polypectomy

Cold forceps polypectomy (CFP) is analogous to hot forceps polypectomy without electrocautery. CFP is the preferred technique for removal of diminutive polyps less than 3 mm in diameter among endoscopists, because cold forceps are immediately available in most endoscopy units, and allow for easy retrieval of the resected tissue. This procedure also requires less coordination between the endoscopist and assistant and is related to fewer postpolypectomy adverse events, such as perforation and bleeding. However, more than one bite is frequently required to remove even a diminutive polyp, and there is concern that oozing blood after the initial bite interferes with accurate aiming of the following bites.

SNARE POLYPECTOMY

There are currently many different types of snares, each with specific advantages that are chosen depending on the clinical situation. The most commonly used snares are oval and hexagonal and are used with or without electrocautery.[11] Traditionally, the

snares used for hot polypectomy were also manipulated for cold resection, but nowadays specific snares have been developed for cold snare polypectomy (CSP) using a thin wire and stiff catheter, producing reliable tissue transection.[12]

Cold Snare Polypectomy

Cold snaring involves an en bloc or piecemeal resection of lesions using mechanical transection of the tissue. Because CSP uses a snare without electrical current, tissue cutting relies solely on the closure of the snare wire. Cold snaring may be considered useful for reducing the risk of delayed bleeding, postpolypectomy syndrome, and perforation because it avoids electrocautery-associated thermal injury. Cold snares differ from traditional snares in that they are composed of a thin wired monofilament where the technique focuses on securing a 2- to 4-mm clear margin of normal tissue so that complete histologic eradication of neoplastic is ensured. The polyp is to be positioned at a 5-o'clock position with the snare opened and lowered over the lesion. The tip of the snare catheter is anchored several millimeters distal to the lesion and is angled down into the colon wall as it is advanced. This ensures ensnaring a margin of normal and healthy tissue surrounding the polyp. The endoscopist then strangulates the targeted lesion by enclosing the snare all while applying continuous forward pressure and downright angulation of the colonoscope tip, and ensuring adequate gas insufflation because suction carries the potential of promoting submucosal tissue entrapment and preventing tissue transection. Immediate bleeding is assessed and managed using endoscopic hemostatic measures.

Hot Snare Polypectomy

HSP is similar to CSP because it involves snaring a polyp using an electric wire. Electrocautery is then delivered in a controlled fashion until complete closure is achieved and the polyp is guillotined. The polyp can then be suctioned and retrieved for histologic assessment. The main purpose of electrocautery in the context of polypectomy is to deliver additional strength when excising tissue and provide coagulation to prevent immediate bleeding. Snares and hot forceps use monopolar electrocautery, and energy deliverance is proportional to the time it is applied. Cautery probes can also use bipolar electrocautery, which means that the electrical circuit runs between two electrodes both located on the tip of the probe. The use of coagulation current may potentially minimize immediate postpolypectomy bleeding by coagulation, but could damage deeper vessels with increased risks of delayed bleeding and perforation.

CURRENT GUIDELINES FOR POLYPECTOMY

Evolving evidence summarized in the 2020 update of the American Gastroenterological Association (AGA) Clinical Practice Guidelines[13] and 2017 version of the European Society of Gastrointestinal Endoscopy Clinical Guidelines[14] has highlighted safe, complete, and effective resection practices, and the superiority of certain techniques when specific lesions are encountered. The Japanese Society of Gastroenterology[15] issued its own guidelines in 2015 and recently published in 2020 a revised version, alongside the Korean Society of Gastrointestinal Endoscopy,[16] which released their own set of recommendations in 2012 (**Table 1**).[17,18]

POLYPECTOMY FOR DIMINUTIVE AND SMALL COLORECTAL POLYPS

Cold techniques are now widely used for addressing diminutive small colorectal polyps and are currently recommended in current guidelines tackling optimal management options for specific lesions. A recent survey published by Willems and

colleagues[19] internationally assessed 808 endoscopists' preferred approach to diminutive and small polyps. CSP was the predominant polypectomy technique for 4- to 5-mm polyps (67.0%; 95% confidence interval [CI], 63.7%–70.2%) and 6- to 10-mm polyps (55.2%; 95% CI, 51.8%–58.6%). For 1- to 3-mm polyps, cold forceps remained the preferred technique (78.4%; 95% CI, 75.6%–81.3%), whereas hot snare polypectomy (HSP) was mainly used for 10- to 20-mm polyps (92.5%; 95% CI, 90.7%–94.3%). Additionally, 87.5% (95% CI, 85.2%–89.8%) of endoscopists reported an increase in CSP use during the past 5 years.

Diminutive Colorectal Polyps

Most encountered colorectal lesions measure less than 5 mm and rarely harbor features of high-grade dysplasia. These lesions benefit nonetheless from complete resection to reduce the impact of interval cancer and cancer mortality. Forceps and snare polypectomy, hot and cold, have been used for the resection of diminutive lesions.

CFP has been associated with a much higher rate of incomplete resection, ranging from 9% to 61% especially for small polyps 6 to 9 mm in size, and its use in these circumstances is not generally recommended outside the smallest of diminutive polyps. A randomized control trial (RCT) including 145 polyps less than 7 mm in size demonstrated that CSP is more effective in complete eradication of polyps when compared with CFP (96.6% vs 82.6%; $P = .011$).[20] However, the complete resection rates for polyps less than 4 mm did not differ significantly between the CSP and CFP groups (100% vs 96.9%; $P = 1.000$). A prospective RCT comprising 117 polyps less than 5 mm found significantly higher complete resection rates in the CSP group compared with the CFP group (93.2% vs 75.9%; $P = .009$).[21] The duration of polypectomy was also significantly shorter in the CSP group (14.29 vs 22.03 seconds; $P<.001$). In a 2018 meta-analysis of seven studies with 968 polyps, complete histologic eradication was best achieved when CSP was used in comparison with forceps polypectomy.[22] Forceps polypectomy may nevertheless play a key role in the management of certain diminutive polyps when jumbo forceps are specifically used. The AGA guidelines recommend that if CSP poses a technical difficulty in removing diminutive lesions less than 2 mm, jumbo or large-capacity forceps polypectomy may be considered and generally to those when resection in a single bite is anticipated. A prospective cohort study including 361 patients with 573 adenomas demonstrated CFP using jumbo forceps for diminutive lesions was a safe and effective way to achieve an adenoma-free colon.[23] The one-bite resection rate with CFP peaked for lesions 3 mm or smaller (94.4%) and decreased significantly with increasing lesion size.

Hot biopsy forceps (HBF) is occasionally considered as an alternative method for the removal of diminutive colorectal polyps, but is generally not recommended. The AGA guidelines state that HBF for polypectomy of lesions less than 10 mm is not endorsed because of high incomplete resection margins, inadequate histopathologic specimens, and nonnegligible complication rates. A prospective RCT evaluated the efficacy and safety between CSP and HBF in 208 patients with a total of 283 evaluated polyps ranging from 3 to 5 mm.[24] CSP achieved a much higher complete resection rate (80.4% vs 47.4%; $P<.0001$). The intraprocedural bleeding (IPB) rate was similar in both groups (8.6% vs 8.1%). The rate of severe tissue injury to the pathologic specimen was greater in the HBF group (52.6% vs 1.3%; $P<.0001$). The use of HBF for addressing diminutive colorectal polyps is generally not favored because of unacceptably high risks of adverse events, inadequate tissue sampling for histopathology, and high incomplete resection rates (IRRs).[25]

The most current AGA guidelines suggest that when compared with HSP techniques, CSP is generally regarded as safe and effective at addressing diminutive colorectal polyps. However, studies comparing HSP and CSP for lesions less than 5 mm specifically in terms of effectiveness and safety are scarce, because most also include polyps 6 to 9 mm in size or use unconventional cutoff values for polyp size, which prevent drawing exact conclusions for diminutive and small lesions separately. Most meta-analyses do not distinguish between both subgroups and many studies are often retrospective in nature or hampered by poor study quality. A retrospective study of 461 lesions resected using HSP or CSP found a trend toward higher complete resection rates among polyps less than or equal to 5 mm (81.3% vs 53.4%; $P = .057$) and there was no significant difference in the incidence of adverse events between the two groups (0.7% vs 0.6%).[26] A pilot study comparing HSP, CSP, and CFP for diminutive lesions (6 mm) reported similar rates of incomplete resection among the three groups. No significant adverse events related to polypectomy were reported intraprocedurally or at the 30-day follow-up.[27]

Diminutive colorectal polyps have traditionally been managed with either forceps polypectomy or cold snaring. Several studies have deemed CSP to be the preferred method for removing diminutive lesions comparatively to forceps polypectomy. Trials demonstrating CSP's superiority over HSP for diminutive polyps have been few and far between. Therefore, although current guidelines recommend CSP over HSP for diminutive lesions, it seems that its overall safety and effectiveness for removal of diminutive polyps can be considered comparable with that of HSP. More RCTs comparing CSP and HSP are required.

Small Colorectal Polyps

CSP is an effective removal technique for colorectal polyps less than 10 mm and has been thought to provide a superior safety profile to HSP with decreased postpolypectomy bleeding and coagulation syndrome. Resection methods for small lesions remain highly variable among endoscopists possibly because of specific exposure during training, personal preference, but also variability in efficacy and safety outcomes reported in current literature. Although CSP requires a shorter procedural time, little data support its general superiority to HSP. Complete resection rates and the occurrence of adverse events seem to be comparable among both techniques.

RCTs reporting on complete resection rates yield similar results for CSP and HSP, averaging around 95%. The CRESCENT study analyzed 796 polyps 4 to 9 mm in size and reported complete resection rates for CSP of 98.2% compared with 97.4% for HSP (<0.0001).[28] Suzuki and colleagues[29] demonstrated that CSP has sufficient resection width and depth to allow complete lesion resection after reporting mean mucosal defect diameter immediately after HSP and CSP of 5.1 mm and 7.5 mm, respectively ($P<.001$), but decreased by 25% ($P<.001$) at Day 1 after resection for CSP. Although the resection depth after CSP was more superficial, muscularis mucosa was obtained at similar rates with HSP and CSP (96% vs 92%; $P = .603$). Another RCT reported shorter procedure time with cold polypectomy as opposed to conventional polypectomy (18 vs 25 minutes; $P<.0001$) and identical complete polyp retrieval rates of 96%.[30]

Although RCTs demonstrate better outcomes with CSP comparatively with HSP, current systematic reviews and meta-analysis comparing data from available trials highlight comparable outcomes between the two. An analysis of eight studies recommended CSP as the standard treatment for resecting small benign colorectal polyps, because this procedure conferred an advantage in terms of shorter procedural time.[31] Complete resection rate using HSP was similar to CSP (relative risk, 1.02; $P = .31$).

Polyp retrieval after HSP was also similar to CSP (relative risk, 1.00; $P = .60$). However, total colonoscopy time for HSP was significantly longer than CSP (mean difference, 7.13 minutes; $P<.001$), and polypectomy time (mean difference, 30.92 seconds; $P = .005$). A systematic review of 18 studies further confirmed the noninferiority of CSP to HSP by reporting no statistical difference on complete histologic eradication (risk difference, 0.08; $P>.05$), but also established significantly shorter time of procedure with CSP (risk difference, -5.92; P 0.05).[32] Overall, although resection rates remain similar between CSP and HSP, CSP is usually preferred across different endoscopists because it is shorter in duration compared with HSP.

It has also been suggested that CSP offers an improved safety profile over HSP. At least eight studies have directly compared CSP with HSP in terms of adverse events in small polyps (**Table 2**).[27,28,33–45] For IPB, two studies found statistically significantly lower IPB for CSP when compared with HSP, whereas three studies found no difference. For post-procedural bleeding (PPB), two studies (one in anticoagulated patients) found statistically significantly lower PPB for CSP when compared with HSP, whereas six studies did not (see **Table 2**). No perforation was reported in all studies for either CSP or HSP. Current studies therefore do not support the superiority of CSP over HSP in terms of safety for the general population for small polyp resection.

Resect and Discard Strategy

The American Society for Gastrointestinal Endoscopy (ASGE) Preservation and Incorporation of Valuable Endoscopic Innovations (PIVI) released in 2011 two statements supporting the resect and discard and diagnose and leave strategies using optical biopsy achieved by real-time endoscopic assessment of the histology of diminutive colorectal polyps using currently available endoscopic technologies.[46] These approaches may allow for a paradigm shift in the assessment and management of diminutive polyps and for a reduction in total colonoscopy cost without compromising efficacy in colorectal cancer risk reduction. The diagnose and leave strategy involves leaving in place diminutive rectosigmoid polyps that are diagnosed as hyperplastic with high confidence. The resect and discard method entails resection of diminutive polyps after endoscopic optical diagnosis and without submission for histopathologic evaluation.

The ASGE Technology Committee published in 2015 a systematic review evaluating the ASGE PIVI thresholds for adopting real-time endoscopic assessment of the histology of diminutive colorectal polyps.[47] The pooled negative predictive value of narrow-band imaging for adenomatous polyps was 91% (95% CI, 88–94) and was even greater in academic medical centers (91.8%; 95% CI, 89–94), for experts (93%; 95% CI, 91–96), and when the optical biopsy assessment was made with high confidence (93%; 95% CI, 90–96). Of note, heterogeneity was high in this study ($I^2 = 89\%$). This systematic review confirmed that the thresholds set by the ASGE PIVI for real-time endoscopic assessment of the histology of diminutive polyps could be met, supporting the diagnose and leave strategy for rectosigmoid diminutive polyps.

A recent survey published in 2020 assessed the uptake of the resect and discard strategy and identified potential barriers preventing the widespread implementation of this method.[48] Eight hundred and eight endoscopists were surveyed internationally and 84.2% report not using the resect and discard strategy and 59.9% report not believing this method to be possible for implementation, identifying several deterrent factors, such as fear of misdiagnosis, not establishing an incorrect surveillance interval, and medicolegal concerns. As for the diagnose and leave strategy, more than half of individuals scheduled for a routine colonoscopy would be compliant to deferring resection of diminutive polyps[49]; this survey interrogating 557 individuals found that

57% of participants would be agreeable to adjourning resection of diminutive polyps outside of a clinical trial, with 50% willing to participate in an RCT setting. Factors associated with agreement of deferral of polyp resection included higher education ($P = .001$), greater knowledge about cancer risk ($P = .002$), and a lower perception of cancer risk ($P<.001$), whereas age, sex, income, history of polyps, and first-degree family history of colorectal cancer were not.

Motives for encouraging such strategies aiming at optical diagnosis are mainly that complications associated with colonoscopy are not trivial and might offset the benefit of surveillance. The risk of malignant transformation of diminutive polyps is low. A recent systematic review dived into the risk of metachronous colorectal cancer among patients with no adenomas, low-risk adenomas,[50] and high-risk adenomas at index colonoscopy in more than 500,000 patients over a follow-up of 8.5 years.[51] Low-risk adenomas carried a slightly higher incidence of colorectal cancer per 10,000 person-years in comparison with those with no adenomas (odds ratio [OR], 1.26; 95% CI, 1.06–1.51); however, the colorectal cancer–related mortality per 10,000 person-years was not significantly different between both groups (OR, 1.15; 95% CI, 0.76–1.74). Progression to cancer has been proven to be a lengthy process within diminutive and small polyps, which inherently carry low risk of malignant transformation. This further supports cost-effective strategies that prioritize optical diagnosis and may ultimately loosen current surveillance intervals and reduce colonoscopy burden.[52]

Colonoscopy performance is also greatly operator dependent. Numerous studies from academic and nonacademic endoscopy centers revealed that correct optical diagnosis of diminutive polyps was easily less than 90% in nonacademic settings, which could be palliated by appropriate diagnosis training sometimes lacking in community settings.[53–56] Raghavendra and colleagues[57] demonstrated that high accuracy and good interobserver agreement on optical diagnosis could be achieved after endoscopists were adequately trained, with rates increasing significantly from 47.6% to 90.8% ($P = .001$).

Despite literature being in support of the diagnose and leave and resect and discard strategies as economical, quick, and improving patient safety, uptake is low among current endoscopists. Better training programs should be instituted to better acquaint and prepare endoscopists to these strategies because resection and histologic evaluation in pathology units are significant and are prone to increase further with artificial intelligence–assisted optical diagnosis permitting improved polyp and adenoma detection rates. Such technologies carry a high yield in increased costs and shorter surveillance intervals with marginal significant benefits on colorectal cancer prevention, equally carrying potential for cumulative risk of colon perforation, estimated at 1.4% with colonoscopy repeated every 3 years.[58] This may controversially lead toward an incentive to limit adenoma detection rate thresholds to constrain such complications from arising. Solutions include focusing on the detection of high-risk lesions within diminutive polyps, even if most are adenomas carrying limited clinical impact,[59] and increasing uptake to alternatives to pathology, such as artificial intelligence–assisted optical diagnosis.

Incomplete Resection Rate

The IRR has been an outcome of interest for polypectomy after several studies reported that 20% to 30% of interval colorectal cancer cases are attributable to incomplete resection of colorectal cancer precursor lesions and often occur at previous polypectomy sites.[60] A meta-analysis of three studies further confirmed that HSP and CSP techniques can be effectively used for the complete removal of polyps 4 to 10 mm in size with IRR (HSP vs CSP: 2.4% vs 4.7%; OR, 0.51; 95% CI, 0.13–

1.99; $P = .33$; $I^2 = 73\%$).[61] Djinbachian and colleagues pooled results from 32 studies and reported that IRR for hot snare removal of polyps 1 to 10 mm was comparable with CSP, respectively 14.2% (95% CI, 5.2–23.2) versus 17.3% (95% CI, 14.3–20.3).[62–64] There was a statistically significant lower snare IRR for polyps 1 to 20 mm in size when expert endoscopists performed polypectomy in contrast to colleagues with less experience (8.0% [95% CI, 4.8–11.3] vs 18.0% [95% CI, 11.8–24.3]). Quality metrics for colonoscopy may include polypectomy technique and photodocumentation of polypectomy site.

Submucosal Injection

The inject and cut technique, also known as submucosal injection polypectomy, has gained in popularity in recent years given its simplicity. The role of submucosal injection in reducing IRR in small and diminutive polyps is not clear. Current literature has not demonstrated much added benefit in targeting such lesions and decreasing IRR accordingly. Djinbachian and colleagues[62] found no statistically significant difference in IRR when submucosal injections were performed for polyps less than 10 mm. Snare IRR using submucosal injection was 14.2% (95% CI, 5.2–23.2) compared with 17.6% (95% CI, 13.1–22.1) when the technique was not used. A recent abstract that assessed IRR when submucosal injection was integrated in standard CSP for 98 nonpedunculated polyps 4 to 20 mm in size showed promising results because overall IRR was 4.35% and so much lower when compared with historical data not using this technique. RCTs are needed to further confirm these results.

Adverse Events

Different complications are associated with polypectomy despite the minimally invasive nature of this procedure. Bleeding is most frequently observed and may occur either during or after the procedure. IPB is defined as occurring during the procedure and persisting for more than 60 seconds or requiring endoscopic intervention. PPB can manifest up to 30 days postpolypectomy and may result in an unplanned emergency department visit; hospitalization; or interventions, such as repeat endoscopy, angiography, or surgery.[14] The reported rate of PPB ranges from 0.07% to 1.7%.[65–67] Several factors associated with PPB have been identified by previous studies, including polyp size, sessile morphology, number of polyps, right colon location, comorbidities, endoscopists' experience, number of polyps removed, and use of antiplatelet and anticoagulant drugs.[68]

Perforation is a more serious and feared complication of polypectomy and is associated with higher morbidity and mortality. The incidence of perforation ranges from 0.016% in all diagnostic colonoscopy procedures to 5% as seen in therapeutic colonoscopies.[69] The rectosigmoid colon remains the most common site of colonic perforation because of sharp angulation at either the rectosigmoid junction or the sigmoid-descending colon junction, and the great mobility of the sigmoid. Factors increasing the risk of perforation include patient-related characteristics, such as increasing age, female sex, right colon polyp removal, and other medical comorbidities.[70] Procedure-related risk factors consist of type of snare or resection tool used, usage of electrocautery, inadequacy of submucosal cushioning for removal of larger lesions, and inexperience of the endoscopist.[71]

Postpolypectomy syndrome is a much rarer consequence of polypectomy, resulting from electrocoagulation injury to the mucosa and the muscularis layers, resulting in transmural burn and inflammation of the peritoneum without colonic perforation. This lesser-known entity has a reported incidence varying from 0.003% to 1%.[72] A large multicenter study identified several risk factors associated with postpolypectomy

electrocoagulation syndrome, such as nonpolypoidal lesions, large lesion size (>2 cm), location in the right colon (attributed to decreased wall thickness), and hypertension.[73]

SUMMARY

Diminutive and small polyps are frequently encountered and CSP is considered the preferred technique to address these lesions. Evidence for its safety and efficacy has been established, even in patients taking anticoagulants and antiplatelet therapy. More recent evidence shows patients receiving continuous anticoagulation may safely undergo polypectomy using cold snaring with minimal risks with regards to immediate and postpolypectomy bleeding, although current guidelines seem to lean toward a discontinuation of anticoagulants, such as warfarin and direct oral anticoagulants because sufficient high-quality studies are lacking. Although large-capacity cold forceps are used to remove tiny polyps ($\leq$2 mm) in a single piece, cold snaring is considered effective for the resection of diminutive ($\leq$5 mm) and small (6–9 mm) polyps. CSP remains noninferior in terms of safety and efficacy in comparison with HSP when incomplete resection and complications rates are contrasted, and may confer a slight advantage with its shorter procedural time. Recent guidelines lean toward optimizing uptake in CSP for small polyps; however, data supporting its superiority to HSP are sparse and available RCTs show comparable incomplete resection and delayed bleeding rates, perhaps even a higher risk of immediate IPB. Hot forceps and ablation are no longer recommended for small and diminutive polyps. Even though uptake of different strategies, such as the resect and discard and diagnose and leave, is low for diminutive rectosigmoid polyps, studies show they are safe and cost-effective and negative predictive values with optical diagnosis are met. IRRs are an essential outcome pertaining to effective polypectomy and correlating with interval colorectal cancer and should be made aware to endoscopists to further improve and standardize current accredited training programs.

CLINICS CARE POINTS

- Practice cold snare polypectomy for all small polyps less than 10mm in diameter, including cold forceps polypectomy for diminutive polyps less than 3 mm remaining as an accepted alternative, and avoid using hot biopsy forceps and ablation.
- Individualise peri-polypectomy anticoagulation management after careful assessment of patient comorbidities and bleeding versus thrombosis risk and withhold anticoagulation accordingly by adhering to current guidelines and after consultation with cardiology and/or internal medicine.
- Integrate optical diagnosis techniques such as resect and discard and diagnose and leave in routine clinical practice for addressing diminutive colorectal polyps as this approach promotes more efficient and cost-effective colonoscopies, prevents costly and cumbersome histopathologic analysis, and may ultimately loosen colonoscopy surveillance interval recommendations.
- Interval colorectal cancer has raised concerns about ineffective polypectomy in regards to either missed or incompletely resected small polyps and creates an incentive to acknowledge incomplete resection rates as a key outcome of interest even if small colorectal polyp progression is slow.
- There is a need to standardize polypectomy training programs and define benchmarks of competent polypectomy in all geographic centers where colonoscopy is practiced to amend complete polyp resection rates and reduce post-polypectomy complications and costly referral to surgery.

DISCLOSURE

R. Djinbachian is supported by an American College of Gastroenterology resident research grant. D. von Renteln is supported by the Fonds de Recherche du Québec Santé career development award; has received research funding from ERBE, Ventage, Pendopharm, and Pentax; and is a consultant for Boston Scientific and Pendopharm.

REFERENCES

1. Amersi F, Agustin M, Ko CY. Colorectal cancer: epidemiology, risk factors, and health services. Clin Colon Rectal Surg 2005;18:133–40.
2. Ponugoti PL, Cummings OW, Rex DK. Risk of cancer in small and diminutive colorectal polyps. Dig Liver Dis 2017;49:34–7.
3. Liu WN, Zhang YY, Bian XQ, et al. Study on detection rate of polyps and adenomas in artificial-intelligence-aided colonoscopy. Saudi J Gastroenterol 2020; 26:13–9.
4. Castaneda D, Popov VB, Verheyen E, et al. New technologies improve adenoma detection rate, adenoma miss rate, and polyp detection rate: a systematic review and meta-analysis. Gastrointest Endosc 2018;88:209–222 e11.
5. Klare P, Sander C, Prinzen M, et al. Automated polyp detection in the colorectum: a prospective study (with videos). Gastrointest Endosc 2019;89:576–582 e1.
6. Rex DK, Boland CR, Dominitz JA, et al. Colorectal cancer screening: recommendations for physicians and patients from the U.S. multi-society task force on colorectal cancer. Gastroenterology 2017;153:307–23.
7. Rex DK. Detection measures for colonoscopy: considerations on the adenoma detection rate, recommended detection thresholds, withdrawal times, and potential updates to measures. J Clin Gastroenterol 2020;54:130–5.
8. Wong JCT, Chiu HM, Kim HS, et al. Adenoma detection rates in colonoscopies for positive fecal immunochemical tests versus direct screening colonoscopies. Gastrointest Endosc 2019;89:607–613 e1.
9. Siegel RL, Miller KD, Fuchs HE, et al. Cancer statistics, 2021. CA Cancer J Clin 2021;71:7–33.
10. Weston AP, Campbell DR. Diminutive colonic polyps: histopathology, spatial distribution, concomitant significant lesions, and treatment complications. Am J Gastroenterol 1995;90:24–8.
11. Fyock CJ, Draganov PV. Colonoscopic polypectomy and associated techniques. World J Gastroenterol 2010;16:3630–7.
12. Hewett DG. Cold snare polypectomy: optimizing technique and technology (with videos). Gastrointest Endosc 2015;82:693–6.
13. Kaltenbach T, Anderson JC, Burke CA, et al. Endoscopic removal of colorectal lesions-recommendations by the US multi-society task force on colorectal cancer. Gastroenterology 2020;158:1095–129.
14. Ferlitsch M, Moss A, Hassan C, et al. Colorectal polypectomy and endoscopic mucosal resection (EMR): European Society of Gastrointestinal Endoscopy (ESGE) Clinical Guideline. Endoscopy 2017;49:270–97.
15. Tanaka S, Saitoh Y, Matsuda T, et al. Evidence-based clinical practice guidelines for management of colorectal polyps. J Gastroenterol 2021;56:323–35.
16. Lee SH, Shin SJ, Park DI, et al. Korean guideline for colonoscopic polypectomy. Clin Endosc 2012;45:11–24.

17. Kaltenbach T, Anderson JC, Burke CA, et al. Endoscopic removal of colorectal lesions: recommendations by the US multi-society task force on colorectal cancer. Am J Gastroenterol 2020;115:435–64.
18. Takeuchi Y, Mabe K, Shimodate Y, et al. Continuous anticoagulation and cold snare polypectomy versus heparin bridging and hot snare polypectomy in patients on anticoagulants with subcentimeter polyps. Ann Intern Med 2019;171:229–37.
19. Willems P, Orkut S, Ditisheim S, et al. An international polypectomy practice survey. Scand J Gastroenterol 2020;55:497–502.
20. 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;81:741–7.
21. 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;108:1593–600.
22. Jung YS, Park CH, Nam E, et al. Comparative efficacy of cold polypectomy techniques for diminutive colorectal polyps: a systematic review and network meta-analysis. Surg Endosc 2018;32:1149–59.
23. Hasegawa H, Bamba S, Takahashi K, et al. Efficacy and safety of cold forceps polypectomy utilizing the jumbo cup: a prospective study. Intest Res 2019;17:265–72.
24. Komeda Y, Kashida H, Sakurai T, et al. Removal of diminutive colorectal polyps: a prospective randomized clinical trial between cold snare polypectomy and hot forceps biopsy. World J Gastroenterol 2017;23:328–35.
25. Panteris V, Vezakis A, Triantafillidis JK. Should hot biopsy forceps be abandoned for polypectomy of diminutive colorectal polyps? World J Gastroenterol 2018;24:1579–82.
26. Yamamoto T, Suzuki S, Kusano C, et al. Histological outcomes between hot and cold snare polypectomy for small colorectal polyps. Saudi J Gastroenterol 2017;23:246–52.
27. Gomez 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:E76–80.
28. Kawamura T, Takeuchi Y, Asai S, et al. A comparison of the resection rate for cold and hot snare polypectomy for 4-9 mm colorectal polyps: a multicentre randomised controlled trial (CRESCENT study). Gut 2018;67:1950–7.
29. Suzuki S, Gotoda T, Kusano C, et al. Width and depth of resection for small colorectal polyps: hot versus cold snare polypectomy. Gastrointest Endosc 2018;87:1095–103.
30. Ichise Y, Horiuchi A, Nakayama Y, et al. Prospective randomized comparison of cold snare polypectomy and conventional polypectomy for small colorectal polyps. Digestion 2011;84:78–81.
31. Shinozaki S, Kobayashi Y, Hayashi Y, et al. Efficacy and safety of cold versus hot snare polypectomy for resecting small colorectal polyps: systematic review and meta-analysis. Dig Endosc 2018;30:592–9.
32. Tranquillini CV, Bernardo WM, Brunaldi VO, et al. Best polypectomy technique for small and diminutive colorectal polyps: a systematic review and meta-analysis. Arq Gastroenterol 2018;55:358–68.

33. Horiuchi A, Nakayama Y, Kajiyama M, et al. Removal of small colorectal polyps in anticoagulated patients: a prospective randomized comparison of cold snare and conventional polypectomy. Gastrointest Endosc 2014;79:417–23.
34. Aslan F, Camci M, Alper E, et al. Cold snare polypectomy versus hot snare polypectomy in endoscopic treatment of small polyps. Turk J Gastroenterol 2014;25:279–83.
35. Yamashina T, Fukuhara M, Maruo T, et al. Cold snare polypectomy reduced delayed postpolypectomy bleeding compared with conventional hot polypectomy: a propensity score-matching analysis. Endosc Int Open 2017;5:E587–94.
36. Zhang Q, Gao P, Han B, et al. Polypectomy for complete endoscopic resection of small colorectal polyps. Gastrointest Endosc 2018;87:733–40.
37. Papastergiou V, Paraskeva KD, Fragaki M, et al. Cold versus hot endoscopic mucosal resection for nonpedunculated colorectal polyps sized 6-10 mm: a randomized trial. Endoscopy 2018;50:403–11.
38. Takeuchi Y, Mabe K, Shimodate Y, et al. Continuous anticoagulation and cold snare polypectomy versus heparin bridging and hot snare polypectomy in patients on anticoagulants with subcentimeter polyps: a randomized controlled trial. Ann Intern Med 2019;171:229–37.
39. Levy I, Gralnek IM. Complications of diagnostic colonoscopy, upper endoscopy, and enteroscopy. Best Pract Res Clin Gastroenterol 2016;30:705–18.
40. Choung BS, Kim SH, Ahn DS, et al. Incidence and risk factors of delayed postpolypectomy bleeding: a retrospective cohort study. J Clin Gastroenterol 2014;48:784–9.
41. Abraham NS. Antiplatelets, anticoagulants, and colonoscopic polypectomy. Gastrointest Endosc 2020;91:257–65.
42. Veitch AM, Vanbiervliet G, Gershlick AH, et al. Endoscopy in patients on antiplatelet or anticoagulant therapy, including direct oral anticoagulants: British Society of Gastroenterology (BSG) and European Society of Gastrointestinal Endoscopy (ESGE) guidelines. Endoscopy 2016;48:c1.
43. Makino T, Horiuchi A, Kajiyama M, et al. Delayed bleeding following cold snare polypectomy for small colorectal polyps in patients taking antithrombotic agents. J Clin Gastroenterol 2018;52:502–7.
44. Arimoto J, Chiba H, Ashikari K, et al. Safety of cold snare polypectomy in patients receiving treatment with antithrombotic agents. Dig Dis Sci 2019;64:3247–55.
45. Won D, Kim JS, Ji JS, et al. Cold snare polypectomy in patients taking dual antiplatelet therapy: a randomized trial of discontinuation of thienopyridines. Clin Transl Gastroenterol 2019;10:e00091.
46. Rex DK, Kahi C, O'Brien M, et al. The American Society for Gastrointestinal Endoscopy PIVI (Preservation and Incorporation of Valuable Endoscopic Innovations) on real-time endoscopic assessment of the histology of diminutive colorectal polyps. Gastrointest Endosc 2011;73:419–22.
47. Committee AT, Abu Dayyeh BK, Thosani N, et al. ASGE Technology Committee systematic review and meta-analysis assessing the ASGE PIVI thresholds for adopting real-time endoscopic assessment of the histology of diminutive colorectal polyps. Gastrointest Endosc 2015;81:502.e1–16.
48. Willems P, Djinbachian R, Ditisheim S, et al. Uptake and barriers for implementation of the resect and discard strategy: an international survey. Endosc Int Open 2020;8:E684–92.
49. von Renteln D, Bouin M, Barkun AN, et al. Patients' willingness to defer resection of diminutive polyps: results of a multicenter survey. Endoscopy 2018;50:221–9.

50. Arya R, Gulati S, Kabra M, et al. Folic acid supplementation prevents phenytoin-induced gingival overgrowth in children. Neurology 2011;76:1338–43.
51. Duvvuri A, Chandrasekar VT, Srinivasan S, et al. Risk of colorectal cancer and cancer related mortality after detection of low-risk or high-risk adenomas, compared with no adenoma, at index colonoscopy: a systematic review and meta-analysis. Gastroenterology 2021;160:1986–96.e3.
52. Benard F, von Renteln D. Adenoma detection: the more the merrier? Endoscopy 2018;50:835–6.
53. Kuiper T, Marsman WA, Jansen JM, et al. Accuracy for optical diagnosis of small colorectal polyps in nonacademic settings. Clin Gastroenterol Hepatol 2012;10:1016–20 [quiz e79].
54. Ladabaum U, Fioritto A, Mitani A, et al. Real-time optical biopsy of colon polyps with narrow band imaging in community practice does not yet meet key thresholds for clinical decisions. Gastroenterology 2013;144:81–91.
55. Paggi S, Rondonotti E, Amato A, et al. Resect and discard strategy in clinical practice: a prospective cohort study. Endoscopy 2012;44:899–904.
56. Murino A, Hassan C, Repici A. The diminutive colon polyp: biopsy, snare, leave alone? Curr Opin Gastroenterol 2016;32:38–43.
57. Raghavendra M, Hewett DG, Rex DK. Differentiating adenomas from hyperplastic colorectal polyps: narrow-band imaging can be learned in 20 minutes. Gastrointest Endosc 2010;72:572–6.
58. Ransohoff DF, Lang CA, Kuo HS. Colonoscopic surveillance after polypectomy: considerations of cost effectiveness. Ann Intern Med 1991;114:177–82.
59. von Renteln D, Barkun AN. Increasing detection rates for diminutive adenomas: are we on the right track? Gut 2016;65:1056–7.
60. Robertson DJ, Lieberman DA, Winawer SJ, et al. Colorectal cancers soon after colonoscopy: a pooled multicohort analysis. Gut 2014;63:949–56.
61. Jegadeesan R, Aziz M, Desai M, et al. Hot snare vs. cold snare polypectomy for endoscopic removal of 4 - 10 mm colorectal polyps during colonoscopy: a systematic review and meta-analysis of randomized controlled studies. Endosc Int Open 2019;7:E708–16.
62. Djinbachian R, Iratni R, Durand M, et al. Rates of incomplete resection of 1- to 20-mm colorectal polyps: a systematic review and meta-analysis. Gastroenterology 2020;159:904–14.e12.
63. Duloy AM, Keswani RN. Assessing the quality of polypectomy and teaching polypectomy. Gastrointest Endosc Clin North Am 2019;29:587–601.
64. Tufman A, Neumann J, Manapov F, et al. Prognostic and predictive value of PD-L1 expression and tumour infiltrating lymphocytes (TiLs) in locally advanced NSCLC treated with simultaneous radiochemotherapy in the randomized, multicenter, phase III German Intergroup lung Trial (GILT). Lung Cancer 2021;160:17–27.
65. Wexner SD, Garbus JE, Singh JJ, et al. A prospective analysis of 13,580 colonoscopies. Reevaluation of credentialing guidelines. Surg Endosc 2001;15:251–61.
66. Bowles CJ, Leicester R, Romaya C, et al. A prospective study of colonoscopy practice in the UK today: are we adequately prepared for national colorectal cancer screening tomorrow? Gut 2004;53:277–83.
67. Sieg A, Hachmoeller-Eisenbach U, Eisenbach T. Prospective evaluation of complications in outpatient GI endoscopy: a survey among German gastroenterologists. Gastrointest Endosc 2001;53:620–7.
68. Pigo F, Bertani H, Manno M, et al. Colonic postpolypectomy bleeding is related to polyp size and heparin use. Clin Endosc 2017;50:287–92.

69. Lohsiriwat V. Colonoscopic perforation: incidence, risk factors, management and outcome. World J Gastroenterol 2010;16:425–30.
70. Gatto NM, Frucht H, Sundararajan V, et al. Risk of perforation after colonoscopy and sigmoidoscopy: a population-based study. J Natl Cancer Inst 2003;95:230–6.
71. Lohsiriwat V, Sujarittanakarn S, Akaraviputh T, et al. What are the risk factors of colonoscopic perforation? BMC Gastroenterol 2009;9:71.
72. Jehangir A, Bennett KM, Rettew AC, et al. Post-polypectomy electrocoagulation syndrome: a rare cause of acute abdominal pain. J Community Hosp Intern Med Perspect 2015;5:29147.
73. Cha JM, Lim KS, Lee SH, et al. Clinical outcomes and risk factors of post-polypectomy coagulation syndrome: a multicenter, retrospective, case-control study. Endoscopy 2013;45:202–7.

APPENDIX

Table 1
Guidelines on polypectomy for diminutive and small colorectal polyps

AGE Clinical Practice Guidelines 2020[72]	Diminutive ($\leq$ 5mm) and small (6-9mm) lesions. a. We recommend cold snare polypectomy to remove diminutive ($\leq$ 5mm) and small (6–9mm) lesions due to high complete resection rates and safety profile. (Strong recommendation, high-quality evidence) b.We recommend against the use of cold forceps polypectomy to remove diminutive ($\leq$ 5mm) lesions due to high rates of incomplete resection. For diminutive lesions $\leq$ 2mm, if cold snare polypectomy is technically difficult, jumbo or large-capacity forceps polypectomy may be considered. (Strong recommendation, moderate-quality evidence) c. We recommend against the use of hot biopsy forceps for polypectomy of diminutive ($\leq$ 5mm) and small (6–9mm) lesions due to high incomplete resection rates, inadequate histopathologic specimens, and complication rates. (Strong recommendation, moderate-quality evidence)
ESGE Clinical Guidelines 2017[11]	Diminutive polyps ($\leq$ 5mm). a. ESGE recommends cold snare polypectomy (CSP) as the preferred technique for removal of diminutive polyps (size $\leq$ 5mm). This technique has high rates of complete resection, adequate tissue sampling for histology, and low complication rates. (High quality evidence, strong recommendation.) Small sessile polyps (6-9mm). b. ESGE suggests CSP for sessile polyps 6 – 9mm in size because of its superior safety profile, although evidence comparing efficacy with hot snare polypectomy (HSP) is lacking. (Moderate quality evidence, weak recommendation.)
JSGE Clinical Practice Guidelines 2020[24]	Indications for cold snare polypectomy. a. Cold snare polypectomy (CSP) is indicated for nonpedunculated benign adenomas < 10mm in size (recommendation weak [agreement rate 100%], level of evidence B). b. CSP is recommended for diminutive lesions $\leq$ 5 mm in size and is acceptable for 6–9-mm lesions (recommendation strong [agreement rate 100%], level of evidence B). c. CSP should be avoided for "flat and depressed-type" lesions and lesions suspected of being carcinoma on colonoscopy even if $\leq$ 5 mm in size (recommendation weak [agreement rate 100%], level of evidence B).
KSGE Guidelines for Colonoscopic Polypectomy 2012[25]	Diminutive polyps ($\leq$ 5mm). a. Considering its complete resection rate, safety, and histological quality, hot biopsy is not recommended method for removing diminutive polyps (low quality evidence, strong recommendation).

Table 2
Studies directly comparing efficacy and adverse events from CSP to HSP

Study	Polyp size (mm)	Polypectomy technique	IPB	PPB	Perforation
Horiuchi *et al.* 2014[a] [40]	1-10	CSP	5.7% (2/35)	0% (0/35)	0% (0/35)
		HSP	23% (8/35)[b]	14% (5/35)[b]	0% (0/35)
Aslan *et al.* 2014 [41]	5-9	CSP	–	1.4% (1/77)	0% (0/77)
		HSP	–	1.3% (1/71)	0% (0/71)
Gomez *et al.* 2015 [73]	2-5	CSP	0% (0/21)	0% (0/21)	0% (0/21)
		HSP	0% (0/18)	0% (0/18)	0% (0/18)
Yamashina *et al.* 2017	2-11	CSP	–	0% (0/231)	0% (0/231)
		HSP	–	2.2% (4/177)[b]	0% (0/177)
Zhang *et al.* 2018	6-9	CSP	2.5% (5/179)	0% (0/179)	0% (0/179)
		EMR	1.7% (3/179)	0% (0/179)	0% (0/179)
Kawamura *et al.* 2018 [35]	4-9	CSP	7.1% (28/394)	0% (0/394)	0% (0/394)
		HSP	3.5% (14/402)[b]	0.5% (2/402)	0% (0/402)
Papastergiou *et al.* 2018 [44]	6-10	Cold EMR	3.6% (3/83)	0% (0/77)	0% (0/77)
		Hot EMR	1.2% (1/81)	0% (0/78)	0% (0/78)
Takeuchi *et al.* 2019	1-9	CSP	0% (0/85)	4.7% (4/85)	0% (0/85)
		HSP	0% (0/83)	12.0% (10/83)	0% (0/83)

IPB : intra-procedural bleeding; PPB : post-polypectomy bleeding
[a] Patients on anticoagulation
[b] Statistically significant

Box 1
BSG and ESGE recommendations for endoscopy in patients on antiplatelet or anticoagulant therapy

High-risk Procedures

a. For high-risk endoscopic procedures in patients at low thrombotic risk, we recommend discontinuing P2Y12 receptor antagonists (e. g., clopidogrel) five days before the procedure (moderate quality evidence, strong recommendation). In patients on dual antiplatelet therapy, we suggest continuing aspirin (low quality evidence, weak recommendation).
b. For high-risk endoscopic procedures in patients at low thrombotic risk, we recommend discontinuing warfarin 5 days before the procedure (high quality evidence, strong recommendation). Check INR prior to the procedure to ensure this value is < 1.5 (low quality evidence, strong recommendation).
c. For high-risk endoscopic procedures in patients at high thrombotic risk, we recommend continuing aspirin and liaising with a cardiologist about the risk/benefit of discontinuing P2Y12 receptor antagonists (e. g., clopidogrel) (high quality evidence, strong recommendation).
d. For high-risk endoscopic procedures in patients at high thrombotic risk, we recommend that warfarin should be temporarily discontinued and substituted with low molecular weight heparin (low quality evidence, strong recommendation).
e. For all patients on warfarin we recommend advising that there is an increased risk of post-procedure bleeding compared to non-anticoagulated patients (low quality evidence, strong recommendation).
f. For high-risk endoscopic procedures in patients on DOACs, we recommend that the last dose of DOACs be taken at least 48 hours before the procedure (very low quality evidence, strong recommendation).
g. For patients on dabigatran with a CrCl (or eGFR) of 30–50mL/min recommend that the last dose be taken 72 hours prior to the procedure (very low quality evidence, strong recommendation). In any patient with rapidly deteriorating renal function a hematologist should be consulted (low quality evidence, strong recommendation).
h. bIf antiplatelet or anticoagulant therapy is discontinued, then we recommend this should be resumed up to 48 hours after the procedure depending on the perceived bleeding and thrombotic risks (moderate quality evidence, strong recommendation).

Adapted from Veitch AM, Vanbiervliet G, Gershlick AH, Boustiere C, Baglin TP, Smith LA, Radaelli F, Knight E, Gralnek IM, Hassan C, Dumonceau JM. Endoscopy in patients on antiplatelet or anticoagulant therapy, including direct oral anticoagulants: British Society of Gastroenterology (BSG) and European Society of Gastrointestinal Endoscopy (ESGE) guidelines. Gut. 2016 Mar;65(3):374-89.