Colonic polypectomy in 2024: hot or cold?

K. Ferdinande[1], L. Desomer[2], D. De Looze [1], D.J. Tate[1]

(1) Department of Gastroenterology and Hepatology, Ghent University Hospital, Ghent, Belgium; (2) Department of Gastroenterology and Hepatology, AZ Delta Rumbeke; Rumbeke, Belgium.

Abstract

Colorectal cancer (CRC) is the second and third leading cause of cancer death in men and women respectively worldwide. Colonoscopy is the gold standard screening test to detect premalignant lesions with endoscopic polypectomy preventing evolution to CRC. Endoscopic polypectomy is effective with a higher safety profile and is less costly as compared to surgery. Best-practice polypectomy technique is crucial, as 10% of polyps <2 cm are incompletely resected and may therefore play a significant role in the development of post colonoscopy colorectal cancer (PCCRC). Hot snare polypectomy (HSP) has traditionally been the technique of choice for endoscopic polypectomy but is associated with a small but appreciable risk of adverse events, primarily post-polypectomy bleeding and perforation. Recent high-quality studies have demonstrated the similar efficacy and superior safety profile of cold snare polypectomy (CSP) for polyps less than 10 mm in size. In daily clinical practice, the vast majority of colorectal polyps encountered by gastroenterologists are less than 10 mm, making CSP the technique of choice. Widespread use of CSP over HSP may therefore significantly reduce the number of adverse events associated with endoscopic polypectomy. The indication for CSP may be extended to larger lesions, including large, non-dysplastic sessile serrated lesions and small pedunculated polyps with a thin stalk. In addition, the risk-benefit ratio of CSP is favourable in patients in whom interruption of anticoagulants is a concern in terms of thromboembolic risk.

In this review, the focus will be on safety of hot versus cold snare polypectomy as a technique for the resection of diminutive and small polyps. (Acta gastroenterol. belg., **2024,** 87, **505-516**).

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Introduction

The impact of colonic polypectomy

Colorectal cancer (CRC) is a major public health concern worldwide. It is the third most common cancer in humans and the second and third leading cause of cancer deaths in males and females respectively (1). A substantial proportion of CRC morbidity and mortality can be mitigated through appropriate screening and surveillance. CRC arises due to a series of mutations, occurring through multiple molecular pathways, transforming normal colonic mucosa into colonic polyps, the precursors of all (2,3). This gradual progression presents opportunities for screening and intervention. Colonoscopy is the gold standard screening test for CRC and has been shown to prevent CRC and deaths from CRC through the detection and removal of premalignant polyps using endoscopic polypectomy (4-6). Studies have shown that previous exposure to colonoscopy was associated with a 77% reduction in CRC incidence and up to a 53% reduction in CRC mortality over a median follow-up of 15.8 years (5,7,8,9,4,10).

However, colonoscopy is highly dependent on the technique of the endoscopist (11,12,13), the quality of the examination (bowel preparation, withdrawal time etc.) and of the colorectal polypectomy (14,15). Incomplete resection of colorectal polyps contributes to the development of PCCRC in 20-27% (16,17,18,19).

For many years, hot snare polypectomy (HSP) was the technique of choice (4,5). HSP has a small but appreciable risk of major complications such as delayed bleeding and perforation resulting in substantial implications in terms of morbidity, lost working days, prolonged hospitalisation and costs to society (20-27).

General principles of endoscopic polypectomy

Historically endoscopic polypectomy was performed using electrocautery applied through a snare, variably utilising a submucosal lift prior to transection. Certainly, there is significant evidence for its efficacy, both in small (<10mm) and advanced polyps (³10mm) (4,5).

Endoscopic polypectomy techniques have evolved rapidly over the last decade and even very large, laterally spreading polyps can be safely and effectively removed with excellent long-term efficacy, low rates of adverse events and at a lower cost to healthcare systems than surgery (20).

The predicted risk of submucosal invasive cancer (SMIC) presented by a particular polyp is crucial to the curative potential of colonoscopic polypectomy. As the size of colorectal polyps increases, the risk of submucosal invasion increases (28). Location, morphology and surface vascular pattern analysis (optical diagnosis) are tools commonly used to estimate the risk of submucosal invasive cancer pre-polypectomy (29). If there is a significant risk of SMIC en-bloc resection is recommended (28,29), and indeed some lesions may not be suitable to endoscopic resection.

Correspondence to: Kementie Ferdinande, Department of Gastroenterology and Hepatology, Corneel Heymanslaan 10, 9000 Ghent, Belgium.
Email: Kymentie.ferdinande@uzgent.be

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The vast majority of colorectal lesions detected and managed by endoscopists on a daily basis are <10mm [~88%; 69% <5 mm (diminutive), 19% 6-9 mm (small)] (30), sessile or flat and present virtually no risk of invasive disease (31). These lend themselves well to a technique which is effective and without significant risk to the patient. In this review, we will focus on safety of hot versus cold snare polypectomy as a technique for the resection of such polyps.

The downside of hot snare polypectomy in daily practice

Hot snare polypectomy (with or without submucosal injection) was the predominant technique used to remove small and diminutive polyps for many years (32,33,34). The main principle of HSP is the use of electrosurgical energy (ESE) to transect tissue, most commonly using a snare. The technique is effective at complete resection of such polyps (35). It is thought to minimize intra-procedural bleeding by cauterizing the transected tissue leading to immediate haemostasis (36). In addition, the thermal injury may ablate any residual polyp tissue at the resection margin potentially reducing the risk of polyp recurrence (34).

Despite the efficacy of HSP, there are infrequent, but potentially serious, adverse events associated with the use of ESE - post-polypectomy bleeding, perforation and thermal damage to the histological sample (37).

1. Bleeding complications

a) Intraprocedural bleeding

Intra-procedural bleeding (IPB) is heterogeneously defined, but generally implies bleeding during or immediately after endoscopic polypectomy requiring any form of active haemostasis (36). Risk factors for IPB include large sessile polyps and laterally spreading lesions >=20 mm (38). IPB can be controlled by the endoscopist using endoscopic coagulation [the tip of the resection snare (snare tip soft coagulation) (38) or a coagulation forceps] or mechanical therapy (clip placement) (39). Clips, however, can impede continuation of the polypectomy in case of piecemeal resection and are therefore not recommended until the field is clear. IPB is endoscopically treatable in the vast majority of cases and usually does not add morbidity nor does it change the outcome of the procedure (40,41).

b) Post procedural (delayed) bleeding

Much more significant in terms of morbidity, is delayed post-procedural bleeding (PPB). Commonly occurring within 48 hours after the procedure (but possible up to 3-4 weeks later) (42), it is the most frequently observed adverse event requiring admission to hospital and/or re-intervention (36,43). It occurs due to invisible damage to blood vessels in the deep submucosa caused by the use of ESE during polypectomy. During the process of ulcer healing and granulation after the resection these vessels may herniate to the surface and start to bleed (41,44). The incidence of PPB critically depends upon on the size of the polyp and the location in the colon. Polyps of less than 10mm in size have a risk of PPB ranging from 0.4-1.1% (45). Larger polyps (³ 20mm) in size have a risk of delayed bleeding up to 6.2% (46). Studies on both large (³ 20mm) and small polyps (<10mm) confirm the right colon (particularly the caecum) as the highest risk location (OR 13.5 (95% CI [3.9, 46.4] in a very large study of 130 831 colonoscopies) (47). Other risk factors demonstrated in ³20 mm polyps include presence of IPB (OR 2.16-95% CI [1.16, 4.05]), and use of non-microprocessor controlled current (OR 2.03 – 95% CI [1.04, 3.95]) (46). Concomitant use of anticoagulants but not of antiplatelet medication was demonstrated as an independent risk factor for PPB (OR 13.37 – 95% CI [4.10, 43.65]) (46). The occurrence of PPB, whilst infrequent, can lead to patient inconvenience and/or morbidity, lost workdays, costs to healthcare systems and secondary mortality (44). There is also the additional risk of inadequate treatment due to an inexperienced endoscopist in an emergency setting (43,44,48).

The occurrence of PPB appears directly related to the use of ESE, since recent studies have demonstrated that CSP results in dramatically lower rates of PPB than HSP (49,50). In a recent large meta-analysis consisting of 8 studies there were no PPB events in the cold snare arms of any of the included studies (23). Other studies of larger lesions removed using piecemeal cold snare also demonstrate no PPB events (51,52). This suggests one way to mitigate the occurrence of PPB is to use cold snare for appropriate lesions

2. Perforation risk

a) Immediate perforation

Immediate perforation is a well-established adverse event during HSP due to diathermic transection or significant injury to the muscularis propria (36). It is extremely rare (0.06% in one prospective study of The English National Health Service Bowel Cancer Screening Programme (NHSBCSP) including 130 831 colonoscopies (167 208 polypectomies)) (53) in HSP of polyps under 10mm in size. Risk factors for immediate perforation include increasing size of polyp, sessile polyp morphology and right colonic location in particular the caecum. The caecum is a risk factor for perforation as the colonic wall is thinner compared to the colonic wall of the ascending and transverse colon (due to the thinner muscle layer). In larger polyps (³ 20mm) attempted en-bloc resection and non-lifting lesions result in higher rates of immediate perforation despite submucosal injection (54). Most immediate perforations can be successfully treated endoscopically with clip placement, and only a minority of patients require surgery (55,56). The degree of deep mural injury has been described by Burgess et al. in the Sydney classification of deep mural injury, with clipping from type 2 deep mural injury onwards to prevent delayed perforation (57,59).

b) Delayed perforation

Delayed perforation is a feared adverse event after polypectomy. It describes the situation where the patient develops significant abdominal pain after having left the procedure room. The pain is usually non-responsive to standard non-opioid analgesia and abdominal imaging shows findings suggestive of a perforation (free air/ fluid on imaging) (58). 48 Hours after completing colonoscopy there is a significant risk of faecal peritoneal contamination and endoscopic therapy is often impossible and the patient requires surgery with closure of the perforation and peritoneal washout (59).

It has emerged that delayed perforation is often the result of an unrecognised muscularis propria injury which could potentially have been treated at the index procedure (60). Submucosal injection with indigo carmine can be applied to accurate assess the resection defect and early recognition of muscularis propria injury' (61).

The avoidance of perforation during polypectomy is a niche for CSP. Many experts believe it is physically impossible (within the boundaries of reasonable clinical practice) to transect the muscularis propria without diathermy. Supportive of this is the fact that reports of perforation after cold snare are limited to a single case report (62).

3. Post polypectomy coagulation syndrome

Post polypectomy coagulation syndrome is a rare manifestation of peritoneal irritation because of diathermy but without evidence of perforation on computed tomography scan. It occurs in 1.35 %-3.7 % of patients undergoing excision of larger lesions. It is characterized by fever, abdominal pain, and increased inflammation markers (C-reactive protein and leukocyte count). Post-polypectomy coagulation syndrome has an excellent prognosis and is managed conservatively (63).

Cold snare polypectomy

Cold snare polypectomy (CSP) is the main alternative to HSP. The technique and use of cold snare polypectomy was first studied by Tappero et al. in 1992 (64). It involves the use of a colonic snare, without diathermy, to entrap, strangulate and excise a gastrointestinal polyp. CSP thereby avoids the above discussed adverse events related to the use of diathermy (65,66,67,68). CSP emerged as a safe and effective technique for the removal of colorectal polyps <10 mm. According to ESGE it is the first line recommendation for resection of diminutive and small polyps <10 mm (20).

Evidence base

1. Complete resection rate (CRR)

Complete resection is an essential requirement of polypectomy. Especially because incomplete resection of colorectal polyps may contribute to the development of post-colonoscopy colorectal (PCCRC (16,17,18,19,69). Several large randomized controlled trials have compared complete resection rate (CRR) of HSP and CSP of non-pedunculated diminutive and small polyps. A large prospective multicenter non-inferiority randomized controlled trial withhold a complete resection rate of 98.2% for CSP and 97.4% for HSP for 4-9 mm colorectal polyps (OR 0.99 – 95% CI [0.97, 1.01]), concluding CRR for CSP was not inferior to that for HSP (non-inferiority P <0.001) (70). Another large monocentric prospective randomized controlled trial reported a CRR of 91.5% for CSP and 98.5% for HSP for 6-9 mm colorectal polyps (OR 1.08 - 95% CI [1.03, 1.13]) (71).

Other smaller randomized controlled trials were unable to detect a statistically significant difference in CRR of HSP in favor of CSP. These studies concluded CSP had similar CRRs when compared to HSP (CRR CSP 77%-92%, CRR HSP 85%-96% - OR 0.95 - 1.19) (19,66,72,73,74)The meta-analysis by Shinozaki et al. (1665 patients with 3195 polyps), including the aforementioned randomized controlled trials, evidenced the HSP group had a similar CRR comparable to the CSP group (95% versus 94%, RR 1.02, 95% CI [0.98, 1.07], P = 0.31) with strong heterogeneity (I^2 = 61%)) (23).

2. Polyp retrieval

Retrieval of specimen after CSP is another essential requirement to determine the completeness of resection in polypectomy. A concern associated with CSP is the difficulty in retrieval of the specimen for pathologic examination. Several large randomized controlled trials compared polyp retrieval rate of CSP to polyp retrieval rate of HSP. In the meta-analysis of Shinozaki et al. reviewing eight randomised controlled trials, the polyp retrieval rate in the eight studies varies between 92% - 100% both in the HSP group and in the CSP group. All eight studies reported in the meta-analysis of Shinozaki had a similar polyp retrieval rate in both HSP and CSP (97% versus 97%, RR 1.00, 95% CI .00-1.01] with no heterogeneity (I^2 = 0%) (75,76,77,66,70,72,73,74).

3. Complications

a) Postprocedural bleeding

The occurrence of PPB appears directly related to the use of ESE, since recent studies have demonstrated that CSP results in dramatically lower rates of PPB than HSP (49,50,78). In a recent meta-analysis including seven randomized controlled trials, there were no detected delayed PPB in the CSP group compared with 0,8% in the HSP group, but there was no statistically significant difference (0% in the CSP versus 0.8% in the HSP group, RR 7.53, 95% CI [0.91-59.33], P = 0.06) (75,77,66,79,80,74,81,82). Other studies of larger lesions removed using piecemeal CSP also demonstrate no PPB events (51,52).

In contrast, in two large randomized controlled trials intra-procedural immediate bleeding was more detected

in the CSP group than in the HSP group. In the study of Paspatis et al., intra-procedural bleeding occurred in 9.13% of the CSP group versus 0.97% of the HSP group (P = <0.001) but without clinical significance because the bleeding resolved spontaneously and require no additional intervention (25). In another large randomized controlled trial, intra-procedural bleeding was also more frequent in the CSP group (7.1%) than in the HSP group (3.5%) (P = 0.022) but was handled with endoscopic haemostasis (70). The bleeding caused by CSP is capillary because small polyps do not contain large blood vessels, so the bleeding stops normally quickly and spontaneously (83).

b) Immediate and delayed perforation

Multiple studies demonstrate better results for CSP compared with HSP in terms of safety, with no immediate or delayed perforations related to CSP described (75,49,77,66,79,84,80,74,85). The avoidance of perforation during polypectomy is a niche for CSP. In two recent published meta-analysis, which included more than 1000 CSPs, no perforations were noted (23,81). Only a single case report of two cases relates to perforation after CSP of diminutive polyps, and no cases to piecemeal CSP (62).

Conclusion

Recent high-quality studies have established cold snare polypectomy as a safe and efficient technique for lesions less than 10 mm. Therefore, CSP is the preferred first choice endoscopic technique for resection of diminutive and small polyps <10 mm (20). CSP has a superior safety profile avoiding any diathermy-related complication. Bleeding is typically minor, immediate and insignificant. The risk of perforation is also virtually nil associated with CSP.

Optimizing efficacy in cold snare polypectomy

1. Is this polyp suitable?

Current evidence-based recommendations (20) suggest that CSP should be the preferred technique for colorectal small and diminutive polyps < 10mm in size. Lesions selected for cold snare should undergo endoscopic imaging using a combination of high-definition white light, virtual chromoendoscopy or chromoendoscopy (86). Polyps suggestive for submucosal invasive disease (according to Paris, NICE, Kudo and JNET classification) should not be resected with a cold snare (see comments above) (28,87,29).

2. Snare choice

Using a dedicated small (10mm or smaller) snare with a stiff thin wire (0.3mm thick or less) versus a standard snare (> 0.47mm thick) is considered to be advantageous for performing CSP. Transection of tissue is quicker and easier with a thin-wire snare and the resection margin is crisp, allowing for the efficient detection of residual adenoma at the margin. Anecdotal evidence suggests immediate bleeding is less frequent using a thin wire snare. The prevalence of delayed PPB is also significantly less common when using a thin wire snare compared with a standard snare (82). These theoretical advantages in terms of bleeding complications and defect inspection are yet to be demonstrated in comparative studies. A recent multicentre randomized trial of Sidhu et al. (88) demonstrates that CSP is safe and effective with very low rates of incomplete resection independent of the diameter of the snare wire used (<0.3mm thick snare vs. > 0.47mm thick snare) (88). This suggests that optimal operator technique is more important than the snare design to minimize residual adenoma after CSP.

The authors in this expert study believe that a dedicated thin-wire snare may have an advantage compared to a thick-wire snare in terms of tissue dissection, defect inspection and immediate bleeding issues, but snare selection does not make a difference in terms of the percentage of complete resection.

3. Cold snare polypectomy: technique

The optimal technique for cold snare polypectomy involves initially placing the polyp to be resected at the 6 o'clock position (since this is the position where accessory channel exits the endoscope tip). The polyp is placed in the centre of the snare with a rim of normal tissue visible between the polyp and the snare. It is the authors opinion, that the most important way to prevent residual tissue at CSP is to ensure a 1-2 mm margin of normal tissue prior to closing the snare (principle of 'Aiming for the fried egg' – figure 1). Firm downward pressure is exerted with the tip of the endoscope using the up-down control. Suction of luminal gas allows the capture of more tissue. The endoscopist asks the assistant to slowly close the snare while observing the closure. The endoscopist checks the amount and mobility of the captured tissue to ensure that the muscularis propria is not entrapped in the snare.

The endoscopist then asks the assistant to transect the tissue. It is important that the assistant does not re-open their hand. Tissue transection can take up to 10 seconds even with a dedicated cold snare. If after this time transection has not occurred, the tissue can be amputated [guillotine technique] on the tip of the endoscope with gentle traction on the snare catheter. If despite this the tissue does not transect the snare can slightly be opened and repositioned. In this situation the endoscopist will often find that the mucosa has been removed from the underlying submucosa and only a stalk of bunched-up submucosa or muscularis mucosae remains (submucosal stalk or protrusion). Under no circumstances should ESE be used when tissue transection does not occur (since the likely reason is muscularis propria entrapment and adding ESE may lead to a perforation). Figure 2 demonstrates how to perform a high-quality CSP, whilst figure 3 demonstrates how not to perform a CSP.

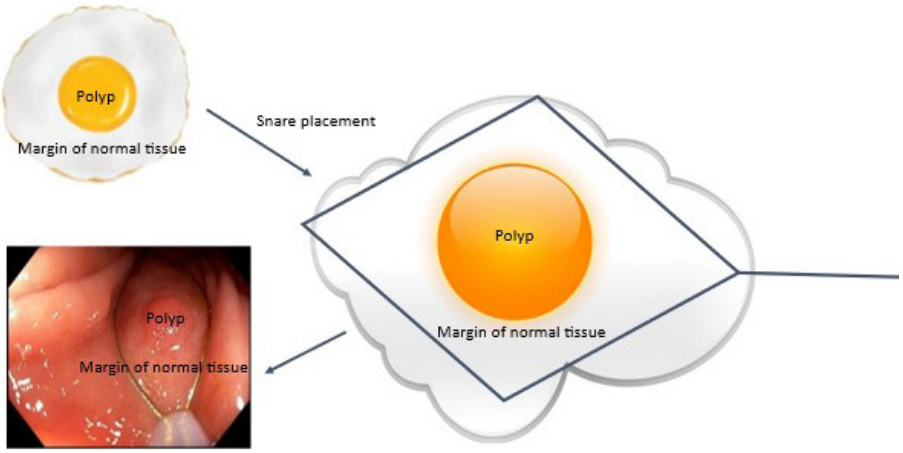

Figure 1. — Principle of the fried egg to determine a rim of normal tissue at the edge of a progressant cold snare polypectomy. The polyp is placed in the centre of the snare with a rim of normal tissue visible between the polyp and the snare as illustrated.

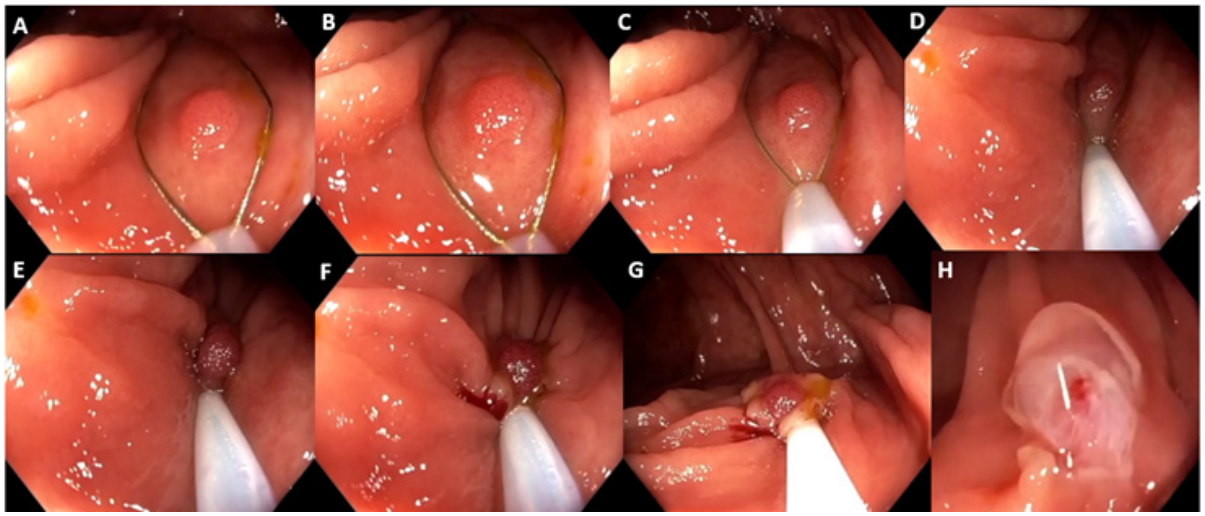

Figure 2. — How to perform a CSP: A and B: The polyp to be resected is placed at the 6 o'clock position, in the centre of the snare with a rim of normal tissue between the polyp and the snare. C and D: Firm downward pressure is exerted with the tip of the endoscope using the up-down control. Suction of luminal gas allows the capture of more tissue. E, F and G: The snare is slowly closing while observing the closure. The endoscopist then asks the assistant to transect the tissue. H: Post-CSP defect inspection after irrigation of the defect with the colonoscope water jet.

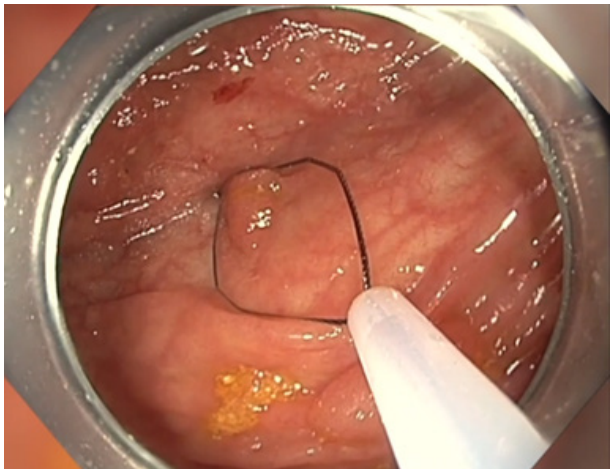

Figure 3. — How not to perform a CSP. The polyp is located at the edge of the snare prior to closure and there is no rim of normal tissue between the polyp and the snare.

4. Inspection of the margin of the resection defect

Once the tissue is transected the defect can be inspected. The post-CSP defect should be irrigated directly with the colonoscope water jet. The stream will often create a submucosal cushion, accentuating the defect's borders and tamponading immediate bleeding. The endoscopist should examine the defect base and edges with both white light and virtual chromoendoscopy to ensure that there is no macroscopic residual polyp tissue at the margin of the resection. If residual tissue is detected this should be treated using a further cold snare resection, with the edge of the defect used as a guide for further snare placement.

Since CSP is not a technique that lends itself easily to histopathological examination of the completeness of excision, the determination of a complete resection of a polyp is by observation by the endoscopist and should be recorded, per polyp, in the procedure report.

Figure 4. — CSDP. Cold snare defect protrusion after cold snare polypectomy. Stalk of bunched-up submucosa or muscularis musosae.

5. Cold snare defect protrusions (CSDP)

Pale protrusions within the CSP defect (cold snare defect protrusions (Figure 4) are observed in up to 6.4% of cases and often concerns endoscopists about the aetiology and significance (89). CSDP have been suggested to represent incomplete polyp resection, vascular structures or submucosal elements. The study of Tutticci et al. (257 polyps <10 mm; 18% of CSP had a tissue protrusion) showed that CSDP are associated with polyp size ≥ 6 mm (OR 3.684 – 95% confidence interval (1.788, 7.593)) and do not represent vascular structures, nor contain residual polyp and are not associated with adverse outcomes (90). CSDP may represent incomplete mucosal layer excision (submucosa in 94% of CSDP, muscularis mucosae in 80% of CSDP histopathologically), so caution with high grade dysplasia is warranted (90). On the other hand, a more recent study published in 2023 showed that forced CSP, i.e. using traction to transect the mucosa, is associated with protrusions in 96.2% (vs 6.4%, P<.001) of cases and an incomplete resection rate (IRR) of 12.5% vs 6.2% (P=0.02) based on sampling the margins of the pathological specimen. This was more likely to happen in lesions ≥ 6 mm (RR 2.37, P<.001) and in SSL (30.5% vs 16%, P<.001) (89). This study does however not show that the protrusion itself contains adenoma. Therefore, focus on technique is remains priority when using CSP, with adequate inspection of the margin of the defect and when necessary, performing an extra snare excision, rather than focus on the protrusion.

6. Bleeding after cold snare polypectomy

Immediate bleeding often concerns endoscopists starting out with CSP. This is rarely significant and, in the absence of pulsatile bleeding does not require treatment. Bleeding is due to the superficial submucosal/lamina propria excision that results from CSP whereby resultant bleeding is often from superficial capillaries rather than larger submucosal vessels (76).

Delayed PPB is extremely rare in patients who do not use anticoagulants and who undergo CSP. CSP resection specimens contain a more superficial transection through the submucosa. Although not proven this is potentially how the risk of delayed bleeding is mitigated via the avoidance of deep submucosal vessels. More importantly, avoiding thermal injury to the deeper submucosal layer will leave the deeper and larger submucosal vessels intact (49). Recent studies have demonstrated that CSP results in lower rates of PPB than HSP (patient basis: RR: 7.53, 95% CI: 0.94-60.24, P = 0.06; polyp basis: RR: 7.35, 95% CI: 0.91-59.33, P = 0.06) (23). In fact, in a recent large meta-analysis there were no PPB events in the cold snare arms of any of the included studies (23). Other studies of larger lesions removed using piecemeal cold snare also demonstrate no PPB events (51,52).

7. Pathological specimen

a) Polyp retrieval

A common problem with CSP is retrieval of the specimen for histological examination and to determine the completeness of the resection. Specimen retrieval is variable with retrieval rates between 81% and 100% (91,92). This is likely to be variable as the resected tissue usually does not remain fixed to the snare and has the potential to be lost in fluid within the colon. Using fluid irrigation and suction of dependent fluid pools can help to retrieve the specimens more efficiently (91). For multiple CSPs a polyp trap (a device to filter the suction channel and separate solid from liquid) can be useful.

b) Avoiding polyp fragmentation

Another limitation to determine the completeness of resection in polypectomy is the potential for polyp fragmentation. Fragmentation of the specimen may occur due to shearing forces on the polyp when passing through the suction channel. Some practitioners suggest that removal of the suction valve button covering the open suction valve cylinder with a finger prior to suction can prevent this (93). Polyp fragmentation can be mitigated using methods that extract polyps through the instrument port using currently available devices, such as a polyp trap (93).

c) Specimen characteristics

In comparison to specimens obtained using ESE, CSP resection specimens contain a more superficial transection through the submucosa (94). This technique is therefore not suitable to remove polyps with endoscopically predicted submucosal invasive disease.

Role of cold biopsy forceps polypectomy

Evidence base for cold biopsy forceps polypectomy (CBFP)

1. Complete resection rate

In recent studies the effectiveness of CBFP has been variable (95,96,97,98). Complete resection rate varies widely between 39 and 92% (95,96,97,98). There are few data on CSP in direct comparison with cold biopsy forceps polypectomy (CBFP) for resection of small and diminutive colorectal polyps. Studies indicate that CSP is superior to CBFP in the completeness of resection of diminutive polyps (95,96). In a randomised controlled trial including diminutive polyps ≤5mm, the rate of histologic eradication was significantly higher when using CSP than using CBFP (93% versus 76%, P=0.009) (95). Lee et al demonstrated in their randomised controlled trial that polyps ≤7mm, the percentage of complete resection was significantly higher for CSP than for CBFP (96.6% versus 82.6%, P=0.01) (96). In a prospective cohort study that included diminutive polyps, histological examination showed that only 39% of the polyps were completely resected using CBFP (97). However, higher complete resection rates were observed in another prospective but small cohort study including small polyps ≤5mm. Approximately 92% (95% CI [85.8,98.8%]) of all diminutive polyps and 100% (95%CI [81.5,100%]) of 1-3 mm polyps were completely resected using CBFP until no polyp was visible by chromoendoscopy using indigo carmine spray (98).

The new ESGE guidelines (not published yet) will recommend against the use of CBFP because of IRR (moderate quality of evidence, strong recommendation).

2. Safety profile of CBFP

Cold biopsy forceps polypectomy equally avoids the adverse events associated with diathermy/electrocautery (post-polypectomy bleeding and perforation) (96,98). In several studies comparing CSP with CFP, no clinically significant intra- and post-procedural bleeding occurred when using CFP (95,96).

3. Polyp retrieval rate

Specimen retrieval rates are greater than other polypectomy methods and have been reported at 100% (92). The excellent retrieval rate probably reflects that resected tissue remains retained within the forceps and no specific retrieval techniques are necessary.

4) The role of CBFP in technically difficult CSP

If CSP is technically difficult in diminutive and small polyps, CFP may be considered (20). The use of cold biopsy forceps for polypectomy should be limited to cases where previous attempts at CSP have been unsuccessful. This occurs when the polyp is located at the 9 to 11 o'clock position and the colonic anatomy does not allow to reorientate the polyp to the 6 o'clock position (optimal technique to perform cold snare polypectomy). In these cases, CBFP may be used as a technique (99). Careful inspection with absence of visible residual polyp is paramount to prevent residual polyp being left in-situ.

5. How to achieve a higher CFP complete resection rate for diminutive polyps?

a) Submucosal injection prior to CBFP

The use of a submucosal injection helps delineate normal from polypoid mucosa. Also, the separation of mucosa from submucosa seems to allow for capturing a greater amount of mucosa including the polyp tissue. A recent prospective cohort study used a submucosal injection prior to CBFP of polyps ≤7mm. Overall the complete resection rate was 86% (95% CI [75-93%]). The 6- and 7-mm polyps had a complete resection rate of 76.2%. Polyps ≤5mm had a complete resection rate of 91.7%. This study showed that a submucosal injection prior CBFP may achieve more effectiveness in terms of complete resection rate than CBFP without prior submucosal injection (100).

b) Use of jumbo cold biopsy forceps polypectomy

Compared with standard cold forceps polypectomy, a jumbo forceps offers the advantage of a wider opening diameter. Currently, only one prospective randomised controlled trial directly compared the complete resection rates of jumbo CBFP with CSP for resection of diminutive colorectal polyps (≤5mm). In this study, the complete resection rate was not significantly different between jumbo CBFP and CSP (92% versus 92,2%; P= 0.947) (101).

Pushing the boundaries for cold snare polypectomy

Improving incomplete resection rate for small and diminutive polyps <10 mm

Large studies suggest polypectomy is often incomplete (16). Incomplete resection rate increases with large polyp size (IRR for polyps <10 mm and ≥10 mm were respectively 18% and 21%) and varies according to histology (IRR higher for serrated polyps (26%) compared with adenomas (16%)) (102).

CSP carries a theoretical risk of residual polyp due to the absence of the coagulation effect of diathermy on the surrounding tissue (protective effect of diathermy on completeness of polypectomy when using HSP). Therefore, ensuring a 1-2 mm of margin of normal tissue (required for efficacy due to the lack of ESE) and margin inspection (absence of visible residual polyp tissue at polypectomy) as described above is paramount

to prevent residual polyp being left in-situ. The study of Sidhu et al. demonstrate that in a randomised study of >700 polyps, with a cohort of endoscopists who had this message reinforced via structured training prior to commencement, the rate of margin positivity was under 1,5% when assessed by quadrantic biopsy (103)

A recent study of Mou et al. Investigated the impact of submucosal saline injection (SI) during CSP for colorectal polyps sized 3-9 mm. The IRR was not decreased in the SI-CSP group compared with that in the conventional CSP group (1.7% vs 1.4%, P = 1.000), concluding that submucosal saline injection during CSP for colorectal polyps sized 3-9 mm did not decrease the IRR or reduce adverse events.

Cold snare polypectomy for non-pedunculated polyps 10-19 mm

HSP and EMR are the standard of care in resecting colorectal polyps ≥10 mm (20). To avoid the risk of electrocautery-induced damage, there is recent evidence about using CSP and SI-CSP (104,105,106). The results of the systematic review and pooled analysis of Chandrasekar et al. were excellent with CSP of colorectal polyps >10 mm in terms of post polypectomy bleeding, complete resection, and residual polyp rates (105). The retrospective study of Van Overbeke et al. indicates similar results. The recent published systematic review and meta-analysis of Abdallah et al. including 2592 polyps in 1922 patients demonstrated that SI-CSP has an excellent safety profile for resection of colon polyps. The polyp recurrence after SI-CSP was 6.7% (95 %CI 2.4 %-17.4%, *I2* = 94%). The recurrence rate was 12.3% (95% CI 3.4%-35.7%, *I2* = 94%) for polyps ≥20 mm, 17.1 % (95% CI 4.6% - 46.7%, *I2* = 93%) for adenomas, and 5.7 % (95% CI 3.2%-9.9%, *I2* = 50%) for SSLs. This study demonstrated an excellent safety profile with variable recurrence rates with as risk factors for incomplete resection rate older age, large polyp size and advanced histology (107).

Randomized controlled trials comparing CSP with HSP of polyps ≥10 mm (without any endoscopic evidence for submucosal invasive cancer (SMIC)) are required for further investigation.

SI-CSP for large non-dysplastic sessile serrated lesions (L-ND-SSL) (≥20 mm)

Sessile serrated lesions (SSLs) are important precursor lesions for colorectal cancer once they have developed dysplasia (108,109). Recent studies demonstrated the safety and feasibility of piecemeal CSP for non-dysplastic SSLs (ND-SSL) (Figure 5) without diathermy-related adverse events (no delayed bleeding and no perforation) (110,111,112). The soft consistency of SSLs maximized the efficacy of a cold-snaring approach. Currently, piecemeal cold snare EMR is the technique of choice for resection of ND-SSL (110,111,112).

Figure 5. — ND-SSL Non-dysplastic sessile serrated lesion.

(Small) pedunculated polyps <10 mm with thin stalk

The ESGE recommends HSP for pedunculated polyps of all size. There is one recent retrospective study of Arimoto et al. conducted to examine the safety of CSP for pedunculated polyps smaller than 10 mm with thin stalks (polyps with a stalk width of >2.6 mm were excluded) (113). Pedunculated polyps are risk factors for delayed PPB after HSP. In this study, there were no delayed PPB in the CSP group compared to HSP group (0% versus 4.7%) (113). Immediate bleeding was significantly higher in the CSP group (38.2% versus 3.5%) (113). There were potential confounding factors in the study: first the rate of prophylactic clipping prior to polypectomy was higher in the HSP group compared to the CSP group (20.9% versus 0%) (113). Second, almost all HSPs had prophylactic clipping after the procedure when compared to CSP (98.8 versus 44.1%) (113). After performing univariate analyses on variables that may influence the risk of delayed post-polypectomy bleeding, HSP was found to be the only significant risk factor (113). Another interesting finding in the study of Arimoto et al. was that in the CSP group 21% of patients were taking antiplatelets, anticoagulation or both (113). Despite continuing antithrombotic/ anticoagulative therapy at the time of the procedure, there was no post-polypectomy bleeding noted in these patients (113). The study mentioned above suggests that CSP can be performed as a safe technique for the removal of <10mm pedunculated polyps, moreover, it could potentially be safe in patients on active antithrombotic or anticoagulative therapy at the time of the procedure (114). The study of Arimoto et al. demonstrated evidence of the safety and efficacy of CSP in small pedunculated polyps but it has a retrospective study design, and the results should be interpreted with some caution (113). Further high-quality research (randomized controlled trials) is recommended to confirm these results.

Cold snare polypectomy whilst continuing anticoagulation: risk – benefit ratio

In an aging population, the risk for thromboembolic events increases as do indications for anticoagulant/antithrombotic therapy. Anticoagulants confer an increased risk for haemorrhage, but withdrawal of anticoagulant therapy puts the patient at risk of thromboembolic events. Recently, several studies demonstrated the possibility of continuing anticoagulant/antithrombotic (including dual antiplatelets) therapy in patient who underwent CSP for treating diminutive and small colorectal polyps without a significant increased risk for delayed PPB (82,115,116). The study of Horiuchi et al. found a significantly increased risk of immediate and delayed bleeding with HSP compared to CSP in patients on Warfarin therapy (115). Tackeuchi et al. compared a group of patients who underwent HSP with withdrawal of oral anticoagulation before the procedure and heparin bridging to a group of patients who underwent CSP whilst continuing anticoagulative therapy. Major bleeding was significantly more common in the HSP group, despite the interruption of anticoagulation before the procedure (116). These findings provide evidence that stopping antiplatelets of anticoagulant before cold snare resection of small polyps may not be necessary. This is particularly important in patients where the risk of interrupting anticoagulant therapy may be significantly higher in terms of risk of thrombotic vascular events than the potential future risk of their colorectal polyp(s). Further large prospective studies are required to further investigate this area.

Conclusion

Colonoscopy has been shown to reduce the risk of colon cancer by enabling the removal of precancerous lesions. However, colonoscopy is not perfect and priorities for improvement include improved polyp detection and improvement in polypectomy completeness and safety to reduce the incidence of interval cancers.

The vast majority of colorectal lesions seen by gastroenterologists every day are <10mm in size and present virtually no risk of invasive disease. These lend themselves well to a technique which is effective and without significant risk. For many years HSP was the standard of care for diminutive and small polyps but has, though infrequent, important adverse events including delayed post-polypectomy bleeding and perforation. Whilst these are not common outside of the resection of large polyps, significant numbers of diminutive polyps are detected and resected every day, potentially translating this into a significant problem at a population level after all.

Driven by an impressive safety and cost profile, CSP for small colonic polyps is being rapidly and widely adopted as an alternative method for hot snare polypectomy. CSP is established by the ESGE as a first-choice endoscopic technique for resection of diminutive and small polyps <10 mm. Complete resection is important to confirm curability. This should be determined endoscopically due to the difficulties surrounding CSP specimen margin interpretation. CSP carries a theoretical risk of polyp residual due to the absence of thermic effect on margin tissue. To overcome this problem, optimal cold snare technique is paramount and more important than the snare design. Multiple recent high-quality studies have demonstrated evidence for a similar complete resection rate compared to HSP with a superior safety profile in large studies avoiding any ESE-related complication as well as a similar polyp retrieval rate. CSP may also be considered in certain circumstances outside these criteria e.g. non dysplastic sessile serrated lesions, small pedunculated polyps <10 mm with thin stalk <2,7 mm and in patients in whom interruption of anticoagulants is a concern in terms of thromboembolic risk.

In conclusion, CSP is the standard of care for the majority of polyps found during everyday endoscopy.

Conflicts of interest

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