Cold snare polypectomy for colorectal polyps: current uses and development

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Cold snare polypectomy (CSP) is one of the endoscopic resection technologies and has been recommended for the removal of diminutive polyps (<5 mm) or noncancerous polyps up to 10 mm in size to reduce the incidence and mortality rate of colorectal cancer.[1] Recently, CSP has made some progress. In this paper, the indications, efficacy, safety, and development of CSP are reviewed.

The European Society of Gastrointestinal Endoscopy (ESGE) Clinical Guideline recommends CSP as the preferred technique for the removal of diminutive polyps (≤5 mm), which achieves a high rate of complete resection, low complication rates, and allows adequate tissue sampling for histology (High-quality evidence, strong recommendation).[1] For small polyps (<10 mm), the results of several randomized, single-center trials have shown that CSP can satisfy the requirements for histological eradication, safety, and promptness.[2,3] ESGE also suggests the use of CSP for sessile serrated polyps (SSPs) that are 6 to 9 mm in size because of its superior safety profile (Moderate quality evidence, weak recommendation.)

Several studies have been conducted to evaluate the outcome of cold snare resection for polyps ≥10 mm in size.[4] The results revealed that using CSP did not increase the risk of adverse events with a complete removal rate in 99.3% of cases. Follow-up colonoscopies revealed that the rate of residual polyps (4.1%) and the recurrence rate (12.2–13.8%) were acceptable. Wide-field piecemeal CSP has also recently been applied for nonpedunculated large colon polyps. Although the evidence for the efficacy of CSP for removing large polyps is still limited, the results of some studies have indicated that CSP is a safe and effective method for resecting colorectal polyps > 10 mm.

For some familial adenomatous polyposis (FAP) patients who choose to delay colectomy surgery to avoid complications, CSP might be an optimal option as a less invasive, sufficient procedure to reduce polyp burden and the mortality rate of FAP patients. Patel *et al*[5] reported that among 79 FAP patients who underwent CSP, no complications occurred after the polypectomy. At subsequent examinations, the number of polyps decreased in 77 patients, and no patients developed colorectal cancer. Thus, FAP is considered a possible indication for CSP.

Besides, researchers tried to use CSP to remove small polyps from patients without stopping therapy with antithrombotic agents, and obtained better results with CSP than with conventional polypectomy.[2] Therefore, CSP may be a potential option for patients receiving anticoagulation therapy.

In the future, if the possibility of tumor invasion can be ruled out, CSP may be used for the piecemeal resection of extensive or even circular SSPs, or for lesions in other locations, such as the anal verge and duodenum, where post-polypectomy bleeding occurs more frequently. For patients who remain on or resume taking anticoagulant/antiplatelet agents, or for those who cannot tolerate electrocautery complications, CSP is a better choice.

CSP Efficacy. Complete resection (R0 resection) is the most important factor for evaluating the feasibility of CSP because interval colorectal cancer occurrences may be related to incomplete polypectomy. Although compared with endoscopic mucosal resection (EMR), CSP got an inferior complete resection rate (91.5% *vs*. 98.5%),[3] the performance of CSP was acceptable compared with other polypectomy methods. Qu *et al*[2] analyzed nine studies that included 1021 lesions removed by CSP and 1012 lesions removed by hot snare polypectomy (HSP). They found that no significant difference existed between CSP and HSP in this regard (77.3–98.2% *vs*. 85–98.5%, $P = 0.410$). When comparing with hot forceps biopsy, CSP is obviously superior (91% *vs*. 77%).[3] This may be because of the ability to remove 2 to 3 mm of normal tissue around the lesion without the risk for transmural thermal injury when using CSP. Lee *et al* indicated that CSP is

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superior to cold forceps polypectomy (CFP) for complete histological eradication of polyps (93.2% *vs.* 75.9%, $P = 0.009$).[3] As for the comparison with the cold biopsy forceps (CBF) and the suction pseudopolyp technique (SPT), no significant difference existed.[3] In conclusion, CSP is obviously superior to CFP and hot forceps polypectomy, similar to HSP, CBF, and SPT, but inferior to EMR in terms of the complete resection rate. The details are shown in Table 1.

CSP can reduce endoscopic operation time, which may reduce patient pain. Studies showed that the total coloscopy time required for CSP was significantly shorter than that for EMR (4.7 min *vs.* 5.5 min) and HSP (16–23 min *vs.* 25–29.6 min, $P < 0.001$).[2,3] This is because electrocautery is not required, and the procedure of submucosal saline injection can be omitted during the CSP procedure. Although snaring can be more time-consuming than using forceps, the results of two trials showed that the polypectomy duration was shorter for CSP than for CFP (14.29 s *vs.* 22.03 s).[3] Multiple applications of the forceps can be required to ensure complete removal, which may be the reason for the prolonged operation time. These results suggest that CSP is time-saving and involves a substantially shorter procedure duration than techniques that require electrocautery.

The rate of recurrence is of great concern. Kim *et al* evaluated residual adenomatous tissues after CSP by using an additional EMR procedure and found that the residual neoplastic rate was significantly lower in the CSP group (6.2% *vs.* 29.7%, $P = 0.013$).[3] In addition, Saito *et al* evaluate the recurrence of residual adenoma at the 1-year follow-up visit after CSP and showed that no patients experienced recurrence.[2] So, it is reasonable to hypothesize that CSP is associated with a low rate of residual adenoma recurrence.

CSP Safety. Bleeding is the most common complication of endoscopic operations, usually divided into delayed or immediate.

The main reason for delayed bleeding is that electrocautery does not completely coagulate blood vessels, and this bleeding usually occurs after sloughing coagulated eschar detaches 5 to 21 days after surgery. Some studies have demonstrated the occurrence of delayed bleeding in patients who received HSP (rate ranged from 1% to 14%).[2] In contrast, CSP does not readily transect large arterial branches and does not form eschars since heated snare loops are not applied, which almost eliminates the risk of delayed bleeding. Some literature reported the occurrence of delayed bleeding in the CSP groups. So, it is reasonable to suggest that using CSP can reduce the incidence of delayed bleeding.

The risk of immediate bleeding with CSP is relatively high and increases as the size of the polyps increases. Immediate bleeding is mainly caused by capillary and venule injury. Protruding lesions and the use of anticoagulation agents are independent factors for immediate bleeding risk. A multicenter randomized trial showed that the rate of immediate bleeding was significantly higher with CSP than with HSP (54% *vs.* 14%).[2] The bleeding area is usually

Table 1: Characteristics of included studies.

Author, year	Polypectomy method comparisons	Polyp size (mm)	No. of polyps	Complete resection rare	Duration of procedure	Immediate bleeding	Delayed bleeding
Aslan, 2013[2]	CSP *vs.* HSP	7.21 ± 1.4 *vs.* 7.56 ± 1.45	78 *vs.* 71	94.9 (74/78) *vs.* 94.4 (67/71)	25.71 ± 4.3 (s) *vs.* 70.28 ± 11.3 (s)	NA	0 *vs.* 0
Gomez, 2015[2]	CSP *vs.* HSP	NA	21 *vs.* 18	90.5 (19/21) *vs.* 94.4 (17/18)	NA	0 *vs.* 0	0 *vs.* 0
Horiuchi, 2014[2]	CSP *vs.* HSP	6.5 ± 1.2 *vs.* 6.8 ± 1.3	73 *vs.* 75	89.0 (65/73) *vs.* 89.3 (67/75)	16 ± 7 (min) *vs.* 26 ± 9 (min)	2 (2.7) *vs.* 8 (10.6)	0 *vs.* 5 (6.7)
Horiuchi, 2010[2]	CSP *vs.* HSP	NA	94 *vs.* 92	90.4 (85/94) *vs.* 84.8 (78/92)	18 (min) *vs.* 25 (min)	0 *vs.* 0	0 *vs.* 0
Ichise, 2011[2]	CSP *vs.* HSP	5.7 ± 4 *vs.* 5.5 ± 6	97 *vs.* 100	89.7 (87/97) *vs.* 85.0 (85/100)	18 ± 6 (min) *vs.* 25 ± 7 (min)	0 *vs.* 0	0 *vs.* 0
Kawamura, 2017[2]	CSP *vs.* HSP	5.4 ± 1.4 *vs.* 5.4 ± 1.4	341 *vs.* 346	98.2 (335/341) *vs.* 97.4 (337/346)	73.6 ± 49.4 (s) *vs.* 97.3 ± 60.6 (s)	28 (8.2) *vs.* 14 (4.0)	0 *vs.* 2 (0.6)
Papastergiou, 2017[2]	CSP *vs.* HSP	8.2 ± 1.6 *vs.* 8.3 ± 1.4	83 *vs.* 81	92.8 (77/83) *vs.* 96.3 (78/81)	23.3 ± 4.8 *vs.* 29.6 ± 7.4	3 (3.6) *vs.* 0	0 *vs.* 0
Suzuki, 2017[2]	CSP *vs.* HSP	5.8 ± 1.7 *vs.* 5.6 ± 1.8	22 *vs.* 26	77.3 (17/22) *vs.* 92.3 (24/26)	NA	0 *vs.* 0	0 *vs.* 0
Paspatis, 2011[2]	CSP *vs.* HSP	5.3 ± 1.4 *vs.* 5.67 ± 1.3	530 *vs.* 553	NA	23.3 ± 4.8 (min) *vs.* 29.6 ± 7.4 (min)	19 (3.6) *vs.* 2 (0.3)	0 *vs.* 0
Zhang, 2018[3]	CSP *vs.* EMR	7.4 ± 1.4 *vs.* 7.7 ± 1.5	212 *vs.* 203	91.5 (194/212) *vs.* 98.5 (200/203)	4.7 ± 3.4 (min) *vs.* 5.5 ± 2.7 (min)	5 (2.6) *vs.* 3 (1.5)	0 *vs.* 0
Ohtsu, 2017[2]	CSP *vs.* EMR	NA	NA	NA	92.2 ± 9.2 (s) *vs.* 144.6 ± 18.9 (s)	NA	1 *vs.* 1
Lee, 2013[3]	CSP *vs.* CFP	3.84 ± 1.11 *vs.* 3.46 ± 1.13	59 *vs.* 58	93.2 (55/59) *vs.* 75.9 (44/58)	14.29 ± 8.74 (s) *vs.* 22.03 s ± 10.87 (s)	NA	0 *vs.* 0
Kim, 2015[3]	CSP *vs.* CFP	4.4 ± 1.4 *vs.* 4.4 ± 1.5	59 *vs.* 69	96.6 (57/59) *vs.* 82.6 (57/69)	2.45 ± 1.03 (min) *vs.* 3.28 ± 1.07 (min)	NA	NA
Park, 2016[3]	CSP *vs.* CFP	NA	115 *vs.* 116	93.0 (107/115) *vs.* 90.5 (105/116)	NA	NA	NA
Gomez, 2015[3]	CSP *vs.* CBF	NA	21 *vs.* 18	90.5 (19/21) *vs.* 83.3 (15/18)	NA	NA	NA
Komeda, 2017[3]	CSP *vs.* HFP	4.2 ± 1.0 *vs.* 3.8 ± 1.0	148 *vs.* 135	99.3 (147/148) *vs.* 80 (108/135)	NA	13 (8.8) *vs.*11 (8.1)	0 *vs.* 0
Din, 2015[3]	CSP *vs.* SPT	4.0 (3–7) *vs.* 4.0 (3–7)	58 *vs.* 59	63.8 (37/58) *vs.* 76.3 (45/59)	NA	0 *vs.* 0	0 *vs.* 0
Din, 2015[7]	CSP *vs.* DCSP	4.0 (3–7) *vs.* 4.0 (3–7)	72 *vs.* 89	61.1 (44/72) *vs.* 83.1 (74/89)	NA	0 *vs.* 0	0 *vs.* 0
Horiuchi, 2015[6]	CSP *vs.* DCSP	6.3 ± 2.2 *vs.* 6.5 ± 1.8	112 *vs.* 98	79 (88/112) *vs.* 91 (89/98)	NA	21 (8/39) *vs.* 19 (7/37)	0 *vs.* 0
Dwyer, 2017[8]	CSP *vs.* DCSP	6 *vs.* 6	173 *vs.* 126	95 (165/173) *vs.* 98 (124/126)	NA	5 (5/173) *vs.* 1 (1/126)	0 *vs.* 0

Data are presented as *n* (%) or % (*n*/N). CBF: Cold biopsy forceps; CFP: Cold forceps polypectomy; CSP: Cold snare polypectomy; DCSP: Dedicated cold snare polypectomy; EMR: Endoscopic mucosal resection; HFP: Hot forceps polypectomy; HSP: Hot snare polypectomy; SPT: Suction pseudopolyp technique; NA: Not applicable.

small and limited. Self-hemostasis can be achieved in most cases without special treatment. Using argon plasma coagulation at the polyp boundary or the basal area, or placing a small number of hemostatic clips is helpful to stop the bleeding.

Perforation is a complication that should be avoided in endoscopic operations. Since CSP is mostly aimed toward eradicating adenoma tissue, deep resection beyond the superficial submucosa is not necessary, and the probability of cutting through the intrinsic muscularis of the intestinal mucosa without electrocautery is almost zero. In fact, several clinal trials revealed that no perforation has occurred during or after a CSP procedure.[2,3]

Without electrocautery, the risk of post-polypectomy electrocoagulation syndrome is eliminated; thus, abdominal pain, abdominal muscle tension, fever, and other clinical manifestations are less likely to occur. Although such adverse events have been reported in some cases, most of these symptoms are mild and do not require special treatment.

CSP *vs*. dedicated cold snare polypectomy (DCSP). The type of snare may play an important role in the procedure because it can affect the difficulty of cold resection. Some studies have compared the complete resection rate and the incidence of adverse events after the excision of small polyps (<10 mm) using conventional CSP *vs*. DCSP.[6-8] In these studies, DCSP was defined as the Exacto cold snare or Optimos Polypectomy Snare Cold Type (Taewoong, Gimpo, Korea), and both snares had thinner braided wires and special shield shapes. The results showed that dedicated snares can improve the complete resection rate. In terms of adverse events, immediate bleeding was the most common adverse event, the rate of immediate bleeding was slightly lower with dedicated cold snares although no significant difference existed (24% *vs*. 28% $P = 0.700$, 1% *vs*. 5% $P = 0.410$). No perforation or delayed bleeding occurred in any of the patients. The details are shown in Table 1.

According to the above literature, DCSP achieved a superior complete resection rate, especially for polyps that are 8 to 10 mm in diameter, regardless of whether the polyps were flat or pedunculated. Meanwhile, DCSP did not increase the risk of adverse events. The thin braided wire and its special shield shape may increase the pressure applied to the mucosal surface and contribute to easier polyp tissue capture and cutting rather than tearing the mucosa. In addition, DCSPs have recently been designed to support electrocautery; thus, the snare does not need to be changed even when a large polyp that requires HSP is found, thereby reducing the required operation time.

However, no study has assessed the performance of DCSP for the removal of polyps > 10 mm in size. DCSP has also not been used as a treatment for FAP patients. Therefore, more studies are needed to explore the indications of DCSP, and it is hoped that DCSP will be more widely applied in the future.

CSP has been recommended by ESGE clinical guidelines as a standard method for removing diminutive colorectal polyps (<5 mm). Several independent studies showed that CSP is a time-saving polypectomy technique for polyps < 10 mm in size with comparable efficacy and safety to traditional methods. Recently, CSP has been shown to perform well for removing polyps > 10 mm (especially SSPs) and for reducing the polyp burden of FAP patients, and is expected to be more widely applied in clinical practice in the future. Furthermore, it has been shown that the complete resection rate of CSP can be improved by using dedicated snares. More studies are needed to explore the upper limit of the polyp diameter for CSP and the recurrence rate of polyps after CSP.

Conflicts of interest

None.

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