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【 ORIGINAL ARTICLE 】

Electric Endocut and Autocut Resection for Endoscopic Papillectomy: A Systematic Review

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Abstract:

Objective Risks of bleeding and pancreatitis after mucosal resection using the purecut/autocut and blendcut/endocut modes for endoscopic papillectomy have not been fully clarified. Thus, a systematic review on electrosurgical cutting modes for endoscopic papillectomy was conducted focusing on the types and incidence of adverse events.

Methods We searched the PubMed and Cochrane library for cases of endoscopic papillectomy recorded as of April 2017. Studies reporting the methods of electrically excising a tumor in the duodenal papilla and the number of adverse events were extracted. Studies were collected and examined separately based on the electrosurgical cutting mode, and the incidence rate for each adverse event was summarized.

Results A total of 159 relevant articles were found; among them, 20 studies were included and 139 excluded. Five studies analyzed endoscopic papillectomy with the purecut/autocut mode and 16 with the blendcut/endocut mode. Only one study investigated both modes (purecut and endocut). With the purecut/autocut mode, the incidence of bleeding was 2.8-50%, and that of pancreatitis was 0-50% (mean: 12.8%). With the blendcut/endocut mode, the incidence of bleeding was 0-42.3%, and that of pancreatitis was 0%-17.9% (mean: 9.5%).

Conclusion Both methods had high adverse event rates for endoscopic papillectomy. Thus, a standard method of endoscopic papillectomy, including the electrosurgical cutting mode, needs to be established.

Key words: ampullary tumor, endoscopic papillectomy, electrosurgical cutting mode

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Introduction

Ampullary tumor is a relatively rare disease; however, the number of cases is increasing because of the increased use of upper gastrointestinal endoscopy during medical examinations. Histopathologically, most ampullary tumors are adenomas or adenocarcinomas, and tumor excision is recommended even with benign lesions because of the adenoma-carcinoma sequence (1, 2). Although pancreaticoduodenectomy is generally performed for ampullary tumors, endoscopic papillectomy (EP) has recently been used for adenoma or adenocarcinoma localized inside the mucosa.

EP was first reported in 1983 (3), and since then, high success and relatively low adverse event rates have been reported (4-6). Currently, EP is recognized as an alternative treatment for surgical resection. To date, various EP methods have been developed; however, a standard EP method has not been established. Fig. 1 shows the EP method used in our hospital. After tumor resection, endoscopic biliary sphincterotomy is usually performed, and a pancreatic duct stent is placed. Although the treatment methods for the bile

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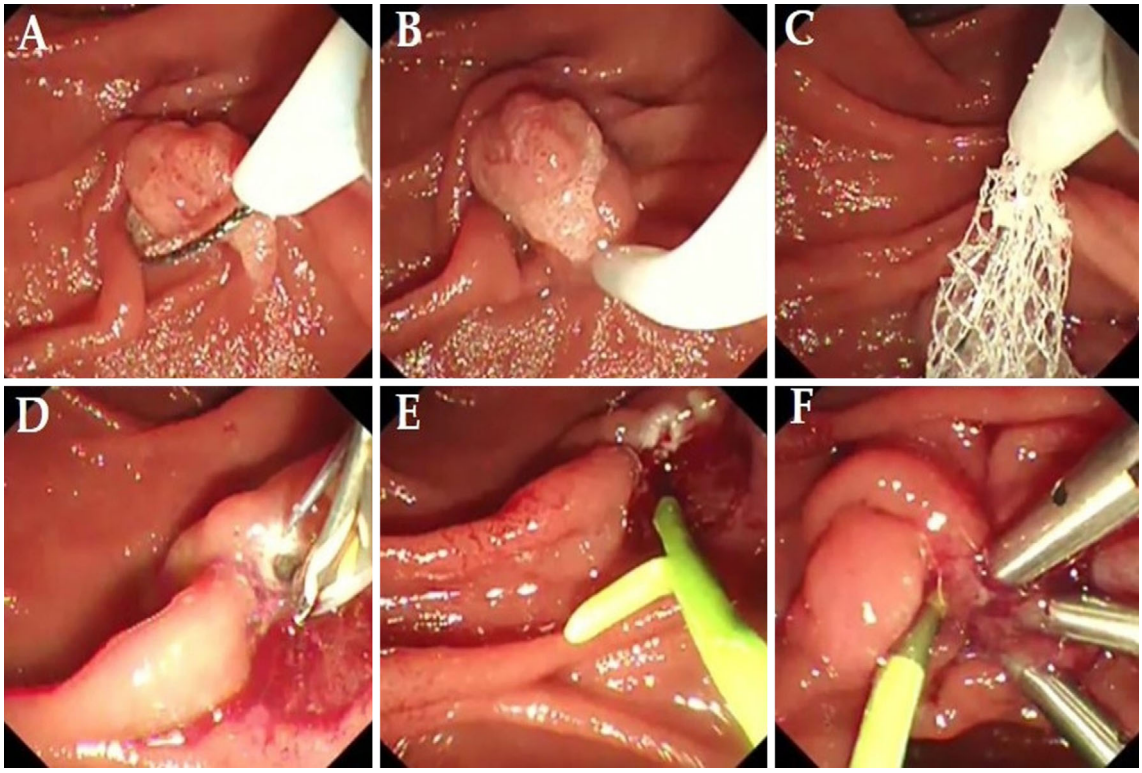

Figure 1. **The endoscopic papillectomy method employed at our hospital. A) Snaring the papillary tumor. B) Resection of the tumor electrically. C) Collecting the tumor with a net. D) Performing endoscopic sphincterotomy after cannulation of the bile duct with a guidewire. E) Placement of a plastic pancreatic stent. F) Clipping at the field after endoscopic papillectomy to prevent bleeding.**

and pancreatic ducts after papillectomy are controversial (e.g., performing sphincterotomy or using a plastic stent), tumor resection with electrosurgical snaring is performed in all cases. There are no guidelines concerning the mode of electric current (cutting and coagulation) for electrosurgical ampullary tumor resection, and selection of the current mode depends on the endoscopists' preferences at present.

Only a simple electrosurgical generator was available when EP was first introduced. Therefore, operators only used an incision wave known as the purecut or autocut mode for resection. An electrosurgical generator has been used for other endoscopic treatments, such as endoscopic mucosal resection (EMR) and endoscopic submucosal dissection. However, concerns have been raised regarding bleeding after treatment using the purecut or autocut mode. This problem was solved by developing a mode comprising mixed incision and coagulation waves known as the blendcut or endocut mode (7).

The endocut mode automatically controls the cutting mode, with the cut and coagulation current cycled at repeated intervals. At present, it is typically used for endoscopic sphincterotomy, helping reduce the rates of poorly controlled (zipper) incisions and immediate hemorrhaging (8). The blendcut and endocut modes are also currently used in EP, although the purecut and autocut modes are still used.

Some clinicians have suggested that mucosal resection using the purecut/autocut mode has a high risk of bleeding after EP, similar to that of endoscopic sphincterotomy (9). However, others have suggested that using the blendcut/endocut mode can lead to pancreatitis after EP because coagulation requires excessive time for tumor resection (10, 11). A longer resection time is thought to increase the risk of the thermoelectric current being transmitted to the pancreas, thereby increasing the risk of pancreatitis. However, these hypotheses have not been compared and examined, and randomized controlled trials (RCTs) have not been performed to resolve these issues.

Therefore, this systematic review of the electrosurgical cutting mode of EP was conducted to provide a better understanding of this procedure, focusing on the types and incidence of adverse events.

Materials and Methods

This systematic review was reported in accordance with the guidelines of Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) (12).

Search strategy

Two of the study's coauthors (KM and EI) independently performed a systematic literature search of PubMed and the Cochrane library in April 2017. A combination of the key words "endoscopic" and "papillectomy," was used.

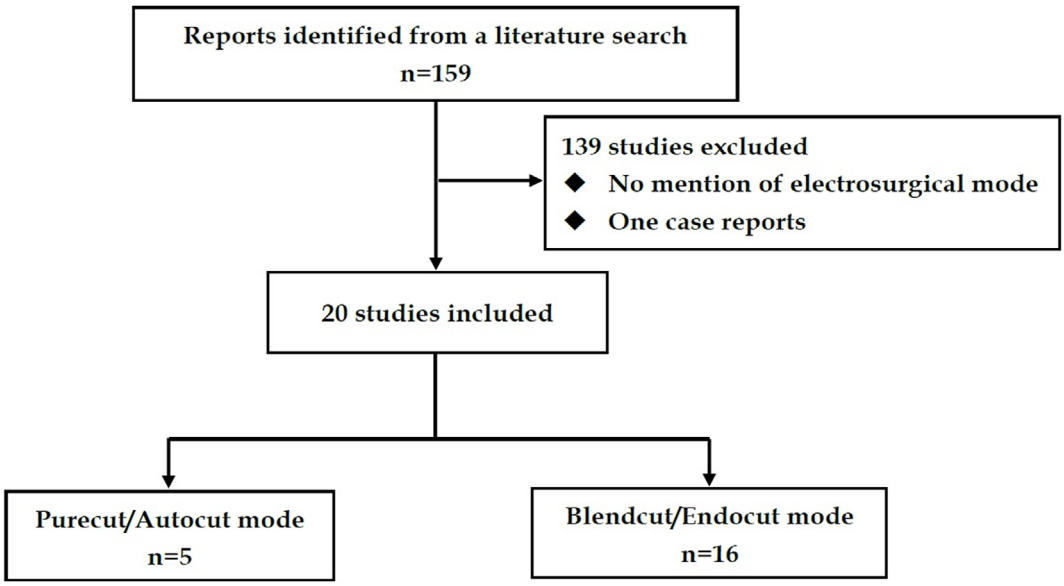

Figure 2. **Study flow diagram of articles included in the systematic review. In one study, endoscopic papillectomy was performed using both modes (purecut and endocut).**

Table 1. **Adverse Events after Endoscopic Papillectomy with the Purecut/autocut Mode.**

Reference	Mode	N	Bleeding*	Pancreatitis*	Perforation*	Cholangitis*	Mortality*	Others*
13	Purecut	25	2 (8)	3 (12)	0	0	0	-
14	Purecut	2	1 (50)	1 (50)	0	0	0	-
5	Purecut	106	Peri-procedure, 24 (22.6) Post-procedure, 3 (2.8)	13 (12.3)	0	0	0	-
9	Purecut	12	6 (50)	0	2 (16.7)	3 (25)	0	Cholecystitis, 1 (8.3)
15	Autocut	35	6 (17.1)	6 (17.1)	1 (2.9)	0	0	-
Range (%)			2.8-50	0-50	0-16.7	0-25	0	

*Values are presented as n (%)

Inclusion and exclusion criteria

This study included all reports on EP that mentioned how to resect tumors electrosurgically. Duplicate publications, reviews, single case reports, and non-English papers were excluded.

Outcome measures

Bleeding and pancreatitis are the important adverse events of EP. Therefore, post-EP bleeding was the primary outcome, and post-EP pancreatitis was the secondary outcome in this study. Other known adverse events of EP, such as perforation and cholangitis, were also recorded.

Data extraction and interpretation

Two of the authors (KM and EI) independently examined all potential reports for eligibility. Disagreements were resolved by consulting other coauthors.

Results

Search results

A total of 159 citations were found during our database search (Fig. 2). Among these, 139 studies were rejected based on the exclusion criteria. The remaining 20 studies included 5 that used the purecut/autocut mode (Table 1) (5, 9, 13-15) and 16 that used the blendcut/endocut mode (Table 2) (4, 9, 16-29). Only one study performed EP using both modes (purecut and endocut) (9).

Bleeding

In studies (5, 9, 13-15) that used the purecut/autocut mode, the incidence of bleeding after EP was 2.8-50% (Table 1), whereas in those that used the blendcut/endocut mode (4, 9, 16-29), the incidence of bleeding after EP was 0-42.3% (Table 2). Only two studies separately reported peri- and postprocedural bleeding (5, 27). In cases of oozing alone, endoscopic hemostasis (e.g., clipping, argon plasma coagulation, and hypertonic saline-epinephrine injection) was effective. However, some difficult cases required blood

Table 2. Adverse Events after Endoscopic Papillectomy with the Blendcut/endocut Mode.

Reference	Mode	N	Bleeding*	Pancreatitis*	Perforation*	Cholangitis*	Mortality*	Others*
16	Blendcut	26	2 (7.7)	4 (15.4)	1 (3.8)	0	0	-
4	Blendcut	103	2 (1.9)	5 (4.9)	0	0	0	Bile duct stenosis, 3 (2.9)
9	Endocut	16	1 (6.3)	0	0	0	0	-
17	Endocut	107	11 (10.3)	10 (9.3)	1 (0.9)	3 (2.8)	0	-
18	Endocut	72	Peri-procedure, 12 (16.7)	6 (8.3)	0	0	0	-
19	Endocut	10	3 (30)	0	0	0	0	-
20	Endocut	39	4 (10.3)	7 (17.9)	2 (5.1)	0	0	-
21	Endocut	82	10 (12.2)	8 (9.8)	0	0	0	-
22	Blendcut	61	11 (18.0)	6 (9.8)	2 (3.3)	0	0	-
23	Endocut	56	4 (7.1)	6 (10.7)	1 (1.8)	0	0	Sepsis, 1 (1.8)
24	Endocut	3	0	0	0	0	0	-
25	Blendcut	27	2 (7.4)	3 (11.1)	0	0	0	-
26	Blendcut Endocut	36	2 (5.6)	2 (5.6)	2 (5.6)	2 (5.6)	0	-
27	Endocut	115	Peri-procedure, 21 (18.3) Post-procedure, 12 (10.4)	12 (10.4)	3 (2.6)	2 (1.7)	1 (0.9) (due to pancreatitis)	Papillary stenosis, 5 (4.3)
28	Endocut	23	2 (8.7)	3 (13.0)	0	0	0	Papillary stenosis, 1 (4.3)
29	Endocut	26	11(42.3)	4 (15.4)	1 (3.8)	1 (3.8)	0	Papillary stenosis, 2 (7.7)
Range (%)			0-42.3	0-17.9	0-5.6	0-5.6	0-0.9	

*Values are presented as n (%)

transfusion or interventional radiology.

Pancreatitis

In studies (4, 9, 16-29) that used the purecut/autocut mode, the incidence of pancreatitis after EP was 0-50% (mean: 12.8%) (Table 1), whereas in those that used the blendcut/endocut mode, the incidence of pancreatitis after EP was 0-17.9% (mean: 9.5%) (Table 2). In all reports, post-EP pancreatitis was defined by the consensus definition and classification proposed by Cotton et al. (30). Most cases of pancreatitis were mild and improved with conservative therapy. Only one patient died from severe pancreatitis (27).

Other adverse events

Retroperitoneal perforation and cholangitis are well-known adverse events of EP. Several studies reported that the rates of retroperitoneal perforation and cholangitis were 0-16.7% and 0-25%, respectively, with the purecut/autocut mode and 0-5.6% and 0-5.6%, respectively, with the blendcut/endocut mode (Tables 1 and 2). Furthermore, in the late period, close to the time of discharge, papillary stenosis can develop and lead to the development of obstructive jaundice and/or pancreatitis. Four studies that used the blendcut/endocut mode reported papillary stenosis that required additional dissection using sphincterotomy, stent placement, and balloon dilation (4, 27-29) (Table 2).

Discussion

This systematic review reported the association between electrosurgical cutting modes and adverse events of EP. This review also showed that both electrosurgical currents have a higher risk of adverse events than endoscopic retrograde cholangiopancreatography (ERCP)-related procedures and that patients may die from EP. According to the American Society for Gastrointestinal Endoscopy (ASGE) guideline, the incidence of post-ERCP pancreatitis is estimated to be 3-10%, and the rate of post-sphincterotomy bleeding is 0.3-2% (31). As mentioned, the purecut/autocut mode was considered to cause more bleeding, whereas the blendcut/endocut mode may lead to a higher rate of pancreatitis, according to our clinical experience. However, this hypothesis was not proven by our review because previous studies only used one electrosurgical method in each institution, and no prospective comparative studies were conducted. Both electrosurgical methods were retrospectively compared in only a single study, and the number of patients was small (9). This study concluded that the endocut mode contributed to the reduced occurrence of early complications (hemorrhaging, cholangitis, perforation, and cholecystitis).

EP has a much higher bleeding risk than EMR, although both procedures are performed similarly in the excision stage. EMR is relatively safe because of the few blood vessels in the mucosal field. However, according to a previous report, an arterial plexus was found in the area from the common bile duct to the duodenal papilla (32). When performing EP, a wide section of that area is resected. Therefore, a high rate of postprocedural bleeding and difficulty achieving hemostasis are expected.

EP is safe compared to surgical treatments, such as pancreaticoduodenectomy, but also has a high rate of adverse events. A previous study reported that the overall rate of adverse events, bleeding, and pancreatitis ranged from 8-35%,

2-16%, and 5-15%, respectively (33). The procedure-related mortality rate has also been reported to range from 0% to 7% in EP (34). Therefore, EP remains an underdeveloped treatment and is not strongly recommended by the ASGE. An appropriate EP method must be established as soon as possible so that it can be considered as a standard therapy. Some phases of a suitable EP method have already been established. One of these is pancreatic stent placement. An RCT suggested that pancreatic stent placement significantly prevented postprocedural pancreatitis [0% (treatment arm) vs. 33% (control group), p=0.02] (35). At present, several institutions use a pancreatic stent during EP (17, 27, 29). Therefore, additional RCTs should be conducted in order to establish a safer EP method.

The degree of specimens with crush artifacts histologically is also expected to differ depending on the electrosurgical cutting mode. Tumor resection, such as EMR, causes thermal denaturation, which is referred to as the burning effect. This burning effect can cause unclear tumor margin, making it difficult to determine the depth of tumor invasion. For residual tumors, deciding on additional treatment or follow-up in the future is important. Previous studies on EP did not report the burning effect. Therefore, this effect should be examined in future studies.

This systematic review has several limitations. First, the target diseases for EP were different among the studies. Most studies treated adenoma, but some treated carcinoma, familial adenomatous polyposis, hyperplasia, and lymphoma. Therefore, not all of the results can be regarded as similar. Second, different electrosurgical generators were used, and the power output of the electrosurgical currents differed slightly among studies. Third, the ERCP-based treatments after papillectomy differed between studies. Sphincterotomy and/or stent placement in the biliary and pancreatic ducts was performed to prevent adverse events. However, the standard treatment methods after papillectomy have not yet been established. Even if cases are managed in the same facility, the treatment often differs among cases. Adverse events also depend on the treatment after papillectomy and must therefore be considered. Given these limitations, a unified device for EP should be used when conducing a prospective RCT. Fourth, the definition of bleeding differed by institution. Among the 20 studies, 4 defined bleeding based on the Cotton criteria, 2 as that requiring hemostasis, 2 according to the clinical evidence, 1 as oozing immediately after resection, and 11 unknown. We believe that peri- and postprocedural bleeding should be distinguished because periprocedural bleeding is observed in most cases, and hemostasis is relatively easy to achieve. However, postprocedural bleeding tends to occur suddenly with shock or melena and often requires urgent endoscopic treatment. Therefore, postprocedural bleeding is more important clinically. From this perspective, postprocedural bleeding should be evaluated when considering the adverse events of EP.

Conclusion

A high rate of adverse events is associated with EP in both electrosurgical cutting modes. These adverse events can be prevented by establishing a standard method, including the electric current, through RCTs in the near future.

The authors state that they have no Conflict of Interest (COI).

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