

Application of Precut Papillotomy in Patients With Surgically Altered Gastrointestinal Anatomy

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Abstract

It is challenging to perform ERCP (endoscopic retrograde cholangiopancreatography) in patients with surgically altered gastrointestinal anatomy. The failure rate of selective bile duct cannulation by the standard method is high. To explore the application of precut papillotomy (PP) technique in patients with gastrectomy, we carried out this retrospective analysis. From January 2017 to September 2020, 107 patients with surgically altered gastrointestinal anatomy were referred to our department for ERCP examination. Among them, 11 cases were duodenal stricture or jejunal stricture, resulting in the inability to reach the duodenal papilla. Eleven patients stopped cannulation because they could not tolerate the further operation. 60 patients were intubated successfully by standard method. Finally, 25 patients using the precut papillotomy technique were included in our analysis. Of the 25 patients who used pp, 21 completed selective biliary cannulation, with a success rate of 84% (21/25). Compared with standard intubation, the PP technique increased the success rate of intubation in patients with altered anatomy by 21.9%. Among the patients we included, 2 cases had adverse events, including 1 case of acute pancreatitis and 1 case of perforation; the incidence of adverse events was 8%. All adverse events were mild and cured after conservative treatment. In patients with gastrointestinal anatomical changes, PP is effective and relatively safe to improve the selective biliary cannulation success rate.

Introduction

With the development of endoscopic technology, endoscopic retrograde cholangiopancreatography (ERCP) has become the first choice for endoscopic diagnosis and treatment of bile duct disease. When applied to patients with normal anatomy, ERCP technology is relatively mature, and its success rate is high. However, it is challenging to complete ERCP examination or treatment in patients with surgically altered gastrointestinal anatomy (Billroth I, Billroth II, and Roux-en-Y gastrectomy).¹⁻⁴ In these patients with gastrointestinal anatomical changes, endoscopists will face the following problems during ERCP: (1) Due to postoperative intestinal stenosis or interference of multiple intestinal cavities, difficulties in entering or identifying the pancreaticobiliary enteral limb; (2) Because the duodenal papilla is too far from the gastrointestinal anastomosis, the endoscope cannot reach the papilla; (3) The position of the papilla is opposite to the normal or not exposed clearly; (4) In patients with Braun's entero-anastomosis or a long afferent loop, it is difficult to pass through the Treitz ligament.^{5,6}

The related literature showed that even with new technologies that improve the success rate of intubation, the success rate of ERCP examination was only about 80% in patients with gastrointestinal anatomical changes.⁷⁻⁹ In order to improve the success rate of duodenal intubation, biliary cannulation and treatment, balloon-assisted enteroscopy (BAE), double-balloon enteroscopy, endoscopic sphincterotomy (EST), anterior oblique-viewing endoscopy, endoscopic papillary balloon dilation (EPBD), and precut sphincterotomy were applied to the process of ERCP.¹⁰⁻¹⁵ Among them, the precut technique was one of the most commonly used after the failure of standard biliary cannulation.¹⁶ In the process of selective biliary cannulation, the use of precut technique ranged from none to as many as 38%.¹⁷ Precut

sphincterotomy (PS) was first developed in the late 1970s and early 1980s.¹⁸ When the standard biliary cannulation failed, the precut technique could improve the success rate to 100%.^{4,15} At present, there are three main precut techniques widely used in ERCP, including precut papillotomy (PP), precut fistulotomy (PF), transpancreatic precut sphincterotomy (TPS). PP is defined as forming an incision into or from the papillary orifice and /or removal of part or all of the main papillary sphincter; PF is defined as that no matter what kind of instrument is used, it will cause a choledochoduodenal fistula, thus avoiding the orifice of the main duodenal papilla; TPS is thought to cut the pancreatic tissue between the main pancreatic duct and the common bile duct, regardless of the instrument used.¹⁵ However, the published articles mainly introduced precut sphincterotomy in difficult intubation under normal anatomy. We conducted a retrospective analysis to further study the efficacy and safety of precut sphincterotomy in patients with gastrointestinal anatomical changes after gastrectomy.

Methods And Patients

Patients. This retrospective study was conducted in a tertiary referral hospital (The second affiliated Hospital of Nanjing Medical University) in China. From January 2017 to September 2020, a total of 107 patients who had undergone gastrectomy were referred to our department for ERCP examination. Among them, 11 patients had duodenal or jejunal stenosis, failing to reach the duodenal papilla. With the help of guidewire or cylindrical balloon dilatation, bile duct cannulation was successful in 60 of the 96 cases. Of the remaining 36 patients who failed to intubate, 25 patients underwent PP (Precut Papillotomy), 11 gave up ERCP examination because they could not tolerate the further operation. Finally, 25 patients with PP were included in this study (5 cases of Billroth I, 11 cases of Billroth II, and 9 cases of Roux-en-Y). All patients' written informed consent was obtained before ERCP.

Study end points. The main endpoint of our study was the success rate of selective biliary cannulation. The secondary endpoints were: (1) the incidence of adverse events ;(2) the outcome of treatment;(3) average cannulation time.

Apparatus. We used duodenoscope (TJF 260 V, Olympus, Tokyo, Japan), gastroscope (GIF Q260J/Q260/H260, Olympus), standard colonoscope (CF HQ260/H260AI, Olympus), long-type colonoscope (CF H260AL, Olympus), double-balloon enteroscope (EN-450T5, Fujifilm, Tokyo, Japan), needle knife (Boston or COOK), and high-frequency surgical unit (ERBE CC80) during our operations.

Methods. All patients received ERCP with remifentanyl and dexmedetomidine under conscious sedation. During ERCP, we monitored the patients' heart and respiratory rate, electrocardiogram, and pulse oxygen saturation. These ERCPs were performed by two endoscopic experts, each of whom had completed more than 1000 operations.

We first used an endoscope (duodenoscope, gastroscope, colonoscope, double-balloon enteroscope) to insert the duodenum, reaching the papilla. For patients who repeatedly inserted the output loop, we marked it with a peptide clip or identified the input loop by enterography and then continued to insert the

pancreaticobiliary enteral limb. Then we performed selective biliary cannulation through the papilla; when the pancreatic duct was repeatedly inserted, we continued to try bile duct cannulation after placing the pancreatic duct stent. In the case of standard cannulation failure, we implemented PP (Precut Papillotomy). The main procedures of PP were as follows: the endoscope doctor placed the needle knife in the upper part of the papilla opening, close to 5 o'clock (Billroth II and Roux-en-Y gastrectomy) or 11 o'clock position (Billroth I), then cut the mucous membrane and papilla ampulla sphincter upward layer by layer, exposing the biliary sphincter. For patients with choledocholithiasis, we performed stone extraction using balloon or net basket under ERCP; and biliary stents were placed in patients with bile duct stricture to relieve the obstruction. Nasobiliary drainage (NBD) was placed to perform repeat cholangiography in patients with multiple choledocholithiasis and suspected residual stones. Precut papillotomy and related treatment after pp are shown in Fig. 1. When the cannulation time exceeded 40 minutes, or the patients could not tolerate the operation, we chose to terminate the process. PTC (percutaneous transhepatic cholangiography) was used as a remedial measure for patients who failed in ERCP examination.

Definitions

Selective biliary cannulation time referred to the time from the first intubation to the end of intubation. Cannulation without advanced methods (precut, double-guidewire technique, PTC-guided rendezvous technique) was regarded as standard intubation.

Adverse events of ERCP operation include acute pancreatitis, perforation, bleeding, and infection. The acute pancreas was defined as the serum amylase level was three times higher than the standard upper limit within 24 hours after ERCP, accompanied by persistent abdominal pain. It was thought to have perforation when subcutaneous emphysema, retroperitoneal air or subphrenic free air were found after ERCP. The diagnostic criteria for infection were right epigastric pain with fever $> 38.5^{\circ}\text{C}$ and white blood cell count $> 10 \times 10^9/\text{L}$ within 24 hours after ERCP. Bleeding was defined as haematemesis or black stool and a reduction in hemoglobin concentration at least 2g/dl after ERCP.¹⁹

Statistical analysis. SPSS23.0 software was used for data analysis. We used the χ^2 test or Fisher exact test to compare classified variables and student t-test or ANOVA (Analysis of Variance) to compare continuous variables. A P value < 0.05 was considered to be statistically significant.

Results

Baseline characteristics. From January 2015 to September 2020, the PP technique was applied to 25 patients with altered gastrointestinal anatomy during ERCP. The 25 patients ranged in age from 45 to 94, with an average age of 70.2 (20 males and 5 females). Among the 25 patients, there were 5 cases of Billroth I reconstruction, 11 cases of Billroth II reconstruction, and 9 cases of gastrectomy with Roux-en-Y anastomosis. Detailed basic information is shown in Table 1.

Table 1
Basic information of patients applying precut technique

	Billroth I reconstruction	Billroth II reconstruction	Roux-en-Y reconstruction	total
Patient, no.	5	11	9	25
Mean age (range), y	61.4	76.3	67.6	70.2
Sex, male/female	10\1	3\2	7\2	20\5
Pathogeny				
Cholelithiasis	4	7	4	15
Cholangiocarcinoma	1	2	1	4
Benign biliary stricture	0	1	4	5
Pancreatic cancer	0	1	0	1
Duodenal papilla morphology				
Normal papilla	5	7	6	18
Peripapillary diverticulum	0	4	1	5
Long nasal papilla	0	0	1	1
Small papilla	0	0	1	1

Results of hospitalization days and hospitalization expenses. The average hospitalization time of patients with surgically altered anatomy by PP technique was 11.72 days. The hospitalization days of patients of Billroth I, Billroth II, and Roux-en-Y reconstruction using PP were 11.47, 11.74, and 11.50, respectively, and there was no significant difference among the three groups ($p = 0.851$). Compared with the precut group, the average hospitalization time of patients without precut was 11.14 days, and there was no significant difference between the two groups ($p = 0.694$). We also draw a similar conclusion on comparing the average hospitalization expenses; the detailed results were shown in Table 2.

Table 2
Comparison of patient hospitalization time and hospitalization expenses

prucut gloup	hospitalization time (mean, day)	P	hospitalization expenses (mean, yuan)	P
Billroth I reconstruction	11.47	0.851	39964.09	0.74
Billroth II reconstruction	11.74		42522.4	
Roux-en-Y reconstruction	11.5		41932.65	
total	11.72	0.694	42256.09	0.39
non-prucut gloup	11.14		39056.58	
A B				

Selection of endoscope type. In the intubation process into the pancreaticobiliary enteral limb, we chose different types of endoscopes according to the gastrointestinal anatomy of the patients. Side-view duodenoscope and forward-view gastroscope were applied to patients undergoing Billroth I reconstruction. Similarly, patients with Billroth II reconstruction mainly chose duodenoscopy and gastroscopy. However, the standard colonoscopy and double-balloon enteroscopy with longer length were mainly selected for cannulation in the gastrectomy cases with Roux-en-Y anastomosis. At the same time, in some patients, we also installed a transparent cap at the tip of the gastroscope or colonoscope to improve the visualization of the endoscope and help biliary cannulation.

Results of Biliary cannulation. From January 2017 to September 2020, our center performed ERCP examinations in 107 patients with gastrointestinal structural changes. Of the 107 patients, 96 reached the duodenal papilla. 60 of the 96 patients completed selective biliary cannulation using the standard method, with a success rate of 62.5%. Eleven patients stopped intubation because they could not tolerate the further operation. Due to the failure of standard intubation, 25 cases chose precut sphincterotomy and continued to try bile duct cannulation. In patients with pp, the success rate of selective bile duct intubation was 84% (21/25). The final success rate of selective biliary cannulation was 84.4% (81/96). PP technology can improve the success rate of intubation in patients with altered gastrointestinal anatomy by 21.9%.

In 11 patients with Billroth II reconstruction using the PP technique, the success rate of selective bile duct cannulation was 90.9% (10/11). In Billroth I patients, the success rate of intubation after precut sphincterotomy was 100% (5/5). The success rate of cannulation in 9 cases of gastrectomy with Roux-

en-Y anastomosis was 66.7% (6/9). There was no significant difference in the success rate of selective biliary cannulation using PP among the three reconstruction methods. ($p = 0.187$)

The average cannulation time of patients with precut was longer than that of patients without precut (21.52 min vs. 12.36 min, $p = 0.036$). In the patients with precut, the average intubation time of Billroth II reconstruction and Roux-en-Y reconstruction was 21.54 minutes and 27.11 minutes, respectively; there was no significant difference between them. However, the average intubation time of Billroth I reconstruction was 11.4 minutes, which was significantly shorter than that of Billroth II and Roux-en-Y reconstruction (p Billroth I vs. Billroth II = 0.013; p Billroth I vs. Roux-en-Y = 0.01).

Of the 15 patients with choledocholithiasis, 7 were treated with NBD because of multiple stones. Subsequent nasobiliary cholangiography showed no residual choledocholithiasis. Biliary stents were implanted in 6 patients with bile duct stricture, and pancreatic duct stents were placed in 12 patients because of repeated insertion of the pancreatic duct. Four patients who failed in ERCP examination were treated with PTCD (percutaneous transhepatic cholangiography drainage).

Postoperative adverse events. Among the 25 patients using the PP technique, 2 patients had adverse events, including 1 case of acute pancreatitis and 1 case of perforation; the incidence of adverse events was 8%. Of the 71 patients who did not apply the precut technique, 6 had adverse events, including 3 cases of acute pancreatitis, 2 cases of biliary tract infection, 1 case of bleeding; the incidence of adverse events was 8.5%. The Chi-square test showed that the incidence of complications was similar between the two groups. ($P = 0.944$). The incidence of pancreatitis in patients with precut technique was 4%, while that in patients with standard intubation was 4.2%; there was no significant difference in success rate between the two ($p = 0.961$). However, compared with standard intubation, there was a perforation in the precut group, which was a small perforation around the duodenal papilla. All complications were cured after treatment.

Discussion

The most common method of PP is to use the needle knife to cut the duodenal papilla layer by layer and directly display and intubate the common bile duct. Standard cannulation was reported to have a 5–10% failure rate in patients with normal gastrointestinal structure.^{20–22} As one of the common advanced methods after the failure of standard cannulation, PP technology can make the success rate of biliary cannulation in patients with normal gastrointestinal anatomy close to 100%.^{4,15} It is extremely challenging for patients with surgically altered anatomy to complete selective bile duct cannulation by standard method. However, there have been no previous studies on applying the PP technique in patients with gastrointestinal structural changes. Therefore, we conducted this retrospective study to explore the safety and effectiveness of this precut technique.

In our study, the success rate of standard intubation in patients with gastrointestinal anatomical abnormalities was 62.5% (60/96). After the application of precut, the overall success rate was 84.4%

(81/96), increasing the success rate of cannulation by 21.9%, and the success rate of precut is 84% (21/25). At the same time, in the comparison of different reconstruction procedures (Billroth I, Billroth II, and Roux-en-Y), there was no significant difference in the success rate of precut. These results suggest that the PP technique was equally effective in patients with gastrointestinal anatomical abnormalities and different types of reconstruction. In the comparison of cannulation time, the precut group was significantly longer than the non-precut group. We considered that the timing of precut was mainly after repeated standard intubation, and it took a certain amount of time to cut the papilla muscle, which led to a longer cannulation time. At the same time, we also found that among the patients who applied precut, the cannulation time of Billroth II and Roux-en-Y reconstruction was significantly longer than that of Billroth I reconstruction. Because the gastrointestinal anatomy of Billroth II and Roux-en-Y reconstruction is more complicated than Billroth I and their papilla positions are reversed during precut and biliary cannulation, which further increase the difficulty of intubation and prolong the time of intubation. Moreover, in the comparison of hospitalization time and cost, the application of precut technique did not significantly increase the cost of patients and prolong the length of hospitalization.

The insertion of the endoscope into the pancreaticobiliary enteral limb is a critical step in the process of ERCP. Compared with patients with normal anatomy, duodenal intubation becomes more complex and challenging in patients with gastrointestinal changes. A variety of surgical reconstruction methods, intestinal cavity angulation, and anastomotic stenosis increase the difficulty of duodenal intubation. Therefore, it is necessary for the operator to clearly understand the various reconstruction methods and select the appropriate endoscope according to the reconstruction mode and anatomical structure. Billroth I patients' anatomical structure is close to normal people, without the interference of multiple intestinal limbs, and its duodenal intubation usually chooses a side-view duodenoscope. In Billroth II reconstruction, there are afferent and efferent limbs, which generally interfere with afferent limb intubation. In our study, peptide clip labeling or enterography was used to identify the input limb. The length of the afferent limb in Billroth II reconstruction is about 30–40 cm, and the side-view duodenoscope or forward-view gastroscope is usually the first choice.²³ For Roux-en-Y reconstruction, the afferent limb is longer, about 40–80 cm, and gastroscope or duodenoscopy may not be able to reach the target position.²³ Therefore, in Roux-en-Y reconstruction, we mainly choose longer colonoscopy or equipment-assisted endoscope (double-balloon enteroscopy (DBE), single-balloon enteroscopy (SBE) and, rotating or spiral enteroscopy (SE)) for pancreaticobiliary enteral limb intubation.

Previous studies demonstrated that the incidence of perforation increased in patients with gastrointestinal structural changes.²⁴ Endoscopic insertion of sharp-angled anastomosis or postoperative fixed and twisted intestinal limbs can easily damage the intestinal wall and lead to perforation. Meanwhile, the incidence of perforation improved due to the unstable position of the endoscope and poor-controlled cutting procedure during precut papillotomy. In our study, the incidence of perforation in precut patients was higher than that in patients with standard intubation (4% vs. 0%). At the same time, Krutsri et al. believed that the occurrence of perforation was related to the application of side-viewing duodenoscopy due to poor visualization, larger diameter, and difficulty bending over the

anastomosis or the angled intestinal cavity.²³ This was consistent with our study, where perforation mainly occurred in patients with Billroth II reconstruction using duodenoscopic.

Although precut is a helpful technique to complete selective biliary cannulation, it has been an important risk factor for PEP (post-ERCP pancreatitis) in several previous pieces of literature.^{25–28} In all of these studies, precut was used in patients with multiple intubation failures. More and more studies agreed that early precut sphincterotomy reduced the incidence of post-ERCP pancreatitis and repeated biliary cannulation attempts were a real risk factor for this complication.^{29–35} Our study did not observe a significant increase in the incidence of PEP (post-ERCP pancreatitis) in patients with precut sphincterotomy. This may be related to the routine placement of pancreatic duct stents in patients who have repeatedly intubated into the pancreatic duct. The study by VeitPhillip et al. proved that preventive placement of pancreatic duct stents is beneficial to reduce the occurrence of pancreatitis after ERCP.³⁶ Meanwhile, Greger et al. further found that compared with short and thin stents, thick and long pancreatic duct stents are more conducive to preventing PEP.³⁷ Besides, our two endoscopists who performed the ERCP operation have a wealth of experience, and we usually give priority to the application of precut technology after 4–5 failed attempts to intubate. Swan et al.'s research revealed the risk of PEP was greatly increased after more than 7 to 8 cannulation attempts during ERCP.³⁴

We must admit some limitations of our study. First of all, it was a retrospective, single-center study with the limitations of small sample size, selection bias, and lack of randomization. Secondly, our study included only one precut method, and the effectiveness and safety of other precut techniques (precut fistulotomy, transpancreatic precut sphincterotomy) in patients with surgically altered anatomy needed to be further studied.

In conclusion, our study preliminarily demonstrated selective biliary cannulation using PP in patients with surgically altered anatomy (Billroth I, Billroth II, and Roux-en-Y reconstruction) was effective and safe. However, multi-center prospective studies are still needed to further verify our findings.

Declarations

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Author contributions

L.L.Y. collected and analyzed the data and wrote the paper. S.Z. and H.L.Z. performed quality assessment and analyzed the data. G.Z.J and X.H.Z. conceived and designed this study. All authors reviewed the paper, read, and approved the final manuscript.

Conflict of interest

The authors declare that they have no competing interests.

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None.

Ethical approval

The institutional review board of second affiliated Hospital of Nanjing Medical University waived the requirement of ethical approval as our research is a retrospective study.

Study statement

Our study followed the European Society of Gastrointestinal Endoscopy (ESGE) Clinical Guideline.

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Figures

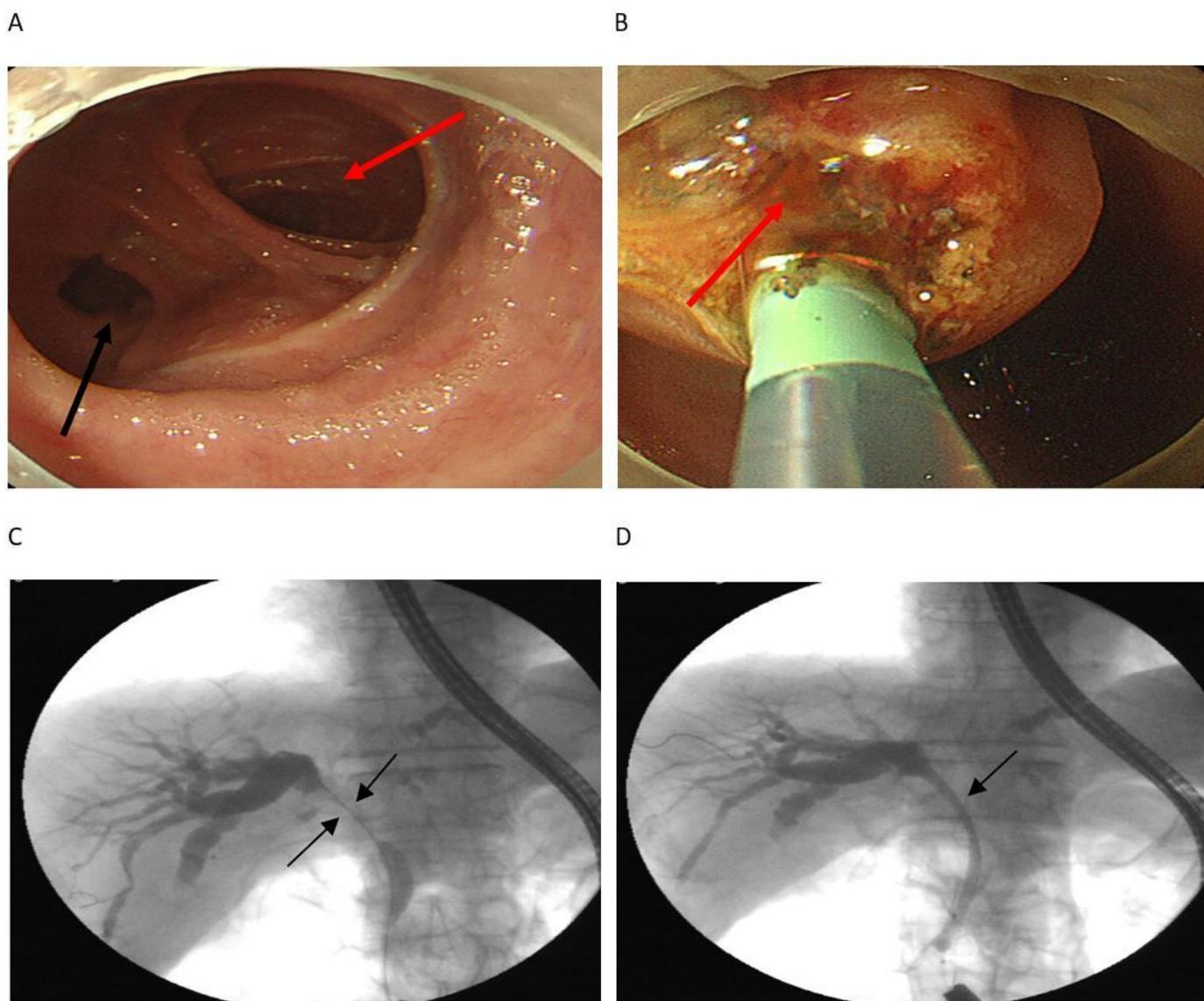


Figure 1

Precut papillotomy and related treatment after precut papillotomy A: Input loop and output loop in Roux-en-Y reconstruction (Red arrow: input loop, black arrow: output loop). B: Selective biliary cannulation after precut papillotomy (Red arrow). C: After precut papillotomy, selective biliary cannulation was successful

and cholangiography showed common hepatic duct stricture (black arrow). D: Place a metal stent at the stricture of the bile duct (black arrow).