# The Significance of Sphincterotomy Techniques in the Complications of Endoscopic Retrograde Cholangiopancreatography

## Endoskopik Retrograd Kolanjiopankreatografi Komplikasyonlarının Gelişiminde Sfinkterotomi Tekniklerinin Önemi

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## ABSTRACT

**Objective:** Endoscopic retrograde cholangiopancreatography (ERCP) has been used primarily for therapeutic interventions. Precut sphincterotomy is a technique that is used after conventional methods of biliary cannulation have failed. We aimed to evaluate whether the precut technique increases the frequency of complications.

**Material and Methods:** Two hundred fifteen patients in whom ERCP was performed were prospectively evaluated. One hundred eighty-five patients included in the study were divided into three groups based on the cannulation technique: Group 1: Deep biliary cannulation or cannulation by guide wire; Group 2: Precut technique; Group 3: If cannulation was not possible with these two techniques within 10 minutes, a precut with needle-knife sphincterotomy was carried out in these patients. Complete blood count, and blood serum amylase and lipase levels were checked before and after the procedure. The patients were monitored for 30 days for the development of any complications.

**Results:** Complications were observed in 26 (14%) of 185 patients, including pancreatitis in 1 8(9.7%) patients, cholangitis in six (3.2%) patients, and hemorrhage in two (1.1%) patients. The frequency of complications was 9.2% in group 1, 9.3% in group 2, and 35.3% in group 3 ($p<0.05$). When multivariate analysis was applied, the difficulty of cannulation and opaque injection into the pancreatic duct were correlated with elevated complication rates.

**Conclusion:** Difficult cannulation and opaque injection into the pancreas are risk factors for complications after ERCP, while the precut technique is safe. Therefore, it is recommended to prefer the precut method earlier instead of insisting on conventional techniques, to avoid the risk of complications.

**Key Words:** Endoscopic retrograde cholangiopancreatography, Complication, Pancreatitis, Precut sphincterotomy

## ÖZ

**Amaç:** Endoskopik retrograd kolanjiopankreatografi (ERCP) öncelikli olarak terapötik girişimler için kullanılmaktadır. Precut sfinkterotomi, klasik safra kanülasyon yöntemleri başarısız olduktan sonra kullanılan bir tekniktir. Çalışmada, precut tekniklerin komplikasyonların sıklığını artırıp artırmadığını araştırmak amaçlanmıştır.

**Gereç ve Yöntemler:** ERCP yapılan 215 hasta prospektif olarak değerlendirildi. Çalışmaya dahil edilen 185 hasta kanülasyon tekniklerini temel alarak üç gruba ayrıldı: Grup 1: Derin bilier kanülasyon veya kılavuz tel ile kanülasyon; Grup 2: Precut tekniği; Grup 3: Bu iki teknikle 10 dakika içinde kanülasyon yapılamayıp, needle-knife sfinkterotomisi uygulanan hastalar. Hastaların prosedürden önce ve sonra tam kan sayımı, kan serum amilaz ve lipaz düzeyleri değerlendirildi, hastalar herhangi bir komplikasyon gelişimi açısından 30 gün boyunca takip edildi

**Bulgular:** Onsekiz hastada pankreatit (% 9,7), altı hastada kolanjit (% 3,2) ve iki hastada (% 1,1) hemoraji olmak üzere 185 hastanın 26'sında (% 14) komplikasyon izlendi. Komplikasyonların sıklığı

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grup 1'de %9,2, grup 2'de %9,3 ve grup 3'te %35,3 idi (p <0,05). Çok değişkenli analiz uygulandığında, kanülasyon ve opak pankreatik kanal enjeksiyonunun zorluğu; komplikasyon oranları ile korele bulundu.

**Sonuç:** Pankreasta zor kanülasyon ve opak enjeksiyonu, ERCP sonrası komplikasyonlar için risk faktörleri olup, precut tekniği güvenli bulunmuştur. Bu nedenle, komplikasyon riskini ortadan kaldırmak için konvansiyonel teknikler üzerinde ısrar etmek yerine bu metodu tercih etmeniz uygun olacaktır.

**Anahtar Sözcükler:** Endoskopik retrograd kolanjiopankreatografi, Komplikasyon, Pankreatit, Precut sfinkterotomi

## INTRODUCTION

Endoscopic retrograde cholangiopancreatography (ERCP) is an endoscopic technique in which a specialized side-viewing upper endoscope is guided into the duodenum, allowing for the cannulation of bile and pancreatic ducts. It has benefits in the minimally invasive management of biliary and pancreatic disorders; however, it is challenged by a higher potential for serious complications (1). Pancreatitis is the most common complication. The rates of ERCP-related complications may vary due to the differences in the definition of the complications (2).

Bile duct (BD) cannulation can be difficult due to particular anatomic features, inflammatory processes, and adenomas of the papilla or periampullary diverticulum. Large prospective studies have demonstrated that difficult cannulation is an independent risk factor for post-ERCP pancreatitis (2-4). In the past few years, various efforts have been made to develop alternative endoscopic techniques, with the goal of increasing the rate of successful biliary cannulation.

Precut sphincterotomy (PS) is a technique used when cannulation cannot be achieved with conventional methods. PS refers to the performance of an incision prior to free cannulation or guide-wire cannulation in order to access the bile duct, or sometimes to reach the pancreatic duct before deep cannulation. Most of the specialists suggest that the precut method is risky and recommend that this method should be performed by qualified endoscopists (3,4). On the other hand, some specialists suggest that precut techniques are efficient and safe (5-11). The present study aimed to investigate whether PS increased the development of complications.

## MATERIALS and METHODS

### Study Design and Patients

The present study prospectively investigated 215 patients who underwent ERCP due to pancreatic and/or BD disorders between January 2012 and August 2012 in the Akdeniz University Department of Gastroenterology. Among these patients, the patients who had a tumor blocking access to the papilla, gastric outlet obstruction, who were under 18 years of age, who had coagulopathy, and who underwent Billroth II gastrectomy or previous papillotomy were excluded. Whole blood count, serum amylase, lipase, and CRP levels were measured before and 12-24 hours after the procedure. After the procedure, the patients were monitored for 30 days through polyclinic controls. In conclusion, a total of 185 patients were followed for post-procedural complication occurrence, and the association of the complications with the precut techniques was investigated.

### ERCP Procedure

The ERCP procedure was performed using an Olympus duodenoscope (Olympus Optical Co., Tokyo, Japan) under fluoroscopy. Propofol was administered to the patients for sedation. Prior to the procedure, each patient was intravenously administered ceftriaxone for prophylaxis and hyoscine N-methyl bromide to minimize intestinal contractions. For cannulation, a guide-wire, triple-lumen papillotome was primarily used in all patients. At the discretion of the endoscopist, opaque was administered prior to cannulation in some patients in order to view the biliary tree. Meanwhile, the patients who were administered pancreatic injection were recorded. Standard methods (group 1), deep biliary cannulation with or without opaque injection was defined as cannulation through guide wire. At the option of the endoscopist, an early precut was performed using the guide-wire, double-lumen, short- or long-nose sphincterotomes in some patients (group 2), and cannulation was attempted for 10 minutes with these methods. For patients in which cannulation failed through these two methods in 10 attempts, the precut procedure proceeded with needle-knife sphincterotomes (Group 3). Precut methods were performed by fistulotomy at the orifice, or an upper area after infundibulotomy with needle-knife papillotomes, or after infundibulotomy at the papilla orifice with double-lumen sphincterotome, or after pancreatic cannulation. The number of cannulation attempts was recorded for each patient and the definition was made as follows: 1-5 attempts, easy cannulation; 6-15 attempts, moderate cannulation; and >15 attempts, difficult cannulation. The status of performing pancreatic cannulation was recorded.

### Definition and Classification of Complications

The following complications were defined and classified in

accordance with the criteria reported by Cotton et al. (12). An elevation in serum levels of amylase and lipase more than three times the upper limit of normal within 24 hours after the procedure, accompanied by new or worsened abdominal pain was defined as pancreatitis. A temperature of 38.5 °C, continuing for post-procedural 24–48 hours was defined as mild; febrile or septic illness requiring more than three days of hospital treatment or endoscopic and/or percutaneous intervention was defined as moderate; and septic shock or surgery was defined as severe cholangitis. Clinical and/or endoscopic evidence of bleeding with no need for transfusion and a hemoglobin level decrease of >3 g was defined as mild; transfusion of ≤4 units with no need for surgical or angiographic intervention was defined as moderate; and transfusion of ≥5 units with need for surgical and angiographic intervention was defined as severe bleeding.

### Statistical Analysis

All analyses were made using the SPSS 18.0 package. The confidence interval was accepted as 95% ($p<0.05$ was considered statistically significant). For descriptive statistics, mean ± standard deviation values were calculated for quantitative variables, and the number and percent values were calculated for qualitative variables. In the univariate analysis, Student's t-test (mean) and ANOVA test (variance) were used for the large sample; whereas the Mann-Whitney U-test (mean) and Kruskal-Wallis test (variance) were used in the small sample for the quantitative variables. The chi-square (Pearson's chi-square or Fisher's exact test) was used for the analysis of qualitative variables. The logistic regression method was used for the multivariate analysis.

## RESULTS

Clinical characteristics, sphincterotomy techniques and ERCP diagnoses of patients are summarized in Table I. The most common complication was pancreatitis (9.7%) (Table I). One of the pancreatitis patients was operated because of severe necrotizing pancreatitis. Complication development was significantly higher in group 3 (35.3%) ($p <0.05$). ERCP related complication rates in different groups are summarized in Table II.

The patients were divided into 3 groups according to the number of cannulations as simple (0-5 trials), medium difficulty (6-14 trials) and difficult cannulation (15 trials and more), and their relation with complication development was investigated. Of the 71 patients in the simple cannulation group, only 1 (1.4%) developed complications, while the relevant number was 9 (15%) of 60 patients in the medium difficulty group and 16 (29.6%) of 54 patients in the difficult cannulation group. The difference between the ratios was statistically significant ($p <0.05$) (Table III).

In all patients and also in patients with complications, the groups were compared according to the number of cannulation trials and sphincterotomy techniques. In all patients, the number of cannulation trials of the 76 patients who underwent conventional cannulation (group 1) was 6.38, while in group 2 (preliminary incision with standard sphincterotomy) this number was 10.23 and in group 3 (with needle-tip sphincterotomy, incision) it was 18.21. Statistically significant differences were found when the two groups were compared and the three groups were compared together ($p <0.05$) (Table IV).

In the patients with complications, the mean number of cannulation trials in 7 patients with complications in group 1 was 14.57 whereas it was 13.7 in 7 patients with complications in group 2, and 19.33 in 12 patients with complications in group 3. There was no significant difference between groups 1 and 2 and between groups 1 and 3 (p: 0.336 and 0.162, respectively) but there was a significant difference between groups 2 and 3 ($p <0.05$) (Table V).

Complication development in the patients with and without pancreatic cannulation with the guide wire was also investigated. Six of the 106 patients (5.7%) without pancreatic cannulation and 20 of the 79 patients (25.3%) with pancreatic cannulation had complications. Complication development was significantly higher in the pancreatic cannulation group ($p <0.05$).

The relationship between pancreas opacification during the procedure and complication development was also investigated. Complication development was observed in 10 (7.5%) of 134 patients without pancreatic opacification, and in 16 (51.4%) of 51 opacified patients (31,04). Complication development was significantly higher in the pancreatic opacification group ($p <0.05$).

Multivariate logistic regression analysis was performed to find out if the sphincterotomy technique, cannulation difficulty, pancreatic cannulation and pancreatic opacification were related to complication development after ERCP. Pancreas opacification (odds ratio 3.220) and cannulation difficulty (odds ratio 3.108) were found to be a risk factor for complication; whereas sphincterotomy technique and pancreatic cannulation were not (Table VI).

## DISCUSSION

ERCP is a procedure that may result in with several complications associated with morbidity and mortality. Due to the advancements in other imaging methods, especially in MRCP and EUS, ERCP is currently used for therapeutic rather than diagnostic purposes. Pancreatitis is the most common complication of ERCP. The incidence of post-ERCP pancreatitis may vary based on the study

designs; however, it is generally reported at rates of 1-7% (13-16), although some prospective studies have reported higher incidence rates varying from 11% to 23% (17-20). The rate of ERCP-related cholangitis is reported at a rate of <1% and bleeding is reported at a rate of 0.76 - 2% in the literature (12, 15, 16).

In the present study, the post-ERCP pancreatitis rate was 9.7%, and cholangitis was found at a rate of 3.2%, and bleeding at 1.1%. Due to the very low number of patients with cholangitis and bleeding, the findings associated with the papillotomy techniques were discussed over the pancreatitis complication. It is common to encounter a

**Table I:** Clinical characteristics of the patients.

| | | n | % |
|---|---|---|---|
| **Gender** | Female | 101 | 54.6 |
| | Male | 84 | 45.4 |
| **Pre-diagnosis** | Obstructive jaundice | 56 | 30.3 |
| | Choledocholithiasis | 117 | 63.2 |
| | Biliary pancreatitis | 8 | 4.3 |
| | Biliary leakage | 4 | 2.2 |
| **Sphincterotomy technique** | Conventional (group 1) | 76 | 41.1 |
| | Precut standard sphincterotome (group 2) | 75 | 40.5 |
| | Precut needle-knife (group 3) | 34 | 18.4 |
| **Cannulation success** | Failure | 32 | 17.3 |
| | Success | 153 | 82.7 |
| **Presence of diverticulum** | No | 165 | 89.2 |
| | Yes | 20 | 10.8 |
| **ERCP Diagnosis** | No procedure | 13 | 7.0 |
| | Choledocholithiasis | 83 | 44.9 |
| | Normal ERCP | 31 | 16.8 |
| | Cholangiocellular carcinoma | 7 | 3.8 |
| | Papillary tumor | 6 | 3.2 |
| | Pancreatic cancer | 8 | 4.3 |
| | Fibrosis of the sphincter of Oddi | 20 | 10.8 |
| | Other | 17 | 9.2 |
| **Procedure performed** | Papillotomy-extraction of stone and gravel | 75 | 40.5 |
| | Papillotomy-stent to choledochus | 29 | 15.7 |
| | Papillotomy-basket and/or balloon | 60 | 32.4 |
| | No papillotomy | 10 | 5.4 |
| | Other | 11 | 5.9 |
| | **Total** | **185** | **100.0** |

**Table II:** Relationship between sphincterotomy techniques and complication development.

| **Papillotomy technique** | **Complication** | | | | **p*** |
|---|---|---|---|---|---|
| | **Negative** | | **Positive** | | |
| | **n** | **%** | **n** | **%** | |
| **Group 1** | 69 | 90.8 | 7 | 9.2 | <0.001 |
| **Group 2** | 68 | 90.7 | 7 | 9.3 | |
| **Group 3** | 22 | 64.7 | 12 | 35.3 | |
| **Total** | 159 | 85.9 | 26 | 14.1 | |

temporary elevated level of pancreatic enzyme after ERCP, even in patients without any complications. The incidence of post-ERCP asymptomatic hyperamylasemia is reported to be 25-75% in the literature (14, 17, 18). In the study by Wozniak et al. (19), this rate was reported to be 25% after diagnostic ERCP and 60% after therapeutic ERCP. In the present study, the amylase level was elevated in 37.74% of the patients and the lipase level was elevated in 45.91% of the patients without any complication. These elevations were significantly lower compared to the patients with pancreatitis. Post-procedural elevation in the enzyme is not sufficient for the diagnosis of pancreatitis by itself. ERCP-related pancreatitis is defined as an elevation in serum levels of amylase greater than three times the normal upper limit within 24 hours after the procedure, accompanied by new or worsened abdominal pain, and requiring at least two days of hospitalization (12). Pancreatitis is mild or moderate in most patients and the symptoms quickly recover; however, there are also some studies that have reported severe pancreatitis at a rate up to 30% (18, 20, 21).

**Table III:** Relationship between cannulation difficulty and complication development.

| Cannulation Difficulty | Complication | | | | | p |
|---|---|---|---|---|---|---|
| | Negative | | Positive | | | |
| | n | % | n | % | n | |
| simple | 70 | 98.6 | 1 | 1.4 | 71 | **<0.001** |
| medium difficulty | 51 | 85.0 | 9 | 15.0 | 60 | |
| difficult | 38 | 70.4 | 16 | 29.6 | 54 | |
| **Total** | 159 | 85.9 | 26 | 14.1 | 185 | |

**Table IV:** The number of cannulation attempts in groups according to sphincterotomy techniques in all patients

| | Papillotomy technique | n | Mean | SD | p1 | p2 |
|---|---|---|---|---|---|---|
| Cannulation difficulty | Conventional (group 1) | 76 | 6.38 | 5.980 | **<0.001** | <0.001 |
| | Precut standart (group 2) | 75 | 10.23 | 5.682 | | |
| | Conventional (group 1) | 76 | 6.38 | 5.980 | **<0.001** | |
| | Precut needle-knife (group 3) | 34 | 18.21 | 4.059 | | |
| | Precut standart (group 2) | 75 | 10.23 | 5.682 | **<0.001** | |
| | Precut needle-knife (group 3) | 34 | 18.21 | 4.059 | | |

**Table V:** Numbers of cannulation attempts in groups according to sphincterotomy techniques in complicated patients.

| | Papillotomy technique | n | Mean | SD | p1 | p2 |
|---|---|---|---|---|---|---|
| Cannulation difficulty | Conventional (group 1) | 7 | 14.57 | 6.294 | **0.336** | .047 |
| | Precut standart (group 2) | 7 | 13.71 | 3.904 | | |
| | Conventional (group 1) | 7 | 14.57 | 6.294 | **0.162** | |
| | Precut needle-knife (group 3) | 12 | 19.33 | 4.334 | | |
| | Precut standart (group 2) | 7 | 13.71 | 3.904 | **0.018** | |
| | Precut needle-knife (group 3) | 12 | 19.33 | 4.334 | | |

**Table VI:** Regression analysis of multiple risk factors.

| | Coefficient | SE | p | Odds ratio | %95 Confidence interval | |
|---|---|---|---|---|---|---|
| | | | | | Min | Max |
| Pancreatic opaque injection | 1.169 | .474 | **.014** | **3.220** | 1.272 | 8.153 |
| Cannulation difficulty | 1.134 | .352 | **.001** | **3.108** | 1.560 | 6.193 |
| Invariant | -4.811 | .885 | .000 | .008 | | |

In the present study, only one of 18 (5.5%) ERCP-related pancreatitis patients had severe pancreatitis.

When considering the presence of complications based on the sphincterotomy techniques in the present study, seven (9.2%) of 76 patients who underwent sphincterotomy with conventional techniques (group 1) had complications, whereas seven (9.3%) of 75 patients who underwent PS with Standard sphincterotomes without needle-knife (group 2) and 12 (35.3%) of 34 patients who underwent PS with needle-knife sphincterotomes (group 3) had complications. The complication rate was significantly higher in group 3. There was no significant difference in developing complications between group 1 and group 2. The study by Loperfido et al. found that the precut methods increased the rate of developing complications (15). Again, the study by Masci et al. found that the precut techniques increased the rate of developing complications and also reported that the pancreatic opaque injection, undilated biliary ducts, and performance of ERCP at a center with <200 ERCP per year increased the rate for developing complications (16). These are relatively old studies. Among the recent studies on the advances in endoscopic techniques and equipment, the study by Kaffes et al. reported that the precut techniques were as safe as conventional methods and had a better rate of success for cannulation (22). The study by Cennamo et al., which included a meta-analysis of six randomized studies, analyzed the studies comparing the patients who were operated on early with the precut method and the patients for whom the conventional method was insisted, and found that the precut techniques were safer in terms of complications (23). Based on the statistical data in the present study, it may be inferred that the precut operation with needle-knife sphincterotome increases the rate of developing complications. However, many factors have a role in pancreatitis development in addition to sphincterotomy techniques, and as such, it would not be correct to deem that the needle-knife sphincterotomy technique alone increases the complication rate. Furthermore, the effects of difficulty in cannulation, pancreatic cannulation, and pancreatic opaque injections on developing complications were evaluated in the present study. In the present study, one (1.4%) of 71 patients from the simple cannulation group (attempts ≤5) developed complications, whereas nine (15%) of 60 patients from the moderate cannulation group (attempts: 6-14) and 16 (29.6%) of 54 patients from the difficult cannulation group (attempts >14) had complications. These findings suggest that the complication rate increases as the number of cannulation attempts increase. The study by Freeman et al., which supports the findings of the present study, found that difficult cannulation increased the rate of developing complications and the odds ratio was 3.4. Additionally, sphincter of Oddi dysfunction, history of post-ERCP pancreatitis, female gender, and pancreatic opaque injection were also among the other factors increasing the complication rate (13). The groups were compared according to the number of cannulation attempts and sphincterotomy techniques in all patients and also in the patients that developed complications. When considering all patients, the mean number of cannulation attempts in 76 patients who underwent cannulation with the conventional method (group 1) was 6.38 compared to 10.23 in group 2 (precut with standard sphincterotome) and 18.21 in group 3 (precut with needle-knife). When the groups were pairwise compared and the three groups were compared, there were statistically significant differences.

The increase in the number of cannulation attempts was already expected to increase from group 1 to group 3, due to the randomization of the study. When these numbers were analyzed, only in the patients with complications, the mean number of cannulation attempts patients that developed complications in group 1 was 14.57, compared to 13.7 in seven patients that developed complications in group 2, and 19.33 in 12 patients that developed complications in group 3. No statistically significant difference was found between groups 1 and 2, and groups 1 and 3; whereas there was a significant difference between groups 2, and 3. This data suggests that the complication rate increased independently of the sphincterotomy technique also in the patients for whom the conventional method was attempted and a higher number of attempts were made. The mean number of cannulation attempts with conventional methods in all patients was 6.38 compared to 14.57 in the patients who developed complications and underwent sphincterotomy with the conventional method. There was a statistically significant difference between groups 1 and 3 in all patients, whereas this difference disappeared in the patients who developed complications. The results of the meta-analysis by Cennamo et al. established that the use of early precut techniques had a lower risk for complications compared to the insistence on conventional methods (23). The present study revealed that the number of cannulation attempts in patients, both with and without complications, in the group of precuts with standard sphincterotomy (group 2) was significantly lower than the group of needle-knife sphincterotomes. However, the difference found between groups 1 and 3 in the patients without complications disappeared in the patients with complications. Therefore, this finding proposes that proceeding to the precut methods with standard sphincterotome in the early period rather than insisting on conventional methods may be associated with a lower risk of complications.

Advancing the guide into the pancreatic duct plays a role in the development of mechanical damage and pancreatitis. In the present study, six (5.5%) of 106 patients without

pancreatic cannulation developed complications, whereas 20 (25.3%) of 79 patients with pancreatic cannulation had complications. The prospective study by Lee et al. reported that unintentional pancreatic cannulations had a role in developing complications (24). The data of the present study also support this study.

The presence of pancreatic opaque injection was positively correlated with developing complications. Ten (7.5%) of 134 patients without opaque injection into the pancreatic duct developed complications, whereas 16 (31.4%) of 51 patients with opaque injection had complications. The hydrostatic damage due to the injection and the allergic and chemical damage due to the opaque agent may have a role in this increased rate. The study by Freeman et al. established pancreatic opaque injection as a risk factor, alongside difficult cannulation, and the sphincterotomy technique with precut and female gender (13).

In the present study, the sphincterotomy technique, cannulation difficulty, pancreatic cannulation, and pancreatic opaque injection were individually associated with developing complications. A multivariate logistic regression analysis was conducted in order to investigate which one of these independent factors caused an increased risk for developing complications. Pancreatic opaque injection (odds ratio: 3.220) and cannulation difficulty (odds ratio: 3.108) were established as risk factors in terms of developing complications. In the study by Freeman et al., the odds ratio for pancreatic opaque injection was 2.7 and the ratio for difficult cannulation was 3.4.

The researchers of the current study encountered the precut methods as a risk factor in the studies by Freeman et al. and Masci et al., and also in the univariate analysis and multivariate analysis (14, 16). In the study by Freeman et al., among the studies that were conducted later, the precut methods were a risk factor in the univariate analysis, whereas they were not a risk factor in the multivariate analysis (13). Additionally, the precut methods were a risk factor in the univariate analysis, whereas they were not a risk factor in the multivariate analysis in the study by Vondervoort et al. (25). The pancreatic opaque injection also appears as a risk factor in both analyses in these studies (13, 14, 16, 25). The mechanism is not clear for how the pancreatic injection causes pancreatic ductal and acinar cell damage.

Difficult cannulation is a risk factor for post-ERCP complications in many studies (13-16, 25). These observations suggest that the repeated traumas of the papilla and pancreatic sphincter play a role in impaired pancreatic drainage and the development of pancreatitis. The data on the number of attempts resulting in the development of pancreatitis are inconsistent. The two studies by Freeman et al. established this number as six (13,14). Furthermore, the study by Vandervoot et al. reported that pancreatitis developed after 20 attempts (25).

In conclusion, the use of the precut technique with standard sphincterotome in the early period rather than insisting on cannulation with the conventional methods reduces the risk for developing complications and decreases the number of cannulation attempts. The administration of opaque into the pancreatic duct and cannulation with guide wire should be avoided during the procedure. The patients who are difficult to cannulate and who are administered opaque into the pancreatic duct during the procedure should be closely followed for complications.


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## REFERENCES


1. Young HS, Keeffe, EB. Complications of gastrointestinal endoscopy. In: Sleisenger & Fordtran's Gastrointestinal and Liver Disease, 6th ed. Philadelphia: WB Saunders, 1998, 301.
2. Mallery JS, Baron TH, Dominitz JA, Goldstein JL, Hirota WK, Jacobson BC, Leighton JA, Raddawi HM, Varg JJ 2nd, Waring JP, Fanelli RD, Wheeler-Harbough J, Eisen GM, Faigel DO; Standards of Practice Committee. Complications of ERCP. Gastrointest Endosc 2003;57: 633-7.
3. Cotton PB. Precut papillotomy-a risky technique for experts only. Gastrointest Endosc 1989;35:578-9.
4. Conio M, Saccomanno S, Aste H, Pugliese V. Precut papillotomy: Primum non nocere. Gastrointest Endosc 1990;36(5):544.
5. Rabenstein T, Ruppert T, Schneider HT. Benefits and risks of needle-knife papillotomy. Gastrointest Endosc 1997;46:207-11.
6. Leung JW, Banez VP, Chung SC. Precut (needle knife) papillotomy for impacted common bile duct stone at the ampulla. Am J Gastroenterol 1990;85:991-3.
7. Foutch PG. A prospective assessment of results for needle-knife papillotomy and standard endoscopic sphincterotomy. Gastrointest Endosc 1995;41:25-32.
8. Goff JS. Common bile duct pre-cut sphincterotomy: Transpancreatic sphincter approach. Gastrointest Endosc 1995;41:502-5.

9. Bruins Slot W, Schoeman MN, Disario JA, Wolters F, Tytgat GN, Huibregtse K. Needle-knife sphincterotomy as a precut procedure: A retrospective evaluation of efficacy and complications. Endoscopy 1996;28:334-9.
10. Gholson CF, Favrot D. Needle knife papillotomy in a university referral practice. Safety and efficacy of a modified technique. J Clin Gastroenterol 1996; 23: 177-80.
11. Rabenstein T, Schneider HT, Hahn EG, Ell C. 25 years of endoscopic sphincterotomy in Erlangen: assessment of the experience in 3498 patients. Endoscopy 1998; 30: 194-201.
12. Cotton PB, Lehman G, Vennes J, Geenen JE, Russell RC, Meyers WC, Liguory C, Nickl N. Endoscopic sphincterotomy complications and their management: An attempt at consensus. Gastrointest Endosc 1991;37:383-93.
13. Freeman ML, DiSario JA, Nelson DB, Fennerty MB, Lee JG, Bjorkman DJ, Overby CS, Aas J, Ryan ME, Bochna GS, Shaw MJ, Snady HW, Erickson RV, Moore JP, Roel JP. Risk factors for post-ERCP pancreatitis: A prospective, multicenter study. Gastrointest Endosc 2001;54:425-34.
14. Freeman ML, Nelson DB, Sherman S, Haber GB, Herman ME, Dorsher PJ, Moore JP, Fennerty MB, Ryan ME, Shaw MJ, Lande JD, Pheley AM. Complications of endoscopic biliary sphincterotomy. N Engl J Med 1996; 335:909-18.
15. Loperfido S, Angelini G, Benedetti G, Chilovi F, Costan F, De Berardinis F, De Bernardin M, Ederle A, Fina P, Fratton A. Major early complications from diagnostic and therapeutic ERCP: A prospective multicenter study. Gastrointest Endosc 1998;48:1-10.
16. Masci E, Toti G, Mariani A, Curioni S, Lomazzi A, Dinelli M, Minoli G, Crosta C, Comin U, Fertitta A, Prada A, Passoni GR, Testoni PA. Complications of diagnostic and therapeutic ERCP: A prospective multicenter study. Am J Gastroenterol 2001;96:417-23.
17. Kiviniemi H, Juvonen T, Makela J. Acute phase response in patients with uncomplicated and complicated endoscopic retrogradic cholangiopancreaticography. HPB Surgery 1994;8:129-31.
18. Dickinson R, Davies S. Post ERCP pancreatitis and hyperamylasemia: The role of operative and patient factors. Eur J Gastroenterol Hepatol 1998;10:423-8.
19. Wozniak B, Wisniewska-Jarosinska M, Drzewoski J. Evaluation of selected parameters of the inflammatory response to endoscopic retrograde cholangiopancreatography. Pancreas 2001;23:349-55.
20. Kaw M, Singh S. Serum lipase, C-reactive protein, and interleukin-6 levels in ERCP-induced pancreatitis. Gastrointest Endosc 2001;54:435-40.
21. Sherman S, Lehman GA. ERCP and endoscopic sphincterotomy induced pancreatitis. Pancreas 1991;6: 350-67.
22. Kaffes AJ, Sriram PV, Rao GV, Santosh D, Reddy DN. Early institution of precutting for difficult biliary cannulation: A prospective study comparing conventional vs. a modified technique. Gastrointest Endosc 2005; 62(5):669-74.
23. Cennamo V, Fuccio L, Zagari RM, Eusebi LH, Ceroni L, Laterza L, Fabbri C, Bazzoli F. Can early precut implementation reduce endoscopic retrograde cholangiopancreatography related complication risk? Meta-analysis of ramdomized controlled trials. Endoscopy 2010;42:381-8.
24. Lee TH, Park do H, Park JY, Kim EO, Lee YS, Park JH, Lee SH, Chung IK, Kim HS, Park SH, Kim SJ. Can wire-guided cannulation prevent post-ERCP pancreatitis? A prospective randomized trial. Gastrointest Endosc 2009; 69:444-9.
25. Vandervoort J, Soetikno RM, Tham TC, Wong RC, Ferrari AP Jr, Montes H, Roston AD, Slivka A, Lichtenstein DR, Ruymann FW, Van Dam J, Hughes M, Carr-Locke DL. Risk factors for complications after performance of ERCP. Gastrointest Endosc 2002;56: 652-6.