

# Endoscopic retrograde cholangiopancreatography using a pediatric colonoscope in patients with Roux-en-Y gastrectomy and an intact major duodenal papilla

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**Abstract.** Endoscopic retrograde cholangiopancreatography (ERCP) in patients with Roux-en-Y gastrectomy and an intact major duodenal papilla is challenging and difficult, with unsatisfactory outcomes using various endoscopes. Limited data are available regarding the outcomes of ERCP using a pediatric colonoscope in such patients. To evaluate the efficacy of a pediatric colonoscope in patients with Roux-en-Y gastrectomy and an intact major duodenal papilla, 93 consecutive patients with Roux-en-Y gastrectomy and an intact major duodenal papilla who underwent ERCP using a pediatric colonoscope at the Medical Center for Digestive Diseases, The Second Affiliated Hospital of Nanjing Medical University, (Nanjing, China) between January 2018 and December 2022 were retrospectively reviewed. Following the failure of bile duct cannulation, a double-guidewire or precut technique was utilized for advanced cannulation. Interventions were performed using standard ERCP therapeutic accessories. The results indicated that distal gastrectomy with Roux-en-Y reconstruction was performed in 38 out of 93 patients, while 55 patients underwent total gastrectomy with Roux-en-Y reconstruction. The success rates associated with endoscope insertion, endoscopic cannulation and therapeutic ERCP were 88.17% (82/93), 85.37% (70/82) and 95.71% (67/70), respectively, while the clinical intervention success and complication rates were 72.04% (67/93) and 7.53% (7/93), respectively. The endoscope insertion time was 40.78±10.04 min, and the ERCP procedure time was 88.55±16.38 min. Student's t-test showed that the endoscope insertion time and the ERCP procedure time in patients undergoing distal gastrectomy were longer

than those in patients undergoing total gastrectomy ( $P<0.05$ ). Binary logistic regression analysis showed that age and number of previous abdominal surgeries were independent risk factors associated with endoscope insertion failure. In conclusion, the present study demonstrated that the use of a pediatric colonoscope is efficacious and safe for patients with Roux-en-Y gastrectomy and an intact major duodenal papilla undergoing ERCP.

## Introduction

Endoscopic retrograde cholangiopancreatography (ERCP) is widely used as an important diagnostic and therapeutic procedure for pancreaticobiliary disease (1). The success rate of the procedure in patients with normal anatomy is 90-95% (2). However, ERCP in patients with surgically altered anatomy is challenging due to the difficulty in accessing the afferent limb, cannulation of a papilla or biliopancreatoenteric anastomosis with a reverse orientation, and the difficulty in performing therapeutic interventions (3,4).

Among all types of reconstruction, Roux-en-Y gastrectomy is one of the most difficult types of reconstruction. During ERCP in patients with Roux-en-Y gastrectomy, entering the afferent limb of the Y anastomosis is difficult due to the long afferent limb length, sharp angulation and severe adhesion (3-5). Additionally, the position of the native papilla in Roux-en-Y gastrectomy markedly differs from that of the normal anatomy, which may increase the difficulty of bile duct cannulation (3,5).

Since balloon enteroscope-assisted ERCP was first successfully performed in a patient with Roux-en-Y choledochojejunostomy reconstruction in 2005 (6), it has been demonstrated to be a useful tool in the management of patients with surgically altered anatomy (7). However, the balloon enteroscope has a 200-cm working length with a small working channel diameter (3.2 mm), which limits the use of numerous commercial ERCP accessories, for example, the sphincterotome (5). The short-type balloon enteroscope has been introduced for patients with surgically altered anatomy, and this allows the use of conventional ERCP accessories (8,9). However, the technique is not readily available in all centers and trained personnel are needed, limiting its routine use (8,9).

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Despite expert hands performing the procedure, the results of Roux-en-Y reconstruction in previous studies were not satisfactory when using various endoscopes (3-5). Based on our practical experience, the pediatric colonoscope is suitable for performing ERCP in patients with Roux-en-Y gastrectomy and an intact major duodenal papilla. The pediatric endoscope is flexible, with a 3.2-cm working channel diameter and 135-cm working length, while maintaining a slim outer diameter (9.9 mm). This type of endoscope is available in almost all centers and provides access to the afferent limb; it also enables the use of conventional ERCP accessories.

However, limited data are available regarding the outcomes of pediatric colonoscope-assisted ERCP in patients with Roux-en-Y gastrectomy. The present study evaluated the efficacy of using a pediatric colonoscope in patients with Roux-en-Y gastrectomy and an intact major duodenal papilla.

## Materials and methods

**Patients.** Consecutive patients with Roux-en-Y gastrectomy and an intact major duodenal papilla who underwent ERCP using a pediatric colonoscope at the Medical Center for Digestive Diseases, The Second Affiliated Hospital of Nanjing Medical University (Nanjing, China) between January 2018 and December 2022 were retrospectively reviewed. Patients with coagulation disorders, severe cardiopulmonary insufficiency and age <18 or >86 years were excluded. Data were extracted from the medical records and endoscopy database. These data included patient demographics, postsurgical anatomy, indications for ERCP, endoscopic findings and therapies, exploration time, and procedural complications.

The present retrospective study was approved by the Ethics Committee of The Second Affiliated Hospital of Nanjing Medical University [approval no. (2022)-KY-122-02]. Written informed consent was obtained from each patient before ERCP. All patients provided written informed consent for publication.

**Methods.** All procedures were performed under conscious sedation with dexmedetomidine and fentanyl or under general anesthesia, according to the judgment of the anesthesiologist, and vital signs were continuously monitored. The patients were placed in the supine or left lateral position, and CO<sub>2</sub> insufflation was used in all cases. ERCP was performed with a pediatric colonoscope (PCF-Q260JI; Olympus Corporation). A transparent cap (D-201-11802; Olympus Corporation) was attached to the tip of the pediatric colonoscope for enhanced visualization of endoscope insertion and to facilitate bile duct cannulation.

After reaching the esophagojejunal or gastrojejunal anastomosis, the pediatric colonoscope was inserted into the Roux limb to find the Roux-en-Y anastomosis, where one limb was selected for insertion of the pediatric colonoscope after using a clip fixed to the mucosa of the limb as a marker. Fluoroscopy was used to identify the afferent limb as it led to the upper abdomen. When the pediatric colonoscope is passed down the lower abdomen, it naturally locates in the efferent limb. On this occasion, the pediatric colonoscope was drawn back to the Roux-en-Y anastomosis, and changed to the other limb (the afferent limb). Any difficulties with endoscope insertion due to

looping or long scope length prompted changes in the patient position or compression of the abdomen.

When selective bile duct cannulation failed and the pancreatic duct was cannulated, the double-guidewire technique was used with another guidewire. The sphincterotome (TRI-25M-P; Cook Medical) was reinserted along the first guidewire after reloading with the second guidewire to attempt cannulation of the bile duct. After successful bile duct cannulation, the pancreatic wire was removed or a pancreatic stent (Zimmon; Cook) was inserted by the first guidewire. Otherwise, the precut technique was used with a sphincterotome or a needle-knife (KD-441Q or KD-10Q-1; Olympus Corporation). The procedure was terminated when bile duct cannulation could not be achieved despite the use of various techniques for ~30 min.

Treatment was performed using standard ERCP therapeutic accessories, including the guidewire, sphincterotome, balloon dilator, basket or retrieval balloon and biliary stent. The endoscopic sphincterotomy (EST) was performed in the 11 to 12 o'clock position of the papilla, and minor EST (3-5 mm) was performed. Stones were removed from the common bile duct with a basket or a retrieval balloon. In the case of biliary strictures or difficult bile duct stones, a plastic stent (Flexstent; Changzhou New District Garson Medical Stent Apparatus Co., Ltd.) or self-expandable metal stent (Wallstent; Boston Scientific Corporation) was inserted, depending on the situation.

The procedure of ERCP using a pediatric colonoscope in total gastrectomy with Roux-en-Y reconstruction is shown in Fig. 1.

**Definitions.** The success of endoscope insertion was defined by access to the afferent limb and identification of the papilla. Endoscopic cannulation success was defined as successful bile duct cannulation and cholangiography, whereas therapeutic ERCP success was defined as the ability to successfully perform stone extraction or stent placement for strictures. Clinical intervention success was defined as successful completion of the intended treatment (stone extraction and stent placement) after successful endoscope insertion.

The endoscope insertion time was defined as the time from the insertion of the scope into the mouth of the patient to papilla identification. The ERCP procedure time was defined as the time from the insertion of the scope into the mouth of the patient to the complete withdrawal of the scope from the mouth of the patient. Standard cannulation was defined by the non-use of advanced methods such as precut or double-guidewire techniques.

ERCP complications, including cholangitis, pancreatitis, bleeding and perforation, were defined according to standard criteria (10,11). Data, including success of endoscope insertion, endoscopic cannulation success, clinical intervention success, the endoscope insertion time, the ERCP procedure time and ERCP complications, were collected from patients over a 2-week follow-up period after the procedure.

**Statistical analysis.** Statistical analysis was performed using SPSS version 25.0 (IBM Corp.). The  $\chi^2$  test or Fisher's exact test was used to compare categorical variables, while independent-samples Student's t-test was used to compare continuous

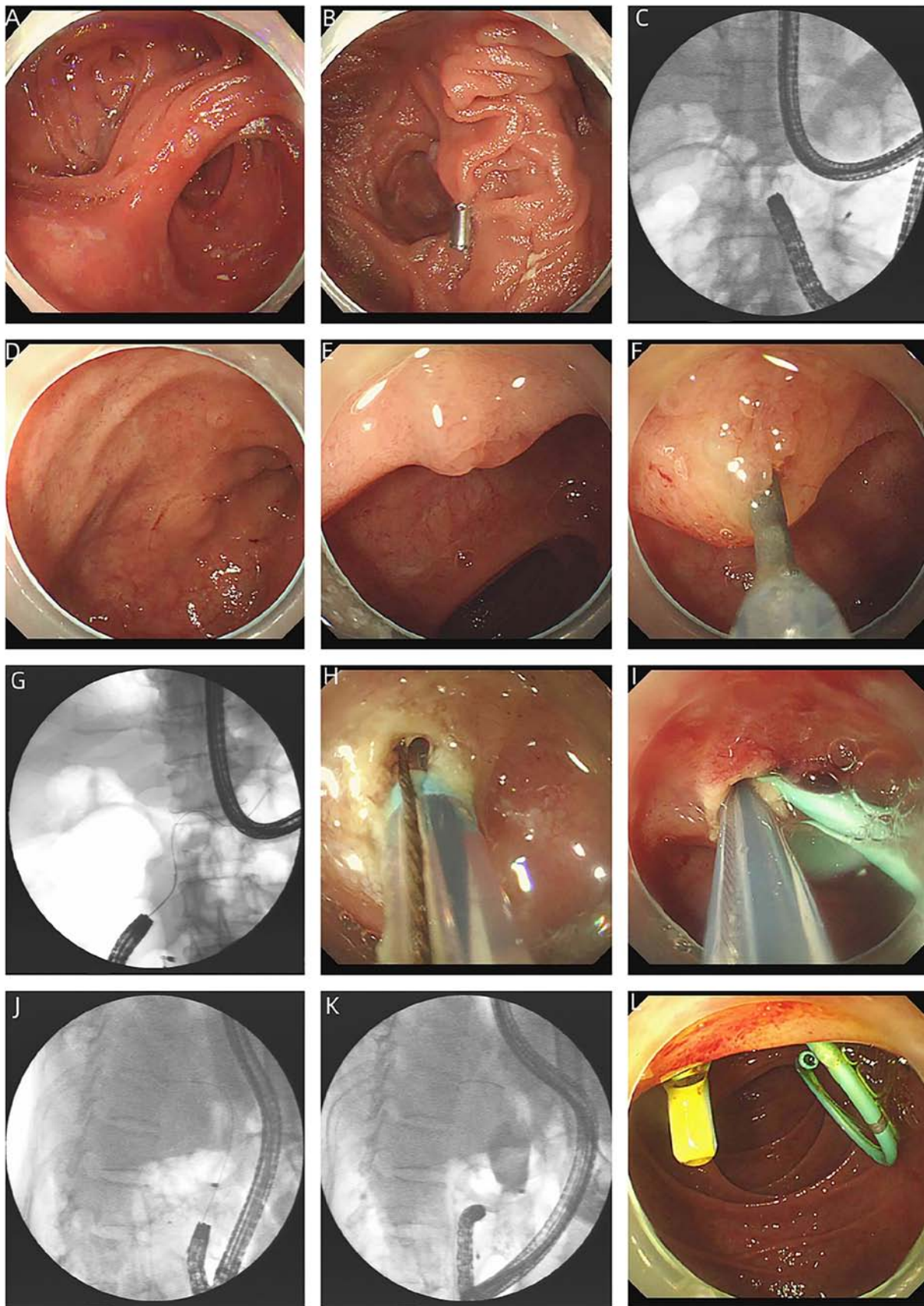


Figure 1. Procedure of endoscopic retrograde cholangiopancreatography using a pediatric colonoscope in a total gastrectomy with Roux-en-Y reconstruction. (A) Esophagojejunal anastomosis. (B) Roux-en-Y anastomosis (using a clip fixed to the mucosa of one limb as a marker). (C) Fluoroscopy (supine position) showing the pediatric endoscope moving to the right upper abdomen. (D) Blind end of the afferent limb. (E) Major papilla. (F) Locating the papilla directly, and making the bile duct axis parallel to the line of sight. (G) Cannulation of the pancreatic duct (supine position). (H) Performing minor endoscopic sphincterotomy in the 11 to 12 o'clock position of the major duodenal papilla. (I) The bile duct was cannulated using the double-guidewire technique and a pancreatic stent was inserted by the first guidewire. (J) Fluoroscopy (left lateral position) confirmed that the bile duct was cannulated. (K) Cholangiography (left lateral position) revealed a large stone in the common bile duct. (L) A biliary plastic stent was inserted.

Table I. Clinical and endoscopic characteristics of the patients (n=93).

| Characteristics                           | Value      |
|---|------------|
| Sex, n (male/female)                      | 61/32      |
| Age, years <sup>a</sup>                   | 67.35±9.45 |
| Indications of ERCP, n                    |            |
| Common bile duct stones                   | 77         |
| Biliary strictures                        | 16         |
| Stone diameter, cm <sup>a</sup>           | 0.95±0.31  |
| Postsurgical anatomy, n                   |            |
| Distal gastrectomy                        | 38         |
| Total gastrectomy                         | 55         |
| Number of previous abdominal surgeries, n |            |
| 1   | 57         |
| 2   | 33         |
| 3   | 3          |

<sup>a</sup>Data are presented as mean ± standard deviation. ERCP, endoscopic retrograde cholangiopancreatography.

variables. Variables with a P-value <0.05 in univariate analysis were included in the model of binary logistic regression analysis. Statistical analysis was performed using SPSS statistical software (version 25; IBM Corp.). P<0.05 was considered to indicate a statistically significant difference.

## Results

A total of 93 patients (32 female patients and 61 male patients) with Roux-en-Y gastrectomy underwent ERCP using a pediatric colonoscope at the Medical Center for Digestive Diseases, The Second Affiliated Hospital of Nanjing Medical University, between January 2018 and December 2022. The mean age of the patients was 67.35±9.45 years (range, 18-86 years). Distal gastrectomy with Roux-en-Y reconstruction was performed in 38 patients, while total gastrectomy with Roux-en-Y reconstruction was performed in 55 patients. The indication for all procedures was common bile duct stones (77 patients) or biliary strictures (16 patients), which were previously confirmed by magnetic resonance cholangiopancreatography or CT. A total of 57, 33 and 3 patients underwent one, two and three abdominal surgeries previously, respectively. Table I shows the demographic, postsurgical anatomical, clinical and endoscopic characteristics of the patients.

In the present study, the major papilla was reached successfully in 82 patients, while the major papilla was not successfully reached in 11 patients. Therefore, the endoscope insertion success rate was 88.17% (82/93). One of the 11 failures was attributed to the obstruction of the afferent limb, whereas 8 failures were due to adhesion and sharp angulation, and the afferent limb was not reached in 2 patients due to intolerance. Of the 11 patients with unsuccessful endoscope insertion, 2 underwent a second ERCP with a double-balloon enteroscope, which was successful, 3 underwent surgery successfully, 4 underwent percutaneous transhepatic papillary

balloon dilation and antegrade stone extraction successfully, and 2 were treated conservatively.

Sex, age, mode of anesthesia, postsurgical anatomy and the number of previous abdominal surgeries were further analyzed. The results showed that age and number of previous abdominal surgeries were associated with the endoscope insertion success rate (P<0.05). Binary logistic regression analysis was used to explore these variables. The results showed that age and number of previous abdominal surgeries were independent risk factors associated with endoscope insertion failure. The risk of failure was higher in younger patients or those who had a history of two to three abdominal surgeries. The results of endoscope insertion are shown in Tables II and III.

Selective bile duct cannulation was achieved in 70 of the 82 patients when the major papilla was reached successfully, thus the endoscopic cannulation success rate was 85.37% (70/82). Of the 70 patients, 48 underwent standard cannulation, while 10 were treated with the precut technique and 12 were exposed to the double-guidewire technique. Selective bile duct cannulation was not completed in 12 patients due to an unfavorable orientation of the papilla or intolerance to the procedure. Among them, 1 patient underwent endoscopic ultrasonography-guided biliary drainage (EUS-BD) successfully, 3 patients underwent percutaneous transhepatic papillary balloon dilation and antegrade stone extraction successfully, 2 patients underwent percutaneous transhepatic biliary drainage and the ERCP rendezvous technique successfully, 4 patients underwent surgery, and 2 patients were treated conservatively.

Stone extraction or stent placement was performed successfully in 67 out of 70 patients who had achieved bile duct cannulation and cholangiography. Of the 67 patients, 64 underwent sphincterotomy, 53 were treated with endoscopic papillary balloon dilation, 55 underwent stone extraction and 12 were stented. A total of 44 patients underwent endoscopic papillary balloon dilatation (EPBD) and 12 patients underwent endoscopic papillary large balloon dilatation (EPLBD), without any bleeding episodes or perforation. A total of 3 patients with common bile duct stones failed to complete the intended treatment. A total of 2 patients underwent stent placement due to stone impaction, while 1 patient was stented due to oxygen desaturation during the procedure.

The present results demonstrated that the success rates of endoscope insertion, endoscopic cannulation, therapeutic ERCP and clinical intervention were 88.17% (82/93), 85.37% (70/82), 95.71% (67/70) and 72.04% (67/93), respectively. The endoscope insertion time was 40.78±10.04 min, while the ERCP procedure time was 88.55±16.38 min. Among the 93 patients, minor reverse EST was performed in 67 patients in total, and no bleeding or perforation was detected. Only 5 patients exhibited mild-to-moderate post-ERCP pancreatitis, while 2 patients exhibited cholangitis. All patients were managed with conventional therapy (including anti-infection and nutrition support). The complication rate was 7.53% (7/93) (Table IV).

The aforementioned variables were further compared between patients undergoing distal gastrectomy with Roux-en-Y reconstruction and patients undergoing total gastrectomy with Roux-en-Y reconstruction. The results revealed no significant differences in the success rates of



Table II. Success or failure of endoscope insertion (n=93).

| Characteristics                           | Success (n=82) | Failure (n=11) | P-value |
|---|----------------|----------------|---------|
| Male, n (%)                               | 55 (67.07)     | 6 (54.55)      | 0.503   |
| Age, years <sup>a</sup>                   | 68.20±9.44     | 61.09±7.11     | 0.018   |
| Anesthesia method, n                      |                |                | >0.999  |
| Conscious sedation                        | 62             | 8              |         |
| General anesthesia                        | 20             | 3              |         |
| Postsurgical anatomy, n                   |                |                | 0.754   |
| Distal gastrectomy                        | 33             | 5              |         |
| Total gastrectomy                         | 49             | 6              |         |
| Number of previous abdominal surgeries, n |                |                | 0.001   |
| 1   | 55             | 2              |         |
| 2   | 26             | 7              |         |
| 3   | 1              | 2              |         |

<sup>a</sup>Data are presented as mean ± standard deviation.

Table III. Binary logistic regression analysis of factors involved in endoscope insertion failure.

| Characteristics                        | OR (95% CI)         | P-value |
|--|---------------------|---------|
| Age (<60 years)                        | 1.129 (1.024-1.244) | 0.014   |
| Number of previous abdominal surgeries |                     |         |
| 1                                      | 1.000               |         |
| 2                                      | 0.089 (0.014-0.577) | 0.011   |
| 3                                      | 0.009 (0.000-0.209) | 0.003   |

OR, odds ratio; CI, confidence interval.

endoscope insertion, endoscopic cannulation and therapeutic ERCP, or in the rates of clinical intervention success and complications, between the two groups. However, the endoscope insertion and ERCP procedure times in patients with distal gastrectomy were significantly longer than those in patients who underwent total gastrectomy. These clinical outcomes are presented in Table IV. A summary of the ERCP results is shown in Fig. 2.

**Discussion**

Among the different types of postsurgical anatomy encountered in clinical settings, Roux-en-Y gastrectomy is one of the most difficult reconstructions. ERCP in these patients is a greater challenge not only due to the long and tortuous afferent limb of the Y anastomosis, but also due to the presence of the native papilla, which is difficult to cannulate (12-14).

Only a few studies with small sample sizes have been published on this subject, and the success rates were different (12-14). The present study evaluated the effect of using a pediatric colonoscope in patients undergoing distal and total gastrectomy with Roux-en-Y reconstruction and,

to the best of our knowledge, it is the largest study to date involving this type of postsurgical anatomy.

At present, there is no consensus regarding the optimal position of the patient during surgery. The supine position or the left lateral position facilitates access to the afferent limb, and also enables manual abdominal compression and enhances the safety of patient sedation (15). The position of the patient is changed if endoscope insertion is difficult or X-ray localization is needed during the procedure. However, studies have demonstrated that some endoscopists naturally place the patient in the prone position (16,17), whereas others prefer the supine position (18). All patients received ERCP >3 months later after the gastrectomy. We consider this to be safe, as ERCP is minimally invasive and low risk.

In the present study, the success rate of endoscope insertion was 88.17% (82/93). Among the 11 patients with insertion failure, the main reason was adhesion and sharp angulation of the afferent limb (8/11). The risk of failure was increased in younger patients or patients with a history of two to three abdominal surgeries. The main reasons underlying endoscope insertion failure may be adhesion and sharp angulation due to previous abdominal surgeries and intolerance in younger patients. The variables were further compared between patients undergoing distal gastrectomy with Roux-en-Y reconstruction and patients undergoing total gastrectomy with Roux-en-Y reconstruction. The results revealed that the endoscope insertion and ERCP procedure times in patients with distal gastrectomy were longer than those in patients with total gastrectomy, potentially due to the sharp angulation at the level of gastrojejunostomy or a long afferent limb leading to loop formation in the gastric remnant, which complicated endoscope insertion.

When the major papilla is identified, bile duct cannulation is the first and most important step. The papilla of Roux-en-Y gastrectomy is difficult to cannulate due to the reverse position of the papilla, difficulty with scope manipulation and improper accessories (lack of an elevator) (12-14). Our clinical experience suggests that it is important to locate the papilla

Table IV. Clinical outcomes.

| Outcomes  | Total (n=93)  | Distal gastrectomy (n=38) | Total gastrectomy (n=55) | P-value |
|---|---------------|---------------------------|--------------------------|---------|
| Endoscope insertion success rate, % <sup>a</sup>    | 88.17 (82/93) | 86.84 (33/38)             | 89.09 (49/55)            | 0.754   |
| Endoscopic cannulation success rate, % <sup>a</sup> | 85.37 (70/82) | 87.88 (29/33)             | 83.67 (41/49)            | 0.834   |
| Therapeutic ERCP success rate, % <sup>a</sup>       | 95.71 (67/70) | 96.55 (28/29)             | 95.12 (39/41)            | >0.999  |
| Clinical intervention success rate, % <sup>a</sup>  | 72.04 (67/93) | 73.68 (28/38)             | 70.91 (39/55)            | 0.769   |
| Endoscope insertion time, min <sup>b</sup>          | 40.78±10.04   | 43.42±10.66               | 38.96±9.25               | 0.035   |
| ERCP procedure time, min <sup>b</sup>               | 88.55±16.38   | 93.68±18.48               | 85.00±13.84              | 0.011   |
| Complications, n                                    |               |                           |                          | 0.429   |
| Perforation   | 0             | 0                         | 0                        |         |
| Pancreatitis  | 5             | 2                         | 3                        |         |
| Bleeding  | 0             | 0                         | 0                        |         |
| Cholangitis   | 2             | 1                         | 1                        |         |

Data are presented as <sup>a</sup>n/total n or <sup>b</sup>mean ± standard deviation. ERCP, endoscopic retrograde cholangiopancreatography.

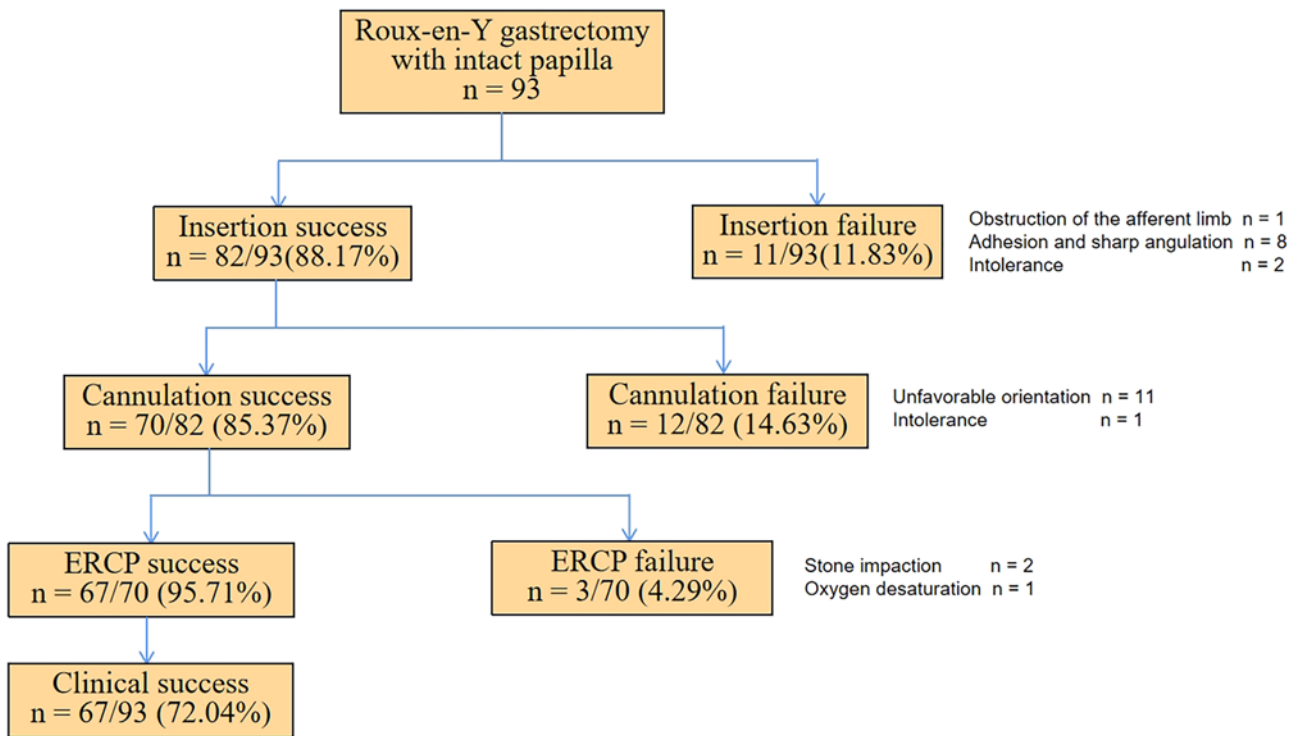


Figure 2. Summary of the ERCP results. ERCP, endoscopic retrograde cholangiopancreatography.

directly, and ensure that the bile duct axis is parallel to the line of sight. In case of failure, advanced methods such as precut or pancreatic guidewire cannulation are indicated (19). In the present study, selective bile duct cannulation was achieved in 70 out of 82 patients with successful access to the major papilla. Selective bile duct cannulation was not completed in 12 patients, primarily due to unfavorable orientation of the papilla.

EST is the most frequently used technique, followed by stone extraction. Based on our previous clinical experience, the incision should be oriented toward 5 to 6 o'clock of the reverse

position of the papilla. However, it is difficult to perform EST in the proper direction using the standard sphincterotome in patients with Roux-en-Y gastrectomy. In the present study, minor EST was performed in the 11 to 12 o'clock position of the major duodenal papilla in 67 patients in total, and no bleeding or perforation was detected. Therefore, it is safe and effective to perform minor reverse EST in patients with Roux-en-Y gastrectomy and an intact papilla.

EPBD is the first option for small common bile duct stones (<8 mm), due to the low associated risk of bleeding and

perforation (20). By contrast, EST combined with EPLBD is preferred for large and multiple common bile duct stones (20). Several randomized trials and systematic reviews have evaluated the benefits and risks of EST combined with EPLBD vs. EST alone for the removal of common bile duct stones, and the results showed that the efficacy of the two methods was comparable, with no significant differences in the rates of complication (21-23). In the present study, 44 patients underwent EPBD and 12 patients were exposed to EPLBD, without any bleeding episodes or perforation. The present results demonstrated that EST combined with EPLBD was safe and effective for stone extraction in patients with Roux-en-Y gastrectomy.

Previous studies reported that the therapeutic ERCP success rate of balloon enteroscope-assisted ERCP for Roux-en-Y gastrectomy ranged between 57.1 and 87.8% (18,24,25), while the therapeutic ERCP success rate of short-type enteroscope-assisted ERCP ranged between 59.1 and 88.9% (26-28). The present therapeutic ERCP success rate results were similar to those of enteroscope-assisted ERCP. Although enteroscope-assisted ERCP is a useful tool in the management of patients with surgically altered anatomy, the procedure cannot be generalized due to its non-availability in all the centers and the requirement for trained personnel, equipment and special accessory devices (in the case of long enteroscopes).

EUS-BD has emerged as an effective alternative for biliary access when the afferent limb or the papilla cannot be accessed (29,30). The success rate of the procedure ranges between 67 and 98%, while the complication rate ranges between 8.1 and 20.4% (31-34). Although EUS-BD is associated with a high success rate, the incidence of adverse events is still high. Furthermore, EUS-BD cannot be used in all patients, only in those with small bile duct stones or bile duct dilatation (31-34).

Tokuhara *et al* (35) conducted a large retrospective study evaluating enteroscope-assisted ERCP procedures in >1,500 patients. The results showed that the overall complication rate was 5.8% and that the most common adverse event was perforation, which was observed in 3.2% of patients. The perforation tended to occur during endoscope insertion and ERCP intervention. Another multi-center prospective study that included >300 enteroscope-assisted ERCP procedures reported a complication rate of 10.6%, with perforation being the most common adverse event, observed in 3.9% of all cases (36). In the present study, 5 patients exhibited mild-to-moderate post-ERCP pancreatitis, while 2 patients exhibited cholangitis. All patients were managed with conventional therapy. The complication rate was 7.53% (7/93), which is equivalent to that of conventional ERCP at 4.88-28.1% (11). The perforation rate in the present study was 0%. This may be due to the endoscope insertion strategy. Fluoroscopy was used to identify the afferent limb and a clip was fixed to the mucosa of the limb as a marker. Any difficulties with endoscope insertion due to looping or long scope length prompted changes in the position of the patient or compression of the abdomen. When the angulation was too sharp or the adhesion was too severe to insert the endoscope, the procedure was stopped without hesitation and other modalities were used instead, especially for patients with two to three abdominal surgeries. Additionally, the pediatric colonoscope is flexible and not as long as the enteroscope, reducing the risk of perforation. However, the present study was a single-center, retrospective study of <100 patients. Complications may occur when the number of patients is increased.

In conclusion, the present study demonstrated that the use of a pediatric colonoscope is efficacious and safe for conducting ERCP in patients with Roux-en-Y gastrectomy and an intact major duodenal papilla. This technique is our preferred approach and other endoscopists are encouraged to adopt these innovations for the management of their patients. Although the present study supports the use of a pediatric colonoscope in this group of patients, further large prospective and multicenter studies are needed to evaluate the efficacy of the intervention to corroborate the present findings.

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### Availability of data and materials

The data generated in the present study may be requested from the corresponding author.

### Authors' contributions

FW designed and performed the research, and wrote the paper. LM designed the research and supervised the study. XXG, XTD, JJJ, YTW, QPL and GBJ contributed to the data analysis and confirm the authenticity of all the raw data. All authors read and approved the final manuscript.

### Ethics approval and consent to participate

The present retrospective study was approved by the Ethics Committee of The Second Affiliated Hospital of Nanjing Medical University [Nanjing, China; approval no. (2022)-KY-122-02]. Written informed consent was obtained from each patient before endoscopic retrograde cholangiopancreatography.

### Patient consent for publication

All patients provided written informed consent for publication.

### Competing interests

The authors declare that they have no competing interests.

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