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Endoscopic retrograde cholangiopancreatography consultation after digestive tract reconstruction and risk factors for complications

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Abstract

Background Endoscopic retrograde cholangiopancreatography (ERCP) has been widely used in the diagnosis and treatment of biliary and pancreatic diseases, and its success rate and therapeutic effect are considerable, and its use in patients with gastrointestinal tract reconstruction is also increasing. The anatomical structure of the digestive tract has been changed in these patients, which makes the use of endoscopic retrograde cholangiopancreatography technically more challenging. The aim of this study was to investigate the efficacy of transendoscopic retrograde cholangiopancreatography in patients after gastrointestinal reconstruction and its risk factors for postoperative complications.

Methods A retrospective analysis was conducted on clinical data of 522 patients who underwent ERCP for diagnostic and therapeutic purposes after gastrointestinal reconstruction surgery at Zhongnan Hospital, Wuhan University, from January 2017 to December 2023. Univariate analysis, multicollinearity testing, and binary logistic regression were performed to explore the factors associated with ERCP efficacy and complications.

Results A total of 522 patients were included in the study. The success rate of intubation was 96.93% (506/522), the success rate of cannulation was 91.09% (466/506), and the therapeutic success rate was 95.28% (444/466). Multivariate logistic regression analysis of failed intubation showed that independent risk factors included total gastrectomy ($P=0.000$, OR = 7.114, 95% CI 2.454–20.622), gastrojejunostomy ($P=0.000$, OR = 46.881, 95% CI 10.250–214.423), and the use of a forward-viewing endoscope ($P=0.010$, OR = 2.322, 95% CI 1.228–4.389). Post-ERCP complications included hyperamylasemia in 67 cases (12.84%), acute pancreatitis in 13 cases (2.49%), acute cholangitis in 3 cases (0.57%), bleeding in 3 cases (0.57%), and perforation in 2 cases (0.38%). Univariate analysis of the complications showed that a history of cholecystectomy ($P=0.042$, OR = 1.800, 95% CI 1.015–3.193) was an independent risk factor for hyperamylasemia; difficult cannulation ($P=0.000$, OR = 47.619, 95% CI 13.317–170.275) was an independent risk factor for acute pancreatitis; and a history of pancreatitis ($P=0.040$, OR = 42.75, 95% CI 3.399–537.620) was an independent risk factor for bleeding.

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Conclusions ERCP performed in patients after gastrointestinal reconstruction at our hospital achieved a high success rate. Total gastrectomy, gastrojejunostomy, and the use of a forward-viewing endoscope were independent risk factors for failed intubation. A history of cholecystectomy, recurrent cannulation, and a history of pancreatitis were identified as independent risk factors for hyperamylasemia, acute pancreatitis, and bleeding, respectively.

Keywords Endoscopic retrograde cholangiopancreatography (ERCP), Gastrointestinal reconstruction, Efficacy, Complications, Risk factors

Introduction

Endoscopic retrograde cholangiopancreatography (ERCP) has been clinically applied since the 1960s and has become an indispensable minimally invasive technique that integrates both diagnosis and treatment in hepatobiliary surgery, gastrointestinal surgery, and digestive internal medicine [1, 2]. ERCP offers advantages such as being minimally invasive and having minimal impact on the internal environment, making it the preferred option for assisting in the treatment of biliary and pancreatic diseases. For patients with normal gastrointestinal anatomy, the success rate of intubation during ERCP can reach 90.0–95.0% [3], with stone removal success rates ranging from 80.0 to 90.0%. In patients with gastrointestinal reconstruction, the altered endoscopic path can lead to difficulties in locating the duodenal papilla or anastomosis, difficulty in cannulation, and tissue injury resulting in edema and bleeding. These factors increase the difficulty of therapeutic procedures and lead to lower success rates of intubation, cannulation, and therapeutic interventions, as well as a higher incidence of complications. This paper conducts a retrospective analysis of a large sample of clinical data, statistically analyzing the success rates of intubation, cannulation, and therapeutic procedures during ERCP in patients after gastrointestinal reconstruction. It also explores the risk factors for postoperative complications to reduce their incidence, which will help assess the efficacy and safety of ERCP in this patient group.

Materials and methods

Materials

Clinical data

This human research project was approved by the Ethics Committee of Zhongnan Hospital of Wuhan University (Ethics Approval No.: 2024181K). Clinical data were collected from 522 patients who underwent ERCP for diagnostic and therapeutic purposes after gastrointestinal reconstruction surgery at the Digestive Endoscopy Center of Zhongnan Hospital of Wuhan University from January 2017 to December 2023. Inclusion criteria: 1. patients who had previously undergone Billroth I or Billroth II gastrectomy, Roux-en-Y gastric bypass, biliary-enteric anastomosis, gastrojejunostomy Roux-en-Y, pancreaticoduodenectomy, or liver transplantation and 2. patients requiring ERCP for diagnosis or treatment.3.Patients with complete medical history and surgical data. Exclusion criteria: 1 unknown surgical procedures; 2. abnormal coagulation function (INR $\leq$ 1.5, platelet count $\geq 50 \times 10$^9, APTT within normal range, or fibrinogen $\geq$ 1.5 g/L); and 3. patients unable to cooperate during the procedure.

Observation index

Procedure-related success rates [4]: 1. *Intubation success*: successful advancement of the endoscope to the duodenal papilla or anastomosis. 2. *Cannulation success*: successful cannulation and contrast injection. 3. *Therapeutic success rate*: successful removal of stones, balloon dilation, stent placement, drainage, etc.

ERCP-related complications [5]: 1. *Post-ERCP pancreatitis (PEP)*: clinical symptoms of pancreatitis lasting for more than 24 h after ERCP, with serum amylase levels greater than three times the normal upper limit. 2. *Post-ERCP hyperamylasemia (PEH)*: elevated serum amylase levels without clinical signs of pancreatitis. 3. *Bleeding*: includes both early and delayed bleeding. Early bleeding refers to active bleeding during or immediately after the procedure that does not stop spontaneously, requiring hemostatic intervention. Delayed bleeding refers to upper gastrointestinal bleeding symptoms occurring hours or even weeks after the procedure. 4. *Gastrointestinal perforation*: severe abdominal pain within 24 h after the procedure, with free gas seen under the diaphragm or retroperitoneal on abdominal X-ray or CT scan.

ERCP preparation and procedure

1. *Preoperative preparation and postoperative treatment*: Patients were instructed to fast and withhold water for 6–8 h before the procedure. One hour before the procedure, 0.1 mg of octreotide acetate was administered subcutaneously (to inhibit pancreatic enzyme secretion, reduce pancreatic injury, and prevent biliary sphincter spasm). Ten minutes before the procedure, 10 mg of morphine was injected subcutaneously (for pain relief), 5 mg of hyoscine-N-butylbromide was administered intramuscularly (to relax the bile ducts and Oddi's

sphincter, reduce bile duct and pancreatic duct pressure, and provide analgesia), and 10 mg of diazepam was given intravenously (for sedation and to reduce anxiety). The procedure was performed using small-bowel endoscopes (SIF-H290S, SIF Q260, Olympus), long-type colonoscopes (CF HQ290L/I, Olympus), gastroscopes (GIF HQ290, Olympus, Tokyo, Japan), duodenoscopes (Olympus TFJ-260, Olympus-FJ260), and standard colonoscopes (CF HQ290L/I, Olympus). A transparent cap was attached to the tip of the endoscope to improve visibility. A Philips Easy Diagnost system (Netherlands) was used for fluoroscopy, and iodixanol or iohexol was selected as the contrast agent. After the procedure, patients were kept fasting and given proton pump inhibitors for acid suppression, somatostatin to inhibit pancreatic enzyme secretion, and intravenous fluids. Blood amylase and lipase levels were checked at 2 and 24 h postoperatively.

2. *Operation procedure*: Once the endoscope reached the duodenal papilla or anastomosis, selective bile duct cannulation was performed. Based on the clinical condition, treatments such as endoscopic nasobiliary drainage (ENBD), endoscopic retrograde biliary drainage (ERBD), biliary and pancreatic duct stent placement, stone removal, or lithotripsy were performed (Fig. 1).

Statistical analysis

Data were analyzed using SPSS 27.0. For continuous variables (age), the Shapiro–Wilk test was used to assess normality. If the data were not normally distributed, the median and interquartile range were reported. Categorical data were presented as frequency and percentage, and analyzed using the χ^2 test or Fisher's exact probability method. The variance inflation factor (VIF) was used to assess multicollinearity between factors associated with failed intubation. For variables with statistically significant differences, logistic regression analysis was conducted for multivariate analysis. A P value of < 0.05 was considered statistically significant.

Results

Patient characteristics

A total of 522 patients who underwent ERCP after gastrointestinal reconstruction were included in the study, including 382 males (73.18%) and 140 females (26.81%).

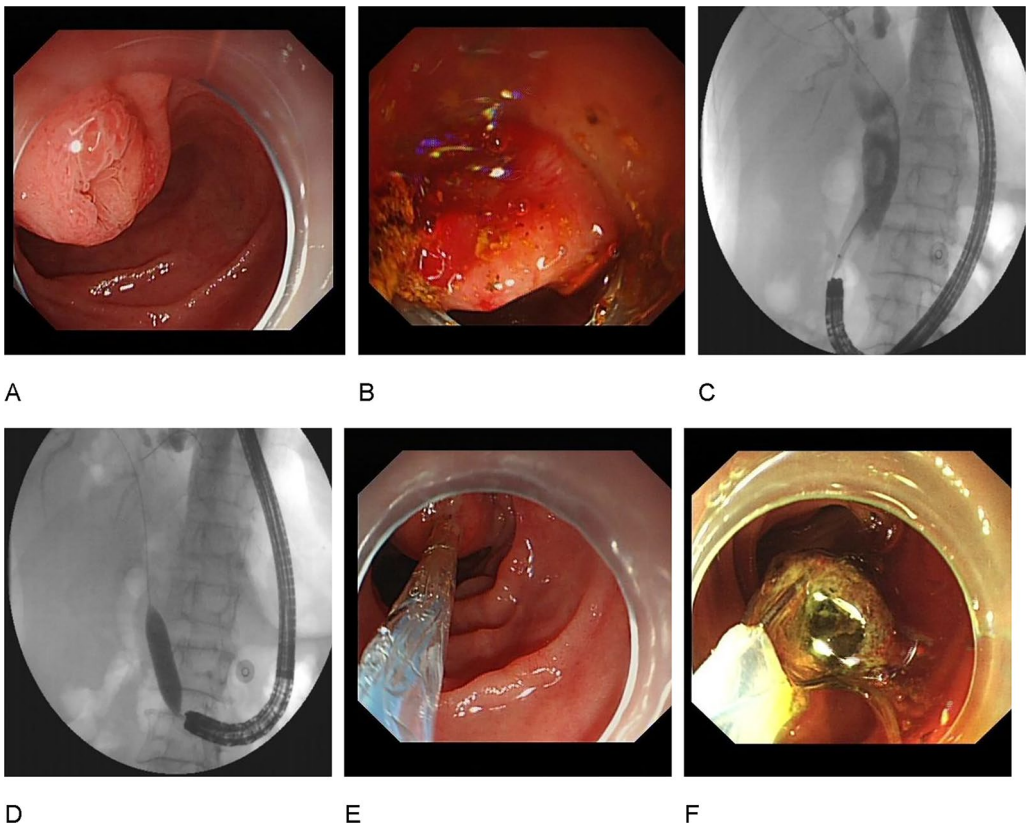

Fig. 1 ERCP procedure. **A** Invertedduodenal papilla seen transduodenoscopically in a patient of Billroth-II gastrectomy. **B** Insertion of the incision knife along the guidewire and incision of the duodenal papilla. **C** Injection of contrast medium, multiple filling defects in the extrahepatic bile ducts were seen. **D** Dilatation of the duodenal papillary opening with a columnar balloon. **E**, **F** Removal of bile duct stones with a mesh basket and balloon

The age range was 18–88 years, with a mean age of (57.50 ± 21) years. The procedures included Billroth II (129 cases), Billroth I (7 cases), Roux-en-Y gastrojejunostomy (16 cases), total gastrectomy (15 cases), biliary-enteric anastomosis (53 cases), pancreaticoduodenectomy (56 cases), and liver transplantation (246 cases). Therapeutic procedures included endoscopic sphincterotomy (EST) in 81 cases, endoscopic papillary balloon dilation (EPBD) in 188 cases, endoscopic pancreatobiliary lithotripsy (EPLBD) in 4 cases, lithotripsy in 18 cases, stone removal in 213 cases, endoscopic retrograde biliary drainage (ERBD) in 179 cases, endoscopic biliary metal stenting (EMBE) in 25 cases, endoscopic retrograde pancreatic drainage (ERPD) in 19 cases, endoscopic nasobiliary drainage (ENBD) in 183 cases, biliary stent placement in 14 cases, pancreatic stent placement in 6 cases, stent removal in 107 cases, and cell brush cytology in 7 cases.

Clinical outcomes

The overall success rates for intubation, cannulation, and therapeutic procedures were 96.93% (506/522), 92.09% (466/506), and 95.28% (444/466), respectively (Table 1). These rates were higher than those reported in related studies, which reported success rates of 89.4% (126/141), 85.7% (108/126), and 75.2% (106/141). In the study by Gao Zhuqing et al., the patients included were primarily those who had undergone Billroth I ($n=33$, 23.4%), Billroth II ($n=74$, 52.5%), biliary-enteric anastomosis ($n=32$, 22.69%), and pancreaticoduodenal anastomosis ($n=2$, 1.41%). In contrast, in this study, 47.12% of the patients had undergone liver transplantation. Among the 246 liver transplant recipients, 241 patients had direct anastomosis between the recipient's bile duct and the donor's bile duct, which allowed successful access to the duodenoscope through the esophagus, stomach, and duodenum. The duodenal papilla was located, and cannulation, contrast injection, and therapeutic procedures were successfully performed. This pathway had a higher success rate for intubation, cannulation, and overall ERCP success. The remaining 5 patients underwent biliary-enteric Roux-en-Y anastomosis, which increased the difficulty of the ERCP procedure. The operators used a short-arm enteroscope to navigate through the pylorus, continue through the Roux-en-Y anastomosis, and proceed further to reach the biliary-enteric anastomosis, where cannulation, contrast injection, and therapeutic interventions were then carried out.

ERCP-complications

Acute pancreatitis (13/522, 2.49%), hyperamylasemia (67/522, 12.84%), acute cholangitis (3/522, 0.57%), hemorrhage (3/522, 0.57%) and perforation (2/522, 0.38%) were among the postoperative complications that occurred following the successful intubation of ERCP in patients with gastrointestinal reconstruction.

Risk factors for failure in ERCP

In the univariate analysis of factors associated with intubation failure in patients after gastrointestinal reconstruction, the use of a forward-viewing endoscope, duodenoscope, gastrojejunostomy, and total gastrectomy showed statistically significant differences (Table 2). The multicollinearity test for risk factors associated with intubation failure is shown in Table 3. Due to the variance inflation factor (VIF) of the duodenoscope being greater than 5, this variable was excluded in the multivariate analysis of risk factors for intubation failure. The results, shown in Table 4, indicate that total gastrectomy, gastrojejunostomy, and the use of a forward-viewing endoscope were independent risk factors.

Common causes of intubation failure typically include repeated cannulation failures, anastomotic stricture, difficulty in navigating through twisted or deformed enteral loops, difficulty in identifying the direction of the enteral loop, and failure to locate the duodenal papilla. In this study, patients who had undergone total gastrectomy or Roux-en-Y gastrojejunostomy mainly faced issues in identifying the enteral loop and the multiple 180° angles between the enteral and afferent loops, making

Table 1 Intubation, cannulation, and therapeutic success rates in 522 patients after gastrointestinal reconstruction surgery

Outcomes	Intubation success (%) ($n=522$)	Cannulation success (%) ($n=506$)	Therapeutic success. (%) ($n=466$)
Biliary-enteric anastomosis	96.23 (51/53)	90.20 (45/51)	88.89 (40/45)
Pancreaticoduodenectomy	96.43 (54/56)	87.04 (47/54)	95.74 (45/47)
Billroth I procedure	100.00 (7/7)	85.71 (6/7)	100.00 (6/6)
Billroth II procedure	95.35 (123/129)	90.24 (111/123)	95.50 (106/111)
Total gastrectomy	80.00 (12/15)	75.00 (9/12)	88.89 (8/9)
Gastrojejunostomy	81.25 (13/16)	53.85 (7/13)	28.57 (2/7)
Liver transplantation	100.00 (246/246)	97.15 (241/246)	98.34 (237/241)

Table 2 Univariate analysis of endoscopic failure in 522 patients undergoing gastrointestinal reconstructive surgery

Risk factor	Endoscopic failure	Endoscopic success	χ^2	*P*	Incidence (%)
> 60 years	10	214	2.585	0.108	4.46
≤ 60 years	6	292			2.01
History of gallstones	3	183	0.051	0.152	1.61
No history of gallstones	13	323			3.87
Post-Billroth II surgery	6	123	1.451	0.363	4.65
Post-non-Billroth II surgery	10	383			2.54
Use of short-arm enteroscope	2	56	0.032	1.000	3.45
Use of non-short-arm enteroscope	14	450			3.02
Post-biliary-enteric anastomosis surgery	2	51	0.100	1.000	3.77
Post-non-biliary-enteric anastomosis surgery	14	455			2.99
Post-total gastrectomy	3	12	14.907	0.009	20.00
Post-non-total gastrectomy	13	494			2.56
Post-pancreaticoduodenectomy	2	54	0.054	1.000	3.57
Post-non-pancreaticoduodenectomy surgery	14	452			3.00
Male	12	370	0.028	1.000	3.14
Female	4	136			
History of ERCP	1	84	1.219	0.447	1.18
No history of ERCP	15	422			3.43
Forward viewing endoscope	8	71	15.623	0.000	10.13
Non forward viewing endoscope	8	435			
Use of duodenoscope	5	351	10.390	0.001	1.40
Use of non-duodenoscope	11	155			
History of diabetes	4	77	1.132	0.476	4.94
No history of diabetes	12	429			
History of hypertension	3	90	0.101	1.000	3.23
No history of hypertension	13	416			
Post-gastrojejunostomy	3	13	13.667	0.010	18.75
Post-non-gastrojejunostomy	13	493			
Use of transparent cap	1	22	0.133	0.519	4.35
Non-use of transparent cap	15	484			3.01
History of cholecystectomy	5	102	1.171	0.443	4.67
No history of cholecystectomy	11	404			2.65

intubation extremely difficult and complicating passage through the anastomosis, leading to ERCP failure. The forward-viewing endoscope, compared to the duodenoscope and enteroscope, has a smaller field of view, which leads to blind spots and increased difficulty in operating within the confined space.

Risk factors for ERCP-complications

In the univariate analysis of factors influencing the occurrence of post-ERCP hyperamylasemia in patients with gastrointestinal reconstruction, a history of cholecystectomy showed a statistically significant difference ($P=0.042$, OR = 1.800, 95% CI 1.015–3.193) (Table 5). This is consistent with the findings of Seleem et al [6], who reported that a history of cholecystectomy increases the difficulty of cannulation and stone removal, leading to prolonged ERCP procedure times and an associated increased incidence of post-ERCP pancreatitis (PEP) and hyperamylasemia.

Among the 3 patients with bleeding, one had bile duct bleeding after nasobiliary catheter placement, one had biliary bleeding after papillotomy along the guidewire, and one had bleeding after biliary stent removal in a patient with a history of pancreatitis. In the univariate analysis of postoperative bleeding, a history of pancreatitis showed a statistically significant difference ($P=0.040$, OR = 42.75, 95% CI 3.399–537.620) (Table 6). Other factors, including potential procedural errors, were not excluded. This conclusion is consistent with the findings of Zhang Hongzhao et al., who suggested that patients

Table 3 Multicollinearity test of factors contributing to endoscopy failure in 522 gastrointestinal reconstruction patients

Outcomes	*B*	Standard error	Beta	*t*	Statistical significance	Tolerances	VIF
Constant	− 0.010	0.042		− 0.235	0.814		
Genders	− 0.005	0.018	− 0.021	− 0.258	0.796	0.872	1.146
Age	− 0.013	0.017	− 0.037	− 0.748	0.455	0.710	1.409
Post-total gastrectomy	0.221	0.050	0.214	4.462	0.000	0.764	1.308
Post-biliary-enteric anastomosis surgery	0.051	0.029	0.089	1.718	0.086	0.662	1.510
Post-gastrojejunostomy	0.199	0.047	0.199	4.203	0.000	0.788	1.269
Post-pancreaticoduodenectomy	0.051	0.032	0.091	1.604	0.109	0.549	1.823
Post-Billroth II surgery	0.040	0.023	0.101	1.764	0.078	0.537	1.861
Use of short-arm enteroscope	− 0.025	0.040	− 0.045	− 0.612	0.541	0.327	3.060
Forward viewing endoscope	0.093	0.041	0.193	2.271	0.023	0.245	4.083
Use of duodenoscope	0.020	0.037	0.055	0.552	0.581	0.176	5.683
History of gallstones	− 0.026	0.016	− 0.072	− 1.578	0.115	0.860	1.163
History of diabetes	0.020	0.021	0.042	0.955	0.340	0.935	1.069
History of hypertension	0.008	0.020	0.019	0.424	0.672	0.905	1.105
History of ERCP	− 0.025	0.020	− 0.054	− 1.246	0.213	0.953	1.050
History of cholecystectomy	0.017	0.019	0.040	0.904	0.366	0.886	1.129
Use of transparent cap	− 0.083	0.041	− 0.099	− 2.004	0.046	0.727	1.375

Table 4 Multivariate analysis of factors contributing to endoscopy failure in 522 gastrointestinal reconstruction patients

	B	Standard error	Wald	df	Statistical significance	Exp (B)	Exp (B) 95% confidence lower bound	Exp (B) 95% confidence upper bound
Post-gastrectomy	1.962	0.543	13.056	1	0.000	7.114	2.454	20.622
Post-gastrojejunostomy	3.848	0.776	24.604	1	0.000	46.881	10.250	214.423
Forward-viewing endoscope	0.842	0.325	6.719	1	0.010	2.322	1.228	4.389
Constant	− 2.206	0.162	186.551	1	0.000	0.110		

Due to the variance inflation factor (VIF) of the duodenoscope being greater than 5, this variable was excluded

with a history of pancreatitis may experience pancreatic swelling due to prior inflammation, which compresses the biliary system and impairs bile drainage, leading to secondary cholangitis. This can cause atrophy, degeneration, and even necrosis of the bile duct tissue, making it more fragile and prone to bleeding.

In the univariate analysis of postoperative acute pancreatitis, only repeated cannulation showed a statistically significant difference ($P=0.000$, OR = 47.619, 95% CI 13.317–170.275) (Table 7). This conclusion aligns with the findings of Freeman et al., who reported that difficult cannulation can cause mechanical damage to the papilla and pancreatic duct opening, leading to local edema and poor drainage due to obstruction [7, 8].

The incidence of postoperative perforation was 0.38% (2/522). One case involved perforation after papillectomy, while another case involved perforation of the enteral loop during repeated intubation due to a large angle of the intestinal lumen. Both cases were immediately managed with endoscopic suturing to close the perforations. The incidence of acute cholangitis was 0.57% (3/522). For patients with biliary obstruction, nasobiliary drainage was performed, which helped reduce the incidence of acute cholangitis [8].

Discussion

ERCP in patients with gastrointestinal reconstruction presents technical challenges and a higher risk of complications [9]. The challenges faced by endoscopists mainly include correctly identifying the enteral loop, sharp angles at the anastomosis or enteral loop, overly long enteral loops, changes in the position of the duodenal papilla, lack of appropriate endoscopic equipment and instruments, and postoperative adhesions in the peritoneal cavity [10–12]. There are many related studies aimed at improving the success rate of ERCP in gastrointestinal reconstruction patients. For example, Wang Hao et al [13]. Recommended the use of an

Table 5 Risk factors for hyperamylasemia after ERCP in 522 gastrointestinal reconstruction patients

Risk factors	Occurrence of Post-ERCP hyperamylasemia	No occurrence of Post-ERCP hyperamylasemia	χ^2	*P*	Incidence (%)
Cholecystectomy					
Yes	20	87	4.126	0.042	18.69
No	47	368			11.33
Duodenal diverticulum					
Yes	6	42	0.005	0.942	12.50
No	61	413			12.87
Pancreatography					
Yes	2	18	0.149	0.964	10.00
No	65	437			12.95
Stent implantation					
Yes	27	203	0.442	0.506	11.74
No	40	252			13.70
EPBD					
Yes	25	163	0.056	0.813	37.31
No	42	292			35.82
Age					
> 60	27	197	0.214	0.643	12.05
≤ 60	40	258			13.42
Gender					
Masculinity	51	331	0.338	0.561	76.12
Female	16	124			13.35
ENBD					
Have	26	157	0.474	0.491	14.21
None	41	298			12.09
Biliary tract stenosis					
Have	1	9	0.073	1.000	10.00
None	66	446			12.89
Bile duct stones					
Have	33	172	3.211	1.000	16.10
None	34	283			10.73
Transparent cap					
Have	1	22	1.549	0.073	4.35
None	66	433			13.23

EPBD: dilatation of the biliopancreatic sphincter of jugular and/or sphincter of papilla by transendoscopic use of a papillary column balloon. ENBD: it uses a thin plastic tube inserted endoscopically into the bile duct through the duodenal papilla, and the other end is led out of the body through the duodenum, stomach, oesophagus and pharynx through the nostrils to establish an extracorporeal drainage route for bile

enteroscope in patients who have undergone total gastrectomy or gastrojejunostomy, as using the appropriate endoscope and performing contrast injection under X-ray fluoroscopy can help in identifying the direction of the enteral loop and locating the duodenal papilla, thus improving the success rate of ERCP. When cannulation difficulties arise, Fan Ling et al. [14] reported that auxiliary cannulation techniques such as pancreatic duct stent-assisted guidewire cannulation, pre-cutting of the pancreatic sphincter, and pre-cutting of the papilla or fistula can increase the cannulation success rate to 95%. When encountering difficulty due to anastomotic stricture during the procedure, Tian Wenjie et al. [15] suggested that techniques such as magnetic anastomosis, percutaneous transhepatic biliary endoscopy with guidewire blunt-tip breakthrough, endoscopic balloon dilation combined with multiple stent placements, and others can be significantly effective. When therapeutic procedures fail, alternatives like endoscopic ultrasound-guided biliary drainage (EUS-BD) and endoscopic ultrasound-guided antegrade biliary drainage (EUS-AG) can be considered [16–21].

Table 6 Risk factors for bleeding during ERCP complications in 522 gastrointestinal reconstructionpatients from 2017 to 2023

Risk factors	Occurrence of bleeding	No occurrence of bleeding	χ^2	*P*	Incidence (%)
Prior pancreatitis					
Yes	1	6	23.343	0.040	14.29
No	2	513			0.39
Hypertension					
Yes	1	2	0.496	0.446	33.33
No	92	427			17.73
Bile duct cleaning surgery					
Yes	2	1	6.129	0.063	66.67
No	78	441			15.03
Age					
> 60 years	1	2	0.113	1.000	33.33
≤ 60 years	223	296			42.97
Previous biliary lithiasis					
Yes	1	2	0.007	1.000	33.33
No	185	334			35.65

Table 7 Risk factors for acute pancreatitis complicating ERCP in 522 patients with gastrointestinal reconstruction

Risk factors	Occurrence of PEP	No occurrence of PEP	χ^2	*P*	Incidence (%)
Repeated intubation					
Have	6	9	89.478	0.000	40.00
None	7	500			1.38
Detained scaffold					
Have	1	120	0.024	0.878	0.83
None	12	389			2.99
Duodenal diverticulum					
Have	2	46	0.612	0.767	4.17
None	11	463			2.32
Pancreatography					
Have	1	19	0.539	0.402	5.00
None	12	490			2.39
ENBD					
Have	4	179	0.108	0.973	2.19
None	9	330			2.65
Bile duct stones					
Have	3	202	1.466	0.226	1.46
None	10	307			3.15
Endoscopic pancreatic sphincterotomy					
Have	1	19	8.410	0.096	5.00
None	12	490			2.39
EPBD					
Have	4	184	0.159	0.915	2.13
None	9	325			2.69
Gender					
Masculinity	9	373	0.106	0.745	2.36
Female	4	136			2.86
Age (years)					
> 60	7	217	0.651	0.420	3.13
≤ 60	6	292			2.01

In terms of auxiliary equipment, the introduction of scissors knives, tapered sheaths, auxiliary enteroscopes, and laparoscopic support has the potential to improve the diagnostic and therapeutic success rates of ERCP [22, 23].

Our center's clinicians take various measures before and during the procedure to improve the success rates of intubation, cannulation, and therapy, as well as to reduce the occurrence of complications. Preoperatively, the surgeon reviews the patient's medical history and surgical records in detail and draws a schematic diagram of the gastrointestinal anatomy to plan the intubation route. During the procedure, the appropriate endoscopic assistance is selected according to the patient type (e.g., duodenoscope for Billroth I and Billroth II patients, enteroscope for pancreaticoduodenectomy and total gastrectomy patients, and enteroscope or duodenoscope for biliary-enteric anastomosis patients), which can help improve the success rate of ERCP [13]. Furthermore, the use of transparent caps and the introduction of single-balloon enteroscopes (SBE) in our center have shown improvements. Studies have reported that the SBE, with its new design features such as high force transmission and passive curvature, helps achieve smoother intubation and clearer high-definition imaging, enhancing visualization [24–26]. The use of double-guidewires and pre-cut techniques also significantly improves the success of difficult cannulation. The mechanism is to place the guidewire into the duct, using gravity or a range effect to separate the bile duct and catheter, which helps to stabilize the papilla and straighten the common bile duct and pancreatic duct axis [27]. When the procedure fails, percutaneous transhepatic cholangiography (PTCD) is often used as an alternative therapy in our center.

The occurrence of postoperative complications in patients with gastrointestinal reconstruction undergoing ERCP is inevitable, and prevention of these complications is a key issue for clinicians. To reduce the risk of bleeding, Freeman et al. suggested that gentle handling during the procedure, appropriate use of electrosurgical cutting and coagulation, and stepwise dissection, as well as discontinuation of anticoagulants for more than a week, are effective preventive measures [7, 28].

To prevent PEP and hyperamylasemia, Hu Shiping et al. recommended using guidewire-assisted cannulation, early pre-cutting, pancreatic stent placement, endoscopic nasobiliary drainage, and papillary balloon dilation to reduce injury to the papilla, assist in cannulation, and ensure proper pancreatic fluid drainage [29]. In addition, pharmacological preventive measures such as somatostatin, proton pump inhibitors, antibiotics, and NSAIDs have been shown to be effective [30]. At our center, most patients undergo preoperative administration of octreotide acetate to inhibit pancreatic enzyme secretion, reduce pancreatic injury, and prevent biliary sphincter spasm. Intraoperatively, we use guidewire-assisted cannulation, perform pre-cutting in 5 cases, and carry out procedures such as EPBD (188 cases), ENBD (183 cases), and pancreatic stent placement (6 cases). Postoperatively, we routinely administer somatostatin to inhibit pancreatic enzyme secretion and proton pump inhibitors for acid suppression, which has been effective in reducing the incidence of PEP and hyperamylasemia.

In conclusion, performing ERCP in patients with gastrointestinal reconstruction presents increased challenges compared to patients with normal gastrointestinal anatomy. Clinicians must possess proficient ERCP skills, understand the patient's altered gastrointestinal anatomy preoperatively, and select the appropriate endoscope to improve the success rate. Patients with a history of pancreatitis are more prone to secondary bile duct fragility and bleeding. Gentle handling during the procedure can reduce the incidence of postoperative bleeding. Guidewire-assisted cannulation and pre-cut techniques can improve cannulation success and avoid repeated cannulation to reduce the incidence of postoperative acute pancreatitis and hyperamylasemia. Based on the findings from this study and numerous related studies, ERCP holds a promising future as a safe and effective diagnostic and therapeutic procedure. Although significant progress has been made, there is still potential for further improvement, such as the development of specialized equipment and the creation of training programs for clinicians. Recent research has also shown that 3D printing technology can be used to create silicone simulators for ERCP training [31], helping operators accumulate rich experience. This study is retrospective, with strict inclusion and exclusion criteria, and cases lacking research factors were excluded to control selection bias. Some patients underwent multiple ERCP procedures, which may have influenced the overall success rate. This limitation could be addressed by conducting high-quality randomized controlled trials to validate the analysis of risk factors in future research.

Abbreviations

ERCP	Endoscopic retrograde cholangiopancreatography
PEP	Post-ERCP pancreatitis
PEH	Post-ERCP hyperamylasemia
ENBD	Endoscopic naso-biliary drainage
ERBD	Endoscopic retrograde biliary drainage
B II	Billroth-II gastrectomy
B I	Billroth-I gastrectomy
EST	Endoscopic-sphincterotomy
EPBD	Endoscopic papillary balloon dilatation

Author contributions

In this study, CY was independently responsible for the design of the study, data collection, statistical analysis, management and coordination responsibility for the research activity planning and execution and writing of the article, FJH, CXJ was responsible for the guidance of the discussion of the results, corresponding author WHL and LJ were responsible for the provision of data and the revision and guidance of the paper. All the authors have read the manuscript and have approved this submission, there is no conflict of interest in the publication of this article.

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Data availability

The data sets generated and/or analysed during the current study are not publicly available due to [reason for data non-disclosure], but are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participation

This study was conducted in accordance with the principles of the NMPA/GCP and the Declaration of Helsinki (approval number: clinical scientific research ethics [2024181K]), and that the clinical study was conducted in accordance with the protocol approved by the Ethics Committee to protect the health and the rights of the subjects.

Consent for publication

This topic uses the case data of the research object for research and does not involve personal privacy and commercial interests, so it applies for exemption informed consent, and the study design was approved by an ethics review board.

Competing interest

All the authors have read the manuscript and have approved this submission, there is no competing interests in the publication of this article. No objections to reviewers at this time.

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