

Use of the Conventional Side-viewing Duodenoscope for Successful Endoscopic Retrograde Cholangiopancreatography in Postgastrectomy Patients

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Objectives: The aim of this study was to evaluate the usefulness of the conventional side-viewing duodenoscope for successful endoscopic retrograde cholangiopancreatography (ERCP) in postgastrectomy patients.

Methods: A total of 220 consecutive patients with bile duct stones or a distal common bile duct stricture who had previously undergone gastrectomy and were referred for ERCP were analyzed for the outcome of their ERCP. All ERCP procedures were performed using a conventional side-viewing duodenoscope. In patients who had undergone a Billroth II gastroenterostomy and total gastrectomy with Roux-en-Y reconstruction, we also used the procedure of retrieval balloon–assisted enterography.

Results: The study group included 220 patients who had previously undergone gastrectomy (77 women and 143 men; mean age, 72.2 y; range, 11 to 93 y). The overall enterography success rate was 90.5% (199/220), and the diagnostic and ERCP success rates were both 88.6% (195/220). Endoscopy was unsuccessful in 21 patients who received Billroth II gastroenterostomy and Roux-en-Y reconstruction. After successful endoscopy, diagnostic and ERCP success was not achieved in 4 patients with Billroth II gastroenterostomy, with or without Braun anastomosis, due to cannulation failure. The procedure-related complication rate was 5.5% (12/220), including immediate bleeding (0.9%, 2/220), pancreatitis (4.1%, 9/220), and perforation (0.5%, 1/220). There were no procedure-related deaths.

Conclusions: The side-viewing duodenoscope is a useful instrument for performing successful ERCP in patients postgastrectomy. In

addition, retrieval balloon–assisted enterography may improve the enterography success rate in postgastrectomy patients with Billroth II and Roux-en-Y reconstruction.

Key Words: side-viewing duodenoscope, endoscopic retrograde cholangiopancreatography, postgastrectomy, retrieval balloon–assisted enterography, optimal ERCP enterography route

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Endoscopic retrograde cholangiopancreatography (ERCP) is an essential modality for diagnosis and therapy in patients with pancreaticobiliary diseases. Although the success rate is >90% in patients with normal anatomy,¹ ERCP in patients who have undergone gastrectomy is difficult because of the anatomic changes in the digestive tract. Several case series have reported that successful ERCP was achieved with the use of a front-viewing endoscope,² a single-balloon enteroscope, or a double-balloon enteroscope.^{3–9} However, 3 major obstacles must be overcome to successfully perform ERCP using those variant enteroscopes: reaching the papilla, performing selective duct cannulation, and achieving procedural integrity, including skillful technique and dedicated devices.⁶ Only a few cases have been reported regarding the use of a conventional side-viewing duodenoscope to perform ERCP in patients postgastrectomy.¹⁰ In the present retrospective study, we aimed to describe ERCP using a conventional side-viewing duodenoscope in challenging patients postgastrectomy.

METHODS

An institutional review board approved this retrospective analysis, which was performed at the Department of General Surgery, Xinhua Hospital, School of Medicine, Shanghai Jiao Tong University. From January 2009 to September 2014, 220 consecutive patients with bile duct stones (152) or a common bile duct (CBD) stricture (68), who had previously undergone gastrectomy and were referred for ERCP, were analyzed. The surgical approaches applied to these patients included proximal gastrectomy with esophagogastrostomy (10 patients), distal subtotal gastrectomy with Billroth I (42 patients) or Billroth II (160 patients, including 25 patients with Braun anastomosis), and total gastrectomy combined with Roux-en-Y reconstruction (8 patients) (Table 1).

Endoscopic Procedures

The procedures were performed in all patients under pharyngeal anesthesia, sedation (intramuscular 10 mg

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The authors declare that they have nothing to disclose.

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TABLE 1. Characteristics of the 220 Patients Who had Previously Undergone Gastrectomy

Characteristics	Patients [n (%)]
All	220 (100)
Sex	
Female	77 (35)
Male	143 (65)
Age (y)	
< 80	150 (68.2)
≥ 80	70 (31.8)
Indication of ERCP	
Cholangitis, CBD stone	152 (69.1)
CBD stricture	68 (30.1)
Type of previous surgery	
Proximal gastrectomy	10 (4.5)
Distal subtotal gastrectomy	202 (91.8)
Total gastrectomy	8 (3.7)
Type of digestive tract reconstruction	
Esophagogastrostomy	10 (4.5)
Billroth I	42 (19.1)
Billroth II	160 (72.7)
Simple Billroth II	135 (61.4)
With Braun anastomosis	25 (11.3)
Roux-en-Y reconstruction	8 (3.7)

CBD indicates common bile duct; ERCP, endoscopic retrograde cholangiopancreatography.

diazepam injection), and pethidine (50 mg). All patients received oxygen administered by nasal prong and were monitored by pulse oximetry and electrocardiography. Antibiotics were not routinely given as prophylaxis. The patients were placed in the prone position. ERCP was performed under fluoroscopic control using a conventional side-viewing duodenoscope with a total length of 120 cm and a working channel of 3.7 mm in diameter, which allows the use of a wide range of catheters according to the diagnostic or therapeutic objective (Olympus V260; Olympus Medical Systems, Tokyo, Japan). Alternatively, we used a triple-lumen retrieval balloon catheter (The Extractor Pro RX Retrieval Balloon Catheter), which is capable of accepting a 0.035-inch (0.089 mm) guidewire in the “open-channel” guidewire lumen, while allowing simultaneous injection and inflation of the balloon in the other 2 lumens.

Review of the surgical procedure notes before initiating ERCP in postgastrectomy patients provided the necessary details, such as the type of reconstruction and the length of the limbs. In addition, review of the available postoperative gastrointestinal imaging studies, including upper gastrointestinal series, abdominal computed tomography examinations, and magnetic resonance imaging, also provided helpful information.

We used a conventional side-viewing duodenoscope for ERCP in patients postgastrectomy. ERCP in patients who had undergone proximal gastrectomy with esophagogastrostomy (Fig. 1) and distal subtotal Billroth I gastrectomy (Fig. 2) was similar to routine ERCP, because endoscopically the postsurgical anatomy appears mostly similar to the normal digestive tract. For ERCP in patients who underwent distal subtotal Billroth II gastrectomy (Figs. 3, 4) or total gastrectomy combined with Roux-en-Y reconstruction (Figs. 5, 6), we facilitated successful enteroscopy with endoscope insertion using a triple-lumen retrieval balloon catheter. The guidewire of the retrieval

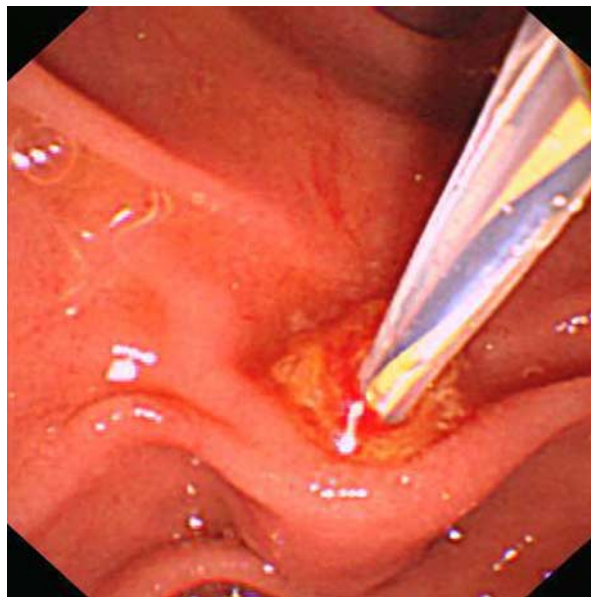


FIGURE 1. Conventional side-viewing duodenoscope for ERCP in patients who had undergone proximal gastrectomy with esophagogastrostomy. ERCP indicates endoscopic retrograde cholangiopancreatography. full color online

balloon was advanced to the appropriate limb (Fig. 7), and then a retrieval balloon was inserted over the guidewire (Fig. 8). Following the injection of contrast agent, we used this retrieval balloon to explore the tract of the target limb on dynamic radiographic images (Fig. 9). The balloon was then hooked to the limb, not only to indicate the direction of the tract to guide the endoscope forward but also to facilitate the forward movement of the endoscope with



FIGURE 2. Conventional side-viewing duodenoscope for ERCP in patients who had undergone distal subtotal Billroth I gastrectomy. ERCP indicates endoscopic retrograde cholangiopancreatography.

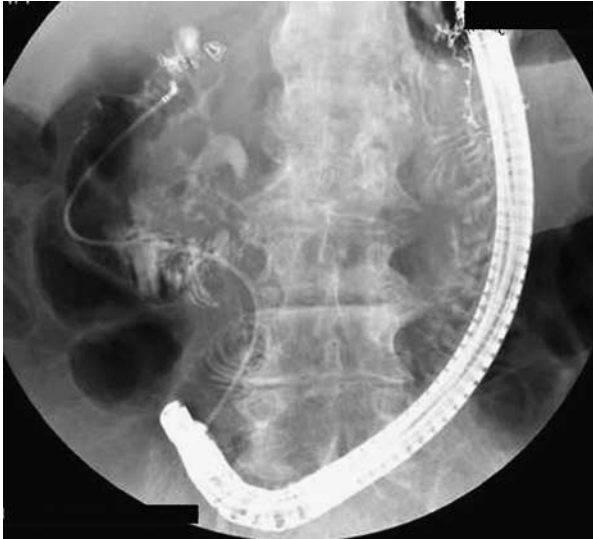


FIGURE 3. The procedure of retrieval balloon–assisted enterography for patients who had undergone Billroth II gastroenterostomy.

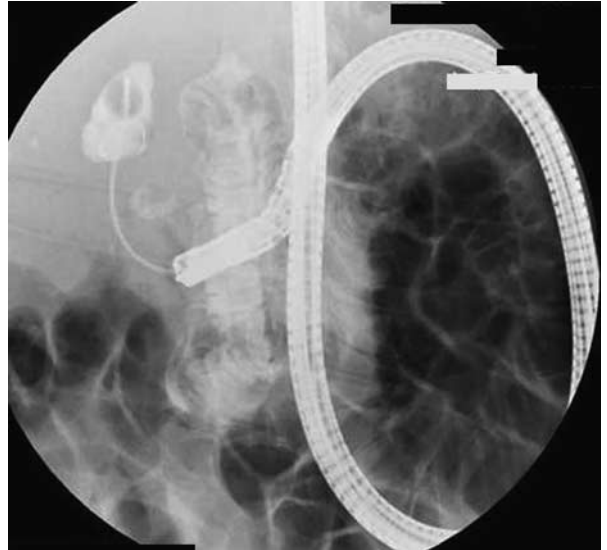


FIGURE 5. The procedure of retrieval balloon–assisted enterography for patients who had undergone total gastrectomy with Roux-en-Y reconstruction.

fewer injuries to the intestinal wall (Fig. 10). As the balloon catheter was strongly retracted into the working channel to allow the scope to advance, the endoscope was propelled slightly forward. It should be emphasized that in ERCP postgastrectomy, we relied not only on what was visible through the endoscope but also on the x-ray dynamic images from enterology. We termed the procedure “retrieval balloon–assisted enterography.”^{11–14} For patients with a Billroth II gastroenterostomy and Braun anastomosis (Fig. 11), we also used the procedure of retrieval balloon–assisted enterography along the optimal route as previously reported¹⁵ (Fig. 12).

All procedures were performed by an experienced pancreaticobiliary endoscopist (X.-F.W.) who routinely performs > 300 to 600 ERCPs each year.

Definitions

Successful enteroscopy (endoscopic success) was defined as enterography along the correct limb and the ability to identify the papilla of Vater. Diagnostic success was defined as successful duct cannulation and a successful cholangiogram leading to a diagnosis. ERCP success was defined as a successful enteroscopy with successful diagnostic and therapeutic interventions.¹⁶ Post-ERCP pancreatitis was defined

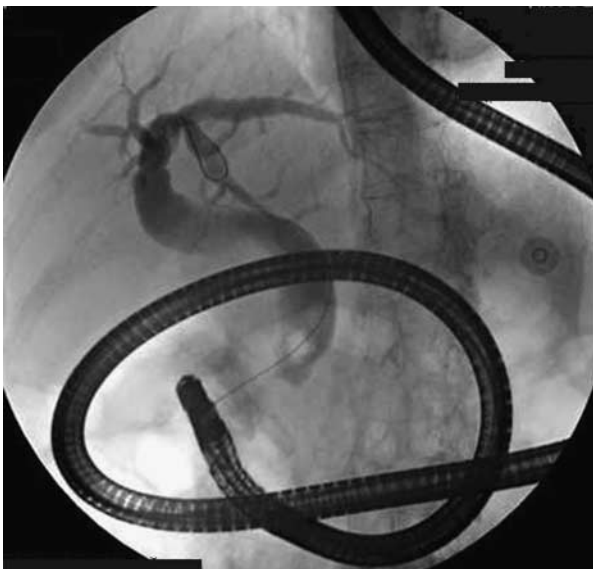


FIGURE 4. Conventional side-viewing duodenoscope for ERCP in patients who had undergone Billroth II gastroenterostomy. ERCP indicates endoscopic retrograde cholangiopancreatography.

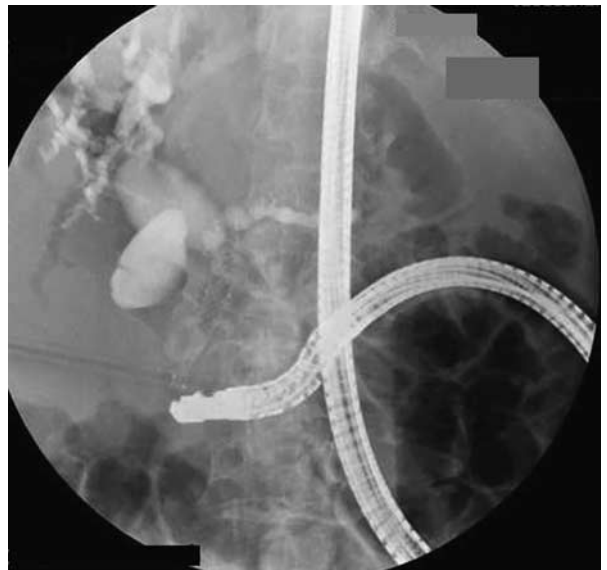


FIGURE 6. Conventional side-viewing duodenoscope for ERCP in patients who had undergone total gastrectomy with Roux-en-Y reconstruction. ERCP indicates endoscopic retrograde cholangiopancreatography.

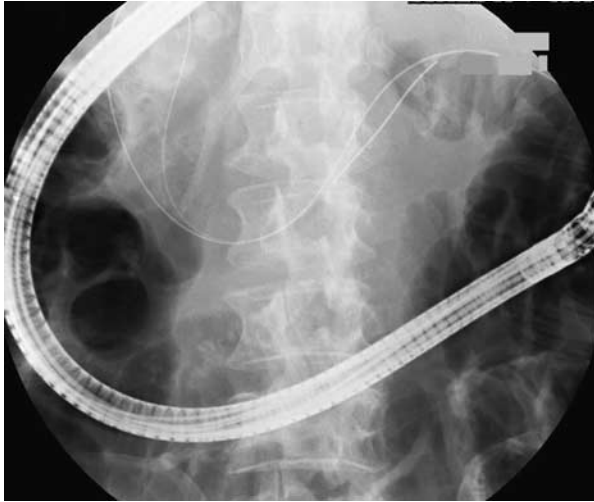


FIGURE 7. The guidewire of the retrieval balloon was advanced to the appropriate limb.

according to Cotton's criteria.¹⁷ Hemorrhage was defined as bleeding requiring the local injection of hemostatic agents or clipping at the time of the procedure or a few days later.

Statistical Analysis

Quantitative data are presented as the mean \pm SD. All statistical analyses were performed using the SPSS software, version 18.0 (SPSS Inc., Chicago, IL). Logistic regression models were constructed by including variables that had significant univariate associations with post-ERCP complications. ANOVA testing was constructed by including independent variables that had significant univariate associations with success rate.



FIGURE 8. The retrieval balloon was inserted over the guidewire.

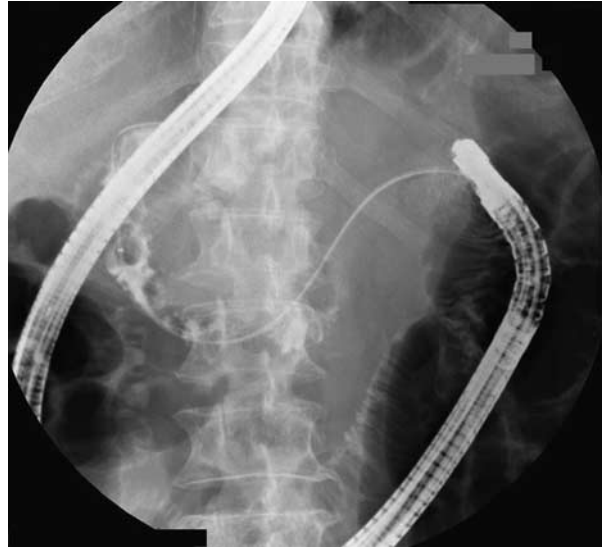


FIGURE 9. Following the injection of contrast agent, we used this retrieval balloon to explore the tract of the target limb on dynamic radiographic images.

RESULTS

The study group included 220 patients with altered gastrointestinal anatomy (77 women and 143 men; mean age, 72.2 y; range, 11 to 93 y). Table 1 summarizes the demographic and clinical characteristics of these patients. The indications for ERCP included CBD stones (152 patients) and CBD stricture because of tumor recurrence (68 patients).

The overall enterography success rate was 90.5% (199/220), and the diagnostic success and ERCP success rates

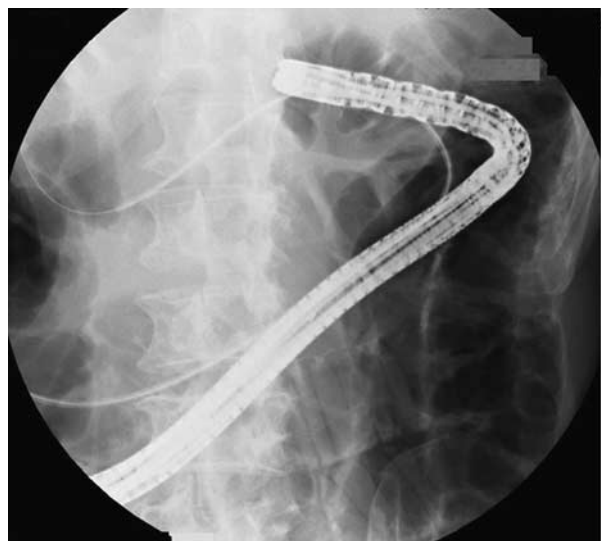


FIGURE 10. The balloon was then hooked to the limb, not only to indicate the direction of the tract to guide the endoscope forward but also to facilitate the forward movement of the endoscope with fewer injuries to the intestinal wall.

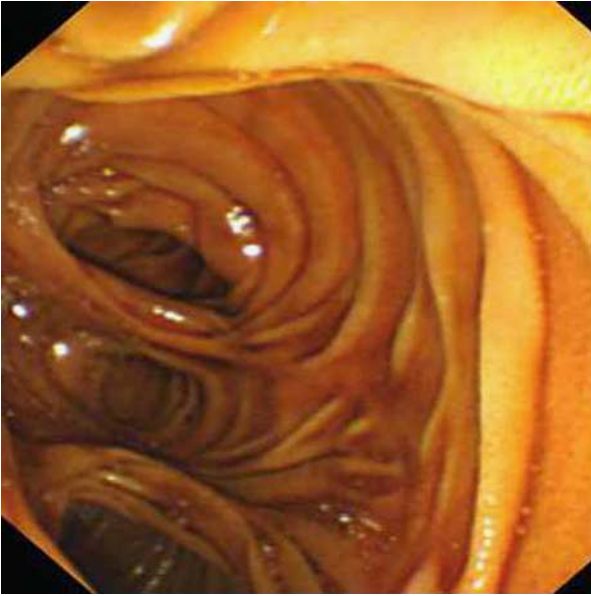


FIGURE 11. Conventional side-viewing duodenoscope for ERCP in patients who had undergone Billroth II gastroenterostomy with Braun anastomosis. ERCP indicates endoscopic retrograde cholangiopancreatography.

were both 88.6% (195/220). Among patients who underwent Billroth I gastroenterostomy and proximal gastrectomy with esophagogastrostomy, endoscopic success rate was 100% (42/42), and the diagnostic success and ERCP success rates were both 100% (42/42). For Billroth II gastroenterostomy, the endoscopic success rates without

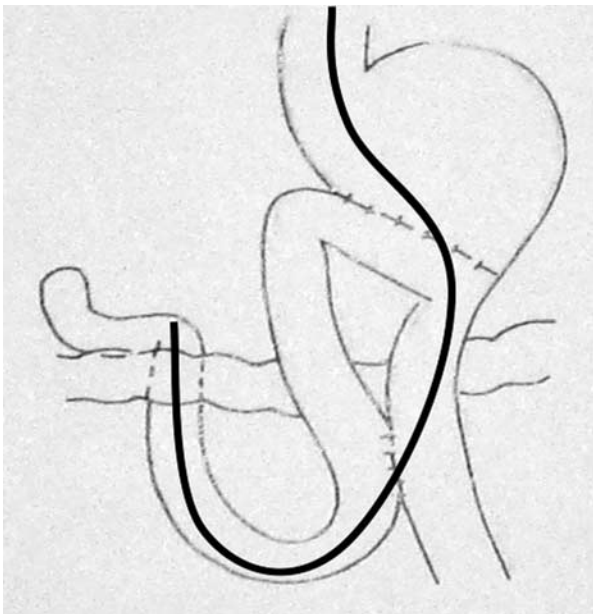


FIGURE 12. The procedure of retrieval balloon–assisted enterography along the optimal enterography route for patients who had undergone Billroth II gastroenterostomy with Braun anastomosis.

or with Braun anastomosis were 88.9% (120/135) and 88.0% (22/25), respectively. The diagnostic success and ERCP success rates for Billroth II gastroenterostomy with the duodenoscope without or with Braun anastomosis were 86.7% (117/135) and 84.0% (21/25), respectively. For patients who underwent total gastrectomy with Roux-en-Y reconstruction, the endoscopic success rate was 62.5% (5/8), and the diagnostic success and ERCP success rates were both 62.5% (5/8). Endoscopy was unsuccessful in 21 patients with a Billroth II gastroenterostomy and Roux-en-Y reconstruction because of failure to access the papilla due to the presence of a long afferent loop and tumor infiltration of the afferent loop. Unsuccessful diagnostic and ERCP outcomes after endoscopic success occurred only in patients with Billroth II gastroenterostomy without or with Braun anastomosis because of cannulation failure in 4 patients due to tumor infiltration. Factors that increased the rates of enterography success, diagnostic success, and ERCP success were CBD stone, proximal gastrectomy, esophagogastrostomy, and Billroth I reconstruction (Table 2). The procedure-related complication rate was 5.5% (12/220), including hemorrhage (0.9%, 2/220), pancreatitis (4.1%, 9/220), and perforation (0.5%, 1/220) (Table 3). No procedure-related deaths occurred. One patient with a Billroth II gastroenterostomy developed afferent loop perforation, underwent laparotomy, and was discharged 2 weeks later. Two patients experienced hemorrhage at the time of ERCP, which was successfully treated by the local injection of epinephrine and clipping. Factor that increased the risk of any procedure-related complication was type of previous surgery (Table 4).

DISCUSSION

ERCP in patients after gastrectomy remains a challenging technique for ERCP endoscopists. As in patients with normal anatomy, anterior oblique-viewing endoscopes, side-viewing endoscopes, forward-viewing gastroscopes, and multibending endoscopes have been reported in previous studies of ERCP for postgastrectomy patients.^{18–22} However, there are 3 major obstacles to overcome to successfully perform ERCP when using these enteroscope variants: (1) the approach to the ampulla of Vater, (2) selective bile duct cannulation, and (3) procedural reliability, including skillful technique and dedicated devices. The forward-viewing endoscope has a long-working length and permits the operator to enter the afferent loop easily and safely because of the ability to see the lumen en face. However, this approach is particularly difficult through a native ampulla because an en face view of the papilla is difficult to obtain using forward-viewing endoscopes. Moreover, optimal access to the papilla is restricted without an elevator function, and compatible devices for these enteroscopes are difficult to obtain. This lack of a cannula elevator makes it difficult to cannulate the native papilla, and the lack of dedicated devices makes it difficult to achieve therapeutic success.^{23,24} Thus, the enterography success rate of the forward-viewing endoscope is relatively higher, but the therapeutic success rate is lower. In contrast, the side-viewing endoscope with a shorter working length has a larger working channel and a cannula elevator. However, the fact that it is impossible to see the lumen en face makes it difficult to enter the limb safely, and there are some reports of small bowel perforation associated with ERCP using a side-viewing endoscope. However, the cannula elevator makes it

TABLE 2. Factors That Affected the Rates of Enterography Success, Diagnostic Success, and ERCP Success

	Enterography Success				Diagnostic Success				ERCP Success			
	DF	SS	F	P	DF	SS	F	P	DF	SS	F	P
Gender	219	50.05	0.03	0.87	219	50.05	0.11	0.74	219	50.05	0.11	0.74
Age	219	47.72	0.68	0.41	219	47.72	0.00	0.98	219	47.72	0.00	0.98
Indication of ERCP	219	46.98	5.08	0.03	219	46.98	3.89	0.05	219	46.98	3.89	0.05
Type of previous surgery	219	17.98	18.7	0.00	219	17.98	16.05	0.00	219	17.98	16.05	0.00
Type of digestive tract reconstruction	219	76.74	10.4	0.00	219	76.74	11.25	0.00	219	76.74	11.25	0.00
Blood thinners	219	22.16	1.00	0.32	219	22.16	1.52	0.22	219	22.16	1.52	0.22

DF indicates degree of freedom; ERCP, endoscopic retrograde cholangiopancreatography; SS, sum of squares.

easy to cannulate the desired duct selectively, and the larger working channel together makes it easy to achieve therapeutic success. Although the enterography success rate of the side-viewing endoscope is relatively lower, the therapeutic success rate is higher after successful enterography. In this study, the therapeutic success rate was 98.0% (195/199) after successful enterography. Therefore, 2 strategies that can improve the ERCP success rate in patients after gastrectomy include improved therapeutic success with the forward-viewing endoscope^{25,26} and improved enterography success with the side-viewing endoscope.^{27,28} From our experience, the working length of the side-viewing duodenoscope is sufficiently long for almost all patients after gastrectomy. Our study also demonstrated a significantly higher therapeutic success rate after successful enterography using the side-viewing duodenoscope. Thus, our strategy for successful ERCP was to improve the enterography success rate of the side-viewing duodenoscope.

Among the patients who underwent Billroth I gastroenterostomy and proximal gastrectomy with esophagogastrostomy, the endoscopic procedures were similar to those performed in normal digestive tracts, and the ERCP success rate was 100% using the side-viewing duodenoscope in this study. Compared with patients with Billroth I gastroenterostomy and esophagogastrostomy, ERCP in patients with Billroth II gastrectomy and Roux-en-Y reconstruction is more difficult and hazardous due to the markedly altered anatomy, with the direction of approach shifted to the 6-o'clock position. These alterations together with abdominal adhesions create more difficulties in the intubation of the afferent loop and the approach to the papilla along the afferent loop when using the side-viewing duodenoscope. In our technique, the guidewire of the retrieval balloon was advanced to the appropriate limb, and then a retrieval

balloon was inserted over the guidewire. We used this retrieval balloon to explore the correct limb with contrast enhancement to observe the tract of the limb on the radiographic images. The balloon was then hooked to the correct limb and inflated, which not only indicated the direction of the tract to guide the endoscope forward but also facilitated the forward movement of the endoscope with fewer injuries to the intestinal wall. As the balloon catheter was strongly retracted into the working channel to allow the scope to advance, the endoscope was propelled slightly forward. By placing it within the correct limb, the retrieval balloon catheter may also be used as a guide to prevent the duodenoscope from sliding out of the correct limb and into another limb upon forward motion. After successful access of the appropriate limb is achieved, the retrieval balloon becomes visible within the tract ahead, instead of emerging from it. This is particularly important at the anastomosis site, where the correct limb must be identified. It should be emphasized that the x-ray dynamic images we observed with balloon-assisted enterography proved more helpful for ERCP in patients with altered gastrointestinal anatomy. Such visualization aids the endoscopist in viewing the altered structure clearly and allows the endoscope to move more smoothly along the digestive duct, minimizing accidental injury to the intestinal wall. We termed this procedure “retrieval balloon-assisted enterography,”^{11,13-15} which may ensure the success of ERCP using the side-viewing duodenoscope. In patients who have undergone Billroth II gastrectomy and Braun anastomosis, we recommend extending the duodenoscope along the greater curvature of the stomach to the gastrojejunal anastomosis, then advancing the endoscope through the efferent loop and along this efferent loop to the Braun anastomosis, whereby the “middle entrance” is the correct

TABLE 3. Details of the ERCP Treatment Procedures

	No. Patients	n (%)			
		Endoscopic Success	Diagnostic Success	ERCP Success	Procedure-related Complication
All	220	199 (90.5)	195 (88.6)	195 (88.6)	12 (5.5)
Esophagogastrostomy	10	10 (100)	10 (100)	10 (100)	1 (10)
Billroth I	42	42 (100)	42 (100)	42 (100)	2 (4.8)
Billroth II	160	142 (88.8)	138 (86.3)	138 (86.3)	9 (5.6)
Without BA	135	120 (88.9)	117 (86.7)	117 (86.7)	7 (5.2)
With BA	25	22 (88)	21 (84.0)	21 (84.0)	2 (8)
Roux-en-Y reconstruction	8	5 (62.5)	5 (62.5)	5 (62.5)	0

BA indicates Braun anastomosis; ERCP, endoscopic retrograde cholangiopancreatography.

TABLE 4. Risk Factors for Post-ERCP Complication in 220 Patients Who had Previously Undergone Gastrectomy

	Odds Ratio (95% Confidence Interval)	P
Gender		
Male	0.89 (0.23-3.4)	0.87
Female		
Age (y)		
< 80	0.44 (0.10-1.90)	0.27
≥ 80		
Indication of ERCP		
Cholangitis, CBD stone	0.11 (0.01-1.50)	0.10
CBD stricture		
Type of previous surgery	0.02 (0.00-1.22)	0.00
Proximal gastrectomy		
Distal subtotal gastrectomy		
Total gastrectomy		
Type of digestive tract reconstruction		
Esophagogastrostomy	0.40 (0.05-3.43)	0.40
Billroth I		
Billroth II		
Roux-en-Y reconstruction		
Blood thinners		
Yes	1.15 (0.19-7.23)	0.88
No		
≥ 1 accidental wire passes into pancreatic duct		
Yes	0.79 (0.11-5.72)	0.81
No		
Precut with needle-knife		
Yes	0.97 (0.17-6.18)	0.99
No		
Biliary sphincterotomy		
Yes	0.12 (0.01-2.10)	0.15
No		
Balloon dilation		
Yes	3.76 (0.33-42.67)	0.29
No		
Biliary stent placement		
Yes	1.36 (0.22-8.33)	0.74
No		
Stone removal		
Yes	1.55 (0.20-11.90)	0.67
No		

CBD indicates common bile duct; ERCP, endoscopic retrograde cholangiopancreatography.

entrance to reach the papilla of Vater. For patients with Billroth II gastroenterostomy and Braun anastomosis, we believe that this is the optimal ERCP enterography route.^{14,29} Using these strategies, we obtained encouraging results. For Billroth II gastroenterostomy, the endoscopic success rates without or with Braun anastomosis were 88.9% (120/135) and 88.0% (22/25), respectively. The diagnostic success and the ERCP success rates for Billroth II gastroenterostomy with the duodenoscope without or with Braun anastomosis were 86.7% (117/135) and 84.0% (21/25), respectively. For patients who underwent total gastrectomy with Roux-en-Y reconstruction, the endoscopic success rate was 62.5% (5/8), and the diagnostic success and ERCP success rates were both 62.5% (5/8). Moreover, retrieval balloon-assisted enterography using the side-viewing duodenoscope was safe for ERCP in

postgastrectomy patients. Only 1 patient with a Billroth II gastroenterostomy developed afferent loop perforation and underwent laparotomy. Two patients experienced hemorrhage at the time of ERCP, which was successfully treated by local injection of epinephrine and clipping. Thus, we believe that retrieval balloon-assisted enterography is an effective and safe method, which can improve the enterography success rate in patients with Billroth II and Roux-en-Y reconstruction postgastrectomy.

In conclusion, the side-viewing duodenoscope is a useful instrument for performing successful ERCP in patients postgastrectomy. In addition, the “retrieval balloon-assisted enterography” procedure may improve the enterography success rate in patients with Billroth II and Roux-en-Y reconstruction postgastrectomy. However, this study was retrospective and reflects the experience of a single center, suggesting that the reproducibility of this technique should be assessed in future prospective studies.

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