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

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
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 Extrac-tor 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 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 1. Conventional side-viewing duodenoscope for ERCP in patients who had undergone proximal gastrectomy with esophagogastrostomy. ERCP indicates endoscopic retrograde cholangiopancreatography.](image1)

![FIGURE 2. Conventional side-viewing duodenoscope for ERCP in patients who had undergone distal subtotal Billroth I gastrectomy. ERCP indicates endoscopic retrograde cholangiopancreatography.](image2)
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
according to Cotton’s criteria. 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 ± 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.

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

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.

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.
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% (5/5). 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 gastrosopes, and multibending endoscopes have been reported in previous studies of ERCP for postgastrectomy patients. 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. 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
advanced to the appropriate limb, and then a retrieval
our technique, the guidewire of the retrieval balloon was
afferent loop when using the side-viewing duodenoscope. In
afferent loop and the approach to the papilla along the
adhesions create more difficulties in the intubation of the
o’clock position. These alterations together with abdominal
anatomy, with the direction of approach shifted to the 6-
is more difficult and hazardous due to the markedly altered
with Billroth II gastrectomy and Roux-en-Y reconstruction
enterostomy and esophagogastrostomy, ERCP in patients
rate of the side-viewing duodenoscope.

high therapeutic success rate after successful enterography.
the side-viewing endoscope is relatively lower, the ther-
apeutic 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 and improved enterography
success with the side-viewing endoscope. From our
experience, the working length of the side-viewing duode-
noscope 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 gastro-
enterostomy and proximal gastrectomy with esophagogas-
troscopy, 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 gastro-
enterostomy and esophagogastroscopy, 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,” 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 gastro-
jejunal 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 2. Factors That Affected the Rates of Enterography Success, Diagnostic Success, and ERCP Success |
|---------------------------------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Gender                                           | DF    | SS    | F    | P    | DF    | SS    | F    | P    | DF    | SS    | F    | P    |
| Age                                              | 219   | 50.05 | 0.03 | 0.87 | 219   | 50.05 | 0.11 | 0.74 | 219   | 50.05 | 0.11 | 0.74 |
| 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.

| TABLE 3. Details of the ERCP Treatment Procedures |
|---------------------------------------------------|-------------------|
| No. Patients | 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.
postgastrectomy patients. Only 1 patient with a Billroth II gastrectomy 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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