Int Surg 2018;**103:**184–190
DOI: 10.9738/INTSURG-D-17-00137.1

Endoscopic Retrograde Cholangiopancreatography in Patients With Surgically Altered Gastrointestinal Anatomy: A Retrospective Study

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Objective: The aim of this study was to evaluate the difficulty of endoscopic retrograde cholangiopancreatography (ERCP) procedures when performed in patients with different types of surgically altered gastrointestinal (GI) anatomies.

Summary of background data: Clinical data of 102 consecutive patients with surgically altered GI anatomy who underwent ERCP using a double-balloon enteroscope or a regular gastroendoscope between January 2008 and March 2015 were retrospectively reviewed.

Methods: The success rate of reaching the destination, the time until reaching the destination, the success rate of the procedures, and complications were assessed for each type of altered GI anatomy using a double-balloon enteroscope and a regular gastroendoscope.

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Results: A total of 180 ERCP procedures were performed. The total success rate of reaching the destination was 91% (164 of 180), and that of treatment was 88% (144 of 164). The success rate of reaching the destination in patients with Roux-en-Y hepaticojejunostomy (HJ + R-Y) was significantly lower than that of the other types of reconstruction. The time until reaching the destination was significantly longer in patients after R-Y reconstruction (gastrectomy or HJ) than that after Billroth-II gastrectomy or pancreatoduodenectomy. GI perforation occurred in 2 patients after R-Y reconstruction (1 patient after gastrectomy, and 1 patient after HJ). However, no other complications, such as severe pancreatitis, bleeding, or air embolism, were observed.

Conclusions: ERCP for patients with surgically altered GI anatomy is feasible. Improvement of the success rate of reaching the destination in patients after HJ + R-Y and prevention of perforation in those with R-Y reconstruction are necessary.

Key words: Endoscopic retrograde cholangiopancreatography (ERCP) – Double balloon endoscopy – Surgically altered anatomy – Complication – Roux-en-Y reconstruction

Endoscopic retrograde cholangiopancreatography (ERCP) has been widely accepted as a diagnostic and therapeutic tool for various pancreatobiliary diseases (PBD).[1] Conversely, surgical or percutaneous procedures have been used to treat PBD in patients with surgically altered gastrointestinal (GI) anatomy. The reason is that it is usually difficult to reach duodenal papilla in such patients by endoscopy. Although surgical or percutaneous procedures have higher treatment success rates compared with ERCP, they are more invasive and require longer hospitalizations than ERCP.[2–5] Because the quality of endoscopes and associated devices has been continuously improving in recent decades, the success rate of ERCP-related procedures has consequently increased, even in patients with surgically altered GI anatomy.[6,7] Since Yamamoto *et al*[8] reported that the DBE enabled endoscopic treatment in patients with surgically altered GI anatomy, ERCPs using double-balloon enteroscope (DBE) have been frequently performed to treat various PBD.[8] There are several types of surgically altered GI anatomies, such as those resulting from Roux-en-Y (R-Y) or Billroth-II (B-II) types of reconstruction after gastrectomy, B-I or B-II types of reconstruction after pancreatoduodenectomy (PD), and R-Y hepaticojejunostomy (HJ + R-Y), among other procedures. Additionally, ERCP procedures using DBE are expected to be useful for patients with surgically altered GI anatomy; however, few studies have evaluated the different difficulties associated with the different types of surgically altered GI anatomies.[9–14] The aim of this study was to elucidate the difficulties of endoscopic diagnosis and treatments, and procedure-related complications in each cohort of patients with surgically altered GI anatomies.

Patients and Methods

Patients

The ethics committee of Kyushu University Hospital (Fukuoka, Japan) approved this study (No. 29-379). Because this was a retrospective study, written informed consent was not obtained. However, the protocol is published on our home page (http://www.surg1.med.kyushu-u.ac.jp), in accordance with the guidelines for research ethics of the Ministry of Education, Culture, Sports, Science and Technology, and the Ministry of Health, Labour, and Welfare of Japan (http://www.lifescience.mext.go.jp/bioethics/ekigaku.html).

A total of 180 ERCP procedures using either DBE (DBE-ERCP) or a regular gastroendoscope (GE) were performed in 102 patients (74 male and 28 female patients) with surgically altered GI anatomy between January 2008 and March 2015 at the Department of Surgery and Oncology, Kyushu University Hospital. We retrospectively reviewed the medical records of these 102 patients. A total of 38 patients had undergone gastrectomy followed by R-Y, 24 had undergone gastrectomy followed by B-II reconstruction, 23 had undergone PD followed by B-II reconstruction, and 17 had undergone HJ + R-Y.

Procedural protocol

The patients with altered GI anatomy underwent ERCP using either a short-type DBE (EC-450B15,

Table 1 Treatment success rate of pancreatobiliary diseases in patients with surgically reconstructed gastrointestinal anatomy[a]

	No. (%)	Procedural success rate: success/total, No. (%)
Total	102	144/164 (88)
Therapeutic endoscopy	78 (76)	122/140 (87)
CBD stones	34 (33)	64/71 (90)
Anastomotic stricture of HJ	18 (18)	26/29 (90)
IHBD stones	15 (15)	13/14 (93)
Chronic pancreatitis and pancreatic stone	6 (6)	16/18 (89)
Retrogressive cholangitis	4 (4)	2/3 (67)
Stenosis of afferent loop	1 (1)	1/1 (100)
Diagnostic endoscopy	24 (24)	22/28 (79)
For pancreatic diseases	19 (18)	13/18 (72)
For biliary diseases	5 (5)	9/10 (90)

[a]There was no significant difference in success rate between each cohort.

Fujinon, Fujifilm, Tokyo, Japan) or a regular GE (GIF-H260Z, Olympus, Tokyo, Japan). The patient was resting in a prone position on the radiographic table, while receiving medication and oxygenation via nasal tube. Subsequently, an antispasmodic drug was injected intravenously. After the patients were sedated, the operator proceeded with the endoscope insertion. Carbon dioxide insufflation was used for improving intubation depth when using the DBE and reducing patient discomfort.[15] After reaching the destination, that is, the duodenal papilla or targeted anastomotic site, such as that of the HJ or pancreaticojejunostomy, the endoscope was controlled and stabilized at an appropriate distance to insert the tube into the biliary or pancreatic duct. Then, selective cannulation using catheters, such as PR-9Q-1 (Olympus) or tandem XL (Boston Scientific, Marlborough, Massachusetts), was performed. Cholangiopancreatography was performed using iodixanol (Visipaque injection, Daiichi Sankyo Company, Tokyo, Japan) after cannulation. Thereafter, a guide wire (Jagwire, Boston Scientific; VisiGlide 2, Olympus) was put forward. In case that the treatment of bile duct stones was required in the normal papilla, a biliary or pancreatic stent (Flexima Biliary Stent, Boston Scientific; Geenen Pancreatic Stent Sets, Cook Japan, Tokyo, Japan) was first inserted. Subsequently, an endoscopic sphincterotomy was performed using a precutting knife (KD-10Q-1, Olympus) along the stent. Then, the stent was removed. Stones were retracted using a lithotripsy basket catheter (Xemex crusher catheter, Zeon Medical, Tokyo, Japan) for small stones, or a stone extraction balloon (MediGlobe Stone Extraction Balloon, Medico's Hirata, Osaka, Japan) for large stones.

The patients who had stones in the intrahepatic bile duct (IHBD) because of anastomotic stricture of the HJ site first underwent dilation of the anastomotic site using a 4- to 8-mm balloon dilation catheter (Max Force Biliary Balloon Dilation Catheter, Boston Scientific). When cancer recurrence was suspected, a biliary stent was placed in the anastomotic site for drainage.

Pancreatic juice was collected for the examination of pancreatic diseases using a catheter (PR-9Q-1, Olympus). If patients received a diagnosis of chronic pancreatitis and stenosis of the pancreatic duct, a plastic stent (Geenen Pancreatic Stent, Cook Medical Inc, Bloomington, Indiana) was placed for drainage.

Outcome assessment

The success rate of reaching the destination, the time until reaching the destination, the success rate of procedures, and the complications were assessed for each type of altered GI anatomy. The time until reaching the destination was defined as the interval from the start of the endoscope insertion to the destination. The treatment success rate was defined as the rate of successfully completed ERCP procedures. For example, the removal of biliary stones was incomplete during 1 session because of numerous stones, but the patient was scheduled to undergo a second session for stone removal, with the latter resulting in complete removal of the stones; thus, the first session was considered successful.

Statistical analysis

Statistical analysis was performed using JMP statistical software (version 11.0.0, SAS Institute, Cary, North Carolina). Continuous data are presented as median and range. The Mann-Whitney *U* test was used for the comparison of continuous data. The Fisher exact test or the χ^2 test was used to evaluate categorical data between the two groups. A *P* value <0.05 was considered to be statistically significant.

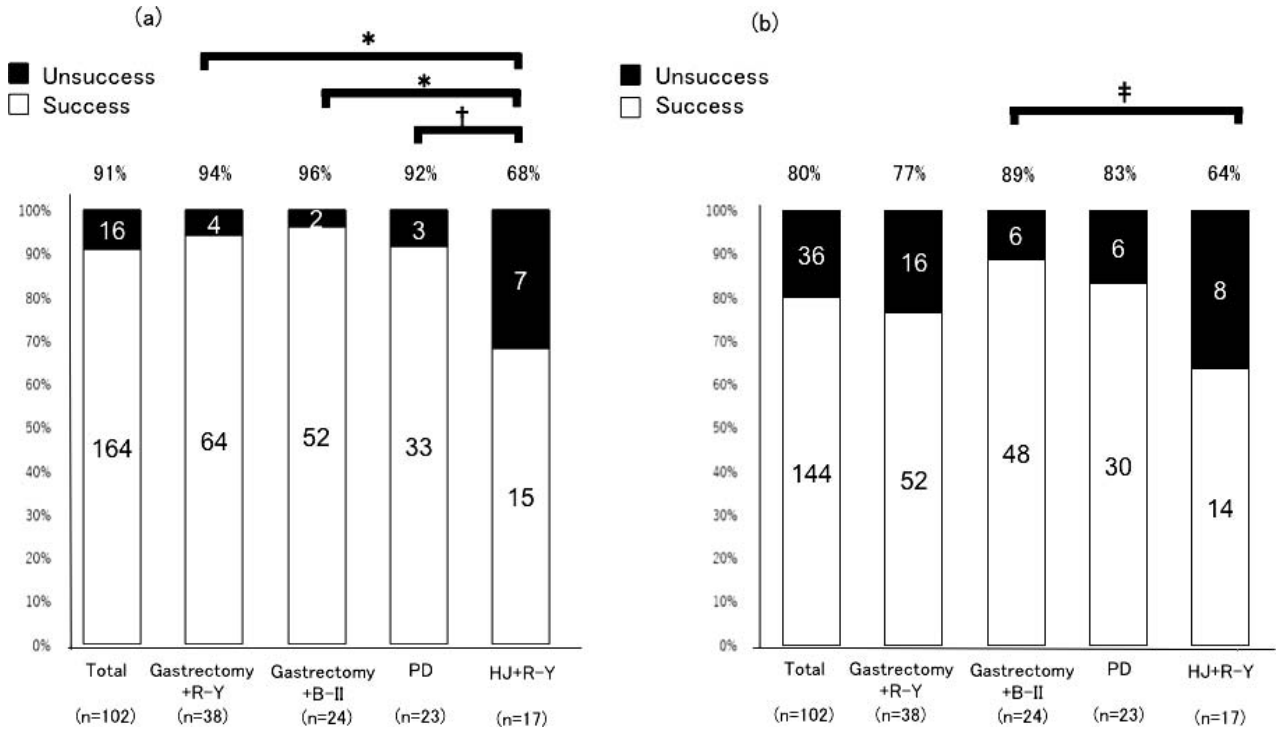

Fig. 1 Success rate of reaching the destination and total success rate of procedures in patients with surgically altered gastrointestinal anatomy. (a) Comparison of the success rate of reaching the destination among 4 cohorts, including R-Y after gastrectomy, B-II after gastrectomy, B-II after PD, and HJ + R-Y. The success rate of HJ + R-Y was significantly lower than those of other cohorts (*$P < 0.01$, †$P < 0.05$). (b) Total success rate of procedures. A significant difference was observed only for the success rate between the B-II gastrectomy and HJ + R-Y (‡$P = 0.01$).

Results

Diseases

The ERCP procedures for PBD are shown in Table 1. A total of 78 of 102 patients underwent therapeutic endoscopy, and the remaining 24 underwent diagnostic endoscopy for PBD. Almost half of the patients required ERCP for the removal of stones in the common bile duct (CBD; n = 34) or IHBD (n = 15). A total of 18 patients had anastomotic stricture of HJ, and 12 of these patients were suspected to have cancer recurrence. The remaining patients underwent the procedure for the treatment of chronic pancreatitis and pancreatic stones (n = 6), reflux cholangitis (n = 4), and stenosis of the afferent loop (n = 1).

Success rate of reaching the duodenal papilla or anastomosis site

The total success rates of reaching the destination were 91% (164 of 180); success rates were 94% (64 of 68) in 38 patients who underwent gastrectomy followed by R-Y, 96% (52 of 54) in 24 patients who underwent gastrectomy followed by B-II, 92% (33 of 36) in 23 patients who underwent PD followed by B-II, and 68% (15 of 22) in 17 patients who underwent HJ + R-Y (Fig. 1a). The success rate of HJ + R-Y was significantly lower than those of R-Y after gastrectomy ($P < 0.01$), B-II after gastrectomy ($P < 0.01$), and B-II after PD ($P < 0.05$). The total success rate of the procedures was 80% (144 of 180), and that of HJ + R-Y was significantly lower than that of B-II after gastrectomy ($P = 0.01$; Fig. 1b).

Time required to reach the duodenal papilla or anastomotic site

The median time until reaching the destination was 33 minutes; 41 minutes in the R-Y after gastrectomy cohort (range, 15–90 minutes), 25 minutes in the B-II after gastrectomy group (range, 6–95 minutes), 26 minutes in the B-II after PD group (range, 10–80 minutes), and 41 minutes in the HJ + R-Y group (range, 13–90 minutes). The time until reaching the destination was significantly longer in R-Y after

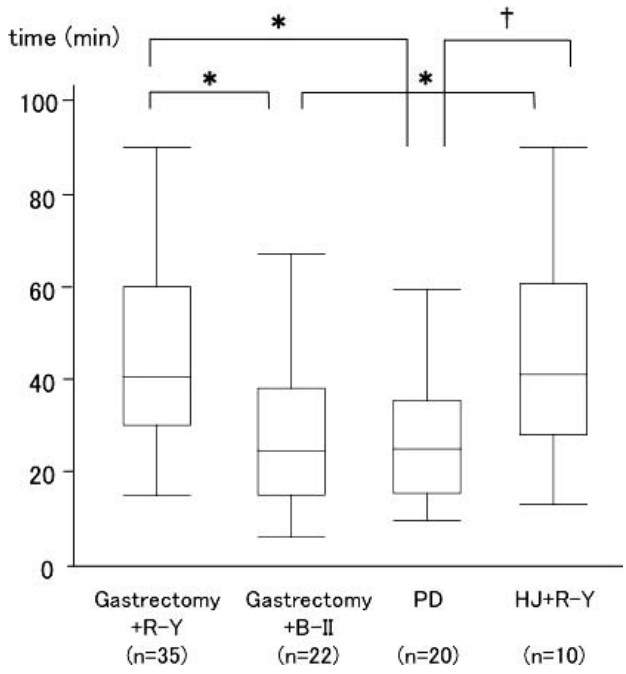

Fig. 2 Comparison of the time until reaching the destination among the different reconstruction methods. R-Y reconstruction after gastrectomy and HJ + R-Y require significantly longer amounts of time than B-II reconstruction after gastrectomy or PD (*$P < 0.01$, †$P = 0.01$).

gastrectomy than those in B-II after gastrectomy ($P < 0.01$) and B-II after PD ($P < 0.01$; Fig. 2). Additionally, the time until reaching the destination was significantly longer in the HJ + R-Y cohort than those in the B-II after gastrectomy ($P < 0.01$) and B-II after PD ($P = 0.01$) cohorts (Fig. 2).

Technical difficulty in reaching the anastomotic site in patients with HJ + R-Y

Of the 22 DBE procedures performed in patients with HJ + R-Y, 7 procedures were not successful in reaching the anastomotic site. Among these 6 patients (7 procedures), 3 presented IHBD stones after resection of the extrahepatic bile duct for congenital biliary dilatation: 1 for anastomotic stricture secondary to cancer recurrence after right lobectomy with extrahepatic bile duct resection, 1 for jaundice after extended right lobectomy, and 1 for repeated reflux cholangitis after extrahepatic bile duct resection for CBD cancer. The success rate of reaching the destination in patients with HJ + R-Y after left hepatectomy (including extended left hepatectomy) was 100% (3 of 3). The success rate after right hepatectomy was 0% (0 of 2).

Differences in the success rates between cannulation of the native papilla and anastomotic site

Of the 87 patients in whom we tried to perform ERCP, the native papilla was present in 57 patients and anastomotic site was in 30. Among these patients, the anastomotic site could not be detected in 2 patients because of severe anastomotic stricture. The success rate of cannulation of the native papilla (77%; 43 of 56) was significantly lower than that of the anastomotic site (96%; 27 of 28; $P = 0.02$).

Success rates of ERCP procedures for PBD

The total success rate of all procedures was 88% (144 of 164). The treatment success rate was 90% (64 of 71) in patients with CBD stones, 90% (26 of 29) in anastomotic stricture of HJ, 93% (13 of 14) in IHBD stones, and 89% (16 of 18) in chronic pancreatitis and pancreatic stones. The success rate for diagnostic endoscopy was 72% (13 of 18) for the examination of pancreatic diseases, and 90% (9 of 10) for biliary diseases (Table 1). There were no significant differences in the success rates of ERCP procedures among each cohort.

Complications

Adverse events were noted in 11 of 180 procedures (6%). A total of 2 patients (1%; 2 of 180 procedures) presented GI perforation: 1 patient who underwent R-Y after gastrectomy had perforation at the afferent loop of the intestine during the manipulation of the DBE, and 1 patient who underwent HJ + R-Y had perforation at the HJ anastomosis during dilation of the anastomotic stricture caused by cancer recurrence. These patients were treated with conservative treatment. Hyperamylasemia occurred in 2 patients (1%), and cholangitis occurred in 7 patients (4%). All of these cases were easily managed by medication. No other related complications, such as severe pancreatitis, bleeding, or air embolism, were observed.

Discussion

This study resulted in the following findings: (1) the success rate of reaching the destination in patients with HJ + R-Y (68%) was significantly lower than those in other cohorts; (2) R-Y after gastrectomy and HJ + R-Y require significantly longer time until reaching the destination than B-II reconstruction after gastrectomy or PD; (3) it was difficult to cannulate the native papilla in patients with

surgically altered GI anatomy; and (4) complications were observed in 6% of procedures.

Our outcomes in each cohort are comparable with or slightly better than those in previous reports of patients with surgically altered GI anatomies. To increase the success rate of DBE-ERCP and reduce the incidence of complications in our institution, all procedures were performed by DBE specialists. In addition, close attention was paid during the procedures by referring to the techniques reported in several studies described below.

In our present study, the success rate of reaching the destination in HJ + R-Y patients was significantly lower than with gastrectomy followed by R-Y. One reason may be that the length of the GI tract from the mouth to the anastomotic site in patients with HJ + R-Y was longer than that in patients with R-Y after gastrectomy. The other reason may be that the afferent limb of the small intestine had severe adhesions. The afferent loop of the intestine occupied the void space after CBD resection and hepatectomy, and thus the small intestine became fixed and lost its flexibility.[14] In fact, our present study showed that the success rate of reaching the destination was 0% in patients with HJ + R-Y after right hepatic lobectomy, whereas it was 100% after left hepatectomy. The success rates of DBE-ERCP procedures in patients with HJ + R-Y have been reported to be high (86%–93%), however; these were small and retrospective studies.[16–18] Additionally, those reports included HJ after PD or liver transplantation, and HJ + R-Y after CBD injury during laparoscopic cholecystectomy. Therefore, we consider that the development of a new endoscope that can bend passively is necessary to pass through the intestines with multiple adhesions.

The success rate of the initial cannulation of the native papilla in patients with surgically altered GI anatomy was relatively low (75%) in the present study. One reason may be that ampulla of Vater is detected in the 9 to 11 o'clock direction when reaching duodenum. Thus, the cannulation of the native papilla is difficult because of the tangential view. The other reason may be that it is difficult to align the axis of the cannulation in the absence of the uprising forceps. The use of a front attachment hood for the DBE and the J-turn technique have been reported to be useful in aligning the axes for successful cannulation.[11,19] In our institution, the native papilla was moved to the 7 o'clock position using these skills to cannulate the bile duct. Pancreatic guide wire cannulation was also useful to increase the success rate of bile duct cannulation. However, further improvement of the device is necessary to increase the success rate of cannulation for the ampulla of Vater during DBE-ERCP.

The incidence of complications, such as perforation, post-ERCP pancreatitis, and bleeding, in patients with surgically altered GI anatomy has been reported to be less than 10%.[9–11,20–22] In the present study, perforation occurred while stretching the endoscope in the shortened intestine and when attempting to dilate the stricture in a case of cancer recurrence. The rate of DBE-ERCP–related perforation has been reported to be 5% to 11%,[10,23] and it is higher than that for ordinary ERCP (0.01%–2.1%).[24–26] Careful attention should be paid during endoscope insertion, and care should be taken to perform procedures without excessive force.[27,28] Additionally, a balloon of a smaller size than the diameter of the distal bile duct should be selected and used under the appropriate pressure to avoid perforation during balloon dilation.[17]

In conclusion, the ERCP procedure seems to yield acceptable outcomes for patients with surgically altered GI anatomy. Methods to improve the success rate of reaching the HJ + R-Y site are required.

Acknowledgments

The Japan Society for the Promotion of Science (JSPS: KAKENHI, grant No. 15K10186) supported this study.

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