

ERCP via gastrostomy vs. double balloon enteroscopy in patients with prior bariatric Roux-en-Y gastric bypass surgery

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Abstract

Background Roux-en-Y gastric bypass (RYGB) is the most common bariatric surgery. The performance of ERCP in bariatric RYGB is challenging due to the long Roux limb. We herein compared the indications and technical outcomes of ERCP via percutaneous gastrostomy (GERCP) and double balloon enteroscopy (DBERCP) for patients with prior bariatric RYGB anatomy.

Methods Between December 2005 and November 2011, consecutive ERCP patients who had undergone RYGB were identified using a prospectively maintained electronic ERCP database. Medical records were abstracted for ERCP indications and outcomes. In most cases, the gastrostomy was done by either laparoscopic or open surgery and allowed to mature at least 1 month before performing ERCP. The choice of route for ERCP was at discretion of managing physician.

Results Forty-four patients ($F = 42$) with GERCP and 28 patients ($F = 26$) with DBERCP were identified. The mean age was younger in GERCP than DBERCP (44.8 vs. 56.1, $p < 0.001$). GERCP patients were more likely to have suspected sphincter of Oddi dysfunction (77 %) as the primary indication whereas DBERCP was suspected CBD stone (57 %). The mean total number of sessions/patient in GERCP and DBERCP was 1.7 ± 1.0 and 1.1 ± 0.4 , respectively ($p = 0.004$). GERCP access to the major papilla was successful in all but two (97 %), whereas duct

cannulation and interventions were successful in all. In DBERCP, the success rate of accessing major papilla, cannulation and therapeutic intervention was 78, 63, 56 %, respectively. There was one (3.1 %) post-ERCP pancreatitis in DBERCP. Complications occurred in 11 GERCP procedures (14.5 %) and 10 were related to the gastrostomy. This was significantly higher than that of DBERCP ($p = 0.022$).

Conclusions GERCP is more effective than DBERCP in gaining access to the pancreatobiliary tree in patients with RYGB, but it is hindered by the gastrostomy maturation delay and a higher morbidity. Technical improvements in each method are needed.

Keywords Roux-en-Y gastric bypass surgery · Endoscopic retrograde cholangiopancreatography · Double balloon enteroscopy · Surgical gastrostomy

The obesity epidemic and the high prevalence of obesity related comorbidities have received considerable attention and represent a worldwide public health problem [1–3]. Surgical treatment of obesity is the most effective means of sustainable weight loss in this patient population [4]. Among all bariatric operations, Roux-en-Y gastric bypass (RYGB) is considered the “gold standard” [4]. RYGB accounts for more than 60 % of bariatric procedures performed in the United States [5, 6]. Because the prevalence of RYGB anatomy has increased exponentially during the past decade, clinicians are increasingly likely to encounter patients with pancreatobiliary pathology (e.g., cholelithiasis) requiring endoscopic retrograde cholangiopancreatography (ERCP).

The length of Roux limb to the biliary tree varies greatly depending on the indication for the Roux-en-Y

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reconstruction. The longest Roux limbs are encountered in patients who have undergone a standard RYGB for bariatric indications [7]. ERCP in RYGB patients is challenging or impossible using conventional side-viewing endoscopes (duodenoscopes) due to the long anatomic route from the mouth to the major papilla. The Roux limb in patients who have undergone a RYGB for weight loss is typically at least 100 cm in length, although limbs of up to 150 cm are not uncommon [8]. This total length from mouth to major papilla may exceed 300 cm, well beyond the access of standard side-viewing scopes [6, 9]. This does not take into account the significant angulations resulting from the multiple anastomoses, particularly the antecolic, retrogastric reconstruction, which is the most common technique in patients undergoing laparoscopic gastric bypass.

There are several ways to overcome this challenge. Baron and Vickers [10] were the first to describe creation of a surgical gastrostomy to access the gastric remnant and facilitate ERCP in an RYGB patient who had previously failed using an enteroscope through the jejunal route. This technique requires initial placement of a surgical gastrostomy in the excluded stomach. ERCP is performed immediately or at a later time through a healed gastrostomy tract. The duodenoscope is passed through the gastrostomy and excluded stomach and ERCP is performed in the usual manner. Later, double balloon enteroscopy was introduced as a new endoscopic technique that allows examination of the entire small bowel [11]. Double balloon enteroscopy-assisted ERCP has been demonstrated as a feasible and less invasive approach to study the pancreatobiliary tree and gastric remnant [12, 13]. There are limited data on indications, success, and complication rates of these two endoscopic approaches to patients with bariatric RYGB.

We sought to compare indications and outcomes of ERCP via gastrostomy (GERCP) and double balloon enteroscopy assisted ERCP (DBERCP) for the patients with prior bariatric RYGB anatomy.

Materials and methods

Patients

Patients were identified by using prospectively maintained electronic databases (ERCP and double balloon enteroscopy) that capture all procedures performed at Indiana University Medical Center. All ERCPs and relevant medical records between December 2005 and November 2011 in patients with prior bariatric RYGB were reviewed. This research was approved by the Institutional Review Board at Indiana University Medical Center.

ERCP via gastrostomy (GERCP)

The gastrostomy was done by either laparoscopic or open surgery depending on surgeon's preference. In most cases, the gastrostomy tract was allowed to mature for 4–6 weeks before performing ERCP. In a few recent cases, the gastrostomy site was utilized within 24 h of creation. In those cases, the stomach was secured by circumferential tacking to the abdominal wall to allow passage of the duodenoscope (TJF-160F, Olympus America, Center Valley, PA) into the gastric remnant lumen within 1 day after surgical gastrostomy. Following the completion of the first endoscopic intervention, the gastrostomy tube (G-tube) was either removed or replaced with a 30–36F tube to permit access to the remnant for repeat ERCP at a later date, if needed. The G-tube was removed when the treating physician considered need for future access to the proximal duodenum was unlikely.

Double balloon enteroscopy-assisted ERCP (DBERCP)

All DBERCP procedures were performed under general anesthesia. DBERCP procedures were performed by using a 9.2-mm diameter, 160-cm-long Fujinon double balloon enteroscopy system, EC-450B15 (Fuji Photo Optical Co., Ltd, Saitama, Japan) associated with a balloon-fitted overtube (TC-13101). This double balloon endoscope has a 2.8-mm accessory channel through which diagnostic and therapeutic interventions may be performed. Some procedures were performed by using a disposable distal attachment (D-201-13404, Olympus) fitted over the tip of the scope.

Definitions

Access to the major papilla was defined as any endoscope position that permitted stable visualization and manipulation of the papilla. The definition of successful cannulation was deep cannulation of the desired duct during ERCP. A successful intervention was defined as the completion of the intended treatment during the procedure. Post-ERCP pancreatitis (PEP) was defined by consensus criteria [14].

Statistics

We used descriptive statistics (mean \pm standard deviation or simple proportions with 95 % confidence intervals) to present variables of interest. Comparative statistics (χ^2 test of independence or Fisher's exact test) were used to measure differences in indications, therapeutic interventions, success rate, and complication rate between GERCP and DBERCP patients. If the expected count of each cell was less than 5, Fisher's exact test was used to evaluate the

difference between groups. Continuous variables were analyzed using two-tailed, unpaired Student's *t* test. A *p* value <0.05 was considered to be significant. Statistical analyses were performed using SPSS version 17.0 (SPSS, Inc., Chicago, IL).

Results

Of 72 patients with prior bariatric RYGB who underwent ERCP during the study period, 44 (42 females) had GERCP and 28 (26 females) had DBERCP. Table 1 summarizes demographics and indications for two groups of patients. The mean time from RYGB to ERCP was 70.5 ± 60.0 months for GERCP and 86.8 ± 74.7 months for DBERCP ($p = 0.33$). The mean age was younger in GERCP than DBERCP (44.8 ± 11.7 vs. 56.1 ± 12.2 years, $p < 0.001$). The indications for GERCP were suspected sphincter of Oddi dysfunction (SOD) in 34 (77 %), recurrent pancreatitis in 8 (18 %), and suspected common bile duct stone (CBDS) in 2 (5 %). In DBERCP, the indications were suspected CBDS in 16 (57 %), suspected SOD in 6 (21 %), suspected pancreatobiliary cancer in 4 (15 %), and postcholecystectomy bile leak in 2 (7 %). The mean total number of sessions per patient in GERCP and DBERCP was 1.7 ± 1.0 and 1.1 ± 0.4 , respectively ($p = 0.004$). The median time delay between surgical gastrostomy and ERCP was 42 days (range 0–240). In all GERCP cases, including repeat procedures, the mean total duration of the procedure was 45.9 ± 26.6 min. The mean endoscopic procedure time for DBERCP was 101.2 ± 36.8 min, which was significantly longer than that of GERCP ($p < 0.001$).

Endoscopic access to the major papilla was successful in all but two GERCP (97 %). These were the first procedure of two patients, and the duodenoscope could not be passed through the gastrostomy due to insufficient tract size. After upsizing the gastrostomy tract, both of the following procedures were successful. After reaching the major papilla, the cannulation and therapeutic interventions were all successful (100 %). Diagnostic and interventional techniques were performed according to the findings for each patient (Table 2). All of the patients who were intended to perform manometry underwent biliary and/or pancreatic manometry successfully ($n = 37$, 84 %). Regarding therapeutic interventions, 41 (93 %) patients had biliary and/or pancreatic sphincterotomy and/or stent. Four patients with recurrent pancreatitis and pancreas divisum had minor papilla sphincterotomy. Once the major papilla was seen, there was no case which failed an intended diagnostic or therapeutic intervention. Average length of postoperative hospital stay for GERCP was 2.1 days (range 0–14).

In all 32 DBERCP procedures, the major papilla was reached via the Roux limb in 25 (78 %). Adequate cannulation of either biliary or pancreatic duct was achieved in 20 of 32 (63 %) of cases. Therapeutic interventions were successful in 18 of 32 cases (56 %). Overall treatment success was 18 of 32 (56 %). The most common treatment was biliary sphincterotomy (Table 2).

There was one case (3.1 %) of moderate PEP in 32 DBERCP procedures (Table 3). This patient had suspected SOD with therapeutic biliary sphincterotomy but failed pancreatic stent insertion. Complications occurred in 11 cases (14.5 %) in 76 GERCP procedures, and all but one were associated with the gastrostomy (Table 3). Mild PEP developed in one patient with suspected SOD who treated biliary and pancreatic sphincterotomy and prophylactic pancreatic stent after biliary and pancreatic manometry. The complications associated with the gastrostomy were as follows: gastrostomy site infection ($n = 5$), spontaneous dislodgement of tube ($n = 2$), gastrostomy tract leak ($n = 1$), gastrostomy site bleeding ($n = 1$), and persistent gastrocutaneous fistula ($n = 1$). Of the five patients who developed wound infection at the gastrostomy site, four were superficial and resolved with antibiotics. One patient experienced severe cellulitis at the gastrostomy site, which required hospitalization for 2 weeks and percutaneous drain placement. A second operation was required in three patients as follows: G-tube replacement ($n = 1$), gastric remnant closure after lost percutaneous access ($n = 1$), and fistula repair ($n = 1$).

Discussion

Because obesity is occurring in the United States in epidemic proportions and is now becoming a major problem in other countries as well, bariatric surgery is increasingly performed as a treatment of morbid obesity. Among various types of surgeries, RYGB surgery is the most common weight-loss surgery performed in the United States [1–3, 5, 15, 16]. Therefore, clinicians are certain to see an increase in the number of patients who present with altered anatomy resulting from RYGB surgery. Furthermore, patients undergoing bariatric surgery typically have a high prevalence of biliary disease (e.g., cholelithiasis, choledocholithiasis) related to the weight loss [17]. Taken together, there will continue to be an increasing number of patients who will require endoscopic interventions via ERCP.

The longest Roux limb is encountered in patients who have undergone a standard RYGB for bariatric indications [7]. In addition to the long length of bowel that the endoscope must pass through, the acute angle of the afferent limb and Roux limb anastomosis may be very difficult to navigate with duodenoscopes or colonoscopes. These problems are

Table 1 Baseline characteristics and indications

	GERCP	DBERCP	<i>p</i> value
No. of patients	44	28	
No. of procedures	76	32	
Mean number of procedures per patients	1.7	1.1	0.004
Age (year, mean \pm SD)	44.8 \pm 11.7	56.1 \pm 12.2	<0.001
Sex (female/male)	42/2	26/2	0.64
Mean time after RYGB (range, mo)	70.5 (7–336)	86.8 (17–324)	0.33
Mean procedure time (range, min)	45.9 (3–131)	101.2 (40–180)	<0.001
Indication of ERCP			<0.001
Suspected SOD	34 (77 %)	6 (21 %)	
Recurrent pancreatitis	8 (18 %)	0	
Suspected CBDS	2 (5 %)	16 (57 %)	
Suspected PB cancer	0	4 (15 %)	
Post-cholecystectomy bile leak	0	2 (7 %)	

ERCP endoscopic retrograde cholangiopancreatography; *GERCP* ERCP via gastrostomy; *DBERCP* double balloon enteroscopy-assisted ERCP; *RYGB* Roux-en-Y gastric bypass surgery; *SOD* sphincter of Oddi dysfunction; *CBDS* common bile duct stone; *PB* pancreatobiliary

Table 2 Interventions performed and success rates

	GERCP (<i>n</i> = 76)	DBERCP (<i>n</i> = 32)	<i>p</i> value
Interventions performed (in all procedures)			
Biliary and/or pancreatic manometry	45 (59 %)	0	
Biliary and/or pancreatic sphincterotomy	45 (59 %)	16 (50 %)	
Minor papilla sphincterotomy	4 (5 %)	0	
Biliary stone removal	2 (3 %)	11 (34 %)	
Pancreatic stent	43 (57 %)	0	
Success rate (accessing MP/all procedure)	74 (97 %)	25 (78 %)	0.003
Success rate (cannulation/all procedure)	74 (97 %)	20 (63 %)	<0.001
Success rate (intervention/all procedure)	74 (97 %)	18 (56 %)	<0.001
Technical therapeutic success rate	74/76 (97 %)	18/32 (56 %)	<0.001

ERCP endoscopic retrograde cholangiopancreatography; *GERCP* ERCP via gastrostomy; *DBERCP* double balloon enteroscopy-assisted ERCP; *MP* major papilla

being addressed by newer techniques, such as single balloon enteroscopy, double balloon enteroscopy, and spiral endoscopy, which allow consistent endoscopic access to the afferent limb and await further study.

DBERCP has been demonstrated as a feasible and less invasive approach to study the pancreatobiliary tree and gastric remnant. However, this approach has limitations: (1) lack of an elevator, (2) absence of the side-viewing perspective, which gives difficulty with cannulation, (3) the procedures are time and labor intensive (our successful procedures spanned 40–180 min, and required general anesthesia), (4) there are limited accessories specially designed to use with the longer double balloon endoscope to perform diagnostic and therapeutic interventions, and (5) there may be a learning curve for endoscopists with this approach. Several studies have described the use of double balloon enteroscopy to facilitate the performance of ERCP in patients with Roux-en-Y anatomy [12, 13]. These studies reported a high success rate of greater than 90 % for reaching the biliopancreatic limb and an 80 % success rate for ERCP; however, most of the subjects studied were not bariatric RYGB patients who have the longest Roux limb.

Because all our patients had prior history of bariatric RYGB, our success rate in DBERCP was lower than other reports.

In 1998, Baron and Vickers [10] reported the first case of surgical gastrostomy placement to gain the access to the major papilla in a patient with RYGB experiencing recurrent pancreatitis. The transgastric approach allows for direct access to the pancreatobiliary ducts independent of the Roux limb length. Furthermore, a standard ERCP endoscope may be used without the perceived need of a “learning curve,” which is associated with the double balloon endoscope. However, this technique is more invasive than other purely endoscopic approaches and is associated with risks related to anesthesia and surgery [9]. Another disadvantage with the matured gastrostomy tract method is the inability to study or intervene on the biliary tract in an acute setting. This approach is applicable to those patients whose conditions are not urgent but elective (e.g., dilated bile duct, suspected sphincter of Oddi dysfunction, pancreas divisum with recurrent pancreatitis, etc.).

In the present study, we compared indications and outcomes between two methods of accessing the pancreatobiliary

Table 3 Complications

	GERCP	DBERCP	<i>p</i> value
ERCP-related complications			
Post-ERCP pancreatitis	1 (1.3 %)	1 (3.1 %)	0.586
Gastrostomy-related complications			
Gastrostomy site infection	5	0	
Spontaneous dislodgement of tube	2	0	
Gastrostomy tract leak	1	0	
Gastrostomy site bleeding	1	0	
Persistent gastrocutaneous fistula	1	0	
Total	11 (14.5 %)	1 (3.1 %)	0.022

ERCP endoscopic retrograde cholangiopancreatography; GERCP ERCP via gastrostomy; DBERCP double balloon enteroscopy-assisted ERCP

tree in patients with prior bariatric RYGB. The majority of the GERCPs in our study were performed because of suspected SOD. This patient population is reflective of referral patterns at our institution for complex ERCP. SOD was suspected in individuals who presented with recurrent, right upper quadrant or epigastric pain with or without elevated pancreatic or liver enzymes. There are several reasons why most of these patients underwent GERCP instead of DBERCP. First, these patients usually require biliary and/or pancreatic manometry. Due to the length of the scope and difficulty of cannulation with using the double balloon enteroscope, it would be better managed by GERCP. Second, SOD patients may need several procedures to achieve optimal response of therapy. If a G-tube is placed and the tract is maintained, further required procedures are easily possible. This is reflected by the total procedure number in GERCP compared with DBERCP in our study. However, a few suspected SOD patients underwent DBERCP instead of GERCP. They were mainly managed by empiric biliary sphincterotomy without manometry.

Performing all needed ERCP maneuvers at one session of gastrostomy is advantageous for GERCP in our study. There are reports of performing ERCP in the operating room at the same time of laparoscopic or open gastrostomy without inserting G-tube [18, 19]. In one study, almost all of the indications for ERCP were choledocholithiasis [18], which could be treated at one procedure without repeat procedure. Another study included 60 % SOD patients, but the mean follow-up period was only 6.4 weeks (range 0–24) [19]. A longer follow-up period is needed to determine patient's response and possible need for repeat procedure. Furthermore, placement of a pancreatic duct stent for prevention of PEP generally requires continued access to the papilla if the stent does not pass spontaneously [20]. Therefore, choice of route for ERCP mainly depends on the

indication of ERCP. Additionally, if patient has post-ERCP bleeding that requires endoscopic intervention, duodenal access is mandatory.

Only two complications (1.8 %) were associated with ERCP procedure in GERCP or DBERCP. This may reflect experience of ERCP team at this hospital. SOD patients usually had prophylactic pancreatic stents. These required endoscopic removal in 35 % (15/43) of patients. However, complications related to the gastrostomy itself or G-tube accounted for three second operations in our series. The most common complication was gastrostomy site infection. There are similar reports that showing the complication rate up to 27 %, which were related to the gastrostomy [21, 22]. Refinements in gastrostomy creation and maintenance are needed.

There is a recent report of performing ERCP in the surgical suite through a surgical gastrostomy on the same day of gastrostomy operation [21]. We also performed early (range 0–1 day) ERCP via gastrostomy in the most recent three patients. They were all suspected SOD patients and managed successfully. One patient developed cellulitis after the procedure. Longer duration of initial antibiotic therapy as well as comparative trials of same day procedure vs. delayed procedure (after gastrostomy tract maturation) need to be evaluated.

There are several limitations in this study. This study is retrospective comparison of two procedures. The two groups of patients had partially different indications for ERCP. Given the relatively small number of procedures involved, and the probable selection bias in this retrospective review, the use of *p* values in this analysis maybe have little value. We cannot directly compare these two procedures in reference to success rate or complication rate, because the study populations per group were different. There are unique advantages and disadvantages to each procedure. The technique of choice to perform ERCP in patients who are post-RYGB is best dictated by indication for the procedure and local expertise. Other factors, such as need for multiple ERCP procedures, acuity, results of prior ERCP attempts, surgical risk, length of Roux limb, and patient's preference, also may play a role in choosing the optimal technique. Patients who may require repeated elective ERCP procedures are best served by placement of a gastrostomy [6]. Also, patients who need pancreatic treatment including minor papilla manipulation or who needed diagnostic intervention, such as manometry, are better treated by GERCP. In the case of successful access to the major papilla via double balloon enteroscope but unsuccessful cannulation or treatment, retrograde percutaneous endoscopic G-tube can be placed for the access to the major papilla after tract maturation.

In conclusion, GERCP is a more effective than DBERCP to gain access to the pancreatobiliary tree in

patients with RYGB but is hindered by the gastrostomy maturation delay and a higher morbidity. DBERCP had a reasonable success rate for managing biliary stone disease but does not adequately address SOD and pancreatic diseases. Development of side-viewing enteroscopes with appropriate accessories is awaited. Technical improvements for each method are needed.

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