Complications of laparoscopic transgastric ERCP in patients with Roux-en-Y gastric bypass

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Abstract

Background The altered anatomy of Roux-en-Y gastric bypass presents a challenge when duodenal access is required for ERCP. One technique, laparoscopic transgastric ERCP, was first described in 2002. Since that time, a total of 77 laparoscopic or percutaneous transgastric ERCPs have been reported. The largest case series includes 26 ERCPs, and no reports specifically address complications. We reviewed our experience with 85 transgastric ERCPs and report the limitations and complications associated with access and ERCP.

Methods Retrospective review was conducted of gastric bypass patients who underwent transgastric ERCP in our practice from 2004–2014.

Results Forty-one patients underwent 85 transgastric ERCPs during the study period. Conversion from laparoscopic to open procedure occurred in 4.8 %, and selective cannulation rate was 93 %. Forty-seven percent of cases were repeat ERCPs performed through a gastrostomy tube tract. During 15-month median follow-up, the overall complication rate was 19 %, with 88 % of complications related to access rather than ERCP. Most complications were minor; there were no deaths or cases of severe pancreatitis. Additional intervention, including repair of a posterior stomach laceration or transfusion for bleeding, occurred in 4.7 % of cases. Operative intervention occurred in two cases: repair of a duodenal perforation, and debridement of an abdominal wall abscess. Post-ERCP hyperamylasemia was common but did not result in increased length of stay or significant clinical pancreatitis.

Conclusions Roux-en-Y gastric bypass eliminates the normal approach to the duodenum for ERCP. Transgastric access has a high rate of successful cannulation but is associated with complications. Conversion to open procedure occurred in 4.8 %, and 16 % developed a complication related to the access site, though the rate of operative intervention was low (2.4 %). Our study is limited by its retrospective design, which may underestimate the complication rate, and by our homogenous patient population (94 % female, 68 % sphincter of Oddi dysfunction).

Keywords Bariatric · ERCP (Endoscopic retrograde cholangiopancreatography) · Complications · GI Endoscopy · Therapeutic Endoscopy

As more patients undergo Roux-en-Y gastric bypass (RYGB) for morbid obesity, the size of the population with altered anatomy continues to increase. Numerous authors have reported weight loss-induced biliary disease, including gallbladder sludge, cholelithiasis, choledocholithiasis, and gallstone pancreatitis. Treatment of these conditions, as well as ampullary or pancreatic pathology such as sphincter of Oddi dysfunction (SOD), pancreatic duct stricture, and/or chronic pancreatitis, can be effectively treated by endoscopic retrograde cholangiopancreatography (ERCP). The trans-oral route is technically difficult due to the long Roux limb and lack of specialized equipment on the front-viewing colonoscopes or balloon enteroscopes [1].

Alternatively, ERCP can be carried out through a gastrostomy stoma. First reported in a patient with radiation stricture of the proximal esophagus by Schapira in 1975

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[2], the technique was first applied to the altered anatomy of RYGB patients by Baron & Vickers in 1998 [3]; they created an open Stamm gastrostomy in the remnant stomach that was dilated 2 weeks later to allow passage of the duodenoscope. Subsequent modifications have included either laparoscopic-assisted access to the remnant stomach, as first described by Peters in 2002 [4], or percutaneous access, as first described by Martinez in 2006 [5].

A handful of case reports and series have been published [1, 6–16]; the total number of transgastric ERCPs reported is 77, and the largest series to date includes 26 cases [12]. None of these reports specifically addresses the complications of the procedure.

The purpose of this study was to review our experience with 85 transgastric ERCPs and to analyze the success rate and complications of both the initial laparoscopic and percutaneous creation of a gastrostomy for transgastric ERCP, as well as subsequent transgastric access for ERCP through a mature gastrostomy.

Materials and methods

Description of operative technique

Laparoscopic-assisted cases were performed as previously described by Bertin [17]. Briefly, access was established with infra-umbilical placement of a Veress needle and 5-mm camera port. Two 5-mm working ports were placed in the right upper quadrant and left mid-abdomen, which were used to identify the remnant stomach and lyse adhesions. Gastrotomy was performed and a 15-mm port was placed through the left upper quadrant into the remnant stomach, which was secured with a purse-string suture. The duodenoscope was passed through the 15-mm port into the duodenum, with ERCP and interventions performed as indicated. The gastrotomy was then either closed with laparoscopic sutures, or a gastrostomy tube (G-tube) was placed at the 15-mm port site for planned repeat access.

Percutaneous cases were performed in patients with a pre-existing G-tube, and all percutaneous cases were performed in the endoscopy suite. In 3 cases, initial percutaneous G-tubes were placed by interventional radiology (IR); ERCP was delayed 6 weeks during upsizing and maturation of the tract. In the remainder of percutaneous cases, a surgical G-tube was placed following an initial laparoscopic-assisted ERCP. To perform the percutaneous ERCP, the G-tube was removed, and the tract was dilated to 15 mm using either Savary dilators, a dilating laparoscopic trocar (15 mm Step-port), Hegar dilators alone, or a nephrostomy balloon dilation catheter with Hegar dilators. The tract and the remnant stomach were first examined with a pediatric gastroscope to ensure dilation did not result in injury or disruption of the tract, and the duodenoscope was then advanced into the duodenum, with ERCP and interventions performed as indicated. The gastrostomy was then either left open and allowed to close spontaneously, or an appropriate sized Mic-Key G-tube was placed for planned repeat access.

Data collection

We conducted a retrospective review of gastric bypass patients who underwent transgastric ERCP in our practice. Patients were identified by office scheduling records, followed by a review of office notes, operative reports, anesthesia records, operating room (OR) nursing notes, and hospital records, including the admission history and physical, consultant notes, discharge summaries, and laboratory data. Patient demographic data were compiled, including body mass index (BMI) at the time of procedure, comorbidities and ASA classification, previous abdominal procedures, indication for ERCP, presence of a pre-existing G-tube, placement of a G-tube at the conclusion of the procedure, administration of pre-operative antibiotics, and pre- and post-operative pain scores. Laboratory data included liver function tests (LFTs), amylase, and/or lipase in cases where these were obtained pre- and/or post-operatively.

Calculations

Length of procedure was calculated from the procedure start and end times documented in the OR nursing notes. For laparoscopic-assisted cases, this includes anesthesia time, laparoscopic access to the remnant stomach, ERCP, and either gastrotomy closure or G-tube placement. For percutaneous cases, it includes anesthesia time, dilation of the G-tube tract to allow passage of the duodenoscope, ERCP, and replacement of the G-tube.

Body mass index (BMI) was determined based on the recorded height and weight in closest proximity to the procedure.

Length of stay was calculated from the date of initial procedure to the date of discharge from the hospital, even in cases where the patient had been admitted pre-operatively.

Identification of complications

Complications were identified by review of operative reports, office notes, and hospital discharge summaries, with particular attention to additional unplanned procedures, prolonged hospital stay, bleeding, infection, and elevated LFTs or pancreatic enzymes.

Bleeding was considered significant if it resulted in transfusion.

Infection was defined by cellulitis or abscess that required antibiotics or surgical debridement.

In cases where serum *amylase and/or lipase* levels were available, they were considered significant for amylase greater than 276 units/L or lipase greater than 1000 units/L, as suggested by Gottlieb [18], or clinical symptoms of pancreatitis.

Statistical analysis

Direct comparisons between groups were performed utilizing a two-tailed unpaired Student's *t* test. Results were considered statistically significant if $p < 0.05$.

Results

Demographics and indications

Forty-one (41) patients underwent 85 transgastric ERCPs (mean 2.1, median 1, range 1–14) in our practice between October 2004 and January 2014. Median follow-up was 15 months (range 2 weeks–8 years). One patient was lost to follow-up.

Demographic and outcome data are summarized in Table 1. Ninety-four percent (94 %) were female. At the time of ERCP, mean age was 48.5 (range 23–69), mean BMI was 34.3 (range 22–48), and mean ASA was 2.8 (range 2–4). Comorbidities included obesity 34 %, diabetes mellitus 27 %, hypertension 20 %, vasculopathy (including peripheral vascular disease or thromboembolism) 18 %, coagulopathy 2.4 %, and renal failure 1.2 %. All patients had previously undergone RYGB; 52 % had undergone additional previous abdominal surgery, including cholecystectomy 27 %, transduodenal sphincteroplasty 19 %, transduodenal ampullectomy 2.4 %, and distal pancreatectomy 1.2 %.

Eighty (80) ERCPs were for chronic abdominal pain, including SOD, pancreatic duct stenosis, and/or chronic pancreatitis. Five (5) ERCPs were for presumed calculus biliary disease. Forty-four percent (44 %) of patients had a G-tube placed in the remnant stomach following ERCP to facilitate access during subsequent procedures, such as repeat transgastric ERCP or transgastric endoscopy with stent removal.

Post-procedure laboratory data were available for 76 % (65/85) of cases.

Initial ERCP—laparoscopic-assisted (38 patients)

Ninety percent (90 %) of laparoscopic-assisted cases were an initial ERCP. Selective cannulation rate was 95 % (36/38),

Table 1 Patient demographic and outcome data

	Initial lap[a]	Initial perc[b]	Repeat lap[c]	Repeat perc[d]
n	38	3	4	40
Age (years)	47.8	47.7	48.8	49.1
Female (%)	95	67	100	95
BMI (kg/m²)	33.9	33.4	29.5	35.1
ASA	2.7	2.3	2.3	2.9
Cannulation[e] (%)	95	67	100	95
Procedure time (min)	264.8	105.0	181.7	122.9
LOS (days)	4.2	2.0	1.5	0.7
Complications[f] (%)	13	67	25	20

n number of patients, *BMI* body mass index, *ASA* American Society of Anesthesiologists classification score, *LOS* length of hospital stay following procedure, *ERCP* endoscopic retrograde cholangiopancreatography

[a] Initial ERCP performed laparoscopic-assisted

[b] Initial ERCP performed percutaneously via dilation of a radiographically placed gastrostomy tube tract

[c] Repeat ERCP performed laparoscopic-assisted

[d] Repeat ERCP performed percutaneously via dilation of a surgically placed gastrostomy tube tract following laparoscopic-assisted initial ERCP

[e] Selective cannulation of biliary and/or pancreatic ducts

[f] Overall complication rate

average procedure time was 265 min, and overall complication rate was 13 % (5/38). Conversion from laparoscopic to open procedure occurred in 2.6 % (1/38) of cases, and was due to the inability to maneuver the duodenoscope through the pylorus; conversion to open facilitated successful ERCP. Average length of stay was 4.2 days (median 3 days).

Initial ERCP—percutaneous via radiologically-placed G-tube tract (3 patients)

Seven percent (7 %) of percutaneous cases were an initial ERCP. Selective cannulation rate was 67 % (2/3), average procedure time was 105 min, and overall complication rate was 67 % (2/3). Average length of stay was 2 days (median 2 days).

Repeat ERCP—laparoscopic-assisted (4 patients)

Ten percent (10 %) of laparoscopic-assisted cases were repeat ERCP. These were performed in cases where a G-tube had either not been placed during the initial ERCP or had been removed prior to the repeat ERCP. Selective cannulation rate was 100 % (4/4), average procedure time was 182 min, and overall complication rate was 25 % (1/4). Conversion from laparoscopic to open procedure occurred in 25 % (1/4) of cases and was due to the inability

to maneuver the duodenoscope through the pylorus; conversion to open facilitated successful ERCP. Average length of stay was 1.5 days (median 1 day).

Repeat ERCP—percutaneous via prior surgically-placed G-tube tract (40 cases)

Ninety-three percent (93 %) of percutaneous cases were a repeat ERCP performed by dilation of a G-tube tract that had been created during an initial laparoscopic-assisted ERCP. Selective cannulation rate was 93 % (37/40), average procedure time was 123 min, and overall complication rate was 20 % (8/40). Average length of stay was 0.7 days (median 0 days).

Access vs. ERCP

Access-related complications were noted in 16 % (14/85) of cases. There was 1 duodenal bulb perforation, which required operative intervention, caused by the tip of the guide wire during dilation of the existing gastrostomy site with Savary dilators. There were 3 injuries to the posterior gastric wall, creation of 1 false tract, and 1 episode of pneumoperitoneum during dilation of the G-tube site; of these, only one posterior stomach laceration required intervention and was repaired with endoscopic clips. There were 4 infections at the G-tube site, one of which required operative debridement, 1 G-tube site with persistent leakage of bile and skin breakdown, and 1 persistent gastrocutaneous fistula 9 months after G-tube removal. There was 1 abdominal wall hematoma, which did not require intervention, and 1 incidence of bleeding that resulted in transfusion.

Within the percutaneous group, 3 patients had a G-tube placed by IR prior to their initial ERCP. Both complications in this sub-group were related to dilation of the G-tube tract; one was pneumoperitoneum managed non-operatively, and the other was bleeding that resulted in transfusion.

ERCP-related complications were noted in 2.4 % (2/85) of cases. There were 2 duodenal perforations caused by precut sphincterotomy, both of which were managed non-operatively. Amylase and/or lipase were elevated beyond the threshold reported by Gottlieb [18] as being suggestive of post-ERCP pancreatitis following 25 % (16/65) of cases for which results were available; the rate was 18 % (6/34) for initial ERCP and 32 % (10/31) for repeat ERCP ($p = 0.2$). Elevation of pancreatic enzymes did not result in a statistically significant increase in length of stay when compared to patients with normal levels for either initial ERCP (7.7 vs. 3.7 days, $p = 0.1$) or repeat ERCP (0.6 vs. 1.0 days, $p = 0.7$).

Sphincter of Oddi dysfunction (SOD) clinical outcomes

Thirty-six (36) patients underwent ERCP for suspected SOD. An average of 2.2 ERCPs were performed per patient (range 1–14). Prior to the initial ERCP, laboratory values were elevated ≥ 1.1 times the upper limit of normal in 55.6 % (20/36) and common bile duct (CBD) was dilated ≥ 10 mm in 16.7 % (6/36) of patients. Quantitative HIDA scan was performed in 72.2 % (26/36) of patients and was positive in 23.1 % (6/26).

Of note, 44 % (16/36) of patients had history of marginal ulcer, 25 % (9/36) had history of internal hernia, and 8 % (3/36) had history of jejuno-jejunal intussusception that had been treated prior to the initial ERCP.

SOD manometry was performed at the initial ERCP in 88.9 % (32/36) of patients; it was successful in 93.8 % (30/32) and positive in 76.7 % (23/30).

Overall pain scores following the initial ERCP were significantly improved from an average of 8.6 on a 10-point scale to an average of 2.0 ($p < 2 \times 10^{-10}$). There was complete resolution of pain (score $= 0$) in 51.5 % (17/33) of patients for which post-operative scores were available, and pain decreased to less than 20 % of baseline in 78.8 % (26/33) of patients.

Six-month follow-up pain scores were available for 80.6 % (29/36) of patients; 69.4 % (25/36) of patients experienced recurrent pain (score ≥ 7), and 52.8 % (19/36) chose to undergo repeat ERCP.

Calculus biliary disease clinical outcomes

Five (5) patients underwent ERCP for presumed calculus biliary disease, and all 5 had pre-ERCP diagnoses of choledocholithiasis or gallstone pancreatitis. Four (4) patients had elevated LFTs and elevated pancreatic enzymes; of these, 2 had CBD dilation by either ultrasound or MRI. The fifth patient had normal laboratory values with CBD dilation by ultrasound. Selective cannulation rate was 100 %. One patient had successful removal of a 1.5 cm CBD stone; 2 patients were found to have biliary sludge; and 2 patients were found to have ampullary hypertrophy. In the first 3 patients, the gastrotomy was closed primarily. The final 2 patients underwent G-tube placement for planned transgastric endoscopic ultrasound (EUS) examination; ampullary biopsies were negative for dysplasia or malignancy. There were no complications in this subgroup.

Overall analysis

The selective cannulation rate overall was 93 %, with no significant differences between laparoscopic, percutaneous, initial ERCP, or repeat ERCP groups.

Overall *conversion* from laparoscopic to open procedure occurred in 4.8 % (2/42) of cases. Both conversions were

in patients with SOD and were due to inability to maneuver the duodenoscope through the pylorus.

The overall complication rate was 19 % (16/85), of which 88 % (14/16) were related to access. ERCP-related complications accounted for only 12 % (2/16) and did not require additional intervention. Access-related complications occurred in 15 % (6/41) of initial ERCPs and 18 % (8/44) of repeat ERCPs ($p = 0.7$).

While approximately 1/4 of patients developed hyperamylasemia and/or hyperlipasemia following ERCP, this did result in a significant increase in length of stay.

Additional intervention was required in 4 cases: laparotomy for repair of a duodenal perforation caused by Savary dilators during a percutaneous repeat ERCP; operative debridement of an abdominal wall abscess following a percutaneous repeat ERCP; a laceration of the posterior stomach wall during laparoscopic-assisted initial ERCP, which was repaired with endoscopic clips; and bleeding that required transfusion following a percutaneous initial ERCP.

Discussion

RYGB eliminates the normal approach to the duodenum for ERCP. While it is possible to reach the ampulla with double-balloon enteroscopy [19], the retrograde approach is limited by lack of an elevator and lack of well-designed catheters; the perforation rate may also be as high as 10 % [20]. Another option is percutaneous transhepatic cholangiography (PTC), which allows access to the biliary tree with the ability to perform some interventions; however, it is not possible to access the pancreatic duct through this approach.

Alternatively, both laparoscopic-assisted and percutaneous access to the remnant stomach allow passage of a standard duodenoscope, which allows visualization of the staple line to rule out marginal ulceration of the gastric pouch [21] and has a high rate of selective cannulation of the ampulla.

Transgastric ERCP in a RYGB patient was first reported by Baron & Vickers in 1998 [3], in which they performed an open Stamm gastrostomy followed 2 weeks later by percutaneous ERCP for evaluation and management of pancreatic disease. Interestingly, they utilized Savary dilators, which, similar to our experience, resulted in a retroperitoneal perforation. They also concluded that placement of a G-tube may be more important for pancreatic than for biliary disease. Martinez utilized G-tubes placed by IR in his series of 3 percutaneous transgastric ERCPs [5]; meanwhile, Dapri has reported placement of a radiopaque silicon marker disk onto the remnant stomach at the time of initial RYGB [22], which may assist IR in

locating the remnant stomach if percutaneous access is later required.

The laparoscopic-assisted approach was first described by Peters in 2002 [4], and even when laparoscopic cholecystectomy is being performed concurrently, some authors prefer transgastric ERCP rather than laparoscopic CBD exploration due to the risk of CBD stricture following choledochotomy [21–23].

In a series that included 23 laparoscopic and 3 planned open transgastric ERCPs [12], of which 65 % were done for pancreatic indications, Gutierrez reported a 4.3 % (1/23) rate of conversion from laparoscopic to open, 3.8 % (1/26) rate of surgical site infection, a mean operative time of 200 min, and a 7.7 % (2/26) rate of reoperation for G-tube complications. Interestingly, they also identified unsuspected internal hernias in 35 % (9/26) of patients.

In our series, the selective cannulation rate was 93 %, with a 4.8 % rate of conversion from laparoscopic to open, and an overall complication rate of 19 %. Access-related issues accounted for the majority of complications, and operative intervention was required in only 2.4 % of cases (2/85). Our rate of selective cannulation is consistent with previous reports, ranging 66–100 % [5, 12, 23], as is our average length of stay of 3.9 days (range 2–4 days [1, 9, 21–23]) for laparoscopic access. We did not identify any previously reported data for length of stay following percutaneous access.

For initial ERCP through the percutaneous approach utilizing IR-placed G-tube tracts, there appeared to be a higher rate of complications; however, only 3 such cases have been previously reported in the literature [5], and in our series, we report an additional 3 cases. We suspect that any apparent difference in complication rate is due to the low number of cases available for analysis. We hypothesize that the use of T-fasteners during initial G-tube placement by IR may help to secure the remnant stomach to the anterior abdominal wall and reduce the incidence of pneumoperitoneum during transgastric endoscopy. There may also be a learning curve involved, in which case we expect the complication rate to decrease as more cases are performed.

The perceived disadvantages of the laparoscopic approach are the potential for port-site hernias and wound infections [9]. In our series, all of the infections were located at the G-tube site, and we found no significant difference in the infection rate between laparoscopic and percutaneous approaches. Port-site hernia following laparoscopic transgastric ERCP has not been previously reported, and we did not identify any hernias related to laparoscopic access in our patients.

Our study is limited by its retrospective design, which may underestimate the complication rate, and by our homogenous patient population (94 % female and 88 %

chronic abdominal pain). It is uncertain whether these results would generalize to male patients and/or calculus biliary disease.

The majority of complications were access related and most were minor. The percutaneous approach requires either use of a 24 French pediatric duodenoscope, as described by Martinez [5], or dilation of an existing gastrostomy to facilitate passage of a standard 35 French duodenoscope. In our center, pediatric duodenoscopes are not available, and dilation is therefore required. Refinements in dilation technique may reduce the rate of complications. In our practice, we transitioned away from Savary dilators following a duodenal perforation early in our series; we now utilize a combination of Hegar dilators, dilating laparoscopic trocars, and urologic radial-dilating balloons. We currently utilize the Hegar dilators until resistance is met, and then we place a 10-mm dilating balloon alongside the 8-mm or 10-mm Hegar dilator to complete the dilation with more radial force. Our hope is that this will reduce the incidence of perforation and bleeding. Additional studies are needed to further evaluate the safety of these techniques.

Conclusion

Both the laparoscopic-assisted and percutaneous approaches are effective at providing access to the ampulla with high rates of selective cannulation. Laparoscopic-assisted cases had a 4.8 % rate of conversion to open procedure.

We prefer the laparoscopic approach for the initial transgastric ERCP. When performed for biliary indications, this has the advantage of immediate access to the ampulla without waiting for a G-tube tract to mature; in cases of chronic abdominal pain from suspected SOD or chronic pancreatitis, it allows a survey of the abdomen to eliminate other potential causes of pain such as adhesions or internal hernias. And if one-time access is required (e.g., choledocholithiasis), the laparoscopic approach allows for closure of the gastrotomy at the conclusion of the case, which can eliminate potential G-tube complications.

We have only used the radiologic percutaneous approach in 3 cases. The advantage is that it avoids an operative procedure and reduces procedure time. The disadvantage is that it delays ERCP for 6 weeks until the tract matures. It also eliminates the ability to explore for other intra-abdominal problems such as adhesions or internal hernias. Either approach is relatively safe and may be indicated depending on the comfort of the surgeon/endoscopist and the patient's clinical presentation. If the IR approach is used, we recommend the use of T-fasteners in four quadrants; this may reduce the risk of separation of the remnant stomach from the anterior abdominal wall from the shearing force during

dilation. Alternately, if a pediatric duodenoscope is available, a large-caliber G-tube could be placed to allow passage of the scope with minimal or no dilation of the tract.

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