

Endoscopic Retrograde Cholangiopancreatography in Patients with Roux-en-Y Anatomy

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KEYWORDS

• Bariatric • Duodenoscope • Cannulation • Roux-en-Y anatomy

Bariatric surgery has been increasingly performed in response to the obesity pandemic. During the last decade, Roux-en-Y gastric bypass (RYGB) has become the preferred surgical approach, presently accounting for more than two-thirds of about 150,000 such procedures performed annually in the United States.¹ In addition, Roux-en-Y reconstruction is also commonly performed after pylorus-preserving pancreaticoduodenectomy and other biliary tract surgeries. Consequently, endoscopists are now often faced with the need to carry out endoscopic examinations and therapeutic interventions in patients with Roux-en-Y anatomy.

Roux-en-Y anatomy poses a serious challenge to endoscopists when access to the biliary tree or the pancreas is required. In patients with this anatomy, an endoscope advanced through the anatomic route needs first to reach the jejunojejunostomy, and subsequently make its way up the biliopancreatic limb until the papilla or the bilioenteric (BE)/pancreatoenteric (PE) anastomosis is reached. The distance from the jejunojejunostomy to the papilla varies greatly depending on the indication for the Roux-en-Y reconstruction. It is typically the maximum after bariatric surgery, frequently exceeding 80 to 100 cm. The distance of the bowel to be traversed certainly affects the success rate of the endoscopic retrograde cholangiopancreatography (ERCP), which is performed by advancing an endoscope through the anatomic route.

This article discusses the different options available for endoscopists who are faced with the need to perform ERCP in patients post-Roux-en-Y reconstruction, with special emphasis on those patients post-RYGB.

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ADVANCEMENT OF DUODENOSCOPES THROUGH THE ANATOMIC ROUTE

The side-viewing duodenoscope is the ideal instrument to perform ERCP, particularly for the cannulation of a native papilla. Nevertheless, advancement of the duodenoscope through the anatomic route is frequently unsuccessful in patients with Roux-en-Y anatomy. For example, Hintze and colleagues² reported a 33% success rate for reaching the papilla with a duodenoscope in patients with short-limb Roux-en-Y anatomy (none post-RYGB). Wright and colleagues³ reported the largest series of patients with Roux-en-Y anatomy and intact papilla who underwent ERCP after advancement of colonoscopes or duodenoscopes through the per os anatomic route. Their approach consisted of an initial exploration of the afferent limb with a forward-viewing colonoscope and an attempted cannulation. If cannulation was not achieved via the colonoscope, a guidewire was placed into the excluded stomach or duodenum to guide the advancement of a duodenoscope, which was inserted over the guidewire under fluoroscopic guidance. On some occasions, an over-the-wire balloon dilator was used to anchor the guidewire to the afferent limb, facilitating the advancement of the duodenoscope. The investigators used techniques similar to those used during colonoscopy to facilitate advancement of the duodenoscope, including alternating advancement and withdrawal with straightening of loops, turning the patient to the left lateral or supine position, and compression of the abdomen. Fifteen patients underwent attempted ERCP using these techniques (11 post-RYGB, 4 postgastric resection). ERCP was possible in 10 patients (67%), some of whom had repeated procedures. Use of the colonoscope was successful in 2 patients (13%), and use of the duodenoscope was successful in 8 patients (53%). Interventions performed included sphincter of Oddi manometry, biliary sphincterotomy, stone extraction, and placement of pancreatic and biliary stents. ERCP was not possible in 5 patients (33%), all of whom had undergone RYGB. All 5 patients in whom the initial attempt to reach the papilla failed underwent a second attempt (1 patient underwent a third attempt), all without success. In contrast, repeated attempts were always successful in those patients in whom the insertion of the endoscope was successful at the first attempt. The large number of failed procedures, even in very experienced hands, underscores the challenges of performing ERCP through the anatomic route in patients with Roux-en-Y anatomy.

ADVANCEMENT OF ENTEROSCOPES OR COLONOSCOPES THROUGH THE PER OS ANATOMIC ROUTE

The use of a pediatric colonoscope (without surgical assistance) to perform ERCP in patients with Roux-en-Y anatomy was first reported by Gostout and Bender⁴ in 1989. Roux-en-Y anatomy was a consequence of gastrectomy for peptic ulcer disease in 2 patients and hepaticojejunostomy for biliary-cutaneous fistula in 1 patient. No patient had undergone bariatric surgery. Two patients had a history of BE anastomosis (hepaticojejunostomy and choledochoduodenostomy), whereas 1 patient had a native papilla. ERCP was successfully performed in all patients, although percutaneous transhepatic cholangiography was initially necessary to guide cannulation in the patient who had a choledochoduodenostomy.

Elton and colleagues⁵ reported their experience with 18 patients with Roux-en-Y anatomy who underwent 25 attempts of ERCP. Of those, 3 patients had undergone RYGB (length of the bypassed segment unknown). Successful insertion to the level of the papilla or PE/BE anastomosis was possible in 86% of patients with an enteroscope and in 82% with a pediatric colonoscope. Biliary cannulation was successful in 4 of 5 patients with native papilla, and pancreatic cannulation was successful in 50%

of the patients. In experienced hands, pediatric colonoscopes and enteroscopes can be successfully used to perform ERCP in patients with a short Roux limb and in those with BE/PE anastomosis. However, only selected reports are available describing cannulation of an intact papilla in patients post-RYGB.^{5,6} To the authors' knowledge, there is no prospective analysis of the success rate of ERCP performed with a colonoscope or enteroscope in patients post-RYGB.

ERCP WITH DOUBLE- OR SINGLE-BALLOON ENTEROSCOPES

As double-balloon enteroscopy (DBE) and single-balloon enteroscopy (SBE) have become more widely available, an increasing number of reports have emerged describing their use for performing ERCP in patients with Roux-en-Y anatomy. Balloon-assisted enteroscopy offers the advantage of reducing loops of small bowel over the endoscope, facilitating progression through the anatomic route in patients post-Roux-en-Y reconstruction. In fact, centers with experience in DBE have reported a success rate greater than 90% for reaching the biliopancreatic limb in patients with Roux-en-Y anatomy and a combined 80% success rate for ERCP.⁷⁻¹⁶ In a recent series of 13 patients, Neumann and colleagues¹⁷ reported a success rate of 61% for reaching the biliopancreatic limb with SBE and 46% for performing ERCP.

Although the high success rates with DBE are encouraging, most of the experience with the technique involved patients with hepaticojejunostomy. Similar to enteroscopes and colonoscopes, forward-viewing DBE is not ideal for the cannulation of a native papilla. Furthermore, it is unclear if DBE performs as well in patients with longer Roux limbs (eg, post-RYGB). The lack of therapeutic instruments long enough for use with the DBE is also a major limitation.⁹

ERCP THROUGH GASTROSTOMY OR JEJUNOSTOMY TRACTS

In 1998, Baron and Vickers¹⁸ reported the first case of surgical gastrostomy placement as a means of access for diagnostic and therapeutic ERCP in a patient post-RYGB experiencing recurrent pancreatitis. After a failed attempt at ERCP with an enteroscope (papilla could not be reached), the investigators obtained access to the excluded stomach via a surgical gastrostomy. Initially, open Stamm gastrostomy of the distal stomach was performed with the placement of a 24F Malecot tube. The gastrostomy tube was removed 2 weeks later, and a 7.9-mm diameter pediatric forward-viewing endoscope was inserted through the gastrostomy site into the distal stomach and the duodenum. Dilation was performed with Savary dilators over a wire to 38F. Immediately after dilatation, ERCP was performed with a diagnostic duodenoscope. Biliary and pancreatic cannulation as well as biliary and pancreatic manometry were performed. Biliary and pancreatic sphincterotomy were performed to treat sphincter of Oddi dysfunction (SOD).

After that initial report, other investigators have described their experience with the technique in patients with Roux-en-Y anatomy.¹⁹⁻²² Matlock and colleagues¹⁹ have reported 14 patients who underwent ERCP through gastrostomy tracts. In 13 patients, ERCP was performed intraoperatively with a sterile duodenoscope, immediately after surgical placement of the gastrostomy; Of 14 gastrostomies, 10 were placed laparoscopically. Success rates for attempted ERCP was 100% for biliary cannulation (25/25), biliary manometry (10/10), biliary sphincterotomy (14/14), pancreatic duct cannulation (19/19), pancreatic sphincterotomy (15/15), a minor papilla cannulation and papillotomy (1).

Although gastrostomy offers reliable access with a side-viewing duodenoscope, this technique is more invasive than other purely endoscopic approaches and is

associated with risks related to anesthesia and surgery. Feeding tubes left in place offer the option of access when the need for repeated procedures is anticipated. Nevertheless, the presence of feeding tubes may also raise issues related to body image and discomfort associated with activities of daily living.²³ For this reason, gastrostomy tubes should be removed after ERCP as soon as feasible. Unless ERCP is performed intraoperatively, it may be impractical to wait for the gastrostomy tract to mature (such as in a patient with cholangitis).

LAPAROSCOPIC-ASSISTED ERCP

Laparoscopic creation of a point of access to the gastric remnant or the small bowel allows for a duodenoscope to reach the papilla (or BE/PE anastomosis) when ERCP is indicated in patients with Roux-en-Y anatomy. Once such access to the excluded stomach or to the small bowel is established, the endoscopist inserts a previously sterilized duodenoscope through a 15-mm trocar and observes as it exits into the peritoneum. The surgeon and the endoscopist work collaboratively to guide the endoscope into the excluded stomach (or biliopancreatic limb) (**Figs. 1** and **2**). The endoscope is then advanced through the pylorus and positioned in the second duodenum, similar to a standard ERCP. Endoscopy technicians assist the endoscopist during the procedure, working independently from the operating room staff (**Figs. 3** and **4**). Although laparoscopic-assisted ERCP (LAERCP) is not yet widely performed, the reported experience with this technique is steadily growing. Reports of 20 patients who have undergone successful LAERCP are available in the literature (attempted in 21, technical success of 95%).^{24–31} The failed procedure was because of stone impaction in the ampulla, which prevented cannulation.²⁷ Therapeutic interventions, such as biliary sphincterotomy ($n = 20$),^{24–31} stone extraction ($n = 7$),^{26,27,29–31} sphincter of Oddi manometry ($n = 2$),⁹ and endoscopic closure of a gastrogastic fistula ($n = 1$), are typically performed after laparoscopic-assisted access.³¹ No complications have been reported.

The authors have submitted their experience with 10 patients who underwent LAERCP at the University of Alabama at Birmingham.³² Of these, 9 patients had undergone RYGB, whereas 1 had a history of partial gastrectomy with Roux-en-Y reconstruction. Indications for LAERCP were (1) choledocholithiasis ($n = 4$, 40%), (2) suspected biliary stricture ($n = 3$, 30%) and (3) suspected SOD type 1 ($n = 3$,

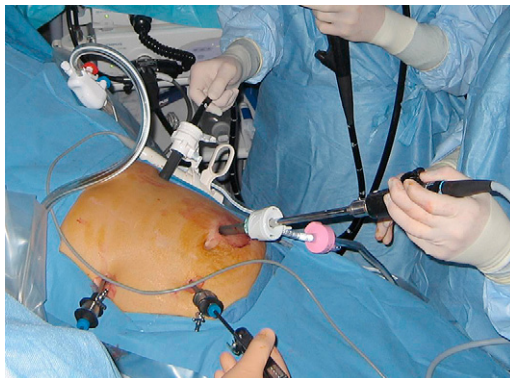


Fig. 1. Operation field during laparoscopic-assisted ERCP. The endoscope is introduced through a 15-mm laparoscopic trocar into the excluded stomach or the small bowel.



Fig. 2. The endoscopist and the surgical team work collaboratively to position the duodenoscope and to carry out the procedure.

30%). Biliary cannulation was successfully performed in 9 of 10 patients (90%); pancreatic cannulation in 3 of 3 patients (100%). All patients underwent biliary sphincterotomy, but pancreatic sphincterotomy was not performed. Two patients underwent sphincter of Oddi manometry, and in 1 patient a 3F pancreatic stent was placed prophylactically (chosen because these almost invariably pass spontaneously). During the laparoscopic examination, internal hernias were diagnosed and treated in 4 patients. An additional patient was treated surgically for symptomatic adhesions. A patient with a previously placed percutaneous transhepatic cholangiography catheter still in place developed a tension pneumothorax during the procedure, as gas tracked along the catheter into the right pleural space. Fortunately, this was promptly recognized, and the patient immediately responded to the placement of a small-bore chest tube, allowing the procedure to be completed successfully.

Although LAERCP is reliably successful, the approach is associated with the inherent risks of anesthesia and surgery. Compared with the purely endoscopic approaches and gastrotomy access (particularly when tube is placed percutaneously), LAERCP offers the benefits of laparoscopic examination of the abdominal cavity and of the ability to diagnose and treat internal hernias. This is an important



Fig. 3. Endoscopy technician assists the endoscopist during laparoscopic-assisted ERCP.



Fig. 4. Endoscopy technicians prepare for sphincter of Oddi manometry.

complication, in view of the high incidence of internal hernias (ranging from 0.2%–9%) in patients post-RYGB.^{33,34} When the need for repeated access is anticipated, placement of a gastrostomy tube should be strongly considered.

CHOOSING THE BEST APPROACH

To determine the best technique to perform ERCP in a patient with Roux-en-Y anatomy, an endoscopist must

1. Understand the anatomy of the patient (long vs short Roux limb, native papilla vs BE/PE anastomosis).
2. Consider the indication for ERCP (likelihood of repeat procedures, need for manometry, need for needle-knife sphincterotomy, possibility of internal hernia).
3. Assess surgical risk.
4. Employ local expertise (DBE/SBE/Spirus, interventional radiologists, surgeons).

Table 1 summarizes the characteristics of the different approaches for ERCP in patients with Roux-en-Y anatomy. In patients with native papilla, techniques that rely on forward-viewing endoscopes are suboptimal. If a short roux limb is anticipated, advancement of a duodenoscope through the anatomic route can be attempted, although this approach is laborious and frequently unsuccessful. LAERCP and gastrostomy access are the authors' preferred approaches in patients fit for surgery, particularly in those with long Roux limbs (such as post-RYGB). If internal hernias are suspected, LAERCP has a distinct advantage; if repeated access is a possibility, gastrostomy tube access is ideal. In poor surgical candidates, percutaneously placed gastrostomy tubes or percutaneous interventions by a skilled radiologist may be the best option.

Forward-viewing endoscopes are often successful when ERCP is to be performed in a patient who has undergone BE/PE anastomosis. Although enteroscopes and colonoscopes can be used in patients with short Roux limbs,^{4,5} according to the authors' experience, they are unlikely to be successful in patients with long Roux limbs. Similarly, SBE seems to have lower success rates in patients post-RYGB.¹⁷ DBE, if available, is a reasonable approach for ERCP in patients with a long Roux limb, particularly in those with BE/PE anastomosis. When SBE/DBE is considered, the endoscopist must anticipate the need for therapeutic instruments, which are of limited availability for these endoscopes.

Table 1			
Comparison of the different approaches for ERCP in patients with Roux-en-Y anatomy			
Technique	Advantages	Disadvantages	Best Application
Duodenoscope through anatomic route	Side-viewing endoscope facilitates cannulation and therapy of native papillas Minimally invasive	Time consuming Often unsuccessful	Patients with native papilla and short Roux limb
Colonoscope/enteroscope through anatomic route	Minimally invasive	Time consuming Often unsuccessful in long Roux limb	BE/PE anastomosis and short Roux limb
Single/double-balloon enteroscopes	Minimally invasive High success rates	Forward viewing Limited availability of instruments	BE/PE (short/long Roux limb)
ERCP through gastrostomy/jejunostomy	Access with side-viewing duodenoscope Allows for repeat procedures	More invasive than purely endoscopic approaches	RYGB with native papilla, when internal hernias not likely or when repeat procedures anticipated
LAERCP	Access with side-viewing duodenoscope Laparoscopy can diagnose and treat internal hernias	More invasive than purely endoscopic approaches	RYGB, particularly when internal hernia is in the differential diagnosis
Interventional radiology	Less invasive than surgical approaches	Morbidity (pain, external drains) No access to pancreas	Patients with biliary pathology, unfit to undergo surgery

As the number of RYGB procedures continues to increase in the United States and worldwide, endoscopists will increasingly face the need to perform ERCP in patients with Roux-en-Y anatomy. Several techniques are available to assist endoscopists in conquering this challenging task. Nevertheless, no single approach will fit the needs of all patients. By understanding the surgical anatomy, carefully planning all steps of the procedure, assessing the patient's surgical risk, and making use of local expertise, endoscopists will greatly increase their chance of success and will certainly improve the quality of care delivered to their patients with surgically altered anatomy.

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