Chapter 17
ERCP in Surgically Altered Anatomy

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Abbreviations

CT	Computer tomography
ERCP	Endoscopic retrograde cholangiopancreatography
EUS	Endoscopic ultrasound
MRCP	Magnetic resonance cholangiopancreatography
PDAC	Pancreatic ductal adenocarcinoma

Case Presentations

Case 1

An 80-year-old woman with a history of Roux-en-Y gastric bypass 20 years ago and a history of cholecystectomy 15 years ago presents with generalized weakness, chills, and altered mental status. Her white cell count is 13,000 μL, and bilirubin

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is 4.2 mg/dL. Patient is found to have Gram-negative bacteremia. Work-up for source of infection is negative. A right upper quadrant ultrasound shows a dilated common bile duct with a 5-mm hyperechoic density associated with shadowing, within the common bile duct. What is the next step?

Case 2

A 52-year-old male with a history of resectable pancreatic ductal adenocarcinoma (PDAC) in the head of the pancreas that was detected 2 years ago. Soon after, he underwent an R0 classic pancreaticoduodenectomy. Subsequently, adjuvant chemotherapy and radiation were administered. He has done well since then. He now presents with elevated liver function tests, right upper quadrant pain, and fever. Gram-negative bacteremia was noted on blood culture. A computer tomography (CT) scan of the abdomen showed dilated biliary tree. What is the most likely cause for these abnormal findings?

Case 3

A 60-year-old male with history of Roux-en-Y gastric bypass approximately 20 years ago presents with right upper quadrant pain, nausea, emesis, and elevated liver function tests. He currently takes amlodipine for primary hypertension. He is otherwise healthy. A right upper quadrant ultrasound was performed in the emergency department. This showed evidence of cholelithiasis, with gallbladder wall thickening and a small amount of pericholecystic fluid. The common bile duct was dilated to 12 mm. The distal common bile duct and pancreas were obscured by bowel gas. What is the best management option?

Case 4

A 60-year-old male with a history of partial gastrectomy now presents with jaundice, fevers, chills, nausea, and vomiting. An

MRI/MRCP was performed and showed a 2 cm stone within the common bile duct. What is the choice of endoscope in this patient with altered surgical anatomy?

Case 5

An 85-year-old female with history of hypertension, hyperlipidemia, and Roux-en-Y hepaticojejunostomy about 35 years ago presents with isolated elevation in alkaline phosphatase (440 μL). She lives alone and her ECOG performance grade is 0. An MRI/MRCP shows an isolated left intrahepatic duct stricture. What is the next step?

Introduction

ERCP was first described in 1965 mainly as a diagnostic procedure [1], and in the following years, cannulation technique was described in 60 patients with a successful cannulation occurring in 73% of patients [2]. Over the ensuing decades, the development in dedicated duodenoscopes along with new therapeutic accessories has transformed ERCP into an effective procedure for the management of pancreaticobiliary diseases. The role of ERCP has evolved mainly into a therapeutic role with the advent of newer and safer alternative imaging techniques such as magnetic resonance cholangiopancreatography (MRCP) and endoscopic ultrasound (EUS) [3, 4].

Surgical procedures on the biliary tract have decreased over the past decades [3]; however, there has been an increase volume of non-biliary gastrointestinal surgery [5, 6]. This can result in alteration of the luminal or biliopancreatic anatomy which presents unique challenges to the endoscopist. There are no specialized endoscopes to access the biliary or pancreatic ducts in this subgroup of patients. Endoscopists are therefore compelled to achieve biliopancreatic access with endoscopes that are generally used for luminal endoscopy. Technical challenges include identification and intubation of the biliopancreatic limb, reaching and visualizing the papilla

or pancreaticobiliary-enteric anastomosis, limited dedicated accessories, and cannulation without the help of an endoscope equipped with an elevator [7, 8].

The aim of this article is to review the common alterations in surgical anatomy and challenges and possible solutions to accomplishing a successful ERCP in patients with either altered luminal or pancreaticobiliary anatomy. Limited data exist to support the endoscopist to make clinical decisions regarding management of these patients. The approach to patients with altered anatomy may vary widely depending on local expertise. This article reviews commonly used techniques and tools when performing an altered anatomy ERCP and provides evidence-based approach, where available.

Procedure Planning

Types of Altered Surgical Anatomy

A thorough understanding of the type of surgery and nomenclature is critical to a successful altered anatomy ERCP. Review of operative reports, when available, is helpful in estimating length of the surgically altered limbs, and this can help in the right choice of endoscope and accessories while preparing for an altered anatomy ERCP. Also, knowledge of the extent of anatomic resection, length of surgically created bowel, type of reconstruction, and type of anastomosis can help in the planning of these procedures. In addition, extensive firsthand review of gastrointestinal imaging may help provide greater insight into potential difficulties and pitfalls that may be encountered during the procedure. The radiological reports may not fully convey the extent of information needed by the endoscopist, and therefore review of the actual images is highly recommended. The images can provide insight into other potential causes of cholangitis that can sometimes be easily missed on endoscopy such as chronic afferent loop syndrome. Further, it can provide an understanding of the possible postsurgical anatomy when limited information is available from the patient and medical records. If this is a repeat ERCP,

previous fluoroscopic images may be reviewed while paying special attention to the small bowel anatomy and/or the orientation of the scope when in optimal position for ERCP.

The presence of altered surgical anatomy may rarely be discovered only after an endoscope is passed into the stomach. This can occur in patients who are new to the health system, have scant outside hospital records, and/or are poor historians. In such situations, when possible, it may be prudent to reschedule a non-emergent procedure with a longer length of block time to help appropriately plan and accomplish a successful ERCP. In centers with high volume of altered anatomy procedures who have well-labeled accessories set aside for this purpose, the procedure can be successfully performed in the allotted time, especially when the altered surgical anatomy is favorable (e.g., Whipple's procedure).

Standard ERCP Techniques in Altered Surgical Anatomy

Patients with prior esophagectomy with gastric pull-through, vertical band gastroplasty, laparoscopic adjustable gastric band placement, choledochoduodenostomy, sleeve gastrectomy, Billroth I surgery, and central pancreatectomy (when evaluating the bile duct or pancreatic duct in the head of the pancreas) can undergo ERCP with a conventional duodenoscope and accessories. The duodenoscope in Billroth I and in choledochoduodenostomy can be unstable without the possibility of gaining a short "hockey stick" position. To gain stability and access, it may be necessary to advance the scope in and maintain an inward tension and/or rotation of physician's axis of the body. Despite the problems with scope stability, most therapeutic interventions can be accomplished with conventional ERCP techniques.

Nonstandard ERCP Techniques in Altered Surgical Anatomy

Billroth II reconstruction, Roux-en-Y gastrojejunostomy, Whipple's procedure, and Roux-en-Y gastric bypass are the

commonest types of altered surgical anatomy encountered that require nonstandard ERCP techniques. The most important part of the preparation for the procedure is the choice of endoscope. This further determines the types of accessories and the stents that can be used.

First successful antrectomy was performed in 1881 by Theodor Billroth in a patient with gastric cancer [9]. Partial gastrectomy became the standard surgery for gastric ulcer since its first publication in 1910 [10]. Partial gastrectomy is commonly performed today for malignant and rarely for benign disease. Surgical therapy is uncommon for gastric ulcers in today's post-proton pump inhibitor era. After an antrectomy, there are three common ways to restore continuity into the small bowel: Billroth I, Billroth II, and Roux-en-Y reconstructions. Billroth I surgical reconstruction involves the primary anastomosis of the resected edges of the stomach and duodenum in an end-to-end fashion. As stated above, in patients with Billroth I surgical anatomy, ERCP can be accomplished using standard tools and techniques.

Billroth II is generally performed when Billroth I cannot be performed such as in a more extensive gastrectomy. The duodenal stump is closed, and loop of jejunum is pulled up to the gastric resection site, and this is reconstructed in an end-to-side fashion. Hence, jejunal continuity is restored in this surgical technique but not the duodenal continuity. Construction of a Roux-en-Y diverts pancreaticobiliary drainage away from the stomach. In this technique, proximal jejunal limb is transected, and an end-to-side gastrojejunostomy is performed. The biliopancreatic limb is then anastomosed to the jejunum at an optimal length of about 40 cm from gastrojejunostomy. This is generally performed to overcome the problem of biliary reflux that can be seen in patients with Billroth II. A Braun's enteroenterostomy may sometimes be performed in patients with Billroth II anatomy to decompress the afferent limb and decrease alkaline reflux into the stomach.

A Whipple's procedure is performed to resect neoplastic lesions in the head of the pancreas, for chronic pancreatitis, or for duodenal lesions/injuries. This involves pancreaticoduodenectomy with partial resection of the stomach. The jejunal limb is then mobilized, and reconstruction of an end-to-side anastomotic gastrojejunostomy is performed. The proximal limb of jejunum is anastomosed with the hepatic duct and the remaining pancreatic duct. This limb is the afferent limb or the biliopancreatic limb. Several variations of this classic Whipple's procedure have been developed. These include pylorus-preserving surgery, pancreaticogastrostomy, and minimally invasive surgery, among others. Any of these variations can be encountered during your procedure, and this mainly depends on local expertise.

Roux-en-Y gastric bypass was first described in 1994 and is currently the second most common bariatric surgery performed in the United States. A 30-mL gastric pouch is created in the proximal stomach, and this is anastomosed with a jejunal limb, known as the Roux limb. The Roux limb can measure between 75 cm and 150 cm in length and connects to a biliopancreatic limb distally to form the common channel. The common alterations in surgical anatomy and their terminology are reviewed in Fig. 17.1.

Choice of Endoscope

The choice of endoscope is based on the anticipated length of the limbs and the difficulty in traversing them. In Billroth II anatomy, the ampulla can be reached with an upper endoscope, a pediatric colonoscope, an adult colonoscope, or a conventional duodenoscope. Similarly, in a patient with Whipple's procedure anatomy, biliary and pancreatic access can be gained with any of the above scopes. Occasionally, a double-balloon enteroscope (DBE) or a single-balloon enteroscope (SBE) may be required, especially in patient with adhesions or with

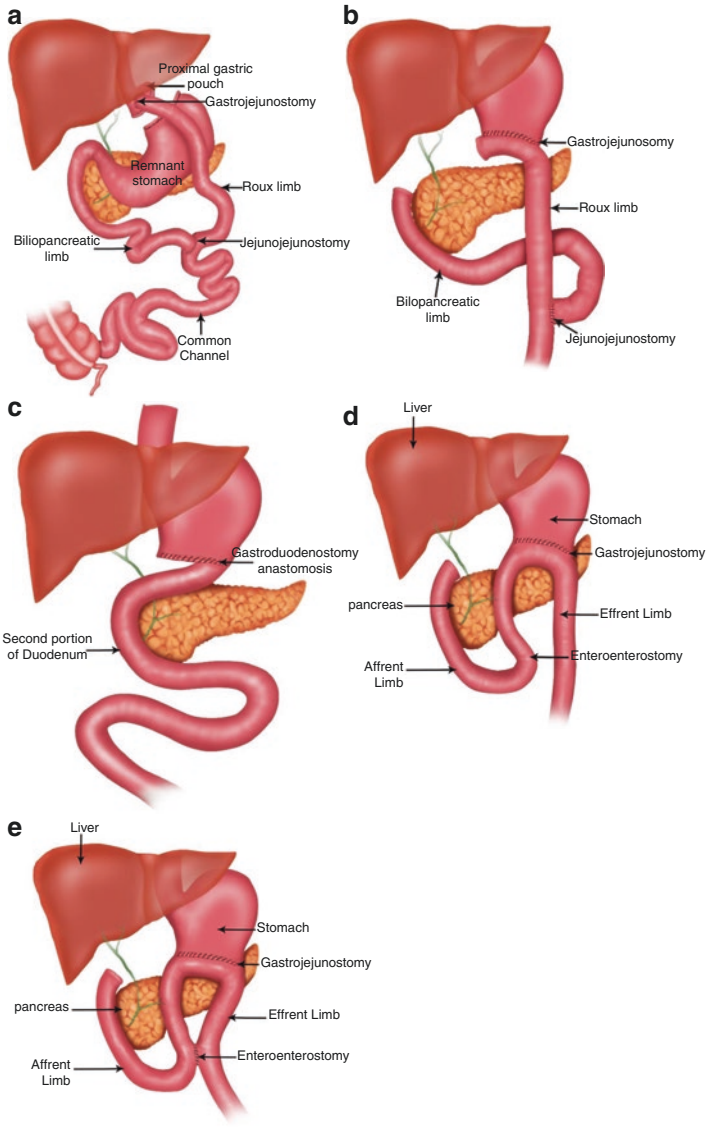

FIGURE 17.1 Types of altered surgical anatomy. (**a**) Roux-en-Y gastric bypass. (**b**) Roux-en-Y gastrojejunostomy. (**c**) Billroth I. (**d**) Billroth II. (**e**) Billroth II with Braun's enteroenterostomy

longer than usual afferent limb. The choice of scopes is also influenced by the local expertise and experience. For example, some centers routinely use a therapeutic upper endoscope for ERCP in both post Whipple's and Billroth II anatomy.

In patients with a Roux-en-Y gastrojejunostomy, access to the ampulla can be gained using a pediatric or an adult colonoscope. In case of Roux-en-Y gastric bypass, the Roux limb is generally about 100 cm, and therefore an SBE or DBE is required to access the papilla. Occasionally, a colonoscope may be adequate to reach the papilla in some patients. Table 17.1 describes the working channel diameter of each endoscope and their merits and limitations. It is ideal to start with the shortest scope with the largest caliber working channel. Please refer to Table 17.1 for details of available endoscopes and their specifications.

Support Staff

The availability of well-trained support staff is imperative for a successful procedure. This is even more important in altered anatomy ERCP. As part of planning, one should confirm that the available staff are trained in altered anatomy ERCP and are familiar with the tools.

Procedure

The skill set for an altered anatomy ERCP procedure is different from that of a conventional ERCP. While the conventional ERCP has one major rate-limiting step, i.e., cannulation, the altered anatomy ERCP has multiple major rate-limiting steps. The correct identification of the afferent limb, successful advancement of the endoscope to the papilla, cannulation without help from an elevator channel, sphincterotomy without dedicated conventional accessories, and stent placement without the conventional ability to push the stent across a tight stricture are all potential bottlenecks preventing successful completion of the procedure.

Table 17.1 Scopes used in altered surgical anatomy ERCP

Endoscope	Working channel length (cm)	Accessory channel diameter (mm)	Altered surgical anatomy	Biliary and pancreatic drainage	Maximum caliber of stent	Strengths	Weaknesses
Therapeutic duodenoscope	124	4.2	Esophagectomy	Native papilla	All stents	Elevator	Possible higher risk of perforation in the small bowel
			Vertical band gastroplasty	Native papilla	Standard ERCP accessories	Side-viewing endoscope	
			Laparoscopic adjustable gastric band placement	Native papilla			
			Choledochoduodenostomy	Native papilla			
			Sleeve gastrectomy	Native papilla			
			Billroth I	Native papilla			
			Billroth II	Native papilla			
			Whipple's procedure	Separate hepaticojejunostomy and pancreaticojejunostomy			
			Central pancreatectomy	Native papilla			

Therapeutic gastroscope	103	3.7	Billroth II	Native papilla	All stents (care should be taken to keep flaps down when advancing stent into the accessory channel)	Can accommodate most standard ERCP accessories	Forward-viewing endoscope
			Whipple's procedure	Separate hepaticojejunostomy and pancreaticojejunostomy		Can place 10 Fr stents	No elevator
Adult colonoscope	168	3.7	Billroth II	Native papilla	All stents (care should be taken to keep flaps down when advancing stent into the accessory channel	Can accommodate most standard ERCP accessories	Forward-viewing endoscope
			Whipple's procedure	Separate hepaticojejunostomy and pancreaticojejunostomy		Can place 10 Fr stents	No elevator

(continued)

Table 17.1 (continued)

Endoscope	Working channel length (cm)	Accessory channel diameter (mm)	Altered surgical anatomy	Biliary and pancreatic drainage	Maximum caliber of stent	Strengths	Weaknesses
			Roux-en-Y hepaticojejunostomy	Hepaticojejunostomy[a]		Can offer better ability to push stents	Can be difficult to advance scope
Pediatric colonoscope	168	3.2	Billroth II	Native papilla	8.5 Fr stents (care should be taken to keep flaps down when advancing stent into the accessory channel)	Easier to advance scope than adult colonoscope	Forward-viewing endoscope
			Whipple's procedure	Separate hepaticojejunostomy and pancreaticojejunostomy	Some fully covered biliary metal stents can be placed		No elevator
			Roux-en-Y hepaticojejunostomy	Hepaticojejunostomy[a]			

Single-balloon enteroscope/ double-balloon enteroscope	200 (SBE)/220 (DBE)[b]	2.8[b]	Whipple's procedure	Separate hepaticojejunostomy and pancreaticojejunostomy	7 Fr stents (care should be taken to keep flaps down when advancing stent into the accessory channel)	Scope is soft and easy to advance	Limited number of accessories
			Roux-en-Y gastric bypass	Native papilla		Ability to reach further than other scopes	Advancing stents and other accessories can be difficult
			Roux-en-Y hepaticojejunostomy	Hepaticojejunostomy[a]			Forward-viewing endoscope
							No elevator

[a]In patients with Roux-en-Y hepaticojejunostomy, while a new bilioenteric anastomosis is created, the pancreatic ductal orifice remains at the major papilla

[b]Newer DBE scopes with shorter length (152 cm) and wider caliber of working channel (3.2 mm) are available

Identification of the Afferent Limb

In patients with Billroth II and Whipple's anatomy, once the gastrojejunal anastomosis has been reached, it is not uncommon to easily locate one of the limbs of small bowel. This is usually the efferent limb. The afferent limb oftentimes is located on the same side as the lesser curvature of the stomach. This is generally the difficulty of the two limbs to find or intubate. Careful evaluation of the peristaltic wave can sometimes help with identification of the limbs. The peristaltic waves travel in a craniocaudal fashion inside the reconstructed afferent and efferent limb. On careful observation, subtle indications in the small bowel peristalsis can generally help identify the afferent limb. The presence of bilious material is a poor predictor of the afferent limb.

If a presumed afferent limb has been intubated, the scope is then advanced as far distally as possible. If the papilla or the bilioenteric anastomosis is not encountered, further evaluation of the possibility of a longer afferent limb can be performed by injection of contrast through the working channel under fluoroscopic guidance. Injection of contrast into the lumen can sometimes result in reflux into the stomach and increase the risk of aspiration. It is prudent to recommend general anesthesia in those patients known to have a history of failed or difficult ERCP. Upon injection of contrast, if the contrast flows to the blind limb or a cholangiogram is noted on contrast injection or there is flow of contrast into the right upper quadrant, it may indicate that the endoscope is in the afferent limb. If further advancement is not possible, change in patient position, abdominal pressure, or change to a SBE or DBE may be warranted. On the other hand, if the contrast seems to flow into the right lower quadrant, it is less likely to be the afferent limb. The endoscope is then pulled back, to the gastrojejunal anastomosis and then advanced into the other limb. It is not uncommon that endoscopists with limited experience in altered anatomy can often fall back and inadvertently readvance back into the same limb. Taking a biopsy

of the mucosa at the entrance of the limb or withdrawing the scope while exchanging for a wire can help identify the two limbs and avoid this pitfall.

Identification of the afferent limb at the jejunojejunostomy can be challenging. Here again, careful examination to identify the direction of peristalsis can give a clue regarding the afferent limb. Experts generally recommend "crossing the anastomosis" as an effective strategy in differentiating the afferent limb from the common channel. The presence of bile, although often advocated, is not a reliable predictor of the afferent limb. In patients who have had revisions of RYGB or have had multiple surgeries in the past, the identification and advancement of scope may be much more challenging. When viewed on fluoroscopy, the scope may assume unusual paths, and therefore many of the above rules may not apply. Acute angulations and inability to advance the scope may be encountered. Changing to a thinner caliber scope can help with angulation issues. Often, acute angles can be the result of excessive torqueing of the scope, insufflation, or looping. When it is impossible to pass and advance the scope, withdrawal of the scope by a 30–50 cm and readvancing can help. At the same time, care should be taken to minimize air insufflation. Changes in patient position and abdominal pressure may be applied if necessary. Just as in all altered anatomy endoscopy, there is not a single solution to addressing issues with scope advancement in patients with history of multiple surgeries. However, difficulty in accomplishing ERCP in this subgroup of patients is significantly higher.

Despite following the above general principles, identification of the afferent limb can sometimes be challenging. Often, the appearance of the anastomosis, relative location of the afferent limb at the anastomosis, and the limb lengths can vary based on local surgical expertise and techniques. It is not uncommon to have difficulty in accomplishing altered anatomy ERCP in patients who present from a different health system or who have undergone surgery several decades ago.

Cannulation

Cannulation is a procedure-limiting step in ERCP. This is further complicated in altered anatomy for several reasons: approach to the papilla from a retrograde or from a caudal approach, use of forward-viewing scope without an elevator, and the use of tools designed for standard ERCP.

Native Papilla

The caudal approach of the papilla alters the endoscopic appearance of the relative locations of biliary and pancreatic orifices. From a caudal view, the biliary and pancreatic orifices are reversed by 180 degrees when compared to standard ERCP. Sometimes, rotation of the scope by 180 degrees such that the papilla is in the bottom half of the screen may be required for successful cannulation. A combination of fluoroscopic and endoscopic images can help identify the correct orientation and angulation that is required for successful cannulation. The use of clear cap can further aid in exposure of the papilla and possibly in straightening of the distal common bile duct. The tools that can be used for cannulation can vary depending upon the type of scope. SBE- and DBE-assisted ERCPs tend to have the greatest limitation in availability of ERCP accessories.

Bilioenteric or Pancreaticoenteric Anastomosis

Identification of the hepaticojejunostomy and pancreaticojejunostomy can be facilitated using a clear cap fitted at the tip of the endoscope. The hepaticojejunostomy can be identified after advancing the tip of the scope to the area of the hilum of the liver on fluoroscopic images. After adequate insufflation of the lumen, the cap maybe used effectively to move the small bowel folds aside to locate the anastomosis. Identification of the anastomosis can be challenging when patient has anastomotic stricture or small bowel luminal strictures. Luminal strictures can form because of tumor

infiltration or radiation. Underwater examination of the afferent loop can sometimes help in identifying the orifice. After identification, cannulation can be achieved with a wire and extraction balloon. When hepaticojejunostomy is performed higher up in the bile duct, two anastomotic orifices can be seen within the lumen.

Therapeutics

It is often desirable to access selective intrahepatic bile ducts to evaluate and treat biliary disease in the liver. This can often be challenging despite the use of curved hydrophilic guidewires. This may be due to acute angulation of the common bile duct, lack of alignment of the scope to the common bile duct, or acute angulation of intrahepatic ducts after extended liver resection. Appropriate changes to the scope tip under endoscopic and fluoroscopic guidance can help improve alignment of the scope to the bile duct. This provides the best opportunity to obtain biliary access to the desired intrahepatic duct. Further, this can help in increasing the chances of a successful stent placement. Changes to patient body position may be attempted as the last resort (i.e., change from prone to semi-prone or supine position) if all other corrective measures have been unsuccessful. The common therapeutic maneuvers are described below.

Sphincterotomy

Sphincterotomy can be achieved with a needle-knife or a special S-shaped Billroth II sphincterotome. Freehand needle-knife sphincterotomy can be associated with higher risk of complications. Often, stents are placed into the bile duct, and an over-the-stent needle-knife sphincterotomy is performed to decrease risks. Alternatively, a small needle-knife sphincterotomy followed by sphincteroplasty can be safe and effective.

Stone Extraction

Stone extraction is a common maneuver performed in altered anatomy ERCP. The caudal approach of the forward-viewing scope to the ampulla alters the angles, and therefore the principles of stone extraction in standard ERCP cannot be applied to these patients. Stone extraction in altered anatomy requires a generous sphincteroplasty. If balloon sweeps alone are not adequate for stone removal from the common bile duct, a combination of balloon and enteroscope may need to be pulled back to facilitate stone removal. Alternatively, long baskets are available to remove stone from the bile duct. However, the use of rescue lithotripsy can be limited, especially in SBE or DBE ERCP.

Stent Placement

Stent placement can be challenging without an elevator on the enteroscope. The caliber of the working channel of the enteroscope severely limits the size of stent that can be placed. The ability to traverse a stricture is severely limited in altered anatomy ERCP. When a stent is being placed to traverse a stricture, it is imperative to perform adequate dilation to accommodate stents. As described above, corrections to the tip of the scope to correct alignment of scope to the bile duct are recommended to achieve successful stent placement. Care should be taken to keep the flaps down when advancing a stent into the working channel. This can be achieved using a positioning sleeve that is supplied with the stent.

Alternatives to Peroral ERCP

Even with experienced endoscopists, altered anatomy ERCP can be unsuccessful. Several alternative approaches to ERCP are available. These maybe performed when altered anatomy ERCP has failed or if equipment or expertise for altered anatomy ERCP is unavailable. For choledocholithiasis,

patients may proceed to cholecystectomy and then undergo common bile duct exploration. If this is successful, ERCP can be avoided.

Laparoscopic-Assisted Transgastric ERCP

When the indication for ERCP is urgent, laparoscopic-assisted transgastric ERCP may be performed in the operating room where the surgeon accesses the gastric remnant with a large-bore trocar that can be used to traverse a duodenoscope. This method offers the added advantage of being able to perform endoscopic ultrasound (EUS) at the same time if needed. In addition, cholecystectomy can also be performed in the same setting, if indicated.

Newer Techniques

In patients with RYGB who have biliary disease that requires multiple ERCPs, it may be necessary to create an access to the gastric remnant either by creation of a gastro-gastric fistula or by creation of a gastrocutaneous fistula. The former can be achieved by endoscopic ultrasound-guided placement of a lumen-opposing stent to create a fistula between the gastric pouch and the gastric remnant [11, 12]. The latter can be achieved by placement of a push or pull percutaneous endoscopic gastrostomy (PEG) tube placement with the help of a DBE or a surgically placed gastrostomy tube. These access points can be dilated after maturation of the tract to help with passage of a duodenoscope. These techniques are helpful for nonurgent procedures.

EUS-guided antegrade biliary access has been described. In this procedure, access to a dilated left intrahepatic bile duct is obtained under endosonographic visualization from the proximal stomach. This access point is used to further direct therapy in an antegrade fashion [13]. Another approach, endoscopic ultrasound-directed transgastric ERCP (EDGE) describes

EUS-guided placement of a PEG tube into the gastric remnant for transgastric access [14]. Further research is needed to evaluate the efficacy and safety of these newer techniques.

Percutaneous Transhepatic Cholangiography

In patients that require emergent access to the bile ducts in the setting of acute cholangitis with hemodynamic instability or when local expertise in altered surgical anatomy is not available, PTC may be performed. This is also an option when altered surgical anatomy ERCP has been unsuccessful. When the failure is primarily due to unsuccessful cannulation, EUS rendezvous or PTC rendezvous may be considered for antegrade passage of wire across the papilla to facilitate retrograde ERCP cannulation.

Outcomes

Studies in altered anatomy ERCP are highly variable in their outcomes. The outcomes' endpoint may be access to the papilla, cannulation, therapeutic success, or overall success. Further, studies in this area have been over several decades. Over the study duration, there have been changes to endoscopes and technology in ERCP accessories. This makes comparison of the study difficult. The underlying altered surgical anatomy likely determines the difficulty, success, and safety of the procedure.

Case Outcomes

Case 1

Patient was taken for an urgent altered anatomy ERCP with a DBE enteroscope fitted with cap at the tip. The afferent limb was selectively intubated by "crossing the anastomosis." Selective biliary cannulation was successfully performed with a 600-cm-long wire with a hydrophilic tip and a 320-cm-long sphincterotome. A small sphincterotomy was performed with a

needle-knife, and common bile duct stone was extracted using 350-mm-long stone retrieval balloon. After multiple balloon sweeps, an occlusion cholangiogram was performed and was normal. Patient tolerated the procedure well, and her mental status improved dramatically after the procedure. Older patients with cholangitis can present with altered mental status more often than younger patients (43% vs. 23%) [15].

Case 2

Patient's CT scan images were carefully evaluated. In addition to the dilation of the bile ducts, there was evidence of dilation of small bowel loops which appeared to be in the afferent limb. Based on these findings, there was clinical suspicion for afferent loop syndrome. ERCP was performed with a therapeutic upper endoscope. At the gastrojejunal anastomosis, the afferent limb appeared to be stenosed, and abnormal mucosa, suspicious for tumor infiltration, was noted. This was biopsied. Dilation of the stenosis was performed to 10 mm, and the endoscope was advanced into the afferent limb. The entire lumen of the afferent limb which was dilated with large amounts of bilious material was noted. The hepaticojejunostomy was widely patent. Cholangiography showed mildly dilated biliary tree without obstructing stone or lesion. A fully covered 10 mm by 6 cm self-expanding metal stent with both internal and external flanges was placed across the stricture at the gastrojejunostomy. Efferent limb was widely patent. Patient tolerated the procedure well and improved clinically. The biopsies showed recurrent adenocarcinoma consistent with PDAC. He was presented at the tumor board for discussion regarding future management.

Case 3

This patient has high probability of choledocholithiasis. Local surgeons have expertise in common bile duct exploration. Patient was referred to minimally invasive surgery and underwent laparoscopic cholecystectomy and CBD stone removal by exploration. Patient recovered well after procedure and was discharged home.

Case 4

Further review of MRI showed that patient may have undergone Billroth I surgery. Previous records were unavailable for review. Based on this finding, the procedure was begun with a duodenoscope. Careful evaluation of the gastroenteric anastomosis confirmed that this was Billroth I. Using standard ERCP techniques, common bile duct stone was removed. Postoperative course was uneventful. Patient improved clinically and was discharged the following day.

Case 5

A family meeting was conducted in clinic. Patient did not wish to undergo surgical resection should that stricture be cholangiocarcinoma; however she was open to chemotherapy, if indicated. A decision was then taken to perform ERCP to obtain a tissue diagnosis.

A DBE ERCP was performed. Choledochojejunostomy was widely patent. Biliary cannulation was achieved with a 350-mm-long stone retrieval balloon and a 600-mm-long guidewire with a straight hydrophilic tip. The common bile duct appeared sigmoid in shape. The isolated left intrahepatic duct stricture was visualized on cholangiography; however, this could not be selectively accessed despite the use of a fully hydrophilic guidewire. Patient was then sent to interventional radiology, and a PTC was performed, and brushings of the stricture were obtained. The brushings were nondiagnostic.

Patient was brought in for a repeat ERCP 6 weeks later. The PTC was removed after advancing a wire through it into the jejunum under fluoroscopic guidance. The tract was dilated, and a thin caliber scope was advanced into the bile duct through the percutaneous route. Water infusion was performed without any air insufflation to minimize risk of air embolization. The stricture was endoscopically visualized, and biopsies were obtained. The biopsies showed cholangiocarcinoma, and patient was referred to oncology for discussion about treatment options.

Pearls and Pitfalls

- Successful completion of an altered anatomy ERCP requires a thorough understanding of the indication, type of altered anatomy, pre-procedure planning (Table 17.2), selection of appropriate scope and accessories, and a keen eye for safety.
- A review of cross-sectional imaging, when available, can provide insights into anatomy that might otherwise be missed on reading the reports alone.
- Familiarizing oneself with the available accessories and organizing them into one labeled cabinet is often helpful. As with standard ERCP, ensuring that there is an appropriate indication for procedure is vital.
- The use of fluoroscopy and a clear cap fitted at the tip of the scope can be invaluable in identifying the afferent limb and major papilla or hepaticojejunostomy. It can also help expose the papilla better and aid in cannulation.
- Reducing and creating a stable scope position at the papilla and evaluating the angles between the scope and bile duct can be time-consuming; however, they are imperative to a successful altered anatomy ERCP.
- When advancing the stent into the working channel, care should be taken to keep the flaps down. This can be achieved with a positioning sleeve that is generally supplied with the stent.
- Advancement of stent into the biliary tree requires a complex maneuver beyond the manual advancement of the stent through the accessory channel. This can include advancement of scope and the use of right/left or up/down control knobs to advance the scope tip closer to the biliary orifice.
- Finally, a multidisciplinary approach with involvement of surgical team in the decision-making process is recommended for optimal outcomes from ERCP in patients with altered surgical anatomy.

Table 17.2 Pre-procedure planning checklistsss for ERCP in patients with altered surgical anatomy

Ensure that the procedure is being performed for appropriate indication.
Obtain relevant history from the patient regarding type of surgery and previous failed ERCP attempts, if any.
Discuss patient in multidisciplinary meeting. Discuss with surgeon and interventional radiologist.
Obtain an informed consent. Discuss openly with the patient regarding risks, benefits, and alternatives.
Review operative reports to understand type of surgical reconstruction.
Consider other alternatives based on local expertise, e.g., surgical common bile duct exploration.
Review cross-sectional images when available.
Consider the use of clear cap affixed at the tip of the endoscope.
Based on above information, pick an appropriate endoscope with widest working channel possible.
If previous history of failed ERCP is noted, consider modification of tools and accessories. Review records to understand the cause of failed prior attempt.
Check GI lab for availability of appropriately trained support staff.
Ensure that appropriately trained staff are available in the procedure room.

Suggested Reading

Suggested reading articles are marked with an *

References

1. Rabinov KR, Simon M. Peroral cannulation of the ampulla of Vater for direct cholangiography and pancreatography. Preliminary report of a new method. Radiology. 1965;85(4):693–7.

2. Cotton PB, et al. Cannulation of papilla of vater via fiber-duodenoscope. Assessment of retrograde cholangiopancreatography in 60 patients. Lancet. 1972;1(7741):53–8.
3. Huang RJ, et al. Evolution in the utilization of biliary interventions in the United States: results of a nationwide longitudinal study from 1998 to 2013. Gastrointest Endosc. 2017;86(2):319–326.e5.
4. Mazen Jamal M, et al. Trends in the utilization of endoscopic retrograde cholangiopancreatography (ERCP) in the United States. Am J Gastroenterol. 2007;102(5):966–75.
5. He J, et al. 2564 resected periampullary adenocarcinomas at a single institution: trends over three decades. HPB (Oxford). 2014;16(1):83–90.
6. Nguyen NT, et al. Trends in use of bariatric surgery, 2003–2008. J Am Coll Surg. 2011;213(2):261–6.
7. *Committee AT, et al. Devices and techniques for ERCP in the surgically altered GI tract. Gastrointest Endosc. 2016;83(6):1061–1075.
8. *Gomez V, Petersen BT. Endoscopic retrograde cholangiopancreatography in surgically altered anatomy. Gastrointest Endosc Clin N Am. 2015;25(4):631–656.
9. Pach R, Orzel-Nowak A, Scully T. Ludwik Rydygier--contributor to modern surgery. Gastric Cancer. 2008;11(4):187–91.
10. Sablinski T, Tilney NL. Ludwik Rydygier and the first gastrectomy for peptic ulcer. Surg Gynecol Obstet. 1991;172(6):493–6.
11. Kedia P, et al. EUS-directed transgastric ERCP for Roux-en-Y gastric bypass anatomy: a minimally invasive approach. Gastrointest Endosc. 2015;82(3):560–5.
12. *Ngamruengphong S, et al. Endoscopic ultrasound-guided creation of a transgastric fistula for the management of hepatobiliary disease in patients with Roux-en-Y gastric bypass. Endoscopy. 2017;49(6):549–552.
13. Binmoeller KF, Nguyen-Tang T. Endoscopic ultrasound-guided anterograde cholangiopancreatography. J Hepatobiliary Pancreat Sci. 2011;18(3):319–31.
14. Kedia P, et al. Endoscopic ultrasound-directed transgastric ERCP (EDGE) for Roux-en-Y anatomy: a novel technique. Endoscopy. 2015;47(2):159–63.
15. Sugiyama M, Atomi Y. Treatment of acute cholangitis due to choledocholithiasis in elderly and younger patients. Arch Surg. 1997;132(10):1129–33.