Biliopancreatic Endoscopy in Altered Anatomy

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Anatomical post-surgical alterations of the upper gastrointestinal (GI) tract have always been challenging for performing diagnostic and therapeutic endoscopy, especially when biliopancreatic diseases are involved. Esophagectomy, gastrectomy with various reconstructions and pancreaticoduodenectomy are among the most common surgeries causing upper GI tract alterations. Several different techniques developed over the years for biliopancreatic diseases in altered anatomy, in order to perform both endoscopic ultrasound (EUS) and endoscopic retrograde cholangiopancreatography (ERCP). They included enteroscopy-assisted ERCP (double and single balloon enteroscopy-ERCP, spiral enteroscopy-ERCP) laparoscopic assisted ERCP, EUS-Directed transgastric ERCP, EUS-directed transgastric intervention, gastric access temporary for endoscopy, and percutaneous assisted trans prosthetic endoscopic therapy.

Keywords: US ; interventional EUS ; ERCP ; biliopancreatic endoscopy ; CH-EUS ; FNB ; difficult biliary stones

1. Introduction

Anatomical gastrointestinal (GI) alterations have always been challenging for performing endoscopy, both in case of diagnostic and therapeutic procedures. Moreover, surgery of the upper GI tract is indicated in different conditions, from oncologic to metabolic and bariatric ones. While the aim of the oncologic surgery is the radical tumor resection, a proper modelling of the stomach and adequate anatomical reconstruction of small bowel are the key to bariatric surgery, with the goal to reduce cost and encourage metabolic changes. Overall, esophagectomy, gastrectomy (with its variants) and pancreaticoduodenectomy are among the most common surgeries causing upper GI tract alteration. Many GI tumors among the approximately 22,000 gastric cancers, 60,000 pancreatic cancers and 19,000 esophageal cancers diagnosed annually in the United States [1][2] require demolitive surgery. In addition, obesity has presently emerged as a western pandemic, so much that bariatric surgery for severe obesity or other metabolic diseases is among the most commonly performed GI interventions. Over the past few years, technological improvements and new methods have increased the endoscopic success in those patients with altered anatomy. Surely, a proper knowledge of the anatomical alterations has been fundamental to perform endoscopy in those patients. In 2011 the global total number of bariatric surgeries was approximately 340,000 [3], and among them Roux-en-Y-Gastric Bypass (RYGB) exceeded other bariatric procedures by 70–80% [4]. In addition, about one-third of post bariatric patients develops gallstones [5]. Furthermore, patients with altered anatomy may also develop those biliopancreatic disorders, which require advanced endoscopy, as endoscopic ultrasound (EUS) or endoscopic retrograde cholangiopancreatography (ERCP). On one hand, a GI post-surgical alteration anatomy may represent for EUS an unpassable hurdle for pancreatic examination and tissue acquisition (TA), because of the difficulty in achieving adequate scans of the pancreas or the distal bile duct, while on the other, it could be insurmountable to achieve the papillary region or the bilioenteric anastomosis during standard ERCP.

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2.1. Surgical Anatomical Variant

Indications for upper GI surgery may include both malignant and benign indications, as peptic ulcer or dysmetabolic diseases in the latter case. Surgical techniques causing a higher difficulty in the post-surgery endoscopic management mainly involve the gastro-duodenal portion, even if esophageal surgery may determine relevant alteration of the anatomy as well. Total or distal esophagectomy, total or sleeve gastrectomy, partial gastrectomy with different reconstruction procedures (i.e.,Billroth I, Billroth II, Roux-en-Y reconstruction) and pancreaticoduodenectomy with its variants are the most involved in relevant anatomic alteration for endoscopic procedures.

2.2. Diagnostic Endoscopic Ultrasound in Altered Anatomy

Endoscopic ultrasound (EUS) is nowadays routinely performed as valuable procedure for detection, staging, and cytohistological characterization of biliopancreatic diseases. An altered anatomy of upper GI tract may represent an issue for an appropriate pancreatic examination and tissue acquisition (TA), due to the difficulty in achieving a proper scan of the pancreas or the bile duct. The quality of endosonographic image resolution is dependent on the proximity of the transducer to the biliopancreatic region, so successful EUS in altered anatomy depends on the knowledge of the anatomic post-surgery alteration and endosonographer experience. Moreover, even experienced endosonographers may not be able to find the way to obtain adequate window, and to move an echoendoscope through an altered anatomy, especially when anastomotic reconstructions are unclear or particularly laborious. Combined techniques consider other access to the biliopancreatic region, in order to avoid anatomic alterations. In fact, Bowman et al. [6] analyzed patients who required laparoscopic biliopancreatic endoscopy, mainly for choledocholithiasis, presenting five patients who performed diagnostic laparoscopic EUS (LA-EUS) before laparoscopic ERCP (LA-ERCP) with a success rate of 100%. Moreover, diagnostic EUS with TA in altered anatomy could be difficult, but surgical tissue acquisition should be considered after at least an endoscopic attempt due to its invasiveness. A decade ago, Wilson et al. [7] showed a success rate of EUS-TA of 73.94% among 188 patients with heterogeneous surgical alterations (Billroth I, Billroth II, Roux-en-Y, gastric bypass, Whipple, Puestow, Nissen fundoplication, esophagectomy) with no AEs reported. More recently, a retrospective study of 242 patients showed a rate of AEs after diagnostic EUS of 1.24% and an overall technical success rate of 78.2%. Actually, the EUS technical success rate was shown to vary depending on the different surgical alterations.In fact, a low success rate was seen in the Roux-en-Y gastric bypass (62.5%) and total gastrectomy (66.7%), while a high success rate was showed in sleeve gastrectomy and Billroth I anastomosis (100 and 95.7%, respectively). In general, TA-failure may also happen due to various reasons, including failed visualization, lesions too deep to be punctured or lesions being impossible to penetrate.

2.3. Biliopancreatic Interventional Endoscopy in Altered Anatomy

2.3.1. Endoscopic Retrograde Cholangiopancreatography (ERCP)

ERCP on surgically altered anatomy is laborious, technically difficult and associated withhigher rate of failure and adverse events in comparison with standard procedures, especially in those with most complex reconstructions [8]. First reports of ERCP techniques in altered anatomy dated back to 40 years ago, with attempts in using a pediatric colonoscope in Roux-en-Y anatomy [9]. Later, Elton et al. described their use of a pediatric colonoscope and enteroscope for diagnostic and therapeutic intervention in long limb bypass patients, with an overall success rate of 84% and cannulation rate of 94%. Despite the high success rates, technical disadvantages included the lack of side viewing orientation and an elevator, and a channel size that precluded the use of conventional stents and accessories [10]. Among the first reports on the use of conventional duodenoscope in altered anatomy, Hintze et al. reported a success rate of only 33% in reaching the papilla in RYGB, and 67% in patients with Billroth II anastomoses. [11] The use of a forward-viewing colonoscope and the duodenoscope in long limb Roux-en-Y gastrojejunostomy patients to perform ERCP was later reported by Wright et al. with a 67% of ERCP success rate [12]. Given the challenge, the development of new tools to improve procedural success remainsthe goal. In fact, instrumental upgrades haves been attempted over the years: multibending backward–oblique-viewing duodenoscope, [13] variable-stiffness duodenoscope, [14] and multibending forward-viewing endoscope (M-scope) [15], but have yet to become routinely used in clinical practice. Alternative techniques consider single-balloon and double-balloon enteroscopes to perform ERCP in altered anatomy, but the long endoscope length limits the use of conventional ERCP accessories [16]. For this reason, the short-type single-balloon and double-balloon enteroscopes have been developed as alternatives [17]. Even if the underwater technique is primarily used to perform colonoscopy, the underwater-ERCP using a cap-assisted pediatric colonoscope was recently proposed in six patients with altered anatomy as an alternative, achieving a success rate of 100% without any AEs [18]. Furthermore, many case reports have been published during the last decade, showing alternative techniques for ERCP in different scenarios, varying from management of Mirizzi syndrome in Billroth II reconstruction to cholangiocarcinoma in RYGB [19][20][21][22][23][24][25][26]. In 2006, the short length double-balloon enteroscopy (s-DBE) was firstly used to perform ERCP in RYGB patients [27]. Since then, the technique has been based on using the short type of endoscope in order to permit to use ERCP accessories (155 cm of length, with a working channel of 3.2 mm). Later, in 2008, ERCP in RYGB patients was reported with the single balloon (SBE) tip overtube, which had a length similar to the long DBE scope (200 cm) with a thinner working channel (2.8 mm). These techniques have showed different success rates over the years, depending mostly on the surgical alterations. Overall, sDBE-ERCP had a success rate between 70.7 and 96% [28][29][30][31][32][33][34], while SBE-ERCP appeared to be as effective as sDBE, with a success rate among 73 and 92.3% [35][36][37][38]. Among studies about SBE-ERCP, Lenze et al. [39] in a prospective single-center study, showed a lower success rate (57.7%), but they also found in univariate analysis that malignant biliary obstruction had a significantly higher risk of SBE-ERCP failure (OR = 11.33, p = 0.001). Another alternative enteroscopy-assisted technique is spiral enteroscopy (SE), which Ali [40] and Zouhairi [41] demonstrated to be successfull among RYGB patients to reach the papilla in 86% and 76.2% of cases, with an overall success rate for SE-ERCP of 86% and 64.3%, respectively. Moreover, a retrospective study compared SBE-ERCP and

SE-ERCP on 54 patients with Roux-en-Y anatomy, showing similar diagnostic and therapeutic yield (diagnostic yield of 48.3% and 40%, respectively), and no significant differences on the rate of E-AEs (only one AE after SBE-ERCP) [42].

2.3.2. EUS-Guided Procedures

Although different aforementioned techniques have been proposed over the years to perform biliopancreatic endoscopy in altered anatomy, improving technical success still needs some implementation and alternatives. Therefore, EUS-guided or assisted procedures to perform ERCP are increasing and many case reports without routine solutions have been reported over the years [43][44][45][46][47], both to get access to the biliary limb and for directly performing the procedure. Recently, a water-filled diagnostic and therapeutic EUS procedure has been proposed for patients with Billroth II or Roux-en-Y reconstruction, in order to achieve a higher success rate and lower adverse event rate, but few cases are described in literature to properly understand its efficacy [48]. In the last decade, a novel technique has been developed in RYGB patients, the EUS-directed transgastric ERCP (EDGE). Kedia et al. [49] proposed the initial technique as a two-stage procedure (double stage EDGE): firstly, inserting a percutaneous gastrostomy (PEG) tube in the excluded stomach after the EUS-assisted identification and distension of the excluded cavity through the pouch; later, the PEG-tube was exchanged for a fully covered self-expanded metal stent (FCSEMS) and anterograde ERCP was performed via the percutaneous FCSEMS. This technique did not propagate as expected due to some limitation, as the risk of PEG site infection (two of the six patients reported in Kedia’s series experienced PEG site infection) and the inability to perform it in case of urgency (i.e., cholangitis). A year later, Kedia et al. [50] improved their technique with the development of the single-stage EDGE (SS-EDGE) thanks to the spread of the Luminal Apposing Metal Stent (LAMS) in clinical practice. In fact, the upgraded technique entails the creation of a gastro–gastric (G–G) or jejunogastric (J-G) fistula with the excluded stomach through a EUS-guided LAMS placement, avoiding the percutaneous access. This case series of five patients with RYGB treated with SS-EDGE reported a technical success of 100% using the 15 mm diameter LAMS, even if initially two of five patients showed difficulty in passing the duodenoscope through the LAMS and three of the five experienced stent migration. Nonetheless, severe AE were not reported. The technique contemplates the use of either over-the-wire (OTW) LAMS placement or the freehand technique to release LAMS, depending on expertise and availability of the centers. The studies about EDGE reported an extremely high success rate of this novel technique, between 96.5 and 100% [51][52][53][54][55][56][57][58]. Adverse events include mostly LAMS maldeployment and migration, which seemed to be mainly seen in those studies in which authors used the OTW technique. The freehand technique seems to give an advantage in terms of LAMS migration.

2.3.3. Alternative Access

Alternative techniques for permitting biliopancreatic endoscopy in altered anatomy have been proposed, including LA-ERCP, percutaneous assisted trans prosthetic endoscopic therapy (PATENT), and the abovementioned EDGE procedure. These alternative techniques permit the use of a conventional duodenoscope with its available standard ERCP accessories. PATENT permits to achieve direct access to the GI area were excluded after surgery, as the biliopancreatic area, and can be performed with device-assisted enteroscopy (DAE) or EUS-guided endoscopy. More precisely, PATENT technique entails the creation of a percutaneous access to GI tract in order to facilitate reaching the area of interest. DAE-PATENT consists of deploying a percutaneous gastrostomy (PEG) tube in the excluded stomach of RYGB patients through an enteroscope, with subsequent performance of ERCP via the PEG. Data from a retrospective case series of five patients showed technical success in all of the procedures attempted and only one AE [59]. The other way to perform PATENT is the EUS-guided technique, but few data are available in the literature about this EUS-guided gastrostomy application and they are mainly pilot studies [60][61]. The EUS-PATENT technique consists of the ultrasound identification of the remnant stomach through the gastric pouch (ultrasound visualization of the sand dollar sign helps to correctly identify the excluded stomach [62]), EUS-guided puncture of remnant cavity and filling it with contrast and carbon dioxide. These maneuvers are necessary to percutaneously detect the excluded stomach in order to correctly insert the devices for PEG insertion. These techniques are obviously not routinely used in clinical practice, because they need a tertiary center and endoscopists with high expertise. Another way to get direct access to the excluded GI area with the scope is performing LA-ERCP, which was first described about 20 years-ago by Peters et al. [63]. This procedure entails a laparoscope-assisted surgical port placement into the excluded stomach, followed by percutaneous passage of the duodenoscope via the lap port into the duodenum.

3. Conclusions

In conclusion, recent evidence suggests the consideration of the novel techniques currently available when approaching patients with altered anatomy who require biliopancreatic endoscopy. The choice of the technique should take into consideration local expertise, previous surgical intervention, indication and the reported success rate in literature. Moreover, a multidisciplinary approach should be routinely applied, with the collaboration among gastroenterologists, radiologists and surgeons in order to better manage the most complex ones among those biliopancreatic patients with altered anatomy. Finally, standardization of outcomes, in terms of technical and clinical success, is mandatory to make results comparable and applicable to clinical practice.

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