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ORIGINAL ARTICLE

Laparoscopy-assisted transgastric endoscopic retrograde cholangiopancreatography: Preliminary experience and technique description

S. Tzedakis[a,d], R. Memeo[a,b,c,*], M. Nedelcu[a,d], M. Rodriguez[d], M. Delvaux[a,d], J. Huppertz[a,d], H. Jeddou[a,d], D. Mutter[a,b,d], J. Marescaux[a,b], P. Pessaux[a,b,d]

[a] IRCAD, Research institute against cancer of the digestive system, 67000 Strasbourg, France
[b] IHU-Strasbourg, institute for image-guided surgery, 67000 Strasbourg, France
[c] Department of Emergency and Organ Transplantation, University of Bari, 70100 Bari, Italy
[d] Department of digestive surgery, university hospital of Strasbourg, 67000 Strasbourg, France

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KEYWORDS
Laparoscopy-assisted transgastric ERCP (LAERCP);
Roux-en-Y gastric bypass (RYGB);
Esophageal stenosis;
Transgastric access ERCP

Summary
Introduction: Common bile duct lithiasis after Roux-en-Y gastric bypass (RYGB) or upper gastrointestinal stenosis has become a challenging problem nowadays, especially as obesity surgery is increasing. In this study, we assess the feasibility and performance of laparoscopy-assisted transgastric endoscopic retrograde cholangiopancreatography (LAERCP) and describe its technique.
Methods: A retrospective review of a prospectively collected database of consecutive patients undergoing a LAERCP between February 2014 and May 2015 was performed at a single institution. Indications were common bile duct lithiasis associated with acute or past episodes of cholangitis and pancreatitis. Endoscopic access to the gastric remnant was obtained laparoscopically.
Results: In total 5 cases were identified. Four of them had undergone a RYGB and one of them presented a benign esophageal peptic stenosis, not allowing peroral gastric access. Biliary cannulation using LAERCP associated with sphincterotomy and stone extraction was successfully achieved in all patients. Mean duration of the entire procedure was 134 minutes (range: 66—200 min). No early major complications were observed and the mean postoperative hospital stay was 4 days (range: 2—5 days).

* Corresponding author. Hepato-biliary and pancreatic surgical unit, general, digestive, and endocrine surgery, IRCAD, IHU MixSurg, institute for minimally invasive image-guided surgery, university of Strasbourg, 1, place de l'hôpital, 67091 Strasbourg, France.
E-mail address: drmemeo@yahoo.it (R. Memeo).

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Conclusions: LAERCP is a safe and successful procedure for the treatment of common bile duct lithiasis when conventional biliary access is not feasible, notably after RYGB. Larger trials still need to be performed to evaluate efficacy, technical success, and complications related to this technique.
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Introduction

Obesity is increasing worldwide, its prevalence has been projected to grow by 40% in the next decade and it's well known that is related to increased risk of gallstone disease and its consequential risk of complication (cholecystitis, cholangitis and pancreatitis) [1,2]. RYGB has represented for many years the gold standard procedure for surgical treatment of obesity. However, obtaining access to the biliary tree after such a procedure is becoming a frequent problem for endoscopists nowadays. As the number of former bypass patients accrues, the need to assess and treat this subset of patients for biliary and pancreatic disease will increase.

Apart RYGB, other upper GI surgery (gastrojejunostomies following Billroth II gastrectomy or Whipple operation) and upper GI stenosis (malignant or benign) are common causes of ERCP failure. In the era of minimally invasive surgery, several techniques have been proposed to solve this problem based on an endoscopic, radiologic, laparoscopic or combined approach. These techniques involve single- or double-balloon endoscopy, ERCP through a percutaneous gastrostomy, endoscopic ultrasound (EUS)-directed transgastric ERCP, percutaneous transhepatic cholangiography (PTC), temporary restoration of the intestinal continuity, and laparoscopy-assisted transgastric access ERCP [3—12]. However, pure endoscopic techniques still remain challenging, and most often success rates are limited [5,6,8,11—13]. Laparoscopy-assisted transgastric ERCP (LAERCP) has been described by many authors as a safe procedure, reporting a high rate of success with the possible advantage of allowing diagnosis and treatment of internal hernias [14—16]. The objective of this study is to report our initial experience of five patients who underwent a LAERCP following RYGB or esophageal stenosis, and finally to describe the technique.

Materials and methods

Study population

A retrospective review of all LAERCP was performed at a single institution from February 2014 to May 2015. Our institution is a tertiary healthcare hospital performing advanced minimally invasive upper GI procedures as well as flexible endoscopy. Demographic data (gender, age, indication for surgery), overall success rate, length of hospital stay and related morbidity and mortality rates were recorded. Procedures performed in an acute setting (acute cholangitis or pancreatitis) were recorded as well as any previous radiologic or endoscopic treatments.

Informed consent was obtained from patients after explaining the risks and benefits of the procedures as well as alternative treatments.

One experienced endoscopist performed all ERCPs and two experienced surgeons performed all laparoscopic operations.

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study.

Indications

Indications included radiologically proven choledocholithiasis associated with cholestasis/jaundice, acute cholangitis or recurrent biliary pancreatitis. At the beginning of the experience, a staged approach was followed attempting primary endoscopic ERCP using double-balloon endoscopes. Failure of this technique leaded to a LAERCP. A concomitant laparoscopic cholecystectomy was performed in order to prevent any future episodes of common bile duct lithiasis. When common bile duct cannulation was impossible during LAERCP, a rendezvous technique was used as described bellow. Contraindications to this technique were general contraindications to laparoscopy such as patient inability to tolerate pneumoperitoneum.

Definitions

Definite diagnosis of common bile duct lithiasis was made by means of ultrasound or MRI-MRCP exam guided by clinical suspicion and liver chemistry in an acute (acute cholangitis, acute biliary pancreatitis) or chronic setting (asymptomatic jaundice).

Technique description

In the operating room the patient is placed in a supine position with legs abducted and secured to the operating table to allow for a reverse Trendelenburg and lateral tilting. The surgeon stands between the patient's legs. The assistant stands on the patient's left, and two video monitors are placed at the head and right side of the patient.

For the patient presenting an esophageal peptic stenosis, an endoscopy was performed initially. This revealed a middle esophageal stenosis not allowing passage of a conventional duodenoscope despite balloon dilation (maximal dilation achieved up to 16.5 mm). A laparoscopy-assisted ERCP was then decided upon.

A 10 mm port is initially placed above the umbilicus using a Hasson's open technique. Subsequently, three 5 mm ports are placed, in the epigastrium, right lateral abdominal wall, and left hypochondrium in order to achieve

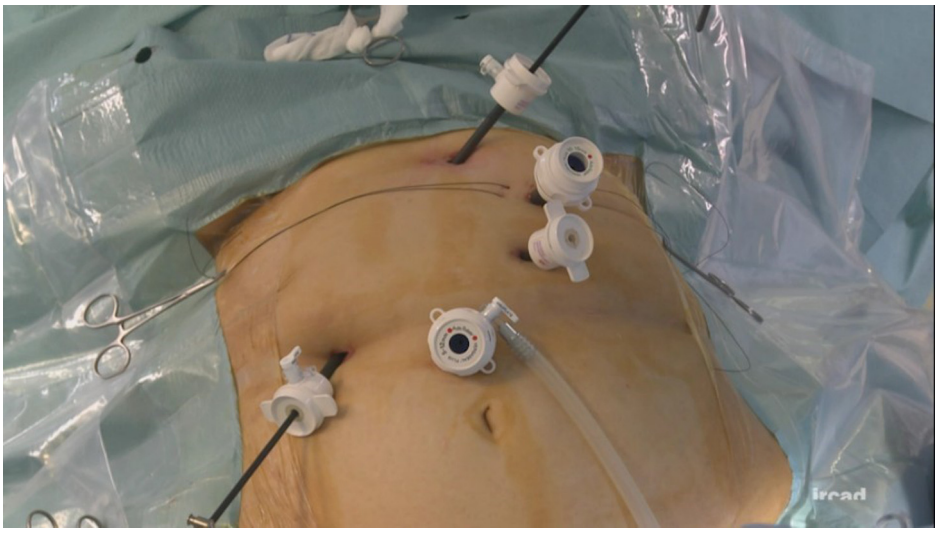

Figure 1. Positioning of ports. A 15 mm port is placed in the left hypochondium for introducing the duodenoscope into the stomach.

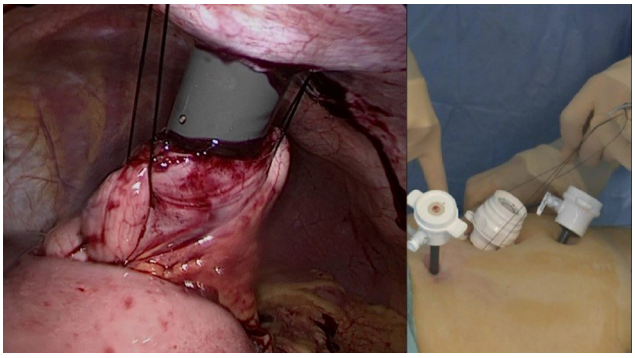

Figure 2. The 15 mm port is placed through the gastric remnant and stabilized on the anterior abdominal wall using 2 transparietal stay sutures.

triangulation (Fig. 1). An initial exploration is performed for the RYGB cases identifying the gastrojejunal and jejunojejunal anastomosis, the afferent Roux limb and the biliopancreatic limb. The mesenteric and Petersen spaces are routinely checked in order to correct any internal hernias. Once the gastric remnant is identified, a gastrotomy is performed at the anterior surface of the stomach. According to our experience, this gastrotomy is usually performed at the level of the gastric antrum. This position offers a significant benefit to the endoscopist by allowing him an easy passage towards the duodenum, limiting thus manipulation of the duodenoscope during common bile duct exploration. Two transparietal straight needle stitches are subsequently passed through the anterior abdominal wall and at both sides of the gastrotomy in order to suspend the stomach (Fig. 2). A 15 mm port is then placed on the left hypochondrium and is introduced into the stomach passing through the gastrotomy. A laparoscopic bowel clamp is placed on the biliopancreatic limb in order to prevent any bowel distension during endoscopy, which could subsequently render laparoscopy difficult. Pneumoperitoneum is then decreased to 5 mmHg and traction is exerted on the extra-corporeal stitches in order to pull up the stomach bringing it in contact with the anterior abdominal wall.

Once laparoscopic access to the stomach has been obtained, endoscopy is performed. A conventional side-viewing endoscope (duodenoscope) is used. The endoscopist guides the duodenoscope, through the pylorus and into the duodenum, just as in a standard ERCP. Cannulation, sphincterotomy, and bile stone extraction is then performed in a standard fashion. Once the ERCP has been completed, the endoscope is removed from the stomach, stitches are relaxed, pneumoperitoneum is increased to 12 mmHg, and the 15 mm port is removed from the stomach. The gastrotomy is finally closed by means of interrupted 3/0 absorbable stitches. Once the procedure has been completed, hemostasis is verified and ports are removed under visual control.

Rendezvous technique

This technique can be used for difficult endoscopic papilla cannulation. It consists in passing a flexible guidewire (Jagwire™) through the cystic duct and down through the papilla laparoscopically (Fig. 3). Subsequently, the guidewire is recovered by the endoscopist and is used as a guide to enter the papilla. Once biliary stone extraction is completed, the guidewire is removed, cholecystectomy is completed and the procedure is completed as described above.

Results

From February 2014 to May 2015, five cases of transgastric LAERCP procedure were identified. All patients were female. Median age at operation was 41 years old (range: 31—64 years). Four (80%) patients had a history of a RYGB, whereas one patient presented with a benign esophageal peptic stenosis. Indications for ERCP were common bile duct lithiasis associated with recurrent episodes of pancreatitis for one patient and recent jaundice with past history of cholangitis for another. The rest of the patients (1 case of peptic stenosis and 2 cases after RYGB) presented with an acute cholangitis that was unresponsive to antibiotic treatment (Table 1).

In total, four patients (80%) underwent an unsuccessful attempt of a double-balloon ERCP (DBE-ERCP) after which a LAERCP was decided.

Biliary cannulation during LAERCP was achieved in all patients ($n = 5$, 100%). One patient (20%) required a laparoscopic assistance using the rendezvous technique. Biliary sphincterotomy and cholangiogram revealed common bile

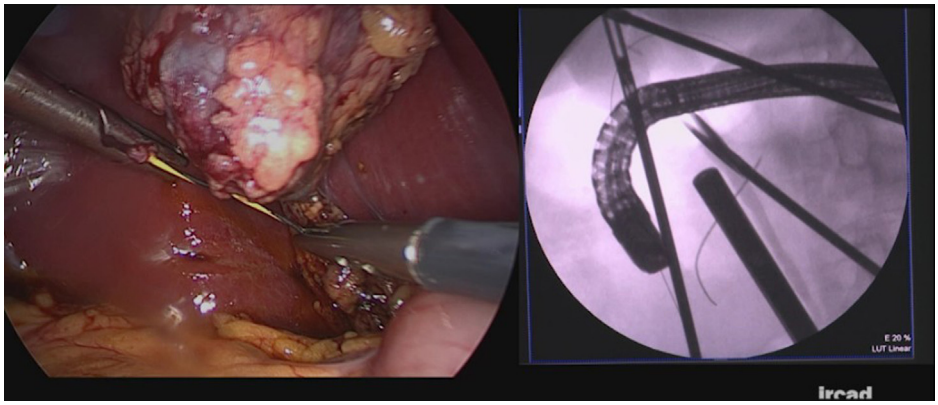

Figure 3. Rendezvous technique. A guidewire is passed through the cystic duct by the surgeon during cholecystectomy procedure and guides difficult common bile duct cannulation.

Table 1 Patients characteristics.

Patient	Age	Sex	Original operation or pathology	Indication	Distance from initial operation (months)	PO hospital stay (days)
1	41	Female	RYGB	Choledocholithiasis/ recurrent pancreatitis	14	3
2	37	Female	RYGB	Acute cholangitis	13	2
3	56	Female	RYGB	Choledocholithiasis	79	5
4	31	Female	RYGB	Acute cholangitis	21	5
5	64	Female	Upper GI stenosis	Acute cholangitis	—	4

PO: postoperative.

Table 2 LAERCP operation details.

Patient	Procedure	Duration of procedure (min)	Complications
1	LAERCP + cholecystectomy	132	No
2	LAERCP	66	No
3	LAERCP	200	No
4	LAERCP	130	No
5	LAERCP + cholecystectomy	144	No

LAERCP: laparoscopy-assisted transgastric endoscopic retrograde cholangiopancreatography.

duct stones in all patients. LAERCP allowed treating choledocholithiasis ($n = 5$, 100%), gallbladder stones ($n = 2$, 40%) and acute cholangitis in 3 patients (60%). No conversion to open laparotomy occurred. LAERCP procedure was associated with concomitant laparoscopic cholecystectomy in two patients, the rest of the patients having already undergone a cholecystectomy.

Postoperative outcomes were uneventful for all patients and no other intraoperative or delayed complications occurred. Median procedure time was 134 minutes (range: 66—200 minutes) with a median postoperative hospital stay of 4 days (range: 2—5 days). No recurrence was observed during follow-up (Table 2).

Discussion

Accessing the biliary tree in patients with a surgically altered anatomy or upper GI stenosis has become an important issue nowadays. This has been widely demonstrated taking into account all different types of techniques described to overcome this problem [5—8,10—12,15,16].

Surgical common bile duct exploration was the gold-standard procedure for treatment of bile duct stones a few decades ago. Its postoperative mortality rate varying 1.3—4%, and high morbidity rates (20—40%) reserved this technique to selected cases. Laparoscopic choledochotomy, as an alternative to open surgery, is indicated in patients with a wide common bile duct (> 9 mm) to avoid bile duct stricture. Its success rate is approximately 86—95%, with 5—18% complication rates [17].

Endoscopic treatment of common bile duct lithiasis in RYGB patients is feasible with an average success rate though of approximately 60%. Methods still remain challenging, requiring specific technical means and skilled operators [4,8]. Standard push endoscopes (enteroscopes and colonoscopes) have been used to perform ERCP, but only a few selected reports with successful cannulation of the papilla have been published [4,13,18]. Wright et al. reported a successful ERCP in 67% of patients (55% of RYGB patients)

by means of peroral duodenoscopy. Similarly, Hintze et al. reported a 33% success rate in reaching the papilla [8,13]. More recently, single- and double-balloon endoscopes (DBEs) have been used in order to successfully reach the biliopancreatic limb. However, successful ERCP rates even in expert hands remain relatively low, ranging from 46 to 80% [6,9,11,12,16]. Part of the reason is probably related to the fact that the papilla is reached from a different angle than with common duodenoscopes. Moreover, enteroscopes lack an elevator, which helps precise orientation of endoscopic instruments, requiring a precise positioning of the enteroscope. Finally, another important disadvantage of this technique is its long procedural time.

Other endoscopic techniques described involve performing an ERCP through a gastrostomy or jejunostomy tube, which has been previously placed under surgery (open or laparoscopic) or radiologic guidance [10,19,20]. In the first case no advantages to the LAERCP exist and in the second case ERCP should be performed in a two-stage manner. This is because progressive balloon or boogie dilation of the matured gastrostomy tract is necessary in order to adjust to the size of a duodenoscope. This delay for the tract to mature prior to transgastric-ERCP makes this technique not useful for urgent cases. A one-stage manner endoscopy-assisted ERCP was described by Kedia et al. He reported a series of 6 patients in which he performed a successful EUS-directed transgastric ERCP (EDGE) using an EUS-guidance to gain percutaneous trangastric access and perform an anterograde ERCP [7]. Furthermore, he described an internal-EDGE during which a temporary gastrogastric or jejunogastric fistula is created in order to access the gastric remnant [21]. Both of these techniques remain quite complex and not enough experience has been reported in order to propose them as a standard of care.

Radiologic percutaneous transhepatic common bile duct access has also been described in literature as an alternative to endoscopic ERCP. Papilloplasty with expulsion of the stones using an occlusion balloon or forceful saline flushes is used with high success rates (97%) and low morbidity and mortality rates have been described in a study of Ozcan et al. [22]. This technique could prove a good alternative to minimal invasive treatment of common bile duct lithiasis and further studies should be carried to evaluate the efficacy in comparison to endoscopy. However, extensive discussion of these particular techniques is beyond the scope of this article.

In our study, four of our patients (80%) had undergone unsuccessful attempts of ERCP using DBEs. Taking in account operative risks, a staged approach was followed depending on local expertise. Like in our experience, other reports of successful LAERCP are available in the literature. Laparoscopy-assisted ERCP had high technical success rates of 95% in a series of 21 patients (one failure as a result of a stone impaction in the ampulla which prevented cannulation) [15,23—27]. Presently, Lopes et al. have reported on 10 patients who underwent LAERCP. Nine patients had undergone a RYGB while one had a partial gastrectomy with Roux-en-Y reconstruction. Biliary cannulation was successful in 90% and pancreatic cannulation in 100% of the patients [15]. Internal hernias were also diagnosed and treated in 4 patients and one patient was treated surgically for symptomatic adhesions. This can be a potential advantage of laparoscopy in diagnosing a pathology that was not discovered during preoperative work-up.

From a technical point of view, in our series, transgastric intraoperative ERCP was performed by surgeons with skills in advanced laparoscopy and endoscopy. ERCP was performed with a standard side-viewing endoscope. However, some technical pitfalls have to be mentioned. Control of the endoscope was more difficult than in an ordinary peroral ERCP as positioning a duodenoscope through a port makes the endoscope unresponsive to normal maneuvers. For this reason, an additional assistant was required to maintain torque and change positions of the scope. This is why we feel that positioning of the transgastric port at the antrum as far as possible from pylorus provides a linear direction of the scope towards the duodenum and thus decreasing useless maneuvers. Carbon dioxide insufflation is mandatory in case of intraperitoneal gas leakage. Decreasing tension of the pneumoperitoneum during endoscopy (and thus tension between the stomach and the anterior abdominal wall) prevents any displacement of the transgastric port and provides more space intraduodenaly (no external pressure from gas insufflation) for the endoscopy. We did not encounter any intraoperative complications or conversion to open surgery but performance of a LAERCP can be strongly influenced by any postoperative adhesions. An eventual disadvantage of the LAERCP method in case of incomplete stone extraction is the requirement of a repeated ERCP. In a case like this a percutaneous gastrostomy tube can be left in place during the first LAERCP procedure and repeat the procedure through the mature gastrostomy tract later on.

In conclusion, although LAERCP is a relatively safe procedure, it is still not widely performed. Yet, the reported experience is steadily growing. Considering the small number of patients in this study, data interpretation with regards to efficacy can only be limited. Our results can be added to the existing literature regarding the successful approach of LAERCP, with an acceptable complication rate. Our operative time is comparable with the previous reports and it represents one of the main advantages of this approach. As a result, LAERCP appears to be a highly successful option to consider in patients with difficult access to the biliary tree in order to treat common bile duct lithiasis. Close collaboration between surgeons and endoscopists is necessary.

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent

Informed consent was obtained from all individual participants included in the study.

Disclosure of interest

The authors declare that they have no competing interest.

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