Biliary Bypass with Laparoscopic Choledochoduodenostomy

Short Title: Lap CDD

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Abstract

Introduction: Laparoscopic choledochoduodenostomy (LCDD) is employed to treat many benign biliary diseases when endoscopic or percutaneous techniques are not feasible.

Technique: We describe our technique for LCDD, which utilizes common bile duct transection and an end-to-side biliary-enteric anastomosis. This procedure includes the following elements: isolation and transection of the common bile duct, mobilization of the duodenum (Kocher maneuver), inspection of the common bile duct, and end-to-side biliary-enteric anastomosis. Key details and pitfalls are discussed.

Results: Over a 5-year period LCDD was performed on eighteen patients. Indications included intractable abdominal pain (10) and choledocholithiasis (8). The majority of patients, 83%, tolerated the operation well with no complications. There was one post-operative intra-abdominal abscess and two anastomotic strictures, one in the immediate post-operative period and the other nine months after the operation. The median length of stay was four days (IQR: 3.0-5.3), and there was minimal blood loss.

Conclusion: Based on our experience, LCDD with transection and end-to-side biliary-enteric anastomosis is a safe and effective biliary bypass technique.

Introduction

The first choledochoduodenostomy (CDD), performed in 1888 by Bernhard Riedel, was used to extract retained bile duct stones and utilized a side-to-side anastomosis between the common bile duct and the duodenum[1]. In the years since, CDD has been used to successfully treat many benign biliary diseases including choledocholithiasis, cholangitis, recurrent/chronic pancreatitis, and biliary tree strictures[1-3]. With the advent of laparoscopic surgery and increasing surgeon experience and technical expertise, laparoscopy is a practical approach for many biliary operations including CDD.

In recent years, however, endoscopic techniques and, in select settings, image-guided percutaneous approaches have largely replaced surgery in the management of benign biliary tract diseases[4-6]. Today, surgery is mainly reserved for instances when endoscopic or percutaneous approaches are not available or not viable options. When biliary bypass is indicated three options are available: CDD with side-to-side biliary-enteric anastomosis, CDD with end-to-side biliary-enteric anastomosis, and biliary-jejunal anastomosis either as a hepaticojejunostomy or a Roux-en-Y choledochojejunostomy. All three can be accomplished via a laparoscopic approach, however, there is no consensus to which is best due to a paucity of data comparing the techniques. Choice of operation is largely left up to the individual surgeon.

Although performed infrequently for benign biliary disease, biliary bypass operations are fundamental for any gastrointestinal surgeon and are considered a core operation by the American College of Surgeons for any general surgery resident [7]. Herein, we describe in detail our technique for laparoscopic choledochoduodenostomy (LCDD) and outcomes when used for benign biliary disease.

Materials and Methods

Human subjects research approval for this study was obtained from the institutional review board of the Indiana University School of Medicine and was carried out in compliance with the IU Standard Operating Procedures for Research Involving Human Subjects.

The electronic medical record was queried for all patients undergoing laparoscopic choledochoduodenostomy at Indiana University Hospital between January 1, 2011 to January 1, 2016. The data presented represents the experience of two surgeons experienced in both laparoscopy and biliary surgery. Selection of laparoscopic choledochoduodenostomy as the biliary bypass operation was at the discretion of the treating surgeon. Operative notes were reviewed for all patients to ensure a laparoscopic approach was used and to record the details of the procedure. Patient charts were reviewed and age, sex, body mass index (BMI), operative time, operative blood loss, length of stay, American Society of Anesthesiologists (ASA) classification, operative indication, and follow up data were recorded.

Operative Technique

The patient is placed in supine position with arms extended. Appropriate preoperative antibiotic prophylaxis is administered and intermittent compression stockings are placed for deep vein thrombosis prophylaxis. Port placement is diagrammed in Figure 1. The Hassan technique is used to gain entry into the abdomen and placement of the first port. The method of initial entry, however, may be adjusted based on surgeon preference. The lateral right abdomen port and the camera ports are 12 mm. All other ports are 5 mm. A 30º laparoscope is used. As is standard with all operations, the abdomen is inspected for visceral organ injury during entry and other abdominal pathology.

Upon entry into the abdomen some degree of adhesiolysis is often necessary due to patient history of previous cholecystectomy or inflammation from biliary disease. A Nathanson retractor is placed through the 5 mm epigastric port to elevate the left lateral segment of the liver. A harmonic scalpel is used to open the port hepatis and circumferentially dissect out the common bile duct from the hepatic artery and portal vein (Figure 2). The common bile duct is then divided just above the duodenum with electrocautery (Figure 3). At this point the distal bile duct is over-sewn with interrupted 2-0 vicryl or PDS sutures. Any biliary stents that are present from previous endoscopic procedures are removed. In patients with biliary stents or suspected or confirmed bile duct stones a biliary fogarty catheter is passed through the proximal common bile duct to clear any stones or debris.

Next, a Kocher maneuver is performed to mobilize the duodenum. A longitudinal duodenotomy is made. Care must be taken to create this duodenotomy at a point that will ensures a tension-free anastomosis is achieved. A primary end-to-side choledochoduodenostomy is then created with a single-layer of 4-0 vicryl sutures in a running or interrupted fashion.

The right upper quadrant is copiously irrigated with warm normal saline and the anastomosis is carefully inspected for a bile leak. A 15 mm blake drain may be placed posterior to the choledochoduodenostomy and brought out through the right abdomen 5 mm port. The pneumoperitoneum is then reversed and all port sites are closed in the standard fashion.

Results

The described technique has been used in the treatment of eighteen patients. Median age was 46.8 years (IQR:37.2-67.4) and BMI was 27.2 kg/m^2 (IRQ:21.7-30.6). There were 13 females and 5 males. Median follow up was 68 days (IQR: 36-116) with one patient lost to follow up. Median common bile duct diameter was 10 mm (IRQ:9.0-13.0), operative time was 165.5 minutes (IRQ:127.0-195.3), blood loss was 35.0 mL (IQR:20.0-100.0), and length of stay was 4.0 days (IRQ:3.0-5.3). Ten patients had intractable abdominal pain and eight had choledocholithiasis. All patients failed endoscopic treatment with ERCP prior to LCDD with 10 (55.6%) undergoing multiple ERCPs without resolution of symptoms. All patients were low to moderate surgical risk with ASA classifications of 2 (33%) or 3 (67%).

The majority of patients, 15, had favorable outcomes with no known complications. One patient developed an intra-abdominal abscess on post-operative day 11, which required percutaneous drainage and a course of antibiotics. The abscess resolved, and the patient recovered with no further complications.

Two patients developed strictures, one in the immediate post-operative period and one at nine months. The patient with immediate CDD stricture was managed with percutaneous transhepatic cholangiographic (PTC) drain placement followed by a recovery period and eventual anastomotic revision with a hepaticojejunostomy. This patient has recovered and is currently without any further issues. The patient with stricture development at nine months has required PTC with stent placement and two subsequent endoscopic retrograde cholangiopancreatographies (ERCP), one for stent removal and one for CDD dilation. This patient has had symptomatic improvement with these interventions.

Discussion

Although infrequently used due to the emergence of endoscopic and image-guided percutaneous approaches, laparoscopic choledochoduodenostomy (LCDD) remains a necessary and fundamental technique for the gastrointestinal surgeon and is considered a core operation for general surgery residency training[7]. This series details our technique for LCDD and demonstrates that it is a safe and effective operation for patients with benign biliary pathology.

Endoscopic and image-guided percutaneous approaches have largely replaced surgical procedures for benign disease of the biliary tract. There are situations, however, when surgery is necessary. Lack of endoscopist or radiologist with the technical expertise, abnormal anatomy such as after Roux-en-Y gastric bypass surgery, and multiple failed endoscopic or percutaneous interventions all call for a surgical approach to management[8-11].

Preoperative assessment for patients is similar to that for any other biliary operation, including laboratory testing (complete blood count, serum electrolytes, and liver function tests). Imaging is performed at the treating physician’s discretion and may include CT scan, magnetic resonance cholangiopancreatography (MRCP), and endoscopic retrograde cholangiopancreatography (ERCP). Patients with intractable abdominal pain are only taken to the operating room for LCDD if the symptoms are biliary in nature and CT scan, MRCP, and ERCP have been performed and failed to identify an alternative origin. An argument can be made that common bile duct diameter should be determined prior to operation as experience with the side-to-side anastomosis technique has indicated that common bile duct diameter > 15 mm is associated with less complications[12-14]. All patients in this study were noted to have dilated common bile duct intra-operatively. Fourteen patients had common bile duct measurements with the median diameter being 10 mm (IQR:9.0-13.0).

Postoperative care is similar to that of a laparoscopic cholecystectomy. Patients are allowed to advance diet as tolerated, adequate pain control is provided, and early ambulation is encouraged. A follow up appointment is schedule for approximately 30 days after hospital discharge. If the patient has recovered well at the initial post-operative visit no additional follow up is necessary.

The technique described above differs from the technique for most data published on LCDD due to the use of an end-to-side biliary-enteric anastomosis. Data published on the side-to-side LCDD report hospital length of stay ranging from 4-10 days and complications as high as 19%[2,10,13-15]. This series has similar results, as the median length of stay was 4.0 days (IQR:3.0-5.3) and the complication rate was less than 20%. The end-to-side anastomosis technique is advantageous in that it eliminates of the potential development of sump syndrome. Sump syndrome occurs as a result of bile stasis and debris accumulation in the infra-anastomotic bile duct resulting in bacterial overgrowth. Sump syndrome has been reported to occur in up to 2.5% of

LCDD utilizing side-to-side anastomoses[1,16]. While rare, sump syndrome is a serious complication that causes continued pain and increases the risk for cholangitis and hepatic abscesses.

Long-term results of open transection choledochoduodenostomy have been excellent. Cuschieri et al. demonstrated greater than 5-years of follow up on 26 patients without a single anastomotic stricture[17]. Our series had two incidences anastomotic stricture. One occurred in the immediate post-operative period and was likely due to a technical error during the operation, as this patient never experienced pain relief after surgery and the stenosis was diagnosed fewer than 30 days after surgery. The other stricture was in a patient who underwent the operation for intractable abdominal pain of biliary origin and it is likely that some degree of chronic inflammation due to the underlying pathology played a role in the development of this stricture. Stricture is a potential long-term complication with any biliary reconstruction. The majority of the patients presented here have only had short-term follow up and it will be important to continue to follow these patients to fully assess the long-term stricture rate of this operation.

A direct comparison between side-to-side CDD, end-to-side CDD, and Roux-en Y choledochojejunostomy has been difficult due to the rarity of patients who fail or are not amendable to endoscopic therapy[18,19]. It has been shown that reconstruction with biliary-duodenal anastomosis can be safely performed and has the added benefit of preserving endoscopic access to the biliary tree. Thus, a strong argument can be made that CDD should be utilized before choledochojejunostomy if possible. Roux-en-Y hepaticojejunostomy is also another options for these patients, however, LCDD has one less anastomosis and is less divergent from normal anatomy and physiology.

Patient factors must always be considered in any operation and LCDD is no exception. All patients in this study were relatively low-risk surgical candidates with ASA scores of either 2 or 3. High-risk surgical candidates, ASA >3, requiring repeated endoscopic interventions should be considered for LCDD. Open surgery has been shown to have no increased risk in morbidity or mortality compared to endoscopic sphincterotomy in this patient population and LCDD may provide a definitive solution[20]. Additionally, the port site placement outlined here may need modified based on the physical and anatomic characteristics of individual patients as well as cosmetic consideration[21,22].

A disadvantage of this technique is the higher technical difficulty of the end-to-side anastomosis compared to the side-to-side approach. Robotic assisted surgery has the potential to resolve this issue. Robotic assisted choledochoduodenostomy has been described in the literature and has been shown to be safe and feasible[23,24]. Additional training, however, is required to develop proficiency using the robot and this training not currently a standard part of a general surgeon’s training. Laparoscopy is a mandatory part of a general surgeon’s skills set and currently is the most widely used minimally invasive approach. Choice of biliary bypass surgery should ultimately be determined by the surgeon with attention to patient factors, plans for future access to the biliary tree, and surgeon expertise and comfort.

Conclusion

Currently there is not adequate data to demonstrate the superiority of any one biliary-enteric anastomotic technique. While endoscopic intervention is the first choice for treatment of benign biliary disease, there are instances where it is not feasible, and thus, choledochoduodenostomy remains a fundamental operation for the gastrointestinal surgeon. The choice of biliary bypass technique depends on several factors and is ultimately up to the operating surgeon. The technique for laparoscopic choledochoduodenostomy described above can be accomplished safely and provides acceptable outcomes in patients with benign biliary disease, while eliminating the risk of sump syndrome.

Conflicts of interest: Drs. Joshua K. Kays, Leonidas G. Koniaris, Daniel P. Milgrom, and Attila Nakeeb have no conflicts of interest or financial ties to disclose.

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Figure 1. Laparoscopic Port Placement. A 12 mm port is placed in the umbilicus and used for the camera. An additional 12 mm working port is placed in the right abdomen just lateral to the midclavicular line. Three 5 mm ports are placed: the epigastric port is used for placement of a Nathanson liver retractor, while the right and left upper quadrant ports are working ports.

Figure 2. Dissection of the porta hepatis. A) Schematic and B) intra-operative view of the dissection of the porta hepatis. A Harmonic scalpel is used to incise the hepatoduodenal ligament and enter the porta hepatis. The common bile duct (CBD) is then circumferentially dissected out and isolated from the proper hepatic artery (PHA) and the portal vein (not in view).

Figure 3. Transection of the common bile duct. The common bile duct is transected with electrocautery just above the duodenum ensuring to leave enough of the distal common bile duct to oversew.

Figure 4. Longitudinal duodenostomy. A) A longitudinal duodenostomy is made using a harmonic scalpel. B) The duodenostomy size will depend on the diameter of the common bile duct. It is important to create the duodenostomy distal to the pylorus and at a point where a tension free choledochoduodenstomy can be created.

Figure 5. Creation of the anastomosis. A) Schematic and B) intra-operative view of final end-to-side anastomosis. The choledochoduodenostomy (CDD) is made in an end-to-side fashion between the common bile duct (CBD) and the duodenum using an absorbable suture. This can be done in a running or interrupted fashion.

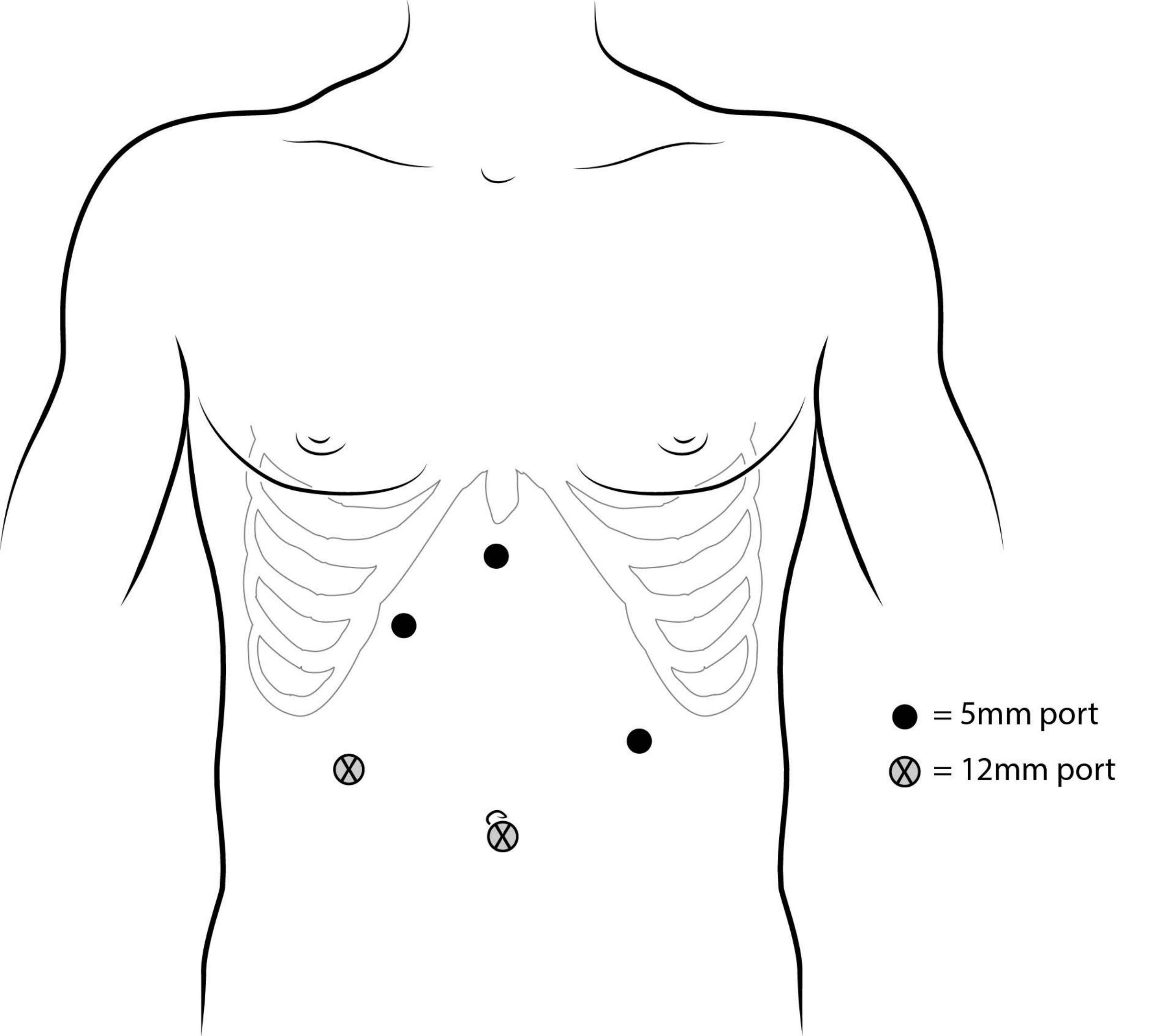
Table 1

Patient and Surgery Characteristics

Age, years	46.8 (37.2-67.4)
BMI, kg/m^2	27.2 (21.7-30.6)
Sex	
Male	5
Female	13
Common Bile Duct diameter, mm	10 (9.0-13.0)
Operative time, minutes	165.5 (127.0-195.3)
Blood loss, mL	35.0 (20.0-100.0)
Length of stay, days	4.0 (3.0-5.3)
Indication for surgery	
Intractable abdominal pain	10
Choledocholithiasis	8
ASA	
2	6
3	12
Complications	
None	15
Intra-abdominal abscess	1
CDD stricture	2

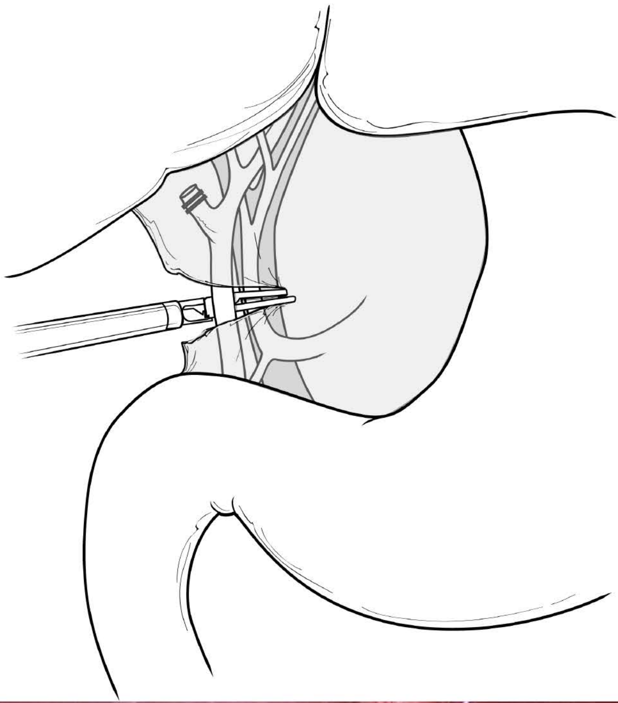
Values are reported as median (interquartile range) or the number of patients.

ASA American Society of Anesthesiologists, *CDD* choledochoduodenstomy



= 5mm port
= 12mm port

a)



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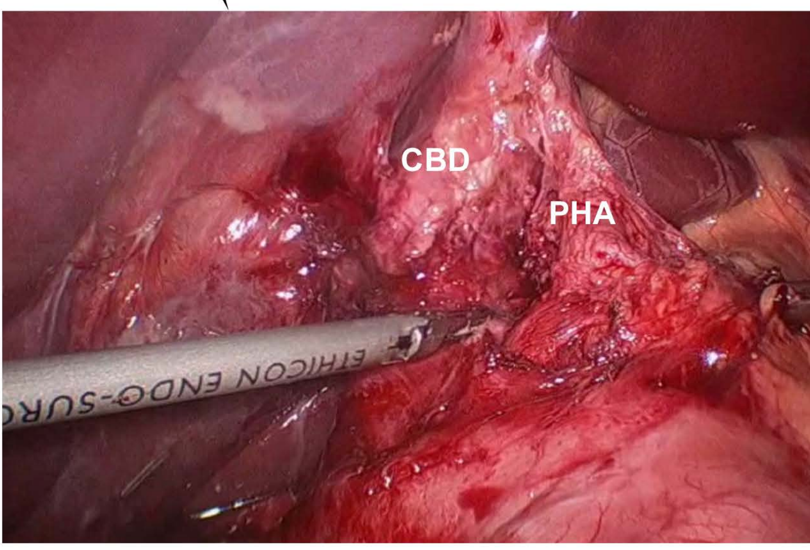

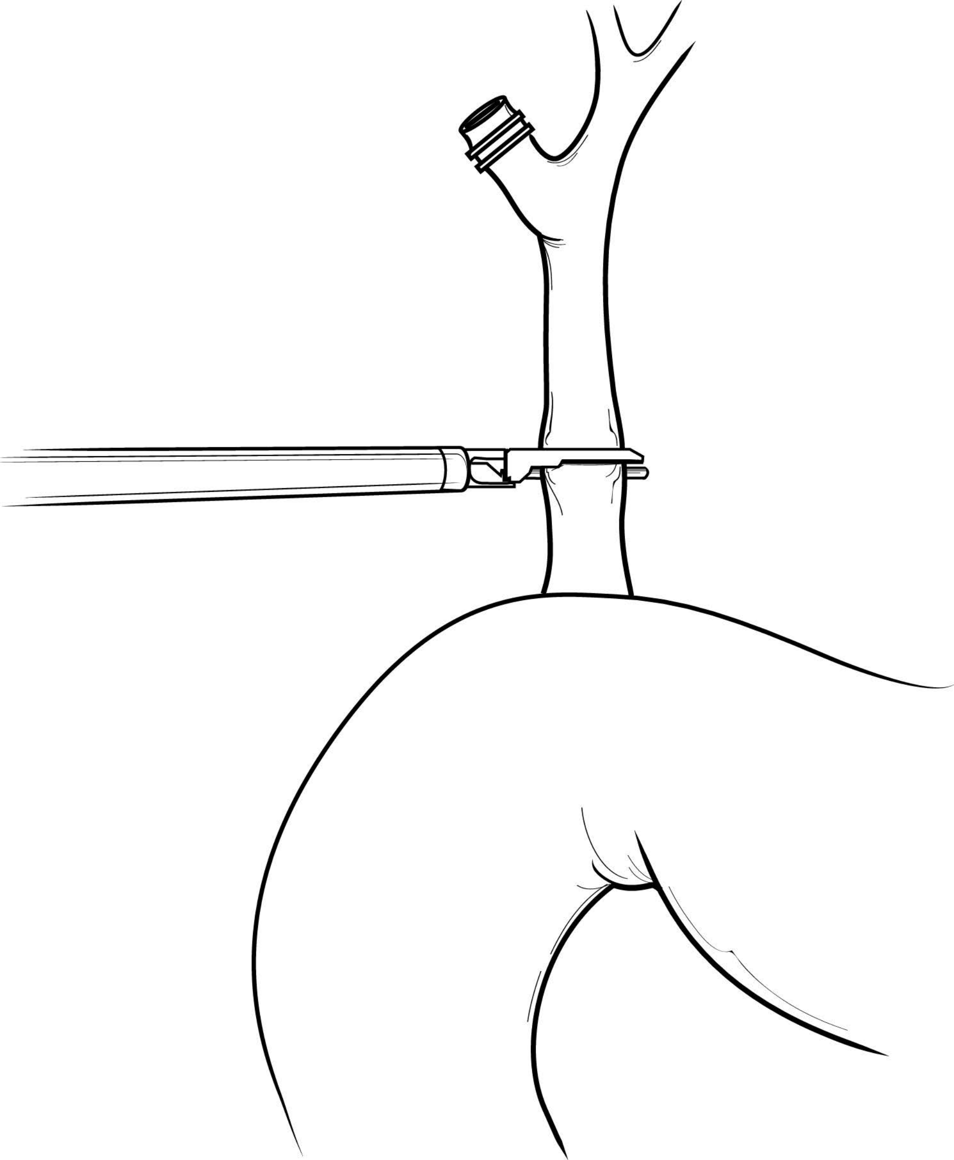

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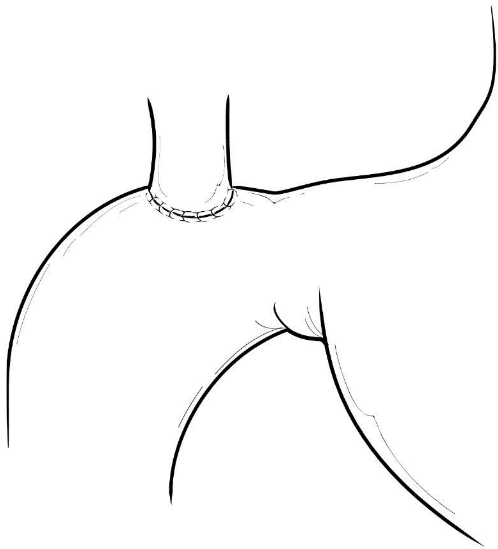

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