Laparoscopic choledochoduodenostomy for management of benign distal biliary stricture: a single-center case series analysis

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Purpose
The aim of this study was to assess the feasibility and safety of laparoscopic choledochoduodenostomy (LCDD) in the management of benign distal biliary stricture (BDBS).
Patients and methods
During a period of 3 years, this prospective study included 30 patients with BDBS and dilated common bile duct (CBD), after failure of endoscopic therapy. Patients were fully assessed (clinically, laboratory, and radiologically) to confirm the diagnosis and exclude malignancy. Surgery was performed 4–6 weeks after the last endoscopic maneuver. After CBD clearance, LCDD was done. Follow-up visits were scheduled at 1, 3, and 6 months, and annually thereafter.
Results
A total of 30 patients met our inclusion criteria. A total of 19 patients were women, with a mean±SD age of 47.4 ± 13.2 years. Overall, 40% of them had previous cholecystectomy. Intraoperatively five cases were excluded, as the choledochoscopy proved no distal stricture. The mean±SD operative time was 200.52 ± 62.17 min with a mean±SD blood loss of 111.6 ± 52.1 ml and one conversion. The mean±SD hospital stay was 5.8 ± 1.62 days, and the mean±SD follow-up period was 22.54 ± 8.11 months. Postoperative morbidity was 20%. There was no stone recurrence, and the mean values of total and direct bilirubin showed significant improvement compared with the preoperative values (1.44 ± 0.75 vs. 2.5 ± 2.48, *P* value=0.021, and 0.76 ± 0.58 vs. 1.83 ± 2.37, *P* value=0.015, respectively).
Conclusion
LCDD for BDBS with or without CBD stones is feasible, safe, and effective. However, longer term follow-up and larger studies are advised.

Keywords:
common bile duct, choledochoduodenostomy, laparoscopic, stones, stricture

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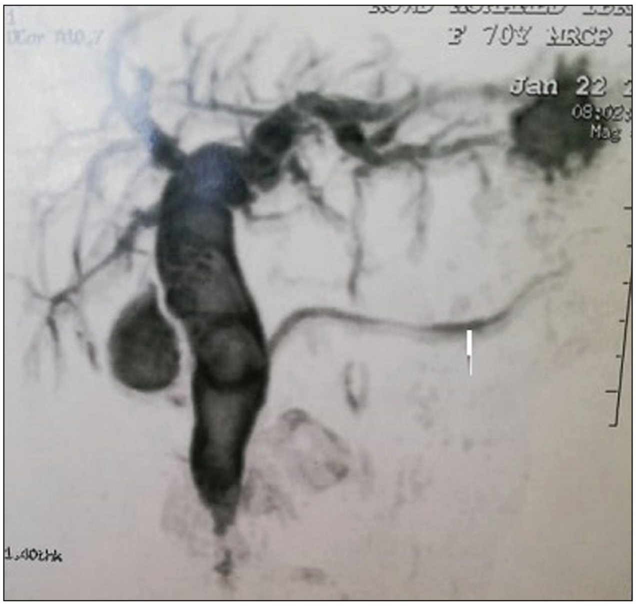
Introduction

Distal biliary strictures (DBSs) are common and may be caused by either malignant or benign pathologies. The differentiation between both carries a significant challenge, and exclusion of malignant etiology requires a wide variety of investigations [1]. Benign distal biliary strictures (BDBSs) have a multifactorial etiology, including choledocholithiasis, chronic pancreatitis, IgG4-associated cholangiopathy, human immunodeficiency virus cholangiopathy, portal biliopathy, and papillary stenosis [2]. In the last few decades, endoscopic procedures and, in selected settings, image-guided percutaneous approaches have greatly developed and largely replaced surgery in the management of benign biliary tract diseases [3]. In spite of the remarkable advances in endoscopic techniques, many patients require a permanent biliodigestive procedure to treat their disease [4]. When biliary bypass is indicated, the following options are available: choledochoduodenostomy (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 [3]. The common indications for CDD have remained unchanged over the years. These are choledocholithiasis, lower bile duct strictures, worm obstruction, papillary or ampullary stenosis, and perivaterian diverticuli [5]. CDD was first described by Riedel in 1888 as a method to relieve biliary obstruction in patients with retained common bile duct (CBD) stones. Laparoscopic choledochoduodenostomy (LCDD) was first performed by Franklin and Balli in 1991 for benign recurrent bile duct obstruction. However, the published literature about LCDD is scarce with limited number of patients [6,7]. The aim of this study was to assess the feasibility, safety, and outcomes of LCDD in the management of BDBSs with or without CBD stones.

Patients and methods

This prospective observational study was carried out at the Gastrointestinal Surgery Unit, Department of General Surgery, Tanta University Hospitals, Tanta, Egypt, during the period from January 2018 till December 2020. It included 30 patients who were diagnosed to have BDBS and dilated CBD greater than equal to than 10 mm (with or without CBD stones) after failed repeated endoscopic therapy (endoscopic sphincterotomy, dilatation, and stenting). Patients with one or more of the following criteria were excluded: CBD less than 10 mm, confirmed malignant distal CBD stricture, stricture of the CBD at sites other than the distal end, and patients who are unfit for laparoscopic surgery owing to cardiopulmonary diseases. The study was approved by the ethical committee of the Faculty of Medicine, Tanta University (No. 32030/12/17), and all patients signed informed consent forms and agreed to participate in the study. All patients were clinically assessed preoperatively by history, examination, basic laboratory investigations (Complete blood count (CBC), liver function tests, renal function tests, and coagulation profile), and tumor markers (Carcino-embryonic antigen (CEA) and CA19-9). Radiological investigations included ultrasonography, Magnetic resonance cholangiopancreatography (MRCP) (Fig. 1), and Contrast enhanced computed tomography (CECT) abdomen pancreatic protocol if needed. Surgery was performed after a period of 4–6 weeks from the last endoscopic maneuver, during which, patients were optimized for surgery.

Figure 1

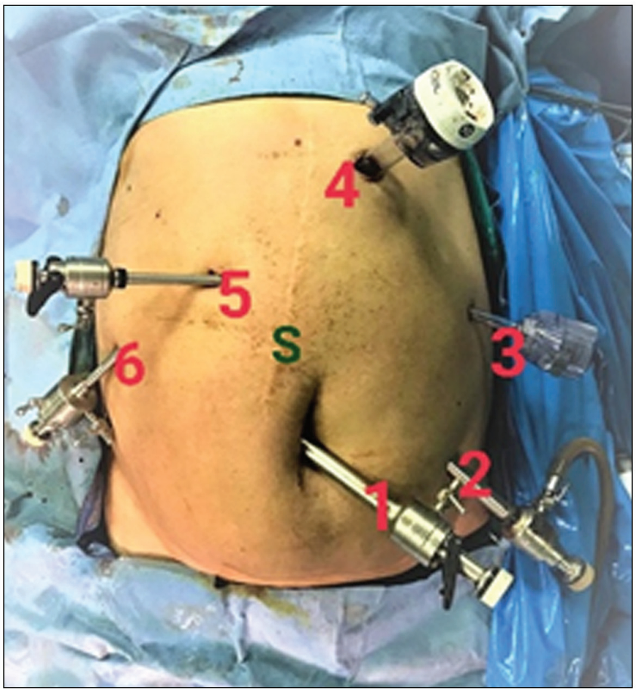


MRCP of patient with previous cholecystectomy showing dilated CBD with distal stricture and multiple stones. CBD, common bile duct.

Surgical technique

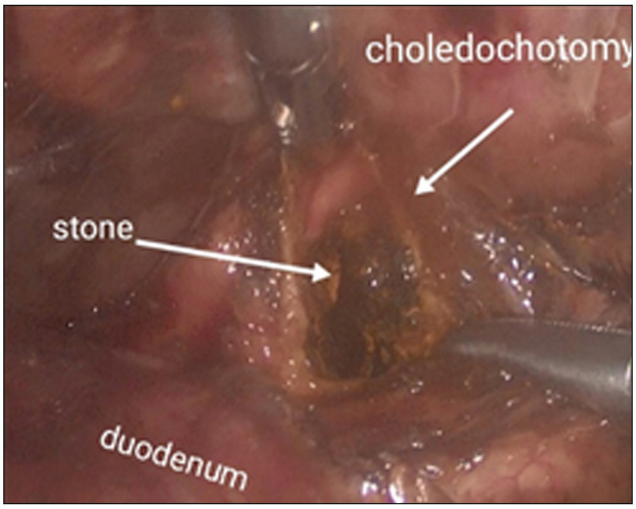
The procedure was performed using the standard four trocars used in the laparoscopic cholecystectomy. Additional fifth and even sixth 5-mm ports were added in the right or left hypochondrium according to the situation (Fig. 2). After initiation of pneumoperitoneum and insertion of the optical port, diagnostic laparoscopy was performed as the first step of the procedure. Then, any adhesions present were taken down to expose the field (the duodenum, liver, and hepatoduodenal ligament), especially in cases with history of previous cholecystectomy. Dissection of the hepatocystic triangle was done to expose the cystic artery (CA) and cystic duct if the gall bladder was not previously removed. Then, clipping and cutting of the CA, clipping of the cystic duct distally, and performing trans-cystic cholangiography if the anatomy was not clearly delineated by the preoperative MRCP were done. Dissection of the hepatoduodenal ligament was done to expose the anterior surface of the supraduodenal CBD. A 2.5-cm longitudinal choledochotomy just above the duodenum was performed (Fig. 3). Clearance of the CBD of stones was done using one or more of the following techniques: milking out the stones, saline flushing to expel out small stones,

Figure 2



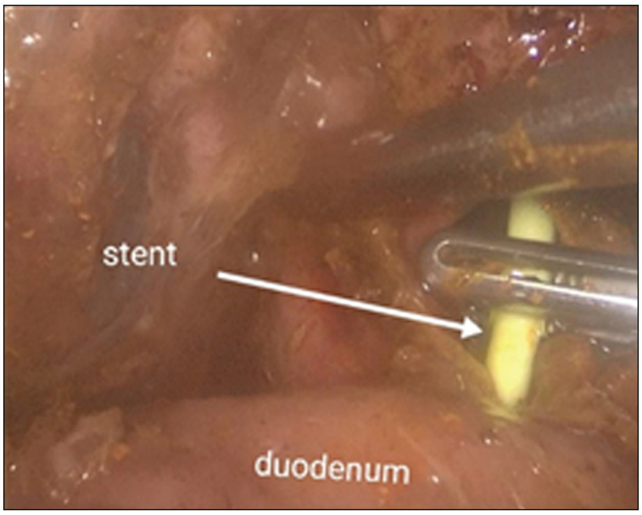
Ports position of patient in Fig. 1. Ports 2 and 3 for initial adhesiolysis. S scar of previous cholecystectomy 30 years ago.

Figure 3



Large stone is seen through the choledochotomy.

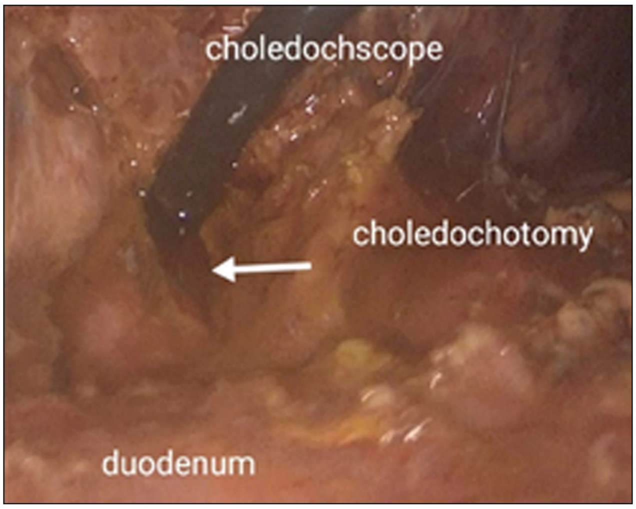
Figure 4



Stent removal through the choledochotomy.

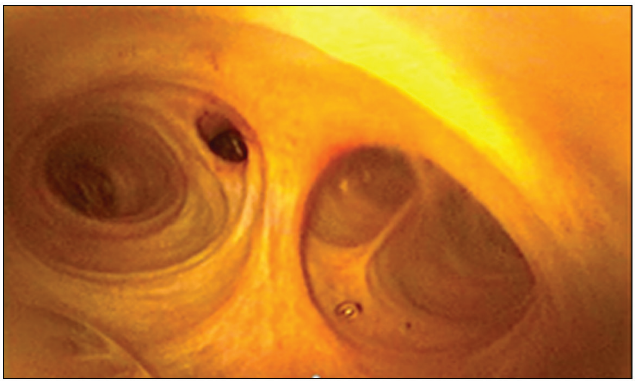
Fogarty catheter and Dormia basket extraction, and removing CBD stent if present (Fig. 4). Completing CBD exploration using the choledochoscope for any remaining stones and its extraction under direct vision and to assess the distal stricture (Figs. 5–7). Complete Kocherization of the duodenum was done to bring it adjacent to the choledochotomy to ensure a tensionless anastomosis. A 2-cm longitudinal duodenotomy was done (Fig. 8). Then, single-layer choledocho-duodenal anastomosis was performed in a diamond fashion with interrupted sutures of the posterior layer using Vicryl or PDS (Ethicon) 3/0 (Fig. 9). Then, closure of the anterior wall was done using continuous Vicryl, PDS (Ethicon) 3/0 or V-lock (Covidien) 3/0 till completing the anastomosis (Fig. 10). gall bladder excision was completed if it was not previously removed, and closed system drain was placed lateral to the anastomosis at the hepatorenal space.

Figure 5



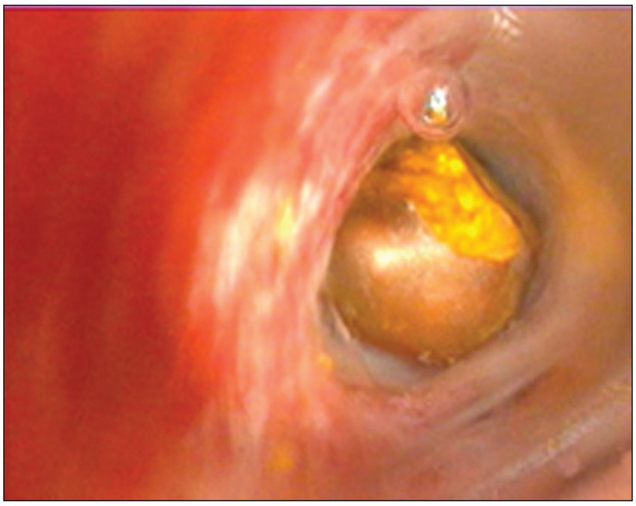
Choledochoscopy of the CBD. CBD, common bile duct.

Figure 6



Choledochoscope view of proximal biliary tree.

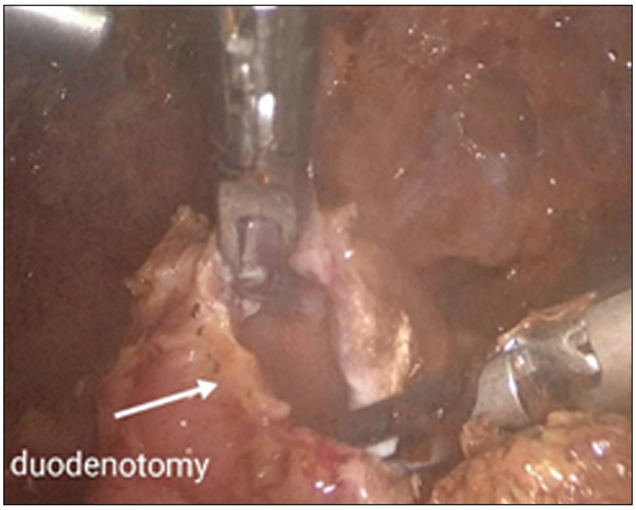
Figure 7



Choledochoscope view of stone at distal end CBD. CBD, common bile duct.

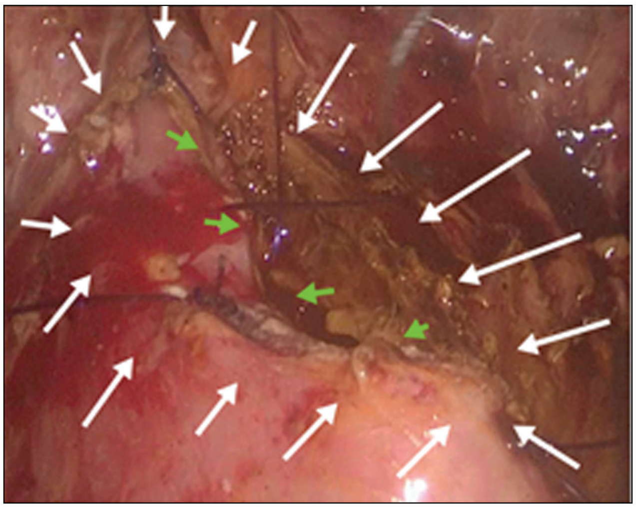
Postoperative care was performed at the general surgical ward. The start of oral intake was determined by the recovery of intestinal function. Drain tubes

Figure 8



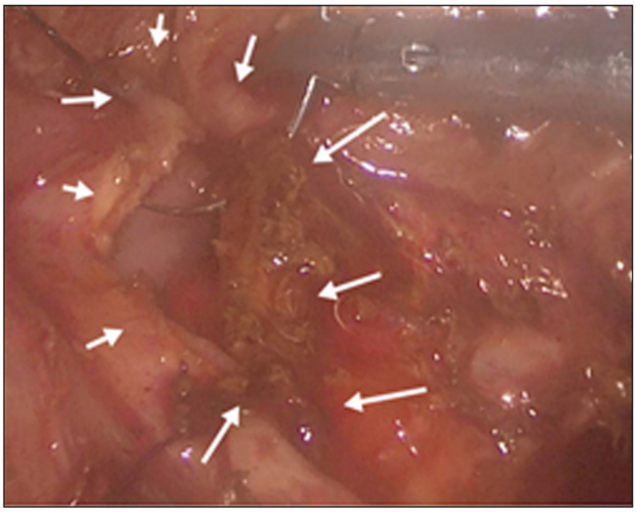
Making duodenotomy.

Figure 9



Interrupted sutures of the posterior wall (green arrows) white arrows indicate anterior wall.

Figure 10



Continuous suturing of the anterior wall (white arrows).

were removed before discharge. Follow-up visits were scheduled after stitch removal at 1, 3, and 6 months postoperatively, with annual appointments thereafter. During each visit, patients were assessed clinically; through laboratory investigations, especially liver function tests; and by ultrasound examination. Further investigations were performed if needed.

Results

This study included 30 patients with BDBS who met our inclusion criteria. A total of 19 (63.3%) patients were women. The mean±SD age was 47.4 ± 13.2 years, and the mean±SD BMI was 27.89 ± 4.62. All our patients were referred from the endoscopy unit after failure of repeated trials of endoscopic therapy by sphincterotomy, dilatation, and repeated sequential stent placement. A total of 12 (40%) cases had previous cholecystectomy, where seven (23.3%) laparoscopically, and five (16.7%) by open surgery through right paramedian incision in three of them and right subcostal incision in the other two. Table 1 shows all patients and disease characteristics. The choledochoscope was able to go through the lower end of the CBD into the duodenum during common bile duct exploration (CBDE) in five patients, indicating false diagnosis of BDBS. Therefore, CDD was not done, and the choledochotomy was closed by primary closure with drain at the hepatorenal space. In the other 25 cases, the diagnosis of BDBS was confirmed by choledochoscope, and CDD was performed after CBD clearance in 24 (96%) cases laparoscopically and one (4%) case was converted open owing to failure of clearance of proximal hepatic ducts stones.

In the 25 cases that underwent CDD, the mean operative time was 200.52 SD 62.17 min, and the median was 176 min. For better assessment, we divided the operative time according to steps into dissection time, CBD exploration time, and anastomosis time. There were no intraoperative complications, and the mean±SD blood loss was 111.6 ± 52.1 ml. Table 2 shows all operative data. There were no cases of mortality and no reported major postoperative complications, but one case of ileus occurred owing to hypokalemia and was managed medically. Three cases of minor wound infections were seen: two cases of port site and the converted open case. All were managed conservatively by repeated dressing and antibiotic according to culture and sensitivity. One of our patients 18 months postoperatively developed cholangitis, recurrent vomiting, anorexia, and upper abdominal discomfort. CECT abdomen showed circumferential mural wall thickening at the second part of duodenum and narrowing of its lumen with periduodenal

Table 1 Patient and disease characteristics

Variables	*N*=30
Age (years)	
Range	29–75
Mean±SD/median	47.4 ± 13.2/47.5
Sex [*n* (%)]	
Male	11 (36.7)
Female	19 (63.3)
BMI (kg/m^2)	
Range	20.2–41.03
Mean±SD/median	27.89 ± 4.62/27.1
Associated comorbidities [*n* (%)]	
Hyperlipidemia	9 (36.7)
DM	3 (10)
Hypertension	2 (6.7)
Chronic liver disease	2 (6.6)
Previous cholecystectomy [*n* (%)]	
Open	5 (16.7)
Laparoscopic	7 (23)
CBD diameter by MRCP (mm)	
Range	10–24
Mean±SD/median	16.46 ± 4.63/15
No of ERCP trials [*n* (%)]	
Three	24 (80)
Two	6 (20)
No of sequential stents [*n* (%)]	
One	1 (3.3)
Two	12 (40)
Three	17 (53.7)
Total bilirubin (mg/dl)	
Range	0.3–11.4
Mean±SD/median	2.5 ± 2.48/1.45
Direct bilirubin (mg/dl)	
Range	0.1–10.4
Mean±SD/median	1.83 ± 2.37/0.37
Serum albumin (gm/dl)	
Range	3.1–4.8
Mean±SD/median	3.94 ± 0.42/3.9

ERCP, Endoscopic retrograde cholangiopancreatography; DM, Diabetes mellitus.

enlarged lymph nodes, suggesting malignant duodenal obstruction. Tumor markers CEA and CA 19.9 were within normal. Upper gastrointestinal endoscopy showed impassable stricture at the second part of duodenum with patent and functioning CDD stoma. Exploration revealed a mass lesion at the region of second part duodenum and adjacent pancreatic tissues. Pancreaticoduodenectomy was performed and histopathological examination of the specimen revealed pancreatic well-differentiated adenocarcinoma with duodenal wall invasion, positive 4/18 lymph nodes for metastasis, with microvascular emboli and perineural invasion, and free resection margins (T3N2Mx). Two of the 25 (8%) patients were lost during follow-up. The mean±SD postoperative hospital stay was 5.8 ± 1.62 days, and the mean±SD follow-up period was 22.54 ± 8.11 months. Table 3 shows postoperative data. There was no stone recurrence, and the mean values of total and direct bilirubin tested the day of patient discharge showed significant improvement compared with the preoperative values (1.44 ± 0.75 vs. 2.5 ± 2.48, *P* value=0.021, and 0.76 ± 0.58 vs. 1.83 ± 2.37, *P* value=0.015, respectively).

Table 2 Operative data

Variables	*N*=25
Operative time (min)	
Range	126–333
Mean±SD/median	200.52 ± 62.17/176
Dissection time (min)	
Range	20.5–92
Mean±SD/median	62.78 ± 19.77/65
CBDE time (min)	
Range	28–139
Mean±SD/median	63.04 ± 33.83/46
Anastomosis time (min)	
Range	24–81
Mean±SD/median	41.88 ± 15.91/39
Intraoperative complications	
Bowel injury	0
Bleeding	0
Blood loss (ml)	
Range	30–220
Mean±SD/median	111.6 ± 52.1/110

Table 3 Postoperative data

Variables	*N*=25
Postoperative complication [*n* (%)]	
Bleeding	0
Bile leak	0
Ileus	1 (4)
Minor wound infection	3 (12)
Reflux cholangitis	1 (4)
Sump syndrome	0
Mortality	0
Total bilirubin	
Range	0.6–3.1
Mean±SD/median	1.44 ± 0.75/1.2
Direct bilirubin	
Range	0.2–2.2
Mean±SD/median	0.76 ± 0.58/0.6
Hospital stays (day)	
Range	4–10.5
Mean/median	5.8 ± 1.62/5
Follow up (month)	
Range	6–34
Mean±SD/median	22.54 ± 8.11/23

Discussion

At our tertiary university hospital, endoscopic therapies are used as the first-line management for the vast majority of biliary disorders including BDBS and choledocholithiasis. However, in spite of resent advances in endoscopic procedures, some cases fail to be managed endoscopically, and surgery becomes required. Minimally invasive biliodigestive bypass procedures, including LCDD, after CBD clearance, are usually the best option in such cases to obtain adequate biliary drainage. This study was conducted to assess feasibility and safety of LCDD as a minimally invasive treatment for cases of BDBS with or without CBD stones, who had failed repeated trials of endoscopic management.

Women predominated our study population (63.3%), which is similar to findings of other series [4,6,8,9]. This could be explained by the higher prevalence of gallstone disease and consequently its complications in females. The mean±SD age of our patients was 47.4 ± 13.2 years, with range of 29–75 years, which is in agreement with other studies [7,8]. The mean±SD CBD diameter estimated by preoperative MRCP in this study was 16.46 ± 4.63 mm. This is similar to that reported by Sankaran *et al.* [7] (16.5 mm) and Okamoto *et al.* [10] (18.4 mm). However, Chander *et al.* [9] and Cuendis-Velazquez *et al.* [4] reported wider mean CBD diameter (24.59 ± 2.564 and 24.9 ± 7, respectively). There is general agreement that, the CBD should be dilated enough to perform an adequately functioning anastomosis to prevent the development of feared CDD complications, like reflux cholangitis, sump syndrome, and anastomotic stricture [4,5,10,11].

Sump syndrome develops due to accumulation of food debris, stones, and mud in the infraanastomotic bile duct, resulting in bacterial overgrowth and recurrent cholangitis. Sump syndrome has been reported to occur in up to 2.5% of CDD utilizing side-to-side anastomoses. Although rare, sump syndrome is a serious complication that causes continued pain and increases the risk for cholangitis and hepatic abscesses [3,12,13]. None of our patients developed sump syndrome during the period of follow-up. This may be explained by selecting sufficiently dilated CBD (our mean CBD diameter was 16.46 mm) and widely constructed diamond-shaped anastomosis (2–2.5 cm).

Overall, 80% of our patients were subjected to three trials of therapeutic endoscopic maneuvers with 56.7% failed three times of sequential stenting. This reflected the complexity of the referred cases, which constituted the population of this study. Another challenge faced in this study was that 40% of its population had previous cholecystectomy with 16.7% by open surgery. This explains the wide range of operative time (126–333 min) and long mean operative time (200.52 SD; 62.17 min) in comparison with some studies [3,5–9,11] who reported operative time of less than equal to 160 min. However, others reported mean operative times of around 200 min, which is comparable to our results [4,10].

For better description, we divided the operative time into three stages (dissection, CBDE, and anastomosis). The mean±SD dissection time was 62.78 ± 19.77 min, the mean±SD CBDE time was 63.04 ± 33.83 min, and the mean anastomosis time was 41.88 ± 15.91 min. Okamoto *et al.* [10] reported mean anastomosis time of 33 min and range of 30–38 min, which is shorter than ours, because they did both anterior and posterior layers by continuous running sutures, which saves time. We used the continuous suturing in the anterior layer only and performed the posterior wall anastomosis by interrupted sutures because we thought it helps in adjusting the choledochotomy to the duodenotomy more accurately.

The main indication for LCDD in our study was BDBS, which failed to be managed endoscopically. In five (16.7%) cases, BDBS was excluded by choledochoscope (false-positive diagnosis), so they were not subjected to LCDD. In the 25 cases confirmed to have BDBS, CDD was performed laparoscopically in 24 (96%) cases, whereas one (4%) case was converted to open owing to failure of clearance of proximal hepatic ducts stones. Khajanchee *et al.* [14] reported conversion in five (25%) casesowing to severe adhesions or portal hypertension, whereas others reported no conversion [4,6,8,15].

This study reported no intraoperative complications with blood loss ranging from 30 to 220 ml with a mean±SD of 111.6 ± 52.1 ml. Chander *et al.* [9] reported mean±SD operative blood loss of 143.3 ± 85.5 ml, Cuendis-Velazquez *et al.* [4] reported mean blood loss of 150 ml (30–600) ml, Sankaran *et al.* [7] reported mean blood loss of 160 ml, Senthilnathan *et al.* [6] reported mean±SD blood loss of 60 ± 19 ml, and Okamoto *et al.* [10] reported mean blood loss of 32 ml. These variations were explained by the presence of adhesions owing to previous upper abdominal surgeries in the studies that reported more blood loss.

The overall postoperative morbidity in this study was 20% (n=5), without mortality. Published literature studies have reported morbidity burden ranging from 3.7 to 23.3% [4–6,9,15]. None of our patients developed anastomotic leak, whereas other studies reported minor leak incidence ranging from 1.5 to 9.1% [6,7,9,14–16]. All of them managed it conservatively by drainage without reoperation. Bayramov *et al.* [15] reported one case of minor leak and other case of major leak with peritonitis that required laparoscopic reoperation.

Although the preoperative assessment of our patients included a wide variety of investigations, and all patients were referred to us after months of trials of endoscopic treatment, one of our patients presented with duodenal obstructive symptoms and found to have periampullary carcinoma 18 months postoperatively. Really, biliary-enteric drainage procedures bypass the intrapancreatic portion of CBD, and so pancreatic head malignancy will present late by the picture of local invasion. So, it is worth keeping patients with BDBS treated by biliary-enteric bypass procedures under long-term follow-up.

Hospital stays in our study ranged from 4 to 10.5 days, with a mean±SD of 5.8 ± 1.62 days. This is similar to that reported by others, who reported mean±SD hospital stays ranging from 4 to 7 days [3,4,6–10,15], whereas Okamoto *et al*. [11] reported longer mean hospital stay of 16 days. Follow-up in this study ranged from 6 to 34 months, with a mean±SD of 22.54 ± 8.11 months. Senthilnathan *et al*. [6] reported mean±SD duration of follow-up of 17 ± 3.2 months, Okamoto *et al*. [10] reported a mean duration of follow-up of 18 months, Cuendis-Velazquez *et al*. (2017) [4] reported a mean duration of follow-up of 18 months, and Okamoto *et al*. [11] reported a mean duration of follow-up of 65 months.

The results of this study indicated that LCDD could be evaluated as satisfactory in managing BDBS, as it resulted in significant improvement of both total and direct bilirubin without stone recurrence and with low morbidity and no mortality. These observations are in agreement with many other studies [14–18], which reported that LCDD is a useful technique in patients with benign and refractory CBD obstruction.

Limitations of this study are the small size of its population and the relatively short follow-up. Moreover, there was absence of comparison with a control or other technique group.

The strength of this study is the characteristics of its population which made the procedure challenging, and it is one of the few studies focusing on BDBS.

Conclusion

LCDD is feasible (completed in 96% of patients), safe (resulting in minor morbidity without mortality), and effective (causes significant improvement in bilirubin levels without stone recurrence). However, longer follow-up and larger studies are advised to confirm these data.

Acknowledgements

We thank all of the participants and physicians who contributed to this project.Declarations

This study was performed in line with the principles of the Declaration of Helsinki.

What is already known? Endoscopic procedures have largely replaced surgery in benign biliary diseases. However, some patients may require a bypass procedure, like choledochoduodenostomy and biliary-jejunal anastomosis. What is new in this study? Laparoscopic choledoduodenostomy for benign distal biliary stricture is safe and effective. Patients should be kept on follow-up to confirm that the stricture is not malignant. What are the future clinical and research implications of the study findings? This study needs more studies to be done in multiple centers to confirm its results.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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