Incidence and management of cases of calcular obstructive jaundice with failed endoscopic retrograde cholangiopancreatography: a 2-year experience

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Received: 11 December 2020
Accepted: 15 December 2020
Published: 5 March 2021

The Egyptian Journal of Surgery 2021, 40:387–392

Background
The 'gold standard' for management of gallstones is laparoscopic cholecystectomy, but there is no consensus for treatment of common bile duct stones. There is insufficient information in the literature on the practice of laparoscopic common bile duct exploration (LCBDE) in cases of endoscopically irretrievable stones. This study presents the technical aspects and results of this approach and comparing it with open common bile duct exploration (OCBDE).

Aim
To assess the management of the patients with calcular obstructive jaundice after failed endoscopic retrograde cholangiopancreatography with LCBDE in comparison with OCBDE.

Patients and methods
A prospective randomized study was conducted for 2 years started from 2017 to 2019 in Theodor Bilharz Research Institute. A total of 600 patients with calcular obstructive jaundice underwent endoscopic retrograde cholangiopancreatography, with failure of stone extraction in 50 patients. Of them, 30 patients underwent LCBDE and the other 20 patients underwent OCBDE. Overall, 40 patients were female and the other 10 were male. They ranged in age from 23 to 80 years old, with a mean age of 46.72 years.

Results
The mean postoperative hospital stay, pain score, and analgesia score were significantly short ($P<0.05$) and less in laparoscopic than OCBDE. The mean intraoperative blood loss, bile leak, and postoperative wound infection were less in laparoscopic than OCBDE, and the mean operative time was less in open than LCBDE ($P>0.05$) but with no statistically significant difference.

Conclusion
LCBDE considered as a safe, efficient and preferred procedure for CBDE whenever possible.

Keywords:
common bile duct exploration, choledocholithiasis, choledocoscopy, endoscopic retrograde cholangiopancreatography, intraoperative ultrasound

Egyptian J Surgery 40:387–392

1110-1121

Introduction

'Gold standard' for management of gallstones is laparoscopic cholecystectomy but there is no consensus for treatment of common bile duct (CBD) stones. In the era of open surgery, treatment was straight-forward, open cholecystectomy with open common bile duct exploration (OCBDE), though it carried high morbidity and mortality [1].

With the advent of noninvasive and minimal invasive techniques, the option of preoperative endoscopic retrograde cholangiopancreatography (ERCP) followed by laparoscopic cholecystectomy emerged as adequate treatment. Major disadvantages of ERCP are that it is a two-stage procedure and is associated with life-threatening complications like pancreatitis, bleeding, and duodenal perforation. It has also been reported that sphincterotomy may cause papillary stenosis and increased risk of bile duct cancer [2].

There is no consensus even for the technique of laparoscopic common bile duct exploration (LCBDE). Various modalities have been tried for entering into CBD [transcystic (TC) vs. transcholedochal (TD)], for confirming stone clearance (intraoperative cholangiogram vs.

choledochoscopy), and for closure of choledochotomy (T-tube vs. biliary stent vs. primary closure) [3].

Notably, prospective randomized trials have documented the advantages of LCBDE and found that the results are comparable to those of endoscopic CBD stone removal. In problematic cases of choledocholithiasis that cannot be feasibly managed with ERCP, either because of failure of duct cannulation or failure of stone extraction, open exploration used to be the alternative procedure.

There is insufficient information in the literature on the practice of LCBDE in cases of endoscopically irretrievable stones. This study presents the technical aspects and results of this approach [4].

Aim

The aim of this work is to assess the management of the patients with calcular obstructive jaundice after failed ERCP with LCBDE in comparison with OCBDE.

Patients and methods

Patients population

A prospective randomized study was conducted for 2 years from 2017 to 2019 in Theodor Bilharz Research Institute. A total of 600 patients with calcular obstructive jaundice underwent ERCP, with failure of stone extraction in 50 patients. Of them, 30 patients underwent LCBDE and 20 patients underwent OCBDE. The age of the patients ranged from 23 to 80 years. Overall, 40 female patients and 10 male patients. Clinically, all patients presented with recurrent attacks of biliary colic, sometimes radiating to epigastrium. All patients had done routine laboratory investigations, such as abdominal ultrasound. All patients underwent ERCP before surgery, which failed owing to difficult cannulation (periampullary diverticulum), large stone (>1.5 cm), barrel-shaped stone, and multiple stones more than 10.

Preoperative preparation

It included the following:

(1) Laboratory investigations: complete blood count, liver functions (alanine aminotransferase, aspartate aminotransferase, total bilirubin, direct bilirubin, alkaline phosphatase, gamma glutamyltransferase, and albumin), renal functions, and coagulation profile.
(2) Radiological investigations: abdominal ultrasonography and radiograph chest.
(3) Consent: approval of the ethical committee of our institute was obtained.
(4) Preparation included fasting for 8 h, shaving, and intravenous antibiotic on induction.

Patient positioning in laparoscopic common bile duct exploration

The patient lies supine in the French position and the surgeon was positioned between the patient leg. The camera operator stood on the patient's left and to the right of the surgeon, whereas the assistant stood on the patient's right. The video monitor was positioned on the patient's right above the level of the costal margin. The table was rotated with the patients' right side up, and then the patient was tilted in the reverse Trendelenburg position to improve the exposure, where gravity pulled the duodenum, the colon, and the omentum away from the gallbladder, thereby the working space available in the upper abdomen increased.

Operative technique

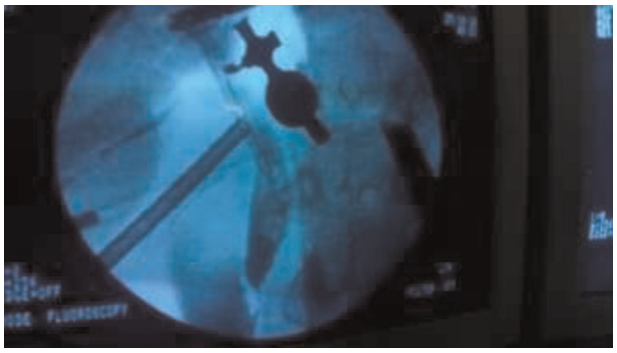
A total of 30 patients underwent LCBDE. It started by infraumbilical incision of 10 mm performed with a scalpel, followed by blunt dissection till identifying the sheath. Traction was applied by two Kelly forceps and cut with scissor, and then reaching the peritoneum. The traction was applied by Kelley clamp and then opened with scissor, and maintaining an upward pull, a blunt trocar was introduced under direct vision followed by insertion of a 10 mm port in left midclavicular, 5 mm right midclavicular, and 5 mm left anterior axillary line. A 30° telescope was then inserted through the umbilical port, and an examination of the peritoneal cavity was performed.

After the trocars were placed, the operation was done like a conventional cholecystectomy. Possible pericholecystic adhesions were freed, and the Hartmann's pouch was grasped by forceps to expose the Y-junction.

Carefully dissection of Calot's triangle was done to expose the cystic duct and artery. The cystic artery was clipped and divided. We put a clip on the cystic duct close to gallbladder to prevent the fall of gallbladder stones into the cystic duct. Intraoperative cholangiography was done for all patients, and the choledocoscope was used whenever available.

The laparoscopic transcystic approach was done for cases of small stones less than or equal to 6 mm in diameter, with diameter of cystic duct of more than 4 mm.

Figure 1



Intraoperative cholangiogram showing CBD stones. CBD, common bile duct.

In the laparoscopic transcystic approach, we made a 50% cystic dichotomy and the duct was milked by gently squeezing it proximally to distally to dislodge any small stones or sludge. Then we performed an operative cholangiogram to identify the following (Fig. 1):

(1) Cystic duct: length, tortuosity, caliber, and point of insertion onto CBD.
(2) CBD: caliber, leak, obstruction, filling defects (stones), and contrast flow into duodenum.

Depending on the caliber of the cystic duct and size of the stones, we inserted dilators into the cystic duct to facilitate removal of the stones and applying the choledochoscope, and finally stone removal by dormia basket (Fig. 2).

The laparoscopic transcholedochal approach was used for large impacted hard stones more than 6 mm in diameter.

In the laparoscopic transcholedochal approach for small stones, we divided the peritoneum overlying the supraduodenal bile duct to expose its anterior surface over a length of around 2 cm.

We used a laparoscopic hook diathermy to create a longitudinal dichotomy of around 1 cm in length, and gently we inserted the tip of the 5-mm laparoscopic sucker to clear bile duct from the stones.

Following retrieval of all the stones, in some patients, we completed assessment of the ducts by choledochoscopy or intraoperative ultrasound to confirm that bile duct is clear of stones.

Then clipping of the cystic duct was done twice proximally below the level of the incision.

In the open approach

Patient positioning

Patient lies in supine position. The surgeon stood on the right side of the patient and the assistant stood on left side of the patient. A right subcostal skin incision was done, opening the abdominal layers till reaching intraperitoneal.

The transcholedochal approach was the routine approach. The supraduodenal CBD was exposed as above, and then the gallbladder was separated from the liver bed. Then we inserted fine 5/0 polydioxanone (PDS) stay sutures on either side of the CBD before a choledochotomy using a number 11 scalpel blade.

The duct was explored as above with a combination of balloon catheter, basket, and choledochoscope.

Then, we closed the choledochotomy using PDS 4/0 rounded monofilament absorbable interrupted sutures either by primary closure or on a T-tube.

Results

The mean operative time in hours in LCBDE was 2.833 and OCBDE was 2.4, with *P* value of 0.0893. The mean intraoperative blood loss in LCBDE was 20.0 ml and in OCBDE was 23.0 ml, with *P* value of 0.0761. The mean intraoperative bile leakage in LCBDE was 11.33 and in OCBDE was 12.0, with *P* value of 0.5044, with no statistically significant difference (Table 1).

The mean hospital stay in LCBDE was 3.8 and in OCBDE was 8.7, with *P* value of 0.009. The mean pain score in LCBDE was 2.533 and in OCBDE was 7.4, with *P* value less than 0.0001, and the mean analgesia score in LCBDE was 2.733 and in OCBDE was 6.2, with *P* value of less than 0.0001, with statistical significance (Table 1).

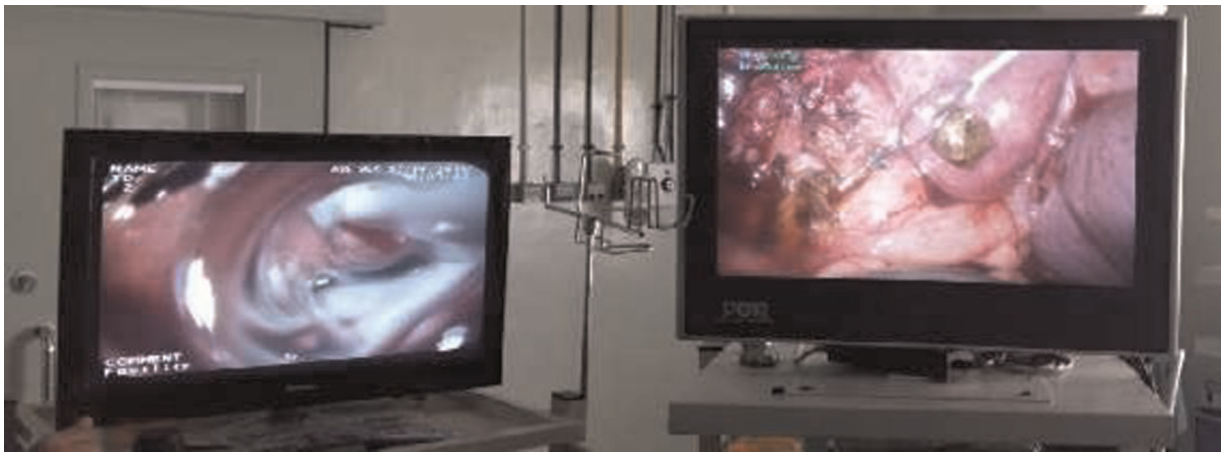
Wound infection occurred in three of 20 patients who underwent OCBDE in contrast to no patients experienced wound infection in LCBDE, with *P* value of 0.3341, and no statistically significant difference (Table 2).

Bile leakage occurred in one patient of 20 patients of T-tube closure and two patients of 30 of primary closure, with *P* value of 0.0510 and no statistically significant difference (Table 3).

Discussion

Several trials have borne out the advantages of laparoscopy, including shorter hospitalizations,

Figure 2



Transcystic CBD stone removal via choledochoscope. CBD, common bile duct.

Table 1 Comparison between laparoscopic and open common bile duct exploration in different variables

	LCBDE (*N*=30) (mean±SD)	OCBDE (*N*=20) (mean±SD)	*P* value	*t* test	Significance
Operative time	2.833±0.1804	2.400±0.1247	0.0893	*t*=1.774	No
Intraoperative blood loss	20.00±1.091	23.00±1.106	0.0761	*t*=1.857	No
Pain score	2.533±0.1919	7.400±0.3712	<0.0001	*t*=12.74	Yes
Analgesia score	2.733±0.2282	6.200±0.2000	<0.0001	*t*=10.68	Yes
Postoperative hospital stay	3.800±0.7051	8.700±1.832	0.0090	*t*=2.855	Yes

LCBDE, laparoscopic common bile duct exploration; OCBDE, open common bile duct exploration.

Table 2 Comparison between Laparoscopic and open common bile duct exploration in wound infection

Wound infection	LCBDE	OCBDE
Positive	0	3
Negative	30	17
P value	0.3341	
Significance	No	

LCBDE, laparoscopic common bile duct exploration; OCBDE, open common bile duct exploration.

Table 3 Comparison between T-tube and primary closure in bile leakage

Bile leakage	T-tube closure		Primary closure	
	Open	Laparoscopic	Open	Laparoscopic
Positive	1	0	1	1
Negative	10	9	7	21
P value	0.0510			
Significance	No			

quicker return to work, decreased complications, and less postoperative pain.

There are several reasons why a practicing surgeon would choose to perform an OCBDE. For some, it is the default approach owing to a lack of training skills in laparoscopic or endoscopic techniques, and a lack of available necessary equipment and staff expertise in the operating room. In other cases, it may be owing to the local culture in a particular hospital, where the availability of advanced endoscopic skills leads to most patients undergoing preoperative or postoperative ERCP for duct clearance, leaving an insufficient number of cases to develop expertise in LCBDE.

The use of OCBDE is a traditional surgical management technique for CBD stones with T-tube placement. The T-tube drainage can decompress the CBD, and the residual stones can be extracted through the T-tube tract, but the stone clearance success rate and post procedural complication rate between LCBDE (without T-tube and stents) and OCBDE (with T-tube) were not significantly different (all $P>0.05$), but LCBDE had advantages over OCBDE in terms of a shorter hospital stay and earlier recovery with a reduced short-term disability period.

The best approach for treating CBD stones remains a matter of debate. Traditional LCBDE can cause adverse events such as stenosis of the bile duct. Moreover, with advances in technology and surgical skills, the use of laparoscopic TC CBD exploration is gradually rising [5].

According to the study of Gupta [6], both TC and TD approaches are safe and effective. TD stone extraction is associated with an increased risk of bile leaks and requires more expertise in intracorporeal suturing and

choledochoscopy. TC stone extraction seems a more accessible technique with lower complication rates. Choice depends on number of stones, size of stone, diameter of cystic duct, and CBD.

In the present study, results suggest that patients undergoing open versus LCBDE experience a statistically significant higher rate of complications and postoperative hospital stay, and this similar to the study done by Halawani *et al.* [7]. As a result, it is recommended to do the laparoscopic approach whenever possible for CBD exploration.

The present study was conducted in 2 years starting from 2017 to 2019 on 50 patients who presented with calcular obstructive jaundice and underwent ERCP and failed before surgery; of them, 30 patients underwent LCBDE and the other 20 patients underwent OCBDE.

Of the 50 patients, 40 (80%) were female, whereas the other 10 (20%) patients were male. They ranged in age from 23 to 80 years old, with mean±SD age of 46.72 ±13.83 years.

In the present study, the total operative time in open approach is shorter than in laparoscopic. The mean operative time in minutes in open was 144 and in laparoscopic was 169.98 (P=0.0893), with no statistically significant difference between the two groups. This is in line with the study done by Grubnik and colleagues, in which the mean total operative time in minutes in open approach was 90 (60–150) and in laparoscopic approach was 82 (40–160), with P value more than 0.1, which is of no statistically significant difference. The results of the present study are in contrary with the study done by Halawani and colleagues, in which total operative time in minutes was significantly longer in open approach than in laparoscopic CBD exploration approach (the mean in open is 197.99±101.19 vs. laparoscopic ±74.49 and P<0.0001), and also in contrary with the study done by Li and colleagues [12], in which total operative time in minutes was significantly longer in open approach than in laparoscopic approach (the mean in open is 87.9±20.6 vs. laparoscopic is 57.5±15.1, and P <0.05).

Comparing clinical outcomes between laparoscopic and OCBDE in the present study, wound infection occurred in three of 20 patients who underwent open approach, whereas wound infection did not occur in any of the 30 patients who underwent laparoscopic approach (P=0.3341) and there was no statistically significant difference. These results are in contrast to the study done by Halawani and colleagues, in which OCBDE was associated with statistically significant increase in morbidity such as wound infection, which occurred in 99 (7.2%) of 1380 patients who underwent OCBDE and occurred in 22 (1.8%) of 1255 patients who underwent LCBDE, with P value of 0.03, and also in contrast to the study done by Grubnik *et al.* [8], in which wound infection occurred in seven (5.9%) of 118 patients who underwent OCBDE and occurred in one (0.7%) of 138 patients who underwent LCBDE, with P value less than 0.01, which is statistically significant.

In the present study, the mean intraoperative blood loss in laparoscopic approach was 20.0 and open approach was 23.0 (P=0.0761) with no statistical significance, and this is in line with the results of the study done by Grubnik and colleagues, in which intraabdominal bleeding occurred in one of 138 patients who underwent LCBDE and occurred in one of 118 patients who underwent OCBDE with P value more than 0.2, which is of no statistically significance, but these results are in contrast to the results in the study done by Halawani and colleagues, in which there was a significant increase in the intraoperative blood loss in open approach, and also the postoperative bleeding occurred in 127 (9%) of 1380 patients who underwent OCBDE and occurred in 20 (1.6%) of 1255 patients whom underwent LCBDE (P=0.02), which denotes significant increase in postoperative bleeding in open than in LCBE. The postoperative hospital stay in the present study is significantly shorter in laparoscopic approach than in open approach. The mean length of stay in days in laparoscopic approach was 3.8±0.7051 and in open approach was 8.7±1.832, with P value of 0.009, and these results are similar to the study done by Grubnik and colleagues, in which the mean length of stay in laparoscopic approach was 4.2±1.8 and in open approach was 12.6±4.5, with P value less than 0.01, which is statistically significant. These results are also in line with the study done by Li and colleagues, in which the mean length of stay in days in laparoscopic approach was 5.3±0.6 and in open approach was 7.9 ±0.8, with P value less than 0.05, which is statistically significant.

In the present study, the mean intraoperative bile leak in laparoscopic approach was 11.33 and in open approach was 12.0 (P=0.5044), which is of no statistical significance, which is similar to the study done by Grubnik and colleagues, in which P value more than 0.05, with no statistically significant difference. Moreover, the results are in line with the results of the study done by Li and colleagues, in which one patient

of 70 who underwent LCBDE experienced bile leakage and one patient of 70 who underwent OCBDE experienced bile duct hemorrhage, which is of no statistical significance.

In primary closure cases (30 patients), bile leakage occurred in two patients of 20 in whom CBD was closed primary without biliary stent, but there was no bile leakage in 10 patients in whom CBD was closed primary with biliary stent (P=0.0577), with no significant statistical difference in both groups.

These results are similar to the study done by leida *et al*. [9], in which bile leakage occurred in two patients of 91 with primary closure of CBD and one patient of 51 with T-tube closure of CBD (P=0.654), and also similar to the study done by Leida and colleagues, in which bile leakage occurred in two patients of 40 with primary closure of CBD and two patients of 40 with T-tube closure of CBD (P=0.210), with no significant statistical difference, but those results are in contrary to the results of the study done by Zhu *et al*. [10], in biliary complications such as bile leakage, as there is statistically significant difference between primary closure and T-tube closure groups (P=0.03); therefore, the T-tube drainage not only failed to minimize the risk but tended to increase the feasibility of dangerous complications and lower the effect of management of surgery.At last, the results in the study done by Yi *et al*., 2015 [11], concluded that primary closure after LCBDE with flexible choledochoscope is considered to be a safe and effective alternative to T-tube drainage with acceptable long-term outcome, as well as short-term outcome.

Conclusion

LCBDE considered as a safe, efficient and preferred procedure whenever possible. With large stone more than 6 mm we prefer laparoscopic TD approach with primary closure if choledoscope or IOUS is available or closure over T-tube if they are not available but we prefer laparoscopic TC in small stone less than 6 mm.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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