

## Original Research Article

# Safety and efficacy of laparoscopic versus open surgery in management of common bile duct stones: experience at the Sohag University Hospital, Egypt

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**Received:** 16 August 2018

**Accepted:** 09 October 2018

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### ABSTRACT

**Background:** Management of common bile duct (CBD) stones includes removal of the gallbladder and clearance of the ductal system which can be achieved through different approaches; endoscopic, laparoscopic or surgical. Objective of this study is to assess the safety, efficacy, technical feasibility and surgical outcomes of laparoscopic common bile duct exploration (LCBDE) versus open surgery in the treatment of patients with cholelithiasis.

**Methods:** From June 2015 to December 2017, 120 patients with CBD stones were prospectively treated at Sohag University Hospital, Upper Egypt. Patients were divided into two groups: the first one treated by LCBDE (60 patients), while the other group treated by open surgery (60 patients).

**Results:** The ages of our patients were ranged from 20 to 80 (mean = 40) years, with a female predominance (female/male = 74/46). Patients in the first group were treated by laparoscopic approaches: transcystic approaches in four patients and transcholedochotomy approaches in 56 patients. Cholelithiasis was routinely used to detect, extract the stones, in addition to assessment of CBD clearance. The conversion rate was done in two cases. The operative time was 120 (90-220) min, the clearance of CBD stones was achieved in 98.4% of cases (one case of missed stones). Hospital stay was 3 (2-4) days, with no mortality, morbidity rate was 5% including bile leak, and missed stone. The operative time in the second group was 100 (80-180) min, the clearance of CBD stones was achieved in 96.6% of cases (two cases of missed stones). Hospital stay was 8 (5-12) days, with no mortality; the morbidity rate was 15% in the form of wound infection, bile leak, missed stone and ileus.

**Conclusions:** Management of cholelithiasis by laparoscopic approach is feasible, effective and safe procedure with good outcome and high success rate.

**Keywords:** Common bile duct stones, Laparoscopic common bile duct exploration, Opens common bile duct exploration

### INTRODUCTION

Gallstones incidence among the adult population varies from 6% to 10%.<sup>1</sup> Approximately 10% to 15% of these patients have concurrent CBD stones.<sup>2</sup> Common bile duct stones can result in recurrent attack of biliary colic, obstructive jaundice, cholangitis or pancreatitis. It is

often diagnosed by clinical data, laboratory tests and radiological signs of a dilated biliary system or evidence of CBD stones on transabdominal ultrasonography (US), magnetic resonance cholangiopancreatography (MRCP) and endoscopic US.<sup>3</sup> The management of combined gallstones and CBD stones should include removal of the gallbladder and clearance of the bile duct stones.<sup>4</sup>

Treatment of the CBD stones is still controversial and can be achieved by conventional open cholecystectomy and choledocholithotomy, laparoscopic common bile duct exploration (LCBDE), pre or post cholecystectomy ERCP in two stages for CBD clearance.<sup>5</sup>

One stage laparoscopic approach for bile duct stones is an alternative option to two stage endo-laparoscopic procedures and to conventional open choledocholithotomy. Several reports demonstrated the feasibility, more safety, efficiency, and cost-effectiveness of the laparoscopic approach.<sup>6</sup>

The goal of this study was to compare the efficacy, safety, and surgical outcomes of LCBDE versus OCBDE for treatment of CBD stones and determine the most appropriate approach for treatment of the patients with CBD stones.

## METHODS

This prospective study was done at surgical department, Sohag University hospital, from June 2015 to December 2017. Including 120 patients with CBD stones. After agreement of the scientific and ethical committee of our institution, the procedure was fully explained to the patients and an informed written consent was obtained from each one. Diagnosis of CBD stones was based on clinical history, laboratory tests and confirmed by imaging studies such as ultrasonography (US), and magnetic resonance cholangio-pancreatography (MRCP).

The inclusion criteria were chronic calculous cholecystitis with CBD stone (single or multiples), in a CBD diameter more than 8mm. Exclusion criteria were children, intrahepatic stones, CBD diameter less than 8 mm, pancreatitis and liver cirrhosis.

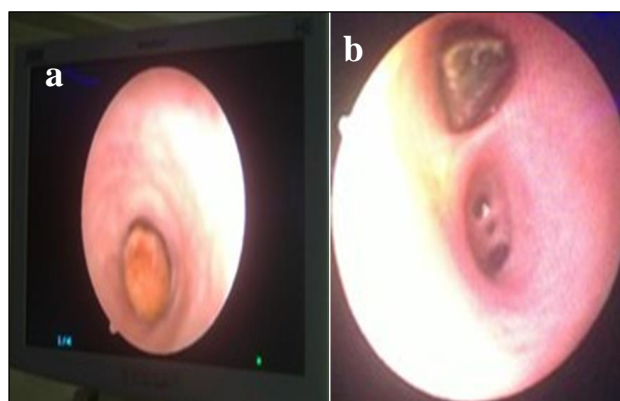
All patients received preoperative parental broad-spectrum antibiotics. All procedures were operated by the same experienced surgical team, under general anesthesia.



**Figure 1: An intraoperative photo showing trocar position for LCBDE.**

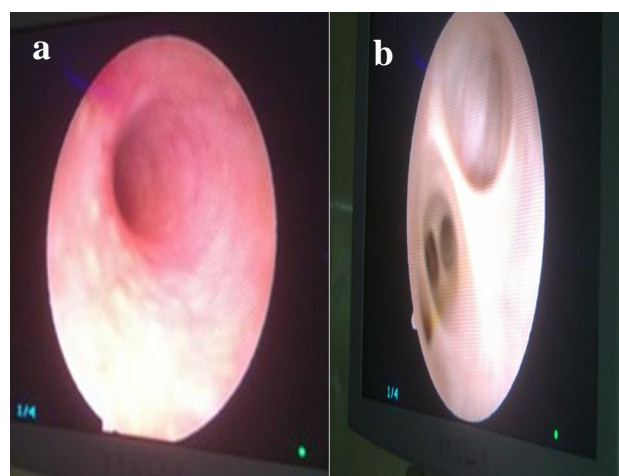
The treatment option was randomly assigned by one of the two procedures of either laparoscopic approaches or conventional surgery as a Group I (underwent laparoscopic CBD exploration in 60 patients), Group II (open CBD exploration in 60 patients).

The patients underwent LCBDE were placed supine. Some reversed Trendelenburg position with slight left rotation was sometimes required; the standard four-port configuration was used for LCBDE. A 10-12mm port was inserted in the subumbilical area for cameras, another 10-12mm working trocar in the epigastric area. A 5 mm working trocar at the right midclavicular line-subcostal margin. The fourth one 5mm port was inserted in the anterior axillary line-subcostal margin (Figure 1).



**Figure 2: (a) An intraoperative choledochoscopic view showing CBD stones; (b) intrahepatic duct stones (left image).**

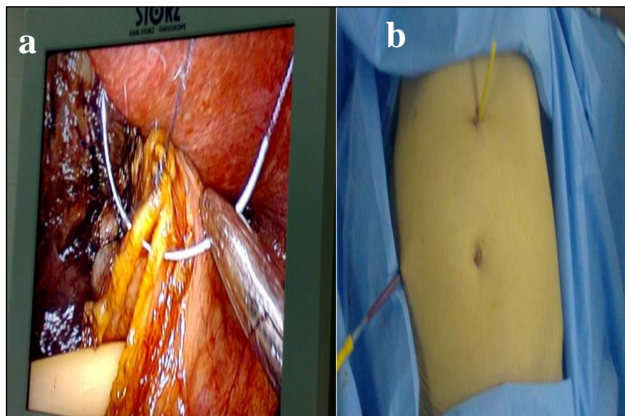
Dissection and exposure of the Calot's triangle with skeletonization of the cystic duct and artery. Careful dissection was used to identify the anterior surface of the supraduodenal part of the CBD, where a longitudinal choledochotomy was performed. A 5mm flexible fiberoptic choledochoscope was routinely used to visualize and to extract stones (Figure 2).



**Figure 3: (a) An intraoperative choledochoscopic view showing clear CBD; (b) intrahepatic duct.**

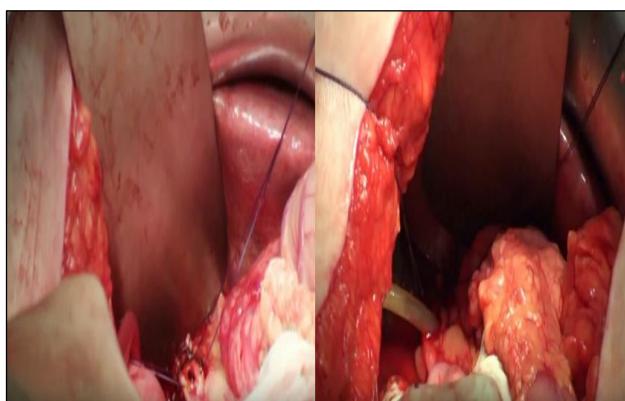
Different methods for stone extraction were used, saline irrigation, milking of the CBD, stone retrieval (Dormia) basket, or balloon extraction techniques through a choledochoscope. After the removal of stones, a choledochoscope was used to assess the clearance of the ductal system (Figure 3).

The choledochotomy incision was either primarily closed using 3-0 or 4-0 polyglycolic acid suture in an interrupted or continuous manner or over a T-tube insertion according to the situation and intraoperative manipulations (Figure 4).



**Figure 4:** (a) An intraoperative photo showing closure of CBD over the T-tube (right image); (b) and patient after LCBDE (left image).

Transcystic approach was performed in the few cases where the CD was dilated; a longitudinal opening of the CD was done and choledochoscope was introduced to visualize the CBD and stones inside. The stone(s) was or were removed by the same previous methods. After CBD Clearance and closure laparoscopic cholecystectomy was done. A drain was routinely inserted in Morison’s pouch.



**Figure 5:** An intraoperative photo for open CBD exploration.

The second group underwent conventional surgical approach includes open cholecystectomy and choledocholithotomy and also choledochotomy incision

was either primarily closed or over a T-tube inserted with a sub hepatic drain in all cases (Figure 5).

**RESULTS**

A total of 120 patients was randomized to the treatment of CBD stones. The ages of our patients were ranged from 20 to 80 (mean = 40) years, with a female predominance (female/male = 74/46). The presentation of our cases was calcular obstructive jaundice in 60 (54.3%) patients, biliary colic in 29 (24.1%) patients, cholangitis in 15 (12.5%), and accidental discovery in 16 (13.3 %).

Patients were categorized randomly into two groups of patients, according to stone treatment as follows: sixty patients were randomized to LCBDE (Group 1) and 60 patients were randomized to open cholecystectomy and choledocholithotomy (Group 2) (Table 1).

**Table 1: Demographic data and clinical presentations.**

Demographics	
Age (years)	20 to 80 (mean = 40)
Sex (F/M)	female/male = 74/46
Clinical presentations	
Obstructive jaundice n (%)	60 (54.3%)
Biliary colic n (%)	29 (24.1%)
Cholangitis n (%)	15 (12.5%)
Accidental discovery n (%)	16 (13.3 %)

**Group I**

The Group I included 60 patients were treated by LCBDE. Transcystic approach was done in 4 (6.6%) cases and via choledochotomy in 56 (93.3%) cases. Choledochoscopy was performed routinely in all cases.

Conversion to open techniques was done in 2 cases; the reasons for conversion in the first were heavy inflammation while difficult anatomy was in the second. Choledochotomy incision was sutured over a T-tube in 26 patients and primary in 20 patients.

The operative time needed for this procedure was ranged (90-220) min, with CBD clearance of stones in 98.4% (one case of missed stone), with no mortality, Postoperative complications occurred in 3 patients (5%); 2 patients had minor bile leak which stops spontaneously from 2-4 days, one case of missed stone. The postoperative hospital stay was 3 (2-4) days.

**Group II**

Group II included 60 patients treated by OCBDE. Transcystic approach was done in 3 cases and via choledochotomy in 57 cases. Choledochoscopy was performed routinely in all cases. Choledochotomy incision was sutured over a T-tube in 35 patients and primary in 22 patients.

**Table 2: Comparison between LCBDE vs. OCBDE (approach, CBD closure, operative time, hospital stay and postoperative complications).**

	LCBDE (60 patients)	OCBDE (60 patients)
<b>Approach</b>		
Trans cystic	4	3
Choledochotomy	56	57
T-tube insertion	36	35
Primary closure	20	22
Conversion rate	2	-
Operative time	120 (90-220)	100 (80-180)
Hospital stays	3 (2-4)	8 (5-12)
Postoperative complications	(3)	(9)
Wound infection	0	3
Bile leak	2	2
Missed stones	1	2
ileus	0	2

The operative time needed for this procedure was ranged (80-180) min, with CBD clearance of stones in 96.6% (two case of missed stone), with no mortality, Postoperative complications occurred in 9 patients (15%); 3 patients had wound infection, 2 patients with minor bile leak which stop spontaneously from 2-5 days, 2 cases of missed stone and 2 patients with illus. The period of hospital stay was 8 (5-12) days.

## DISCUSSION

Gallstones incidence among the adult population varies from 6% to 10%.<sup>1</sup> Approximately 10% to 15% of these have associated bile duct stones.<sup>2</sup>

Choledocholithiasis is the second common complication of gallstones after acute cholecystitis, and can result in gallstone pancreatitis, obstructive jaundice, hepatic dysfunction and cholangitis. Which are responsible for much morbidity and mortality from these complications.<sup>7</sup>

The management of CBD stones showed considerable evolution over the last few years. The cause of this evolution has been related to the up gradation of technology, equipment and experience, which allows physicians to offer a cure with minimal morbidity and mortality.<sup>8</sup> Treatment of the CBD stones is still controversial and can be performed by conventional open cholecystectomy and choledocholithotomy, laparoscopic common bile duct exploration (LCBDE), pre or post cholecystectomy ERCP in two stages for CBD clearance.<sup>5</sup>

Choosing the ideal method of CBD stone clearance should be based on the local availability of expert endoscopists, availability of laparoscopic and choledochoscopic equipment, surgeons' own experience and the general condition of the patient.<sup>9</sup> Although

endoscopic treatment (ERCP) is a procedure that is frequently used for the management of CBD stones, its major drawbacks are that it requires more than one stage procedure and can result in fatal complications such as bleeding, duodenal perforation, cholangitis, and pancreatitis.<sup>10-12</sup> In the era of conventional open cholecystectomy, several studies showed that open common bile duct clearance and cholecystectomy as one stage procedure was found to be superior in achieving stone clearance and associated with less morbidity and mortality than endoscopic (ERCP/ES) treatment of CBD stones with two-stage management.<sup>13,14</sup>

With the advancement in laparoscopic equipment, skills and experience, laparoscopic approach have become the gold standard for management of the CBD stones over the past few decades.<sup>15,16</sup> Although it is safe and highly effective method in the management of CBDS, It requires surgeons with advanced laparoscopic experience and skills, advanced laparoscopic techniques and equipment.<sup>17,18</sup>

Laparoscopic treatment for CBDS is a safe, efficient, cost-effective with a high success rate of stone clearance from 84 to 97%, with a morbidity rate 4-16%, and a mortality rate 0-0.8%. Patients treated by LCBDE had a significantly shorter stay in the hospital post operatively with subsequently lower hospital cost compared with those who underwent a two-stage procedure or open surgical approach.<sup>14,19</sup>

In the present study, laparoscopic clearance of the ductal system was successful in 98.4% of patients. No mortality occurred, the hospital stay was ranged from (2-4) days. Postoperative complications were observed in 5% of the patients. Transcystic approach is generally advised for small stones below the cystic duct insertion, whereas laparoscopic choledochotomy usually is preferable for large stones in a wide CBD.<sup>20</sup>

However, choledochotomy approach is technically requires more advanced laparoscopic skills and experience with longer operative time, and hospital stays. Many laparoscopic surgeons preferred it as it provides unrestricted access to more difficult and large stones.<sup>9,21</sup>

In the present study, LCBDE was performed via transcystic approach in 4 (6.6%) cases, whereas choledochotomy was performed in 56 (93.3%) patients. Although many laparoscopic surgeons prefer transcystic approach as it is easy, possible and highly successful in a large percentage of patients, however, it is demanding and requires complex mechanical or pneumatic dilatation of the CD.<sup>9</sup> This explains the fewer number of patients who were treated by transcystic approach in our series as these facilities of mechanical or pneumatic dilators of the CD were not available in our theater.

Closure of the choledochotomy incision can be done either over T-tube insertion or via primary closure. The

T-tube is usually used to decompress the bile duct, provide post-operative access to ductal imaging and provide routing for removal of missed CBD stones.<sup>9,23</sup>

On the other hand, a lot of complications related to its insertion, such as bacteremia, dislodgment, obstruction, bile infection, and wound infection. In addition to the other sequels of its removal which may occur includes bile leakage, biliary peritonitis and reoperation.<sup>22,23</sup>

In our study, the T-tube drain was used in 36 (60%) patients who were treated by LCBDE, CBD closure was performed primarily in 20 (33.3%) patients. Patients were treated by the OCBDE T-tube was used in 35 (58.3%) and primary closure in 20 (36.3%).

Complications were occurred in patients treated with primary closure, were not statistically evident; these results can be explained by routine use of choledochoscopy in the assessment of the clearance of the biliary system. In addition to significant decrease in postoperative hospital stay and total cost of treatment. These results were similar to many series.<sup>24-26</sup> Moreover, a well-known disadvantage of primary closure is the inability of postoperative visualization of the biliary system to detect any retained calculi.<sup>27,28</sup>

The operative time in this series was less in the open group 100 (80-180) min than the laparoscopic group 120 (90-220) min but this was statistically not significant. These results similar to that obtained by Grubnik et al.<sup>6</sup>

Hospital stay was significantly reduced in laparoscopically treated patients versus patients were treated by conventional surgery 3 (2-4) days versus 8 (5-12) days respectively with a P value of 0.002. This result was in agreement with many studies.<sup>6,29,30</sup>

The complication rate in the second group (OCBDE) was higher (laparoscopic 5% vs. open 15%). Wound infection and ileus was the main complications in the open group. Rafailidis et al, Grubnik et al and Halawani et al, also showed the higher complication rate of the open approach vs. LCBDE.<sup>6,24,31</sup> Although OCBDE is a safe and effective approach for the treatment of CBDS, nowadays with advancement in the equipment and laparoscopic skills, LCBDE can be performed with high efficiency, safety, low morbidity and mortality.<sup>6,31</sup> However, open surgery is still the standard for removal of the bile duct stones. If the surgical team has a lack of the laparoscopic experience, or highly expert endoscopists are not available, an open surgery should be employed.<sup>32</sup>

## CONCLUSION

LCBDE is feasible, effective and safe procedure in treatment of CBD stones with good outcome and high success rate. It has many benefits of minimally invasive technique, particularly less pain postoperatively, hospital

stays with rapid recovery, and fewer complications when compared to open surgery.

The successful management of CBD stones by mean of laparoscopy depends on several factors including; surgeon's experience in laparoscopy and the availability of laparoscopic and choledochoscopic equipment. By this study the attitude of the management of the CBD stones actually changed in our institution.

*Funding: No funding sources*

*Conflict of interest: None declared*

*Ethical approval: The study was approved by the Institutional Ethics Committee*

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**Cite this article as:** Helmy MZ, Ahmed AE. Safety and efficacy of laparoscopic versus open surgery in management of common bile duct stones: experience at the Sohag University Hospital, Egypt. *Int Surg J* 2018;5:3727-32.