Management of concomitant gall bladder and common bile duct stones, single stages laparoscopic versus endo-laparoscopic: A center experience

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Background
One-stage laparoscopic cholecystectomy and endoscopic retrograde cholangiopancreaticography (ERCP-LC) was compared with one-stage laparoscopic cholecystectomy and laparoscopic exploration of common bile duct (LC-LCBDE) in patients with choledocholithiasis in an attempt to find the best mini-invasive treatment for choledocholithiasis.

Patients and methods
For this study, 46 patients with cholelithiasis and choledocholithiasis diagnosed with preoperative ultrasonography and other diagnostic studies were divided randomly into an ERCP-LC group (group A) (23 cases) and an LC-LCBDE group (group B) (23 cases).
The surgical time, surgical success rate, postoperative complications, retained common bile duct stones, postoperative length of stay, and hospital charges for operative procedures were compared prospectively.

Results
There were no statistically significant differences between the two groups in terms of surgical time, surgical success rate, postoperative complications, retained common bile duct stones, and postoperative length of stay, but there was a big difference in hospital charges for operative procedures.

Conclusion
Finally, we can conclude that there was no statistically significant difference between the two groups in terms of surgical time, surgical success rate, postoperative complications, mortality rates, retained common bile duct stones, and postoperative length of stay. However, patients in group A were more vulnerable than patients in group B to developing low-grade cholangitis because of sphincterotomy performed during stone extraction.

Keywords:
choledocholithiasis, laparoscopic cholecystectomy and endoscopic retrograde cholangiopancreaticography, laparoscopic cholecystectomy and laparoscopic exploration of common bile duct

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Introduction

Worldwide, there is large variability in the incidence and prevalence of choledocholithiasis. In most patients in western countries, choledocholithiasis is secondary to cholelithiasis. In contrast, higher rates of primary choledocholithiasis have been reported from Asian countries [1].

Ten percent of the female population and 6% of the male population is affected by cholelithiasis. About 10–20% of them are associated with common bile duct (CBD) stones, with the percentage of association between 8 and 15% in patients under the age of 60 and between 15 and 60% in patients over the age of 60 [2].

Choledocholithiasis is often suspected in patients who have elevated liver enzymes, jaundice, pancreatitis, radiologic signs of dilated intrahepatic or extrahepatic ducts, or evidence of CBD stones either on transabdominal ultrasound, computed tomography, MRI, endoscopic ultrasonography, or cholangiography [3].

Recently, laparoscopic common bile duct exploration (LCBDE) emerged as a safe and effective therapy for CBD stones. Many stones can be quickly and simply cleared by transcystic means or through the CBD, providing patients with a single-stage procedure [4].

ERCP with sphincterotomy has become the gold standard nonoperative modality for the removal of CBD stones. Morbidity is 2–10%, and mortality is less than 2%. Immediate complications include bleeding, duodenal perforation, cholangitis, and pancreatitis, but many of these can be prevented by using various tools, including an alternating coagulation and cutting diathermy, routine biliary stenting, frequent

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use of guidewire to avoid precutting, and mechanical lithotripsy [5].

Patients and methods

This study was carried out on 46 patients who presented with choledocholithiasis at the General Surgery department of Zagazig University Hospitals between January 2013 and January 2015. The patients were divided into two treatment groups: The first group (23 patients) (group A) comprised patients who underwent one-stage laparoscopic cholecystectomy and endoscopic retrograde cholangiopancreaticography (ERCP-LC). The second group (23 patients) (group B) comprised patients who underwent one-stage laparoscopic cholecystectomy and laparoscopic exploration of the common bile duct (LC-LCBDE).

All patients were subjected to routine history taking, physical examination, and routine laboratory investigations in the form of complete blood count, liver and kidney function tests, and evaluation of PT and INR, lipase, amylase, and CA19-9.

All patients underwent imaging studies in the form of transabdominal ultrasonography to assess the gall bladder, CBD dilatation, or stones, and to assess the liver for diseases such as cirrhosis, fibrosis, and dilated intrahepatic radicals. Magnetic resonance cholangiopancreaticography (MRCP) in patients with a positive history suggestive of biliary stone disease and ultrasonography did not reveal stones in a dilated CBD.

A preoperative broad-spectrum antibiotic was given to all patients and preoperative intramuscular injection of vitamin K was given for 3 days to patients with prolonged PT to correct the coagulopathy.

The operative interventions for group A

Patients randomized to group A (ERCP/S + LC group) were scheduled to undergo the endoscopic procedure using fluoroscopy before intended laparoscopy.

The endoscopic retrograde cholangiopancreaticography technique

The endoscope was passed gently down the esophagus into the stomach and then advanced toward the pylorus. Gentle rotation and pressure was used to pass the endoscope through the pylorus into the proximal duodenum. Selective cannulation of the CBD was performed. Thereafter, we injected 1–2 ml of 50% Hypaque dye gently to delineate the biliary tree (to determine the presence or absence of intrahepatic and extrahepatic biliary dilatation and stones in CBD). A wire-guided sphincterotomy was performed with the sphincterotome over the guidewire. Further procedures were then performed, either stone extraction using balloons (for stones that were <1 cm in diameter) or a Dormia basket (for larger stones) with stenting using plastic stents of 7-Fr diameter and 10 cm long (Fig. 1).

Patients were subjected to laparscopic cholecystectomy at the same setting after complete suction of air introduced into the gut during endoscopy. Liver function tests for pancreatic enzymes were conducted for all patients before hospital discharge. The patients in this group were readmitted to the hospital 1 month after discharge as 1-day surgical cases for plastic stent removal by ERCP.

Figure 1

(a) Cannulation of common bile duct (CBD). (b) Completed sphincterotomy. (c) Stone bulging from papilla. (d) Multiple extracted CBD stones. (e) Basket stone extraction. (f) Balloon stone extraction. (g) Endoscopic view of the biliary stent. (h) Radiographic view of the biliary stent.

The operative interventions for group B

Intraoperative cholangiogram

After clipping the cystic duct at or near its termination on the gallbladder and before dividing it, a small transverse incision was made about 1 cm from its insertion into the common hepatic duct. Then a 3-Fr cholangiocatheter was introduced through a gray cannula sheath inserted in the right hypochondrium. This catheter was connected to a 20-ml syringe filled with urografin 76% diluted with warm normal saline (1 : 1). The catheter was advanced 1–2 cm into the dochotomy in gradual motion and was secured in place by a clip on the cystic duct (Fig. 2).

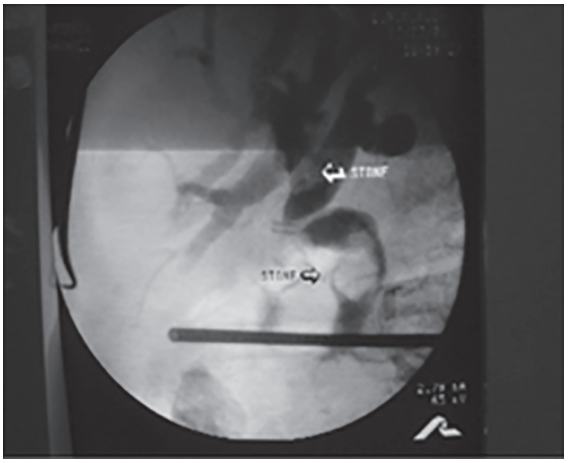
After confirmation of the presence of CBD stones, we proceeded toward a transcystic approach or a choledochotomy approach (Fig. 3).

Transcystic approach

The transcystic approach was applied in seven patients. The catheter was removed and a balloon dilatation catheter was inserted over a guidewire into the cystic duct, and dilatation of the cystic duct to 5–7 mm in diameter was carried out in 3 min. Thereafter, stone extraction through transcystic common bile duct exploration (TCBDE) was performed using a three-wire soft Dormia basket with three different approaches:

(1) By blunt introduction of the instrument into the CBD through the cystic duct (in one patient).
(2) Under fluoroscopic guidance (safer for ensuring stone capture and avoiding instrumental CBD injury) (in four patients).
(3) Under visual cholangioscopic guidance (for small stones) (in two patients).

Figure 2



Intraoperative cholangiogram showing two stones in the common bile duct.

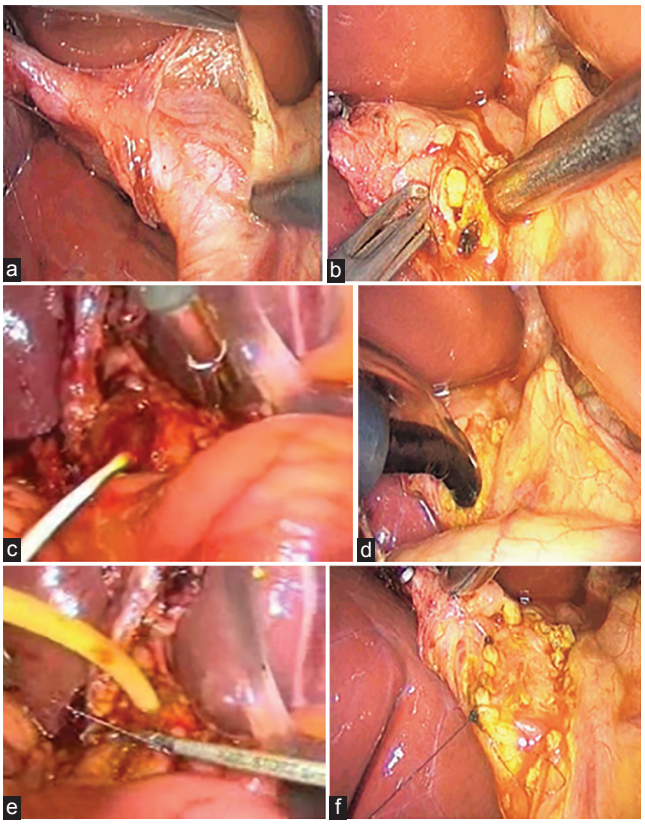
We did not use a balloon catheter during TCBDE to avoid stone migration to the upper part of the CBD. Stone clearance assessment was performed in two different ways, by control cholangiography or by using a flexible choledochoscope. When doubt existed about the completeness of stone clearance, the CBD was drained by means of a transcystic duct drain.

Choledochotomy approach

The choledochotomy approach was performed in 14 patients. A longitudinal incision was made in the CBD. Stone extraction was carried out as per the transcystic approach, but the balloon could be used. Thereafter, stone clearance assessment was made as in the transcystic approach. Suture of the choledochotomy was done by primary CBD closure or by external biliary drainage using a T-tube exteriorized through the site of the most lateral trocar. Closure of the choledochotomy was performed with interrupted or continuous suture with vicryl 4-0 stitches. After finishing CBD exploration, laparoscopic cholecystectomy was performed as in group A.

Postoperative assessment was made clinically, by means of liver function tests, assessment of pancreatic

Figure 3



(a) Exposure of common bile duct (CBD). (b) Stone extraction. (c) Balloon stone extraction. (d) Cholangioscope. (e) Closure of CBD by means of a T-tube. (f) Primary closure of CBD.

enzymes, checking of biliary drains, and through control cholangiography on postoperative days 2–3 (before hospital discharge) if a T-tube drain is in place, to exclude a residual CBD stone or a biliary leak.

All patients were followed up after 1, 2 weeks, 1, 2, and 6 months on outpatient basis with repeated assessment of patients' symptomatic status, physical exam, liver function tests, and abdominal ultrasonography.

Results

This study included 46 patients with cholelithiasis and choledocholithiasis; half of them (50%) were in the age group of 41–60 years (mean age 42.5 ± 15.7 years). The majority were female (67.4%). Some patients were found to have comorbid medical problems: five patients were hypertensive, one was diabetic, and two were found to have ischemic heart disease (Table 1).

Most of our patients (39, 84.8%) complained of right upper-quadrant pain (RUQP).

There was disturbance in liver functions in most of the cases. Elevated serum bilirubin level was detected in 38 patients (82.6%), elevated γ-glutamyl transeferase levels were found in 45 patients (97.8%), and elevated serum glutamic oxaloacetic transaminase and serum glutamic pyruvic transaminase levels were found in 42 patients (91.3%); in 31 of them, elevated enzymes were up to two-fold of normal, and in 11 patients the elevated enzymes were more than two-fold of normal. Normal laboratory results were found in four patients.

Abdominal ultrasonography was performed on all patients. It revealed chronic calcular cholecystitis in 46 patients. Dilatation of CBD with stones inside was detectable in 37 patients (80.4%) only (dilated >1 cm in 34 cases and dilated >2 cm in three cases). The remaining nine cases showed equivocal results and were subjected to MRCP to ensure the diagnosis of calcular obstructive jaundice.

The operative procedures in group B were completed in 20 cases (86.9%). The transcystic approach was applied in seven cases and the choledochotomy approach in 14 cases, of which four cases were closed by means of a T-tube, nine cases were closed primarily, and one case failed because of a large impacted stone in the distal part of the CBD.

Group A

The procedures were completed in 21 cases (91.3%) in group A, with two cases converted to open surgery (8.7%). The conversion included one case in whom CBD clearance could not be achieved because of an impacted large stone in its lower part with failed CBD cannulation and one case because of the presence of the papilla in the floor of the large duodenal diverticulum. The diameters of the stones removed ranged between 5 and 15 mm. The procedure time ranged from 145 to 180 min with a mean of 160 ± (10.4) min. The duration of the procedure was longer in the early cases than in the late cases. Our procedure's mean operative time was 160 min. Efficacy of CBD clearance was 86.9% (two cases that failed ERCP were converted to open surgery and one patient had retained CBD stones postoperatively in this group).

Group B

The procedures were completed in 20 cases (86.9%) in group B; three cases were converted to open surgery (13%): two because of severe adhesions in Calot's triangle and one because of impacted large stones measuring 2 cm with no available lithotripsy. The diameters of the stones removed ranged between 8 and 24 mm. The procedure time ranged from 160 to 190 min with a mean of 176.4 min. The efficacy of CBD clearance was 82.6% (three cases were converted to open surgery and one patient had retained CBD stones postoperatively in this group) (Table 2).

As regards group A, postoperative complications occurred in three patients (13%): minor complications in the form of mild pancreatitis with elevation of serum amylase in two patients, which was managed conservatively, and pneumonia in one patient. As regards group B, postoperative complications occurred in four patients (17.4%): minor complications in the form of minimal biliary leakage in the subhepatic drain in two patients, which was managed conservatively, pneumonia in one patient, and T-tube infection in one patient.

The postoperative length of hospital stay in group A ranged from 2 to 5 days (mean 3 days). In group B, the postoperative length of hospital stay ranged from 2 to 7 days (mean 3.5 days). Mortality was zero in both groups.

Comparison of the surgical cost in noncomplicated cases as regards the operative charges only in Zagazig university hospitals revealed that the mean cost in group A (2542.5 ± 64.4 EP) was significantly higher than that in group B (720.6 ± 40.1 EP) (Table 3).

Table 3 shows that of 41 patients who had undergone successful procedures (21 patients in group A and 20 patients in group B) 37 patients (90.2%) were followed up until the time of submission of this study and four cases (9.8%) were lost to follow up after 2 months. One

Table 1: Age and sex distribution among the studied group

Items	No. (46) (%)
Age (years)	
0–20	4 (8.7)
21–40	15 (32.6)
41–60	23 (50)
61–80	4 (8.7)
Sex	
Male	15 (32.6)
Female	31 (67.4)

Table 2: Surgical results among groups (A) and (B)

	Group (A)		Group (B)		*P* value
	No.	%	No.	%	
Success rate	21	91.3	20	86.9	0.029*
Conversion to open surgery	2	8.7	3	13	0.029*
Efficacy of CBD clearance	20	87	19	82.6	0.029*
Mean Surgical time in minutes ± (SD)	160 ± (10.4)		176.4 ± (10.1)		0.061**
Stones diameter range (mm)	5-15		8-24		

**P* value of chi square test, ***P* value of student *t* test.

Table 3: Long term follow up data among successful cases

	Group A (No. = 21)		Group B (No. = 20)	
	No.	%	No.	%
Incomplete follow up	2	9.5	2	10
Completed follow up				
Cholangitis	2	9.5	0	0.0
Retained CBD	1	4.8	1	5
Uncomplicated	8	76.2	17	85

patient in group A suffered from repeated attacks of cholangitis, which responded to conservative treatment, and one patient had retained CBD stones, which were removed after 1 month during removal of the stent. One patient in group B suffered from retained CBD stones, which required readmission and endoscopic sphincterotomy.

Discussion

Approximately 20 years ago, there were not many options for management of patients with CBD stones; surgery was the only possible solution, and open cholecystectomy with choledocholithotomy was the treatment of choice [6–8].

The current options available for the management of choledocholithisis at the time of LC include preoperative ERCP and endoscopic sphincterotomy, intraoperative ERCP, postoperative ERCP, laparoscopic transcystic common bile duct exploration, laparoscopic choledochotomy and LCBDE, and open bile duct exploration [9]. The obvious goal of therapy in choledocholithiasis is to achieve ductal clearance with the fewest interventions, at the lowest cost, and with least morbidity [9].

Since the advent and progress of endoscopic surgery in biliary diseases, various procedures have been suggested for the management of CBD condition, including endoscopic sphincterotomy before or after laparoscopic cholecystectomy [7].

This novel discovery of minimally invasive surgery has also extended to LCBDE, but its progress is somewhat retarded by the introduction of ERCP. In addition, LCBDE has its limitation. It is more technically demanding and requires an experienced laparoscopic surgeon equipped with advanced laparoscopic skills. The operating time is also prolonged in LCBDE, and this makes it a relative contraindication in patients with poor anesthetic risk [10].

Our study was carried out on 46 patients with CBD stones and gallbladder stones. Our study revealed that cholecysto-choledocholithiasis is more common in the female population (67.4%). In our study it was more common in the fourth and sixth decades of life (50% of our patients; mean age 42.5 ± 15.7 years). This was in agreement with the results of Desai and Shokouhi *et al.* and Reshetnyak and colleagues [9,11,12].

The most common complaint in our patients was RUQP (84.8%), followed by jaundice (82.6%). These findings were in some agreement with those of Rajendra *et al.* and Reshetnyak *et al.* [12], who reported that the most common complaints were RUQP (81%), jaundice(74%), epigastric pain, and nausea [9,11,12].

Abdominal ultrasonography revealed gallstones in all patients. Dilatation of CBD with stones inside was detected in 37 patients only. This denotes that ultrasonography is highly accurate for detection of gallstones (100%), but less accurate for detection of CBD stones (80.4%). These finding were also reported by Majid *et al.* [13] and Costi *et al.* [14], as they stated that the sensitivity of ultrasonography for detection of gallstones and CBD stones was 80–100 and 70–90%, respectively.

MRCP was used successfully to diagnose CBD stones in nine patients who had equivocal results on transabdominal ultrasonography with a sensitivity near 100%. These findings were also reported by Mandelia *et al.* [15] and Wong *et al.* [16], as they stated that MRCP has an excellent overall sensitivity of 95% and

a specificity of 97% for demonstrating CBD stones.

Intraoperative cholangiography was found to be an accurate method for detecting CBD stones and it helped us greatly in avoiding injury to the bile ducts. It was performed in 21 patients of group B before LCBDE and it revealed stones in all patients (100% sensitivity). These findings were similar to the findings of Griniatsos and Karvounis [17], who denoted that IOC (intraoperative cholangiography) has a sensitivity of 98% and specificity of 94% for detection of CBD stones.

In our study, the procedures were completed in 21 patients (91.3%) of group A; two cases were converted to open surgery (8.7%). The conversion included one case in whom CBD clearance could not be achieved because of an impacted large stone in its lower part with failed CBD cannulation, and one case with absent papilla in the floor of the large duodenal diverticulum.

There was one patient with retained CBD stones in group A, which was removed during stent removal; efficacy of CBD clearance was 87% (two cases that failed ERCP were converted to open surgery and one patient had retained CBD stones postoperatively). This was in contrast to the study carried out by Dasari *et al.* [18] who reported retained CBD stones in 21/85 (25%) patients.

Postoperative complications occurred in three patients (13%): minor complications in the form of mild pancreatitis with elevation of serum amylase in two patients and pneumonia in one patient; mortality was zero, nearly in agreement with several studies that reported morbidity and mortality rates of 5–11 and 8–12%, respectively, with this method [19].

In group B, the procedures were completed in 20 cases (87%); three cases were converted to open surgery (13%): two due to severe adhesions in Calot's triangle and one due to impacted large stones measuring 2 cm with no available lithotripsy. A similar study carried out by Alexakis and Connor [20] denoted a success rate of 80–91%. In another study by Lu *et al.* [19], success rates of 89–95% were reported.

The transcystic approach was applied in seven cases and choledochotomy was performed in 14 cases, of which four cases were closed using a T-tube, nine cases were closed primarily, and one failed because of impacted large stone.

In this study we used the choledochoscope in 11 patients (in two undergoing the transcystic approach and in nine undergoing choledochotomy), but in these cases the operating time was slightly longer. In the other nine cases we used fluoroscopic guidance and confirmatory IOC. This was in agreement with the results of Alexakis and Connor [20] but different from those of Topal *et al.* [21], who reported that the use of a flexible choledochoscope is preferable to fluoroscopic guidance.

Fourteen patients were subjected to choledochotomy, and the procedure was completed in 13 cases. CBD was closed primarily in nine cases and the other four cases were drained by means of a T-tube. Biliary leakage occurred postoperatively in two patients (one of them was drained with a T-tube and in the other one the CBD closed primarily). Many studies comparing primary closure with T-tube drainage suggest similar rates of complications, with shorter operating times and a trend toward shorter hospital stay with primary closure. But some authors believe that for the safety of the patient bile duct decompression must be achieved. Despite its advantages, the T-tube has significant complications such as postoperative bacteremia, stone formation around the tube, skin excoriations at the exit site, prolonged biliary fistula, retention of a fragment of the tube, late bile duct stricture, and dislodgement of the tube with subsequent bile peritonitis and sepsis leading to mortality [22].

The efficacy of CBD clearance was 82.6% (three cases were converted to open surgery and one patient had retained CBD stones postoperatively). This was in contrast to the study carried out by Dasari *et al.* [18], who reported retained CBD stones in 9/81 (9%) patients.

Postoperative complications occurred in four patients (20%): minor complications in the form of minimal biliary leakage in the subhepatic drain managed conservatively in two patients, pneumonia in one patient, and t-tube infection in one patient; all of these complications were managed conservatively, and mortality was zero. This was in agreement with several studies that reported a morbidity rate of 8–19% and a mortality rate of around 0–1% [20]. This was in contrast to the study carried out by Shojaiefard *et al.* [23], who reported 5.55% morbidity but 0% mortality.

Conclusion

Finally we can conclude that there was no statistically significant difference between the two groups in terms of surgical time, surgical success rate, postoperative complications, mortality rates, retained CBD stones, and postoperative length of stay. However, patients belonging to group A were more vulnerable than

patients belonging to group B to developing low-grade cholangitis because of sphincterotomy performed during stone extraction.

Regarding indications, ERCP is more preferable for the management of CBD stones when the CBD is smaller than 10 mm in diameter, when there is cholangitis, biliary pancreatitis, and suspected malignancy, whereas LCBDE is more prefereable in case of multiple large calculi in CBD larger than 10 mm in diameter, in young patients, and when there is doubt about the presence of CBD stones.

Finally, further studies should be carried out to reveal the long-term hazards in sphincterotomized patients.

Acknowledgements

Conflicts of interest

None declared.

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