Transcystic approach of laparoscopic choledochoscopy for choledocholithiasis

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Received: 27 February 2021
Accepted: 27 February 2021
Published: 12 October 2021

The Egyptian Journal of Surgery 2021, 40:703–710

Background
The best management strategy for common bile duct (CBD) stones remains debatable. The use of laparoscopic transcystic common bile duct exploration (LTCBDE) is gradually rising in comparison with conventional CBD exploration that can lead to bile duct stenosis.
Aim
The aim of the present study was to evaluate the safety and feasibility of transcystic approach of CBD exploration (LTCBDE).
Patients and methods
This prospective quantitative clinical study was carried out in Theodor Bilhariz Research Institute and Damanhur Teaching Hospital from 2017 to 2019. CBD stones were present in 40 (7.8%) of 512 patients who underwent laparoscopic cholecystectomy, where these 40 patients underwent LTCBDE and laparoscopic cholecystectomy in one stage.
Results
The procedure was completed in 38 (95%) patients through transcystic approach, and two patients were converted to choledochotomy with T tube insertion (5%). Retained stone had occurred in one (2.5%) patient, so success rate was 92.5%. Mortality was nil. No patients were lost to follow-up (median: 30 months; range: 6–36 months). No signs of bile stasis, no recurrent ductal stones, and no biliary stricture were observed.
Conclusions
With proper selection of cases, LTCBDE is an effective single-stage procedure for the treatment of gall bladder and CBD stone in one session avoiding the drawbacks of endoscopic retrograde cholangiopancreatography as well as open CBD approach.

Keywords:
common bile duct stones, laparoscopy, transcystic approach

Egyptian J Surgery 40:703–710

1110-1121

Introduction

Gallstones are an extremely common condition, arising in ~10–20% of the adult population, and as such pose an important public health problem [1,2].

Choledocholithiasis is a common problem that necessitates intervention. It is managed either endoscopically or surgically [3,4].

Common bile duct (CBD) stones may be small or large, single or multiple, and are found in 6–12% of patients with stones in the gall bladder. The incidence increases with age. Approximately 20–25% of patients above the age of 60 years with symptomatic gallstones have stones in the CBD as well as in the gall bladder. Choledochal stones may be silent and often are discovered incidentally. They may cause obstruction, complete or incomplete, or they may manifest with cholangitis or gallstone pancreatitis [5,6].

CBD stones can be caused by either primary bile duct stones that originate in the bile duct or secondary bile duct stones that have descended from the gall bladder. In the primary stones, bilirubin is a dominant component and is associated with biliary stasis and infection. In secondary stones, cholesterol is the dominant component. It is therefore important to distinguish between primary and secondary stones [7,8].

Traditional surgical treatment comprises intraoperative cholangiography to detect the presence of bile duct calculi followed by choledocholithotomy and T-tube placement. For many years, this procedure offered effective therapy and was associated with a morbidity rate of 10–15%, a mortality rate of less

than 1% (in patients under 65 years), and a retained stone rate less than 6% [9].

The National Institute of Health consensus in 1993 asserted that CBD stones must be detected and removed either prior, during, or after cholecystectomy. After the establishment of the laparoscopic cholecystectomy (LC) as the treatment of choice for gall bladder removal and considering the lack of experience and equipment available at the time, exploration of the duct was passed on to the endoscopist and the endoscopic retrograde cholangiopancreatography (ERCP), with endoscopic sphincterotomy becoming the most common technique used. With advancing technology and minimally invasive surgery, laparoscopic biliary surgery has become safe, efficient, and cost effective [10].

One-stage management of symptomatic CBD stone is associated with less morbidity and mortality (7 and 0.19%) than two-stage management (13.5 and 0.5%) [3,4].

The best management of CBD stones remains debatable. The use of laparoscopic TC CBD exploration is gradually rising in comparison with conventional CBD exploration that can lead to bile duct stenosis [11].

The best approach for concomitant gallstones and CBD stones is laparoscopic transcystic common bile duct exploration (LTCBDE), with successful stone clearance rates ranging from 85 to 95%. LTCBDE protects the CBD from choledochotomy and without affecting the sphincter of the Oddi with less morbidity and less hospital stay in comparison with LC CBD exploration [12].

LTCBDE is affected by anatomy of the cystic duct for introducing the choledochoscope with extraction of CBD stones. The feasibility of LTCBDE depends on preoperative and intraoperative findings of anatomy of bile duct and the characteristics of CBD stones [13].

The best choice for bile duct exploration is LTCBDE by using the ultra-slim choledochoscope with cystic duct diameter less than 3 mm. Transcholedochal approach is done for CBD stones with a diameter more than 10 mm or anatomical variants of the cystic duct, the cystic duct severe angulation to the left side of the CBD, or a low insertion of the cystic duct and tortuous CBD followed either by primary closure or T-tube insertion [14].

Therefore, LTCBDE is done for patients with CBD stone diameters that are more than or equal to 3 and less than or equal to 10 mm, and who have a dilated CBD.

Patients and methods

This prospective quantitative clinical study was carried out in Theodor Bilhariz Research Institute and Damanhur Teaching Hospital from 2017 to 2019. It included 40 patients with concomitant gall bladder stones and CBD stones who underwent LTCBDE and LC in one stage. The study was approved by the Theodor Bilhariz Research Institute Ethics Committee and conducted in accordance with the Helsinki II Declaration. An IRB-approved and written consent form was obtained from all patients after detailed explanation of the procedures and its possible complications. The main inclusion and exclusion criteria were followed (Table 1).

All patients of our study were evaluated clinically before the operation and underwent standard laboratory investigations (complete blood count, prothrombin time, partial thromboplastin time,

Table 1 Inclusion and exclusion criteria for this study

Inclusion criteria
Favorable cystic duct anatomy (long straight dilated cystic duct)
Cystic duct diameter ≥3 mm
CBD stones ≤10 mm in diameter and ≤3 small stones
Dilated CBD that was feasible for 5-mm choledochoscope exploration
Exclusion criteria
Anatomical variants of the cystic duct (tortuous or low insertion or too long or too thin to allow introduction of the choledochoscope)
Mirizzi syndrome
Hepatolithiasis
Pancreatitis, pregnancy, and contraindications to laparoscopic surgery (previous upper abdominal open surgery) or general anesthesia
Suspected bile duct or gall bladder cancer

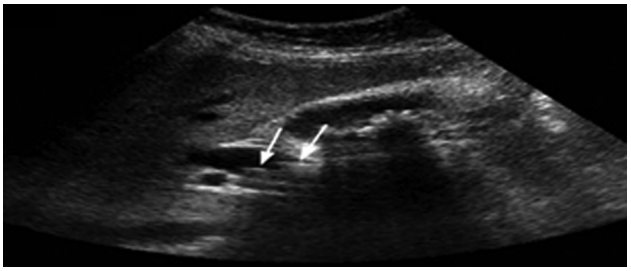
CBD, common bile duct.

international normalized ratio, liver function tests, serum amylase, and lipase), as well as radiological study, including abdominal ultrasonography, magnetic resonance cholangiopancreatography, and endoscopic ultrasound that were performed for several patients with suspected CBD stones (elevated bilirubin and liver enzymes or ultrasound suspicion of CBD stones) (Figs 1–3).

Operative techniques

Broad-spectrum antibiotic was given preoperative followed by general anesthesia. The patient was placed in the supine position. LTCBDE was preformed using a 5-trocar technique. The first 10-mm trocar was introduced transumbilicus for pneumoperitoneum by insufflation of carbon dioxide at 12–14 mmHg (1 mmHg=0.133 kPa) and the introduction of a 30°-angled laparoscope (Karl Storze, Walsdorf, Germany). The other four trocars were placed under direct vision: a 12-mm trocar was placed in the epigastric region, a 5-mm trocar was introduced in the right midclavicular line 1–2 cm below the costal margin, a 5-mm trocar was placed in the right axillary line 4–5 cm below the costal margin, and finally, a 5-mm trocar was placed in the left midclavicular line 1–2 cm below the costal margin as an assistant hand.

Figure 1



A transverse shows multiple shadowing stones in CBD (arrows). CBD, common bile duct.

Figure 2

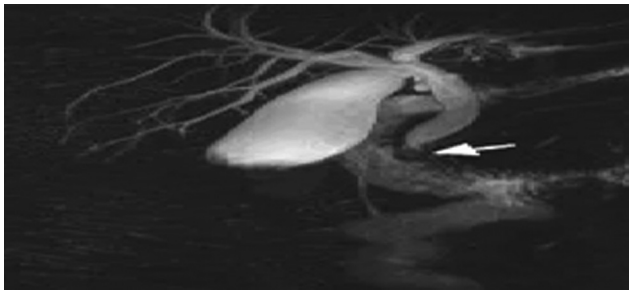
EUS showing CBD stone. CBD, common bile duct; EUS, endoscopic ultrasound.

With dissection of triangle of Calot, the cystic artery was clipped and cut off. The cystic duct was dissected near the gall bladder and clipped after identification to prevent stone and bile migration. Then dissection of the cystic duct toward CBD, and then, IOC through the cystic duct was done in all cases; intraoperative ultrasound was done in 20 cases for further evaluation of the anatomy of the bile duct and stone characteristics (Figs 4–6).

The transcystic (TC) approach was selected if the cystic duct diameter was more than or equal to 3 mm. to facilitate the introduction of the 5-mm choledochoscope (Olympus, Tokyo, Japan). We made a transverse incision of the cystic duct followed by dilation of cystic duct by using a golden finger retractor, which is our technique, being much easier than balloon in dilation of cystic duct till entering CBD (Fig. 7).

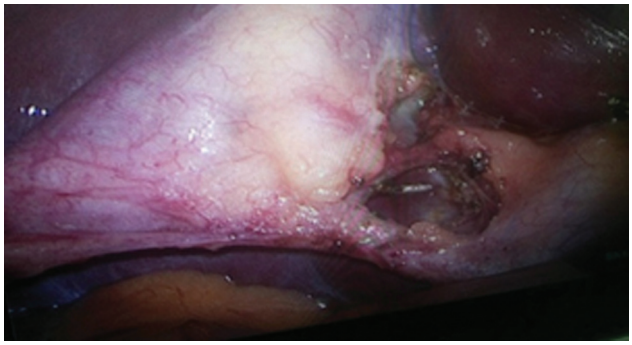
The 5-mm choledochoscope was introduced in the epigastric region through the cystic duct to the CBD, and the CBD stones were visualized directly. The CBD stones were generally retrieved through the cystic duct using Dormia basket, irrigation. Fragmented stones were extracted by using Dormia

Figure 3



MRCP showing CBD stone (arrow). CBD, common bile duct; MRCP, magnetic resonance cholangiopancreatography.

Figure 4



Identification of cystic duct and artery.

Figure 5

IOUS showed CBD hyperechoic stone with posterior acoustic shadow. CBD, common bile duct; IOUS, intraoperative ultrasound.

Figure 6

IOC showing a filling defect in CBD. CBD, common bile duct.

basket also, and a choledochoscopy was done for confirmation of bile duct stone clearance and the absence of bile duct mucosal injury (Figs 8 and 9).

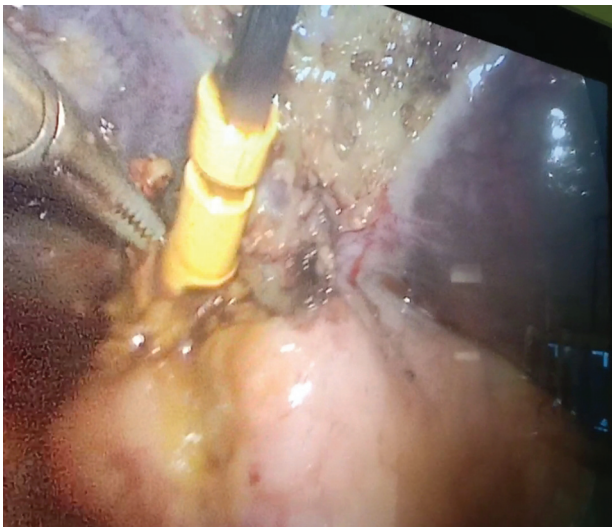
We closed the proximal end of cystic duct by using clips after complete clearance of the CBD stones. The gall bladder was removed from the hepatic attachments using standard techniques, and abdominal drainage was routinely placed in the subhepatic area. No T-tubes or biliary stents were used after successful stone extraction in any patients.

All data were recorded intraoperatively according to operative time, the rate of passing the choledochoscope into the duodenum, the rate of conversion of TC approach to choledochotomy or to open technique, and intraoperative complications, for example, injury to right hepatic artery, CBD, or duodenum.

Postoperative care and follow-up

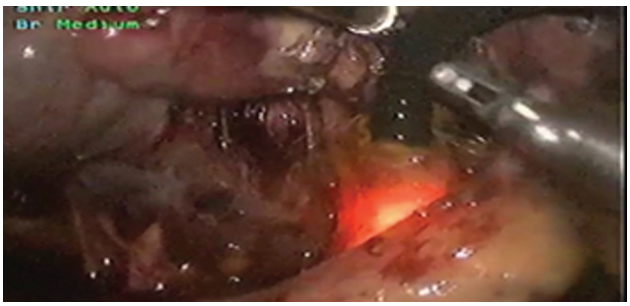
Patients recovered in the general wards of the department of general surgery in quiet and stable conditions after surgery. Oral intake was started after the first 24 h postoperatively.

Figure 7



Dilatation of the cystic duct.

Figure 8



Choledochoscopy.

Postoperative follow-up included pain score scale (1–10), patient satisfaction score (1–7), length of hospital stay, resumption of usual activities, and postoperative complications, for example, missed stone, biliary leakage, and wound infection.

All patients were followed up for at least 6 months after hospital discharge, that is, after 1, 3, and 6 months. Abdominal ultrasonic examination and liver function tests were measured in every patient during follow-up.

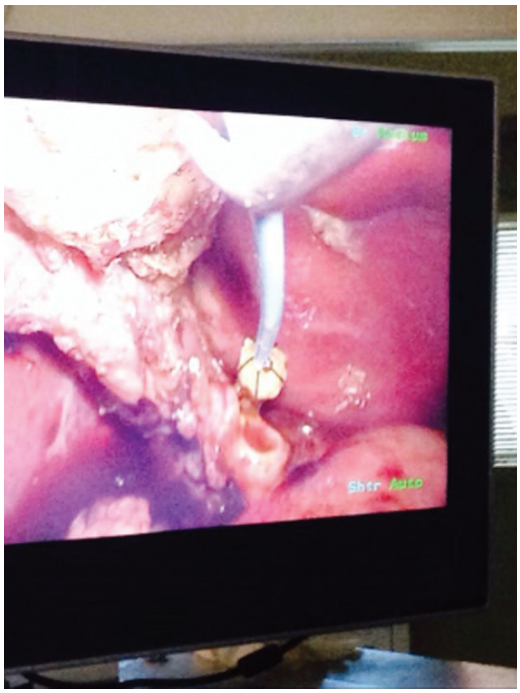
Statistical analysis

Collected data were tabulated. Quantitative data were expressed by the mean±SD, and qualitative data were expressed as number and percent (%).

Results

During the study period from 2017 to 2019, a total of 40 patients were included in this study for the treatment of CBD stones through laparoscopic TC approach.

Figure 9



Stone removal using the dormia basket.

Table 2 Age and sex distribution of the studied patients

Age	Sex	
Mean±SD	Male	Female
47.24±2.774	9	31

Epidemiological data of the patients included in this work are illustrated in Table 2. This study was carried out on 40 patients, comprising nine (22.5%) males and 31 (77.5%) females. Their ages ranged between 21 and 70 years, with a mean age of 47.24 years. The most common clinical presentations in patients of this study are shown in Table 3. By far, the most common complaint was right upper quadrant abdominal pain, which was found in 33 (82.5%) patients.

There was disturbance in liver functions in most of cases. Elevated serum bilirubin level was detected in 30 (75.0%) patients, elevated alkaline phosphatase and gamma glutamyl transferase levels in 35 (87.5%) patients, and elevated serum glutamic oxaloacetic transaminase and serum glutamic pyruvic transaminase in 35 (87.5%) patients (Table 4).

Abdominal ultrasonography was done for all patients in this study. It was able to reveal chronic calculous cholecystitis in all patients. Dilatation of CBD with stone/stones inside was detectable in 28 patients only. Magnetic resonance cholangiopancreatography and endoscopic ultrasound were done for several patients

Table 3 Clinical presentations of the studied patients

Complaint	No [*n* (%)]
Right upper quadrant pain	33 (82.5)
Jaundice	29 (72.5)
Pruritus	19 (47.5)
Fever	2 (5)
Nausea and vomiting	7 (17.5)
Cholangitis	0
Pancreatitis	0

Table 4 Laboratory workup of the studied patients

Laboratory investigations	
Leukocyte count (mean±SD) (1000 cells/mm^3)	8.72±0.60
Serum total bilirubin (mean±SD) (mg/dl)	2.31±0.37
Alkaline phosphatase (mean±SD) (IU/dl)	532.8±53.38
ALT (mean±SD) (IU/dl)	89.72±10.16

Table 5 Results of imaging studies done for studied patients

Imaging studies		Sensitivity (%)
Ultrasound (*n*)		
CCC	40/40	100
Dilated CBD	33/40	82.5
CBD stones	28/40	70
MRCP (*n*)	20/20	100
EUS (*n*)	19/20	95
Max. size of CBD stones (mean±SD) (cm)	0.81±0.072	
Single CBD stones (*n*)	9	
Multiple CBD stones (*n*)	16	

CBD, common bile duct; EUS, endoscopic ultrasound; MRCP, magnetic resonance cholangiopancreatography.

to ensure the diagnosis of calcular obstructive jaundice (Table 5).

The surgical results

The procedures were completed in 38 (95%) cases (Tables 6–8). Of 40 patients, two cases (5%) were converted to choledochotomy approach and stone extraction followed by T-tube and drain insertion. The T-tube was removed after 10 days following T-tube cholangiography, and the drain was removed on the next day. The reasons for conversion were narrow cystic duct (one patient) and extension of opening of cystic duct to CBD wall (one patient).

Only one patient presented with postoperative bile leakage owing to retained CBD stone. Abdominal ultrasound showed retained single stone with no collection and she subsequently underwent successful

Table 6 The operative data of the studied patients

Success rate [n (%)]	37 (92.5)
Failure rate [*n* (%)]	3 (7.5)
Operative time (mean±SD) (min)	199.2±8.601 (90)
Intraoperative cholangiogram	38/40 (95% sensitivity)
Intraoperative ultrasound	19/20 (95% sensitivity)
Choledochoscope	39/40 (97.5% sensitivity)

Table 7 Postoperative complications of the studied patients

Bleeding [n (%)]	0
Bile leak [*n* (%)]	1 (2.5)
Port infection [*n* (%)]	2 (5)
Acute pancreatitis [*n* (%)]	0
Acute cholangitis [*n* (%)]	0
Duodenal perforation [*n* (%)]	0
Mortality [*n* (%)]	0
Total complications [*n* (%)]	3 (7.5)

Table 8 Postoperative follow-up of the studied patients

24-h pain score scale 1–10 (mean±SD)	6.120±0.240
Hospital stay (mean±SD) (days)	4.440±0.798 (2)
Patient satisfaction score 1–7 (mean±SD)	6.60±0.408

ERCP and stone clearance. Thus, the actual success rate was 37 (92.5%) of 40 patients.

Discussion

A concomitant CBD choledocholithiasis is common in patients who have gallstones, so this requires proper strategy to solve. There are many options based on one-stage or two-stage management, starting by open surgery to laparoscopic and endoscopic management [15,16].

According to the study of Gupta [17], 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.

The TC approach is technically easier, feasible, and less invasive with better patient satisfaction. Surgeons usually try it first, but it has its limitations and indications, for example, dilated cystic duct, small stones (preferably single stone), and there should be no stent in the CBD [18].

The present study was conducted in 2 years starting from 2017 to 2019 on 40 patients who presented with calcular obstructive jaundice. All 40 patients underwent LTCBDE.

Of the 40 patients, 31 (77.5%) were female, whereas the other nine (22.5%) patients were male. They ranged in age from 21 and 70 years old, with mean ±SD age of 47.24±2.774 years.

In this study, we present our experience of LTCBDE in our institutes in collaboration with Damanhur Teaching Hospital, with success rate of 92.5% (37/40), which are comparable to the results of ERCP and open CBD exploration with less morbidity and mortality, and hopefully, the success rate will increase with increasing experience [19].

In the present study, the total operative time in LTCBDE approach was shorter, with mean operative time in minutes being (90 min) 199.2 ±8.601. In line with the study done by Grubnik *et al*. [20], in which the mean total operative time in minutes in open approach was 90 (60–150) min and in laparoscopic approach was 82 (40–160) min. The results of the present study are in contrary with the study done by Halawani *et al*. [21], in which total operative time in minutes was significantly longer in open approach than in laparoscopic approach (the mean in open is AQ9 197.99±101.19 vs. laparoscopic ±74.49 and $P<0.05$).

Regarding clinical outcomes, port-site infection occurred in two (5%) of 40 patients with LTCBDE approach. These results are in contrast with the study done by Halawani *et al*. [21], in which open common bile duct exploration (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*. [20], 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, there is no intraoperative blood loss or duodenal perforation; this is in line with the results of the study done by Grubnik *et al*. [20], in which intra-abdominal 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 *et al*. [21], 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 LCBDE.

The postoperative hospital stay in LTCBD is significantly shorter, with mean length of stay in days was 2 days (4.440±0.798). These results are similar to the study done by Grubnik *et al*. [20], in which the mean length of stay in LCBDE approach was 4.2±1.8. These results are also in line with the study done by Li *et al*. [22], in which the mean length of stay in days in LCBDE was 5.3±0.6.

In the present study, the postoperative bile leakage occurred in one patient. Moreover, the results are in line with the results of the study done by Li *et al*. [22], in which one patient of 70 who underwent LCBDE experienced bile leakage.

We routinely used intraoperative cholangiogram before stone extraction for confirmation of the presence of stones and after to make sure of complete clearance of the CBD with success rate of 38/40 (95% sensitivity). We used the choledocoscope in most of our cases [39/40 (97.5% sensitivity)] to confirm the complete clearance of the CBD and to inject saline for washout of stone fragments and debris. Moreover, laparoscopic intraoperative ultrasound was performed in 19/20 (95% sensitivity) to detect number of stones.

Laparoendoscopic rendezvous is a good alternative procedure. It provides selective cannulation of CBD and avoids cannulation of pancreatic duct [23].

In most of studies, the mortality of laparoscopic CBD exploration is 0–1% in the hands of experienced biliary surgeons. This rate is similar to the incidence found in open CBD exploration [12]. In our study, we have no reported mortality cases, which may be attributed to improved preoperative preparation, improved anesthesia, and selection of cases.

Conclusion

In cases of small stones less than or equal to 6 mm in diameter with diameter of cystic duct more than 4 mm, it is recommended to do laparoscopic TC exploration of CBD.

LTCBDE is an effective single-stage procedure for the treatment of gall bladder and CBD stone in one session making use of the benefits of minimally invasive approach, such as including shorter hospitalizations, quicker return to work, decreased complications, and less postoperative pain, and avoiding the drawbacks of ERCP as well as open CBD approach. LTCBDE can be performed after proper training and adequate equipment and laparoscopic facilities.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1 Pak M, Lindseth G. Risk factors for cholelithiasis. Gastroenterol Nurs 2016; 39:297–309.

2 Kharbutli B, Velanovich V. (2008) Management of preoperatively suspected choledocholithiasis: a decision analysis. J Gastrointest Surg 2016; 12:1973–1980.

3 Ahmad M, Ansari NA, Hingora OM. Comparison of T-tube drainage versus primary closure of common bile duct after choledochotomy in case of choledocholithiasis. Era's J Med Res 2017; 4:14–17.

4 Schirmer B, Winters KL, Edlich RF. (2005): Cholelithiasis and cholecystitis. J Long Term Eff Med Implants 2017; 15:329–338.

5 Shabanzadeh DM, Sørensen LT, Jørgensen T. A prediction rule for risk stratification of incidentally discovered gallstones: results from a large cohort study. Gastroenterology 2016; 150:156–167.

6 Kulkarni JS. (2007) Detection and management of CBD stones in the era of laparoscopic cholecystectomy. Compreh Laparosc Surg 2016; 11:90–95.

7 Cox MR. Gallbladder stones and common bile duct stones. in surgical diseases of the pancreas and biliary tree. Singapore: Springer; 1998. pp. 65–120.

8 Paganini AM, Guerrieri M, Sarnari J, Sanctis AD, Ambrosio G, Lezoche G, Perretta S, Lezoche E. Thirteen years' experience with laparoscopic transcystic common bile duct exploration for stones. Effectiveness and long-term results. Surg Endosc 2007; 21:34–40.

9 Bove A, Di Renzo RM, Palone G, Testa D, Malerba V, Bongarzoni G. Single-stage procedure for the treatment of cholecysto-choledocolithiasis: a surgical procedures review. Ther Clin Risk Manag 2018; 14:305.

10 Bhutani MS, Vilmann P, Saftoiu A. Fast facts: diseases of the pancreas and biliary tract, 2006. John P Neoptolemos, Manoop S Bhutani. Health Press Ltd, Abingdon, Oxfordshire, OX14 3LN, United Kingdom. 2007; 21:150.

11 Pang L, Kong J, Wang Y, Zhang Y. Laparoscopic versus open pyloruspreserving pancreatoduodenectomy. The first meta-analyse of retrospective matched cases. Acta Cir Bras 2018; 33:40–48.

12 Fang L, Wang J, Dai WC, Liang B, Chen HM, Fu XW, *et al*. Laparoscopic transcystic common bile duct exploration: surgical indications and procedure strategies. Surg Endosc 2018; 32:4742–4748.

13 Mukherjee I, Demin A, Kania T, Mironenko A, Gibbs KE. Scientific session of the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES), Baltimore, Maryland, USA, 3–6 April 2019: Exhibit Hall Videos. Surg Endosc 2019; 33:S115–S129.

14 Elkeleny MR. Laparoscopic management of large common bile duct stones via choledochotomy. Egypt J Surg 2019; 38:58.

15 Petelin JB. Laparoscopic common bile duct exploration. Surg Endosc 2003; 17:1705–1715.

16 Traverse LW, Roush TS, Koo K. CBD stones-outcomes and costs. Laparoscopic transcystic techniques other than choledochoscopy. Surg Endosc 1995; 9:1242–1244.

17 Gupta N. Role of laparoscopic common bile duct exploration in the management of choledocholithiasis. World J Gastrointest Surg 2016; 8:376.

18 Cai H, Sun D, Sun Y, Bai J, Zhao H, Miao Y. Primary closure following laparoscopic common bile duct exploration combined with intraoperative cholangiography and choledochoscopy. World J Surg 2012; 36:164–170.

19 Zhang WJ, Xu GF, Huang Q, Luo KL, Dong ZT, Li JM, *et al.* Treatment of gallbladder stone with common bile duct stones in the laparoscopic era. BMC Surg 2015; 15:7.

20 Grubnik VV, Tkachenko AI, Ilyashenko VV, Vorotyntseva KO. Laparoscopic common bile duct exploration versus open surgery: comparative prospective randomized trial. Surg Endosc 2012; 26:2165–2171.

21 Halawani HM, Tamim H, Khalifeh F, Mailhac A, Taher A, Hoballah J, Jamali FR. Outcomes of laparoscopic vs open common bile duct exploration: analysis of the NSQIP database. J Am Coll Surg 2017; 224:833–840.

22 Li KY, Shi CX, Tang KL, Huang JZ, Zhang DL. Advantages of laparoscopic common bile duct exploration in common bile duct stones. Wien Klin Wochenschr 2018; 130:100–104.

23 Baloyiannis I, Tzovaras G. Current status of laparoendoscopic rendezvous in the treatment of cholelithiasis with concomitant choledocholithiasis. World J Gastrointest Endosc 2015; 7:714–719.