LAPAROSCOPIC EXPLORATION OF THE COMMON BILE DUCT AND T-TUBE DRAINAGE IN CHINA

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Summary

Biliary stones that are seen in the Asian population are very different from those seen in the west. It is frequent to see multiple, large, and impacted stones and a hugely dilated Common Bile Duct (CBD). Many of these patients have been managed by open cholecystectomy, even after the advent of Laparoscopic Cholecystectomy (LC) because these large stones pose significant challenges for extraction by endoscopic retrograde cholangio-pancreatography. This study represents an experience of managing intra and extra hepatic bile ducts using a laparoscopic approach. A retrospective data analysis was done during the period of November 2010–April 2015 and correspondingly 85 patients with documented intra and extra hepatic biliary stones were treated laparoscopically at Qilu Hospital under Shandong University, School of Medicine. There were 23 men and 62 women patients with age ranging from 23 to 76 years. The mean diameter of the CBD was 12mm. The number of stones extracted varied from 1 to 35 and the size of the extracted stones from 0.3X0.3X0.3 to 4X3.5X3.5 mm. The average duration of surgery was 170 min. There were 7 conversions to open procedures and 24 patients (29%) had nonfatal postoperative complications. Four patients had retained stones (4.7%).

Though patients presented with multiple and impacted CBD stones, laparoscopy presents a unique approach for a minimally invasive procedure with its benefits in the form of laparoscopic intra and extra hepatic bile ducts exploration.

Key words : Common bile duct; T-tube; Laparoscopic cholecystectomy.

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Introduction

Since the first Laparoscopic Cholecystectomy (LC) was performed in France in 1987, it has gained world-wide acceptance for gall bladder disease. However, 5-10% of patients in Western countries and 20-45% in Asian countries have stones in the Common Bile Duct (CBD) [1-4]. Primary multiple intra and extra hepatic cholangiolithiasis is a common disease in China and Asia. The incidence of this disease is high and is damaging to both liver function and general condition of the patients. A large number of these patients have required open choledocholithotomy, especially in China. Therefore, to enable the patients with stones in intra and extra hepatic ducts to avoid extensive laparatomy, direct exploration of CBD during laparoscopic cholecystectomy and to efficiently evacuate in primary intra and extra hepatic stones at only one initial operation had become an important and difficult problem demanding a prompt solution. Before attempting laparoscopic choledocholithotomy, laparoscopic anatomy of porta hepatic, exposing the bile duct, incision of the duct, fibre-optic choledochoscopy, removal of stones and T-tube drainage were all considered.

The aim of this study is to introduce our novel technique for Laparoscopic Common Bile Duct Exploration (LCBDE) and T-tube drainage, which may overcome some of the limitations of conventional LCBDE. The advantages of this technique are that it is less invasive than conventional open surgery and it permits single-stage management, and also safe,efficient and cost-effective.

Materials and methods

A retrospective data analysis conducted between November 2010—April 2015 of a total of 85 patients with CBD stones (23 were male and rest were female) underwent Laparoscopic exploration of intra or extra hepatic bile ducts using T-tube drainage, were employed as per the merit of each case at Qilu Hospital,School of Medicine under Shandong University. All data collected in a record form including age, sex, biochemical data and other special data for special cases before surgery.

All patients were diagnosed pre-operatively as having stones in common bile duct or intra hepatic bile ducts with ultrasound, Computed Axial Tomography (CAT) scans and Endoscopic Retrograde Cholangiopancreatography (ERCP) or Magnetic Resonance Imaging (MRI) and Magnetic Resonance Cholangiopancreatography (MRCP). Fifty one (51) patients had common bile duct stones, thirty two (32) patients had intra hepatic stones and fifty seven (57) patients had concurrent gall-bladder stones. Thirty three (33) patients had a previous surgery. Among them nineteen (19) female patients had undergone Lower Uterine Cesarean Section (LUCS) and thirteen (13) had previously undergone Appendicectomy and one (01) patient had open cholecystectomy (Table 1). Fifty nine (59) patients suffered from mild upper abdominal pain while twenty three (23) patients had rigors and fever (Charcot fever) and mild jaundice and four (04) patients had Acute Obstructive Purulent Cholangitis (AOPC).

Statistical analysis

All data were recorded in a form regarding clinical presentation, clinical examination, investigations, peroperative and postoperative evaculation of 85 patients CBD stone disease. Statistical analyses were carried out by using the Statistical Package for Social Sciences (SPSS inc, Chicago,Illinois,USA) for windows version 19.0. The mean values were calculated for continuous variables. The quantitative observations were indicated by frequencies and percentages.

Instruments and equipment

We used a Wolf laparoscope for cholecystectomy, Richard Corporation (Germany) and Olympus fiber optic choledochoscope (Japan) (CHF B4: Working length 330 mm, 4.8 mm outer diameter with an irrigation and instrumentation channel of 2 mm diameter, OES P10: Working length 400 mm, 5 mm outer diameter with an instrumentation and irrigation channel of 2 mm diameter, OES P20 working length 400 mm, 5 mm outer diameter with an instrumentation channel of 2 mm and irrigation channel of 1 mm diameter, lithotomic baskets, working length 800-1000 mm, 2 mm outer diameter with wire basket length of 50-60 mm, and tridentate lithotomic forceps working length 500-600 mm, 2-3 mm outer diameter with wire trident of 30-40 mm).

Additional special appliances were constructed and these included:

1. A puncture needle for the CBD. This was a 400 mm steel tube with 3 mm inside and 5 mm outside diameter. Both ends could be fitted with different sized needles and syringes respectively.
2. A scalpel with a long handle to open the CBD. This had a long handle 5 mm in diameter and 400 mm in length which could be fitted with a No.11 blade.
3. A suture needle for use with laparoscopy. This was a straight needle with a small hook at the sharp end.
4. A variety of needle holders. Two needle holders with curved and straight angles respectively and one with sharp point end. All needle holders cross serrations were a little deeper than normal.
5. A stone collecting bag. The bags which were 30 mm in diameter and 60-90 mm in length could be made from thin nylon cloth (Instead of a condom or a finger glove).
6. Absorbent haemostatic gauze. Different gauze roles which ranged from 10X10 to 30X60 mm containing local haemostatic drug for stoppage bleeding.
7. Forceps to crush stones. These were strong duck mouth forceps similar to forcep which remove the gallbladder.

Pre-operative preparation and exclusion

Every patient had pre-operative preparations for laparoscopy including full blood count, urine analysis, bleeding and coagulation time, hepatitis B surface antigen, liver function tests, Electrocardiogram (ECG) Chest radiography and other special examinations for special cases. Patients deemed unfit for general anesthesia and/or laparoscopy (High surgical risks: 80 years of age with multiple co-morbid conditions and ASA grade 4 or above) were excluded from the present series. The criteria for inclusion in the study specified a patient older than 12 years who had undergone a laparoscopic choledochotomy. The exclusion criteria specified a patient 12 years of age or younger who had acute supportive cholangitis, severe acute biliary pancreatitis, ampullary stenosis, and a previous gastrectomy or failure of Endoscopic Retrograde Cholangiopancreatography (ERCP).

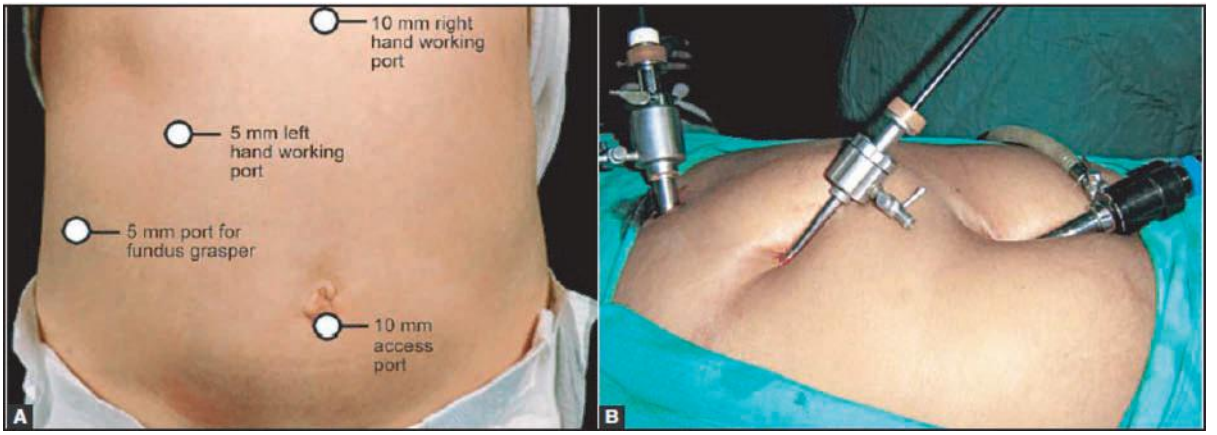

Fig 1 (A, B) : Trocars entry points

Surgical procedure

All laparoscopic operation was conducted by trained laparoscopic surgeons of department of Surgery, Qilu Hospital, Shandong University. All patients were placed in the supine position with a steep head-up and left tilt.

For the procedure, We used the following steps:

Step 1 : Insertion of the Trocar

First Port (10 mm): Skin incision was made at the infra-umbilical region. Pneumoperitonium was established with carbon-di-oxide through a long needle. A 10 mm trocar was inserted blindly into the abdominal cavity. A 30 degree telescope was inserted through the initial sheath. The peritoneal cavity was inspected to ensure no injury as a result of inserted of trocar and sheath. The stomach, the liver, the intestines, the gall-bladder and the surrounding the porta hepatis were examined for any obvious abnormalities.

The other ports were placed under direct vision with the laparoscope.

Second Port: Right subcostal trocar, A 5 mm trocar was placed in the mid-clavicular line, was used to insert grasping forceps or the applicans during surgery. This was also used for the T-tube exit site. If retained stones were found during the post-operative cholangiography (2 weeks postoperative), a fibra-optic choledochoscope was used through the incision for stone removal.

Third Port: A 5 mm trocar was placed in the right anterior axillary line for irrigation suction and post-operative peritoneal cavity drainage tube.

Fourth Port: A 10 mm trocar was inserted just below the xiphoid process, left to the falciform ligament. This was used for Maryland forceps, cautery hook, scissors, clip applicator, scapel, needles, needle holders, sutures, T-tube and for the flexible choledochoscope.

Step 2 : Dissect out the cystic artery and the cystic duct

The procedure was initiated by the dissecting Calot's triangle carefully to expose the confluence of the cystic duct and the Common Hepatic Duct (CHD). The gall bladder was dissected first, if the GB was adherent with the omentum. The cystic duct and the cystic artery were dissected, and the cystic artery was clipped, then divided. The cystic duct was left initially to use for traction to assist in identification of the CBD. The cystic duct was clipped or ligated with threads at the GB side to prevent the passage of any gall bladder stones into the CBD during manipulation. The Gall-bladder was separated from its fossa using diathermy. The fundus of the GB or Hartman's pouch was held with grasping forceps and retracted superiorly laterally to help identify the CBD.

For those patients who had primary cholangiolithiasis with a normal gall-bladder or who had acute obstructive pyogenic cholangitis with obstruction caused by primary stones, the gall-bladder was not removed. However, in Caucasians bile duct stones usually occur with gall-bladder stones and the gall-bladder invariably must be removed. The primary duct stones of primary obstructive pyogenic cholangitis are different. Those patients who had stones in both the biliary duct and gall-bladder and also those who had cholecystitis had the gall-bladder removed.

Step 3 : Dissect out the CBD and open the CBD

The fat at the porta hepatic and connective tissue on the surface of the common duct was dissected free using diathermy hook or Maryland forceps and gauze rolls for pushing. During the procedure, lap gauze was placed at Morrison's pouch to prevent the spillage of extracted stones. The identification of the CBD was confirmed by puncturing it with a needle and withdrawing bile. To confirm the clearance the CBD, A 1-4 cm incision was then made in the avascular area of the CBD (Commonly supraduodenal part of the CBD) with a long-handle scalpel after using little diathermy to prevent oozing. A stone collecting bag was inserted into the peritoneal cavity through the main sheath.

Step 4 : Explore the CBD with a choledochoscope and extraction of the CBD stones

After exploration of the CBD, if stones were found into the CBD, then the stones were extracted by simply manipulating bile duct using blunt forceps and collected into the bag. A fibra-optic choledochoscope was inserted into the CBD to assess the stones numbers and size. All the stones were taken out using eight stone forceps, dormia basket, Fogarty balloon catheter, saline irrigation with suction or direct manipulation by blunt forceps. In case of a very large and impacted stones were fragmented first by electrohydraulic lithotripsy and either extracted with a dormia basket forceful saline lavage or pushed out through the ampulla. We never dilated the papilla because of the high risk of acute pancreatitis. If the bag contained only stones, it could be pulled through the main sheath. If the bag couldn't contain all the stones, another bag would be used. If stones were too large or hard to be readily removed or were in irregular shape, the stone bags were temporarily kept to the greater momentum and then removed with the gall-bladder before the end of operation.

Step 5 : Examine the biliary tree through the choledochoscope

To confirm the clearance of the CBD, the choledochoscope was passed downwards and advanced to just proximal to the Ampulla of Vater (AOV) or sometimes into the duodenum to check the patency of the AOV.The lumen of the ascending CBD, the right and left hepatic ducts were also assessed to check for residual stones by moving the choledochoscope upward.

Step 6 : Place a T-tube in the CBD and suture the CBD

After confirmation of CBD patency or no stones retained, both short arms of a T-tube (14-20 fr size) was inserted into the common bile duct incision.After the tube was secured in place, the CBD incision was closed using interrupted sutures (3/0vicryl) as required. Saline was flushed through the long arm of the T-tube to rule out leakage or to expel out ait bubbles.

Step 7 : Ligate and divide the cyst duct

At the end of the procedure, another clip was given at the lower of the cystic duct and divided between the clips. The gall bladder was separated from the GB bed of the liver (Glisson's capsule) if not done firstly.

Step 8 : Extract the GB and stone collecting bag and toileting the peritoneal cavity

The GB and endobag of the collecting stones were removed through the infra-umbilical incision, and also lap-gauze from the Morrison's pouch.

The peritoneal cavity was then irrigated and sucked dry. The long arm of the T-tube was brought out through the mid-clavicular line incision. A silicon drainage tube was inserted through the main sheath, placed such that the holes were near the foramen of Winslow, and pulled out through the right anterior axillary line incision. The fascial defect and skin incisions were then closed by a small Band-Aid and the two tubes were fixed to the skin.

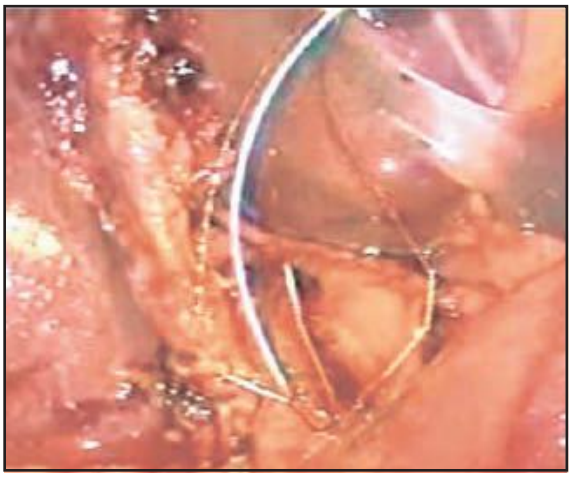

Fig 2 a : Dormia Basket applied over extended stone

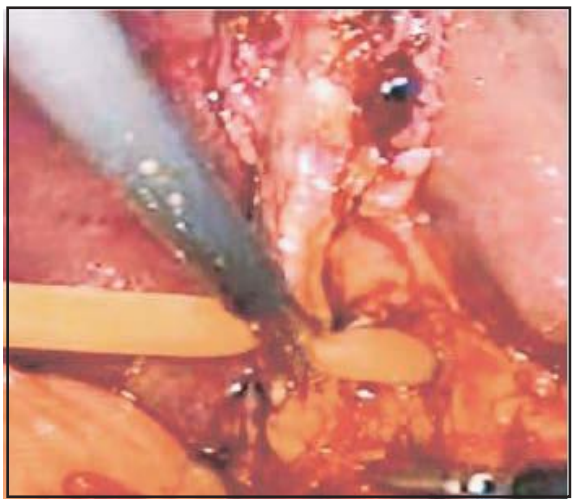

Figure 2 b : T-tube placed in situ

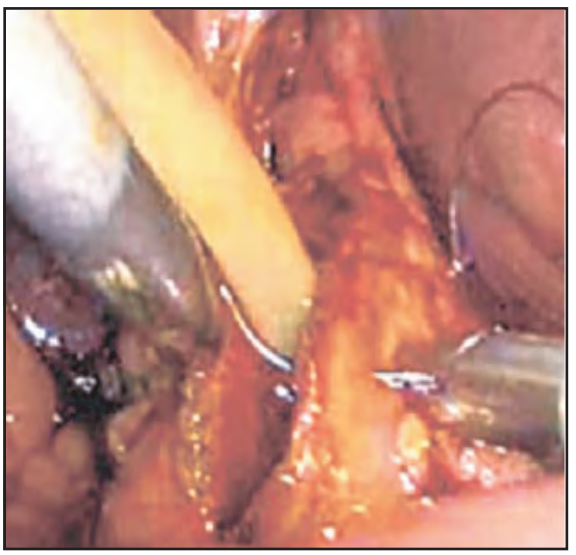

Figure 2 c : T- tube secured by sutures

Results

There were 23 men and 62 women patients with age ranging from 23 to 76 years. The mean age was 48 years and the mean weight was 63 kg (Table I).

Out of 85 patients during a period , were treated laparoscopically and form the present series. Operative findings, site of the stones and maximum size of stone in CBD were recorded in table II. The average operating time was 170 min (Range 100 to 230 min). The diameter of the CBD was evaluated preoperatively in all patients using US and MRCP. The mean diameter of the CBD was 12 mm (Range, 6–32 mm). The average number of stones extracted per patient was 8 (Range, 1–35). Fifty-four patients (63%) had more than five stones. The size of the extracted stones varied from 0.3 X 0.3 X 0.3 to 4 X 3.5 X 3.5 mm. There were seven conversions (8%) to open procedure due to impacted stone in CBD, dense adhesion, bowel injury and anaesthetic cause (Table III).

Twenty four patients (29%) had nonfatal postoperative complications, ranging from minor complications, such as wound infection and transient hyperamylasemia, to more serious ones, such as bile leakage, intra-abdominal collection, and upper gastrointestinal hemorrhage. Bile leakage was transient and occurred when the drainage tube was in situ, none required any auxiliary procedure (Table IV). There were four cases of retained stones (4.7%) two cases were managed by ERCP and two cases were performed by flexible choledochoscope through the T-tube sinus tract after confirmation by USG and MRCP.

In patients with T-tube drainage, the average duration for which the T-tube was kept was 13 (Range 9–36) days. However, the patients were discharged with a functional T-tube whenever their clinical condition merited and were asked to return for a check cholangiogram 10 days postoperatively. Postoperative stay ranged from 4 to 23 days with an average of 5 days. Eighty-one percent of the patients had a stay of 5 days or less. Most patients had oral fluids on day one, were mobile on the second day. Postoperative follow-up of the patients ranged from 3 to 12 months. 17% of patients were lost to follow up after an average duration of 08 months, whereas 52% were lost to follow-up at 12 months.

Table I : Patient characteristics

Patient number	85	
Male	23	
Female	62	
Female : Male (Ratio)	2.7:1	
Age: mean years (Range)	48	(23-76)
Weight: mean kg (Range)	63	(45-77)
Previous surgery :		
LUCS 19		
Appendicectomy	13	
Open cholecystectomy	01	
Time in hospital after laparoscopy (Days)	5-9	

Table II : Opertative finding, site and maximum size of stone

Finding	No. of patients (%)
Site of calculi	
Common Bile Duct (CBD)	49 (57)
Intra Hepatic (IH)	36 (43)
CBD+IH	37 (44)
Gall-bladder+CBD &/or IH	71 (84)
Maximum size of stone in CBD	4X3.5X3.5 mm

Table III : Reason for conversion to open procedures

Reason for conversion	No. of patients
Impacted stone in CBD	4
Dense adhesion	1
Bowel injury	1
Anesthetic cause (Hypotension on CO_2 insufflation)	1
Total	7

Table IV : Complications on follow up

Complications	No. events
Nonfatal	
Bile leakage	8
Wound infection	7
Intra abdominal collection	3
Retained CBD calculi	4
Hyperamylasemia	1
Upper gastrointestinal bleed	1
Total (Nonfatal)	24

Discussion

Since the first successful Laparoscopic Cholecystectomy was reported in 1987, it progressively replaced open cholecystectomy [5]. Laparoscopic exploration of the CBD via the transcystic route was first reported in 1991 [6,7]. Laparoscopic choledochotomy and CBD exploration were also first reported in 1991 but has been less widely documented [8]. Berci and Morgenstern, in the multi-institutional SAGES study, documented the procedure for laparoscopic extraction of CBDS in 1994 [9].

Approximately 05-10% patient in western countries and 20-45% patients of Asia have stones in intrahepatic duct [4,10,11]. In western countries gall stones are usually seen in the gall bladder and cholesterol is their main component and most of the calculi in the bile duct originate from the gall bladder. In Asia, in addition to cholesterol and mixed stones in the gall bladder, there is another kind of gallstone originating from the intra and extra hepatic duct, in which bilirubin is the major component.

The ideal method of biliary stone removal is the one that does not cause injury to the sphincter of Oddi, because it is desirable to preserve the sphincter in patients younger than aged 60 years [12,13]. One-stage management of CBDS with LC and Laparoscopic exploration of intra and extra hepatic bile ducts has lowest morbidity and mortality and is cost-effective with a short hospital stay. It treats both gallstones and CBDS in single stage compared with staged procedures, and can be performed as a daycare procedure [12]. Laparoscopic exploration of intra and extra hepatic bile ducts also preserves the function of sphincter of Oddi and hence reflux-related complications, such as cholangitis and recurrent stones associated with sphincter damage are not seen [12]. In this study we presented the laparoscopic management of CBDS in patients and attempted to share our experiences.

The male to female ratio in this series is 1:2.7, which is in agreement with the published literature, but with female predominance. The majority of the patients were between age 40 and 60 years, which is again conversant with that reported by other authors [13-17]. The mean diameter of CBD was 12 mm (Range, 6–32 mm).

These values indicate the difference in the patients seen in this part of the world, who have a dilated CBD at presentation, in contrast with the western series where the average diameter of the CBD is <8 mm evident due to the preponderance of Transcystic (TC) route employed [18-21]. The average number of stones extracted per patient in this series was 8 (Range, 1–35) and the average size of the stones varied from 0.3 X 0.3 X 0.3 to 4 X 3.5 X 3.5 mm. This is again in variance with the western reports where the majority of patients have a low stone load with small stone size, making the TC route feasible [18-21]. The few Asian series that have been published have data similar to the present series with large stone size, higher stone load, and dilated CBDs [22-24].

The average operating time was 170 min (Range 100 to 230 min). The maximum duration was seen with patients with conversion to open procedures because all of these were failures of laparoscopic surgery. The patients with T-tube drainage also had longer operative time, because external biliary drainage was mostly used during the initial part of the series or in cases of complicated CBDS. The operative time is similar to that reported in the published data. The comparative operative times in various series worldwide were Berci et al. (146 min) Dion et al. (172 min) and Petelin (168 min) [9,14,20]. However, it needs to be noted that the majority of the cases in the present series were done through Transductal (TD) route, which takes longer because of the stone characteristics and intracorporeal suturing involved. On the other hand, the majority of the patients in the reported series were operated on using the TC route [9,14,20]. The operative time decreased as the proficiency increased.

The incidence of retained calculi in this series was 7% which is similar with many published reports [5,9,20,22]. There were only 2 episodes of retained calculus in our last 40 cases. It assumed that to achieve high stone clearance rates, advanced laparoscopic skills, although desirable, are not sufficient on their own. In addition and in fact more important is conversance and familiarity with endoscopic skills, which is required to visualize and clear the CBD of stones, especially those located at the lower end of the CBD.

Availability of Holmium laser for intracorporeal lithotripsy was an additional help to tackle impacted stones, it was used in four cases to fragment the calculi. In addition it was much easier to deliver laser pulses with a rigid choledochoscope because it offers straight and clear vision of stones located at awkward positions.

The incidence of nonfatal postoperative complications showed a decreasing trend with increasing experience. Postoperative stay ranged from 4 to 23 days (Average, 5) days. The patients with conversion to open procedures had the longest stays, which may be because of the increased postoperative pain experienced by these due to the technique of access (Open) which was minimized in the Laparoscopic exploration of intra and extra hepatic bile ducts group. The duration of stay also decreased with an increasing experience with this technique. This can be explained by a decreased incidence of complications as the experience with the technique grew and also the familiarity with the postoperative course, thus there was a renewed confidence to discharge the patients earlier. In today's scenario with increasing patient load and in-patient treatment costs, the surgeon is expected to ensure a shorter hospital stay for the patient. However, it has been stated in the literature that the length of hospital stay should not be a criterion for assessing outcome of surgery because it is not only dependent on the surgical procedure performed but is influenced by several factors independent of patient's postoperative recovery, such as socioeconomic aspects of patients and medical institutions [25]. Postoperative follow-up of the patients ranges from 3 to12 (Average, 6) months. The patients were evaluated for development of any late complications attributable to the procedure performed.

We believe that the best treatment for choledocholithiasis is the one that is simple, reliable, readily available, and cost-effective for most patients. With advances in technology and an increasing experience in laparoscopic techniques making laparoscopic exploration of intra and extra hepatic bile ducts feasible and safe, this has emerged as the favorable choice in the hands of experienced laparoscopic surgeon. However we still believe that open procedure is still the safest technique for most injuries to the CBD resulting from laparoscopic cholecystectomy.

Conclusions

In our experience a single stage laparoscopic treatment of gall stones with intra and extra hepatic bile ducts stones is a variable and cost-effective option with minimum complications. There were seven conversions to open procedure and four cases of retained stones in our study. Closure of the CBD after placement of the T-tube is a feasible option but requires advanced skills in minimalaccess surgical tachniquces, especially endosuturing to prevent bile leakage. Laparoscopic exploration of intra and extra hepatic bile ducts is a safe method of exploring CBD, which gives more or less satisfactory results without proceeding to open cholecystectomy. If performed with an experienced hand laparoscopic exploration of intra and extra hepatic bile ducts can be performed within an operative time comparable to that for open operation. Patients with successful laparoscopic exploration proves that when performed by an experienced surgeon results in no additional morbidity or mortality as compared to open surgery, with excellent success rates.

Disclosure

All the authors declared no competing interest.

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