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Original Research Article

Alternative laparoscopic techniques for stone extraction during laparoscopic CBD exploration: pros and cons

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ABSTRACT

Background: A prospective work to study various laparoscopic techniques used for stone extraction during laparoscopic common bile duct exploration (LCBDE) with assessment of CBD clearance by each technique with discussion of its feasibility and difficulties.
Methods: Patients with chronic calcular cholecystitis with CBD stone(s) were treated randomly by laparoscopic cholecystectomy plus choledocholithotomy. Various methods were used for stone extraction either through the scope technique, direct access technique, or irrigation/suction technique. Assurance of CBD clearance of stones was done later using intra-operative choledochoscopy, cholangiogram, or post operatively using sonography or MRCP.
Results: Out of sixty seven patients, laparoscopic CBD stone extraction was done through scope control in 25 patients, direct access technique in 22 patients, while irrigation/suction technique was done in 20 cases. Choledochoscope method was the most effective method for CBD clearance with success rate (96%), it was effective in distal CBD stones of average size (0.5-1.0 cm), and number (1-5), but unfortunately missed stone is a relative risk (4%). Direct access technique is as effective blindly especially if associated with irrigation/suction with success rate (81.8%) specially in non-impacted single distal stone of average size (0.5-1.0 cm) well recognized by MRCP a night before operation. Irrigation / suction technique was the least effective with success rate (50%) only with the need to convert to other technique in 50% of cases.
Conclusions: Choledocoscope guided stone extraction technique was the technique of choice for CBD clearance during LCBDE.

Keywords: CBD stones, LCBDE, Cholodocholithiasis

INTRODUCTION

Patients with concomitant gallstones and common bile duct stones (CBDS) are common.[1] The incidence of CBD stones in patients undergoing elective cholecystectomy is 5–15% while it is higher and more variable in patients with suspected CBD stones on ultrasonography or with abnormal laboratory findings.[2-4] Both surgeons and patients are often faced with difficulties in making treatment decisions when choosing the optimal treatment. Surgical common bile duct (CBD) exploration, retrograde cholangiopancreatography (ERCP) with endoscopic sphincterotomy (EST) and laparoscopic CBD exploration (LCBDE) are the three different modalities used for treatment of CBD stones. ERCP with EST carries a significant risk of complications such as acute pancreatitis, duodenal perforation, bleeding, cholangitis, and injury of the sphincter of Oddi.[5,6] LCBDE has the advantage of simultaneously treatment of cholelithiasis and choledocholithiasis, short hospital stays and hence less costs but it needs surgeons with high laparoscopic skills and advanced equipment. LCBDE has been

performed more frequently nowadays as it is less invasive than open surgery although it is associated with risk of postoperative CBD stricture and bile leakage due to technical difficulty.[7,8] The overall success rate of LCBDE was reported to be 94.6%.[9] Surgeons have proposed various laparoscopic techniques for stone extraction during LCBDE, either through the scope method using basket and balloon with choledochoscopic control, direct access extraction of stones using basket, balloon or reticulated graspers with CBD milking, or irrigation/ suction techniques.[10-12] Till now there is no consensus about the best surgical treatment method. In this study we tried to assess CBD clearance of stones for each maneuver with discussion of its feasibility and difficulties encountered to evaluate its role in laparoscopic procedure.

METHODS

Study design

This study is a prospective cohort study. Ethical committee approval for the study was obtained. Informed consent was signed by all patients after full explanation of the surgical procedure and possible benefits and side effects. The study was performed utilizing the "Strengthening the Reporting of Observational Studies in Epidemiology (STROBE)" statement.

Settings and participants

The study was conducted at general surgery department, Sohag University, Egypt. The study included patients with chronic calcular cholecystitis with CBD stone(s) that match the assigned eligibility criteria between January 2015 and October 2018. The study purpose was to compare different laparoscopic methods for stone extraction from the CBD. These methods included stone extraction using basket, balloon or reticulated grasper with choledochoscopic control (group 1), direct access extraction of stones using basket, balloon, or reticulated graspers with CBD milking (group 2), or irrigation/ suction technique (group 3).

Eligibility criteria

All adult patients diagnosed as having chronic calcular cholecystitis with CBD stones were included in this study. Patients who have CBD diameter less than 1 cm, uncontrolled or advanced debilitating diseases were excluded from this study. Also transcyctic approach for stone extraction is not included in the study.

Data collection

During the period of recruitment, 85 patients were diagnosed as having CCC associated with CBD stones. 10 patients with uncontrolled diabetes plus 8 patients with cardiac disease and low ejection fraction rate were excluded from the study. Therefore, 67 patients only that match our eligibility criteria are included in our study. All patients were subjected to complete preoperative assessment including proper history-taking, clinical examination, laboratory investigations (CBC, LFTs, serum amylase, lipase, blood glucose, serum creatinine) and imaging studies (U/S and/or MRCP). Antibiotic prophylaxis was given at time of induction of general anesthesia. Laparoscopic cholecystectomy and LCBDE was done by the same surgical team using the standard 4 port technique. Assurance of CBD clearance of stones was done later using intra-operative choledochoscope, cholangiogram, or post operatively using sonography, or MRCP.

Study variables and measurement

The study variables included operative time, number and size of the extracted stone, need for T-tube insertion intra operative difficulties and conversion rate. Other studied variables included length of hospital stay, morbidity and mortality rates. Operative time was defined as the time from the incision to the skin closure. The conversion rate was defined as the need to replace the used method with another method described in this study. Length of hospital stay was defined as the length of patient stay in the hospital from the first postoperative day (POD) until discharge. Postoperative first 3-month morbidity and mortality rates were analyzed.

Bias assessment

Consecutive patients matching the inclusion and exclusion criteria were enrolled in this study. All members of the endpoint assessment committee were blinded to the study participants' baseline risk factor information.

Statistical analysis

Continuous variables were presented as means and standard deviation, while categorical variables were expressed as percentages. A $p<0.05$ was considered statistically significant. All statistical tests were performed using IBM SPSS Statistics for Windows, Armonk, NY: IBM Corp, Version 20.

RESULTS

From January 2015 to October 2018, sixty seven patients (39 females and 28 males) matching the eligibility criteria were subjected to laparoscopic cholecystectomy and exploration of the CBD. Twenty five patients were managed by laparoscopic basket and/or balloon or reticulated grasper CBD stone extraction under choledochoscope control (group 1) (Figure 1 A-C).

Direct access basket, balloon, or grasper technique (Figure 2 A and B) was done in 22 patients (group 2), while irrigation/suction technique was done in 20 cases (group 3) (Figure 3).

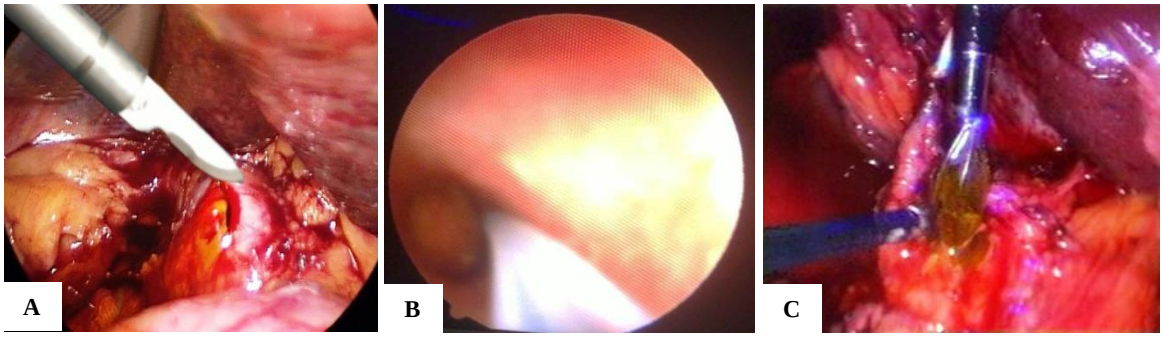

Figure 1: (A) Cheldochotomy with protected scalpel; (B) Choledochoscope visualization and basketting retrieval of stone; (C) Choledochoscopic basket stone retrieval.

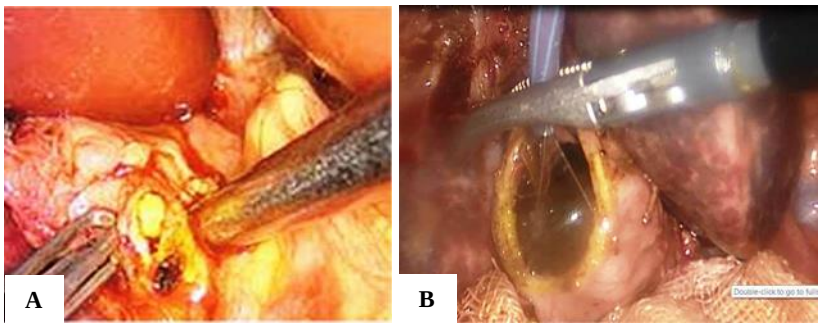

Figure 2: (A) Grasper stone retrieval; (B) Direct access basket big stone retrieval.

Table 1: Demographic features and clinical characteristics of patients.

Variables	Group 1 (n=25)	Group 2 (n=22)	Group 3 (n=20)
Age (mean±SD)	49.1±19.6	47±16.5	42.1±15.4
Sex			
Male	5	4	6
Female	20	18	14
BMI (mean±SD)	26±6.2	28±4.6	27±3.6
Bilirubin mg/dl	4.13±2.50	4.3±6.1	4.4±3.8
AST U/L (mean) range 15-115	42.3±30.5	48.3±32,4	41.2±29±4
ALT U/L (mean) range 9-250	32±21.4	29.6±25.4	28.6±16.9
Diameter of CBD range (10-20 mm)	14.2±3.2	13.2±2.6	12.9±3.8
No of stones			
Single	15	14	11
Multiple	10	8	9
Size of stone (mean) range (5-15 mm)	8.6±4.4	7.6±3.8	6.1±4.4

Group 1=Choledochoscope, group 2=direct access, group 3=irrigation/suction.

Demographic criteria of all participants were summarized in Table 1.

Group1 (cholodocoscope guided stone extraction) includes 5 males and 20 females, the mean patients age in this group was 49.1±19.6 years, The bilirubin level (done one day before operation) ranged from 0.28 to 7.77 mg/dl (mean 4.13±2.50 mg/dl), the diameter of the CBD ranged from 10 to 20 mm (mean 14.2±3.2 mm), and the number of CBD stones ranged from 1 to 5. The size of the CBD stone ranged from 5 to 15 mm (mean 8.6±4.4 mm). This maneuver was completed successfully without any complications in 24/25 patient (96%) and failed in one case (4%).

Group 2 (direct access group) included 4 males and 18 females, the mean patients age in this group was 47±16.5 years, The bilirubin level ranged from 0.58 to 7.87 mg/dl (mean 4.3±6.1 mg/dl), the diameter of the CBD ranged from 11 to 18 mm (mean 13.2±2.6 mm), and the number of CBD stones ranged from 1 to 5. The size of the CBD stone ranged from 6 to 14 mm (mean 7.6±3.8 mm). This technique succeeded in 21/22 (95.4%) and conversion to the cholodocoscopic technique was needed for the 1

failed case and succeeded in extraction the stone that confirmed by intra operative cholangiography.

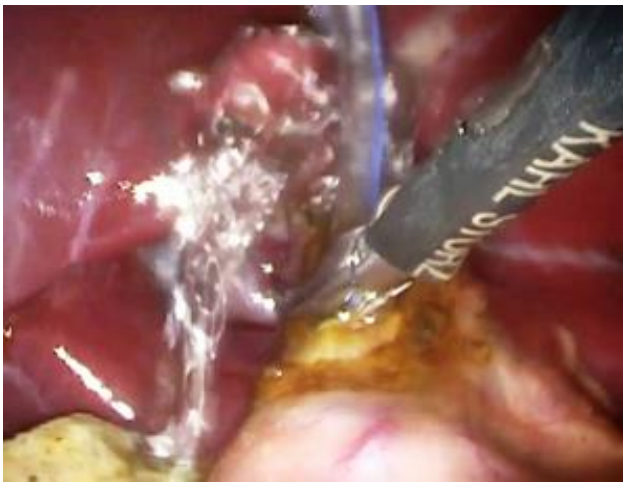

Figure 3: Irrigation-suction techniques.

In Group 3 (irrigation/suction group) there was 6 males and 14 females, the mean patients age in this group was 42.1±15.2 years, the bilirubin level ranged from 0.69 to 8.57 mg/dl (mean 4.4±3.8 mg/dl), the diameter of the CBD ranged from 10 to 19 mm (mean 13.9± 3.8 mm), and the number of CBD stones ranged from 1 to 5. The size of the CBD stone ranged from 5 to 1.1 mm (mean 6.1±4.4 mm). This technique succeeded in 10/20 (50%) and conversion to the direct access technique was done in 4 cases (4/10) and succeeded to extract stones in 3 cases and fragmentation of stone occurred in the fourth case. In the other 6 cases (6/10) the cholodocoscope technique succeeded in 4 cases and failed to visualize the stones in 2 cases. T-tube insertion was only needed in 6 cases all over the study (Figure 4) either due to fragmentation of stones or failure to visualize the stone while the CBD was closed primary without T-tube drainage in all other cases. The operative time was significantly shorter in group 3 compared to group 2 and 1 (107±26 min group 3 versus 95±24 min in group2 and 82±26 min in group 1) as shown in Table 2.

There was no significant difference as regard the hospital stay (3±2.1 days in group 1 versus 3±1.3 days in group 2 and 3.4±2.3 in group 3). There was on mortality in the three groups.

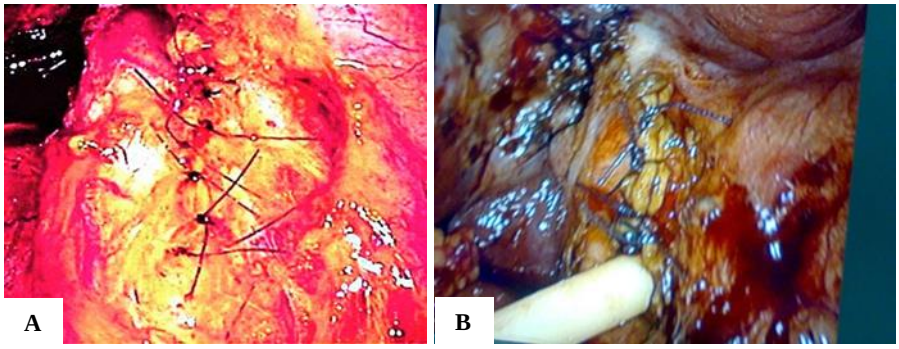

Figure 4: (A) Primary repair of choledocotomy incision; (B) T-shaped tube drainage of CBD.

Table 2: Operative outcome.

Parameters	Group 1 (n=25)	Group 2 (n=22)	Group 3 (n=20)	P value 1vs2; 1vs3; 2vs3
CBD clearance	24l25 (96%)	21/22 (95%)	10/20 (50%)	0.001; 0.001; NS
Conversion to other technique	1→ (wash)	1→ (cholodocoscope)	10→ 4 direct access 6 cholodocoscope	0.001; 0.001; NS
T-tube insertion	2	1	3	NS; NS; NS
Conversion to open laparotomy	None	None	None	NS; NS; NS
Operative time (mean±SD)	107±26 min	95±24 min	82±26 min	0.04; 0.001; NS
Postoperative morbidity				
Bile leak	1	1	1	NS
Jaundice	None	None	None	
Fever	No	No	1	
Missed stone	1	None	1	
Pancreatitis	None	None	None	
Hospital stay	3±2.1 days	3±1.3 days	3.4±2.3 days	NS; NS; NS
Mortality	None	None	None	NS; NS; NS

NS= not specific, p<0.05 was significant. Group 1=Choledochoscope, group 2=direct access, group 3=irrigation/suction.

DISCUSSION

Management of CBD stone(s) has changed after recent innovation and developments in minimally invasive techniques.[13] LCBDE for stone extraction from CBD has similar incidence of morbidity when compared to the two stage procedure ERCP and ES followed by laparoscopic cholecystectomy but it has the advantage of simultaneous treatment of cholelithiasis and cholodocholithiasis and hence, it has shorter hospital stay and less cost.[6] LCBDE requires specialized laparoscopic equipment and techniques and should be done by surgeons with advanced laparoscopic skills.[4] LCBDE is relatively contraindicated in patients with acute cholangitis, impacted stone in ampulla of vater, severe biliary pancreatitis and severe comorbidity for whom ERCP with ES should be done preoperatively while in fit patients with ASA I and II one stage LCBDE is the better option.[14] LCBDE can be performed either through cyst duct or CBD, the trans-cystic approach is preferred than choledochotomy as it is less invasive, safe and efficient.[15]

However cholodochotomy approach is indicated when the size of stone is larger than the lumen of cystic duct, number of stones more than 5, stone in common hepatic duct, junction of cystic duct with CBD is low or medial and CBD diameter should be more than 1cm to facilitate its closure and avoid postoperative stpicture.[16] In this study we compared three different methods for stone extraction using basket, or balloon guided choledochoscopic control (group 1), direct access extraction of stones using basket, balloon, or reticulated grasper (group 2), or irrigation/suction technique (group 3). The novel approach of the study is to compare laparoscopic techniques used to retrieve CBD stones through trans-choledochotomy approach, and this comparative approach was not appreciated before in the literatures up to our knowledge, as most of literatures comparing CBD clearance, morbidity or mortality of single versus two approaches only. We used our long cumulative experience of ERCP techniques to study such 3 techniques.[17]

Extraction of CBDS laparoscopically has gained popularity.[18] There are several reasons for this. The reported success rate for LCBDE was over 92% using a variety of techniques. These include: flushing of the CBD with the use of IV glucagon, which is especially useful when the common bile duct stones are smaller than 2 mm, when sludge is present, or sphincter spasm is the cause of the retained stones; balloon manipulation with biliary Fogarty catheters; use of Dormia baskets to capture the stone; choledochoscopy; and lithotripsy.[2,3] Transcystic approach was preferred over transductal approach in cases with smaller stones <6 mm or smaller bile duct <6–10 mm because of the higher success rate and lower complication rate in these circumstances.[19] But based on our inclusion criteria of selecting dilated CBD for better handling of tissues; we restrict our study to trans-choledochotomy approaches only. Approximately 90% to 95% of CBD stones can usually be accessed and removed endoscopically using balloon-tipped catheters or baskets.[20]

Although small stones are easily retrieved with a balloon catheter, larger stones should be extracted by using a basket because it provides better traction than a balloon catheter. Balloons are not always successful in removing stones larger than 1 cm because they may slip past the stone. Although balloons are fragile, they have a subtle advantage over a basket because. Therefore, it is advised to start stone removal by using a balloon and then, if not successful, to change to a basket.[21] We used choledochoscopic visualization of stone then balloon and/or basket guided retrieval in group 1 with good success rate approaching 96%, and the only failed case to be visualized may be due to intrahepatic escape of small sized stone beyond the reach of choledochoscope used (0.5 mm choledochoscope Pentax series).[20,21] This explanation may be applicable to all failed cases in the three groups of the study as intrahepatic radicles is hidden area for these techniques especially when direct current saline stream pushes the content by its hydrostatic pressure during choledochoscopic inspection (group 1), or irrigation/suction techniques (group 3). Moreover, choledochoscopic conversion was also needed in group 2 successfully in one patient, and also needed in group 3 with a comparable success rate (4/6 cases). In contradistinction to direct access balloon and basket CBD stone extraction which was resold to because of facility shortage and some technical problems, it must be mentioned here that this blind techniques needed superior surgical, laparoscopic, and endoscopic skills to succeed in retrieving CBD stones, and necessitates good diagnostic visualization of stone by prior night MRCP. Fortunately; this techniques revealed a comparable success rate to choledochoscopic approach 95.4% (21/22). Irrigation/Suction techniques is more blinded techniques, but an easy one to retrieve nearly 50% of CBD stones (10/20), as the countercurrent mechanism push any CBD content to outside the lumen.

The base line characteristics of patients and demographic data in the three groups were comparably similar. Operative time was shorter in group 3 than 1 and 2 because it is an easy technique and it was comparable between group 2 and 1. Closure with t-tube occurred in 2 cases in group 1 as in one of them fragmentation of the stone occurred and in other one we could not visualize the stone, and in group 2 in one case only due to stone fragmentation while closure with t-tube occurred in 3 cases in group 3 (2 due to non- visualization of stone and one due to its fragmentation). As regard postoperative complication there was no significant difference bet the three group (bile leak occurred in one case in each group, fever occurred in one case in group 3,one case of missed stone in group 1 and 3;diagnosed by MRCP post operatively and we did not report any case of jaundice in the three groups). In no case conversion to laparotomy

was needed and hospital stay was comparable in all groups. There was no mortality in all groups.

CONCLUSION

LCBDE is feasible and effective method to clear CBD from stones. Choledochoscopic extraction of stones is the best way, however you can clear the CBD by irrigation/suction technique or direct access technique. You must test CBD clearance by cholodocoscope or better by intra operative cholangiography or post operatively by MRCP or trans-tubal cholangiography.

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

REFERENCES

1. Lu J, Cheng Y, Xiong XZ, Lin YX, Wu SJ, Cheng NS. Two-stage vs single-stage management for concomitant gallstones and common bile duct stones. World J Gastroenterol. 2012;18(24):3156-66.
2. Kharbutli B, Velanovich V. Management of Preoperatively Suspected Choledocholithiasis: A Decision Analysis. J Gastrointest Surg. 2008;12:1973–80.
3. Hamouda AH, Goh W, Mahmud S, Khan M, Nassar AHM. Intraoperative cholangiography facilitates simple transcystic clearance of ductal stones in units without expertise for laparoscopic bile duct surgery. Surg Endosc. 2007;21:955–9.
4. Kim EY, Lee SH, Lee JS, Hong TH. Laparoscopic CBD exploration using a V-shaped choledochotomy BMC Surg. 2015;15:62.
5. Paik KY, Kim EK. Laparoscopic common bile duct exploration after unsuccessful endoscopic stone removal. J Laparoendosc Adv Surg Tech A. 2013;23:137–40.
6. Lu J, Xiong XZ, Cheng Y, Lin YX, Zhou RX, You Z, et al. One-stage versus two-stage management for concomitant gallbladder stones and common bile duct stones in patients with obstructive jaundice. Am Surg. 2013;79:1142–8.
7. Gu AD, Li XN, Guo KX, Ma ZT. Comparative evaluation of two laparoscopic procedures for treating common bile duct stones. Cell Biochem Biophys. 2011;59:159–64.
8. Cuschieri A, Lezoche E, Morino M, Croce E, Lacy A, Toouli J, et al. E.A.E.S. multicenter prospective randomized trial comparing two-stage vs single-stage management of patients with gallstone disease and ductal calculi. Surg Endosc. 1999;13:952–7.
9. Paganini AM, Lezoche E. Follow-up of 161 unselected consecutive patients treated laparoscopically for common bile duct stones. Surg Endosc. 1998;12(1):23-9.
10. Huang SM, Wu CW, Chau GY, Jwo SC, Lui WY, P'eng FK. An alternative approach of choledo-cholithotomy via laparoscopic choledochotomy. Arch Surg. 1996;131:407–11.
11. Sinha R. Laparoscopic choledocholithotomy with rigid nephroscope. J Laparoendosc Adv Surg Tech A. 2013;23:211–5.
12. El-Geidie AA. Laparoendoscopic management of concomitant gallbladder stones and common bile duct stones: what is the best technique? Surg Laparosc Endosc Percutan Tech. 2011;21:282–7.
13. Podda M, Polignano FM, Luhmann A, Wilson MS, Kulli C, Tait IS. Systematic review with meta-analysis os studies comparing primary duct closure and T-tube drange after laparoscopic common bile exploration for cholodocholithiasis. Surg Endosc. 2016;30:845-61.
14. Cushieri A, Lezoche E, Morino M, Croce E, Lacy A, Toouli J, et al. E.A.E.S. multicenter preoperative randomized trial comparing two stage vs single stage management of patients with gallstone disease and ductal calculi. Surg Endosc. 1999;13:952-7.
15. Patelin JB. laparoscopic common bile duct exploration lessons learned from>12 years' experience. Surg Endosc. 2003;17:1705-15.
16. Paganini AM, Gaerrier M, Sarnari J, De Sanctis A, D'Ambrosio G, Lezoche G, et al. thirteen years' experience with laparoscopic transcystic common bile duct exploration for stones. Effectivness and long-term results. Surg Endosc. 2007:21:34-40.
17. Redwan AA. The Challenging Dilemma of Post Cholecystectomy Problems: Time to be settled. Tactics of Management with 15 Years' Experience in a Major Referral Center. JSM Gastroenterol Hepatol. 2017;5(1):1076.
18. Ghazal AH1, Sorour MA, El-Riwini M, El-Bahrawy H. Single-step treatment of gall bladder and bile duct stones: A combined endoscopic–laparoscopic technique. Int J Surg. 2009;7:338–46.
19. Ebner S, Rechner J, Beller S, Erhart K, Riegler FM, Szinicz G. Laparoscopic management of common bile duct stones. Surg Endosc. 2004;18:762–5.
20. Cotton P. Non-operative removal of bile duct stones by duodenoscopic sphincterotomy. Br J Surg. 1980;67:1-5.
21. Frossard JL, Morel PM. Detection and management of bile duct stones. Gastrointest Endosc. 2010;72(4):808-16.

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