Int J Clin Exp Med 2017;10(2):3612-3617
www.ijcem.com /ISSN:1940-5901/IJCEM0033773

Original Article

Laparoscopic intraoperative cholangiography for common bile duct lithiasis associated to calculous cholecystitis

Fausto Fama'[1], Marco Cicciù[1], Gabriele Cervino[2], Christian Ferrara[1], Giuseppa Giacobbe[1], Martina Fiumano'[1], Ennio Bramanti[2], Giuseppe Lo Giudice[2], Floriana Lauritano[2], Arnaud Piquard[3], Olivier Saint-Marc[3], Maria Gioffre'-Florio[1]

[1]*Department of Human Pathology, University Hospital of Messina, Via Consolare Valeria, 1, 98125 Messina, Italy;* [2]*Department of Morphology Medical Sciences and Odontostomatology,* [3]*Department of General, Endocrine and Thoracic Surgery, Regional Hospital of Orleans, 14, Avenue de l'Hôpital, Orléans (cedex 2) 45067, France*

Received June 15, 2016; Accepted July 6, 2016; Epub February 15, 2017; Published February 28, 2017

Abstract: Background and study aims: The aim of this study was to evaluate the efficacy and safety of the laparoscopic common bile duct exploration performed within 24 hours from the urgent hospitalisation of patients with calculous cholecystitis associated to choledocholithiasis either proven or suspected. Patients and methods: From November 2010 to May 2012, 126 patients hospitalised at the Regional Hospital of Orleans (France) were retrospectively reviewed. All patients were preoperatively assessed only by means of routine blood tests and abdominal ultrasounds. Results: In our study were collected: 67 choledochotomies and 59 transcystic approaches; the laparoscopic procedure was successfully achieved in 97.6% of the cases. Statistical significant differences were found about common bile duct dilatation ($P < 0.05$) and in-hospital stay ($P < 0.001$). Conclusion: We suggest that the laparoscopic-first approach for choledocholithiasis, realised in specialised centres by skilled surgeons in hepatobiliary diseases, represents a feasible, safe and cost-effective management also in patients urgently admitted and treated for acute calculous cholecystitis.

Keywords: Choledocholithiasis, calculous cholecystitis, laparoscopy, choledochotomy, transcystic approach, short-stay hospitalisation

Introduction

Choledocholithiasis or common bile duct stones (CBDS) occurs in the natural history of patients with cholelithiasis in the 10-15% of the cases. In Europe its prevalence range from 5 to 20% approximately, and increases in old age [1, 2]. CBDS, that is more frequently symptomatic, can bring about some potentially life-threatening complications, i.e. obstructive jaundice, ascending cholangitis and acute pancreatitis. It is known that the endoscopic retrograde cholangiopancreatography (ERCP) provides a sphincterotomy, with exposition of the patient at a higher incidence of infections as a consequence of a duodeno-biliary reflux secondary to a permanent injury of the sphincter of Oddi [2, 3]. In addition, ERCP can be responsible of serious postoperative sequelae, such as acute pancreatitis, bleeding and duodenal perforation with retropneumoperitoneum. In patients with concomitant symptomatic cholelithiasis and choledocholithiasis, the one-stage procedure with associated laparoscopic cholecystectomy (LC), intraoperative cholangiography (IOC) and laparoscopic common bile duct exploration (LCBDE) may be considered a comfortable and effective technique [4-6]. After the years 90's the routine use of the LCBDE during LC, just as it had become for the open procedures, was long debated; overall, many reports state that IOC reduces the bile duct injury rate, because it allows a better evaluation of the biliary tree and prevents intraoperative complications [6]. Notwithstanding the development of the magnetic resonance cholangiopancreatography (MRCP) as well as the endoscopic ultrasounds (EUS), these techniques are not yet eas-

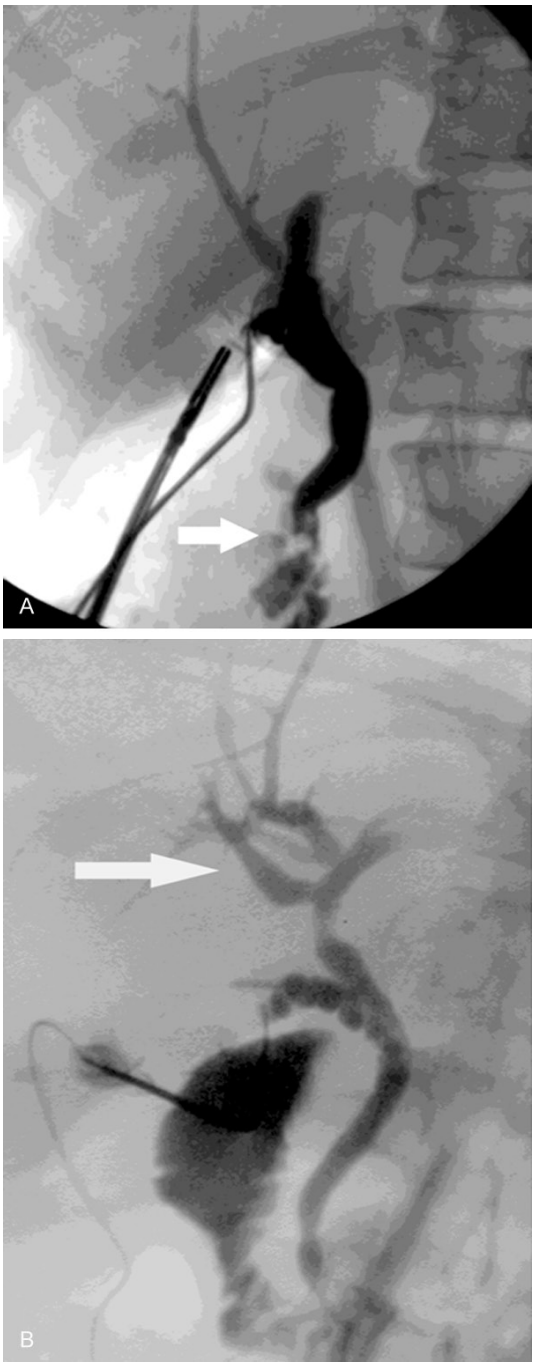

Figure 1. A: Intraoperative cholangiography showing common bile duct stones (white arrow); B: Anatomical variation of the biliary tree at level of the right hepatic duct (merger failure between the right posterior and the right anterior segmental branch) before the common bile duct takes form (white arrow).

ily and routinely available everywhere [3]. The purpose of this study was to evaluate the efficacy and safety of the LCBDE, performed within 24 hours from the urgent admission, in patients hospitalised for calculous cholecystitis associated to choledocholithiasis either proven or suspected, i.e. without evidence of gallstones and common bile duct (CBD) dilatation but with cholestasis and hepatic cytolysis. We hypothesize that, also in these patients, a one-stage procedure performed by trained surgeons and in high-volume surgical centres, can decrease unnecessary endoscopic sphincterotomy and determine a shorter hospitalisation period with costs saving.

Material and methods

We retrospectively reviewed 126 patients treated for CBDS with laparoscopic IOC followed by a gallstones removal through a choledochotomy or a transcystic approach, out of a total of 169 IOC and 582 LC performed from November 2010 to May 2012 at the Regional Hospital of Orleans (France). The American Society of Anaesthesiologist (ASA) physical status classification system and the body mass index (BMI) were assessed in all cases. Inclusion criteria include: clinical and US features of acute cholecystitis with concomitant, proven or suspected, diagnosis of choledocholithiasis; urgent hospitalisation with surgical procedure performed within 24 hours from admission. Exclusion criteria were considered: IOC negative for stones research; previous surgical and endoscopic treatments on biliary tree; preoperative imaging assessment with MRCP and EUS; ASA status greater to 4. To obtain a cohort homogeneity and to avoid potential bias, were also excluded patients with other concomitant severe gallstones-related diseases (e.g. acute pancreatitis), that delayed the surgical procedure over the established time, and patients underwent other simultaneous procedures on biliary or gastrointestinal tract (e.g. suture of bilio-digestive fistula). All patients were urgently admitted and studied preoperatively no more than by routine blood tests and abdominal ultrasounds (US). The CBD was considered normal up to 5 mm in largest diameter. All laparoscopic procedures were performed, using a four-trocar approach and maintaining a pneumoperitoneum pressure at 12 mmHg, by 3 experienced surgeons in laparoscopy. A transcystic IOC was performed in all cases (**Figure 1A** and **1B**), regardless of the LCBDE technique used, before and further after the procedure to verify the successful clearance. In our study,

Table 1. Operative characteristics

Characteristic	CT-group n = 67	TA-group n = 59
Common bile duct dilatation (mm)*	8.9 ± 4.0	7.4 ± 3.3
Operative time (min)	92.2 ± 13.9	72.6 ± 8.0
Hospital stay (days)**	4.4 ± 1.8	3.4 ± 1.2
Laparoscopic successful surgical procedures	64	59
Conversions to open surgery	3	0
Number of drainages	16 (T-tube)	59 (Transcystic)
Drainage time duration (days)	37.1 ± 6.8	29.2 ± 4.0
Histopathological findings		
Acute Cholecystitis	38	27
Chronic Cholecystitis	29	32
Postoperative sequelae	5 (7.5%)	11 (18.6%)
Early lithiasis recurrence	1	6
Delayed lithiasis recurrence	2	1
Biliary acute pancreatitis	0	2
Drain dislocation	0	2
Bile duct stricture	1	0
Biliary leakage	1	0
Postoperative treatments		
ERCP	2	6
Bilio-digestive derivation	1	0

*$P < 0.05$, **$P < 0.001$.

according to the surgeon's choice on which CBDS clearance technique was to be carried out (i.e., size, site and number of gallstones), we divided the patients into two groups: CT-group submitted to choledochotomy with transcholedochal stones removal and TA-group treated by an exclusive transcystic approach. The CBD was systematically drained following a transcystic gallstones removal, while after a choledochotomy a polydioxanone primary closure was carried out. In the latter, realised in patients with a greater CBD dilatation, when procedure was hard and/or a large number of gallstones removed a T-tube drainage was placed in alternative to the suture. Laboratory tests were checked after 48 hours from the surgical procedure. All data were analysed in order to evaluate the differences relatively to the CBD diameters, operative time, in-hospital stay duration and complications rate. The results are expressed as mean ± standard deviation (SD) and 95% confidence interval (CI). The Student's t-test was used to analyse the association between the parametric continuous data of two groups. The level for statistical significance was set at $P < 0.05$.

Results

Overall, patients were 81 females aged 49.7 ± 19.4 years (range 16-86) and 45 males aged 50.1 ± 19.4 years (range 33-80). ASA score, mainly affected for arterial hypertension and tobacco smoke, was for 25 patients ASA 1, for 83 ASA 2 and for 18 ASA 3. The BMI was 27.3 ± 4.8 for the CT-group and 26.9 ± 4.6 for the TA-group. Imaging detected a cholelithiasis in 102 cases combined with a simultaneous proven choledocholithiasis in 77 cases and an abnormal diameter of the CBD in 49 cases. Nevertheless, in all cases a diagnosis of choledocholithiasis or a suspicion of CBD gallstones migration was made. Preoperative blood tests, regarding cholestasis and hepatic cytolysis values, were abnormal in 94 cases (74.6%). In our study were collected: 67 choledochotomies (number of gallstones removed 2.4 ± 1.3, range 1-5) and 59 transcystic approach (2.1 ± 1.4, range 1-6). In the CT-group (67 patients), were realised 51 primary choledochal closures and alternatively were placed 16 T-tube drainages. In all patients of the TA-group (59 patients) it was placed a transcystic drain. Statistical significant differences were found about CBD dilatation ($P < 0.05$) and in-hospital stay ($P < 0.001$). All operative characteristics are summarised in **Table 1**. There were no statistical differences between pre- and postoperative laboratory values (**Table 2**). No mortality was observed in both groups. The laparoscopic CBDS clearance was successfully obtained in 123 (97.6%) out of 126 patients since 3 conversion to open surgery, all in the CT-group, were necessary. Fourteen patients out of the 67 CT-group ones had previously undergone to a failed transcystic attempt. The mean follow-up time was 42.1 ± 4.8 months (range 34-52). All postoperative lithiasis recurrences, early and delayed, were managed by ERCP. Besides, a second recurrence associat-

Table 2. Preoperative (at moment of hospitalisation) and postoperative (after 48 hours from the surgical procedure) values of blood laboratory tests: A) CT-group; B) TA-group

A) Laboratory tests CT-group, n = 67	Preoperative	Postoperative
White blood cells (WBC) 10^9/L (nr 4-11)	9.7 ± 6.2	9.0 ± 4.9
Glutamyl oxaloacetic transaminase (GOT) U/L (nr 9-50)	144.9 ± 34.7	96.7 ± 29.9
Glutamyl pyruvic transaminase (GPT) U/L (nr 7-40)	265.8 ± 35.8	220.9 ± 23.6
Gamma-glutamyl transpeptidase (gGT) U/L (nr 10-65)	391.8 ± 53.3	327.2 ± 31.9
Alkaline phosphatase (ALP) U/L (nr 25-100)	408.1 ± 23.4	292.5 ± 24.5
Total bilirubin mMol/L (nr 0-20)	56.1 ± 21.8	34.4 ± 13.7
Conjugated bilirubin mMol/L (nr 0-5)	30.1 ± 19.3	15.0 ± 9.1
B) Laboratory tests TA-group, n = 59	Preoperative	Postoperative
White blood cells (WBC) 10^9/L (nr 4-11)	8.5 ± 3.6	7.5 ± 1.8
Glutamyl oxaloacetic transaminase (GOT) U/L (nr 9-50)	129.6 ± 36.8	104.4 ± 17.7
Glutamyl pyruvic transaminase (GPT) U/L (nr 7-40)	260.4 ± 47.5	167.2 ± 24.3
Gamma-glutamyl transpeptidase (gGT) U/L (nr 10-65)	272.5 ± 45.1	214.8 ± 36.7
Alkaline phosphatase (ALP) U/L (nr 25-100)	295.1 ± 21.1	184.8 ± 15.6
Total bilirubin mMol/L (nr 0-20)	29.3 ± 12.6	23.8 ± 9.2
Conjugated bilirubin mMol/L (nr 0-5)	14.0 ± 8.3	10.1 ± 5.4

nr: Normal range.

ed to a bile duct stricture occurred in a patient of the CT-group that required a bilio-digestive derivation on Roux-en-Y jejunal loop. No other complications were observed during the follow-up period.

Discussion

Laparoscopy represents the standard technique for the treatment of patients with symptomatic cholelithiasis. LC developed from the late 80's, has spread quickly for its postoperative benefits: less pain, short hospitalisation, and better cosmetics results [7]. The appropriate surgical timing in patients with acute cholecystitis has long been debated; many studies and meta-analysis indicate that early treatment (within 72 hours from admission) allows short in-hospital stay and reduce costs and antibiotics administration compared to delayed one, without significant difference regard postoperative complications and conversion rates [8, 9]. When a choledocholithiasis is suspected, the diagnostic tools to better evaluate these patients include: preoperative ERCP, MRCP, EUS and IOC. Nevertheless, the best management for simultaneous cholecysto-choledocholithiasis in non elective patients remains controversial [10-12]. The LCBDE, during cholecystectomy, enables patients to undergo complete treatment of their disease with only one-stage invasive procedure, allowing an accurate intraoperative evaluation of biliary anatomy thus limiting, as consequence, the bile duct injury rate [13-16]. Several authors describe the routine intraoperative treatment, mainly concerned with selected cohorts of patients who underwent elective surgery, as safe and effective to obtain the clearance of CBD [11, 17, 18] and lower the bile duct injuries, as a consequence of a complete evidence of the bile duct anatomy and its variations [19, 20]; while others emphasize, always on elective patients, the role of preoperative endoscopic techniques and of non-invasive imaging [21, 22]. However systematic reviews revealed no significant differences in clearance efficacy and morbidity-mortality rates between the surgical and endoscopic method [23-25]. Experiences on transcystic or transcholedochal management of CBDS are widely reported in worldwide literature. The first technique, is more adopted by surgeons because of its feasibility [26-28]; the second-one, despite more invasive, can ensure an higher clearance stones success rate [11, 29, 30]. The implementation of choledochal primary closure has reduce the routine T-tube placement [25, 31-33].

End-points of the current study was analyse the efficacy and safety of two different approaches to the CBD gallstones disease in a series of consecutive patients admitted for calculous

cholecystitis and choledocholithiasis either proven or suspected. In our 18 month study-period, all patients underwent to a one-stage early invasive procedure and benefitted of a short-stay hospitalisation.

Conclusions

Comparing the two groups, a better gallstones clearance was obtained in the CT-group, associated with a low rate of postoperative complications and only three conversion to open surgery. In the TA-group, the operative time was shorter but non statistically significant and more postoperative complications occurred. We suggest that the laparoscopic-first approach for choledocholithiasis, realised in specialised centres by skilled surgeons in hepato-biliary diseases, represents a feasible, safe and cost-effective management also in patients urgently treated for acute calculous cholecystitis. However more prospective experiences must follow to confirm the routine use of this technique even in non elective patients.

Acknowledgements

For the accurate revision of the manuscript, we wish to thank Mr Sam Palella, a native speaker, with an extensive experience on scientific papers; furthermore we also thank Dr. Maria Grazia Lombardo who contributed to the study as independent physician processing data collection.

Disclosure of conflict of interest

None.

Authors' contribution

All authors contributed significantly to the paper. The study design was created by F. Fama', M. Cicciu', M Gioffre'-Florio, G. Giacobbe, A. Piquard and O. Saint-Marc, G. Cervino, F. Lauritano, G Lo Giudice. The acquisition of data was performed by F. Fama', M. Cicciu', M Gioffre'-Florio, A. Piquard and O. Saint-Marc and Ennio Bramanti. The analysis and interpretation of data were done by F. Fama', G Buccheri, C. Ferrara, M Fiumano', and J. Palella. A draft of the paper was written F. Fama', G Buccheri, C. Ferrara, M Fiumano', and J. Palella and critical revision was performed by F. Fama', M. Cicciu', M Gioffre'-Florio, G. Giacobbe, A. Piquard and O. Saint-Marc.

Address correspondence to: Dr. Marco Cicciù, Department of Human Pathology, Dental School, Messina University, Via Consolare Valeria 98100, Messina, Italy. Tel: 0039-090-221-6911; E-mail: acromarco@yahoo.it

References

[1] Hungness ES, Soper NJ. Management of common bile duct stones. J Gastrointest Surg 2006; 10: 612-9.

[2] Costi R, Gnocchi A, Di Mario F, Sarli L. Diagnosis and management of choledocholithiasis in the golden age of imaging, endoscopy and laparoscopy. World J Gastroenterol 2014; 20: 13382-401.

[3] Lee HM, Min SK, Lee HK. Long-term results of laparoscopic common bile duct exploration by choledochotomy for choledocholithiasis: 15-year experience from a single center. Ann Surg Treat Res 2014; 86: 1-6.

[4] Memon MA, Hassaballa H, Memon MI. Laparoscopic common bile duct exploration: the past, the present, and the future. Am J Surg 2000; 179: 309-15.

[5] Miller BM, Kozarek RA, Ryan JA Jr, Ball TJ, Traverso LW. Surgical versus endoscopic management of common bile duct stones. Ann Surg 1988; 207: 135-41.

[6] Dorman JP, Franklin ME Jr. Laparoscopic Common Bile Duct Exploration By Choledochotomy. Semin Laparosc Surg 1997; 4: 34-41.

[7] Keus F, de Jong JA, Gooszen HG, van Laarhoven CJ. Laparoscopic versus open cholecystectomy for patients with symptomatic cholecystolithiasis. Cochrane Database Syst Rev 2006; CD006231.

[8] Lo CM, Liu CL, Fan ST, Lai EC, Wong J. Prospective randomized study of early versus delayed laparoscopic cholecystectomy for acute cholecystitis. Ann Surg 1998; 227: 461-7.

[9] Siddiqui T, MacDonald A, Chong PS, Jenkins JT. Early versus delayed laparoscopic cholecystectomy for acute cholecystitis: a meta-analysis of randomized clinical trials. Am J Surg 2008; 195: 40-7.

[10] Nagaraja V, Eslick GD, Cox MR. Systematic review and meta-analysis of minimally invasive techniques for the management of cholecystocholedocholithiasis. J Hepatobiliary Pancreat Sci 2014; 21: 896-901.

[11] Sirinek KR, Schwesinger WH. Has intraoperative cholangiography during laparoscopic cholecystectomy become obsolete in the era of preoperative endoscopic retrograde and magnetic resonance cholangiopancreatography? J Am Coll Surg 2015; 220: 522-8.

[12] Ding GQ, Cai W, Qin MF. Is intraoperative cholangiography necessary during laparoscopic cholecystectomy for cholelithiasis? World J Gastroenterol 2015; 21: 2147-51.
[13] Podnos YD, Gelfand DV, Dulkanchainun TS, Wilson SE, Cao S, Ji P, Ortiz JA, Imagawa DK. Is intraoperative cholangiography during laparoscopic cholecystectomy cost effective? Am J Surg 2001; 182: 663-9.
[14] Nickkholgh A, Soltaniyekta S, Kalbasi H. Routine versus selective intraoperative cholangiography during laparoscopic cholecystectomy: a survey of 2,130 patients undergoing laparoscopic cholecystectomy. Surg Endosc 2006; 20: 868-74.
[15] Ford JA, Soop M, Du J, Loveday BP, Rodgers M. Systematic review of intraoperative cholangiography in cholecystectomy. Br J Surg 2012; 99: 160-7.
[16] Alvarez FA, de Santibañes M, Palavecino M, Sánchez Clariá R, Mazza O, Arbues G, de Santibañes E, Pekolj J. Impact of routine intraoperative cholangiography during laparoscopic cholecystectomy on bile duct injury. Br J Surg 2014; 101: 677-84.
[17] Rhodes M, Sussman L, Cohen L, Lewis MP. Randomised trial of laparoscopic exploration of common bile duct versus postoperative endoscopic retrograde cholangiography for common bile duct stones. Lancet 1998; 351: 159-61.
[18] Vezakis A, Davides D, Ammori BJ, Martin IG, Larvin M, McMahon MJ. Intraoperative cholangiography during laparoscopic cholecystectomy. Surg Endosc 2000;14:1118-22.
[19] Tranter SE, Thompson MH. Comparison of endoscopic sphincterotomy and laparoscopic exploration of the common bile duct. Br J Surg 2002; 89: 1495-504.
[20] Alkhaffaf B, Parkin E, Flook D. Endoscopic retrograde cholangiopancreatography prior to laparoscopic cholecystectomy: a common and potentially hazardous technique that can be avoided. Arch Surg 2011; 146: 329-33.
[21] Sahai AV, Mauldin PD, Marsi V, Hawes RH, Hoffman BJ. Bile duct stones and laparoscopic cholecystectomy: a decision analysis to assess the roles of intraoperative cholangiography, EUS, and ERCP. Gastrointest Endosc 1999; 49: 334-43.
[22] Livingston EH, Miller JA, Coan B, Rege RV. Indications for selective intraoperative cholangiography. J Gastrointest Surg 2005; 9: 1371-7.
[23] Berci G. Preoperative ERCP and intraoperative cholangiography in the age of laparoscopic cholecystectomy. Surg Endosc 1993; 7: 2.
[24] Fiore NF, Ledniczky G, Wiebke EA, Broadie TA, Pruitt AL, Goulet RJ, Grosfeld JL, Canal DF. An analysis of perioperative cholangiography in one thousand laparoscopic cholecystectomies. Surgery 1997; 122: 817-21.
[25] Dasari BV, Tan CJ, Gurusamy KS, Martin DJ, Kirk G, McKie L, Diamond T, Taylor MA. Surgical versus endoscopic treatment of bile duct stones. Cochrane Database Syst Rev 2013; 9: CD003327.
[26] Hanif F, Ahmed Z, Samie MA, Nassar AH. Laparoscopic transcystic bile duct exploration: the treatment of first choice for common bile duct stones. Surg Endosc 2010; 24: 1552-6.
[27] Liverani A, Muroni M, Santi F, Neri T, Anastasio G, Moretti M, Favi F, Solinas L. One-step laparoscopic and endoscopic treatment of gallbladder and common bile duct stones: our experience of the last 9 years in a retrospective study. Am Surg 2013; 79: 1243-7.
[28] Zhu JG, Han W, Guo W, Su W, Bai ZG, Zhang ZT. Learning curve and outcome of laparoscopic transcystic common bile duct exploration for choledocholithiasis. Br J Surg 2015; 102: 1691-7.
[29] Zhang HW, Chen YJ, Wu CH, Li WD. Laparoscopic common bile duct exploration with primary closure for management of choledocholithiasis: a retrospective analysis and comparison with conventional T-tube drainage. Am Surg 2014; 80: 178-81.
[30] Hongjun H, Yong J, Baoqiang W. Laparoscopic Common Bile Duct Exploration: Choledochotomy Versus Transcystic Approach? Surg Laparosc Endosc Percutan Tech 2015; 25: 218-22.
[31] Hua J, Lin S, Qian D, He Z, Zhang T, Song Z. Primary closure and rate of bile leak following laparoscopic common bile duct exploration via choledochotomy. Dig Surg 2015; 32: 1-8.
[32] Zhang WJ, Xu GF, Huang Q, Luo KL, Dong ZT, Li JM, Wu GZ, Guan WX. Treatment of gallbladder stone with common bile duct stones in the laparoscopic era. BMC Surg 2015; 15: 7.
[33] Estellés Vidagany N, Domingo Del Pozo C, Peris Tomás N, Díez Ares JÁ, Vázquez Tarragón A, Blanes Masson F. Eleven years of primary closure of common bile duct after choledochotomy for choledocholithiasis. Surg Endosc 2016; 30: 1975-82.