European Review for Medical and Pharmacological Sciences 2015; 19: 3649-3654

The clinical efficacy of laparoscopy combined with choledochoscopy for cholelithiasis and choledocholithiasis

W. QIU, X.-D. SUN, G.-Y. WANG, P. ZHANG, X.-H. DU, G.-Y. LV

Department of Hepatobiliary and Pancreas Surgery, the First Hospital of Jilin University, Changchun, Jilin, China

Abstract. – OBJECTIVE: To compare and analyze the clinical efficacy of laparoscopy combined with choledochoscopy, and laparoscopy combined with duodenoscopy, for cholelithiasis and choledocholithiasis.

PATIENTS AND METHODS: A total of 105 patients with cholelithiasis and choledocholithiasis from our hospital, from January 2014 to January 2015, were enrolled in this study. All patients weren given primary treatment. After obtaining consent from our hospital Ethics Committee and the patients, all 10529 cases were divided into two groups according to their time of admission. The observation group consisted of 59 cases and the control group consisted of 46 cases. The control group were treated by laparoscopy combined with duodenoscopy (cholecystectomy +ERCP+calculi extraction with an endoscope) and the observation group were treated by laparoscopy combined with choledochoscopy. We then compared the clinical efficacy between the two groups of patients.

RESULTS: The success rate of the first surgery in the observation group, was higher than that in the control group. The time of surgery and intraoperative blood loss of the observation group were less than the control group. The differences had statistical significance $p < 0.05$). When compared the post-operative fasting and evacuation time, average hospital stay and hospitalization expenses for the observation group were less than those of the control group. The difference had statistical significance ($p < 0.05$). The prevalence of post-operative complications and recurrence rate in the observation group were statistically significantly ($p < 0.05$) less than the control group ($p < 0.05$).

CONCLUSIONS: Laparoscopy combined with choledochoscopy was effective and safe for treating cholelithiasis and choledocholithiasis. Its treatment outcomes might be superior to laparoscopy combined with duodenoscopy.

Key Words:
Laparoscopy, Choledochoscopy, Duodenoscopy, Cholecystolithiasis, Choledocholithiasis, Minimally invasive surgery.

Introduction

The incidence of biliary calculi is increasing, the attributes of which goes to the immoderate diet and lifestyle. The prevalence of cholecystolithiasis and choledocholithiasis is about 1.6%, and patients with acute onset account for 42.6%[1]. Patients with severe cases of cholecystolithiasis and choledocholith usually present with high fever, stomachache, shock, and death. Among all traditional surgeries, open cholecystectomy, laparoscopic common bile duct exploration and T-tube drainage are the oldest therapies. They have limitations for elderly patients, patients intolerable to surgery, and patients with small calculi. All of these therapies could result in serious trauma, long recovery time, and infections[2]. With the development of minimally invasive surgery, therapies, composed of multiple endoscopies, are mainstream in clinical studies. But findings on the clinical efficacy and complication occurrence of various portfolios were quite different[3]. In our study, we examined laparoscopy (LC) in combination with choledochoscopy and laparoscopy in combination with duodenoscopy and further analyzed their efficacy in treating cholecystolithiasis and choledocholithiasis.

Patients and Methods

Patients

A total of 105 patients that were diagnosed with cholelithiasis and choledocholithiasis in our hospital from January 2014 to January 2015 were enrolled in our study. All patients received primary treatment. The inclusion criteria were as follows: (1) Patients aged from 18 years old to 70 years old; (2) Patients with corresponding clinical symptoms, pains in the upper right quadrant accompanied by fever, jaundice, and so on; (3)

Corresponding Author: Guoyue Lv, MD; e-mail: weiqiu2013@126.com

Patients confirmed with cholelithiasis and choledocholithiasis by abdominal Doppler ultrasound, CT, Magnetic Resonance Cholangiopancreatography (MRCP); (4) Patients that conformed to endoscopic surgical indication. The exclusion criteria were as follows: (1) Patients with a history of abdominal surgery; (2) Patients combined with other biliary tract diseases, such as biliary tract polyp, tumor, pancreatitis, and biliary stricture; (3) Patients with severe organ dysfunctions, including heart, liver, kidney, and patients with severe hypertensive shock; (4) Patients with poor compliance.

After obtaining consent from our hospital Ethics Committee and the patients, all 105 cases were divided into two groups. The observation group consisted of 59 cases and the control group consisted of 46 cases. In the observation group, there were 20 male and 26 female patients, who were aged from 37-62 years old, with an average age of (46.5 ± 10.3) years old. The course of the disease was at 1h-1.5 year, with the median time of 5.6 months and with 3-16 calculi. The average number of calculi was (5.3 ± 2.1), with a diameter of 0.5-4.7 cm, with an average (2.7 ± 0.8) cm. In the control group, there were 28 male and 31 female patients, aged 37-62 years old, with an average of (46.7 ± 12.4) years old. The course of the disease was between 1.3h-1.8 years, and the median time was 5.3 months. The number of calculi was 2-18, with an average (5.4 ± 1.7). The size of the calculi was 0.4-5.2 cm in diameter with an average of (2.9 ± 1.1) cm. The difference on the gender, age, course of the disease, number and diameter of calculi between the two groups had no statistical significance ($p > 0.05$).

Methods

All patients were given expectant treatment. Patients in the control group were treated by laparoscopy in combination with duodenoscopy. The details were as follows[4]: 1. Laparoscopic cholecystectomy: apply the three-hole method to fill in CO_2 and build pneumoperitoneum, set the intra-abdominal pressure at 12-14 mm Hg, insert 1.0 cm Trocar, connect to pneumoperitoneum apparatus, and imbed the corresponding apparatus. Use the laparoscope to investigate, and the ultrasound knife or hook to separate the calot's triangle. Then, expose the location of ductus cysticus, ductuli hepaticus communis, and common bile duct. Then, carefully dissociate the ductus cysticus and cystic artery, and clip to occlude the proximal end of ductus cysticus and the distal end of ductus cysticus in place 0.3-0.5 cm from the common bile duct. Then, proceed by cutting off the ductus cysticus. Dissociate the distal end of ductus cysticus, locate the cystic artery, and clip to occlude the proximal end of the cystic artery. Use a titanium clip to occlude the distal end of cystic artery close to the cholecyst side, and cut off the cystic artery. Use the ultrasound knife or hook to separate the gallbladder, peel off the cholecyst, and adopt fulguration to stop the bleeding, and remove the cholecyst from below the xiphoid. (2) Endoscopic Retrograde Cholangiopancreatography (ERCP): insert the duodenoscope through the patient's mouth. After the duodenoscope is inserted into the colon, locate the duodenal papilla, and radiograph the papilla. After confirming that there are calculis inside the bile duct, conduct an endoscopic treatment. (3) Calculi extraction with endoscope by balloon dilatation which is applicable to choledocholithiasis < 8 nim. Insert the zebra guide wire through endoscopic biopsy hole along the radiography catheter, and remove the radiography catheter and keep the guide wire. Then, insert the balloon catheter along the guide wire into the papilla to locate the middle part of balloon in the narrow part of papilla. Then inject normal saline through the balloon catheter to 5-8 atmosphere, and expand for 2-3 minutes. Then, stop for 30 seconds, and then expand again for 2 minutes. Cut open the duodenal papilla. This is applicable for choledocholithiasis > 8 nim, length of the incision of the sphincter between 10-12 mm. After Endoscopic Papillary Balloon Dilatation (EPBD) or Endoscopic Sphincterotomy (EST), remove the calculi and sacculus. After the calculi is removed, inject a contrast agent to observe whether there is any calculi residue. Endoscopic Naso Biliary Drainage (ENBD): put ENBD routinely under the surveillance of endoscope.

Patients in observation group were treated by laparoscopy in combination with choledochoscopy. The details were as follows[5]: (1) Build pneumoperitoneum and use laparoscopy to explore. Adopt a four-hole method to fill in the CO_2 and build the pneumoperitoneum, set the intra-abdominal pressure at 12-14 mm Hg, insert 1.0 cm Trocar, connect to pneumoperitoneum apparatus, and imbed the corresponding apparatus. (2) Use the choledochoscope to explore the common bile duct under laparoscopy. Bluntly separate the Calot's Triangle, expose the ductus cysticus, duc-

tuli hepaticus communis, and common bile duct, and observe whether there was any expansion or tension on the common bile duct. Then, cut off the cystic artery, clip to occlude the ductus cysticus in the place, 0.3-0.5 cm away from the common bile duct to avoid the small calculi from flowing into the common bile duct. Then, suspend cutting off to tract and fix the common bile duct. Tract the neck of the gallbladder outwards, dissociate and expose the common bile duct by 1.0-2.0 cm in the lower part where the ductus cysticus joins the common bile duct, and use a hook to cut off its antetheca along the vertical axis of the common bile duct. Laparoscopy is convenient for observation, and no major blood vessel running were discovered, but the variation of the cystic artery was noted. Choledochoscopy is convenient for surgery. After indwelling of the T catheter, the incision length should be convenient for choledochoscopy, and is normally between 0.8-1.5 cm. After bile was completely sucked, embed the choledochoscope through xiphoid, and explore the common bile duct for size, number and distribution of calculis and prepare for the removal of the calculis. Check whether there are any anomaly in the biliary tract, intra-and extrahepatic bile duct and duodenal papilla. (3) To remove the calculi, there are three methods which include mechanical calculi extraction, water-washed calculi extraction and choledochoscope calculi extraction net. The three methods could be used separately or jointly. They could greatly reduce the residue rate of calculis. (4) Indwell the T catheter to drain. (5) Cut off the cholecyst under laparoscopy.

Observation Indicators

We compared and analyzed the differences on success rate of the first surgery, post-operative fasting time, evacuation time, average hospitalization time and expenses, and the complication incidence as well as recurrent rate between the two groups.

Statistical Analysis

The SPSS 19.0 software package (SPSS Inc., Chicago, IL, USA) was used for statistical analysis. The measurement data was presented by means±standard deviation. The *t*-test was applied in comparison between the two groups and the enumeration data was presented by case or percentage. The χ^2-test was applied in comparison between the two groups and a $p < 0.05$ was statistically significant.

Results

Comparison of the Success Rate of the First Surgery, Operation Time and Intra-Operative Blood Loss

The success rate of the first surgery in the observation group was significantly higher than that in the control group; the operation time and intra-operative blood loss in the observation group were significantly lower than those in the control group, and the differences had statistical significance ($p < 0.05$) (Table I).

Comparison of the Post-Operative Fasting time, Evacuation Time, and Average Hospitalization Time and Expenses

Post-operative fasting time, evacuation time, and average hospitalization time and expenses in the observation group were less than those in the control group. The differences had statistical significance ($p < 0.05$) (Table II).

Table I. Comparison on the success rate of the first surgery, operation time and intra-operative blood loss.

Group	Case	Success rate of the first surgery	Twice or more	Post-operative calculi residue	Conversion to laparotomy	Operation time (min)	Intra-operative blood loss (ml)
Control group	46	36 (78.26)	3	5	2	124.5 ± 27.4	458.7 ± 56.4
Observation group	59	56 (94.92)	1	2	0	86.7 ± 16.9	264.8 ± 43.7
t (χ^2)		6.609				3.427	4.529
p		0.010				0.039	0.034

Table II. Comparison on the post-operative fasting time, evacuation time, average hospitalization time and hospitalization expenses between the two groups.

Group	Post-operative fasting time (h)	Evacuation time (h)	Average hospitalization time (d)	Hospitalization expenses (thousand)
Control group	29.5 ± 8.2	15.3 ± 4.6	7.6 ± 1.5	56.1 ± 10.5
Observation group	16.7 ± 7.4	6.4 ± 2.3	4.2 ± 0.7	32.7 ± 6.6
t	3.527	3.647	2.859	4.027
p	0.037	0.034	0.041	0.031

Comparison of the Occurence of Post-Operative Complications and Recurrence Rate

The occurrence of post-operative complications and the rate of recurrence in the observation group were significantly lower than those in the control group. The differences had statistical significance ($p < 0.05$) (Table III).

Discussion

It is commonly believed that the formation of biliary calculi might be related with multiple factors. This includes over saturation of the bile or cholesterol, physical and chemical changes of the nature of bile, sedimentation of the bile vesicles and cholesterol, imbalance between nucleating and anti-nucleating factors, anomaly of cholecystic function, and infections of intestinal bacteria and parasites[6]. Among all the biliary calculi, the proportion of cholesterol calculus was the highest while cholecystolithiasis was the most common, accounting for 60.4%, and choledocholithiasis, accounting for about 42.7%, which were commonly seen in the lower part of common bile conduct and duodenal ampulla[7].

Calculis removal, focus elimination, obstruction relief and complete drainage were the basic approaches to treating cholangiolithiasis. Laparoscopy in combination with choledochoscopy could protect the sphincter and avoid peripheral tissues from injuries. Post-operative recovery time is relatively short, with relatively no pain, and a high success rate of about 92.8%[9].

In our study, the success rate of the first surgery in the observation group was 94.92%, which was significantly higher than that in the control group. Such a high success rate might be related with the complete pre-operative examination, and mature positioning technology. This therapy could be applied in patients with the number of biliary calculi les than 9, and the maximum diameter of calculi was less than 10 mm and inner diameter of common bile duct was no less than 1 cm[10]. This could not be applied in patients with the following circumstances[11]: (1) Diameter of choledocholithiasis > 1 cm, such that lithotripsy cannot be performed; (2) Serious inflammation in the Calot's Triangle; (3) Combination with hepatolith or common bile duct stricture; (4) Type II-IV Mirizzi syndrome; (5) Acute severe cholangitis. The major factors that might affect the success rate of surgery include[12]: (1) Calculi removal basket net could not be installed into choledoch ampullary portion; (2) Bile duct diameter < 1 cm, distortion and blocking, common bile conduct was impaired during the

Table III. Comparison on the incidence of post-operative complications and recurrence rate [(%)]

Group	Case	Incision infection	Gastrointestinal dysfunction	Uprising serum amylase	Secondary biliary stricture	Complication occurrence	Recurrent rate
Control group	46	2	3	2	2	9 (19.57)	11 (23.91)
Observation group	16.7 ± 7.4	6.4 ± 2.3	4.2 ± 0.7	32.7 ± 6.6			
t	3.527	3.647	2.859	4.027			
p	0.037	0.034	0.041	0.031			

process of Calot's Triangle dissection; (3) Calculi was too large and exceeded the bile duct diameter or calculi was located in intrahepatic bile duct that could not be taken out through bile duct.

For patients with extrahepatic bile duct combined gallbladder stone, muddy calculi and calculi > 1.5 cm in diameter. The number of calculi < 2 were absolute indications for laparoscopic combined ERCP[13]. During the process of surgery, we conducted LC at first, then conducted ERCP and EST or EPBD, so that we could avoid cholecystolithiasis from falling into bile duct and thus resulting in residual calculi in the bile duct during LC operation. If ERCP was conducted in the first place, it might lead the intestinal canal to dilate and result in incomplete exposure of gall bladder under laparoscope, thus increasing the difficulty of cholecystectomy and increasing the prevalence of complications[14,15]. But this therapy also had its own shortcomings: (1) Calculi could hardly be taken out completely because of local dissection, so there was certain failure rate; (2) EST would damage the functions of duodenal papilla sphincter, which might result in an increasing long-term complications in the biliary system, especially when it was applied to the young patients; (3) ERCP complications mainly included hyperamylasemia, hemorrhage, acute pancreatitis, and acute cholangitis infection[16,17].

Conclusions

The results of our study have shown that operation time and intra-operative blood loss of the observation group were less than those of the control group. The post-operative fasting time, evacuation time, average hospital stay and hospitalization expenses of the observation group were less than the control group. The post-operative complications (incision infection, gastrointestinal dysfunction, uprising serum amylase and secondary biliary stricture[18]) and recurrence rate in the observation group were less than those in the control group. All of these differences had statistical significance. Although the number of samples in our study was relatively small and our study was not a double-blind test, but a single center study, we can conclude that laparoscopy in combination with choledochoscopy was effective and safe in treating cholelithiasis and choledocholithiasis. Its treatment outcomes might be superior to laparoscopy in combination with duodenoscopy.

Conflict of Interest

The Authors declare that they have no conflict of interests.

References

1) Lyass S, Phillips EH. Laparoscopic transcystic duct common bile duct exploration. Surg Endosc 2006; 20: 441-445, 540.
2) Van Dijk AH, Lamberts M, Van Laarhoven CJ, Drenth JP, Boermeester MA, De Reuver PR. Laparoscopy in cholecysto-choledocholithiasis. Best Pract Res Clin Gastroenterol 2014; 28: 195-209.
3) Tzovaras G, Baloyiannis I, Zachari E, Symeonidis D, Zacharoulis D, Kapsoritakis A. Laparoendoscopic rendezvous versus preoperative ERCP and laparoscopic cholecystectomy for the management of cholecysto-choledocholithiasis: interim analysis of a controlled randomized trial. Ann Surg 2012; 255: 435-439.
4) Calu V, Dumitrescu I, Miron A. The role of laparoscopy in the surgical treatment of scleroatrophic cholecystitis. Chirurgia 2010; 105: 653-656.
5) Rábago L, Quintanilla E, Delgado M, Castro JL, Cura Gonzalez I. Is "laparoscopy-first" the final answer to cholecystocholedocholithiasis management? Surg Endosc 2011; 25: 975-976.
6) Krska Z, Sváb J, Schmidt D, Ulrych J. Laparoscopic surgery in senior age. Cas Lek Cesk 2008; 147: 482-486.
7) Shamiyeh A, Wayand W. Current status of laparoscopic therapy of cholecystolithiasis and common bile duct stones. Dig Dis 2005; 23: 119-126.
8) Liu JS, Li JZ, Zhao QK, Jin D, Hou ZS, Huang KQ. The analysis of follow-up results of 612 cases of cholecystolithiasis treated with the minimal invasive operation with gallbladder preserved via choledochoscopy. Zhonghua Wai Ke Za Zhi 2009; 47: 279-281.
9) Degovtsov EN, Vozliublennyĭ SI, Vozliublennyĭ MS. Improved minilaparotomical choledochoscopy and litoextraction in cholecystocholedocholithiasis. Eksp Klin Gastroenterol 2008; 6: 48-50.
10) Wu W, Faigel DO, Sun G, Yang Y. Non-radiation endoscopic retrograde cholangiopancreatography in the management of choledocholithiasis during pregnancy. Dig Endosc 2014; 26: 691-700.
11) Cuendis-Velázquez A, Rojano-Rodríguez ME, Morales-Chávez CE, González Angulo-Rocha A, Fernández-Castro E, Aguirre-Olmedo I, Torres-Ruiz MF, Orellana-Parra JC, Cárdenas-Lailson LE. Intraoperative choledochoscopy usefulness in the treatment of difficult biliary stones. Rev Gastroenterol Mex 2014; 79: 22-27.

12) Rajman I. Choledochoscopy/cholangioscopy. Gastrointest Endosc Clin N Am 2013; 23: 237-249.
13) Ahmed T, Alam MT, Ahmed SU, Jahan M. Role of intraoperative flexible Choledochoscopy in calculous biliary tract disease. Mymensingh Med J 2012; 21: 462-468.
14) 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.
15) Kong J, Wu SD, Xian GZ, Yang S. Complications analysis with postoperative choledochoscopy for residual bile duct stones. World J Surg 2010; 34: 574-580.
16) Degovtsov EN, Vozliublennyĭ SI, Vozliublennyĭ MS. Improved minilaparotomical choledochoscopy and litoextraction in cholecystocholedocholithiasis. Eksp Klin Gastroenterol 2008; 6: 48-50.
17) Schwarz J, Simsa J, Pazdírek F. Our experience with peroperative choledochoscopy. Rozhl Chir 2007; 86: 180-183.
18) Costamagna G, Boškoski I. Current treatment of benign biliary strictures. Ann Gastroenterol 2013; 26: 37-40.