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Original Article

Study on effectiveness of combined use of laparoscopic and choledochoscopic techniques for treating concomitant gallstones and common bile duct stones

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Abstract: Objective: To investigate the effectiveness of the combined use of laparoscopic and choledochoscopic techniques for treating concomitant gallbladder stones and common bile duct (CBD) stones. Methods: As a retrospective study, the clinical records of 50 patients who had concomitant gallstones and CBD stones and received the combined laparoscopic and choledochoscopic surgery (CLCS) in the department of hepatobiliary surgery in our hospital from Jan 2014 to May 2015 were selected for review (minimally invasive (MI) group), while the records of another 50 patients who underwent conventional laparotomy during the same timeframe were included as control (control group). The operation time, amount of intraoperative bleeding, postoperative drainage volume, blood biochemical indicators, postoperative anal exhaust time, time for being able to get out of bed, hospital length of stay (LOS), postoperative complications, and the recurrence rate of stones were studied and compared between two groups. Results: There was no intergroup difference in operation time and postoperative drainage volume ($P>0.05$), however, the amount of intraoperative bleeding in MI group was significantly less than that in control group ($P=0.028$). The variation in white blood cell count and the decline of the total bilirubin level were similar in both groups 24 h after operation ($P>0.05$), whereas the lowering of the albumin level in MI group was not as great as that in control group ($P=0.038$). Besides, the postoperative anal exhaust time, time for being able to get out of bed and LOS in MI group were significantly less than those in control group (all $P<0.001$), and the incidence of postoperative complications in MI group was also much lower (8% versus 48%, $P<0.001$). During the 2-year follow-up, it was found that there was no intergroup difference in terms of recurrence rate of stones ($P>0.05$). Conclusion: In comparison with the conventional laparotomy, the combined use of laparoscopic and choledochoscopic techniques for treating concomitant gallstones and CBD stones could provide some advantages, such as lower amount of bleeding, faster recovery, lower incidence of complications and shorter LOS, while the operation time and recurrence rate were similar in two groups. The result demonstrated that CLCS is a safe and effective approach to treating gallstones and CBD stones, and can be promoted for clinical application.

Keywords: Fiberoptic choledochoscopy, laparoscopy, common bile duct stone, gallstone

Introduction

The concomitant gallstones and common bile duct (CBD) stones is a common disease in department of general surgery with high incidence. It has been reported that 9%-16% patients who are suffering gallstones also have CBD stones [1-3]. Patients with symptomatic gallstones and CBD stones usually need to receive surgery for the treatment. The conventional surgical management is open cholecystectomy and choledocholithotomy with T-tube drainage [4]. Although this method can achieve decent results, it can cause big surgical trauma, and long hospital length of stay (LOS) [5]. In recent years, due to the development of minimally invasive (MI) technique, there has been a growing use of laparoscopy in the department of hepatobiliary which provides a safe and effective way for treating biliary tract diseases. Meanwhile, the combined use of laparoscopic and choledochoscopic techniques has been

gaining increasing population clinically and has become an important method in the treatment of concomitant gallstones and CBD stones [6, 7]. However, it is still unclear whether there is any difference in the areas such as surgical effectiveness, postoperative recovery, incidence of complications between the combined laparoscopic and choledochoscopic surgery (CLCS) and conventional laparotomy. Therefore, the present study reviewed 50 patients who received CLCS for treating concomitant gallstones and CBD stones to analyze and compare the clinical effectiveness and safety of CLCS with those of conventional laparotomy.

Materials and methods

Case selection

The clinical records of 50 patients who had concomitant gallstones and CBD stones and received CLCS in the department of hepatobiliary surgery in our hospital from Jan 2014 to May 2015 were chosen for the retrospective study. All diagnoses were confirmed based on clinical signs and symptoms, as well as lab and imaging tests. Meanwhile, based on a 1:1 ratio, a total of 50 patients who underwent conventional laparotomy for removing gallstones and CBD stones during the same timeframe were included as control. The study was approved by the Ethics Committee of the hospital.

Inclusion criteria: Patients aged above 18 years; patients suffered disease for the first time; patients developed indications for surgery; patients had no hepatolithiasis; patients either received CLCS and CBD exploration or the conventional open cholecystectomy, choledocholithotomy and T-tube drainage; patients had a complete record of 2-year follow-up after the surgery (the follow-up was conducted in the form of outpatient follow-up visit, which took place after the telephone booking of the appointment; in addition, patients were reexamined by B-ultrasound or abdominal CT scan every six months).

Exclusion criteria: Patients had upper abdominal surgery in the past; patients had abdominal adhesion and severe infection in abdominal cavity; patients had severe acute inflammation of biliary tract; patients had severe organ (such as heart, lung, liver, or kidney) failure.

The CLCS was conducted according to the following procedure: after general anesthesia, patient was placed in a head up, feet down position with a 30 degree left lateral tilt. The artificial pneumoperitoneum was established and the pressure was maintained at 14 mmHg. The surgery adopted the three-puncture approach, in which one puncture was made at 3 cm below xiphoid process, 1-2 cm to the right, while the locations of the rest of the punctures were as same as those in regular laparoscopic cholecystectomy. The Calot's triangle was dissected, and the absorbable clips were used for the ligation of cystic duct close to the CBD. The anterior wall of CBD was incised longitudinally for about 1 cm, and the choledochoscope was entered through the puncture below the xiphoid process for CBD exploration. The stones were extracted with the use of a basket. After that, CBD was rinsed and washed, and the patient was checked again by choledochoscope. If it showed no residual stone, the primary suture of CBD incision would then be performed. Lastly, the cholecystectomy was carried out according to routine procedure. The drainage tube was placed and the incision was sutured layer by layer.

The laparotomy was performed according to the following procedure: after general anesthesia, a longitudinal incision was made through the rectus abdominis muscle on the right upper quadrant, splitting the skin layer and muscle before entering into the abdominal cavity. According to the routine procedure, the cholecystectomy was first performed followed by the choledocholithotomy. Meanwhile, the T-tube was placed for drainage, and patient was checked by T-tube cholangiogram between week 3 and week 4 following the surgery. The T-tube could be removed from the patient if the cholangiogram showed that CBD was cleared up with no existence of residual stones.

Data collection

The following data were collected from the patients: basic information (gender, age, basic diseases), preoperative data (course of disease, diameter of CBD, size of CBD stones, white blood cell (WBC) count, total bilirubin, and albumin level), intraoperative data (operation time, amount of intraoperative bleeding), postoperative data and follow-up result (WBC count in the peripheral blood, albumin and total bilirubin level at 24 h after operation, postoperative drainage volume, anal exhaust time, time for being able to get out of bed, LOS, post-

Table 1. Comparison of basic clinical information in two groups

Group	Male / Female (case)	Age (year)	Course of disease (year)	Size of CBD stones (cm)	WBC count ($*10^9$)	Total bilirubin (μmoL/L)	Albumin (g/L)
MI	27/23	47.1±12.2	3.9±1.8	1.3±0.6	12.3±5.8	52.7±18.2	37.8±4.6
Control	31/19	47.8±12.5	4.3±2.1	1.1±0.5	12.7±6.1	49.8±16.7	38.2±4.9
t	0.501	0.291	0.545	0.444	-0.082	0.203	-0.103
P	0.480	0.771	0.588	0.680	0.938	0.849	0.923

Note: MI, minimally invasive.

Table 2. Comparison of intraoperative data in two groups

Group	Operation time (min)	Amount of intraoperative bleeding (mL)
MI	132.3±25.2	50.4±10.1
Control	129.4±22.7	80.2±11.4
t	0.148	-3.389
P	0.889	0.028

Note: MI, minimally invasive.

operative complications which included pain, wound infection, bile leakage and incisional hernia).

Outcome measures

Main outcome measures were as follows: operation time, amount of intraoperative bleeding, and the recurrence rate of stones within 2 years after operation. Secondary outcome measure was the incidence of complications after operation.

Statistical analysis

SPSS 20.0 was applied for statistical analysis in this study. The measurement data was presented as mean ± standard deviation; t test for two independent samples was used for comparison between two groups; the count data was expressed as percentage, and comparison between groups was conducted by χ^2 test. $P<0.05$ was considered as statistically significant.

Results

Basic clinical information in two groups

There was no intergroup difference between two groups in terms of basic clinical information, including gender, age, course of disease, size of CBD stone, WBC count, total bilirubin level, and albumin level ($P>0.05$, **Table 1**), thus, the study results of two groups were comparable.

Intraoperative data in two groups

The operation time in two groups was similar ($P=0.889$), whereas the amount of bleeding in MI group was significantly less than that in control group ($P=0.028$, **Table 2** and **Figure 1**).

Postoperative data in two groups

The WBC count, total bilirubin and albumin level were measured again at 24 h after operation, which showed no intergroup difference in the variation of WBC count and the decline of total bilirubin ($P>0.05$). However, the lowering of albumin level in MI group was significantly less than that in control group ($P=0.038$, **Table 3**).

The postoperative anal exhaust time in MI group (1.7±0.5 d vs. 3.1±0.8 d), the time for being able to get out of bed (1.5±0.7 d vs. 2.7±0.9 d), and LOS (7.6±2.3 d vs. 12.7±2.5 d were much less than those in control group (all $P<0.001$). No statistical difference was observed between two groups regarding the total drainage volume after operation ($P=0.825$, **Figure 2**).

Incidence of complications in two groups

There was no postoperative pancreatitis or bleeding in two groups. The total incidence of complications was 8% in MI group, in which there were 3 cases of postoperative pain (6%), and 1 case of bile leakage (2%). There was no wound infection or incisional hernia. In contrast, the total incidence of complications in control group was 48%, in which there were 13 cases of postoperative pain (26%), 3 cases of wound infection (6%), 5 cases of incisional hernia (10%), and 3 cases of bile leakage (6%). There was significant difference in postoperative pain and total between two groups

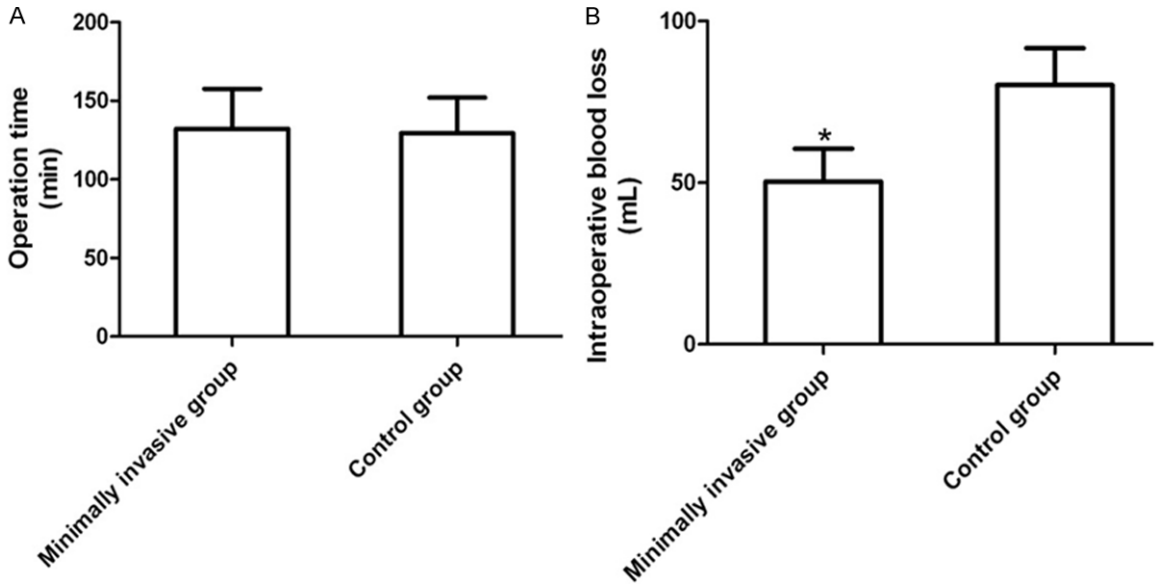

Figure 1. Comparison of intraoperative data in two groups. A: Operation time; B: Amount of intraoperative bleeding; *P<0.05 versus control group.

Table 3. Comparison of the changes in biochemical indicators after operation in two groups

Group	Variation in WBC count (*10^9)	Decrease in total bilirubin level (μmoL/L)	Decrease in albumin level (g/L)
MI	3.8±1.9	27.4±11.2	4.1±1.2
Control	3.5±1.4	25.1±9.8	9.0±2.5
t	0.220	0.268	-3.055
P	0.837	0.802	0.038

Note: MI, minimally invasive.

(P=0.014), whereas no difference was found in wound infection (P=0.242), incisional hernia (P=0.056), and bile leakage (P=0.610). The two groups had significant difference in the total incidence of complications (P=0.001, **Figure 3**).

Recurrence rates in two groups

Both surgical methods could successfully remove the CBD stones with a removal rate of 100%. The follow-up visits (2.1±0.4 years) were performed after operation, which found two cases of recurrence of gallstones in MI group and three cases of recurrence in control group. The results presented no significant difference (4% vs. 6%, P=1.000, **Figure 4**).

Discussion

With the improvement of people's standard of living and the changes in people's diet, the incidence of concomitant gallstones and CBD stones has now been rising significantly [8]. The conventional open cholecystectomy and choledocholithotomy is usually the standard surgical management for this disease [9]. However, people are more willing to choose surgical methods with good clinical effects and less surgical trauma rather than laparotomy. Due to the advancement of medical technology, the MI techniques are now broadly applied in the clinical surgery [10], and the laparoscopic surgery has become the first-choice of treatment for gallstones [11]. The integration of various MI techniques such as laparoscopy, choledochoscopy and duodenoscopy has now been a popular topic in the biliary surgery. Although the number of people who received CLCS for treating concomitant gallstones and CBD stones are growing currently, it is still unclear whether there is any difference in terms of clinical effectiveness between the CLCS and the conventional laparotomy [12-15].

Since the CLCS in the present study didn't require any open surgery or dissection of the CBD, it wouldn't harm the structure of CBD or carunculae major, and the primary suture of CBD incision could be performed [16-18]. In view of analyzing the effectiveness of this surgical management for gallstones and CBD stones, the clinical records of the patients who received either CLCS or conventional laparotomy were studied for comparison. The result showed that there was no intergroup difference

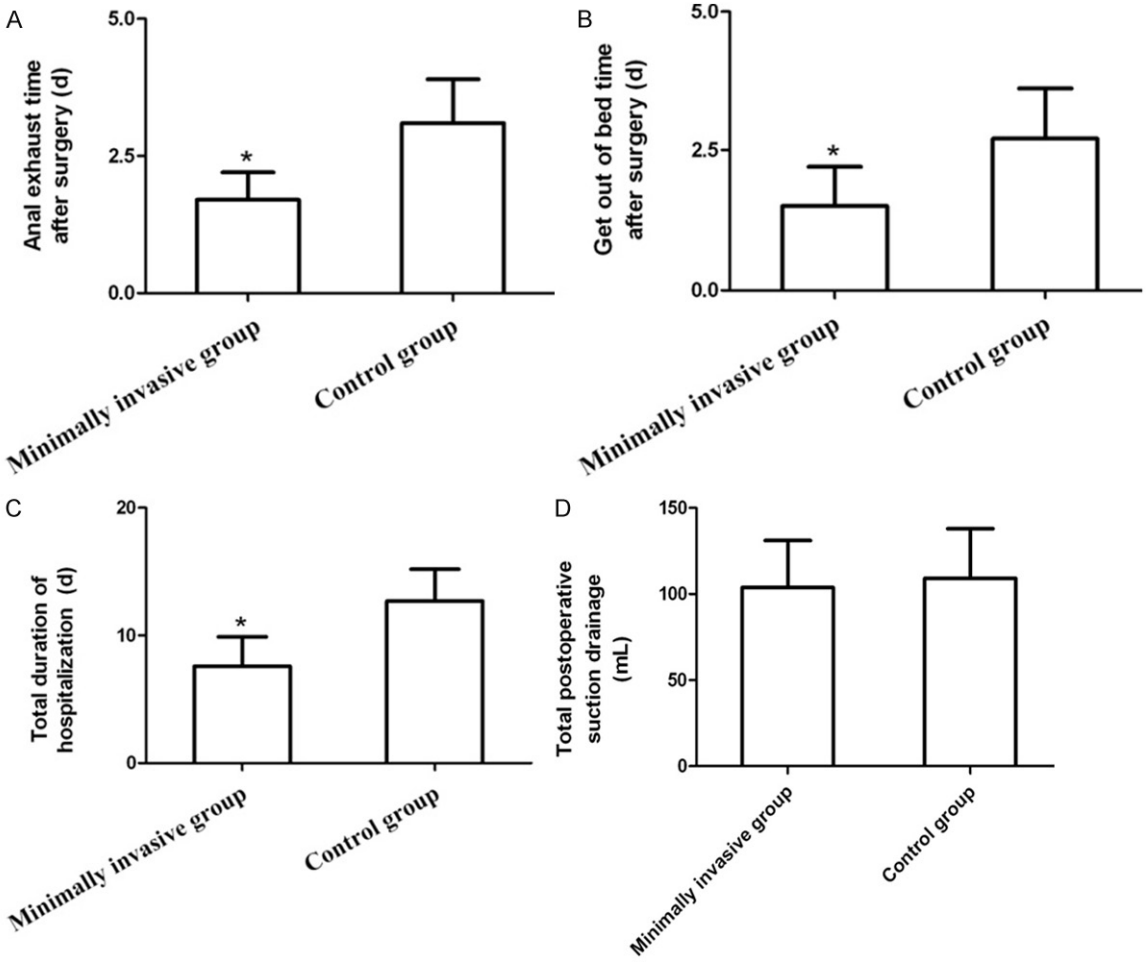

Figure 2. Comparison of postoperative data in two groups. A: Postoperative anal exhaust time; B: Time for being able to get out of bed; C: LOS; D: Postoperative drainage volume; *P<0.001 versus control group.

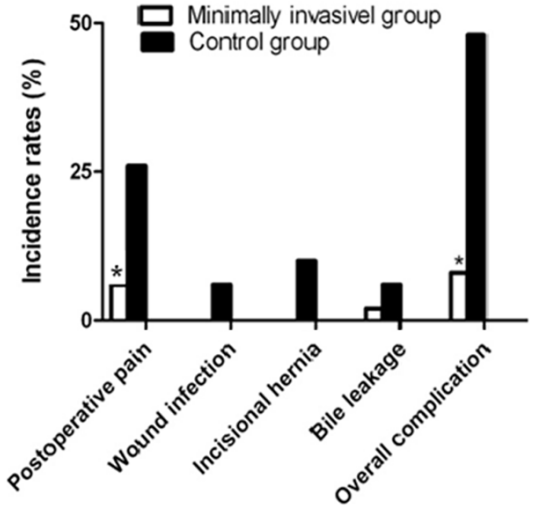

Figure 3. Comparison of incidence of complications in two groups. *P<0.05 versus control group.

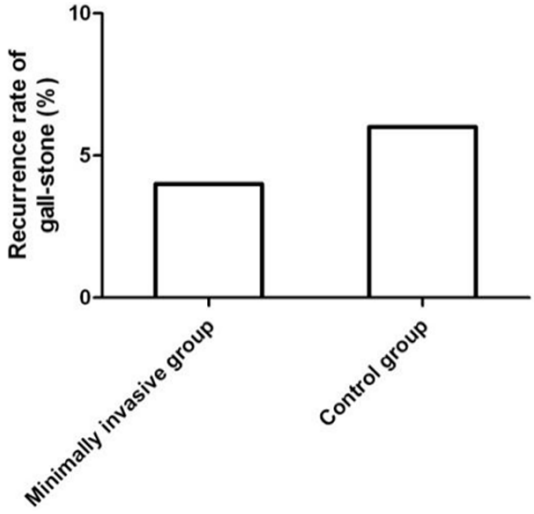

Figure 4. Comparison of recurrence rate in two groups.

in operation time and amount of postoperative drainage volume, whereas the amount of intraoperative bleeding was significantly less than that in control group. This was due to the fact that MI procedure wouldn't sever or incise any larger blood vessels, thus causing less surgical trauma and amount of bleeding. Although the MI surgery was more complicated than the laparotomy, the former one didn't require any T-tube drainage. In addition, measures were taken to control the bleeding from the wound in both surgical procedures. Therefore, the operation time and postoperative drainage volume were similar in two groups. CLCS also caused less harm to the abdominal cavity and gastrointestinal tract, which would be helpful for a fast recovery of the gastrointestinal function. The result showed that the lowering of the albumin level at 24 h after operation, as well as the postoperative exhaust time, time for being able to get out of bed, and LOS were much less than those in control group. Meanwhile, the variation in WBC count and the reduction of total bilirubin were similar in two groups, this might be due to the similarity of the inflammatory response in two groups and the fact that both surgical methods could significantly relieve the biliary obstruction, which would be conducive to the excretion of bilirubin. Since patients in MI group had smaller incision and less surgical trauma, the postoperative pain, and total incidence of the complications were significantly less than those in control group. Besides, the MI procedure avoided excessive stripping of the CBD wall, so that the occurrence of bile leakage was less than that in laparotomy. As compared with control group, the total incidence of complications in MI group was significantly lower ($P<0.05$), which was consistent with the findings by Hua et al. [19]. The recurrence of the stones in MI group was similar to that in control group during the 2-year follow-up ($P>0.05$), which could be caused by the fact that both surgical managements had successfully removed the CBD stones. Therefore, it can be seen from the study that CLCS can provide more advantages than laparotomy in treating gallstones and CBD stones, as it offers the operator a clear view of the lesion, including the location and size of the CBD stones. Nevertheless, there are also some shortcomings in this surgical method. For example, the indications for surgery need to be accurately assessed, and the surgery requires a high level of technical skill [20, 21].

In sum, the combined use of laparoscopic and choledochoscopic techniques for treating concomitant gallstones and CBD stones could provide some advantages including faster recovery, less pain, less amount of bleeding, lower incidence of complications, shorter LOS and non-necessity of placing T-tube for drainage. Hence, it has high application value provided that the patient's indications for surgery are well evaluated. However, some limitations still existed in the study, for example, the sample size was relatively small, and the research was a single-center retrospective study. Therefore, a prospective, randomized controlled trial with larger sample size would be necessary in the future for further verification.

Disclosure of conflict of interest

None.

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