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Original Article

Clinical effect of laparoscopic common bile duct incision with primary suture and nasobiliary drainage

Tongli Yuan, Huayong Tang, Mei Zhou, Yi Yang, Gang Yan, Haitao Hu, Qun Xiao, Yanyu He, Xiaoxue Chen

Department of Hepatobiliary Surgery, The First Affiliated Hospital of Hunan Traditional Chinese Medical College, Zhuzhou, Hunan Province, China

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Abstract: Objective: To investigate the clinical efficacy of nasobiliary drainage after laparoscopic cholecystectomy and primary suture combined with exploration of common bile duct. Methods: A retrospective analysis of 92 cases with cholelithiasis and choledocholithiasis underwent laparoscopic cholecystectomy (LC), laparoscopic common bile duct exploration (LCBDE) with biliary drainage was performed, and 50 patients (nasal bile duct group) underwent laparoscopic common bile duct incision with primary suture and nasobiliary drainage, and 42 patients (T-tube group) underwent laparoscopic common bile duct incision with T-tube drainage. Data of the surgical time, ventilation time, intraoperative blood loss, liver function and other indicators in two groups were compared. Results: There was no significant difference in the ventilation time and the eliminating rate of stone between the two groups ($P>0.05$). The time of operation and extubation, the amount of intraoperative blood loss and the average hospital stay in the nasal bile duct group were significantly less than those in the T-tube group ($P<0.05$). There were no significant differences in liver function indexes between the two groups before and after surgery ($P>0.05$). There were no serious complications in the two groups after surgery, and no difference in the complication rate was found between the two groups ($P>0.05$). Conclusion: Laparoscopic common bile duct incision with primary suture and nasobiliary drainage is a reasonable procedure for the treatment of cholelithiasis and choledocholithiasis. The curative effect is reliable, and the operation method is worthy of clinical promotion.

Keywords: Laparoscopic cholecystectomy, common bile duct exploration, cholelithiasis, clinical efficacy

Introduction

Cholelithiasis and choledocholithiasis are common diseases with very high incidence in clinical surgery. Open cholecystectomy, common bile duct incision and T-tube drainage were routine surgical treatments in the past [1, 2]. With the development and innovation of laparoscopic surgery techniques, laparoscopic treatments have been widely used for the treatment of cholelithiasis and choledocholithiasis [3]. It has always been the core of the discussion of surgeons to find a treatment with better effect and smaller trauma.

Traditional open common bile duct exploration with T-tube drainage are classic surgical procedures for cholelithiasis and choledocholithiasis. However, open surgery has large trauma, long recovery time and risks of electrolyte imbalance with huge losses of bile. Also, the infection rate of intra-abdominal or incision is high, and so is the residual rate of stones. Besides, serious complications such as bleeding and perforation might occur [4, 5]. With the advancement of minimal invasive surgeries, laparoscopic cholecystectomy (LC) has become the optimum treatment for cholelithiasis and choledocholithiasis. Current minimally invasive treatments have different surgical indications and advantages, but they also have different shortcomings [6-8]. Laparoscopic common bile duct exploration (LCBDE) with primary suture has narrow indications. After the surgery, inflammatory edema occurs easily in the papillary muscle and biliary mucosa due to surgical injury. The common bile duct lacks effective support and drainage. This would lead to biliary obstruction, bile leakage, or even acute pancreatitis [9, 10]. If the nasal bile duct was placed first by endoscopic retrograde cholangiopancreatography, and then LC and LCBDE with primary suture

were performed, the patient would need staged surgery, which were also two independent processes, and the medical expenses were higher. There might also be risks of gastrointestinal bleeding or perforation, complicated biliary infection, and acute pancreatitis [11, 12]. Considering the above factors, we used a laparoscopic common bile duct incision with primary suture and nasobiliary drainage. The indications for laparoscopic common bile duct primary suture are wide. Staged surgery was no longer needed, and the length of hospital stay could be reduced.

This study retrospectively analyzed the case data of 92 patients to explore the effect of laparoscopic common bile duct incision with primary suture and nasobiliary drainage and to provide guidance for clinical treatment.

Materials and methods

General information

Data of 92 cases with cholelithiasis and choledocholithiasis patients underwent LC and LCBDE with biliary drainage in The First Affiliated Hospital of Hunan Traditional Chinese Medical College from January 2013 to December 2016 was retrospectively analyzed. Among all the patients, 50 patients (nasal bile duct group, N group) underwent laparoscopic common bile duct incision with primary suture and nasobiliary drainage, and 42 patients (T-tube group, T group) underwent laparoscopic common bile duct incision with T-tube drainage. This study was approved by the Medical Ethics Committee of The First Affiliated Hospital of Hunan Traditional Chinese Medical College.

Inclusion criteria: All patients were examined by abdominal ultrasound, upper abdominal CT (sweep and enhancement) or MRCP and other imaging examinations to confirm the diagnoses of cholelithiasis and choledocholithiasis, referred to the "*Surgery (8th Edition)*" diagnostic guidelines [13]. No history of upper abdominal surgery. Preoperative Child-pugh classification of patients were A or B grade [14]. No acute suppuration or gangrenous cholecystitis. No Oddi sphincter dysfunction and other abnormalities. Complete history of medical data.

Exclusion criteria: Patients with acute severe cholangitis, biliary tract bleeding, acute severe pancreatitis, Mirizzi syndrome, potential benign, malignant tumors obstructing the biliary tract, severe liver and kidney disfunction or blood system diseases.

Surgical method

Laparoscopic common bile duct incision was performed firstly in the N group. After the biliary stone removal by choledochoscopy, zebra guide wire was inserted from the choledochoscope surgical incision under the direct view of choledochoscopy (Hunan Reborn Medical Science and Technology Development Co., Ltd., China), through the common bile duct and duodenal papilla into the duodenal cavity. At the same time, the gastroscope was inserted into the descending part of duodenum from the oral cavity. The zebra guide wire and gastroscope (Shanghai Outai Medical Equipment Co., Ltd., China) were slowly taken out from the mouth. The nasobiliary duct was placed in the common bile duct along the zebra guide wire. Then the zebra guide wire was taken out from the mouth, and the head of nasobiliary duct was placed in the hepatic duct. The nasobiliary duct was led out through the nasal cavity. The end of nasobiliary duct was connected with an empty injection syringe by adjusting the length of the external tube, and the bile was drained out from the end of nasobiliary duct. The common bile duct incision was closed with 3-0 absorbable suture (Yangzhou ZX Medical Appliance Co., Ltd., China), and a 22-gauge silicone drainage tube was placed around the wound (Germany Lu Industrial Technology Wuxi Co., Ltd., China). The drainage tube was taken out from the anterior margin of incision under the right rib [15].

In the T group, common bile duct incision was performed firstly by laparoscopy. After the biliary stone removal by choledochoscopy, the T-tube (Jiangsu Ealontech Medical Co., Ltd., China) was placed under the condition that the biliary system was confirmed without stenosis, tumor and residual stones. After cutting off the distal end of the T-tube straight arm, the 7-0 suture (Yangzhou Zhixiang Medical Products Co., Ltd., China) was used for ligature. The trocar was placed again through the subxiphoid incision and the T-tube was placed into the abdominal cavity. The transverse arm was placed through the incision into the upper segment of the common bile duct. Then the left curved forceps were used to close the junction of the straight arm and the other arm, and the bending of the arm was clamped so that the

Table 1. Comparison of general information of two groups

		Nasal bile duct (n=50)	T-tube (n=42)	t/χ^2	P
Sex	Male	27 (54.0)	20 (47.6)	0.372	0.542
	Female	23 (46.0)	22 (52.4)		
Age		50.2±14.7	51.1±15.2	0.288	0.774
Clinical symptoms	Stomachache	39 (78.0)	31 (73.8)	0.220	0.639
	Fever	11 (22.0)	9 (21.4)	0.004	0.947
	Jaundice	12 (24.0)	10 (23.8)	0.000	0.983
	Nausea and Vomiting	24 (48.0)	21 (50.0)	0.037	0.848
	Bile duct diameter (mm)	13.22±3.43	13.61±3.84	0.533	0.596
	Size of bile duct stones (mm)	10.24±4.62	10.53±4.93	0.302	0.763
Number of bile duct stones	>5	17 (34.0)	22 (52.4)	3.158	0.076
	≤5	33 (66.0)	20 (47.6)		
Location of bile duct stones	Middle and Lower	34 (68.0)	29 (69.0)	0.012	0.914
	Upper	16 (32.0)	13 (31.0)		
Course of disease (month)		15.22±4.21	15.63±4.34	0.450	0.654

Table 2. Comparison of surgical data of the two groups (mean ± sd)

	Nose bile duct (n=50)	T-tube (n=42)	t/χ^2	P
Operation time (min)	93.52±24.22	116.81±27.24	4.347	<0.001
Ventilation time (h)	43.48±5.61	44.71±6.23	0.975	0.332
Intraoperative blood loss (mL)	82.52±31.44	96.13±31.85	2.054	0.043

distal arm could enter the incision of common bile duct. At this time, the visceral surface of liver was supported by the straight arm of the T-tube so as to expose the surgical field. The common bile duct was sutured with a 4-0 suture (Yangzhou ZX Medical Appliance Co., Ltd., China), and the serosa of common bile duct was sutured with a 1-0 silk suture. The straight arm of T-tube was drawn through the abdominal wall incision or the right clavicular midline subcostal incision or the subxiphoid incision. The ligature of the distal straight arm was cut to inject the liquid into the irrigator. Laparoscopy was performed to see if there was any leakage around the suture and additional sutures were added if necessary. The abdominal cavity was cleaned, and the drainage tube was placed into the foramen of Winslow and led out through the inferior of incision under the right rib [16].

Observation indicators

Main outcome indicators: Comparison of operation time (from disinfection to end of surgery), surgical treatment effect (eliminating rate of stone), liver function, surgical success rate, extubation time, satisfaction score, rate of postoperative complications (wound infection, abdominal infection, etc.) and postoperative blood amylase levels in two groups. The total bilirubin (T-Bil), direct bilirubin (D-Bil), aspartate transaminase (AST), alanine transaminase (ALT), alkaline phosphatase (ALP) and amylase levels in blood were detected by Olympus AU5800 automatic biochemical analyzer (Beckman Coulter Commercial Enterprise (China) Co., Ltd.). Rate of complications = number of cases with complications/number of patients in each group * 100%.

Secondary indicators: Ventilation time, intraoperative blood loss and average hospital stay between two groups.

Statistical analysis

Statistical analysis was performed using SPSS 19.0 software (Asia Analytics Formerly SPSS China Ltd.). The count data were represented by n (%) and tested by χ^2 and Fisher exact probability method. The measurement data were represented by mean ± sd; data not meeting normal distribution were compared using K-S nonparametric test, and the data conforming to the normal distribution was compared using the t test. $P<0.05$ is considered to be statistically significant.

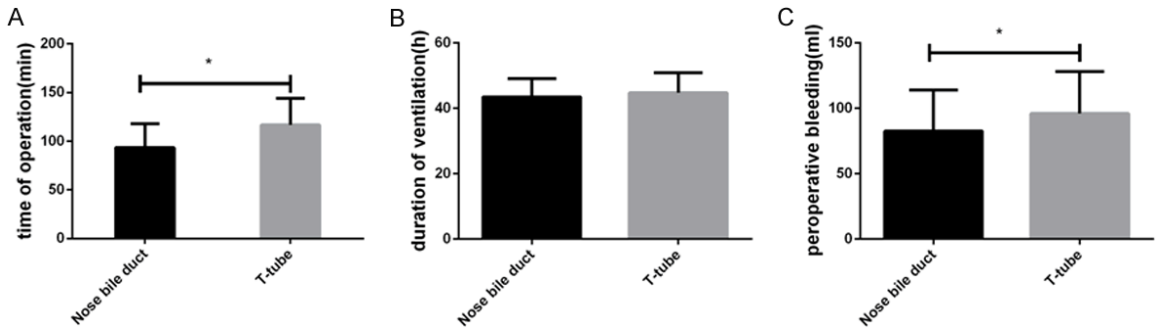

Figure 1. Comparison of surgical data between the two groups. A: Time of operation; *P<0.05. B: Duration of ventilation. C: Preoperative bleeding; *P<0.05.

Table 3. Comparison of postoperative recovery data in both groups

Group	Nose bile duct (n=50)	T-tube (n=42)	t/χ^2	P
Success rate of surgery	50 (100.0)	42 (100.0)		
Eliminating rate of stone	50 (100.0)	40 (95.2)		0.206#
Extubation time (d)	7.21±1.31	16.44±3.62	16.826	<0.001
Average hospital stay (d)	10.23±1.81	15.92±2.75	11.790	<0.001
Satisfaction score	9.63±1.34	8.43±0.91	5.050	<0.001

Note: #represents the Fisher test.

Results

Comparison of general information

Among 92 patients with cholelithiasis and choledocholithiasis, 50 patients were included in the N group, and 42 patients were in T group. There was no significant difference in gender and age between the two groups (both P> 0.05). The clinical symptoms of the two groups were mainly abdominal pain and malignant vomiting. There was no difference between the two groups in the incidence of each symptom (all P>0.05). There was no significant difference in the diameter of common bile duct and the size, number and position of bile duct stones between the two groups of patients (all P>0.05). There was no difference in the length of the disease between the two groups (P>0.05). See **Table 1**.

Comparison of surgical data of the two groups

The average operation time of the N group was significantly less than that of the T group (P<0.05). The intraoperative blood loss in the N group was also significantly less than that in the T group (P<0.05). There was no significant difference in the ventilation time between the N group and the T group (P>0.05). See **Table 2** and **Figure 1**.

Comparison of the data of postoperative recovery in both groups

There were no failures in patients who underwent surgeries. The success rate of surgery was 100.0%. The eliminating rate of stone between the N group and the T group was not significant (P>0.05). The time of extubation in the N group was significantly less than that in the T group (P<0.05). The average hospital stay in the N group was significantly less than that in the T group (P<0.05). The average satisfaction score for patients in the N group was also higher than that in the T group (P<0.05). See **Table 3**.

Comparison of liver function before and after surgery in two groups

There were no significant differences in preoperative T-Bil, D-Bil, AST, ALT, and ALP levels between the two groups (all P>0.05). After surgery, T-Bil, D-Bil, AST, ALT, and ALP levels fluctuated in both groups, but no significant difference was found in comparison with the data before surgery (all P>0.05). Also, there were no significant differences in T-Bil, D-Bil, AST, ALT, and ALP levels between the two groups (all P>0.05). See **Table 4**.

Comparison of postoperative complications in two groups

There were no serious complications in the two groups after surgery. There was no statistic difference in the total complication rate was found between the two groups (*P*>0.05). All the

Table 4. Comparison of liver function before and after surgery in two groups (mean ± sd)

		Nose bile duct (n=50)	T-tube (n=42)	t/χ^2	P
T-Bil (μmol/L)	Pre-operation	24.42±11.65	26.73±12.13	0.930	0.355
	Post-operation	25.12±12.26	26.83±12.34	0.664	0.508
D-Bil (μmol/L)	Pre-operation	13.52±3.74	12.82±3.55	0.920	0.360
	Post-operation	13.94±3.91	13.44±4.12	0.596	0.553
AST (U/L)	Pre-operation	34.52±12.33	35.31±12.64	0.303	0.763
	Post-operation	38.64±14.12	39.25±14.47	0.204	0.839
ALT (U/L)	Pre-operation	62.55±21.56	67.34±23.48	1.019	0.311
	Post-operation	66.98±22.74	68.41±23.17	0.298	0.767
ALP (U/L)	Pre-operation	84.72±24.16	86.13±25.45	0.272	0.786
	Post-operation	88.81±25.22	90.11±25.75	0.244	0.808

Note: T-Bil: total bilirubin; D-Bil: direct bilirubin; AST: aspartate transaminase; ALT: alanine transaminase; ALP: alkaline phosphatase.

Table 5. Comparison of postoperative complications

	Nose bile duct (n=50)	T-tube (n=42)	P
Wound infection	1 (2.0)	1 (2.4)	1.000#
Abdominal infection	0 (0.0)	1 (2.4)	0.457#
Hyperamylasemia	0 (0.0)	3 (7.1)	0.091#
Total adverse reaction	1 (2.0)	5 (11.9)	0.136*

Note: #represents the Fisher test. *represents calibration chi-square test (χ^2=2.228).

complications of patients were controlled after corresponding treatments. See **Table 5**.

Discussion

Cholelithiasis and choledocholithiasis are common surgical diseases [17]. The incidence of cholelithiasis is about 20%, and 21% of patients with gallstones have choledocholithiasis [18]. Long-term bile duct stones can cause liver damage, cholangitis, pancreatitis, systemic infections, etc. [19]. Surgical treatment is the only effective cure to remove stones and relieve obstruction. However, due to the complicated structure of the biliary tract and various surgical procedures, it has been a clinical problem for surgeons to find a safe, effective and minimally invasive method to remove stones, relieve the obstruction of the common bile duct and reduce the incidence of complications [20, 21]. This study retrospectively analyzed the medical records of 92 patients with gallstones and bile duct stones, and explored the therapeutic effect and safety of laparoscopic common bile duct incision with primary suture and nasobiliary drainage in order to provide valuable opinions for clinical treatment.

There were no statistical differences in the age, gender, clinical symptoms, common bile duct diameter and the size, number, and location of gallstones for the patients included in this study, suggesting that the two groups in this study were comparable. In this study, patients who underwent laparoscopic common bile duct incision with T-tube drainage were regarded as control group. The operation time and intraoperative blood loss of the N group were significantly less than those of the T group. There was no difference in the length of ventilation between the two groups of patients. It shows that the nasobiliary drainage has less stimulation to the intestinal and internal environment of human than the T-tube drainage, which meets human physiology and is conducive to recovery. The analysis of the recovery data of the postoperative patients showed that there was no difference in the success rate of surgery and eliminating rate of stones between the two groups of patients. However, the patients with nasobiliary drainage had significantly less extubation time, average hospital stay, and higher satisfaction scores than the T group patients. About 7 days after the nasobiliary drainage, the common bile duct healed. The sphincter edema caused by the operation has been basically restored, and the drainage tube can be removed to avoid the complications such as retrograde infection of biliary tract, gastrointestinal bleeding, acute pancreatitis and recurrence of biliary stones caused by Oddi sphincter incision [22, 23]. However, it took 4 weeks for the T-tube to be extubated. Only when the sinus was formed could the T-tube to be extubated. But bile leakage may occur due to incomplete sinus formation, and the long-term indwelling tube increases the chance of retrograde infection [24, 25]. Besides, the patients with T-tube need to take the tube with them after discharge, which would cause inconvenience in life, increase the physical and psychological suffering of patients,

and affect the recovery of patients [26, 27]. This may also be a reason why patients are more satisfied with nasobiliary drainage.

The analysis of liver function in the two groups showed that both treatments did not cause abnormal liver function in patients. There was no statistically significant difference in liver function between the two groups after surgery. Analysis of the complications in two groups showed that there was no difference in the incidence of complications between the two groups. Studies have reported that the incidence of postoperative complications associated with T-tubes is about 10%, which is similar to our findings [28, 29]. Many studies have reported that the friction of T-tube may cause duodenal injury, continuous bile leakage or T-tube slippage displacement, leading to biliary obstruction, bile leakage or infection around the tube, and hydroelectrolytic disorders caused by massive bile loss [30, 31]. Therefore, surgeons began to explore the primary suture technique of the common bile duct and other drainage methods. The nasobiliary drainage not only avoids the defects of the T-tube, but also solves the problem of biliary hypertension and biliary inflammatory edema after primary suture, with significant advantages [32]. However, there are still some shortcomings in this study. The number of cases included was small, and there were some differences in endoscopic operators. The results still require more multicenter randomized controlled trial to support.

In summary, laparoscopic common bile duct incision with primary suture and nasobiliary drainage is a reasonable and reliable surgical treatment for cholelithiasis and choledocholithiasis, and worthy of clinical promotion.

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Disclosure of conflict of interest

None.

Address correspondence to: Huayong Tang, Department of Hepatobiliary Surgery, The First Affiliated Hospital of Hunan Traditional Chinese Medi cal College, No.571 Renmin Road, Zhuzhou 412000, Hunan Province, China. Tel: +86-0731-28290005; E-mail: tanghuayong1547@163.com

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