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Laparoscopic and Seldinger techniques for the treatment of concomitant gallstones and choledocholithiasis. A retrospective study

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Keywords: minimally invasive cholelithotomy; cholelithiasis and choledocholithiasis; postoperative recovery.

Abstract. This study aimed to determine the efficacy and safety of a minimally invasive combined approach for concomitant stone clearance of cholelithiasis and choledocholithiasis. From November 2018 to March 2021, 30 patients were enrolled in this retrospective study that compared two methods of treating combined cholelithiasis and choledocholithiasis. The study comprised two groups: 15 patients in Group A underwent combined laparoscopic and Seldinger techniques for complete stone clearance, retaining the gall bladder in situ. In Group B, 15 patients underwent laparoscopic cholecystectomy and choledocholithotomy with T-tube drainage. The rates of successful completion of the operations, procedure-related complications, length of hospitalization, hospital cost, and patient satisfaction were compared between the two groups. The two groups had no differences in general patient characteristics, and all procedures were successfully completed. Compared to Group B, patients in Group A had a shorter operative time (84 vs. 105 min), less blood loss (10 vs. 28 mL), were less expensive, and had a shorter postoperative recovery. A single patient in group B developed bile leakage. The satisfaction rate was 93% in Group A, in contrast to 80% in Group B. The combined use of laparoscopic and Seldinger techniques to achieve complete stone removal in patients with concomitant cholelithiasis and choledocholithiasis was demonstrated to be safe and successful.

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Técnicas laparoscópica y de Seldinger para el tratamiento de cálculos biliares y coledocolitiasis concomitantes. Un estudio retrospectivo.

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Palabras clave: colelitotomía mínimamente invasiva; colelitiasis y coledocolitiasis; recuperación postoperatoria.

Resumen. Este estudio tuvo como objetivo determinar la eficacia y la seguridad de un enfoque combinado mínimamente invasivo para la eliminación de cálculos de la vasícula biliar y del conducto colédoco. Desde noviembre de 2018 hasta marzo de 2021, treinta pacientes se inscribieron en este estudio retrospectivo que comparó dos métodos combinados de tratamiento de colelitiasis y coledocolitiasis. El estudio comprendió dos grupos: en el Grupo A 15 pacientes se sometieron a coledocotomía laparoscópica y a colecistostomía con la técnica de Seldinger para el tratamiento simultáneo de la litiasis de la vesícula biliar y coledociana, dejando la vesícula biliar in situ. En el grupo B, 15 pacientes se sometieron a colecistectomía y coledocotomía laparoscópica con drenaje del tubo T. Las tasas de conclusión exitosa de las operaciones, complicaciones relacionadas con el procedimiento, la duración de la hospitalización, el costo hospitalario y la satisfacción del paciente se compararon entre los dos grupos. No hubo diferencias en las características generales del paciente entre los dos grupos y todos los procedimientos se completaron con éxito. En comparación con el grupo B, los pacientes en el Grupo A tuvieron un tiempo operativo más corto (84 frente a 105 min), menos pérdida de sangre (10 frente a 28 mL), eran menos costosas y tenían una recuperación postoperatoria más corta. Un solo paciente en el Grupo B desarrolló fugas biliares. La tasa de satisfacción fue del 93% en el Grupo A en contraste con el 80% en el Grupo B. La técnica laparoscópica combinada con la colecistostomía de Seldinger para lograr la eliminación completa de cálculos en pacientes con cálculos de la vesícula biliar y del colédoco fue segura y exitosa.

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INTRODUCTION

Cholelithiasis is a commonly encountered condition caused by several factors, such as metabolic abnormalities and unhealthy lifestyle habits [1]. The treatment of patients with combined cholelithiasis and choledocholithiasis is more complex. In recent years, multiple operative approaches have been undertaken to address both problems. These have included the combination of laparoscopic cholecystectomy (LC) with laparoscopic common bile duct exploration (LCBDE), endoscopic retrograde cholangiopancreatography (ERCP), and LC plus transcystic exploration [2-4]. There have been advantages and disadvantages to all these strategies. Similar to the classic open cholecystectomy and CBD (common bile duct) exploration, a T-tube has often been placed

during LCBDE to prevent postoperative bile leakage. An associated potential of damage to the CBD exists, and the postoperative management and inconveniences of the T-tube are well known. Transcystic stone removal can avoid the need for a T-tube and obviate the need and risk of postoperative ERCP for stone management.

Additional minimally invasive treatments are needed for patients with cholelithiasis combined with choledocholithiasis. In 2016, Pet *et al.* [2] reported the placement of an intraoperative endoscopic nasobiliary drainage (ENBD) tube in the common bile duct with primary closure of the CBD to prevent postoperative bile leakage. This was accomplished using Tri-scope (laparoscope, choledochoscope, and gastroscope) surgery, which appeared feasible, safe, and cost-effective.

In the present study, we treated patients with concomitant cholelithiasis and choledocholithiasis with a combination of laparoscopic and Seldinger technology. Management involved a guide wire, catheter, and balloon catheter placed into and through the gallbladder into the CBD to clear the stones. To provide a frame of reference, we compared the outcomes of the above patients with those treated with laparoscopic choledocholithotomy and T-tube drainage.

METHODS

Patients

Thirty patients (17 males, 13 females) with concomitant cholelithiasis and choledocholithiasis were enrolled from November 2018 to March 2021. These patients (age range, 24-80 years) were diagnosed using computed tomography (CT) and magnetic resonance cholangiopancreatography (MRCP). All patients underwent preoperative physical examination, including blood tests, to assess liver and kidney function, urine amylase, and coagulation parameters.

Inclusion criteria included: no previous surgical treatment of the hepatobiliary system, duodenum, or stomach and preoperative confirmation of concomitant cholelithiasis and choledocholithiasis by MRCP. The gallstones were removed, leaving the intact gallbladder in Group A. The cholecystectomy was performed in Group B.

Exclusion criteria in all two groups: acute or suppurative inflammation of the hepatobiliary system; mental illness; the presence of pancreatic cancer, diabetes, or other relatively serious diseases; and the presence of severe lung or kidney problems.

Patients group

All patients signed informed consent. The approach of surgery was performed according to the principle of voluntary participation. This study was approved by the ethics committee of our hospital (registration No. ChiCTR2100047160).

Surgery techniques

Combined laparoscopic and Seldinger techniques

Group A. Under satisfactory general endotracheal anesthesia, a pneumoperitoneum was established through a standard umbilical incision, and two ports were placed [5]. A 2-3 cm incision was made 10 mm below the umbilical cord to establish pneumoperitoneum by injecting CO2 and finding the gallbladder. The bottom of the gallbladder was sutured with a traction line, and the bottom of the gallbladder was filled with sterile gauze to protect the tissues around the gallbladder. With laparoscopic visualization, the gallbladder was elevated, and a 1-cm incision was performed. Bile was aspirated with steady fixation of the gallbladder, and the gallstones were completely removed using a rigid choledochoscope. An 8.5-F Dawson-Mueller drainage catheter was then inserted into the gallbladder lumen under the guidance of fluoroscopy. Stone removal was performed after the alleviation of cholecystitis or cholangitis at a mean of 4.5 days after cholecystostomy. The drainage catheter was then exchanged over a 0.035-inch super-stiff

guide wire to an 8-F sheath. A 5F catheter (40 cm long) was introduced through the sheath, and a 0.035-inch hydrophilic guide wire was used to navigate the cystic duct. After crossing the cystic duct, the guide wire was further inserted down the common bile duct (CBD) through the papilla of Vater into the duodenum. The size, location, and number of stones in the common bile duct were determined by choledochography using iodixanol. A stone extractor was used to remove the gallbladder directly for smaller stones. For larger stones, a biopsy forceps was used for crushing the stones before removing them. According to the size of the stones and the common bile duct dilatation, a suitable balloon catheter was used to expand the duodenal papilla. The stone could be pushed through the papilla into the duodenum using a stiff guide wire. Intraoperative choledochography was performed again to verify there were no residual stones and patency of the common bile duct. After withdrawing the guide wire and catheter, the gallbladder incision was sutured, and the abdomen was closed. The sheath was finally exchanged with an 8.5-F Dawson-Mueller drainage catheter in the gallbladder to allow drainage and prevent complications.

In group A, the gallbladder was normal in size, without structural abnormality, and its wall was smooth without thickening. The stones can move within the capsule, and it is better if they are large and few.

Laparoscopic choledocholithotomy and T-tube drainage

Group B. Under satisfactory general endotracheal anesthesia, a pneumoperitoneum was established through a standard umbilical incision, and a four-port technique was performed [6,7]. The gallbladder was dissected, and the cystic and common bile ducts were visualized and safely dissected. The cystic duct was ligated with No.7 silk, and the common bile duct was opened using hook electrocautery at the point where the cystic duct joins the common bile duct. The stones were removed using previous choledochoscopic irrigation. If necessary, the operation was converted to a laparotomy, and the CBD stones were retrieved with choledocholithotomy forceps through the infra xiphoid incision. At the completion of the choledochoscopic exploration, a T-tube was placed in the common bile duct, which was closed with a 3-0 absorbable suture, and the gallbladder was then removed. The gallbladder bed drainage tube and T-tube exited through laparoscopic portholes. On postoperative day 2 or 3, the drainage tube was removed if the drainage was satisfactory. One month postoperatively, after satisfactory T-tube cholangiography, the T-tube was removed.

In group B, the gallbladder structure was abnormal, and the cyst wall was thickened. The contraction function of the gallbladder was lost.

Operative and postoperative comparison parameters

Comparison parameters for the two groups included operative success rate, operative time and blood loss, postoperative fasting time and complications, total hospitalization time and expenses, and patient satisfaction.

All patients were contacted postoperatively either by telephone or WeChat as well as the scheduled one-month follow-up visit. All 30 patients were successfully followed.

Statistical analysis

The SPSS 20.0 (SPSS Inc., Chicago, IL, USA) software was used to analyze the data. Measurement data were analyzed by the Student's *t*-test, and categorical data were analyzed by the Chi-square test or Fisher's exact test. Statistical significance was defined by $p<0.05$.

RESULTS

General characteristics

The general characteristics of the patients in both groups are shown in Table 1.

Table 1
General characteristics of the two groups.

Characteristics	Group A	Group B	p
Age (years)	60.67±12.06	56.07±16.54	0.391
Female	7	6	
Male	8	9	
Aspartate aminotransferase (U/L)	256.67±342.23	167.27±136.87	0.356
Alanine aminotransferase (U/L)	201.07±214.38	199.07±152.87	0.977
Glutamyl transpeptidase (U/L)	449.73±314.36	456.33±456.85	0.964
Globulin ratio	1.46±0.46	1.44±0.47	0.907
Direct bilirubin (umol/L)	39.85±28.07	33.80±30.94	0.579
Uric acid (umol/L)	275.67±98.13	299.27±91.68	0.502
Creatinine (umol/L)	64.80±14.10	72.80±20.58	0.225

The differences in data between groups were analyzed by the Student's *t*-test.

There were no significant differences with respect to age, aspartate aminotransferase (AST), alanine aminotransferase (ALT), glutamyl transpeptidase (GGT), globulin ratio, direct bilirubin, uric acid, or creatinine.

Postoperative complications

The patients in both groups underwent successful operations. Postoperative complications are detailed in Table 2. In group A, one patient had elevated amylase and hematuria on the day of the operation but recovered to normal with fasting and treatment with somatostatin for two days. In group B, one patient developed bile leakage after removing the drainage tube three days postoperatively. The remaining group B patients were discharged with T-tubes from five to seven days postoperatively.

Outcomes of procedures

The outcome parameters of operative time, blood loss, postoperative times of fasting and hospitalization, and expenses are tabulated in Table 3. Group A patient outcomes were significantly better than Group B with regard to operative time, blood loss, fasting, and hospitalization times ($p<0.01$). The two groups had no significant difference in average hospitalization expenses ($p= 0.745$).

Clinical follow-up

Longer-term follow-up results are shown in Table 4. The time needed to return to work in Group A was significantly shorter than in group B ($p<0.001$). Except for a single patient with incisional discomfort in Group A and one case of upper abdominal discomfort in Group B, no other problems were encountered at the 1-month follow-up. Patient satisfaction rates of group A and B were 93% (14/15) and 80% (12/15), respectively. In group B, three patients noted that the time interval the T-tube remained in place was too long, which greatly impacted their daily life.

DISCUSSION

The development of minimally invasive surgery has provided various options for treating concomitant cholelithiasis and choledocholithiasis. The laparoscopic approach, enhanced with choledochoscopy and duodenoscopy to perform common bile duct exploration and lithotomy, has been recognized as unique minimally invasive biliary surgery technology [8,9]. With the development of multi-disciplinary consultation and joint treatment of diseases, disciplines previously working independently have been united, minimizing iatrogenic injury and improving work efficiency.

Table 2
Postoperative complications in the two groups.

Postoperative complications	Group A	Group B	p
Bile leakage	0	1	1.000
Residual stone	0	0	
Postoperative acute pancreatitis	0	0	

The difference in data between groups was analyzed by the Chi-square test.

Extending these advanced combined technologies, laparoscopy combined with the Seldinger techniques described for stone clearance when cholelithiasis is complicated with choledocholithiasis offers advantages of minimal tissue trauma, quicker recovery, and preservation of sphincter of Oddi's anatomy and function. The present study data would also indicate this technique provides extraordinary patient satisfaction.

With the increasing demand by patients to maximize quality of life, increasing attention has been paid to gallbladder preservation [10,11]. Although the long-term assessment of this approach has yet to be fully reviewed, combining laparoscopic and Seldinger techniques to clear the gallbladder and CBD of stones while preserving the gall bladder in situ and avoiding the need for a T-tube pays attention to the restoration of normal anatomy and function. Moreover, if gallstones recur, the minimal tissue trauma of this operation should pose minimal scarring or other issues if reoperation is needed.

However, this study has limitations. The overall patient numbers were relatively small, and the follow-up was limited to the early postoperative period (one month). Additionally, advanced laparoscopic skills are required, and longer follow-ups with larger patient series are necessary for the validation of the present findings.

As a conclusion, combined laparoscopic and Seldinger techniques to clear stones in patients with concomitant cholelithiasis and choledocholithiasis, with preservation of the gallbladder in situ, has the advantages of minimal tissue trauma, quick recovery, avoidance of a T-tube, high patient satisfaction, and restoration of normal anatomy and function.

Table 3
Outcomes of procedures in the two groups.

Outcomes of procedures	Group A	Group B	p
Blood loss (mL)	9.95±2.45	27.55±7.57	0.000
Operation time (min)	84.20±16.84	105.75±14.80	0.001
Fasting time (h)	24.15±11.21	43.65±11.55	0.000
Hospitalization time (d)	4.27±1.03	10.20±1.52	0.000
Hospitalization expenses (CnY)	16108.93±1366.11	16430.0±3516.5	0.745

The difference in data between groups was analyzed by the Student's *t*-test.

Table 4
The follow-up results in the two groups.

Follow-up results	Group A	Group B	p
Time return to work (d)	3.67±0.82	32.87±1.19	0.000
Number of people with discomfort (n)	1	1	
Satisfaction rate (%)	93.3%(14/15)	80%(12/15)	0.598

The difference in "time return to work" between groups was analyzed by the Student's *t*-test. The difference in "satisfaction rate" between groups was analyzed by the Chi-square test.

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Conflict of interests

All authors declare there are no conflicts of interest.

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Author contributions

SJ and FL analyzed and interpreted the patients' data. SJ, LX, QT, GM and YB performed the surgery. SJ and QT were major contributors to writing the manuscript. All authors read and approved the final manuscript.

Availability of data and materials

The datasets during the current study could be available from the corresponding author upon reasonable request.

REFERENCES

1. **Jiang X, Yang G, Wang K, Bi W, Shang D, Zhang G.** Clinical efficacy analysis of the combination of the laparoscope and preoperative or intraoperative duodenoscope in the treatment of cholecystolithiasis with choledocholithiasis: A retrospective study. J Laparoendosc Adv Surg Tech A 2019; 29(12):1539-1543. *doi: 10.1089/lap.2019.0541.*
2. **Yin P, Wang M, Qin R, Zhang J, Xiao G, Yu H, Ding Z, Yu Y.** Intraoperative endoscopic nasobiliary drainage over primary closure of the common bile duct for choledocholithiasis combined with cholecystolithiasis: a cohort study of 211 cases. Surg Endosc 2017; 31(8):3219-3226. *doi: 10.1007/s00464-016-5348-1.*
3. **Lou SM, Zhang M, Wu ZR, Jiang GX, Shen H, Dai Y, Liang YL, Cao LP, Ding GP.** Combined gastroscopic and choledochoscopic transabdominal nasobiliary drainage. J Zhejiang Univ Sci B 2019; 20(11):940-944. *doi: 10.1631/jzus.B1900060.*
4. **Ricci C, Pagano N, Taffurelli G, Pacilio CA, Migliori M, Bazzoli F, Casadei R, Minni F.** Comparison of efficacy and safety of 4 combinations of laparoscopic and intraoperative techniques for management of gallstone disease with biliary duct calculi: A systematic review and network meta-analysis. JAMA Surg 2018; 153(7):e181167. *doi: 10.1001/jamasurg.2018.1167.*
5. **Sun DP, Wang WC, Wen KC, Lin KY, Lin YF, Wen KS, Uen YH.** Two-port laparoscopic common bile duct exploration with T-tube choledochostomy for management of choledocholithiasis: an initial clinical report. Am Surg 2011; 77(4):422-425. *doi: 10.5606/tgkdc.dergisi.2011.035.*
6. **Choi WK, Kim JK, Yang JB, Ko YB, Nam SL, Lee KH.** Two-port access versus four-port access laparoscopic ovarian cystectomy. Obstet Gynecol Sci 2014; 57(5):379-385. *doi: 10.5468/ogs.2014.57.5.379.*
7. **Sulu B, Allahverdi TD, Altun H, Koksal N.** The comparison of four-port, two-port without suspension suture and single port laparoscopic cholecystectomy results. Adv Clin Exp Med 2016; 25(1):101-109. *doi: 10.17219/acem/26237.*
8. **Zhang Z, Liu Z, Liu L, Song M, Zhang C, Yu H, Wan B, Zhu M, Liu Z, Deng H, Yuan H, Yang H, Wei W, Zhao Y.** Strategies of minimally invasive treatment for intrahepatic and extrahepatic bile duct stones. Front Med 2017; 11(4):576-589. *doi: 10.1007/s11684-017-0536-5.*

9. **Lv F, Zhang S, Ji M, Wang Y, Li P, Han W.** Single-stage management with combined tri-endoscopic approach for concomitant cholecystolithiasis and choledocholithiasis. Surg Endosc 2016; 30(12):5615-5620. *doi: 10.1007/s00464-016-4918-6.*
10. **Qu Q, Chen W, Liu X, Wang W, Hong T, Liu W, He X.** Role of gallbladder-preserving surgery in the treatment of gallstone diseases in young and middle-aged patients in China: results of a 10-year prospective study. Surgery 2020; 167(2):283-289. *doi: 10.1016/j.surg.2019.09.001.*
11. **Carrilho-Ribeiro L, Serra D, Pinto-Correia A, Velosa J, De Moura MC.** Quality of life after cholecystectomy and after successful lithotripsy for gallbladder stones: a matched-pairs comparison. Eur J Gastroenterol Hepatol 2002; 14(7):741-744. *doi: 10.1097/00042737-200207000-00005.*