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How-I-Do-It

Usefulness of intraoperative choledochoscopy in laparoscopic subtotal cholecystectomy for severe cholecystitis

Rui-Hui Zhang*, Xiang-Nan Wang*, Yue-Feng Ma, Xue-Qian Tang, Mei-Ju Lin, Li-Jun Shi, Jing-Yi Li, Hong-Wei Zhang

Department of Biliary Minimally Invasive Surgery, Affiliated Zhongshan Hospital of Dalian University, Dalian, China

Laparoscopic subtotal cholecystectomy (LSC) has been a safe and viable alternative to conversion to laparotomy in cases of severe cholecystitis. The objective of this study is to determine the utility of intraoperative choledochoscopy in LSC for the exploration of the gallbladder, cyst duct, and subsequent stone clearance of the cystic duct in cases of severe cholecystitis. A total of 72 patients diagnosed with severe cholecystitis received choledochoscopy-assisted laparoscopic subtotal cholecystectomy (CALSC). A choledochoscopy was performed to explore the gallbladder cavity and/or cystic duct, and to extract stones using a range of techniques. The clinical records, including the operative records and outcomes, were subjected to analysis. No LSC was converted to open surgery, and no bile duct or vascular injuries were sustained. All stones within the cystic duct were removed by a combination of techniques, including high-frequency needle knife electrotomy, basket, and electrohydraulic lithotripsy. A follow-up examination revealed the absence of residual bile duct stones, with the exception of one common bile duct stone, which was extracted via endoscopic retrograde cholangiopancreatography. In certain special cases, CALSC may prove to be an efficacious treatment for the management of severe cholecystitis. This technique allows for optimal comprehension of the situation within the gallbladder cavity and cystic duct, facilitating the removal of stones from the cystic duct and reducing the residue of the non-functional gallbladder remnant.

Key Words: Laparoscopic cholecystectomy; Gallstones; Biliary tract diseases

INTRODUCTION

With improvements in laparoscopic equipment and technology, severe cholecystitis is no longer a taboo for laparoscopic surgery. Nevertheless, in instances of severe inflammation or fibrosis in the gallbladder triangle accompanied by dense adhesion with surrounding tissues, the execution of a standard laparoscopic cholecystectomy (LC) is more challenging and carries a higher risk. The likelihood of complications, including bleeding, bile duct injury, and conversion to laparotomy, is significantly elevated in such cases [1,2]. So, laparoscopic subtotal cholecystectomy (LSC), which circumvents the risky dissection at Calot's triangle, has been proposed as a secure and viable alternative to conversion to open surgery in cases of severe cholecystitis or liver cirrhosis [3-9]. However, inadequate visualization of the anatomy may result in incomplete gallbladder removal, leaving behind a dysfunctional remnant [10,11]. Furthermore, the procedure may also be associated with an increased risk of residual stones in the remnant cystic duct [7,12,13]. Therefore, the strategy to minimize the gallbladder remnant and residual stones in the cystic duct in LSC remains to be elucidated.

In this context, choledochoscopy appears to be an efficacious treatment modality, as it facilitates direct visualization of Hartmann's pouch and the orifice of the cystic duct through the inner lumen of the gallbladder, and active extraction of the stone with the assistance of electrohydraulic lithotripsy and a basket. Nevertheless, the successful application of choledochoscopy in

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Corresponding author: Yue-Feng Ma, MD
Department of Biliary Minimally Invasive Surgery, Affiliated Zhongshan Hospital of Dalian University, Dalian 116001, China
Tel: +86-0411-62893617, Fax: +86-0411-62893617, E-mail: myf1992@163.com
ORCID: https://orcid.org/0009-0003-6669-4770

*These authors contributed equally to this study.

LSC for severe cholecystitis has only been scarcely documented thus far. With regard to cyst duct stones, some scholars have postulated that the option of endoscopic exploration and mechanical lithotripsy was impractical and unsafe, primarily due to the challenging accessibility of the cystic duct via the gallbladder remnant and the elevated risk of basket entrapment [14].

The recent enhancements to choledochoscopic instruments and the growing expertise in choledochoscopic treatment of challenging biliary stones have paved the way for the utilization of choledochoscopy as a means of addressing the aforementioned challenges in LSC. In this study, we conducted a systematic review of our experiences with the application of choledochoscopy-assisted laparoscopic subtotal cholecystectomy (CALSC) for severe cholecystitis. The objective was to evaluate the safety and effectiveness of this approach.

PATIENTS AND METHODS

Patients

From January 2014 to January 2022, 72 patients with severe cholecystitis underwent CALSC at the Department of Biliary Minimally Invasive Surgery at Affiliated Zhongshan Hospital of Dalian University. In this series, the rationale for LC is that dense inflammation or fibrosis impairs the safe dissection of the gallbladder triangle. The indications for choledochoscopy included the following: (1) distinguishing the dilated cystic duct from the gallbladder neck was challenging; (2) impacted stones in the cystic duct, which could not be cleared by conventional laparoscopic devices; (3) preoperative imaging data indicating stones or suspicious stones in the cystic duct, while no stones were observed in the cystic duct orifice under laparoscopy; and (4) no bile outflow from the orifice of the remnant cystic duct.

A retrospective review was conducted of the clinical factors, operative records, and clinical outcomes of the 72 patients included in this study. Prior to undergoing surgery, all patients were asked to provide written, informed consent. Furthermore, the surgical procedure was approved by the institutional ethical committees at the Affiliated Zhongshan Hospital of Dalian University.

Endoscopic equipment and accessories

The following equipment and accessories were employed during the endoscopic procedure: CYF-AV2 electron choledochoscope, CHF-XP20 fiber cholangioscopy (Olympus), VIO-200s high frequency generator (mixed currents, cut current of 40-W, coagulation current of 40-W) (ERBE), DLZ-2 plasma shock wave lithotripter (Edragon), needle knife (Endo-Flex), extraction basket (COOK), and self-made pyramid-type adsorber.

Surgical technique

Laparoscopic procedure

The conventional 4-port method, utilizing two 5-mm ports and two 12-mm ports, was employed. In the event of significant difficulties being encountered in the dissection of the gallbladder neck and Calot's triangle, the surgical procedure was converted to LSC. The peritoneal surface of the gallbladder wall was excised from fundus to the Hartmann's pouch, with the exception of the area of the hepatocytic triangle and common bile duct, which were left untouched. The contents of the gallbladder, comprising stones and debris, were evacuated. The cystic duct orifice was confirmed from the view of the inner lumen and closed by using 3/0 barbed suture from the internal aspect of the gallbladder. To prevent relapse of cholecystolithiasis, the remnant gallbladder mucosal surface was cauterized with the electric scalpel. The operative field was washed copiously, and one 18- or 20-Fr silicone was routinely placed in the subhepatic space for postoperative monitoring.

In accordance with the aforementioned indications for choledochoscopy, a therapeutic choledochoscopy was subsequently performed.

Therapeutic choledochoscope

Choledochoscopy

A choledochoscope was introduced into the gallbladder orifice via the 12-mm port in the upper abdomen to visualize the inner lumen morphology of the gallbladder and the cyst duct (Fig. 1). A pyramid-type adsorber was attached to the end of the choledochoscope, which might facilitate navigation through the narrow portion of the gallbladder and the Heister fold of the cyst duct (Fig. 2). The choledochoscope with forceps

Fig. 1. A choledochoscope was introduced into the gallbladder orifice via the 12-mm port in the upper abdomen to visualize the inner lumen morphology of the gallbladder and the cyst duct.

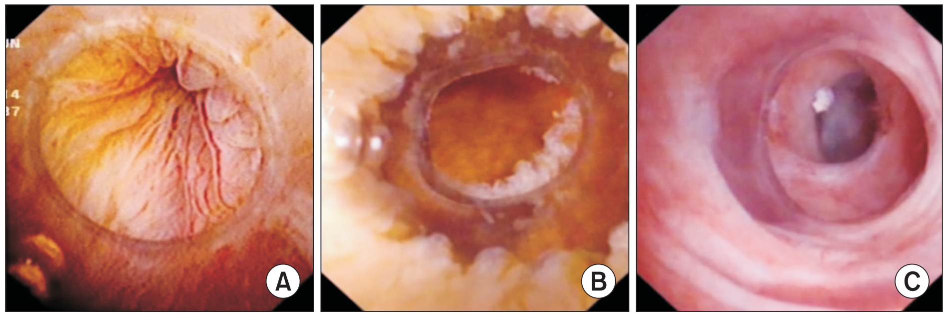

Fig. 2. A pyramid-type adsorber was attached to the end of the choledochoscope, which might facilitate navigation through the narrow portion of the gallbladder and the Heister fold of the cyst duct: (A) a narrow ring was observed in the gallbladder cavity, which was morphologically similar to the cystic duct orifice. (B) With the aid of the conical absorber, the gallbladder cavity located beneath the narrow ring was observed through choledochoscopy. (C) With the aid of conical adsorber, choledochoscopy allows for the observation of the condition of the cystic duct in a systematic manner through the Heister fold.

was also employed to provide additional support. In the case of a narrow cystic duct, an ultra-fine choledochoscopy with a pyramid-type adsorber was employed to facilitate comprehensive exploration of the distal end of the cystic duct. The choledochoscope enables observation of the gallbladder cavity, differentiation of the narrow ring in the gallbladder cavity (particularly in cases of adenomyomatosis) from the cystic duct orifice, and identification of stones within the cyst duct (Fig. 2). Throughout the procedure, low-pressure irrigation must be conducted with caution to prevent displacement of the stone into the common bile duct.

Choledochoscopic high-frequency needle knife electrotomy

The stones embedded in the bile duct are often tightly covered with a spiral flap, which presents a challenge for the removal with conventional laparoscopic instruments (Supplementary Video 1). The use of a choledochoscopic high-frequency needle knife electrotomy (CHFNKE) could be considered as an alternative approach, as previously described. Firstly, the end of the choledochoscope was secured, and the spiral fold of the cyst duct, which was in contact with the stone, was focused on the center of the visual field. Subsequently, a high-frequency needle knife was introduced into the cyst duct via the working channel of the choledochoscope until the needle knife tip was positioned centrally within the visual field. Typically, the needle knife was situated at a distance of 2 to 3 mm from the choledochoscope's working channel opening. Subsequently, the primary power source was activated, and the choledochoscope head was gradually retracted to the base of the spiral fold. The spiral fold was excised in a gradual manner until the root was reached, with direct visualization facilitated by the use of a blend current (Fig. 3). In the event that the cyst duct tissue exhibited indications of hemorrhage, electrocoagulation would be undertaken to forestall further bleeding.

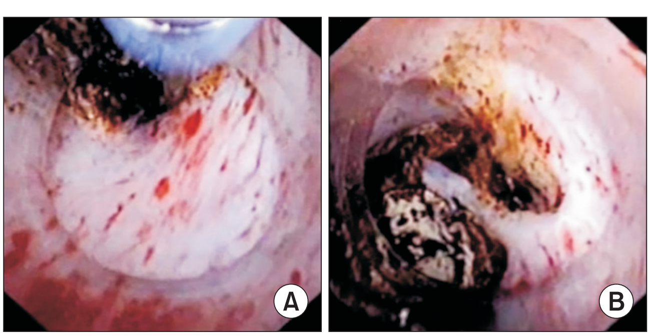

Fig. 3. The spiral fold was excised in a gradual manner until the root was reached, with direct visualization facilitated by the use of a blend current: (A) the presence of impacted stones within the cyst duct was identified through the use of a choledochoscope. (B) The spiral fold was cut by using a high-frequency needle knife.

Removal of cyst duct stones under choledochoscope

Once the stricture had been resolved, an extraction basket was inserted into the cyst duct to remove the stones. The smaller stones were extracted via the adsorber at the distal end of the choledochoscope, while the larger stones were fragmented using a plasma shock wave lithotripter (Fig. 4). Subsequent choledochoscopic operations were conducted until residual

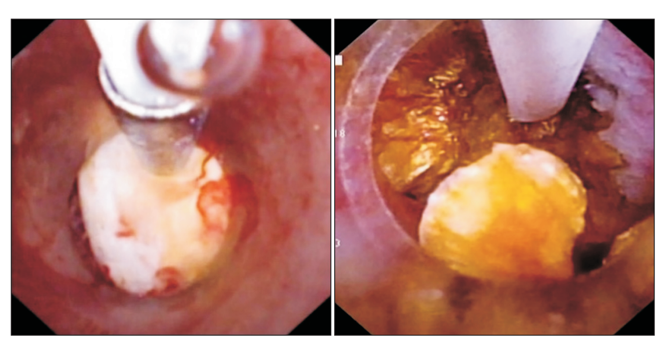

Fig. 4. The larger stones were fragmented using a plasma shock wave lithotripter.

Fig. 5. Residual stones were no longer visible and bile flow from the distal cyst duct was observed under choledochoscopy.

stones were no longer visible and bile flow from the distal cyst duct was observed under choledochoscopy (Fig. 5).

Follow-up

All patients were provided with the same postoperative care by the same surgical team. Postoperative liver function was assessed via ultrasound every three to six months, with subsequent assessments conducted annually or whenever symptoms suggestive of cholangitis were observed. In cases where ultrasound imaging indicated the presence of recurrent stones or ductal strictures, magnetic resonance cholangiopancreatography (MRCP) and computed tomography (CT) were conducted.

Table 1. Surgical outcomes of the CALSC patients (n = 72)

Outcome	Number
Median operative time (min)	158 (110–234)
Median blood loss (mL)	44.6 (5–55)
Median postoperative hospital stay (day)	6.2 (3–12)
Conversion to laparotomy	0 (0)
Incidental gallbladder carcinoma	0 (0)
Postoperative mortality	0 (0)
Postoperative complication	
Bile leakage	2
Cholangitis	4
Subhepatic collection	2
Port-site infection	3

Values are presented as median (range), number (%), or number only.

RESULTS

Patient characteristics

The mean age of the 72 patients (23 males, 49 females) was 56.3 years (range 22–72 years). The ultrasonography and CT scans revealed cholecystitis in all 72 patients (100%), while MRCP was conducted in 67 patients. These imaging studies demonstrated the presence of stones or suspicious stones in the cystic duct in 56 patients (77.8%), and Mirizzi syndrome was diagnosed in four of these 72 patients. Percutaneous transhepatic gallbladder drainage was performed in 10 patients (13.9%), while endoscopic retrograde cholangiopancreatography (ERCP) was required for therapeutic purposes in 4 patients (5.6%) when bile duct diseases were suspected.

Surgical outcomes

The results of 72 cases of CALSC are presented in Table 1 for analysis. The mean operative time was 158 minutes, with a mean blood loss of 44.6 mL. No LSC was converted to open surgery, and no bile duct or vascular injuries were sustained. Closure of the stump was performed in 71 cases, with the exception of one instance where the stump was left open due to severe inflammation.

A choledochoscopy was conducted in all cases, comprising 61 instances of cystic duct exploration, 5 instances of gallbladder cavity exploration, and 6 instances of gallbladder cavity exploration plus cystic duct exploration. Exploration of the gallbladder cavity was undertaken due to the inability of laparoscopy to accurately assess the connection between Hartmann's pouch and the cystic duct. Of the 11 cases of gallbladder exploration, seven were found to have a narrow ring, while the orifice of the cystic duct was successfully identified in all cases. The primary indications for cystic duct exploration were the absence of bile outflow in the cystic duct (11 cases) and the identification of a suspicious stone in the cystic duct based on preoperative imaging (56 cases). Table 2 presents the choledochoscopic outcomes of the cystic duct exploration. In 67 cases of cystic duct exploration, 58 cases of cystic duct stones were identified (45 cases of

Table 2. Choledochoscopic outcomes of the cystic duct exploration (n = 67)

Outcome	Number
Choledochoscopy	
Cyst duct stone	58
Inflammatory occlusion	5
No positive findings	4
Treatment methods	
Basket extraction	8
Shock wave lithotripter + Basket extraction	13
CHFNKE + shock wave lithotripter + Basket extraction	37

CHFNKE, choledochoscopic high-frequency needle knife electrotomy.

stones were initially identified under laparoscope but could not be removed by conventional laparoscopic instruments). A total of 13 cases of stones were identified via choledochoscopy, 5 cases of inflammatory occlusion of the cystic duct were observed, and 4 cases demonstrated no positive findings due to lumen stenosis. In 8 cases, the stone basket was employed for removal, while in 13 cases, a combination of plasma lithotripsy and stone basket removal was utilized. In 37 cases, the approach involved the use of CHFNKE in conjunction with plasma lithotripsy and stone basket removal. No instances of bleeding or perforation were observed. Following the removal of stones from the cystic duct, bile was observed to flow from this duct in 58 patients, including four cases where bile was observed to flow from the cystic duct orifice prior to stone removal.

The median postoperative hospitalization period was 6.2 days. Postoperative complications related to the surgical procedure were observed in 11 patients (15.3%), including bile leakage in two cases, cholangitis in four cases, subhepatic abscess in two cases, and port-site infection in three cases. All complications were successfully resolved without the necessity for reoperation. Percutaneous intervention was performed for two subhepatic abscesses. Four cases of cholangitis were successfully treated with anti-inflammatory conservative therapy. This series did not result in any mortalities. During the follow-up period, which had a mean duration of 82.6 months (ranging from 32 to 128 months), only one patient (1.4%) experienced fever and epigastric pain due to a common bile duct stone two months after LSC. This patient underwent endoscopic sphincterotomy and stone extraction. The remaining patients did not present any symptoms or complications.

DISCUSSION

The prevalence of LSC in large series of cases has been reported to range from 0.4% to 3.7%. Approximately 10% to 23% of individuals who undergo surgery for this condition subsequently develop symptoms and seek medical advice [15-19]. The primary causes of long-term symptoms and post-intervention complications are the retention of a portion of the diseased gallbladder stump and the presence of the stone itself [10,19]. Despite the plethora of literature on various techniques for LSC, there is a paucity of detailed guidance on the removal of stones embedded in the cystic duct [20-22]. In light of the potential for residual stones to remain following LSC, many scholars advocate that the safety of the procedure should be the primary consideration prior to the thorough removal of gallstones in cases of severe cholecystitis [9,23]. Consequently, the incidence of retained stones following LSC (3.0%) was higher than that following LC (0.3%) [24]. The treatment of cystic duct remnant calculi following an operation is challenging. The use of ERCP or extracorporeal shock wave lithotripsy does not ensure the complete removal of the stones, and the risk and complexity of reoperation increase [14,19]. Furthermore, it is postulated that the diagnosis of residual small stones in the cystic duct following surgery is erroneous, which may contribute to an increased incidence of post-cholecystectomy syndrome [5,13,19]. Laparoscopic ultrasound or intraoperative cholangiography through the intraluminal orifice of the cystic duct may prove useful for the recognition of the anatomy of the bile duct and cystic duct during surgery [5,24,25]. However, it should be noted that these imaging methods have no therapeutic effect on gallstones in the cystic duct.

Choledochoscopy is a valuable tool in the diagnosis and treatment of hepatobiliary system diseases, enabling direct visualization of the biliary tract and active extraction of the stone with the assistance of a basket and electrohydraulic lithotripsy. Nevertheless, there has been a paucity of reports on the utilization of choledochoscopy in LSC for severe cholecystitis. This study represents the inaugural attempt to assess the feasibility and safety of choledochoscopy in LSC for severe cholecystitis. Our technique of CALSC was informed by the experiences of laparoscopic common bile duct exploration for the treatment of common bile duct stones and open intrahepatic bile duct exploration [26,27]. One advantage of the CALSC is the ability to conduct a more thorough examination of the gallbladder cavity through the inner lumen. This allows for precise assessment of the position of the Hartmann's pouch of the gallbladder and the cyst duct orifice, particularly in cases where significant adhesion is present. Additionally, the tumor of the gallbladder can be identified, although no malignant tumor of the gallbladder was observed in our study group.

A further advantage of CALSC is that it can effectively examine the condition of the neck of the gallbladder. With the aid of appropriate equipment and surgical expertise, the stone in the cystic duct can be removed with optimal clarity. The transparent conical cap positioned in front of the choledochoscope is capable of straightening the curved cystic duct. By means of rotation, the choledochoscope can be passed through the spiral flap in a sequential manner, thereby facilitating observation of the distal end of the gallbladder neck to the greatest possible depth. In certain cases, observation of the common bile duct is also possible. In the present series, 67 cases underwent choledochoscope examination of the cystic duct. Of these, 86.6% (58/67) were found to have stones in the bile duct, while only 77.6% of cases (45/58) were confirmed in the initial laparoscopy. The prevalence of gallstones in the neck of the gallbladder may contribute to the formation of dense adhesions in the gallbladder triangle. This may also explain why the residual stone rate following LSC is higher than that observed following LC, as documented in the literature. In numerous articles pertaining to LSC, the underlying cause of a dry cystic duct stump is attributed to inflammatory obliteration [13,28]. However, in our cohort, only five cases of cholangitis stenosis were identified. In the remaining cases of dry cystic duct stump (with the exception of four cases where no positive finding was made due to narrow cavity), stones were identified in the deep part of the gallbladder neck canal. Upon removal of the stone, yellow bile was observed to flow from the cystic duct stump. Consequently, we propose that the dry cystic duct stump represents a suitable indication for choledochoscope exploration of the gallbladder neck.

The removal of stones from the narrow gallbladder neck tube represents a technically challenging procedure, which is undertaken as part of the CALSC operation. A stone located within the depth of the gallbladder was invariably encased in a spiral flap. The CHFNKE technique could be employed to cut the spiral valve, dislodge the stone, and facilitate subsequent stone extraction. The large stone could be pulverized using plasma lithotripsy. All of the aforementioned procedures were conducted within the lumen of the gallbladder, with minimal dissection around the neck of the gallbladder and careful avoidance of damage to surrounding tissues. In this series, multiple techniques were employed until no residual stones were visible. In the postoperative follow-up period (ranging from 32 to 128 months), no residual cyst duct stones were identified, and no significant cholecystectomy syndrome was observed.

It is important to note that our technique has several potential drawbacks that require further investigation and potential modification. Firstly, it is not possible to guarantee that choledochoscopy will provide a comprehensive understanding of the situation in the neck of the gallbladder. This is particularly the case in instances where the lumen is narrow, and the cystic duct is tortuous. In this group, four cases were identified as having negative findings due to the reasons. One case of choledocholithiasis was identified during the postoperative follow-up. Secondly, incorrect performance of this procedure may result in the migration of smaller stones into the common bile duct. In our series, four patients developed cholangitis following surgery. It is postulated that intraoperative choledochoscopy may result in the promotion of small stone debris into the common bile duct. However, the postoperative treatment of choledocholithiasis is more efficacious than the treatment of residual stones in the cystic duct. Thirdly, CALSC is a more time-consuming procedure than traditional LSC and is therefore not suitable for critically ill patients. Furthermore, the sample size of this study was relatively limited, and thus, further studies with larger cohorts are necessary to confirm the effectiveness and clinical relevance of CALSC.

In conclusion, the findings of this study indicate that CALSC may represent a viable treatment option for the management of severe cholecystitis in certain specific circumstances. This technique allows for optimal comprehension of the intra-gallbladder and cystic duct environments. It can remove the stones from the neck of the gallbladder to the greatest extent possible, while simultaneously reducing the quantity of residual matter from a non-functional gallbladder remnant.

SUPPLEMENTARY DATA

Supplementary data related to this article can be found at https://doi.org/10.14701/ahbps.25-010.

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CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

ORCID

Rui-Hui Zhang, https://orcid.org/0009-0001-6269-5800
Xiang-Nan Wang, https://orcid.org/0000-0001-9999-8920
Yue-Feng Ma, https://orcid.org/0009-0003-6669-4770
Xue-Qian Tang, https://orcid.org/0009-0005-3269-4304
Mei-Ju Lin, https://orcid.org/0000-0002-1227-3714
Li-Jun Shi, https://orcid.org/0000-0002-5231-0364
Jing-Yi Li, https://orcid.org/0000-0003-4830-5180
Hong-Wei Zhang, https://orcid.org/0000-0003-0642-216X

AUTHOR CONTRIBUTIONS

Conceptualization: YFM. Data curation: XQT, MJL, LJS, JYL, HWZ. Methodology: YFM, RHZ, XNW. Visualization: RHZ, XNW. Writing - original draft: RHZ, XNW. Writing - review & editing: YFM, RHZ, XNW.

REFERENCES

1. Davidoff AM, Pappas TN, Murray EA, Hilleren DJ, Johnson RD, Baker ME, et al. Mechanisms of major biliary injury during laparoscopic cholecystectomy. Ann Surg 1992;215:196-202.
2. Mercado MA, Chan C, Orozco H, Tielve M, Hinojosa CA. Acute bile duct injury. The need for a high repair. Surg Endosc 2003;17:1351-1355.
3. Henneman D, da Costa DW, Vrouenraets BC, van Wagensveld BA, Lagarde SM. Laparoscopic partial cholecystectomy for the difficult gallbladder: a systematic review. Surg Endosc 2013;27:351-358.
4. Ji W, Li LT, Li JS. Role of laparoscopic subtotal cholecystectomy in the treatment of complicated cholecystitis. Hepatobiliary Pancreat Dis Int 2006;5:584-589.
5. Kuwabara J, Watanabe Y, Kameoka K, Horiuchi A, Sato K, Yukumi S, et al. Usefulness of laparoscopic subtotal cholecystectomy with operative cholangiography for severe cholecystitis. Surg Today 2014;44:462-465.
6. Michalowski K, Bornman PC, Krige JE, Gallagher PJ, Terblanche J. Laparoscopic subtotal cholecystectomy in patients with complicated acute cholecystitis or fibrosis. Br J Surg 1998;85:904-906.

7. Chowbey P, Sharma A, Goswami A, Afaque Y, Najma K, Baijal M, et al. Residual gallbladder stones after cholecystectomy: a literature review. J Minim Access Surg 2015;11:223-230.
8. Shingu Y, Komatsu S, Norimizu S, Taguchi Y, Sakamoto E. Laparoscopic subtotal cholecystectomy for severe cholecystitis. Surg Endosc 2016;30:526-531.
9. Haldeniya K, R KS, Raghavendra A, Singh PK. Laparoscopic subtotal cholecystectomy in difficult gallbladder: our experience in a tertiary care center. Ann Hepatobiliary Pancreat Surg 2024;28:214-219.
10. Gupta V, Sharma AK, Kumar P, Gupta M, Gulati A, Sinha SK, et al. Residual gall bladder: an emerging disease after safe cholecystectomy. Ann Hepatobiliary Pancreat Surg 2019;23:353-358.
11. Singh A, Kapoor A, Singh RK, Prakash A, Behari A, Kumar A, et al. Management of residual gall bladder: a 15-year experience from a north Indian tertiary care centre. Ann Hepatobiliary Pancreat Surg 2018;22:36-41.
12. Pernice LM, Andreoli F. Laparoscopic treatment of stone recurrence in a gallbladder remnant: report of an additional case and literature review. J Gastrointest Surg 2009;13:2084-2091.
13. Supit C, Supit T, Mazni Y, Basir I. The outcome of laparoscopic subtotal cholecystectomy in difficult cases - a case series. Int J Surg Case Rep 2017;41:311-314.
14. Quoraishi S, Ahmed J, Ponsford A, Rasheed A. Lessons learnt from a case of extracorporeal shockwave lithotripsy for a residual gallbladder stone. Int J Surg Case Rep 2017;32:43-46.
15. Kim Y, Wima K, Jung AD, Martin GE, Dhar VK, Shah SA. Laparoscopic subtotal cholecystectomy compared to total cholecystectomy: a matched national analysis. J Surg Res 2017;218:316-321.
16. Shin M, Choi N, Yoo Y, Kim Y, Kim S, Mun S. Clinical outcomes of subtotal cholecystectomy performed for difficult cholecystectomy. Ann Surg Treat Res 2016;91:226-232.
17. Jara G, Rosciano J, Barrios W, Vegas L, Rodríguez O, Sánchez R, et al. Laparoscopic subtotal cholecystectomy: a surgical alternative to reduce complications in complex cases. Cir Esp 2017;95:465-470.
18. van Dijk AH, Donkervoort SC, Lameris W, de Vries E, Eijsbouts QAJ, Vrouenraets BC, et al. Short- and long-term outcomes after a reconstituting and fenestrating subtotal cholecystectomy. J Am Coll Surg 2017;225:371-379.
19. Slater M, Midya S, Booth M. Re-interventions and re-admissions in a 13-year series following use of laparoscopic subtotal cholecystectomy. J Minim Access Surg 2021;17:28-31.
20. Hubert C, Annet L, van Beers BE, Gigot JF. The “inside approach of the gallbladder” is an alternative to the classic Calot’s triangle dissection for a safe operation in severe cholecystitis. Surg Endosc 2010;24:2626-2632.
21. Segal MS, Huynh RH, Wright GO. case report: modified laparoscopic subtotal cholecystectomy: an alternative approach to the "difficult gallbladder". Am J Case Rep 2017;18:186-189.
22. Matsumura T, Komatsu S, Komaya K, Ando K, Arikawa T, Ishiguro S, et al Closure of the cystic duct orifice in laparoscopic subtotal cholecystectomy for severe cholecystitis. Asian J Endosc Surg 2018;11:206-211.
23. Hashimoto M, Matsuda M, Watanabe G. Intraoperative ultrasonography for reducing bile duct injury during laparoscopic cholecystectomy. Hepatogastroenterology 2010;57:706-709.
24. Elshaer M, Gravante G, Thomas K, Sorge R, Al-Hamali S, Ebdewi H. Subtotal cholecystectomy for "difficult gallbladders": systematic review and meta-analysis. JAMA Surg 2015;150:159-68.
25. Navaratne L, Al-Musawi J, Mérida AA, Vilaça J, Isla AM. Trans-infundibular choledochoscopy: a method for accessing the common bile duct in complex cases. Langenbecks Arch Surg 2018;403:777-783.
26. Yang YL, Zhang C, Wu P, Ma YF, Li JY, Zhang HW, et al. Choledochoscopic high-frequency needle-knife electrotomy for treatment of anastomotic strictures after Roux-en-Y hepaticojejunostomy. BMC Gastroenterol 2016;16:54.
27. Yang YL, Zhang C, Zhao G, Wu P, Ma YF, Zhang HW, et al. Choledochoscopic high-frequency needle-knife electrotomy as an effective treatment for intrahepatic biliary strictures. J Gastroenterol Hepatol 2015;30:1438-1443.
28. Santos BF, Brunt LM, Pucci MJ. The difficult gallbladder: a safe approach to a dangerous problem. J Laparoendosc Adv Surg Tech A 2017;27:571-578.