Cohort Study

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Subtotal cholecystectomy for difficult gall bladder due to chronic cholecystitis: a retrospective cohort study

Bishnu Prasad Kandel, MBBS, MS, MCh[a,*], Prajjwol Luitel, MBBS[b], Nishnata Koirala, MBBS, MS, MCh[a], Deepak Sharma, MBBS, MS, MCh[a], Narendra Maharjan, MBBS, MS, MCh[a], Sumita Pradhan, MBBS, MS, MCh[a], Ramesh Singh Bhandari, MBBS, MS, MCh[a], Paleswan Joshi Lakhey, MBBS, MS, MCh[a]

Background: Subtotal cholecystectomy (STC) is a valuable technique when severe inflammation, fibrosis, or anatomical variations obscure the critical view of safety essential for identifying the cystic duct and artery. It helps reduce the risk of bile duct injuries and other complications that arise during a total cholecystectomy (TC) when these structures are not visible.
Aim: This study was conducted to review our single-center experience with STC for chronic cholecystitis.
Methods: A single-center, retrospective cohort study was conducted on 1149 patients who underwent cholecystectomy between May 2021 and November 2024. Demographics, clinical characteristics, and postoperative outcomes (median follow-up 22 months) of STC were compared with TC.
Results: Of the 1149 cholecystectomies, 38 (3.3%) were STCs (36 reconstituting and 2 fenestrating types). Of these STCs, 29 (76.3%) were performed laparoscopically. History of cholecystitis (47.4% vs 1.9%, $P = 0.001$), choledocholithiasis (21.1% vs 2.9%, $P = 0.001$), and biliary pancreatitis (28.9% vs 1.8%, $P = 0.001$) were significantly higher in patients undergoing STC than in those undergoing TC. There was no bile duct injury in either group. On a median follow-up of 22 months, no recurrent stone formation was noted in the remnant gallbladder in the STC group. There was no BDI or mortality in either group.
Conclusion: STC is a safe bailout procedure in a difficult laparoscopic cholecystectomy, especially in those with a history of cholecystitis, choledocholithiasis, and biliary pancreatitis.

Keywords: bile duct injury, bile leak, cholecystitis, laparoscopic cholecystectomy, subtotal cholecystectomy

Introduction

Cholelithiasis is one of the most common surgical conditions worldwide, with a prevalence of 6.1%[1]. Laparoscopic cholecystectomy (LC) is the gold standard for cholelithiasis, and the most feared complication is bile duct injury (BDI)[2]. The critical view of safety (CVS) has been defined to prevent BDI[3,4]. The term "difficult cholecystectomy" or "difficult gall bladder (GB)" does not have a universal definition. Still, a case is considered difficult if surgery time is prolonged, more blood loss, and a "bailout" procedure is required[5]. It is usually caused by inflammation or anatomical variations around the hepatic hilum and hepatocystic triangle. Resection of part of the GB without dissection in the hepatocystic triangle has been practiced for a long time and is called a partial cholecystectomy or subtotal cholecystectomy (STC)[6].

Different techniques and classifications of STC have been defined since its introduction in 1947[7]. Palanivelu *et al* classified STC into three types: Type 1, where the posterior wall of the gallbladder is left intact; Type 2, where the infundibulum stump of GB is left and closed with suture; and Type 3, where both the posterior wall and the infundibulum are left[8]. Henneman *et al* classified STC into four types where type A is the resection of only the anterior wall of GB leaving behind the posterior wall

HIGHLIGHTS

- Subtotal cholecystectomy (STC) was safely performed in 3.3% of elective cholecystectomies, with no bile duct injuries.
- STC can be an important bailout procedure when dissection in the hepatocystic triangle is difficult due to chronic inflammation.
- On a median 22-month follow-up, no stone formation was noted in the remnant gallbladder, and most bile leaks resolved without major intervention.

[a]Department of Surgical Gastroenterology, Institute of Medicine, Tribhuvan University Teaching Hospital, Kathmandu, Nepal and [b]Maharajgunj Medical Campus, Institute of Medicine, Tribhuvan University, Kathmandu, Nepal

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*Corresponding author. Address: Department of Surgical Gastroenterology, Tribhuvan University Institute of Medicine, Maharajgunj, Kathmandu 44600, Nepal. Tel.:+977-9851164240. E-mail: drkandel@hotmail.com (B.P. Kandel).

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and open GB stump, type B is similar to A but the GB stump is closed, type C is the resection of anterior and posterior wall of the GB with its stump closed, and type D is similar to C but the GB stump is left open[9]. Strasberg *et al* classified STC into reconstituting type, where most of the GB is removed, leaving behind the neck and infundibulum, and with sutures to create a new small GB, and fenestrating type, where the infundibulum is left open but the cystic duct may be closed with a suture inside the lumen[10]. Fenestrating STC is associated with more bile leaks, whereas reconstituting STC is associated with more stone formation in the remaining GB[11].

Prior studies have shown that while STC may reduce the risk of BDI, it is associated with increased rates of bile leak, longer hospital stay, and, in reconstituting types, possible long-term risks such as stone formation in the gallbladder remnant. Reported rates of STC vary from 4% to 9.38% of cholecystectomies, with most data coming from centers in high-income countries[12]. However, this study aims to review our experience with STC in resource-limited settings for chronic cholecystitis and compare patient characteristics, safety, and complications with standard cholecystectomy. The study was conducted following the ethical principles outlined in the Declaration of Helsinki 2013 and has been reported in line with the STROCSS 2025 guidelines[13]. A completed STROCSS 2025 checklist has been submitted as the Supplemental Digital Content File, available at: http://links.lww.com/MS9/B18.

Materials and methods

Study design

This was a retrospective cohort study of patients admitted from May 2021 to November 2024.

Inclusion and exclusion criteria

All patients with cholelithiasis and GB polyps planned for LC were included in the study. Although elective cholecystectomies were only included in this study, several patients had a prior history of biliary pancreatitis or choledocholithiasis. All such patients were operated on after clinical resolution of the acute condition and had completed appropriate medical or endoscopic management (e.g., endoscopic retrograde cholangioPancreatogrphy (ERCP) for common bile duct stones). In some cases, surgery was delayed due to resource constraints or waitlist backlog, resulting in these patients being treated electively following an acute presentation.

Patients who underwent STC were compared with patients who underwent a standard cholecystectomy (total cholecystectomy). Patients who had undergone cholecystectomy in other centers, underwent management of complications in other centers after LC performed in our center, and had missing information on follow-up were excluded. Similarly, patients who underwent other procedures along with cholecystectomy, like bile duct exploration, bile duct excision for choledochal cyst, and GB malignancy, were excluded.

A standardized perioperative protocol was followed for all patients. Indications for elective cholecystectomy included symptomatic cholelithiasis, GB polyps >10 mm, and history of cholecystitis, biliary pancreatitis, or choledocholithiasis. Patients with recent cholecystitis or pancreatitis underwent surgery at least 6 weeks after resolution, while those with choledocholithiasis had ERCP and stone clearance before surgery. All procedures were performed by certified gastrointestinal and hepatobiliary surgeons with more than 5 years of post-specialization surgical experience. The surgeons performing STC had prior exposure to advanced laparoscopic techniques and were involved in the standardization of the STC approach within our unit. LC was performed using the conventional four-port technique with attempts to achieve the CVS. STC was performed when there were dense adhesions or inflammation in the hepatocystic triangle, and two surgeons agreed that further dissection in attempts to achieve CVS is not safe. In reconstituting STC, the infundibular stump was closed intracorporeally using absorbable sutures. A tube drain was placed in all STC patients. Details of the operative technique are provided in Supplemental Digital Content File S1, available at: http://links.lww.com/MS9/B17.

Data collection

Medical records involving patients who underwent elective LC from May 2021 to November 2024 were reviewed for patients' age, gender, symptoms, history of cholecystitis, biliary pancreatitis, choledocholithiasis, ERCP performed, intraoperative complications, need for conversions, and need for STC. Post-operative outcomes were recorded, including duration of hospital stay, admission to the intensive care unit, complications, and need for readmission. Follow-up records or telephone calls were used to obtain information on the recurrence of symptoms for patients who underwent STC. The information obtained during follow-up was history, examination, and ultrasonography abdomen. Postoperative complications occurring within 30 days of surgery were graded according to Clavien–Dindo's grading and the Comprehensive Complication Index (CCI).

Outcome

The primary objective was to compare the history of cholecystitis, choledocholithiasis, and pancreatitis STC and TC. Secondary objectives were to compare the BDI and length of stay between the groups.

Statistical analysis

The Statistical Package for Social Sciences (SPSS) version 26 was used for data analysis. Categorical data were presented as percentages, and continuous data as mean and median. Due to the non-randomized nature and the significant baseline differences between groups, data analysis is presented primarily as descriptive and hypothesis-generating rather than a definitive comparative evaluation. Student's *t*-tests and chi-square tests were used where appropriate. A *P*-value of less than or equal to 0.05 was considered significant.

Results

During 3.5 years, 1149 patients underwent cholecystectomy. Thirty-eight (3.3%) were STCs, of which 36 (3.1%) were reconstituting type and 2 (0.2%) were fenestrating type. Of these STCs, 29 (76.3%) were performed laparoscopically. The mean age was 46.2 ± 14.0 years, and the female-to-male ratio was 2.2:1. History of cholecystitis, choledocholithiasis, and biliary pancreatitis was significantly higher in patients undergoing STC (Table 1). Among STC patients, 28.9% had a history of biliary pancreatitis and

Table 1

Patient demographics and preoperative characteristics of the total cholecystectomy and subtotal cholecystectomy groups

	All patients (*n* = 1149)	Total cholecystectomy (*n* = 1111)	Subtotal cholecystectomy (*n* = 38)	*P*-value
Mean age (years)	46.2 ± 14.0	46.2 ± 14.0	49.7 ± 10.9	0.12*
Gender				0.14†
Male	359 (31.2%)	343 (30.9%)	16 (42.1%)	
Female	790 (68.8%)	768 (69.1%)	22 (57.9%)	
Indications				**0.001**†
Cholelithiasis	1121 (97.5%)	1083 (97.2%)	38 (100%)	
GB polyp	28 (2.5%)	28 (2.5%)	0 (0%)	
History of cholecystitis				**0.001**†
Yes	139 (12.1%)	121 (10.9%)	18 (47.4%)	
No	1010 (87.9%)	990 (89.1%)	20 (52.6%)	
History of CBD stones				**0.001**†
Yes	40 (3.5%)	32 (2.9%)	8 (21.1%)	
No	1109 (96.5%)	1079 (97.15)	30 (78.9%)	
History of pancreatitis				**0.001**†
Yes	31 (2.7%)	20 (1.8%)	11 (28.9%)	
No	1118 (97.3%)	1091 (98.2%)	27 (71.1%)	
Procedure				**0.001**†
Laparoscopic	1127 (98.1%)	1098 (98.8%)	29 (76.3%)	
Open	22 (1.9%)	13 (1.2%)	9 (23.7%)	
Co-morbidities				0.77†
HTN	231 (20.1%)	119 (10.7%)	12 (31.6%)	
IHD	24 (2.1%)	23 (2.1%)	1 (2.6%)	
DM	84 (7.3%)	76 (6.8%)	8 (21.1%)	
COPD	27 (2.3%)	25 (2.2%)	2 (5.3%)	
Hypothyroidism	61 (5.3%)	58 (5.25)	3 (7.9%)	
Others	35 (3.0%)	33 (3.0%)	2 (5.3%)	

CBD: common bile duct; COPD: chronic obstructive pulmonary disease; DM: diabetes mellitus; GB: gall bladder; HTN: hypertension; IHD: ischemic heart disease.
*Student's *t*-test.
†Chi-square test.
Values in the bold: significant p value

Table 2

Early postoperative outcomes of STC and TC

	All patients (*n* = 1149)	Total cholecystectomy (*n* = 1111)	Subtotal cholecystectomy (*n* = 38)
Duration of hospital stay (days)	1.41 ± 1.40	1.35 ± 1.3	3.26 ± 2.7
Clavien–Dindo grading			
No complications	972 (84.6%)	949 (85.4%)	23 (60.5%)
Minor complications	165 (14.4%)	153 (13.8%)	12 (31.6%)
Major complications	12 (1.0%)	9 (0.8%)	3 (7.9%)
CCI	0.90 ± 4.5	0.78 ± 4.1	4.1 ± 10.6
Placement of the drain during surgery	147 (12.8%)	109 (9.8%)	38 (100%)
Early complications			
SSI	124 (10.8%)	116 (10.4%)	8 (21%)
Urinary retention	23 (2.0%)	21 (1.9%)	2 (5.3%)
PONV	22 (1.9%)	17 (1.5%)	5 (13.2%)
RTI	16 (1.3%)	14 (1.3%)	2 (5.3%)
Cardiac complications	12 (1.0%)	11 (1.0%)	1 (2.6%)
Bleeding	4 (0.4%)	2 (0.2%)	2 (5.3%)
Bile leak	6 (0.5%)	2 (0.2%)	4 (10.5%)
Bowel injury	1 (0.1%)	1 (0.1%)	0 (0%)

CCI: comprehensive complication index; PONV: postoperative nausea and vomiting; RTI: respiratory tract infection; SSI: surgical site infection.

21.1% had choledocholithiasis; however, all underwent surgery electively after resolution of the acute conditions.

The most common postoperative complication for both groups was superficial surgical site infection of the umbilical port site, followed by postoperative nausea and vomiting (PONV) within 24 hours after surgery. Duration of hospital stay, Clavien–Dindo complications, CCI, and use of drain were higher in the STC group (Table 2). Six patients developed postoperative bile leak, which was detected by drainage of bilious fluid from the tube drain placed during surgery. In four patients, bile leak gradually decreased and stopped within 2 weeks without radiological or biochemical features of major BDI or stricture. However, two patients in the STC group required readmission and ultrasound-guided drain placement for treatment of biloma. Both patients improved after drainage of biloma, and the drains were removed after 4 weeks. Twelve patients developed cardiac complications, which were mainly arrhythmias and ischemic events. Three patients in subtotal and six patients in total cholecystectomy required ICU admission due to their comorbid conditions. There was no BDI or mortality in either group.

Only STC patients were followed up for long-term outcomes, among whom three patients were lost to follow-up. The median follow-up was 22 months. Ten (28.6%) patients reported recurrent right upper abdominal pain, five (14.2%) were readmitted for abdominal pain, and three (8.65%) underwent reintervention. The reintervention was percutaneous drain placement for an intra-abdominal fluid collection for two patients and ERCP for choledocholithiasis for one patient.

Discussion

Based on our findings, STC should be considered when dense adhesions, severe inflammation, or anatomical distortion prevents safe dissection in the hepatocystic triangle, and the CVS cannot be achieved. STC is recommended in patients where fibrosis or anatomical changes make total cholecystectomy unsafe. A reconstituting STC allows closure of the infundibular stump, which may reduce the risk of postoperative bile leak. In cases where stump closure is not possible (fenestrating STC), intraoperative measures such as using an omental plug or falciform patch may help reduce biliary fistula rates[14,15].

The absence of a universal classification of STC makes it difficult to compare the outcomes across studies. The classification proposed by Strasberg *et al* is the most frequently used because of the ease of documentation, and the consequences of STC are based on the presence of new GB or leaving the cystic duct open[10]. We used the Strasberg classification and, whenever possible, performed a reconstituting STC where a minimum infundibulum part of the GB was left behind, just adequate for safely applying sutures. A fenestrating STC was performed where the GB wall was severely inflamed, and suturing was not possible.

STC was performed in 3.3% of all cholecystectomies in our study, a rate lower than that reported in the prior review[16]. This may be because we included only elective cholecystectomies. The rate of STC is also determined by individual surgeons' preference for this technique and the extent of dissection performed in the hepatocystic triangle before declaring the need for a bailout procedure. Prior studies have reported a higher rate in patients

with acute inflammatory pathology, including cholecystitis, choledocholithiasis, or biliary pancreatitis[8,17,18].

Prior studies have reported that STC is associated with higher postoperative bile leak rates, readmission rates, and a lower rate of BDI[19–21]. There was no BDI in our STC group. While the absence of BDI in both the STC and TC groups is reassuring, this finding should be interpreted with caution due to the relatively few STC cases. Hospital stays and early complications were higher in STC in our study. However, the advantages of preventing a BDI outweigh these postoperative morbidities. Similar to the prior findings, our study highlights that when CVS cannot be achieved, it is safer to do STC than attempt total cholecystectomy even after conversion to open surgery[20].

In our study, 100% of patients with a fenestrating type and 5.56% of patients with a reconstituting type had a bile leak, all of which subsided in 2–4 weeks with extra percutaneous drain placement as needed. Prior studies also reported bile leak to be significantly higher in fenestrating STC, where the cystic duct was not closed, than in reconstituting STC[11,22–24]. Postoperatively, all STC patients should be monitored closely for signs of bile leak, and a subhepatic drain is advisable.

No stone formation in the remnant GB was seen on a median follow-up of 22 months. Abdominal pain could be because of inflammation in the remaining gallbladder. The remnant GB in reconstituting STC can cause delayed complications, including stone formation and cholecystitis. Long-term outcomes of a reconstituting STC are poorly reported, with varying conclusions. Palanivelu *et al* found stone formation in the remnant GB in 1.1% at 1-year follow-up[8]. Slater *et al* found that 2.2% had recurrent stone formation during a 13-year follow-up[22]. However, in another study from Japan, no stone formation was found in 60 patients of STC with a median follow-up of 42 months[21].

A low threshold for STC may reduce BDI risk in patients with severe inflammation. These patients should be monitored for bile leak and managed accordingly during the postoperative period.

Long-term surveillance may be important for patients undergoing reconstituting STC, as the remnant gallbladder can occasionally become symptomatic over time. These recommendations may of help to surgeons practicing in low-resource settings where intraoperative decision-making must balance safety with limited imaging or surgical support.

Limitations

This study is subject to selection bias due to its retrospective design and the non-randomized allocation of patients to STC versus TC. We did not perform multivariable regression or propensity-score analysis due to the small sample size of the STC group, limiting adjustment for baseline differences. The single-center design may limit the external validity of the study. The significantly higher incidence of cholecystitis, choledocholithiasis, and pancreatitis in the STC group may reflect the indications that necessitated STC, leading to inherent baseline differences between the groups. Given the low incidence of BDI and the small sample size of the STC group, the study may not be adequately powered to detect differences in these rare complications. Likewise, the outcomes of STC, especially the reconstituting type, need to be followed for a longer time, as they may develop symptoms later on.

Conclusion

STC performed via laparoscopic or open technique appears to be a safe bailout procedure to prevent BDI in cases where a CVS cannot be achieved due to chronic inflammation and adhesions. Further prospective, multi-center studies with standardized follow-up protocols are needed to validate these findings and better define the long-term outcomes of different STC subtypes.

Ethical approval

Ethical clearance was obtained from the Institutional Review Committee (IRC) of the Institute of Medicine (reference number: 416(6-11)E2.081/082).

Consent:

Written consent obtained from all patients for publication and any accompanying images, a copy of which is available for review by the Editor-in-Chief of this journal on request.

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Author contributions

Conceptualization: B.P.K., P.L., and N.K. Research design: B.P.K., P.L., N.K., R.S.B., and P.J.L. Literature review: P.L., P.J.L., D.S., N.M., and S.P. Data collection: B.P.K., D.S., N.M., and S.P. Data analysis: P.L., D.S., N.M., and S.P. Manuscript preparation: B.P.K., P.L., and N.K. Supervision and manuscript editing: R.S.B. and P.J.L. All authors have contributed to the study and approved the final version of the manuscript.

Conflicts of interest disclosure

There were no conflicts of interest among all authors.

Research registration unique identifying number (UIN)

1. Name of the registry: ClinicalTrials.gov.
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Guarantor

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Provenance and peer review

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Data availability statement

The datasets used during this study will be available from the corresponding author upon reasonable request.

Declaration

All the authors declare that the information provided here is accurate to the best of our knowledge.

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