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Original Article

Subtotal Cholecystectomy as a Bailout Procedure in Difficult Gallbladder Surgery: A Hospital-Based Observational Study

Dr. Bodepudi Sisir[1], Dr. Dugganapalli Dinesh Kumar Reddy[2], Dr. Ratakonda Srividya[3]

[1]Assistant Professor, Department of General Surgery, Mamata Medical College, Khamma, Telangana
[2]Assistant Professor, Department of General Medicine, Mamata Medical College, Khamma, Telangana
[3]Assistant Professor, Department of General Surgery, Mamata Medical College, Khamma, Telangana

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Corresponding Author:

Dr. Bodepudi Sisir
Assistant Professor, Department of General Surgery, Mamata Medical College, Khamma, Telangana

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ABSTRACT

Introduction: Difficult gallbladder surgery is commonly encountered in patients with acute cholecystitis, recurrent inflammation, empyema, contracted gallbladder, dense adhesions, and frozen Calot's triangle. In such cases, attempting total cholecystectomy may increase the risk of bile duct injury. Subtotal cholecystectomy is used as a bailout procedure when the critical view of safety cannot be achieved. Aim of the study was to evaluate subtotal cholecystectomy as a bailout procedure in difficult gallbladder surgery and assess its indications, intraoperative findings, postoperative complications, and early outcomes.
Materials and Methods: This hospital-based observational study was conducted in the Department of General Surgery, Mamata Medical College and General Hospital, Khammam, among 75 patients undergoing subtotal cholecystectomy for difficult gallbladder surgery. Demographic details, clinical presentation, radiological findings, intraoperative difficulty, type of subtotal cholecystectomy, complications, ERCP requirement, and hospital stay were recorded and analyzed.
Results: Dense adhesions were seen in 84.0%, thickened fibrosed gallbladder in 77.3%, frozen Calot's triangle in 66.7%, and distorted biliary anatomy in 61.3% of patients. Fenestrating subtotal cholecystectomy was performed in 56.0% and reconstituting type in 44.0%. Bile leak occurred in 17.3%, ERCP was required in 10.7%, and no mortality or major bile duct injury was observed.
Conclusion: Subtotal cholecystectomy is a safe and effective bailout procedure in difficult gallbladder surgery, especially when critical view of safety cannot be achieved.

Keywords: *Subtotal cholecystectomy; difficult gallbladder; bailout procedure; bile duct injury; frozen Calot's triangle; acute cholecystitis.*

INTRODUCTION

Laparoscopic cholecystectomy is the standard surgical treatment for symptomatic gallstone disease and acute cholecystitis; however, a subset of cases continues to pose major technical difficulty because of dense adhesions, severe acute or chronic inflammation, empyema, contracted gallbladder, Mirizzi-like anatomy, distorted Calot's triangle, bleeding, or inability to achieve the critical view of safety. In such situations, persistence with complete dissection of the hepatocystic triangle may increase the risk of major bile duct injury, vascular injury, conversion to open surgery, postoperative bile leak, retained stones, and prolonged morbidity. Contemporary safety guidelines emphasize that when safe anatomical identification is not possible, the surgeon should abandon hazardous dissection and adopt a bailout strategy rather than force completion of a total cholecystectomy [1]. Subtotal cholecystectomy has therefore emerged as an important damage-control or "bailout" procedure in difficult gallbladder surgery, aiming to remove the diseased gallbladder as much as safely possible while avoiding dissection close to the common bile duct and hepatic hilum.

Subtotal cholecystectomy may be performed by fenestrating or reconstituting techniques. In the fenestrating type, the gallbladder remnant is left open with management of the cystic duct orifice when possible, while in the reconstituting type,

the gallbladder stump is closed to recreate a small residual pouch. Each technique has distinct advantages and complications: fenestrating procedures may reduce remnant gallbladder problems but are associated with higher bile leak, whereas reconstituting procedures may reduce early bile leakage but carry risk of recurrent biliary symptoms, retained stones, or remnant cholecystitis. Systematic reviews after 2020 have supported laparoscopic subtotal cholecystectomy as a feasible and safe option in difficult acute cholecystitis when performed with adequate drainage, secure stump/cystic duct control, and careful postoperative monitoring [2]. LeCompte et al. reported the increasing adoption of subtotal cholecystectomy in a hepatopancreatobiliary unit as a deliberate safety strategy rather than a failure of technique, reflecting a shift in surgical culture toward avoiding bile duct injury [3]. Loh et al. compared fenestrating and reconstituting subtotal cholecystectomy with total cholecystectomy and highlighted that short- and long-term outcomes vary by technique and patient selection [4]. However, Lucocq et al. emphasized that subtotal cholecystectomy is not a benign procedure and may carry significant perioperative morbidity; hence, this risk profile should be clearly included in preoperative counselling, particularly in patients with anticipated difficult cholecystectomy [5].

Recent comparative literature has further clarified the role of subtotal cholecystectomy in difficult gallbladder surgery. Braschi et al. observed differences in early outcomes between subtotal and total cholecystectomy for acute cholecystitis, suggesting that subtotal cholecystectomy is often selected in more severe operative situations and therefore requires outcome interpretation in the context of disease severity [6]. Ramírez-Giraldo et al. summarized the current state of subtotal cholecystectomy and emphasized its role when the critical view of safety cannot be achieved, while also noting persisting variability in terminology, operative technique, stump closure, drain placement, and postoperative follow-up [7]. Al-Azzawi et al. reviewed laparoscopic subtotal cholecystectomy for difficult gallbladders and concluded that although it can be lifesaving as a bailout option, it remains associated with bile leak, collections, retained stones, ERCP requirement, and readmission in selected cases [8]. Koo et al. reported that subtotal cholecystectomy is a reasonable alternative to total cholecystectomy in difficult gallbladders and may reduce common bile duct injury risk, but also noted the need for better evidence defining which patients benefit most [9]. Hajibandeh et al. further demonstrated that fenestrating and reconstituting techniques have different complication profiles, supporting the need for procedure-specific outcome analysis rather than treating subtotal cholecystectomy as a single uniform operation [10].

Despite growing evidence, important research gaps remain. Most available studies are retrospective, heterogeneous in definitions, and vary in operative indications, surgeon experience, severity grading, drain policy, cystic duct management, intraoperative cholangiography use, conversion thresholds, and follow-up duration. There is limited institution-specific evidence from many regional settings on the actual indications, intraoperative decision-making, technique used, postoperative complications, need for ERCP, hospital stay, readmission, and recurrence after subtotal cholecystectomy. Therefore, the present study aims to evaluate subtotal cholecystectomy as a bailout procedure in difficult gallbladder surgery, with particular emphasis on indications, operative technique, intraoperative findings, early postoperative outcomes, complications, and its practical role in preventing major bile duct injury when safe total cholecystectomy is not feasible.

MATERIALS AND METHODS

This hospital-based observational study was conducted in the Department of General Surgery, Mamata Medical College and General Hospital, Khammam**,** among patients undergoing surgery for difficult gallbladder disease. A total of 75 patients who underwent subtotal cholecystectomy as a bailout procedure during difficult gallbladder surgery were included in the study. The study was designed to assess the indications, intraoperative findings, surgical technique, postoperative complications, and early outcomes of subtotal cholecystectomy in patients where safe total cholecystectomy was not feasible. Ethical clearance was obtained from the Institutional Ethics Committee, and informed written consent was taken from all patients before inclusion in the study.

Methodology

All patients admitted to the Department of General Surgery with clinical and radiological diagnosis of gallbladder disease requiring cholecystectomy were evaluated during the study period. Patients were assessed by detailed history, general physical examination, systemic examination, abdominal examination, relevant laboratory investigations, and ultrasonography of the abdomen. Preoperative assessment included complete blood count, liver function tests, renal function tests, serum electrolytes, coagulation profile, viral markers, chest X-ray, ECG, and anesthetic fitness.

Patients with features suggestive of difficult gallbladder such as dense adhesions, recurrent attacks of cholecystitis, contracted gallbladder, empyema gallbladder, thickened gallbladder wall, impacted stone at Hartmann's pouch, frozen Calot's triangle, or unclear biliary anatomy were considered for inclusion when subtotal cholecystectomy was performed as a bailout procedure. All patients were initially planned for standard cholecystectomy either by laparoscopic or open approach depending on clinical condition, operative findings, and surgeon's decision.

Intraoperatively, Calot's triangle was carefully assessed. When the critical view of safety could not be achieved due to severe inflammation, fibrosis, adhesions, bleeding, or distorted anatomy, the decision was taken to perform subtotal cholecystectomy to avoid bile duct injury and vascular injury. Depending on intraoperative findings, either fenestrating or

reconstituting subtotal cholecystectomy was performed. Gallstones were removed, the gallbladder mucosa was cauterized where required, the cystic duct opening was identified and secured whenever possible, and a drain was placed in the subhepatic region. Intraoperative details such as type of procedure, operative duration, difficulty encountered, conversion to open surgery, bile spillage, bleeding, and drain placement were recorded.

Postoperatively, patients were monitored for pain, fever, bile leak, surgical site infection, abdominal collection, jaundice, need for ERCP, duration of drain placement, duration of hospital stay, readmission, and mortality. Drain output was assessed daily and removed when the output was minimal and non-bilious. Patients with persistent bile leak, suspected retained stones, or postoperative collection were further evaluated and managed accordingly. All collected data were entered into a structured proforma and analyzed according to the study objectives.

Inclusion Criteria

- Patients aged 18 years and above.
- Patients diagnosed with symptomatic gallstone disease, acute cholecystitis, chronic cholecystitis, empyema gallbladder, contracted gallbladder, or difficult gallbladder.
- Patients in whom total cholecystectomy was considered unsafe due to dense adhesions, unclear Calot's triangle anatomy, severe inflammation, fibrosis, bleeding, or inability to achieve critical view of safety.
- Patients undergoing subtotal cholecystectomy as a bailout procedure.
- Patients willing to provide informed written consent.

Exclusion Criteria

- Patients below 18 years of age.
- Patients undergoing routine uncomplicated total cholecystectomy.
- Patients with suspected or confirmed carcinoma gallbladder.
- Patients with common bile duct stones requiring primary CBD exploration.
- Patients with severe coagulopathy or patients medically unfit for surgery.
- Patients refusing consent.
- Patients with incomplete clinical, operative, or follow-up records.

Study Tool

A predesigned structured proforma was used as the study tool for data collection. The proforma included demographic details, clinical presentation, laboratory investigations, radiological findings, intraoperative findings, type of subtotal cholecystectomy performed, postoperative complications, and follow-up outcomes.
The following parameters were recorded:

- Age and sex of the patient.
- Presenting complaints such as pain abdomen, fever, vomiting, jaundice, and duration of symptoms.
- History of previous attacks of cholecystitis or previous hospitalization.
- Comorbidities such as diabetes mellitus, hypertension, obesity, or other systemic illnesses.
- Laboratory parameters including complete blood count, liver function tests, renal function tests, and coagulation profile.
- Ultrasonography findings including gallbladder wall thickness, contracted gallbladder, impacted stone, pericholecystic collection, empyema, and common bile duct diameter.
- Intraoperative findings such as adhesions, frozen Calot's triangle, gallbladder perforation, bleeding, impacted Hartmann's pouch stone, and inability to achieve critical view of safety.
- Type of subtotal cholecystectomy performed, namely fenestrating or reconstituting type.
- Operative duration, drain placement, conversion to open surgery, and intraoperative complications.
- Postoperative outcomes such as bile leak, surgical site infection, fever, abdominal collection, ERCP requirement, hospital stay, readmission, and mortality.

Data Collection

Data were collected from all eligible patients admitted under the Department of General Surgery after obtaining informed consent. Detailed clinical history and examination findings were recorded at the time of admission. Preoperative laboratory and imaging findings were documented. Intraoperative findings were recorded from operative notes and direct surgical assessment. The decision to perform subtotal cholecystectomy was made intraoperatively when safe total cholecystectomy was not possible due to distorted anatomy or inability to achieve the critical view of safety.

Postoperative data were collected during the hospital stay and follow-up visits. Patients were observed for early complications such as bile leak, fever, wound infection, abdominal collection, retained stones, need for ERCP, prolonged

drain output, and readmission. All data were entered into a master chart and analyzed to assess the safety, feasibility, indications, complications, and outcome of subtotal cholecystectomy as a bailout procedure in difficult gallbladder surgery.

Statistical Analysis

The collected data were entered into Microsoft Excel and analyzed using appropriate statistical software such as SPSS Version 21.0. Categorical variables were expressed as frequency and percentage, while continuous variables were expressed as mean, standard deviation, or median where applicable. Associations between categorical variables were analyzed using Chi-square test or Fisher's exact test. Continuous variables were compared using Student's t-test or Mann–Whitney U test depending on the distribution of data. A p-value of <0.05 was considered statistically significant.

RESULTS

Table 1: Demographic and Clinical Profile of the Study Population

Parameter	Number of Patients	Percentage (%)
Age group		
18–30 years	8	10.7
31–40 years	14	18.7
41–50 years	20	26.7
51–60 years	19	25.3
>60 years	14	18.7
Sex		
Male	31	41.3
Female	44	58.7
Comorbidities*		
Diabetes mellitus	16	21.3
Hypertension	14	18.7
Obesity	11	14.7
No comorbidity	39	52.0
Previous history of cholecystitis	43	57.3

*Comorbidities may overlap in the same patient.

The majority of patients belonged to the middle and elderly age groups, with the highest proportion seen between 41 and 60 years. Females were more commonly affected than males, which is consistent with the known higher prevalence of gallstone disease among women. More than half of the patients had a previous history of cholecystitis, suggesting recurrent inflammation as an important contributor to operative difficulty. Diabetes mellitus and hypertension were the common associated comorbidities. These demographic and clinical variables are important because advanced age, recurrent attacks, and comorbidities may influence surgical risk, postoperative recovery, and complication rates.

Table 2: Presenting Symptoms and Clinical Diagnosis among Study Subjects

Clinical Parameter	Number of Patients	Percentage (%)
Presenting symptoms*		
Right upper abdominal pain	75	100.0
Fever	38	50.7
Vomiting	42	56.0
Jaundice	8	10.7
Dyspepsia / bloating	31	41.3
Duration of symptoms		
<3 days	17	22.7
3–7 days	28	37.3
>7 days	15	20.0
Recurrent episodes	15	20.0
Clinical diagnosis		
Acute cholecystitis	35	46.7
Chronic cholecystitis	18	24.0
Empyema gallbladder	10	13.3
Contracted gallbladder	9	12.0
Mucocele gallbladder	3	4.0

*Symptoms may overlap in the same patient.

Right upper abdominal pain was the universal presenting complaint among the study population. Vomiting and fever were also common, reflecting acute inflammatory pathology in a large proportion of patients. Jaundice was present in a smaller

number of cases and may indicate transient obstruction, impacted stone, or associated biliary pathology. Acute cholecystitis was the most common clinical diagnosis, followed by chronic cholecystitis. The presence of empyema, contracted gallbladder, and recurrent symptoms explains the difficult operative field and the need for subtotal cholecystectomy as a bailout procedure.

Table 3: Preoperative Laboratory and Ultrasonography Findings

Parameter	Mean ± SD / Number	Percentage (%)
Laboratory parameters		
Hemoglobin, g/dL	12.8 ± 1.6	
Total leukocyte count, cells/mm³	12450 ± 4180	
Total bilirubin, mg/dL	1.4 ± 0.9	
SGOT, IU/L	58.6 ± 32.4	
SGPT, IU/L	64.2 ± 36.8	
Alkaline phosphatase, IU/L	168.4 ± 72.5	
Serum creatinine, mg/dL	1.02 ± 0.28	
Ultrasonography findings		
Gallstones present	75	100.0
Thickened gallbladder wall	61	81.3
Contracted gallbladder	23	30.7
Impacted stone at Hartmann's pouch	29	38.7
Pericholecystic collection	19	25.3
Empyema gallbladder	16	21.3
Dilated common bile duct	8	10.7

Preoperative investigations showed raised total leukocyte count, suggesting active inflammation in many patients. Mild elevation of bilirubin and liver enzymes was observed in selected cases, probably due to inflammatory edema or transient biliary obstruction. Ultrasonography showed gallstones in all patients, while gallbladder wall thickening was the most common radiological marker of difficult cholecystectomy. Impacted Hartmann's pouch stone, contracted gallbladder, and pericholecystic collection were important predictors of operative difficulty. These findings helped in preoperative risk assessment, although the final decision for subtotal cholecystectomy was made intraoperatively.

Table 4: Intraoperative Findings Suggestive of Difficult Gallbladder

Intraoperative Finding	Number of Patients	Percentage (%)
Dense adhesions around gallbladder	63	84.0
Frozen Calot's triangle	50	66.7
Distorted biliary anatomy	46	61.3
Thickened and fibrosed gallbladder	58	77.3
Contracted gallbladder	24	32.0
Empyema gallbladder	16	21.3
Impacted Hartmann's pouch stone	30	40.0
Gallbladder perforation	14	18.7
Bile / stone spillage	18	24.0
Bleeding from gallbladder bed	11	14.7
Critical view of safety not achieved	75	100.0

This table 4 shows the operative reasons for choosing subtotal cholecystectomy. Dense adhesions, thickened fibrosed gallbladder, frozen Calot's triangle, and distorted biliary anatomy were the most frequent intraoperative findings. The critical view of safety could not be achieved in all cases, which was the principal indication for avoiding complete cholecystectomy. Impacted Hartmann's pouch stone and contracted gallbladder further increased the difficulty of safe dissection. Subtotal cholecystectomy was therefore used as a bailout procedure to prevent bile duct injury and vascular injury in these high-risk operative situations.

Table 5: Operative Details and Type of Subtotal Cholecystectomy Performed

Operative Parameter	Number / Mean ± SD	Percentage (%)
Initial surgical approach		
Laparoscopic approach attempted	68	90.7
Primary open approach	7	9.3
Conversion from laparoscopic to open surgery	6	8.0
Type of subtotal cholecystectomy		
Fenestrating subtotal cholecystectomy	42	56.0
Reconstituting subtotal cholecystectomy	33	44.0
Cystic duct opening identified	54	72.0

Cystic duct secured	44	58.7
Mucosal cauterization done	61	81.3
Drain placed	72	96.0
Mean operative time, minutes	83.2 ± 20.7	—
Mean intraoperative blood loss, mL	92.6 ± 48.4	—

Most patients were initially managed by the laparoscopic approach, while a small proportion required primary open surgery due to anticipated difficulty. Conversion to open surgery was required in 8.0% of cases, mainly due to dense adhesions, bleeding, or unclear anatomy. Fenestrating subtotal cholecystectomy was performed slightly more often than the reconstituting type. Cystic duct identification and closure could not be achieved in all cases because of inflammation and fibrosis in Calot's triangle. Drain placement was done in most patients to monitor postoperative bile leak and collection.

6: Postoperative Complications and Early Surgical Outcomes

Postoperative Outcome	Number of Patients	Percentage (%)
Bile leak	13	17.3
Prolonged drain output	15	20.0
Surgical site infection	5	6.7
Postoperative fever	11	14.7
Intra-abdominal collection	4	5.3
Retained CBD stone	4	5.3
Requirement of ERCP	8	10.7
Percutaneous drainage	2	2.7
Reoperation	1	1.3
Readmission	6	8.0
Mortality	0	0.0
Mean duration of drain placement, days	4.5 ± 2.4	—
Mean hospital stay, days	5.6 ± 2.8	—

Bile leak was the most important postoperative complication and was observed in 17.3% of patients. Most bile leaks were managed conservatively with drain monitoring, while selected patients required ERCP and biliary stenting. Surgical site infection, fever, and intra-abdominal collection were observed in a smaller number of cases. Retained CBD stones were detected in 5.3% of patients, and ERCP was required in 10.7% of cases. There was no mortality in the study population, supporting the role of subtotal cholecystectomy as a safe bailout procedure when complete cholecystectomy is unsafe.

Table 7: Association between Type of Subtotal Cholecystectomy and Postoperative Complications

Postoperative Outcome	Fenestrating STC, n = 42	Reconstituting STC, n = 33	p-value
Bile leak	10 (23.8%)	3 (9.1%)	0.128
Prolonged drain output	12 (28.6%)	3 (9.1%)	0.045*
Surgical site infection	4 (9.5%)	1 (3.0%)	0.377
Intra-abdominal collection	3 (7.1%)	1 (3.0%)	0.626
Retained CBD stone	3 (7.1%)	1 (3.0%)	0.626
ERCP requirement	6 (14.3%)	2 (6.1%)	0.453
Readmission	5 (11.9%)	1 (3.0%)	0.220
Overall complications	17 (40.5%)	7 (21.2%)	0.087
Mean drain duration, days	5.1 ± 2.5	3.7 ± 1.8	0.006*
Mean hospital stay, days	6.1 ± 3.0	5.0 ± 2.4	0.082

*Statistically significant; $p < 0.05$. Fisher's exact test was used for categorical variables and independent t-test was used for continuous variables.

Postoperative bile leak was more common in the fenestrating subtotal cholecystectomy group compared with the reconstituting group, although the difference was not statistically significant. Prolonged drain output was significantly higher among patients who underwent fenestrating subtotal cholecystectomy. Mean drain duration was also significantly longer in the fenestrating group. ERCP requirement, readmission, and overall complications were numerically higher in the fenestrating group, but these differences did not reach statistical significance. These findings suggest that both techniques are useful bailout options, but fenestrating subtotal cholecystectomy may require closer postoperative monitoring for bile leak and prolonged drainage.

DISCUSSION

Subtotal cholecystectomy has become an important bailout procedure in difficult gallbladder surgery, particularly when the critical view of safety cannot be achieved. In the present study of 75 patients, subtotal cholecystectomy was performed in cases where dense adhesions, frozen Calot's triangle, distorted biliary anatomy, severe inflammation, fibrosis, impacted Hartmann's pouch stone, or contracted gallbladder made safe total cholecystectomy hazardous. The principal objective of

subtotal cholecystectomy in such situations is to avoid dissection close to the common bile duct and hepatic hilum, thereby reducing the risk of bile duct injury and vascular complications. Koo et al. compared laparoscopic fenestrating and reconstituting subtotal cholecystectomy and reported that subtotal cholecystectomy is a useful and safe alternative in difficult gallbladder cases when standard dissection cannot be safely continued [11].

In the present study, the majority of patients belonged to the 41–60 years age group, and females constituted 58.7% of the study population. This female predominance is in accordance with the general epidemiology of gallstone disease. Right upper abdominal pain was present in all patients, followed by vomiting in 56.0%, fever in 50.7%, and dyspeptic symptoms in 41.3%. Acute cholecystitis was the most common clinical diagnosis, accounting for 46.7% of cases, followed by chronic cholecystitis in 24.0%, empyema gallbladder in 13.3%, and contracted gallbladder in 12.0%. Gallaher and Charles described acute cholecystitis as a common gallstone-related emergency, usually presenting with right upper quadrant abdominal pain, fever, nausea, vomiting, and inflammatory changes of the gallbladder, which is comparable with the clinical profile observed in the present study [12].

The intraoperative findings in the present study clearly demonstrated the difficult nature of the gallbladder disease. Dense adhesions around the gallbladder were present in 84.0% of patients, thickened and fibrosed gallbladder in 77.3%, frozen Calot's triangle in 66.7%, and distorted biliary anatomy in 61.3%. The critical view of safety could not be achieved in any of the 75 cases, which was the key indication for performing subtotal cholecystectomy. Byskosh et al. reported that subtotal fenestrating cholecystectomy is a safe and effective procedure for difficult gallbladders, especially in cases where inflammation prevents safe dissection of Calot's triangle [13]. These findings support the present study observation that subtotal cholecystectomy should be considered a planned safety strategy rather than a compromise procedure.

In the present study, the laparoscopic approach was attempted in 90.7% of patients, while 9.3% underwent primary open surgery. Conversion from laparoscopic to open surgery was required in 8.0% of cases. The relatively low conversion rate suggests that subtotal cholecystectomy can help complete difficult gallbladder surgery without mandatory conversion in every case. Grossman et al. compared subtotal cholecystectomy with open cholecystectomy as bailout procedures for difficult gallbladder and reported that subtotal cholecystectomy is a valuable alternative that may reduce the need for open conversion in selected patients [14].

Postoperative complications in the present study included bile leak in 17.3%, prolonged drain output in 20.0%, surgical site infection in 6.7%, intra-abdominal collection in 5.3%, retained CBD stones in 5.3%, ERCP requirement in 10.7%, readmission in 8.0%, and reoperation in 1.3%. No mortality or major bile duct injury was observed. Ibrahim et al. reported that subtotal cholecystectomy is a safe option for difficult gallbladders, although bile leak and postoperative morbidity remain important concerns [15]. The present study findings are comparable, as bile leak was the most common complication but was manageable in most cases with drainage, observation, or ERCP when required.

In the comparison between the two operative techniques, fenestrating subtotal cholecystectomy was performed in 56.0% of cases and reconstituting subtotal cholecystectomy in 44.0%. Bile leak was more common in the fenestrating group than in the reconstituting group, 23.8% versus 9.1%, although the difference was not statistically significant. However, prolonged drain output was significantly higher in the fenestrating group, 28.6% versus 9.1%, with $p = 0.045$. Lunevicius and Nzenwa developed a logistic regression model to predict bile leak after subtotal cholecystectomy and reported that open-tract or fenestrating-type subtotal cholecystectomy and acute cholecystitis were important predictors of postoperative bile leak [16]. This is consistent with the present study, where the fenestrating technique showed a higher tendency toward bile leak and significantly prolonged drainage.

Preoperative imaging is also important in anticipating difficult cholecystectomy. In the present study, ultrasonography showed thickened gallbladder wall in 81.3%, impacted Hartmann's pouch stone in 38.7%, contracted gallbladder in 30.7%, pericholecystic collection in 25.3%, and empyema in 21.3%. Sekioka et al. reported that magnetic resonance cholangiopancreatography findings, especially cystic duct abnormalities, could help predict conversion from laparoscopic cholecystectomy to bailout procedures in acute cholecystitis [17]. Although ultrasonography was the main imaging tool in the present study, the findings suggest that preoperative radiological markers can alert the surgeon to possible difficulty and the potential need for bailout surgery.

Thomas et al. compared fenestrating and reconstituting subtotal cholecystectomy and reported that the two techniques differ in their postoperative complication profiles [18]. The present study also observed that fenestrating subtotal cholecystectomy was associated with higher bile leak, prolonged drain output, and longer mean drain duration. Mean drain duration was significantly higher in the fenestrating group, 5.1 ± 2.5 days compared with 3.7 ± 1.8 days in the reconstituting group, with $p = 0.006$. This finding indicates that although fenestrating subtotal cholecystectomy is effective in avoiding dangerous dissection, it requires careful postoperative drainage and monitoring.

Deng et al. described the evolution of laparoscopic subtotal cholecystectomy technique at a teaching hospital and emphasized the importance of technical refinements, cystic duct control, mucosal cauterization, and drain placement in

reducing postoperative complications [19]. In the present study, cystic duct opening was identified in 72.0% of cases, cystic duct was secured in 58.7%, mucosal cauterization was done in 81.3%, and drain was placed in 96.0%. These operative steps are important in reducing bile leak, controlling residual mucosal secretion, and allowing early detection of postoperative complications.

Dhanasekara et al. compared subtotal cholecystectomy with open total cholecystectomy as bailout procedures for severe cholecystitis and reported that subtotal cholecystectomy may reduce bile duct injury compared with open total cholecystectomy [20]. In the present study, no bile duct injury was observed, supporting the role of subtotal cholecystectomy as a protective surgical strategy in difficult gallbladder surgery. This finding is clinically important because prevention of major bile duct injury is one of the most important goals in difficult cholecystectomy.

Ramírez-Giraldo et al. compared subtotal laparoscopic cholecystectomy with conversion to open surgery as bailout procedures and observed that conversion to open surgery may be associated with higher rates of bile duct injury, bleeding, intestinal injury, and wound infection [21]. The present study also supports the feasibility of subtotal cholecystectomy as a laparoscopic bailout procedure, as conversion was required in only 8.0% of patients and no major biliary injury was recorded.

Nordness et al. evaluated the incidence of ERCP after subtotal fenestrating and reconstituting cholecystectomy and reported that ERCP may be required after both techniques, especially in patients with bile leak or retained stones [22]. In the present study, ERCP was required in 10.7% of patients, mainly for persistent bile leak or retained CBD stones. This highlights the importance of postoperative surveillance and availability of endoscopic management after subtotal cholecystectomy.

CONCLUSION

Subtotal cholecystectomy is a safe, feasible, and effective bailout procedure in difficult gallbladder surgery when the critical view of safety cannot be achieved. In the present study, dense adhesions, frozen Calot's triangle, distorted biliary anatomy, thickened fibrosed gallbladder, and impacted Hartmann's pouch stone were the common operative indications. The procedure helped avoid major bile duct injury and mortality. Fenestrating subtotal cholecystectomy was associated with higher bile leak and significantly prolonged drain output compared with reconstituting subtotal cholecystectomy. Therefore, subtotal cholecystectomy should be considered a planned safety strategy rather than a surgical failure in difficult cholecystectomy.

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