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AN INNOVATIVE STUMP STENTING APPROACH FOR RESIDUAL GALLBLADDER STUMP AFTER SUBTOTAL CHOLECYSTECTOMY IN DIFFICULT GALLBLADDERS: A PROSPECTIVE STUDY

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ABSTRACT

Background: The management of difficult gallbladders frequently requires modified or innovative surgical approaches and cannot always be safely accomplished using the conventional antegrade dissection technique, as dense adhesions from recurrent chronic inflammation may distort the anatomy of Calot's triangle and increase the risk of biliovascular injury. In such circumstances, subtotal cholecystectomy performed using alternative techniques serves as a practical bailout strategy to prevent biliary and vascular damage. However, the retained cholecystocystic stump after subtotal cholecystectomy may lead to complications such as stump cholecystitis, residual calculi, and post-cholecystectomy syndrome. The objective is to minimize complications arising from the residual cholecystocystic stump, we extend the procedure beyond conventional subtotal cholecystectomy by introducing a stent into the remaining gallbladder stump using a feeding tube or guidewire. This maneuver helps define the orientation and course of the cystic duct and common bile duct, thereby guiding safe and precise further dissection. By facilitating optimal excision of the residual stump, the technique effectively eliminates the remaining gallbladder lumen and converts the procedure into a functional complete cholecystectomy, reducing the risk of stump-related complications.

Materials and Methods: The study was conducted in postgraduate department of surgery Government Medical College Jammu over a period of three years from January 2018 to January 2022. A total of 100 patients of difficult gallbladders associated with frozen and distorted calot's triangle were included in the study.

Results: During the postoperative and follow-up period in our study of 100 patients with difficult gallbladders and frozen Calot's triangle, bile leak occurred in 7 patients (7%). Among these, a few cases were attributed to missed CBD stones with subsequent slipping of cystic duct clips; ERCP with CBD stone clearance and stenting was performed, and patients improved within 3–5 days. The remaining cases were likely due to accessory ducts and resolved spontaneously within 3–7 days. No major bile duct injury was observed. Port site infection was noted in 9 patients (9%), including a few confirmed atypical mycobacterial infections. Systemic complications occurred in 18 patients (18%) and were managed conservatively. Three elderly patients with severe disease succumbed to systemic complications. The remaining patients had an uneventful and satisfactory recovery.

Conclusion: Stent-guided management of the residual cholecystocystic stump, followed by careful dissection is a safe, practical, and effective technique for converting a subtotal cholecystectomy into a complete cholecystectomy, thereby reducing the risk of long-term complications related to a retained gallbladder stump.

Keywords: Cholecystocystic stump, laparoscopy, cholecystectomy, complications, subtotal cholecystectomy.

INTRODUCTION

Subtotal cholecystectomy refers to the intentional retention of a portion of the gallbladder— excluding the cystic duct—when safe identification of structures within Calot's triangle is not possible and the critical view of safety cannot be established.[1] A "difficult gallbladder" describes a clinical situation in which conventional antegrade dissection,[2] carries a substantially higher operative risk compared with modified or alternative approaches that avoid direct dissection in an unfavourable Calot's triangle.[3-5] In cases characterized by a frozen Calot's triangle, dense inflammatory adhesions and anatomical distortion frequently preclude attainment of the critical view of safety. Under such circumstances, persistent attempts at standard antegrade dissection may result in major bile duct or vascular injury. Therefore, an alternative dissection strategy culminating in subtotal cholecystectomy often becomes the safest bailout option to prevent biliovascular complications. As aptly stated by Asher Hirshberg, removing 95% of the gallbladder (subtotal cholecystectomy) is preferable to removing 101% (including a portion of the bile duct).[6]

Subtotal cholecystectomy should not be viewed as a replacement for total cholecystectomy; rather, it is a justified rescue procedure in complex cases with severe inflammation, dense fibrosis, and complete anatomical distortion within Calot's triangle. In such scenarios, whether operating laparoscopically or via an open approach, misidentification of structures can lead to catastrophic biliary or vascular injury. While complete cholecystectomy using antegrade external dissection at Calot's triangle remains the gold standard for safe gallbladder removal, this method may not be feasible when the anatomy is obscured and the critical view of safety cannot be achieved. Direct confrontation of a hostile Calot's triangle increases the likelihood of bile duct injury—one of the most serious complications in hepatobiliary surgery. Hence, in these challenging situations, alternative operative routes are preferable.

Several strategies have been described for such difficult cases: (1) fundus-first (retrograde) dissection, (2) intraluminal guided retrograde dissection, and (3) transection of the gallbladder above the infundibulum followed by a combination of antegrade and retrograde dissection, proceeding to either total or subtotal cholecystectomy depending on feasibility. Although subtotal cholecystectomy serves as an effective bailout technique, the intentionally retained residual gallbladder stump (RGB) may predispose patients to long-term complications. These include recurrent calculi within the stump, stump cholecystitis, biliary pancreatitis, recurrent cystic duct stones, obstructive jaundice, and, in some cases, the need for reoperation—thereby increasing overall morbidity and potential mortality.[7-10] Consequently, strategies aimed at minimizing both early and delayed complications of the residual cholecystocystic stump are of considerable clinical importance.

The present technique extends one step beyond conventional subtotal cholecystectomy. Further dissection around the residual cholecystocystic stump is technically demanding due to fibrosis, adhesions, and altered anatomy. However, leaving the stump in situ may expose the patient to preventable short- and long-term sequelae. Provided the patient's physiological status permits, a definitive attempt to eliminate the residual stump is advisable using a guided and controlled approach.

Intraoperative cholangiography (IOC) can delineate biliary anatomy, detect filling defects, and assist intraoperative decision-making.[11] Nevertheless, it requires additional equipment such as a C-arm, prolongs operative time, and does not serve as a tangible intraoperative guide during dissection. In contrast, cannulation of the residual cholecystocystic stump using a guidewire or feeding tube following subtotal cholecystectomy offers a practical alternative. This maneuver provides real-time orientation of the cystic duct and common bile duct (CBD), helping define their direction and approximate length. The stent acts as a physical roadmap, facilitating safe and meticulous dissection of the residual stump while maintaining awareness of both normal and variant biliovascular anatomy.

Following cannulation, the residual stump can be carefully mobilized using hydrodissection, gentle blunt dissection, or controlled energy sources such as bipolar electrocautery or a Harmonic scalpel. Once adequate exposure is achieved, the cystic duct is securely clipped or suture-ligated, thereby completing the procedure and effectively eliminating the residual stump. This structured and guided approach enhances operative safety and aims to reduce both immediate and delayed complications associated with subtotal cholecystectomy.

MATERIALS AND METHODS

This prospective study included patients operated on in the Postgraduate Department of Surgery at Government Medical College, Jammu, over a four-year period from January 2018 to January 2022, with an additional follow-up duration of six months. A total of 100 patients presenting with difficult gallbladders characterized by a frozen and anatomically distorted Calot's triangle were enrolled. These patients were admitted either through the emergency department or the outpatient department and were selected intraoperatively for the procedure.

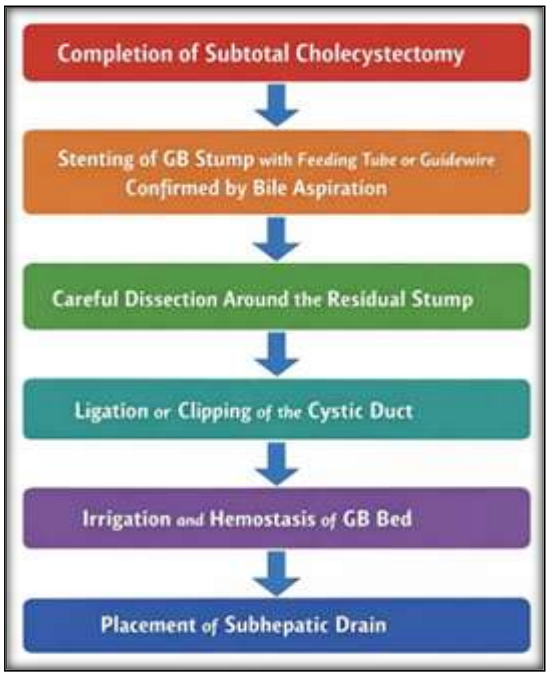
Inclusion in the study was based strictly on operative findings, namely the presence of dense inflammatory adhesions, distorted biliary anatomy, and a complete visual obscuration of structures within Calot's triangle, rendering safe identification impossible. Patients in whom a standard laparoscopic cholecystectomy could be safely completed using the

conventional Calot's-first (antegrade) approach were excluded.

Comprehensive data were systematically recorded for each patient, including demographic profile, clinical history, presenting features and disease severity, hematological parameters, liver and renal function tests, radiological investigations, timing of surgery, operative duration, need for conversion to open surgery, intraoperative and postoperative complications, duration of hospital stay, mortality, additional relevant investigations, and follow-up outcomes.

All patients received prophylactic antibiotics in accordance with the institutional surgical site infection prevention protocol. Port placement was consistent with the standard four-port laparoscopic cholecystectomy technique: a 10 mm umbilical port, a 10 mm subxiphoid port, a 5 mm port in the right midclavicular line, and a 5 mm port in the right midaxillary line. After establishing pneumoperitoneum, an initial diagnostic laparoscopy was performed to confirm operative findings. Based on intraoperative assessment, a decision was made to proceed either with a routine cholecystectomy or to adopt an alternative innovative approach.

Diagram shows the technique how the procedure is conducted:



In cases where standard antegrade dissection was deemed unsafe due to frozen and distorted anatomy at Calot's triangle, subtotal cholecystectomy was carried out using one of several techniques. These included the fundus-first (retrograde) approach, longitudinal gallbladder splitting, intraluminal guided retrograde dissection, or transection just above Hartmann's pouch. The choice of technique was guided by intraoperative findings and feasibility, prioritizing patient safety and avoidance of biliovascular injury.

Step 1: Completion of subtotal cholecystectomy.

Step 2: Once the subtotal cholecystectomy is accomplished, the gallbladder (GB) stump is gently grasped and stabilized. Stenting is then performed using either a No. 5 infant feeding tube or by first introducing a guidewire followed by railroading the feeding tube over it. Successful cannulation of the cholecystocystic stump and common bile duct (CBD) is confirmed by aspiration of bile, indicating cystic duct patency and correct intraluminal placement within the CBD. The stent provides guidance regarding the direction and approximate length of the cystic duct and CBD, and is secured in position.

Step 3: Careful dissection of the residual cholecystocystic stump is initiated with extreme caution, keeping the plane of dissection close to the stump. Techniques such as hydrodissection, peanut (blunt) dissection, sharp dissection, and the use of safe energy devices are employed. At least 5 mm of the cystic duct distal to the cholecystocystic junction is meticulously exposed.

Step 4: Ligation of the cystic duct is performed. After adequate dissection of the GB stump and exposure of approximately 5–10 mm of the cystic duct, it is securely transfixed, ligated, or clipped as appropriate.

Step 5: Irrigation of the gallbladder bed is carried out using copious normal saline to clear debris and blood clots, and to ensure complete hemostasis. The irrigating fluid is suctioned out, and a dry white gauze is placed in the GB fossa for approximately five minutes. The pneumoperitoneum is then reduced to check for any evidence of bile leakage from the gallbladder bed or surrounding areas.

Step 6: Placement of a subhepatic drain is performed. The drain is typically removed within 24–48 hours, depending on the volume and nature of the output.

RESULTS

A total of 100 patients underwent surgery using this technique, maintaining the same maleto-female ratio as in the original cohort. Of these, 57 were males and 43 were females. The age range of the patients was 41 to 76 years, with the majority being older than 58 years.

Most patients had a prolonged history of recurrent episodes of cholecystitis (approximately 69 patients). Seventeen patients presented as emergencies with gallbladder perforation. A history of prior lower abdominal surgery was noted in sixteen patients. Additionally, one patient had previously undergone surgery for hydatid disease of the liver, and another had been operated on for a liver abscess nineteen years earlier.

Twenty-seven patients had associated comorbid conditions. According to the American Society of Anesthesiologists (ASA) classification, 55 patients were categorized as ASA I and 45 as ASA II. Overall, the study population was comparable with respect to demographic characteristics, clinical presentation, laboratory findings, and radiological parameters.

Table 1: Demographic parameters and patient characteristics

Parameter	Number (n=100)	Percentage (%), Mean and SD
Age (years) (range)	41–79	59.2 ± 18.1
Male/Female	57: 43	57% : 43%
Recurrent cholecystitis	70	70%
Diabetes	25	25%
Hypertension	33	33%
Hypothyroidism	8	8%
COPD	16	16%
Upper abdominal surgery	4	4%
Lower abdominal surgery	20	20%
ASA–I	59	59%
ASA–II	41	41%

Table 2: Details of investigations of all patients in terms of range, mean and standard deviation

Name of the investigation	Range, (Mean ±SD)
Hemoglobin (gm/dl)	7.4–12.4 (9.9 ± 2.1)
White blood cell count	4.8–14.6 (9.8 ± 4.3)
Platelets count	128–268 (196.5 ± 58.4)
Serum urea	25–58 (42.1 ± 13.8)
Serum creatinine	0.6–2.3 (1.5 ± 0.7)
Serum bilirubin	0.2–2.1 (1.2 ± 0.8)
Serum alkaline phosphate	152–210 (181 ± 16)
SGOT (IU/L)	24–68 (44 ± 15)
SGPT (IU/L)	12–58 (31 ± 17)
Total proteins(gm/dl)	6.0–8.4 (7.3 ± 1.0)
Serum albumin (gm/dl)	2.3–4.8 (3.6 ± 1.0)
Serum amylase	40–102 (67.8 ± 21.4)
PTI	82–100 (92 ± 7)

Table 3: Intraoperative findings.

Finding	Number (%)
Frozen and distorted calot's triangle	100
Perforated gallbladder	13 (13%)
Fibrosed and contracted gallbladder.	25 (25%)
Inflammed thick walled gallbladder.	11 (11%)
Gangrenous gallbladder	6 (6%)
Empyema gallbladder	10 (10%)
Mucocele of gallbladder	7 (7%)
Mirrizi's syndrome type 1 and 2	6 (6%)
Cholecystoduodenal fistula	3 (3%)
Chronic cholecystitis with liver cirrhosis	5 (5%)
Chronic cholecystits with giant stones >4 cm.	5 (5%)
Xanthogranulomatous cholecystitis	3 (3%)
Small fibrosed GB containing only stones.	6 (6%)

Table 4: Surgical outcome of the patients

Type of the surgery	Number (%)
Laparoscopic cholecystectomy	71 (71%)
Lap converted to open cholecystectomy	11 (11%)
Open cholecystectomy	22 (22%)
Succesfull stenting of cholecystocystic stump	69 (69%)
Failure of stenting of cholecystocystic stump	19 (19 %)
Operation time (min)	45-90 (67.5±22.5)
Hospital stay (days)	2-6 (4.5±1.5)
Return to normal activities (days)	3-6 (4.5±1)
Complications	25 (25%)
Port site infection	9 (9%)
Biliary leak	7 (7%)
Systemic complications	18 (18%)
Mortality	3 (3%)

DISCUSSION

In patients with difficult gallbladders characterized by a frozen and distorted Calot's triangle, continuation with the conventional antegrade dissection at Calot's triangle is often unsafe. Attempting to proceed in such circumstances increases the likelihood of misidentification of biliary structures and inadvertent biliovascular injury. Therefore, subtotal cholecystectomy becomes the most appropriate bailout strategy, although it carries

the possibility of certain early as well as delayed complications.

A fundamental principle in surgery is to prioritize safety above all else. Sound surgical judgment lies in recognizing hazardous situations early and adapting strategy accordingly. While risk is an unavoidable component of operative practice, it can be minimized through anticipation, experience, and appropriate use of available resources and technology. A prudent surgeon avoids unnecessary confrontation with hostile anatomy and instead chooses safer alternatives when indicated.

Subtotal cholecystectomy was first described by Madding in 1955 as a rescue procedure for technically challenging gallbladders. His technique involved opening the gallbladder at the fundus and excising the wall up to approximately 1 cm from the cystic duct.[12] Three decades later, Bornman and Terblanche reported their approach for managing severe cholecystitis and portal hypertension by performing subtotal cholecystectomy while leaving a strip of posterior gallbladder wall in situ and closing the cystic duct internally with a pursestring suture.[13-15] Since that time, multiple modifications of subtotal cholecystectomy have been proposed and practiced by surgeons worldwide.[16-19] Thus, subtotal cholecystectomy is widely accepted as a justified rescue option in difficult operative scenarios. As emphasized by Asher Hirshberg, removing 95% of the gallbladder (subtotal cholecystectomy) is preferable to removing 101%, which includes a portion of the bile duct.

In certain clinical settings—such as cirrhotic liver with portal hypertension, densely inflamed thick-walled gallbladder adherent to the liver bed, fibrotic gallbladder, or completely intrahepatic gallbladder—the risk of bleeding is significantly increased. In these cases, leaving a portion of the gallbladder wall after mucosectomy and fulguration may be the safest approach. However, concerns remain regarding the retained gallbladder stump with a patent lumen and elongated cystic duct remnant, which may predispose to early or late postoperative complications.

Our innovative technique addresses this limitation by cannulating the residual stump using a guidewire followed by placement of a feeding tube. The stent serves as a tactile and visual guide, delineating the orientation and extent of the cystic duct and common bile duct, thereby facilitating careful and controlled dissection of the remaining gallbladder stump and cystic duct remnant. Subsequent ligation or clipping of the cystic duct effectively converts the subtotal procedure into a laparoscopic completion cholecystectomy. By eliminating the gallbladder stump and long cystic duct remnant (>1 cm), this approach aims to reduce both immediate and long-term stump-related complications.

In our series of 83 subtotal cholecystectomies, successful cannulation and guided dissection were achieved in 61 cases. In the remaining cases—primarily empyema gallbladder, xanthogranulomatous cholecystitis, giant gallstones, and small fibrosed contracted gallbladders—absence of intraluminal bile suggested obliteration of the cystic duct by the inflammatory process. In these situations, the residual mucosa was completely ablated, and a subhepatic drain was placed for 24–48 hours. If no biliary drainage was observed, the drain was subsequently removed. It is presumed that in such cases, further intervention such as clipping or ligation is unnecessary because the cystic duct is already sealed by fibrosis. Nonetheless, surgical outcomes inevitably vary according to individual surgeon expertise, as technical proficiency plays a decisive role in managing complex biliary pathology.

The reported incidence of difficult cholecystitis ranges from 10–15% of all acute cholecystitis cases.[20] This variation largely depends on the criteria used to define operative difficulty. Factors contributing to classification as a difficult cholecystectomy include disease severity, presence of dense adhesions causing anatomical distortion, surgeon experience in laparoscopy, and availability of advanced surgical instruments. Severe inflammation within Calot's triangle can result in fibrosis and obliteration of normal anatomical landmarks, increasing the risk of iatrogenic injury to the common hepatic duct, common bile duct, or cystic duct.[21-23] According to the Tokyo Guidelines 2018, increasing severity of acute cholecystitis correlates with a higher incidence of bile duct injury (BDI).[24] BDI is associated with prolonged hospitalization, increased morbidity and mortality, and in severe cases may necessitate major hepatic resection.[25-28]

Several operative strategies have been developed to minimize bile duct injury and achieve the critical view of safety. This view is established by clearing the fibrofatty tissue within Calot's triangle, exposing the lower one-third of the gallbladder, and ensuring that only two structures are seen entering the gallbladder, without exposing or injuring the common bile duct (CBD) or common hepatic duct (CHD).[29-31] Adjunctive intraoperative modalities such as intraoperative cholangiography and fluorescent cholangiography can further aid in delineating the biliary anatomy and reducing the risk of misidentification during difficult dissections.

Limitation of the study: This study has certain limitations. It was conducted as a non-randomized, single-arm study without a control group undergoing conventional subtotal cholecystectomy, which limits direct comparison of outcomes. Being performed in selected center, the findings may not be fully generalizable to all surgical settings, particularly where levels of expertise and available resources differ. The technique is also surgeon-dependent, and outcomes may vary according to operative experience and skill. Although the sample size of 100 patients provides meaningful insight, a larger multicentric study would enhance statistical strength and external validity. Furthermore, the follow-up period of six months may not be sufficient to assess

very late complications such as recurrent stump calculi or delayed biliary symptoms.

CONCLUSION

Subtotal cholecystectomy is a reliable and time-tested bailout procedure in difficult gallbladders with frozen and distorted Calot's triangle, where standard antegrade dissection risks serious biliovascular injury. Despite its safety advantage, concerns remain regarding complications arising from a residual gallbladder and cystic duct stump. An effective solution requires a method that eliminates the remaining lumen and duct remnant. Our stent-guided technique enables safe and precise completion of stump dissection. By facilitating ligation of the cystic duct under guidance, it effectively converts subtotal into a complete cholecystectomy. This approach helps prevent both early and long-term stump-related complications.

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