Half-dome down versus subtotal cholecystectomy in difficult laparoscopic cholecystectomy: A retrospective study

Original Article

Amr Madyan, Mohamed Khidr Mohamed, Mohamed Hossam Eldin Mohamed , Mohamed Abd Allah Abd Elhady

Department of General Surgery, Faculty of Medicine, Mansoura University, Mansoura, Egypt.

ABSTRACT

Background: Laparoscopic cholecystectomy can be challenging in some instances. This study aimed to compare outcomes between half-dome down cholecystectomy and subtotal cholecystectomy in difficult laparoscopic procedures.
Patients and Methods: This retrospective study included 60 patients undergoing laparoscopic cholecystectomy. Patients were divided into two equal groups: half-dome down (group I) and subtotal cholecystectomy (group II). Operative details, postoperative complications, and hospital stay were analyzed.
Results: Operative time, blood loss, and intraoperative difficulties were comparable between groups. Total postoperative complications were significantly lower in group I compared with group II (16.67 vs. 43.33%, *P=0.047*). Port site infection was the most common complication in group II (16.67%). Hospital stay was significantly shorter in group I compared with group II (3.57±1.25 days vs. 4.33±0.99 days, *P=0.011*). No mortality occurred in either group.
Conclusion: Both half-dome down and subtotal cholecystectomy techniques are viable options for difficult laparoscopic cholecystectomies. However, the half-dome down approach demonstrated advantages in lower postoperative complication rates and shorter hospital stays without compromising operative outcomes. These findings suggest that the half-dome down technique may be preferable in managing challenging gallbladder cases.

Key Words: Difficult, half-dome down, laparoscopic cholecystectomy, postoperative complications, subtotal cholecystectomy..

Received: 30 September 2024 **Accepted:** 29 October 2024, **Published:** 01 April 2025

Corresponding Author: Amr Madyan, MD, Department of General Surgery, Faculty of Medicine, Mansoura University, Mansoura, Egypt. **Tel.:** 01007780180, **E-mail:** Profamoora@gmail.com

ISSN: 1110-1121, April 2025, Vol. 44, No. 2: 588-594, © The Egyptian Journal of Surgery

INTRODUCTION

Gallbladder stones represent one of the most prevalent conditions requiring surgical intervention[1–3]. Laparoscopic cholecystectomy (LC) has emerged as the gold standard for treating symptomatic cholelithiasis[4].

The widespread adoption of LC is attributed to its numerous advantages over the open approach, including reduced postoperative pain, shorter hospital stays, improved cosmetic outcomes, and higher patient satisfaction[4,5]. Surgical complications, such as biliary and vascular injuries, have been reported more frequently in LC, especially when dealing with severely inflamed gallbladders[6–8].

Visualizing critical anatomical structures during LC can be significantly impaired by various factors, including severe inflammation, scar tissue, short cystic ducts, ductal structure tenting, anomalous right hepatic arteries or ducts, and Mirizzi's syndrome[9].

The dome-down technique, adapted from open cholecystectomy, involves removing the gallbladder from its bed first[10]. This method allows for a comprehensive evaluation of the cystic duct before division, potentially reducing the risk of bile duct injury due to anatomical misidentification[11].

Subtotal cholecystectomy involves partial removal of the gallbladder, typically through dissection at the infundibulum. It is classified into four types based on the preservation of the posterior wall, area of dissection, and management of remaining structures, making it a useful option when complete removal is too risky[12].

Given the ongoing challenges in managing difficult laparoscopic cholecystectomies, there is a need to compare the efficacy and safety of these alternative techniques. Therefore, this study aims to compare the outcomes of half-dome down and subtotal cholecystectomy approaches in difficult LC procedures.

PATIENTS AND METHODS:

This retrospective study was conducted on 60 patients aged 18–60 years of both sexes, scheduled for LC at Mansoura University Hospitals, Egypt, from April 2021

DOI: 10.21608/EJSUR.2024.325117.1219

to 2024. The institutional ethical committee approved the study protocol (R.24.08.2728.R2).

Exclusion criteria comprised suspected common bile duct stones and gallbladder malignancy.

Preoperatively, patients underwent a comprehensive assessment, including a thorough history, general and local abdominal examination, routine laboratory work-up, liver function tests, and abdominal ultrasonography. Computed tomography and magnetic resonance cholangiopancreatography were performed when common bile duct stones were suspected.

The surgical procedures employed were standard cholecystectomy, dome-down technique, and subtotal cholecystectomy.

Patients were divided into two groups based on the surgical technique used: group I (n=30): Patients who underwent half-dome down cholecystectomy; group II (n=30): Patients who underwent subtotal cholecystectomy.

Preoperative assessment

Preoperatively, we used a combination of clinical, laboratory, and imaging findings to assess the potential difficulty of the cholecystectomy. Factors considered included duration of symptoms, number of previous attacks, white blood cell count, gallbladder wall thickness on ultrasound (>4mm considered predictive of difficulty), presence of pericholecystic fluid, and impacted stones. Cases meeting two or more of these criteria were anticipated to be difficult and were scheduled with experienced laparoscopic surgeons.

For the standard cholecystectomy, patients were prepped and draped, exposing the upper right abdomen. The pneumoperitoneum was created using a Veress needle, with pressure set at 14mmHg. A zero-degree scope was introduced through a 10mm supraumbilical port. Patients were positioned in a 30° reverse Trendelenburg position with a 10° left tilt. The American four-port technique was utilized, with two 10mm trocars in the supraumbilical and epigastric regions and two 5mm trocars in the right midclavicular and anterior axillary lines.

Dome-down technique[13]

The half-dome down technique is used when difficult anatomy or severe inflammation makes it too risky to begin dissection at Calot's triangle due to the potential for bile duct injury. The procedure begins with a standard four-port laparoscopic setup, and if difficulties are encountered with the conventional approach, the decision is made to switch to the dome-down technique. Dissection is initiated at the gallbladder fundus, with either monopolar diathermy or a 5mm ultrasonic vessel sealing device employed. The dissecting instrument is introduced through the epigastric 10mm port. An assistant provides lateral traction using a grasper inserted through the right axillary 5mm port to retract the gallbladder fundus downward and laterally, while another grasper through the right clavicular 5mm port retracts the liver upward and medially.

With the application of traction and counter-traction, dissection proceeds carefully along the gallbladder wall to avoid injuring the liver or other nearby structures. The dissection continues till mid part of the gallbladder body then dissection of the calot triangle become more easy. As the procedure advances, the cystic artery is identified, clipped, or sealed, followed by the dissection of the cystic duct. At this point, the cystic duct is often the only structure still connecting the gallbladder to the bile ducts.

The dissection is limited by the extent of inflammation and the difficulty in identifying key structures, particularly in the triangle of Calot. Once only the cystic duct remains connected, it is clipped and divided, completing the cholecystectomy. In all cases, a drain is left in the subhepatic space. If there is uncertainty regarding the anatomy or risk of bile duct injury, conversion to open surgery may be considered.

Subtotal cholecystectomy

For subtotal cholecystectomy, the procedure began with cranial traction of the gallbladder fundus, followed by infundibulum dissection. If the critical view was impossible, the division was performed at the infundibulum using monopolar or ultrasonic energy. The gallbladder remnant was inspected for stones, closed with interrupted sutures, and a subhepatic drain tube was placed.

To assess the difficulty of cholecystectomy, we used the Nassar Scale[14], which grades the operative difficulty from 1 (least difficult) to 4 (most difficult) based on the appearance of the gallbladder, ease of access, and degree of adhesions. All cases included in this study were graded as Nassar Grade 3 or 4, indicating significantly difficult cholecystectomies.

The primary outcome measure was postoperative complications, while secondary outcomes included mortality and length of hospital stay. Conversion to open cholecystectomy was planned if dissection progress failed during the dome-down technique.

The choice between half-dome down and subtotal cholecystectomy was made intraoperatively based on the following criteria: half-dome down was preferred when the fundus and body of the gallbladder could be easily identified, there was a plane of dissection between the gallbladder and liver bed, and the degree of inflammation allowed for safe dissection from above. Subtotal cholecystectomy was chosen when severe inflammation obliterated the plane

between the gallbladder and liver, there was a risk of liver bed injury with complete dissection, and the cystic duct could not be safely identified or isolated.

The final decision was based on the operating surgeon's judgment of which technique would allow for the safest procedure completion.

Sample size calculation

The sample size was calculated using G*Power software, version 3.1.9.2 (Universität Kiel, Germany). According to previous studies, the postoperative complication rate was 21.6% with the dome-down technique[13] and 55% with subtotal cholecystectomy[15]. The following parameters were considered: an alpha error of 0.05, a study power of 80%, and an allocation ratio 1 : 1. Consequently, 30 patients were assigned to each group.

Statistical analysis

Statistical analysis was done by SPSS v27 (IBM, Armonk, New York, USA). Shapiro–Wilks test and histograms were used to evaluate the normality of the data distribution. Quantitative parametric data were presented as mean and standard deviation (SD) and were analyzed by the unpaired Student *t*-test. Qualitative variables were presented as frequency (%) and analyzed using the χ^2 test or Fisher's exact test when appropriate. A two-tailed *P value* less than 0.05 was considered statistically significant.

RESULTS:

Age, sex, and medical history were insignificantly different between the groups (Table 1).

As regards the operative data of the studied groups, there were no significant differences between group I and group II in terms of operative time, blood loss, method of dissection, or intraoperative difficulties (Table 2).

Regarding postoperative complications, while individual complication rates were not significantly different between the groups, the total postoperative complication rate was significantly lower in group I than group II, with relative risk 0.3895 and confidence interval 0.15–0.94 (*P=0.047*) (Table 3).

Regarding the length of hospital stay and mortality among the studied groups, a statistically significant reduction was observed in group I compared with group II (*P=0.011*). No mortality was reported in either group (Table 4).

Table 1: Demographic data and medical history of the studied groups

	Group I (*n*=30)	Group II (*n*=30)	*P* value
Age (years)	40.83±11.2	43.67±13.44	0.379
Sex			
Male	13 (43.33)	16 (53.33)	0.438
Female	17 (56.67)	14 (46.67)	
Medical history			
Hypertension	8 (26.67)	6 (20)	0.542
DM	13 (43.33)	12 (40)	0.793
Ischemic heart disease	3 (10)	5 (16.67)	0.706
Renal impairment	1 (3.33)	2 (6.67)	1
COPD	3 (10)	1 (3.33)	0.612

Data are presented as mean±SD or frequency (%); COPD: Chronic Obstructive Pulmonary Disease; DM: Diabetes Mellitus.

Table 2: Operative data of the studied groups

	Group I (*n*=30)	Group II (*n*=30)	*P value*
Operative time (min)	94.33±60.61	96.33±59.45	0.898
Blood loss (ml)	77.2±44.97	84.87±37.74	0.477
Method of dissection			
Monopolar diathermy	20 (66.67)	22 (73.33)	0.573
Ultrasonic energy (Harmonic)	10 (33.33)	8 (26.67)	
Difficulties			
Marked adhesion	19 (63.33)	22 (73.33)	0.405
Acute attack	21 (70)	23 (76.67)	0.559
Empyema	8 (26.67)	11 (36.67)	0.405
History of acute pancreatitis	2 (6.67)	3 (10)	1
Cirrhosis	2 (6.67)	4 (13.33)	0.670
Perforated gall bladder	2 (6.67)	3 (10)	1

Data are presented as mean±SD or frequency (%).

Table 3: Postoperative complications of the studied groups

	Group I (*n*=30)	Group II (*n*=30)	*P* value
Port site infection	1 (3.33)	5 (16.67)	0.194
Port site hernia	1 (3.33)	3 (10)	0.612
Subcutaneous hematoma	1 (3.33)	3 (10)	0.612
Urinary retention	0	5 (16.67)	0.052
Pulmonary atelectasis	0	4 (13.33)	0.112
Biliary injury(lateral wall)	1 (3.33)	0	1
Recurrent stump stone	0	1 (3.33)	1
Total postoperative complications	5 (16.67)	13 (43.33)	0.047

Data are presented as frequency (%).

Table 4: Hospital stays and mortality of the studied groups

	Group I (*n*=30)	Group II (*n*=30)	*P* value
Length of hospital stay (days)	3.57±1.25	4.33±0.99	0.011
Mortality	0	0	–

Data are presented as mean±SD or frequency (%).

DISCUSSION

The present study compared the outcomes of half-dome down cholecystectomy and subtotal cholecystectomy in difficult laparoscopic cholecystectomies. Our findings provide valuable insights into the relative merits of these two approaches in managing challenging gallbladder cases.

Our study revealed comparable operative outcomes between half-dome down cholecystectomy and subtotal cholecystectomy. The mean operative time was (94.33±60.61min) in group I compared with group II (96.33±59.45min). This finding aligns with the results reported by Kassem *et al*.[13], who found a mean operative time of 102.84min for the dome-down technique in difficult laparoscopic cholecystectomies. The similarity in operative times suggests that both techniques are feasible options for managing challenging cases without significantly prolonging surgery duration.

Intraoperative blood loss was marginally lower in group I (77.2±44.97ml) than in group II (84.87±37.74ml), but this difference did not reach statistical significance (*P=0.477*). This observation is particularly noteworthy given the potential for increased bleeding in difficult cholecystectomies. The comparable blood loss between the two techniques suggests that both approaches can be safely employed without significantly increasing the risk of hemorrhagic complications.

The most common intraoperative difficulties encountered were acute attacks (70% in group I and 76.67% in group II) and marked adhesions (63.33% in group I and 73.33% in group II). These findings corroborate the challenging nature of the cases included in our study and are consistent with the difficulties reported by Panni *et al*.[16], who found that 93% of aborted cholecystectomies were classified as the highest level of difficulty on the Nassar scale[14] (Grade 4). The ability to complete these challenging procedures using either the half-dome down or subtotal approach underscores the value of these techniques in managing difficult gallbladders.

Analysis of postoperative complications revealed a notable difference between the two groups, with group II experiencing a higher overall complication rate (43.33%) compared with group I (16.67%), which was statistically significant (*P=0.047*). This finding is particularly important as it suggests that the half-dome down technique may offer a safety advantage over subtotal cholecystectomy in difficult cases.

The most frequent complication in group II was port site infection (16.67%), followed by urinary retention and pulmonary atelectasis (13.33% each). In contrast, group I had lower rates of these complications, with only one case each of port site infection, port site hernia, subcutaneous hematoma, and biliary injury. This disparity in complication rates aligns with the findings of Al-Azzawi *et al*.[17], who reported bile leakage as the most prevalent complication (18%) in their systematic review of laparoscopic subtotal cholecystectomy. However, our study found a lower incidence of bile leakage than their report.

Interestingly, group I had no urinary retention or pulmonary atelectasis cases, while group II had no cases of biliary injury. The absence of biliary injury in group II is consistent with the low rate (0.23%) Al-Azzawi *et al*.[17] reported for subtotal

cholecystectomy. However, the presence of a biliary injury case in group I highlights the persistent risk of this serious complication even with the half-dome down technique.

The unique complication of recurrent stump stones (3.33%) observed in group II is a known risk associated with subtotal cholecystectomy, as reported by Concors *et al*.[18]. This complication underscores the importance of thorough stone removal and proper management of the gallbladder remnant in subtotal cholecystectomy to minimize the risk of recurrent symptoms.

The analysis of hospital stays revealed a statistically significant difference between the two groups (*P=0.011*), with patients in group I having a shorter mean hospital stay of 3.57±1.25 days compared to 4.33±0.99 days in group II. This finding is particularly valuable from both clinical and economic perspectives. The shorter hospital stay associated with the half-dome down technique aligns with the trend towards minimally invasive approaches in gallbladder surgery and their associated benefits of faster recovery and reduced healthcare costs.

Our results compare favorably with those reported by Henneman and da Costa[12], who found a median length of stay of 4.5 days (ranging from 0 to 48 days) for subtotal cholecystectomy. The shorter hospital stay observed in our study for both groups may reflect advancements in perioperative care and the surgical team's expertise in managing difficult cholecystectomies.

Importantly, neither group reported mortalities, indicating that both techniques were safe in terms of survival outcomes. This zero mortality rate is encouraging and compares favorably with the low mortality rates reported in the literature for difficult cholecystectomies. For instance, Koo *et al*.[19] reported a 30-day mortality rate of 0.2% in their meta-analysis of laparoscopic subtotal cholecystectomy cases.

Despite the challenging nature of the cases, the absence of mortality in our study underscores the value of employing specialized techniques like half-dome down and subtotal cholecystectomy in difficult laparoscopic cholecystectomies. It also reflects the importance of surgical expertise and appropriate case selection in managing these complex cases.

The subtotal cholecystectomy technique employed in our study aligns with the reconstituting subtype described by Koo *et al*.[19]. Their meta-analysis found that reconstituting subtotal cholecystectomy was associated with lower open conversion rates, retained stones, subhepatic collections, and the need for reoperation compared with fenestrating subtotal cholecystectomy. While our study did not differentiate between subtypes of subtotal cholecystectomy, the overall complication rates we observed fall within the ranges reported in their analysis.

While the higher rate of port site infections in group II (subtotal cholecystectomy) may be related to longer operative times and more extensive tissue manipulation, and increased number of patients with empyema and perforation, the increased incidence of urinary retention and pulmonary atelectasis is likely multifactorial. These complications may be associated with anesthesia time, postoperative bed rest due to pain or drainage tubes, and the overall inflammatory response to more extensive surgery. However, it is important to note that the difference in these individual complication rates did not reach statistical significance, and a larger study would be needed to confirm any direct relationship between the surgical technique and these specific complications.

Our study's findings also contribute to the ongoing discussion about the optimal management of difficult gallbladders, as addressed by Seshadri *et al*.[20]. Their review emphasized the importance of adopting a culture of safe cholecystectomy and highlighted the role of bailout procedures like subtotal cholecystectomy when a critical view of safety cannot be achieved. Our results support this approach, demonstrating that both half-dome down and subtotal techniques can be employed safely in challenging cases, with the half-dome down method potentially offering some advantages regarding postoperative complications and hospital stay.

The decision to proceed with half-dome down or subtotal cholecystectomy rather than converting to open surgery was based on several factors: the surgeons' expertise in advanced laparoscopic techniques, the potential benefits of maintaining a minimally invasive approach (reduced pain, faster recovery, shorter hospital stay), and the assessment that these techniques could safely complete the procedure without compromising patient safety. If there is uncertainty regarding the anatomy or risk of bile duct injury, conversion to open surgery may be considered.

This study has several limitations. As a retrospective analysis, it is subject to selection bias and confounding factors that may have influenced outcomes. The sample size is relatively small and may limit generalizability. The single-center design reflects practices at one institution, potentially reducing external validity. Future prospective, multi-center studies with larger sample sizes and extended follow-up periods would help validate these findings and provide more robust evidence for optimal management of difficult LC.

CONCLUSION

Both half-dome down cholecystectomy and subtotal cholecystectomy are good options for managing difficult laparoscopic cholecystectomies and decreasing the rate of conversion to open cholecystectomy. The half-dome down technique offers advantages in terms of lower postoperative complication rates and shorter hospital stays without compromising operative times or intraoperative outcomes (Fig. 1).

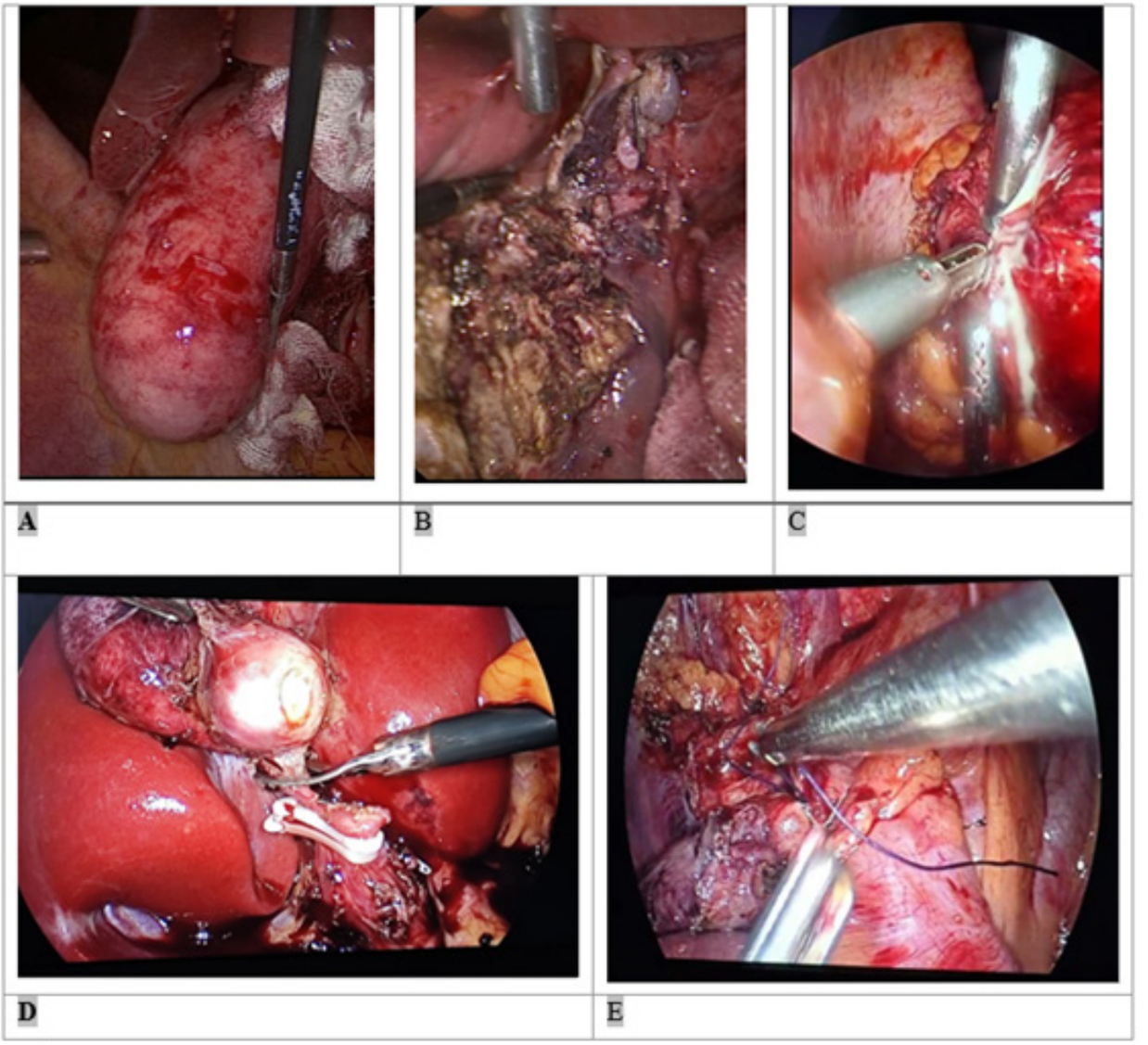

Fig. 1: A–E Intraoperative findings and techniques in difficult LC: half-dome down vs. subtotal approach. A: Intraoperative view of a gallbladder mucocele. B: Gallbladder bed after completion of half-dome down LC. C: Intraoperative image of a gallbladder pyocele encountered during difficult cholecystectomy. D: Completion of subtotal cholecystectomy using hemoclip application on the gallbladder stump. E: Closure of gallbladder remnant using vicryl sutures in subtotal cholecystectomy.

CONFLICT OF INTEREST

There are no conflicts of interest.

REFERENCES

1. Jacoby H, Rayman S, Oliphant U, Nelson D, Ross S, Rosemurgy A, *et al*. Current operative approaches to the diseased gallbladder. Diagnosis and management updates for general surgeons. Am Surg 2024; 90:122–129.

2. Strosberg DS, Nguyen MC, Muscarella P, Narula VK. A retrospective comparison of robotic cholecystectomy versus laparoscopic

cholecystectomy: operative outcomes and cost analysis. Surg Endosc 2017; 31:1436–1441.

3. Handzel RM, Peitzman AB. Laparoscopic cholecystectomy: semi-top-down technique. Ann Laparosc Endosc Surg 2019; 4:121–128.

4. Igbal Y, Adam YA, Awan FN. Clinical outcomes of delayed laparoscopic cholecystectomy in patients with acute calculous cholecystitis: A single centre study. SAS J Surg 2024; 3:345–364.

5. Mehmood A, Mei SY. Laparoscopic cholecystectomy versus open cholecystectomy. World J Biol Pharm Health Sci 2024; 17:396–404.

6. Pesce A, Fabbri N, Feo CV. Vascular injury during laparoscopic cholecystectomy: An often-overlooked complication. World J Gastrointest Surg 2023; 15:338–341.

7. Gupta V, Gupta V, Joshi P, Kumar S, Kulkarni R, Chopra N, *et al*. Management of post cholecystectomy vascular injuries. The Surgeon 2019; 17:326–333.

8. Sorrentino L, Serra F, Cabry F, Gelmini R. Dome down laparoscopic cholecystectomy: Our experience and the state of art. Ann Emerg Surg 2017; 2:1022–1027.

9. Stuart CM, Huey MG, Ghincea CV, Pieracci FM, Brooke M. Mirizzi syndrome complicated by type IV cholecystobiliary fistula to the right hepatic duct. J Minim Invasive Surg 2023; 26:35–39.

10. Sharma M, Vindal A, Lal P. Gall bladder Flip technique in laparoscopic cholecystectomy. J Minim Access Surg. 2017; 13:318–320.

11. Missori G, Serra F, Gelmini R. A narrative review about difficult laparoscopic cholecystectomy: technical tips. Laparosc Surg 2022; 6:1–10.

12. 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.

13. Kassem MI, Elzeiny MM, El-Haddad HM, AbuNasr AA. Dome down approach for difficult laparoscopic cholecystectomy. Egypt J Surg 2015; 34:203–209.

14. Nassar AH, Hodson J, Ng HJ, Vohra RS, Katbeh T, Zino S, *et al*. Predicting the difficult laparoscopic cholecystectomy: development and validation of a preoperative risk score using an objective operative difficulty grading system. Surg Endosc 2020; 34:4549–4561.

15. Coelho JCU, Dalledone GO, Domingos MF, Nassif LT, de-Freitas ACT, Matias JEF. Outcome of laparoscopic cholecystectomy in the elderly. J Braz College of Surgeons 2018; 45:e2020.

16. Panni UY, Williams GA, Hammill CW, Sanford DE, Hawkins WG, Strasberg SM. Cause and outcome of aborting a difficult laparoscopic cholecystectomy due to severe inflammation: a study of operative notes. Surg Endosc 2022; 36:7288–7294.

17. Al-Azzawi M, Abouelazayem M, Parmar C, Singhal R, Amr B, Martinino A, *et al*. A systematic review on laparoscopic subtotal cholecystectomy for difficult gallbladders: a lifesaving bailout or an incomplete operation? Ann R Coll Surg Engl 2024; 106:205–212.

18. Concors SJ, Kirkland ML, Schuricht AL, Dempsey DT, Morris JB, Vollmer CM, *et al*. Resection of gallbladder remnants after subtotal cholecystectomy: presentation and management. HPB 2018; 20:1062–1066.

19. Koo JG, Chan YH, Shelat VG. Laparoscopic subtotal cholecystectomy: comparison of reconstituting and fenestrating techniques. Surg Endosc 2021; 35:1014–1024.

20. Seshadri A, Peitzman AB. The difficult cholecystectomy: What you need to know. J Trauma Acute Care Surg 2024; 97:325–336.