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Original Article

# Safety and Efficacy of Retrograde Versus Conventional Technique in Difficult Laparoscopic Cholecystectomy

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## ABSTRACT

Background: Laparoscopic cholecystectomy (LC) is the standard treatment for calculous cholecystitis due to its minimal invasiveness and favorable postoperative outcomes. However, difficult laparoscopic cholecystectomy remains a significant surgical challenge because of factors like severe inflammation, adhesions, or anatomical anomalies. These factors increase the risk of complications such as bile duct injuries, conversion to open surgery. To enhance safety in such cases, alternative techniques like the retrograde (fundus-first) approach have been proposed. This study was designed to compare the safety and efficacy of the conventional technique and the retrograde technique in difficult LC, with the goal of selecting the most appropriate method for managing these complex cases. Methods: This prospective randomized controlled trial was conducted at the Liver, GIT, and Endo-Lap Surgery Unit, General Surgery Department, Zagazig University Hospital, and involved 32 patients predicted to be cases of difficult cholecystectomy. Preoperative evaluation involved ultrasonographic measurement of gallbladder wall thickness and CBD diameter, along with the Nassar score for predicting surgical difficulty. Results: Mean operative times were similar between groups (53.19±9.32vs. 55.94±13.72 minutes; p=0.66). Intraoperative bleeding was significantly higher in the retrograde group (31.25% vs. 0%; p=0.043). Other intraoperative complications and postoperative recovery parameters showed no significant differences. Conclusion: Retrograde LC is a feasible alternative in difficult cases when conventional dissection is unsafe. However, it may carry a higher risk of intraoperative bleeding, highlighting the importance of careful patient selection and surgical expertise.

Keywords: Difficult Laparoscopic cholecystectomy, Retrograde technique, Fundus-first

## INTRODUCTION

The treatment of patients with cholecystitis and cholelithiasis symptoms has been transformed by laparoscopic cholecystectomy. An explosion of minimally invasive surgical techniques results from the quick adoption of this technique by both surgeons and patients [1].

Because of its benefits, laparoscopic cholecystectomy improves quality of life more quickly than open cholecystectomy. These include less postoperative pain, quicker recovery, and improved cosmetic outcomes [2].

Pregnancy, prior abdominal surgery, obesity, cirrhosis, and acute cholecystitis were all

regarded as absolute contraindications for the laparoscopic procedure when it was first introduced in the early 1990s. All of these conventional contraindications are, at best, relative because of the variety of increasingly complicated procedures performed as laparoscopic skills and equipment have improved [3].

Nonetheless, a sizable portion of patients still require conversion to open surgery because laparoscopic cholecystectomy [LC] cannot be completed effectively. Nevertheless, switching to open surgery does not ensure that vascular or biliary damage will not occur. Conversion is concurrently linked to open surgery complications [4].

To meet the critical view of safety for standard laparoscopic cholecystectomy, the contents of Calot's triangle must be safely dissected [5]. Acute inflammation, Mirizzi syndrome, chronic inflammation that has persisted for a long time, and poor access to the gallbladder because of extensive omental adhesions for any reason make this step challenging. This raises the risk of bile duct damage, which can be up to 3.5 times higher than the risk of a typical cholecystectomy **[6].**

Due to its subjective nature, difficult cholecystectomy lacks a precise definition. Numerous research attempted to use objective criteria to characterize and forecast complicated cholecystectomy. Male gender, age over 60, history of prior upper laparotomy, repeated episodes of acute cholecystitis, increased serum amylase, post-ERCP cases, gallbladder adhesions, acute inflammation, and Mirizzi syndrome are some of these criteria [7, 8]. This study compares the results of the retrograde technique and the regular approach in cases of expected difficult laparoscopic cholecystectomy since problems from the traditional approach are common in cases of difficult cholecystectomy.

**Aim of the work:**

This study was designed to compare the safety and efficacy of the conventional technique and the retrograde technique in difficult LC, with the goal of selecting the most appropriate method for managing these complex cases.

## METHODS

This prospective randomized controlled trial was conducted at the Liver, GIT, and Endo-Lap Surgery Unit, General Surgery Department, Zagazig University Hospital, between January and December 2024. The study included 32 patients with symptomatic gallstone disease. Eligible participants were patients aged 18 years or older, of either gender, who were medically fit for laparoscopic cholecystectomy and had no contraindications to general anesthesia. Furthermore, only patients classified as medium or high risk for difficult laparoscopic cholecystectomy based on the Nassar scoring system were included **(table 1) [8]**. Exclusion criteria comprised absolute contraindications to laparoscopic surgery, such as significant cardiovascular or pulmonary disease, end-stage liver disease, coagulation disorders, or an American Society of Anesthesiologists (ASA) score that precluded safe laparoscopic intervention. Patients classified as low risk by the Nassar scoring system were also excluded. Approval was taken from the research ethical committee and the institutional review board (IRB#11314-21/11-2023) of Zagazig University's Faculty of Medicine. Every patient gave their consent to take part in the trial. The work was conducted in compliance with the World Medical Association's Code of Ethics, the 1964 Declaration of Helsinki, and its later unifications for research involving human people.

Patients were randomly allocated using an alternating number method, whereby patients with odd numbers were assigned to Group 1 (conventional technique), and

Group 2 (retrograde approach) was assigned to individuals with even numbers.

All patients had preoperative data gathered, including demographic information including age, gender, and body mass index (BMI, kg/m²). The clinical history included previous acute cholecystitis hospitalizations, length of symptoms, time from the last incident or admission, endoscopic retrograde cholangiopancreatography (ERCP) history, and comorbidities such as liver cirrhosis and diabetes mellitus. Regular blood tests, such as complete blood counts, coagulation profiles, fasting blood sugars, liver function tests, and kidney function tests, were part of the laboratory studies. Abdominal ultrasound was used for radiological evaluation in order to measure the diameter of the common bile duct (CBD) and the thickness of the gallbladder wall. When ultrasonography proved unable to identify stones in a normal or dilated CBD, magnetic resonance cholangiopancreatography (MRCP) was used selectively in patients with increased serum bilirubin levels. Additionally, the Nassar rating system was used to evaluate each patient before to surgery.

Preoperative preparation included fasting for at least six hours, preoperative showering with mild antibacterial soap to clean the abdomen and groin areas, and administration of a single intravenous dose of ceftriaxone, a third-generation cephalosporin, within one hour prior to the skin incision.

**Surgical technique**:

Every case had a laparoscopic cholecystectomy using the conventional four-port method. After the pneumoperitoneum was established, patients were placed supine with a sharp head-up tilt. The following ports were inserted: a 5 mm aiding port at the anterior axillary line, a 10 mm operating port at the epigastrium, a 10 mm telescope port at the umbilicus, and a 5 mm port at the right mid-clavicular line. To evaluate the operation field and verify the viability of the laparoscopic surgery, a preliminary laparoscopic examination was performed.

**Group A (Conventional Laparoscopic Cholecystectomy):**

In the conventional technique group, a safe dissection was performed to achieve the "critical view of safety" prior to dividing any structures **(figure 1).** This involved complete exposure and delineation of the hepatocystic triangle, The bottom portion of the gallbladder was carefully dissected from the liver bed, and it was evident that there was only one cystic duct and one cystic artery entering the gallbladder. Following confirmation of the critical attitude of safety, the cystic artery and cystic duct were individually secured using clips and divided with scissors. Following this, the gallbladder was detached across the areolar tissue plane that connects the gallbladder to Glisson's capsule, which is carefully dissected from the liver.

**Group B (Fundus-First Laparoscopic Cholecystectomy):**

In the retrograde (fundus-first) technique group, dissection was initiated at the gallbladder fundus, which was separated from the liver bed using electrocautery **(figure 2).** The dissection then proceeded in a downward direction toward the infundibulum, with careful attention to remain close to the gallbladder wall to reduce the possibility of damage to the liver or bile ducts. This method caused the cystic artery and cystic duct to pedunculate the gallbladder, which were then cut and separated.

Drains were not routinely inserted after elective laparoscopic cholecystectomy unless intraoperative circumstances necessitated their use**.**

**Operative Parameters:**

Intraoperative data were collected for all patients and included operative time,

measured as the time between the first port being inserted and the last port being removed. Intraoperative adverse events were documented, including bleeding, gallbladder or cystic duct perforation, bile or stone spillage, and injuries to the common bile duct, liver, or other intra-abdominal organs. The overall operative difficulty was assessed using the scoring system proposed by **Sugrue et al. [7].**

**Postoperative Care and Data Collection:**

Postoperatively, patients were allowed to start oral intake once intestinal sounds returned. Drains, if placed, were removed 24 hours postoperatively unless there was evidence of bile leakage or a drain output exceeding 100 mL of blood. The majority of patients were discharged on the first postoperative day following toleration of oral feeding and removal of drains when present.

Postoperative parameters collected included time to first passage of flatus, evaluation of postoperative pain within 24 hours using the Visual Analog Scale (VAS), the type and amount of analgesia administered (nonsteroidal anti-inflammatory drugs [NSAIDs] or opioids), drain output, postoperative fever, total leucocytic count (TLC), liver enzyme levels, and the incidence of postoperative ileus, time till discharge from hospital, along with the incidence of long-term complications such as biliary injury, biliary obstruction, cholangitis, intra-abdominal abscess, and the need for re-intervention procedures such as ERCP or interventional radiology.

**Statistical analysis**

Analysis was conducted using the Statistical Package for the Social Sciences (SPSS) software, version 20.0. Fisher's exact test or the Chi square test (X2) were used to evaluate the differences and associations between the qualitative variables. The Mann Whittney U test for non-parametric data and the t test for parametric data were used to evaluate differences between quantitative variables. A P value of less than 0.05 was deemed statistically significant, while a value of less than 0.001 was deemed extremely significant.

## RESULTS

A total of 32 patients were equally divided between the conventional (n = 16) and retrograde (n = 16) technique groups (**Table 2).** None of the baseline features showed statistically significant differences.

With a median (IQR) of 8 (6-9) versus 6.5 (6-9) in the conventional group, the mean Nassar score was somewhat higher in the retrograde group; however, this difference was not statistically significant (P = 0.41). Other preoperative clinical data also showed no discernible differences between the two groups **(Table 3)**.

The operative data revealed no significant difference in operative time or Sugrue scores. However, intraoperative bleeding was significantly more frequent in the retrograde group, occurring in 5 patients (31.25%) compared to none in the conventional group (P = 0.0434), 2 cases had bleeding from the pedicle (cystic artery) who were managed by hemostatic clips and 3 cases had bleeding from the gall bladder bed who were managed by electrocautery. None of the cases required blood transfusion **(Table 4)**.

Other intraoperative complications, including gallbladder perforation, bile or stone spillage **(Figures 3A, B)**, and conversion to open surgery occurred only in the retrograde group but with no statistically significant difference. No cases of common bile duct or other organ injury were reported in either group.

Early postoperative outcomes **(Table 5)** showed no statistically significant differences between the conventional and retrograde technique groups regarding time to first flatus, visual analogue scale (VAS) or postoperative stay. All patients were discharged within 24 hours except for: 1 patient in the conventional group discharged

after 48-hours as there was 150 cc serosanguinous in the drain during the first 24 hours, and 2 patients in the retrograde group, the first of which was converted to open surgery and discharged after 48-hours, and the second was delayed in discharge to 1 week due to bile leakage. There were no cases of postoperative ileus, bleeding, or biliary obstruction were reported in either the conventional or retrograde groups **(Table 6)**. Bile leakage was observed in 1 patient in the retrograde group and none in the conventional group (P = 0.99). Abdominal pain occurred equally in one patient in both groups. One patient in the retrograde group required an additional intervention i.e. ERCP (P = 0.99) for the case of biliary leakage from the cystic duct stump and the patient required placement of a plastic biliary stent. There were no readmissions in either group.

**Table (1):** Nassar scoring system **[8]**.

| | **Points** |
|---|---|
| **Age (years)** | |
| • **<40** | **0** |
| • **40+** | **1** |
| **Gender** | |
| • **Female** | **0** |
| • **Male** | **1** |
| **ASA classification** | |
| • **1** | **0** |
| • **2** | **1** |
| • **3** | **2** |
| • **4-5** | **7** |
| **Primary diagnosis** | |
| • **Pancreatitis** | **0** |
| • **Biliary colic** | **0** |
| • **CBD stones** | **1** |
| • **Cholecystitis** | **4** |
| **Thick-walled gall bladder (≥ 3 mm)** | |
| • **No** | **0** |
| • **Yes** | **2** |
| **CBD dilatation (>6mm)** | |
| • **No** | **0** |
| • **Yes** | **1** |
| **Pre-operative ERCP** | |
| • **No** | **0** |
| • **Yes** | **1** |
| **`Admission type** | |
| • **Elective** | **0** |
| • **Delayed** | **1** |
| • **Emergency** | **2** |
| **patients are classified according to total score into:**<br>**0–1 → low risk**<br>**2-6 → medium risk**<br>**7+ → high risk** | |

**Table (2):** Comparison between the conventional and retrograde techniques groups regarding basal characteristics:

| | Conventional technique (N = 16) | Retrograde technique (N = 16) | P. Value |
|---|---|---|---|
| Age (years, Mean ± SD) | 55.63 ± 7.7 | 54.88 ± 7.39 | 0.8146 [t] |
| Sex | | | |
| • Male (%) | 5 (31.25%) | 6 (37.5%) | 0.7205 [X] |
| • Female (%) | 11 (68.75%) | 10 (62.5%) | |
| BMI ($Kg/m^2$, Mean ± SD) | 28.66 ± 1.85 | 29.18 ± 1.83 | 0.3289 [t] |
| Hospitalisation for acute cholecystitis (%) | 6 (37.5%) | 7 (43.75%) | 0.7294 [X] |
| Duration of symptoms (years, Median /IQR) | 4.5 (2.75 - 7.75) | 5 (2.75 - 8.5) | 0.879 [MWU] |
| Time of last attack (weeks, Median /IQR) | 8.5 (7.5 - 12) | 8 (4 - 14.5) | 0.7452 [MWU] |
| History of ERCP (%) | 3 (18.75%) | 2 (12.5%) | 0.6395 [X] |
| Comorbidities | | | |
| • No comorbidities (%) | 5 (31.25%) | 4 (25%) | 0.7054 [X] |
| • Hypertension (%) | 7 (43.75%) | 6 (37.5%) | 0.7294 [X] |
| • Diabetes Mellitus (%) | 6 (37.5%) | 7 (43.75%) | 0.7294 [X] |
| • Hypothyroid (%) | 2 (12.5%) | 1 (6.25%) | 0.5592 [X] |
| • Bronchial asthma (%) | 1 (6.25%) | 2 (12.5%) | 0.5592 [X] |
| • Cardiomyopathy (%) | 1 (6.25%) | 1 (6.25%) | 0.99 [X] |
| • History of upper abdominal operations (%) | 1 (6.25%) | 2 (12.5%) | 0.5592 [X] |

**BMI: Body mass index, ERCP: Endoscopic Retrograde Cholangiopancreatography.**
**t: Student's t-test, X: Chi square test, MWU: Mann Whittney U test.**

**Table (3):** Comparison between the conventional and retrograde techniques groups regarding clinical data:

| | Conventional technique (N = 16) | Retrograde technique (N = 16) | P. Value |
|---|---|---|---|
| GB wall thickness | | | |
| • Average (%) | 10 (62.5%) | 9 (56.25%) | 0.7294 [X] |
| • Increased thickness (≥ 4 mm) (%) | 6 (37.5%) | 7 (43.75%) | |
| CBD diameter | | | |
| • Normal (%) | 13 (81.25%) | 14 (87.5%) | 0.6395 [X] |
| • Dilated (%) | 3 (18.75%) | 2 (12.5%) | |
| ASA classification | | | |
| • 1 (%) | 6 (37.5%) | 5 (31.25%) | 0.7714 [X] |
| • 2 (%) | 6 (37.5%) | 8 (50%) | |
| • 3 (%) | 4 (25%) | 3 (18.75%) | |
| Nassar score (Median /Range) | 6.5 (6 - 9) | 8 (6 - 9) | 0.41 [MWU] |

**GB: Gall bladder, CBD: Common bile duct, ASA: American Society of Anesthesiologists.**
**X: Chi square test, MWU: Mann Whittney U test.**

**Table (4):** Comparison between the conventional and retrograde techniques groups regarding operative data:

| | Conventional technique (N = 16) | Retrograde technique (N = 16) | P. Value |
|---|---|---|---|
| Operative time (min, Mean ± SD) | 53.19 ± 9.32 | 55.94 ± 13.72 | 0.6611 [MWU] |
| Intraoperative complications | | | |
| • Intraoperative bleeding (%) | 0 (0%) | 5 (31.25%) | 0.0434* [f] |
| • Gall bladder perforation (%) | 0 (0%) | 1 (6.25%) | 0.99 [f] |
| • Bile / stone spillage (%) | 0 (0%) | 3 (18.75%) | 0.2258 [f] |
| • Common bile duct injury (%) | 0 (0%) | 0 (0%) | - |
| • Other organ injury (%) | 0 (0%) | 0 (0%) | - |
| • Conversion to open surgery (%) | 0 (0%) | 1 (6.25%) | 0.99 [f] |
| Sugrue score (%) | | | |
| • Mild | 4 (25%) | 3 (18.75%) | 0.4118 [X] |
| • Moderate | 7 (43.75%) | 4 (25%) | |
| • Severe | 4 (25%) | 5 (31.25%) | |
| • Extreme | 1 (6.25%) | 4 (25%) | |

**MWU: Mann Whittney U test, f: Fisher exact test, X: Chi square test, *: significant difference.**

**Table (5):** Early postoperative outcomes in both group:

| **Postoperative outcomes** | | | |
|---|---|---|---|
| Time to first flatus (Hours) | 4 (3 - 4) | 4 (3 - 4.25) | 0.362 [MWU] |
| VAS pain score | 5 (4.75 - 5.25) | 6 (5 - 6) | 0.0881 [MWU] |
| Post-operative analgesia (type and dosage) | | | |
| • NSAIDs | 15 (93.75%) | 14 (87.5%) | 0.5592 [X] |
| • Nalbuphine hydrochloride | 1 (6.25%) | 2 (12.5%) | |
| Post-operative stay (days, median/ range) | 1 (1-2) | 1 (1-7) | 0.3681 [MWU] |

**MWU: Mann Whittney U test, X: Chi square test, VAS: Visual analogue scale, NSAID: non-steroid anti-inflammatory drug.**

**Table (6): comparing postoperative complications in both group:**

| **Postoperative Complications** | | | |
|---|---|---|---|
| Post-operative ileus | 0 (0%) | 0 (0%) | - |
| Post-operative Bleeding | 0 (0%) | 0 (0%) | - |
| Bile leakage | 0 (0%) | 1 (6.25%) | 0.99 [f] |
| Abdominal pain | 1 (6.25%) | 1 (6.25%) | 1.00 [X] |
| Biliary obstruction | 0 (0%) | 0 (0%) | - |
| Re-admission | 0 (0%) | 0 (0%) | - |
| Need for other interventions (ERCP) | 0 (0%) | 1 (6.25%) | 0.99 [f] |

**f: Fisher exact test, X: Chi square test, ERCP: Endoscopic Retrograde Cholangiopancreatography.**

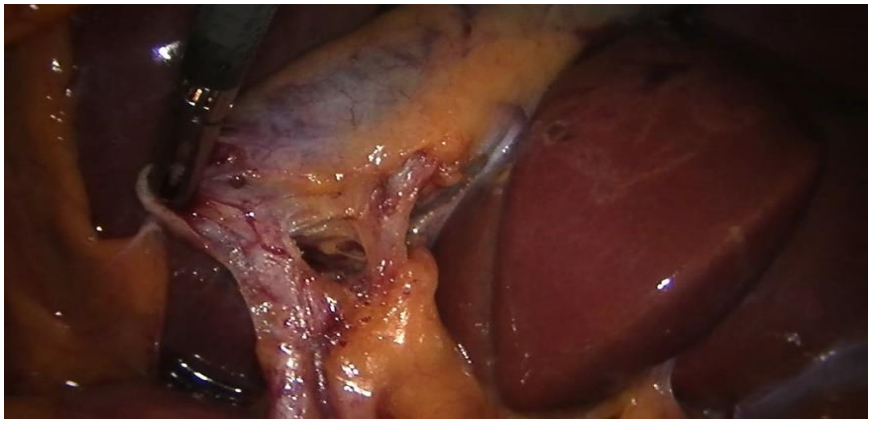


**Figure (1): Critical view of safety**

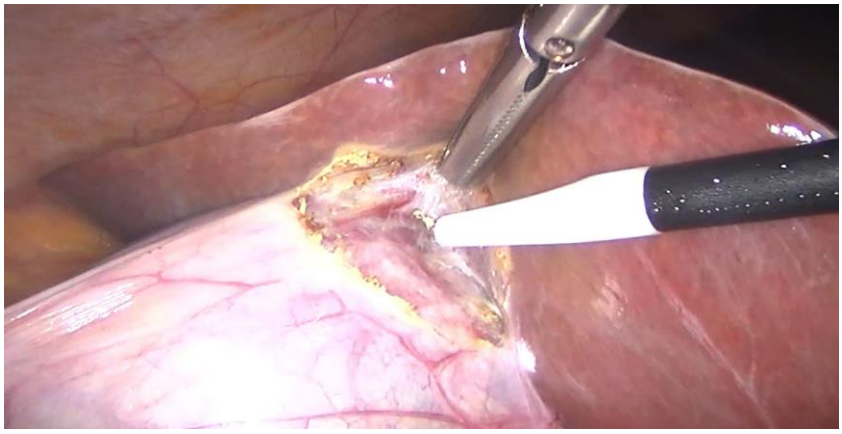
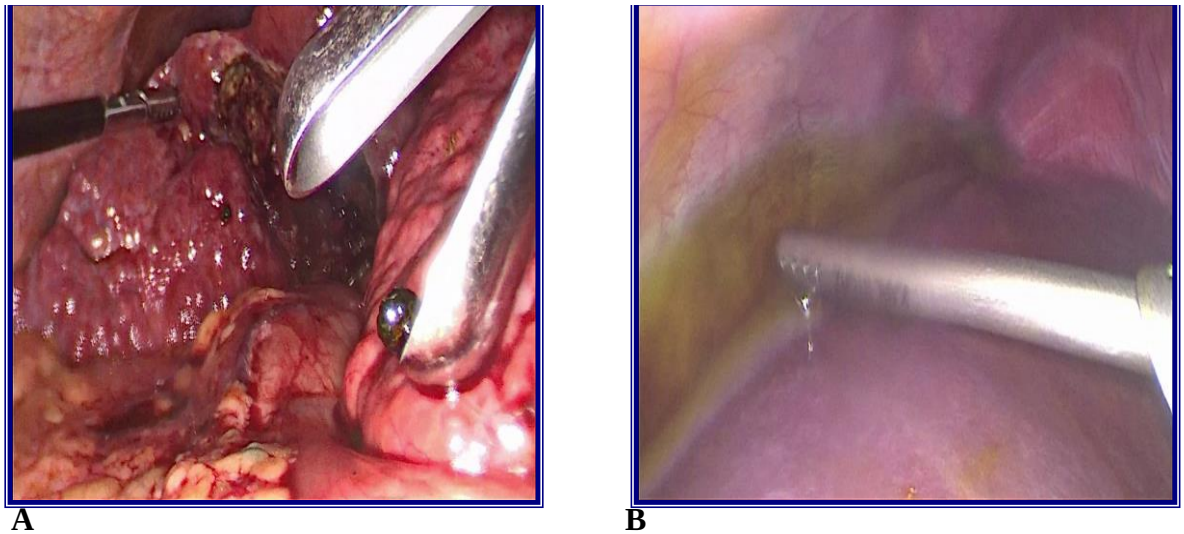


**Figure (2): Dissection at the gallbladder fundus**



**A** **B**

**Figure (3):** A) All stones were located and removed from peritoneal cavity. B) Suction aspiration of bile.

## DISCUSSION

The standard method for performing a cholecystectomy is via laparoscopy, it usually starts with the dissection of the gallbladder fundus after Calot's triangle. The method of fundus-first, originally introduced by French surgeons in the late 1980s, has since emerged as an alternative approach, primarily used in situations where dissection of Calot's triangle is difficult or not feasible **[9]**.

By commencing dissection at the gallbladder fundus, the retrograde approach enables the surgeon to distinctly identify the cystic duct and cystic artery before proceeding with ligation. This method enhances visualization of the critical structures, lowering the possibility of unintentional harm to the right hepatic artery or common bile duct. When inflammation, adhesions, severe induration, and thickening at the junction of the common and cystic ducts obscure the anatomy, it is very helpful in enabling a safer and more controlled dissection **[9-11]**.

The fundus-first approach is particularly indicated in laparoscopic cholecystectomy cases involving: **[12,13]**

Dense adhesions: Severe scarring that obscures Calot's triangle, complicating identification of critical structures.

Impacted stones in Hartmann's pouch: Large or multiple stones lodged in the gallbladder infundibulum, leading to external compression of the common bile duct.

Short, dilated cystic duct: differences in anatomy that raise the possibility of bile duct damage during routine dissection.

Mirizzi syndrome: A rare condition where impacted stones in the cystic duct or gallbladder neck compress the common hepatic duct, causing obstructive jaundice.

Contracted "burned-out" gallbladder: An atrophic gallbladder with thickened walls, often due to chronic inflammation, making standard dissection challenging.

In challenging laparoscopic cholecystectomy cases, opting to convert to open surgery or to abandon the procedure entirely can be prudent decisions to ensure patient safety. Such difficult scenarios often arise when the gallbladder cannot be adequately visualized, or when dense adhesions or anatomical anomalies obscure the critical structures, making safe dissection unfeasible. Converting to open surgery in these situations lowers the risk of complications such bile duct damage by improving exposure and control. Alternatively, the safest course of action might be to stop the procedure, particularly in cases of severe inflammation, hemodynamic instability, or when the anatomy is unrecognizable, as continuing laparoscopically could lead to inadvertent injury **[14]**.

Experts recommend employing the fundus-first (FF) approach or partial cholecystectomy as safe substitute methods in these circumstances where it is not possible to achieve the critical view of safety. In difficult situations where traditional techniques might be dangerous, these tactics seek to reduce the chance of bile duct damage. The FF approach involves initiating dissection from the gallbladder fundus, which can enhance visualization of critical structures and reduce complications. Partial cholecystectomy entails removing a portion of the gallbladder to avoid dissection in areas with unclear anatomy, Consequently, the risk of harm is reduced. In challenging laparoscopic cholecystectomy cases, both methods have been linked to decreased rates of conversion to open surgery and fewer occurrences of bile duct damage **[15]**.

In this study, the operative times observed ($53.19 \pm 9.32$ minutes for the conventional group and $55.94 \pm 13.72$ minutes for the fundus-first group) showed no statistically significant difference ($P = 0.66$). These findings suggest that both techniques can be performed with comparable efficiency in moderately

difficult laparoscopic cholecystectomy cases.

Interestingly, our results contrast with several recent studies that report a significant reduction in operative time when using the fundus-first technique, particularly in challenging scenarios involving dense adhesions or inflamed gallbladders. For instance, in 2024 **Bhoopathy et al. [16]** reported a mean operative time of 91.5 minutes for the fundus-first group versus 143.8 minutes for the conventional approach in difficult cases, a statistically significant difference favoring the retrograde method. **Mishra et al. [17]** demonstrated a time reduction of approximately 15 minutes when employing the fundus-first method in difficult laparoscopic cholecystectomy. **Edergren et al. [18]** also noted improved operative efficiency among surgeons routinely using fundus-first dissection. These differences may stem from surgeon experience, case selection, and operative technique standardization.

Our relatively shorter overall operative times compared to these studies may be attributed to the moderate severity of cases included, absence of severe inflammation or anatomical distortion. This might explain why no significant difference was observed in our study, whereas in more complex cases, the retrograde technique provides a clearer dissection plane and facilitates earlier control of the infundibulum.

However, a significant increase in intraoperative bleeding was noted in the fundus-first group (31.25%) compared to none in the conventional group (P = 0.043). While this contrasts with some earlier reports suggesting a reduction in bleeding due to early decompression and avoidance of the inflamed Calot's triangle **[13]**, it may reflect a learning curve effect, as the fundus-first technique was not a common approach in our department, particularly in cases with severe fibrosis or adhesions. It is worth noting that none of the patients required blood transfusion, indicating that the bleeding was controllable.

Conversion to open surgery occurred in only one patient (6.25%) in the retrograde group, which is consistent with the lower conversion rates observed in similar cohorts employing the fundus-first technique **[16,17].** The avoidance of critical view dissection in severely inflamed areas may explain this outcome, making fundus-first dissection a useful bailout strategy.

Postoperative recovery was comparable in both groups. Pain scores, time to first flatus, and hospital discharge rates did not significantly differ. Notably, 90.6% of patients were discharged within 24 hours, and only one required prolonged hospitalization due to bile leakage, and was managed successfully with ERCP. The overall incidence of postoperative complications including fever, drain output, ileus, and length of hospital stay was comparable between both groups. These results support prior findings indicating that fundus-first LC is associated with favorable recovery profiles and low morbidity when performed carefully by experienced surgeons **[18]**.

The limited sample size and single-center design of this study are among its drawbacks, as they may limit its generalizability. Additionally, intraoperative outcomes such as bleeding might have been influenced by surgeon experience as fundus-first technique was not routinely used before this trial in our department. Future multi-institutional studies are warranted to assess the reproducibility of these findings and to further evaluate fundus-first cholecystectomy as a standardized approach in difficult cases.

**Conclusion:**

The fundus-first technique appears to be a safe and viable alternative to the conventional approach in managing difficult laparoscopic cholecystectomy. Despite a higher incidence of bleeding in this study, the technique demonstrated comparable operative time, recovery, and complication rates. With adequate training, careful case selection and operative technique standardization, it can serve as a valuable strategy in avoiding open conversion and managing difficult cholecystectomies.

**Conflict of Interest:** The authors declare that they have no competing interest.
**Financial Disclosures:** This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.
**Availability of the data:** The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.
**Authors contribution:** The authors were responsible for data collection and analysis, as well as writing and preparing the manuscript for publication. All authors reviewed and approved the final version.

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