Cover Page

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Fundus-First Laparoscopic Cholecystectomy in Difficult Gallbladders: A Retrospective Cross-Sectional Study on a Safe Alternative to Avoid Conversion

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ABSTRACT

Background:
Difficult cholecystectomies pose a significant challenge due to severe inflammation and obscured anatomy in Calot's triangle. Fundus-first laparoscopic cholecystectomy (FFLC) has been proposed as a safe alternative in such cases.

Methods:
A total of 124 laparoscopic cholecystectomy (LC) procedures were retrospectively analysed. Surgical difficulty was classified using the Nassar scoring system. Cases graded as 3 or 4 were considered 'difficult cholecystectomies' and were managed using either Calot-first laparoscopic cholecystectomy (CFLC) or FFLC. The techniques were compared in terms of operative time, conversion rates, postoperative complications and length of hospital stay.

Results:
Among the 124 cases, 12 were classified as difficult cholecystectomies. CFLC was successfully performed in eight cases, with a mean operative time of 38.5 min. FFLC was used in four cases, with a mean operative time of 62.5 min. All FFLC procedures were completed laparoscopically without conversion or partial cholecystectomy. No bile duct injuries or major complications were observed. Routine drain placement enabled early discharge, and complications were minimal. Prophylactic cefazolin was sufficient in most cases.

Conclusion:
FFLC is a safe and effective alternative for managing difficult cholecystectomies, particularly when Calot's triangle dissection is not feasible. While it may prolong operative time, it reduces the need for conversion and related complications. Surgeons should be proficient in this approach for optimal outcomes in complex gallbladder surgery.

Keywords: fundus-first laparoscopic cholecystectomy; difficult cholecystectomy; Cross-sectional study; General surgery; Laparoscopic cholecystectomy, Tertiary care hospital

INTRODUCTION

Laparoscopic cholecystectomy (LC) is one of the most widely performed procedures in modern surgical practice. Since the standardisation of Calot's triangle dissection in 1992 and the introduction of the 'critical view of safety' (CVS) concept in 1995, conventional laparoscopic cholecystectomy (CFLC) has been established as the gold standard [1]. This technique involves meticulous dissection within Calot's triangle to isolate the cystic duct and artery, which are then clipped and transected, followed by gallbladder detachment from the liver bed.

While CFLC is successful in most cases, certain clinical scenarios pose unique challenges. Extensive adhesions, severe inflammation, fibrosis or distorted anatomy within Calot's triangle can compromise visibility and hinder safe dissection. These 'difficult cholecystectomies' have increased risks, including bile duct injury, biliary fistula formation, vascular trauma and heightened perioperative morbidity and mortality. In addition, anatomical anomalies and dense adhesions often necessitate conversion to open surgery due to the inability to safely delineate structures within Calot's triangle [2].

The fundus-first laparoscopic cholecystectomy (FFLC) technique, introduced by Cooperman in 1990, serves as an alternative strategy in such cases [3,4]. Unlike CFLC, FFLC initiates dissection at the gallbladder's fundus and progresses towards Calot's triangle, allowing the gradual exposure of obscured structures while minimising the risks of bile duct and vascular injuries. This method is particularly beneficial in acute or chronic cholecystitis, in which severe inflammation obscures Calot's anatomy.

Given these considerations, FFLC provides an effective alternative to CFLC in difficult cases, potentially reducing conversion rates while maintaining a minimally invasive approach. This study aims to compare FFLC with CFLC in managing difficult cholecystectomies and to explore the technical nuances involved in FFLC.

This study has been reported in line with the STROCSS 2025 criteria (35).

METHODS

This retrospective cross-sectional study analysed 124 LC procedures performed between January 2023 and March 2024. Surgical difficulty was classified using the Nassar scoring system, and cases graded as 3 or 4 were designated as 'difficult cholecystectomies. FFLC was used exclusively in cases in which CFLC was deemed unfeasible due to obscured anatomy or severe inflammation.

This study compared CFLC and FFLC based on operative time, postoperative complications, conversion rates, additional trocar placement, postoperative drain usage and hospital discharge times.

Nassar Scoring System

The Nassar scoring system, introduced in 1995, categorises the intraoperative difficulty of LC based on findings related to the gallbladder, cystic pedicle and extent of adhesions [5]. A revised version in 1996 added grade 5, which includes complex conditions such as Mirizzi syndrome type 2, cholecystocutaneous fistulas and biliary-enteric fistulas.

1. Grade 1: Soft gallbladder with no adhesions; thin, easily identifiable cystic pedicle.

Figure 1.

2. Grade 2: Distended or stone-filled gallbladder; moderately thickened cystic pedicle.

Figure 2.

3. Grade 3: Fibrotic or adherent gallbladder due to acute cholecystitis; complex, short or unclear cystic pedicle; dense adhesions.

Figure 3.

4. Grade 4: Gangrenous or empyematous gallbladder; cystic pedicle obscured by inflammation or fibrosis; extensive adhesions.

Figure 4.

FFLC Technique

All LC procedures adhered to the principles of the CVS. A hook cautery was used as the primary dissection tool, and hemolock clips were used to secure the cystic artery (single clip) and cystic duct (two clips) before transection.

In difficult cholecystectomy cases, various techniques—including hydrodissection, gauze-assisted blunt dissection and the use of fine-tip dissectors—were employed to facilitate the visualisation of Calot's triangle. When these methods failed to establish a safe operative field, the FFLC approach was initiated. Among the 12 difficult cases, eight were managed using CFLC with additional measures, while the FFLC technique was necessary in four cases.

FFLC Procedural Steps

1. Initial Setup: The gallbladder fundus was grasped and retracted upward to enhance exposure. In cases of severe distension, bile was aspirated via a small fundal incision using a laparoscopic aspirator.

2. Dissection: Fundus-to-infundibulum dissection was initiated by incising the peritoneum at the gallbladder–liver bed interface using a hook cautery. Gradual traction facilitated dissection despite venous bleeding caused by inflammation and fibrosis. Haemostasis and visibility were maintained with gauze placement and gentle irrigation (Figure 5).

3. Approach to Calot's Triangle: Blunt dissection with gauze and hydrodissection techniques was utilised to visualise and isolate cystic structures. Increased traction enabled the clear identification of the cystic artery and duct, which were then clipped and transected individually (Figure 6).

4. Completion: The surgical field was irrigated and aspirated. Haemostasis in the liver bed was achieved using high-voltage spray coagulation with a hook cautery. The gallbladder was retrieved using an endobag, and a Jackson–Pratt drain was routinely placed via the right lateral trocar site.

This systematic approach ensured that all FFLC cases were completed laparoscopically without conversion to open surgery or partial cholecystectomy.

Figure 5.

Figure 6.

This retrospective study was conducted at a private healthcare institution without an established institutional review board. All patient data were anonymised prior to analysis. Informed consent was not required due to the retrospective nature of the study and the use of de-identified data, in accordance with local ethical standards.

This retrospective study was not prospectively registered in any research registry. The study design and data analysis were conducted in line with the ethical principles of the Declaration of Helsinki.

RESULTS

Among the 124 LC procedures, 12 cases were identified as difficult cholecystectomies (Nassar grades 3 and 4). The mean operative time for CFLC was 38.5 min (range: 22–50 min), while FFLC required significantly longer, averaging 62.5 min (range: 51–71 min). Despite the increased duration, all FFLC cases were successfully completed laparoscopically without conversion to open surgery or partial cholecystectomy. Drain placement facilitated smooth recovery, with all patients discharged on postoperative day one. No bile duct injuries, vascular trauma, or postoperative infections were observed.

A single dose of 2 g of intravenous cefazolin was administered perioperatively as an antibiotic prophylaxis in all cases. No additional postoperative antibiotic therapy was required, except in two patients with gallbladder empyema managed using CFLC. A significant deviation from standard practice was observed in the FFLC cases in which a Jackson–Pratt drain was routinely placed. The drains were removed after 24 h, ensuring adequate monitoring of postoperative haemostasis.

Notably, all cases were successfully completed laparoscopically, without the need for conversion to open surgery or partial cholecystectomy, in either the CFLC or FFLC groups. Furthermore, there were no complications/adverse outcomes like bile leaks, intra-abdominal abscesses, or reoperations were observed during the follow-up period.

DISCUSSION

The findings of this study demonstrate that the fundus-first approach may be particularly beneficial in technically demanding cholecystectomies. These findings support the hypothesis that early exposure of Calot's triangle via the fundus-first approach in challenging cholecystectomies may facilitate safer dissection and minimize conversion risk.

The terminology distinguishing CFLC and FFLC has been inconsistent in the literature [6]. While CFLC is often referred to as ‘retrograde laparoscopic cholecystectomy’, (7) FFLC is sometimes labelled ‘antegrade laparoscopic cholecystectomy’ [7–11]. To avoid ambiguity, this study classifies procedures based on the site where dissection begins: CFLC at Calot’s triangle and FFLC at the gallbladder fundus.

Several scoring systems have been developed to assess the difficulty of cholecystectomy, most of which rely on preoperative parameters, such as BMI (body mass index), prior abdominal surgeries or radiological findings indicative of complicated cholecystitis [12–15]. However, preoperative assessments are inherently limited by their reliance on imaging and subjective interpretation. Conversely, intraoperative scoring systems are limited in number [16,17] and have not found widespread clinical application, as they have been developed based on a restricted number of patients. Moreover, most of these scoring systems are designed as a combination of both preoperative and intraoperative findings. Intraoperative scoring systems, such as the Nassar scoring system employed in this study, provide a more practical and accurate classification based on real-time surgical findings. Nassar's system has proven to be straightforward, reproducible and effective across diverse clinical settings [18].

Conversion rates from laparoscopic to open cholecystectomy have been reported in the literature at a range of 1.8%–27.7% [19–21]. The most frequent reason for conversion is the inability to safely identify and isolate cystic structures due to anatomical anomalies or dense adhesions within Calot's triangle. While bile duct injury during LC occurs at a rate of 0.5%–3%, these injuries are significantly less frequent in open procedures (0.1%–0.5%) [22]. However, open conversion is associated with increased postoperative morbidity, prolonged hospital stays, delayed recovery and heightened mortality rates [21, 23, 24]. By providing an alternative approach in such challenging cases, FFLC has been shown to minimise the need for conversion while maintaining patient safety.

In our series, FFLC was successfully employed in cases in which the anatomy of Calot's triangle was obscured, enabling the completion of all procedures laparoscopically without complications or extended hospital stays. The FFLC approach offers a critical advantage over partial or subtotal cholecystectomy [25, 26], which carries the risks of recurrent cholecystitis and biliary complications [27–29]. Moreover, although percutaneous cholecystostomy may serve as a temporary measure in high-risk or elderly patients, it is associated with its own set of complications and does not offer the definitive management achieved through LC [30–34].

The operative durations observed in our study align with previously reported findings. The FFLC cases in our series required a mean operative time of 62.5 min, longer than the 38.5 min mean for difficult CLC cases. This discrepancy reflects the additional time required to transition to the fundus-first approach after failed attempts at dissecting Calot's triangle. More importantly, despite this increased duration, FFLC facilitated safe laparoscopic completion in all cases, avoiding the need for open conversion.

A key strength of this study is the real-world applicability of the fundus-first technique in a variety of difficult cholecystectomy scenarios, reflecting practical surgical decision-making.

A potential limitation of FFLC is the absence of early vascular control, which can lead to venous bleeding from the liver bed. Nevertheless, this challenge can be effectively managed with gauze packing, superficial coagulation and meticulous haemostasis techniques.

Future prospective, multicenter studies with larger sample sizes and standardized grading of gallbladder difficulty would be valuable to validate these findings and further refine surgical guidelines.

CONCLUSION

FFLC is a safe and effective alternative for managing difficult cholecystectomies. By reducing conversion rates and preserving the benefits of minimally invasive surgery, FFLC is a valuable addition to laparoscopic techniques. Surgeons should be proficient in this method to optimise outcomes in complex cases.

Future studies with larger cohorts and prospective designs are warranted to further validate these findings.

Declarations

Ethical approval:
This retrospective study was conducted at a private healthcare institution without an established ethics committee. All patient data were anonymised prior to analysis, and written informed consent was obtained from all patients for the academic use of their clinical information.

Funding:
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Conflict of interest:
The authors declare that they have no competing interests.

Author contributions:
The first author was responsible for study conception and design, data interpretation, manuscript drafting, and final approval of the submitted version. The second author contributed through surgical supervision, clinical oversight, and critical revision of the manuscript.

Consent:
Written informed consent was obtained from all patients for the use of their anonymised data.

Data sharing statement
The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Protocol:

No formal protocol was registered prior to the study due to its retrospective design.

REFERENCES

1. Strasberg SM, Brunt LM. Rationale and use of the critical view of safety in laparoscopic cholecystectomy. J Am Coll Surg. 2010;211(1):132-8. doi:10.1016/j.jamcollsurg.2010.02.053.

2. Gupta A, Agarwal PN, Kant R, Malik V. Evaluation of fundus-first laparoscopic cholecystectomy. JSLS. 2004;8(3):255. PMID: 3016813.

3. Garzali IU, Aburumman A, Alsardia Y, Alabdallat B, Wraikat S, Aloun A. Is fundus first laparoscopic cholecystectomy a better option than conventional laparoscopic cholecystectomy for difficult cholecystectomy? A systematic review and meta-analysis. Updates Surg. 2022;74(6):1797-803. doi:10.1007/s13304-022-01403-5.

4. Kelly MD. Laparoscopic retrograde (fundus first) cholecystectomy. BMC Surg. 2009;9(1):19. doi:10.1186/1471-2482-9-19.

5. Nassar AHM, Ashkar KA, Mohamed AY, Hafiz AA. Is laparoscopic cholecystectomy possible without video technology? Minim Invasive Ther Allied Technol. 1995;4(2):63-5. doi:10.3109/13645709509152757.

6. Pran L, Maharaj R, Baijoo S. Antegrade versus retrograde cholecystectomy: What's in a name? J Clin Med Res. 2016;9(1):79. doi:10.14740/jocmr2803w.

7. Abdel H, Mohamed A. Fundus-first technique is good one for difficult laparoscopic cholecystectomies. 2015. Available from: https://www.researchgate.net/publication/344263528.

8. Neri V, Ambrosi A, Fersini A, Tartaglia N, Valentino TP. Antegrade dissection in laparoscopic cholecystectomy. JSLS. 2007;11(2):225. PMID: 3015719.

9. Tartaglia N, Cianci P, Di Lascia A, Fersini A, Ambrosi A, Neri V. Laparoscopic antegrade cholecystectomy: A standard procedure? Open Med (Wars). 2016;11(1):429-32. doi:10.1515/med-2016-0078.

10. Vivek MA, Augustine A, Rao R. A comprehensive predictive scoring method for difficult laparoscopic cholecystectomy. J Minim Access Surg. 2014;10(2):62-7. doi:10.4103/0972-9941.129947.

11. Takegami K, Kawaguchi Y, Nakayama H, Kubota Y, Nagawa H. Preoperative grading system for predicting operative conditions in laparoscopic cholecystectomy. Surg Today. 2004;34(4):331-6. doi:10.1007/s00595-003-2714-0.

12. Nassar AHM, Hodson J, Ng HJ, Vohra RS, Katbeh T, Zino S, et al. Predicting the difficult laparoscopic cholecystectomy: Development and validation of a pre-operative risk score using an objective operative difficulty grading system. Surg Endosc. 2020;34(10):4549-61. doi:10.1007/s00464-019-07244-5.

13. Berci G, Morgenstern L. An analysis of the problem of biliary injury during laparoscopic cholecystectomy. J Am Coll Surg. 1995;180(5):638-9. PMID: 7748353.

14. Hanna GB, Shimi SM, Cuschieri A. Randomised study of influence of two-dimensional versus three-dimensional imaging on performance of laparoscopic cholecystectomy. Lancet. 1998;351(9098):248-51. PMID: 9457094.

15. Sugrue M, Sahebally SM, Ansaloni L, Zielinski MD. Grading operative findings at laparoscopic cholecystectomy: A new scoring system. World J Emerg Surg. 2015;10(1):14. doi:10.1186/s13017-015-0015-4.

16. Griffiths EA, Hodson J, Vohra RS, Marriott P, Katbeh T, Zino S, et al. Utilisation of an operative difficulty grading scale for laparoscopic cholecystectomy. Surg Endosc. 2019;33(1):110-21. doi:10.1007/s00464-018-6281-2.

17. Sippey M, Grzybowski M, Manwaring ML, Kasten KR, Chapman WH, Pofahl WE, et al. Acute cholecystitis: Risk factors for conversion to an open procedure. J Surg Res. 2015;199(2):357-61. doi:10.1016/j.jss.2015.04.058.

18. Al-Mulhim A. Male gender is not a risk factor for the outcome of laparoscopic cholecystectomy: A single surgeon experience. Saudi J Gastroenterol. 2008;14(2):73-9. doi:10.4103/1319-3767.39617.

19. King NKK, Siriwardana HPP, Siriwardena MAK. Cholecystitis after cholecystectomy. J R Soc Med. 2002;95(3):138-9. doi:10.1177/014107680209500311.

20. Horn T, Christensen SD, Kirkegård J, Larsen LP, Knudsen AR, Mortensen FV. Percutaneous cholecystostomy is an effective treatment option for acute calculous cholecystitis: a 10-year experience. HPB (Oxford). 2015;17(4):326-31. doi:10.1111/hpb.12368.

21. Philip Rothman J, Burcharth J, Pommergaard HC, Viereck S, Rosenberg J. Preoperative risk factors for conversion of laparoscopic cholecystectomy to open surgery - A systematic review and meta-analysis of observational studies. Dig Surg. 2016;33(5):414-23. doi:10.1159/000445505.

22. Kato K, Kasai S, Matsuda M, Onodera K, Kato J, Imai M, et al. A new technique for laparoscopic cholecystectomy--retrograde laparoscopic cholecystectomy: an analysis of 81 cases. Endoscopy. 1996;28(4):356-9. doi:10.1055/s-2007-1005422.

23. Wolf AS, Nijsse BA, Sokal SM, Chang Y, Berger DL. Surgical outcomes of open cholecystectomy in the laparoscopic era. Am J Surg. 2009;197(6):781-4. doi:10.1016/j.amjsurg.2008.07.042.

24. Harboe KM, Bardram L. The quality of cholecystectomy in Denmark: outcome and risk factors for 20,307 patients from the national database. Surg Endosc. 2011;25(5):1630-41. doi:10.1007/s00464-010-1446-5.

25. Sharp CF, Garza RZ, Mangram AJ, Dunn EL. Partial cholecystectomy in the setting of severe inflammation is an acceptable consideration with few long-term sequelae. Am Surg. 2009;75(3):249-52.

26. Horiuchi A, Watanabe Y, Doi T, Sato K, Yukumi S, Yoshida M, et al. Delayed laparoscopic subtotal cholecystectomy in acute cholecystitis with severe fibrotic adhesions. Surg Endosc. 2008;22(12):2720-3. doi:10.1007/s00464-008-9879-y.

27. King NKK, Siriwardana HPP, Siriwardena MAK. Cholecystitis after cholecystectomy. J R Soc Med. 2002;95(3):138-9. doi:10.1177/014107680209500311.

28. Sosulski AB, Fei JZ, Demuro JP. Partial cholecystectomy resulting in recurrent acute cholecystitis and choledocholithiasis. J Surg Case Rep. 2012;2012(9):17. doi:10.1093/jscr/2012.9.17.

29. M H, S N. Biliary pancreatitis secondary to stones from a gall bladder remnant. Trop Gastroenterol. 2010;31(3):230-3.

30. Horn T, Christensen SD, Kirkegård J, Larsen LP, Knudsen AR, Mortensen FV. Percutaneous cholecystostomy is an effective treatment option for acute calculous cholecystitis: a 10-year experience. HPB (Oxford). 2015;17(4):326-31. doi:10.1111/hpb.12368.

31. McKay A, Abulfaraj M, Lipschitz J. Short- and long-term outcomes following percutaneous cholecystostomy for acute cholecystitis in high-risk patients. Surg Endosc. 2012;26(5):1343-51. doi:10.1007/s00464-011-2027-5.

32. Sanjay P, Mittapalli D, Marioud A, White RD, Ram R, Alijani A. Clinical outcomes of a percutaneous cholecystostomy for acute cholecystitis: a multicentre analysis. HPB (Oxford). 2013;15(7):511-6. doi:10.1111/hpb.12003.

33. Jang WS, Lim JU, Joo KR, Cha JM, Shin HP, Joo SH. Outcome of conservative percutaneous cholecystostomy in high-risk patients with acute cholecystitis and risk factors leading to surgery. Surg Endosc. 2015;29(8):2359-64. doi:10.1007/s00464-014-3988-2.

34. Loozen CS, Van Santvoort HC, Van Duijvendijk P, Besselink MG, Gouma DJ, Nieuwenhuijzen GA, et al. Laparoscopic cholecystectomy versus percutaneous catheter drainage for acute cholecystitis in high-risk patients (CHOCOLATE): multicentre randomised clinical trial. BMJ. 2018;363:k3965. doi:10.1136/bmj.k3965.

35. Agha RA, Mathew G, Rashid R, Kerwan A, Al-Jabir A, Sohrabi C, Franchi T, Nicola M, Agha M. Revised Strengthening the reporting of cohort, cross-sectional and case-control studies in surgery (STROCSS) Guideline: An update for the age of Artificial Intelligence. Premier Journal of Science 2025:10;100081.

FIGURE LEGENDS

Figure 1. Grade 1 laparoscopic cholecystectomy operating image according to the Nassar scoring system. There is no any adhesion and cystic pedicle thin and visible.

Figure 2. Grade 2 laparoscopic cholecystectomy operating image according to the Nassar scoring system. Cystic pedicle fatty but still can easily to dissect pedicle.

Figure 3. Grade 3 laparoscopic cholecystectomy operating image according to the Nassar scoring system. Mobilization is quite difficult due to the increase in wall thickness due to inflammation in the gallbladder.

Figure 4. Grade 4 laparoscopic cholecystectomy operating image according to the Nassar scoring system. It is impossible to identify the cystic pedicle due to extensive adhesions and advanced fibrosis of the gallbladder.

Figure 5. In the FFLC technique, use of gauze in the gallbladder bed and subhepatic area to minimize venous leakage from the liver bed and to keep the image clear.

Figure 6. The cystic duct, which was clipped and cut during FFLC, and the cystic artery, which is still dissected.