

REVIEW ARTICLE

DOI:

<https://doi.org/10.5281/zenodo.21005682>[do.21005682](https://doi.org/10.5281/zenodo.21005682)

Volume 1 Issue 2

July 2026

*Corresponding author

Vinod Kumar Singhal
Submitted 05 April 2026

Accepted 16 May 2026

Published 01 July 2026

Citation

Vinod Kumar Singhal.
Consultant General
Surgeon, Prime
Hospital, Dubai, UAE,
Vol 1: Iss 2, 2026.The article was
originally submitted in
ENGLISH.Translations into other
languages were
reviewed and validated
by the authors and the
editorial team.Nevertheless, for the
most accurate
representation of the
subject matter, readers
are encouraged to
consult the article in its
original language.

SHOULD OPEN CHOLECYSTECTOMY REMAIN IN SURGICAL TRAINING? A NARRATIVE REVIEW IN THE ERA OF ADVANCED LAPAROSCOPY AND ROBOTICS

Vinod Kumar Singhal¹, Adil Mohammed Suleman², Janhavi Sirsat³, Amrithraj Thiyagarajan⁴, Faris Dawood Alaswad⁵, Mr. Hemant. Sharma⁶, Abhishek Panikar⁷, Dr. Ahmad Mokhtar Mohamed Ziad Rahima⁸, Vidher V V Singhal⁹, Minisha Singhal¹⁰, Aditi Panikar¹¹

¹ Consultant General Surgeon, Prime Hospital, Dubai, UAE.² Specialist General Surgeon, Prime Hospital, Dubai, UAE.³ Surgery Registrar, Prime Hospital, Dubai, UAE⁴ Specialist General Surgery, Prime Hospital, Dubai, UAE⁵ Consultant General Surgeon, Gladstone Hospital, Perth, Australia.⁶ MD MS FACS, FEBS, Diplomate Multi-Organ Transplant & HPB Surgery (American Society of Transplant).⁷ General Surgery Resident (R1).⁸ General Surgery Resident, Prime Hospital.⁹ Postgraduate UCL, UK¹⁰ BTech AI, BIT, Ranchi, India.¹¹ GMERS SOLA medical college, 2nd Year Medical Student.

Abstract

Gallstone disease remains common worldwide, and cholecystectomy continues to be a core procedure in general surgery. Although laparoscopic cholecystectomy is now the standard approach and robotic surgery is increasingly adopted, open cholecystectomy remains relevant in selected difficult cases, conversion, and complication management. Declining trainee exposure to open surgery has raised concern about whether this skill should still be preserved in surgical education. This narrative review evaluated whether open cholecystectomy should remain part of the surgical training curriculum in the era of advanced laparoscopy and robotics. This study was conducted as a narrative review. Relevant English-language literature was searched in PubMed, Scopus, and Google Scholar from inception to March 2026. Guidelines, reviews, cohort studies, surveys, and educational papers were selected based on relevance to open cholecystectomy, difficult gallbladder surgery, conversion, bailout strategies, robotic surgery, and surgical training. Findings were synthesized thematically without meta-analysis. The reviewed literature showed that open cholecystectomy has shifted from a routine operation to a selective safety procedure. It remains important in severe inflammation, frozen Calot's triangle, dense adhesions, bleeding, suspected bile duct injury, and resource-limited settings. Studies also showed declining trainee exposure and confidence in open biliary surgery. This relevance persists despite the growing adoption of robotic surgery. Open cholecystectomy should be retained in surgical training as a selective but essential competency. Although no longer a routine procedure for all trainees, it remains important for safe conversion, for managing difficult biliary anatomy and complications, and for maintaining context-appropriate operative preparedness.

Keywords: Open cholecystectomy, Surgical training, Laparoscopic cholecystectomy, Robotic surgery, and Surgical curriculum.

Introduction

Gallstone disease is one of the most common gastrointestinal disorders worldwide, and cholecystectomy remains among the most frequently performed abdominal operations in general surgery. Recent global evidence indicates that the burden of gallstones is substantial, with considerable regional variation by sex, age, and socioeconomic setting.

A 2024 systematic review and meta-analysis reported a pooled global prevalence of approximately 6.1%, with higher rates among women and older adults, highlighting the continuing clinical importance of gallbladder disease across diverse healthcare systems [1]. Because gallstone disease is so common, the operative management of biliary pathology remains a core component of surgical practice and training.

Over the past several decades, laparoscopic cholecystectomy has become the standard operative approach for symptomatic gallstone disease and acute cholecystitis. The Tokyo Guidelines 2018 and other contemporary recommendations endorse laparoscopic cholecystectomy as the preferred treatment in most appropriately selected patients, while emphasizing safe dissection, careful intraoperative judgment, and timely escalation when anatomy is unclear or operative difficulty is encountered [2,3]. Similarly, the World Society of Emergency Surgery guideline on bile duct injury stresses that patient safety should take precedence over persistence with a minimally invasive approach when the operative field becomes hazardous [4]. As a result, open cholecystectomy has shifted from a routine procedure to a selective approach reserved mainly for difficult cases, conversion, or management of intraoperative complications.

Despite this decline in frequency, open cholecystectomy remains clinically relevant. Difficult gallbladder surgery may still occur in the setting of severe inflammation, fibrosis, frozen Calot's triangle, dense adhesions, bleeding, distorted anatomy, or suspected bile duct injury. In these circumstances, the literature consistently emphasizes the importance of the critical view of safety and the use of structured bailout strategies when safe laparoscopic dissection cannot be achieved [4-6]. Subtotal cholecystectomy has gained recognition as an effective bailout option for difficult gallbladders, but conversion to an open approach remains an important protective strategy when minimally invasive completion is unsafe or technically unfeasible [7,8]. Therefore, open cholecystectomy continues to have value not as the dominant technique, but as a rescue procedure in the highest-risk operative situations.

At the same time, the technical landscape of biliary surgery is evolving further with the expansion of robotic surgery. Robotic platforms have been rapidly adopted across general surgery, and cholecystectomy has been among the most common procedures performed during this transition [9]. However, evidence suggests that the spread of robotics has introduced new learning-curve challenges rather than removing the need for sound operative judgment. Contemporary studies have raised concerns regarding bile duct injury rates and the number of cases required to achieve proficiency in robotic-assisted cholecystectomy [10,11]. These developments are important for surgical education because they may intensify curricular emphasis on advanced minimally invasive skills, while simultaneously reducing exposure to open biliary procedures.

This creates an important educational dilemma. Several studies have shown that exposure to open cholecystectomy during training has declined considerably, and that many surgical trainees and newly qualified surgeons report limited confidence in performing the procedure independently [12-14]. Reduced exposure may leave future surgeons insufficiently prepared for open conversion, difficult gallbladder surgery, or management of intraoperative biliary complications when these arise unexpectedly. Although current literature has extensively addressed safe cholecystectomy, bailout strategies, and robotic adoption, fewer reviews have focused specifically on whether open cholecystectomy should remain an intentional part of the modern surgical curriculum [7-14].

Against this background, a focused global review is justified. The key question is no longer whether open cholecystectomy should remain the primary operative method, because minimally invasive approaches have clearly assumed that role. Rather, the issue is whether open cholecystectomy should continue to be taught as a core, selective, or advanced competency in contemporary surgical training. Therefore, this narrative review aims to evaluate the continuing place of open cholecystectomy in the surgical curriculum by examining its epidemiologic context, clinical relevance, educational benefits, and limitations in the era of advanced laparoscopy and robotic surgery.

Methods

This study was conducted as a narrative review to evaluate whether open cholecystectomy should remain part of the surgical training curriculum in the era of advanced laparoscopy and robotic surgery. The review focused on four main domains: the current clinical role of open cholecystectomy, its educational value in surgical training, its limitations within modern curricula, and its relevance in difficult gallbladder surgery, conversion scenarios, complication management, and resource-constrained surgical practice.

A literature search was performed in PubMed, Scopus, and Google Scholar. The databases were searched from inception to March 2026. The search was limited to English-language articles. The search strategy used combinations of the following terms: open cholecystectomy, laparoscopic cholecystectomy, robotic cholecystectomy, surgical training, surgical education, surgical curriculum, resident training, conversion to open surgery, difficult gallbladder surgery, subtotal cholecystectomy, bailout strategies, bile duct injury, and biliary surgery. Additional relevant articles were identified by manually reviewing the reference lists of selected publications.

Article screening and selection were performed by the authors through title and abstract review, followed by full-text review of potentially relevant articles. Because this was a narrative review rather than a systematic review, no formal PRISMA-based selection process was applied. However, articles were prioritized based on their relevance to the review objective, methodological strength, recency, and contribution to clinical practice or surgical education.

The review included clinical guidelines, narrative reviews, systematic reviews, meta-analyses, cohort studies, survey-based studies, educational reviews, and expert opinion articles. Studies were considered relevant if they addressed at least one of the following areas: current indications for open cholecystectomy, conversion from laparoscopic to open surgery, difficult gallbladder management, trainee exposure to open biliary surgery, trainee confidence and competency, safe cholecystectomy principles, bailout strategies, bile duct injury prevention or management, and the influence of robotic or advanced laparoscopic surgery on training exposure.

Articles that focused exclusively on technical outcomes without clear relevance to surgical training, curriculum development, safety, bailout decision-making, or difficult biliary surgery were given lower priority. The selected evidence was synthesized thematically under the following headings: current clinical role of open cholecystectomy, educational benefits of retaining it in surgical training, limitations of continued curriculum inclusion, influence of minimally invasive and robotic surgery on trainee exposure, and implications for competency-based curriculum development.

As this was a narrative review, no formal risk-of-bias assessment, meta-analysis, or quantitative pooled analysis was performed. The findings were interpreted descriptively to provide a balanced overview of the continuing relevance of open cholecystectomy in contemporary surgical education and practice.

Results

The reviewed literature was synthesized thematically according to the major areas relevant to open cholecystectomy in contemporary surgical training: current clinical role, difficult gallbladder surgery and bailout strategies, trainee exposure and confidence, influence of robotic surgery, and curriculum-related implications.

Current clinical role of open cholecystectomy

The reviewed guidelines consistently identify laparoscopic cholecystectomy as the standard operative approach for most patients with symptomatic gallstone disease and acute cholecystitis [2,3,15]. Open cholecystectomy is now less commonly performed as a primary operation, but it remains relevant when laparoscopic dissection is unsafe or technically difficult [4,15]. Severe acute cholecystitis, frozen Calot's triangle, dense adhesions, distorted anatomy, uncontrolled bleeding, and suspected bile duct injury were repeatedly identified as situations in which bailout strategies may be required [4,16,17]. The continuing global burden of gallstone disease also supports the need for maintaining safe cholecystectomy capability across different healthcare settings [1,18].

Difficult gallbladder surgery and bailout strategies

The critical view of safety was consistently described as a key method for preventing bile duct injury during laparoscopic cholecystectomy [5,6,19]. When the critical view of safety cannot be achieved, the literature supports the use of bailout strategies rather than continued unsafe dissection [4,17]. Subtotal cholecystectomy was reported as an important bailout

option in hostile gallbladder anatomy [7,8]. Conversion to open surgery remains an accepted safety option when bleeding, dense fibrosis, unclear anatomy, or suspected bile duct injury prevents safe laparoscopic completion [4,15,17].

Trainee exposure and confidence

Several studies reported declining exposure to open biliary surgery among surgical trainees [12-14,20]. Reduced exposure was associated with lower confidence in performing open cholecystectomy independently and in managing conversion from laparoscopic to open surgery [12,21]. One study also suggested that self-reported confidence may exceed actual operative exposure, indicating a possible gap between perceived and practical competence. Open cholecystectomy was described as educationally valuable because it supports anatomical exposure, tissue handling, hemostasis, operative judgment, and management of intraoperative complications [12,13].

Influence of robotic surgery

Robotic surgery has been increasingly adopted across general surgery, including cholecystectomy [9,23,24]. However, studies on robotic-assisted cholecystectomy have raised concerns about bile duct injury risk, learning curves, and the effect of patient complexity [10,11,22]. These findings suggest that robotic surgery expands the technical environment of gallbladder surgery, but does not remove the need for judgment, bailout readiness, or conversion competence [10,11].

Curriculum-related findings

The educational literature shows a mismatch between declining open cholecystectomy exposure and the continuing need to manage difficult gallbladder surgery [12-14,21]. Traditional case-volume-based training may therefore be insufficient for maintaining competence in uncommon but high-stakes procedures [13,20]. Competency-based surgical education and entrustable professional activities provide a more suitable framework for assessing readiness in selective procedures such as open conversion and difficult biliary surgery [23]. Simulation, cadaveric teaching, video-based learning, supervised exposure, and workplace-based assessment may help compensate for reduced operative volume [13,23].

The reviewed literature consistently highlights three central findings. First, laparoscopic cholecystectomy remains the standard operative approach; however, open cholecystectomy still retains an important role in difficult or unsafe cases where laparoscopy is not advisable. Importantly, there is overlap, as both approaches require operative judgment to determine the safest method. Furthermore, trainee exposure to open biliary surgery is progressively declining. Finally, the evidence also suggests that although robotic surgery is expanding, it does not eliminate the need for sound operative judgment or selective open surgical competence.

Sl. No.	Article	Study type	Main focus	Key contribution to this review
1	SAGES guideline on laparoscopic biliary tract surgery [15]	Guideline	Standard approach, indications, conversion	Confirms laparoscopic cholecystectomy as the standard approach; frames conversion to open surgery as a safety measure; reports overall conversion rates of 2% to 15%
2	de'Angelis et al., 2021, WSES guideline [4]	International guideline	Bile duct injury prevention and management	Emphasizes safe cholecystectomy principles, risk of bile duct injury, and the continuing importance of sound bailout strategy
3	Abdallah et al., 2025 [16]	Narrative review	Difficult laparoscopic cholecystectomy	Supports the current role of subtotal cholecystectomy and other bailout strategies in hostile anatomy
4	Mendes et al., 2025 [24]	Nationwide residency study	Biliary surgery exposure during residency	Shows limited resident confidence in open cholecystectomy despite some case exposure; highlights training gap
5	Campbell et al., 2018 [12]	Survey study	Exposure and confidence of trainees/new fellows	Demonstrates declining exposure and confidence in open cholecystectomy among trainees

6	Riccardi et al., 2021 [13]	Educational review	Challenges in teaching open cholecystectomy	Highlights declining case volume and suggests simulation/cadaveric teaching to compensate
7	Sirinek et al., 2016 [14]	Workforce/training analysis	Future capacity for open biliary surgery	Raises concern that reduced exposure may leave future surgeons underprepared for open biliary procedures
8	Mullens et al., 2025 [25]	Cohort study	Robotic vs laparoscopic cholecystectomy	Shows robotic use is increasing, but bile duct injury rates remain higher than with laparoscopy

Table 1. Summary of the key articles included in this narrative review

Open cholecystectomy continues to be relevant in selected clinical situations, particularly in severe acute cholecystitis, frozen Calot's triangle, dense adhesions, uncontrolled bleeding, bile duct injury, and other complex biliary conditions. Moreover, it remains educationally valuable because it teaches operative judgment, anatomical exposure, hemostasis, and management of complications, especially in high-risk or resource-constrained settings.

Clinical situation	Why open cholecystectomy may still be required	Educational relevance
Severe acute cholecystitis	Dense inflammation and unsafe dissection	Teaches judgment in hostile operative fields
Frozen Calot's triangle	Critical view of safety cannot be achieved	Reinforces timely bailout decisions
Dense adhesions from prior surgery	Limited safe laparoscopic access	Develops open exposure and dissection skill
Uncontrolled intraoperative bleeding	Need for rapid exposure and hemostasis	Teaches bleeding control and operative composure
Suspected bile duct injury	Better access for assessment and repair planning	Important for complication recognition and management
Choledocholithiasis or complex biliary pathology	May require broader operative access in selected cases	Expands biliary surgical understanding
Resource-limited settings	Limited access to advanced laparoscopy or robotics	Preserves real-world and global applicability

Table 2. Continuing role of open cholecystectomy in current surgical practice

Including open cholecystectomy in the surgical curriculum offers several benefits, such as strengthening anatomical understanding, improving tissue handling, and preparing trainees for conversion or rescue situations. However, important limitations are also evident. These include declining case volume, reduced trainee exposure, competition with laparoscopic and robotic skill acquisition, and difficulty maintaining competency through infrequent practice.

Benefits	Pitfalls
Preserves competence for conversion and rescue situations	Declining case volume limits hands-on exposure
Improves understanding of hepatobiliary anatomy	Competes with laparoscopic and robotic training time
Strengthens tissue handling, exposure, and hemostasis	Hard to ensure competency through case numbers alone
Prepares trainees for difficult gallbladder surgery	Skill decay may occur if experience is infrequent
Supports management of bile duct injury and bleeding	May be seen as lower priority in high-resource centers
Remains highly relevant in low-resource settings	Ethical and logistical issues arise when teaching infrequent procedures
Encourages operative judgment beyond technology dependence	Simulation may be needed because real cases are limited

Table 3. Benefits and pitfalls of including open cholecystectomy in the surgical curriculum

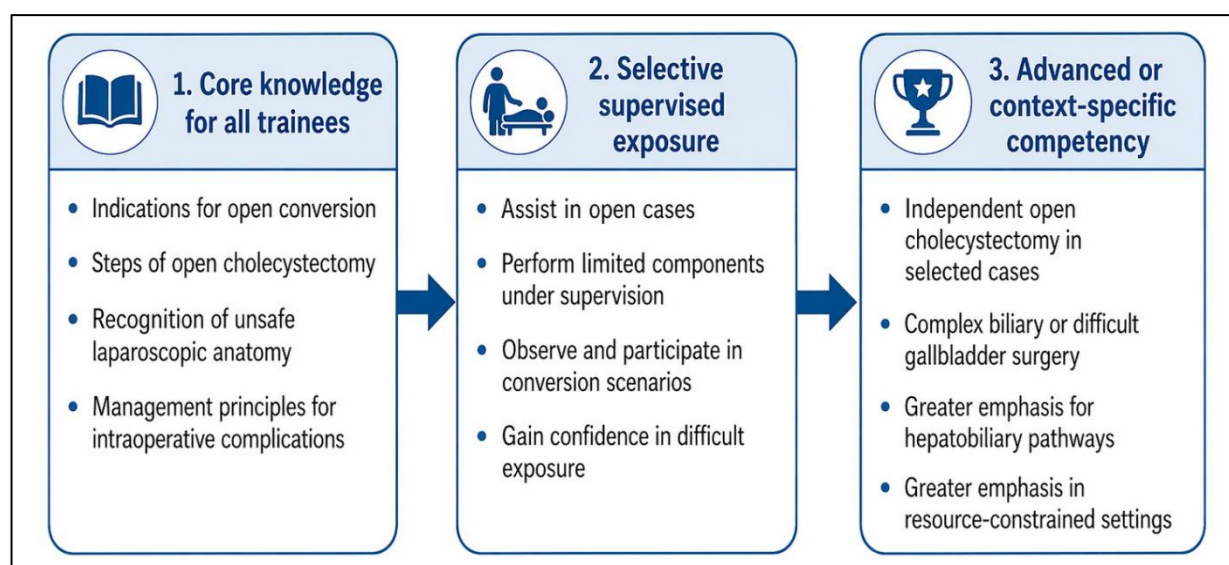


Figure 1. Proposed place of open cholecystectomy in the modern surgical training curriculum

The proposed curriculum framework suggests that open cholecystectomy should be preserved at different levels of training. To achieve this, all trainees should acquire core theoretical knowledge. Furthermore, some should receive supervised operative exposure, and selected trainees, particularly those likely to manage complex biliary disease or work in limited-resource environments, may require more advanced competency.

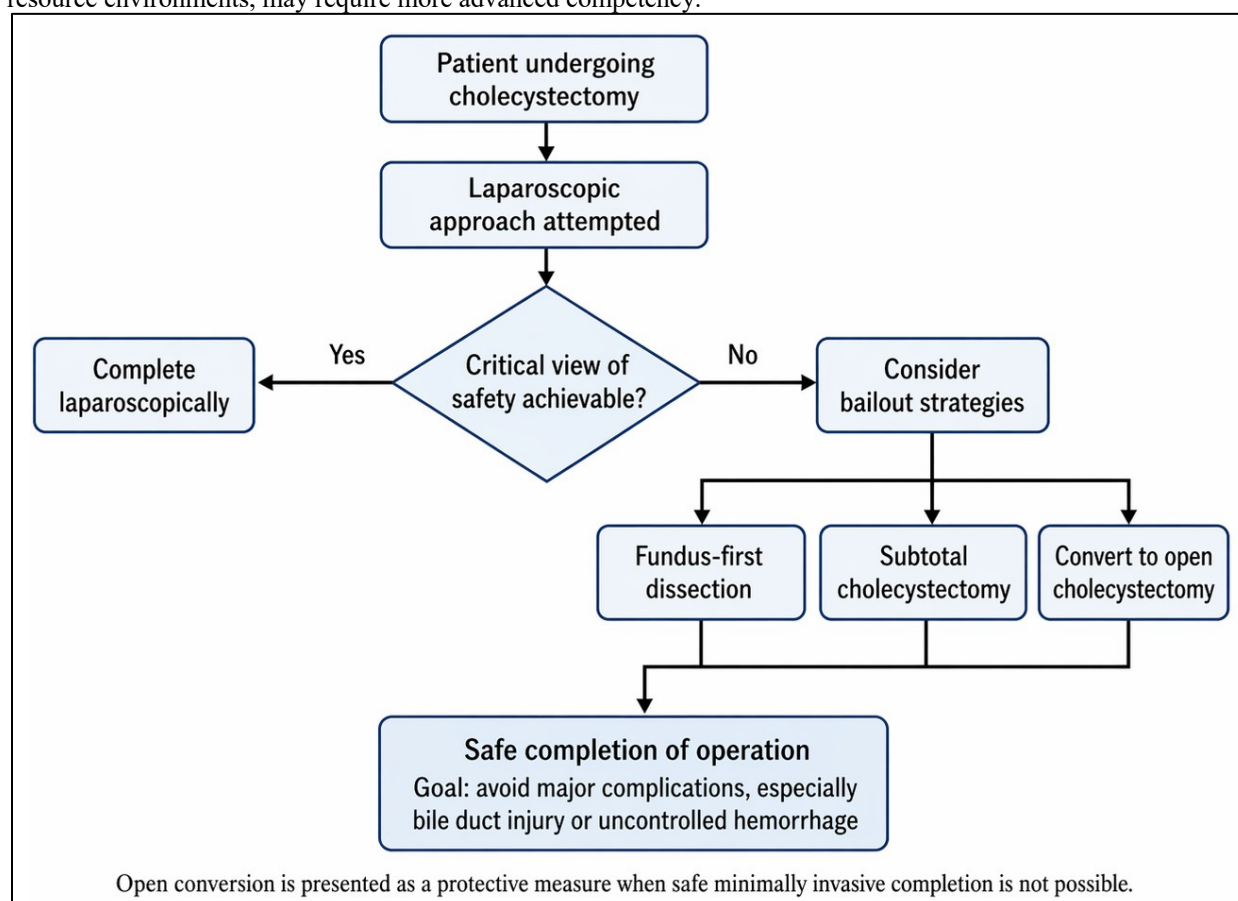


Figure 2. Decision pathway for difficult gallbladder surgery and the place of open conversion

The decision pathway for difficult gallbladder surgery emphasizes that laparoscopy should remain the initial approach. However, when the critical safety view cannot be achieved, structured bailout strategies should be used. In this context, conversion to open cholecystectomy should be regarded as a protective, safety-focused decision intended to prevent major complications, rather than a technical failure.

Discussion

The present review suggests that the question is not whether open cholecystectomy should reclaim its former dominance. Instead, it is whether it should remain a deliberate educational competency in a minimally invasive era. That distinction is important. Gallstone disease remains common worldwide, with a pooled global prevalence of about 6.1%. Its burden varies by age, sex, and geography. This means that the clinical demand for cholecystectomy, including difficult cases, is unlikely to disappear soon [1]. At the same time, modern guidelines firmly support laparoscopic cholecystectomy as the standard approach in most patients with symptomatic gallbladder disease and acute cholecystitis [2,3]. In that context, our findings best support a selective but persistent role for open cholecystectomy. This should not be seen as an argument against minimally invasive progress.

A central message from the reviewed literature is that patient safety, not procedural tradition, is the strongest reason to retain open cholecystectomy in surgical training. Both the WSES guideline and the multi-society safe cholecystectomy consensus emphasize that bile duct injury remains the most serious technical complication of cholecystectomy. Surgeons must prioritize safe completion over persisting with a hazardous laparoscopic dissection [4,17].

The critical view of safety is now the cornerstone of safe biliary surgery. Recent reviews continue to reinforce its role in reducing misidentification errors [6,17]. However, when the critical view cannot be achieved because of severe inflammation, fibrosis, frozen Calot's triangle, bleeding, or distorted anatomy, the surgeon must have a bailout strategy. In that setting, open conversion remains conceptually important. It reflects mature surgical judgment, not technical failure [4,6,17].

Our findings also align with contemporary literature showing that difficult gallbladder surgery is increasingly approached through structured bailout strategies, with a focus on subtotal cholecystectomy. The systematic review by Elshaer et al. and the more recent meta-analysis by Koo et al. both support subtotal cholecystectomy as a reasonable option in hostile operative fields [7,8].

This does not make open cholecystectomy obsolete. Rather, it narrows its role. In modern practice, the surgeon managing a difficult gallbladder must be competent in a hierarchy of responses. These include stopping unsafe dissection, reassessing anatomy, considering fundus-first or subtotal techniques, and converting to open when minimally invasive completion is no longer safe [4,6,7,19]. For training, this means that open cholecystectomy should be taught as part of a broader culture of bailout surgery and operative humility.

Another important implication of the review is that clinical need and educational exposure are moving in opposite directions. Studies of resident and fellow experience consistently show that exposure to open cholecystectomy is limited. Confidence depends heavily on actual case involvement [12,21]. Campbell et al. found that greater exposure was associated with greater confidence in independently performing an elective open cholecystectomy and in converting from laparoscopic to open surgery [12]. Ahmed and colleagues similarly reported very low levels of independent open cholecystectomy experience among senior trainees. They also noted that self-reported comfort sometimes exceeded real operative exposure [21]. Riccardi et al. framed this as a structural training problem created by declining case availability. Sirinek et al. warned that the workforce capable of performing open biliary surgery may shrink if training pathways do not compensate for this loss [13,14].

This training gap is reinforced by broader trends in surgical education. Open operative experience has declined across general surgery residency even as total case numbers and minimally invasive exposure have increased [20,26]. The implication is not simply that trainees see fewer open gallbladders. The training environment increasingly rewards proficiency in laparoscopy and robotics while offering fewer opportunities to learn how to manage the rare but high-stakes case that requires open rescue [20,26]. From a curriculum perspective, this review therefore supports a competency-based model, rather than a volume-based nostalgia model. Not all trainees may need routine independent open cholecystectomy experience. However, all should understand the indications for conversion, the principles of open exposure, and the management of intraoperative crises. Selected trainees, especially those entering hepatobiliary, acute care, or lower-resource practice settings, may need deeper hands-on competence [13,14,20,26].

The rise of robotic surgery complicates this discussion, but does not resolve it. Robotic platforms have expanded rapidly across general surgery, including cholecystectomy [9,27]. Yet, increased technological sophistication does not necessarily

mean a safer learning environment. In a large Medicare cohort, robotic-assisted cholecystectomy increased 37-fold between 2010 and 2019. It was associated with higher bile duct injury rates than laparoscopic cholecystectomy [10]. A related study on learning curves suggested that achieving stable performance in robotic-assisted cholecystectomy requires substantial experience [11]. These findings are highly relevant to curriculum design. If trainees devote more time to new platform-specific skills but still graduate with little preparation for open bailout, training may become narrower rather than more complete [9-11].

This review also supports the idea that open cholecystectomy retains disproportionate importance in global surgery. Operative reality is not uniform across settings. International guidance and epidemiologic data show that gallbladder disease remains common, while access to advanced laparoscopy and robotics varies widely [1-4]. In many systems, surgeons still encounter late presentation, severe inflammation, equipment constraints, or referral delays. These factors may increase operative difficulty and the need for conversion or open management. Therefore, a universal curriculum that assumes high-resource minimally invasive access for all trainees would be poorly aligned with global practice realities. A more defensible model is to preserve open cholecystectomy as universal cognitive knowledge, selective supervised exposure, and advanced practical competence where service needs justify it [1-4,14].

Limitations of the study: This narrative review is limited by the absence of systematic review methodology. Possible selection bias and heterogeneity among the included studies are also concerns. Most evidence is from surveys, institutional experience, or observational data. Standardized outcome measures are absent. Differences in surgical training and available resources across settings may also limit the extent to which the findings apply.

Conclusion

In conclusion, open cholecystectomy is no longer the routine benchmark operation it once was, and current evidence does not justify preserving it as a high-volume core index case for every trainee. However, the literature equally does not support removing it from training altogether. Its enduring value lies in safety, conversion, complication management, difficult biliary anatomy, and global applicability. The most rational curricular response is therefore neither abandonment nor overemphasis, but selective preservation within a modern culture of safe cholecystectomy, structured bailout, and context-sensitive competency.

Recommendations

Open cholecystectomy should remain in surgical training as a selective safety competency, not as a standard high-volume procedure, to ensure trainees understand when and why it is required. Training programs should adopt a tiered curriculum. First, all trainees should receive core teaching on biliary anatomy, indications for conversion, the critical view of safety, recognition of difficult gallbladder anatomy, and bailout strategies to build a foundation of decision-making. Second, where clinical exposure is limited, programs should use simulation, cadaveric or wet-lab training, video-based teaching, and case-based discussions to support skills in operative judgment, exposure, tissue handling, and hemostasis. Third, advanced hands-on competence should be a priority for trainees entering fields where open cholecystectomy is more likely encountered, such as hepatobiliary surgery, acute care surgery, rural surgery, district hospital practice, or low-resource settings. This approach ensures that open cholecystectomy remains a context-sensitive skill and aligns training with current laparoscopic, robotic, and safe cholecystectomy practices.

References

1. Wang X, Yu W, Jiang G, Li H, Li S, Xie L, Bai X, Cui P, Chen Q, Lou Y, Zou L. Global epidemiology of gallstones in the 21st century: a systematic review and meta-analysis. *Clinical Gastroenterology and Hepatology*. 2024 Aug 1;22(8):1586-95.
2. Wakabayashi G, Iwashita Y, Hibi T, Takada T, Strasberg SM, Asbun HJ, Endo I, Umezawa A, Asai K, Suzuki K, Mori Y. Tokyo Guidelines 2018: surgical management of acute cholecystitis: safe steps in laparoscopic cholecystectomy for acute cholecystitis (with videos). *Journal of Hepato-biliary-pancreatic Sciences*. 2018 Jan;25(1):73-86.
3. Okamoto K, Suzuki K, Takada T, Strasberg SM, Asbun HJ, Endo I, Iwashita Y, Hibi T, Pitt HA, Umezawa A, Asai K. Tokyo Guidelines 2018: flowchart for the management of acute cholecystitis. *Journal of Hepato-biliary-pancreatic Sciences*. 2018 Jan;25(1):55-72.

4. de'Angelis N, Catena F, Memeo R, Coccolini F, Martínez-Pérez A, Romeo OM, De Simone B, Di Saverio S, Brustia R, Rhaïem R, Piardi T. 2020 WSES guidelines for the detection and management of bile duct injury during cholecystectomy. *World journal of emergency surgery*. 2021 Jun 10;16(1):30.
5. Manatakis DK, Antonopoulou MI, Tasis N, Agalianos C, Tsouknidas I, Korkolis DP, Dervenis C. Critical view of safety in laparoscopic cholecystectomy: a systematic review of current evidence and future perspectives. *World Journal of Surgery*. 2023 Mar;47(3):640-8.
6. Gupta V. How to achieve the critical view of safety for safe laparoscopic cholecystectomy: technical aspects. *Annals of hepato-biliary-pancreatic surgery*. 2023 May 31;27(2):201-10.
7. Elshaer M, Gravante G, Thomas K, Sorge R, Al-Hamali S, Ebdewi H. Subtotal cholecystectomy for “difficult gallbladders” systematic review and meta-analysis. *JAMA surgery*. 2015 Feb;150(2):159-68.
8. Koo SS, Krishnan RJ, Ishikawa K, Matsunaga M, Ahn HJ, Murayama KM, Kitamura RK. Subtotal vs total cholecystectomy for difficult gallbladders: A systematic review and meta-analysis. *The American Journal of Surgery*. 2024 Mar 1;229:145-50.
9. Sheetz KH, Claflin J, Dimick JB. Trends in the adoption of robotic surgery for common surgical procedures. *JAMA network open*. 2020 Jan 10;3(1):e1918911.
10. Kalata S, Thumma JR, Norton EC, Dimick JB, Sheetz KH. Comparative safety of robotic-assisted vs laparoscopic cholecystectomy. *JAMA surgery*. 2023 Dec;158(12):1303-10.
11. Sheetz KH, Thumma JR, Kalata S, Norton EC, Dimick JB. Learning curve for robotic-assisted cholecystectomy. *JAMA surgery*. 2024 Jul;159(7):833-6.
12. Campbell BM, Lambrianides AL, Dulhunty JM. Open cholecystectomy: exposure and confidence of surgical trainees and new fellows. *International Journal of Surgery*. 2018 Mar 1;51:218-22.
13. Riccardi M, Dughayli M, Baidoun F. Open Cholecystectomy for the New Learner—Obstacles and Challenges. *JLS: Journal of the Society of Laparoscopic & Robotic Surgeons*. 2021 Apr;25(2):e2021-00026.
14. Sirinek KR, Willis R, Schwesinger WH. Who will be able to perform open biliary surgery in 2025?. *Journal of the American College of Surgeons*. 2016 Jul 1;223(1):110-5.
15. Society of American Gastrointestinal Endoscopic Surgeons. Guidelines for the clinical application of laparoscopic biliary tract surgery. *Surg Endosc*. 2000;14(8):771-2.
16. Abdallah HS, Sedky MH, Sedky ZH. The difficult laparoscopic cholecystectomy: a narrative review. *BMC surgery*. 2025 Apr 12;25(1):156.
17. Brunt LM, Deziel DJ, Telem DA, Strasberg SM, Aggarwal R, Asbun H, Bonjer J, McDonald M, Alseidi A, Ujiki M, Riall TS. Safe cholecystectomy multi-society practice guideline and state-of-the-art consensus conference on prevention of bile duct injury during cholecystectomy. *Surgical endoscopy*. 2020 Jul;34(7):2827-55.
18. Harrison E, Kathir Kamarajah S, NIHR Global Health Research Unit on Global Surgery. Global evaluation and outcomes of cholecystectomy: protocol for a multicentre, international, prospective cohort study (GlobalSurg 4). *BMJ open*. 2024 Jul;14(7):e079599.
19. Strasberg SM, Brunt ML. Rationale and use of the critical view of safety in laparoscopic cholecystectomy. *Journal of the American College of Surgeons*. 2010 Jul 1;211(1):132-8.
20. Bingmer K, Ofshteyn A, Stein SL, Marks JM, Steinhagen E. Decline of open surgical experience for general surgery residents. *Surgical endoscopy*. 2020 Feb;34(2):967-72.
21. Ahmed O, Walsh TN. Surgical trainee experience with open cholecystectomy and the Dunning-Kruger effect. *Journal of Surgical Education*. 2020 Sep 1;77(5):1076-81.
22. Mullens CL, Sheskey S, Thumma JR, Dimick JB, Norton EC, Sheetz KH. Patient complexity and bile duct injury after robotic-assisted vs laparoscopic cholecystectomy. *JAMA Network Open*. 2025 Mar 25;8(3):e251705.
23. Strasberg SM, Brunt ML. Rationale and use of the critical view of safety in laparoscopic cholecystectomy. *Journal of the American College of Surgeons*. 2010 Jul 1;211(1):132-8.
24. Mendes FD, Sousa M, Silva S. Biliary surgery during residency: a nationwide study. *Portuguese Journal of Surgery*. 2025 Jan 31;58(1):35-46.
25. Mullens CL, Sheskey S, Thumma JR, Dimick JB, Norton EC, Sheetz KH. Patient complexity and bile duct injury after robotic-assisted vs laparoscopic cholecystectomy. *JAMA Network Open*. 2025 Mar 25;8(3):e251705.
26. Eurboonyanun C, Aphinives P, Wittayapairoch J, Eurboonyanun K, Srisuk T, Punchai S, Ruangwannasak S,

- Jenwitheesuk K, Petrusa E, Gee D, Phitayakorn R. Trend of minimally invasive and open surgery experience of general surgery residents: Accreditation Council for Graduate Medical Education general surgery case log in Thailand. *Journal of Minimally Invasive Surgery*. 2023 Sep 15;26(3):121.
27. Donald N, Sebastian J, Preziosi G. Adoption and expansion of robotic surgery across General Surgery in the United Kingdom: a 10-year procedure-specific analysis (2015–2024). *Journal of Robotic Surgery*. 2026 Jan 28;20(1):205.