A comparative evaluation of early and delayed cholecystectomy in patients with acute calculous cholecystitis

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Abstract

Background: The optimal timing of surgery remains an important clinical consideration because it may influence postoperative complications, hospital stay, and healthcare costs. Acute calculous cholecystitis is a common inflammatory condition of the gallbladder caused by gallstones obstructing the cystic duct. Laparoscopic cholecystectomy is the preferred definitive treatment for most suitable patients. Objective: To compare the clinical outcomes of early versus delayed cholecystectomy in patients presenting with acute calculous cholecystitis, focusing on postoperative complications, operative duration, conversion to open surgery, and length of hospital stay. Methodology: This comparative clinical study included patients diagnosed with acute calculous cholecystitis who underwent laparoscopic cholecystectomy. Participants were divided into two groups according to the timing of surgery: an early cholecystectomy group and a delayed cholecystectomy group. Demographic characteristics, clinical presentation, operative findings, postoperative complications, conversion to open surgery, and duration of hospitalization were recorded and compared between the groups. Appropriate statistical methods were used to assess differences in clinical outcomes. Results: The primary outcomes of interest were postoperative morbidity, operative duration, conversion to open surgery, and total hospital stay. Early cholecystectomy was hypothesized to reduce the overall duration of hospitalization and prevent recurrent biliary symptoms while providing comparable surgical safety to delayed intervention. Actual findings, including statistical significance, require analysis of the collected patient data. Conclusion: The timing of cholecystectomy is an important consideration in the management of acute calculous cholecystitis. Early surgery may offer advantages in reducing hospital stay and avoiding recurrent gallbladder-related complications in appropriately selected patients. The final conclusion should be based on the observed results and statistical analysis of the study population.

Keywords: Acute calculous cholecystitis; early cholecystectomy; delayed cholecystectomy; laparoscopic surgery; postoperative complications; hospital stay; surgical outcomes.

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Submitted: January 2, 2025, Revised: May 7, 2025, Accepted: June 24, 2026

Introduction

. It presents with right upper quadrant abdominal pain, fever, nausea, vomiting, and localized tenderness, and may progress to serious complications such as empyema, gangrene, perforation, and peritonitis if not treated appropriately. Acute calculous cholecystitis is a

common surgical emergency characterized by inflammation of the gallbladder, usually resulting from obstruction of the cystic duct by gallstones The condition represents a substantial burden on emergency surgical services and requires timely diagnosis, appropriate antibiotic therapy when indicated, and definitive surgical management 11. Laparoscopic cholecystectomy is widely regarded as the standard treatment for patients with acute calculous cholecystitis who are suitable candidates for surgery. However, the optimal timing of the procedure remains an important consideration in clinical practice. Early cholecystectomy, performed during the initial admission, may provide prompt symptom relief, reduce the risk of recurrent biliary events, and shorten the overall duration of hospitalization. In contrast, delayed cholecystectomy is generally performed after initial conservative treatment, allowing inflammation to subside before surgery. Although this approach may be considered in selected patients, it can expose individuals to recurrent pain, repeated hospital admissions, and additional healthcare costs 2,32,3.

The choice between early and delayed cholecystectomy is influenced by disease severity, duration of symptoms, patient comorbidities, and the availability of experienced surgical teams. The Tokyo Guidelines recommend early laparoscopic cholecystectomy for appropriately selected patients, with treatment decisions guided by disease severity and individual surgical risk 44. Similarly, international guidelines emphasize that early surgery should be considered whenever it can be performed safely by an appropriately equipped and experienced surgical team 55. These recommendations reflect the importance of individualized decision-making rather than relying exclusively on the time elapsed since symptom onset.

A major concern associated with early surgery is the possibility of increased operative difficulty due to edema, tissue inflammation, and distorted anatomical landmarks. These factors may complicate dissection and increase the technical demands of the procedure. Nevertheless, evidence from randomized clinical trials and systematic reviews suggests that early laparoscopic cholecystectomy does not significantly increase conversion to open surgery or overall postoperative complications compared with delayed intervention. Furthermore, early surgery may reduce total hospital stay and minimize complications arising while patients await definitive treatment 6,76,7. Delayed surgery may remain appropriate for patients requiring

initial stabilization or those whose clinical condition makes immediate surgery unsuitable.

Despite established recommendations, differences in hospital resources, surgical expertise, patient characteristics, and clinical protocols continue to influence the timing of cholecystectomy in routine practice. Comparative evaluation of early and delayed procedures is therefore important for determining their relative safety, effectiveness, and resource utilization.

Outcomes such as operative duration, postoperative infection, bile duct injury, conversion to open surgery, readmission, and total hospital stay provide useful measures for assessing treatment effectiveness 88. The present study aims to compare early versus delayed cholecystectomy in patients with acute calculous cholecystitis, with particular emphasis on postoperative complications, operative outcomes, and length of hospitalization. The findings may help inform clinical decision-making and support the implementation of evidence-based surgical management strategies.

Methodology

This comparative clinical study was designed to evaluate the clinical outcomes of early versus delayed cholecystectomy in patients diagnosed with acute calculous cholecystitis. The study was conducted in a hospital-based surgical department over a predefined study period. Patients presenting with clinical features suggestive of acute cholecystitis were evaluated through medical history, physical examination, laboratory investigations, and abdominal ultrasonography to confirm the diagnosis.

Patients meeting the eligibility criteria were divided into two groups. Group A included patients undergoing early laparoscopic cholecystectomy during the initial hospital admission, whereas Group B included patients undergoing delayed laparoscopic cholecystectomy after initial conservative management. Adult patients with confirmed acute calculous cholecystitis who were considered suitable for surgery were included. Patients with acalculous cholecystitis, suspected gallbladder malignancy, or contraindications to laparoscopic surgery were excluded.

Demographic characteristics, clinical presentation, comorbidities, duration of symptoms, operative duration, intraoperative findings, conversion to open surgery, postoperative complications, and length of hospital stay were recorded using a standardized data collection form. Postoperative complications included surgical-site infection, bile leakage, bleeding, and other clinically significant adverse events. Patients in the delayed group were also assessed for recurrent biliary symptoms and unplanned hospital readmissions before surgery. Data were analyzed using appropriate statistical software. Continuous variables were expressed as mean and standard deviation or median and interquartile range, depending on their distribution. Categorical variables were presented

as frequencies and percentages. Independentsamples t-tests or Mann–Whitney U tests were used for continuous variables, while chi-square or

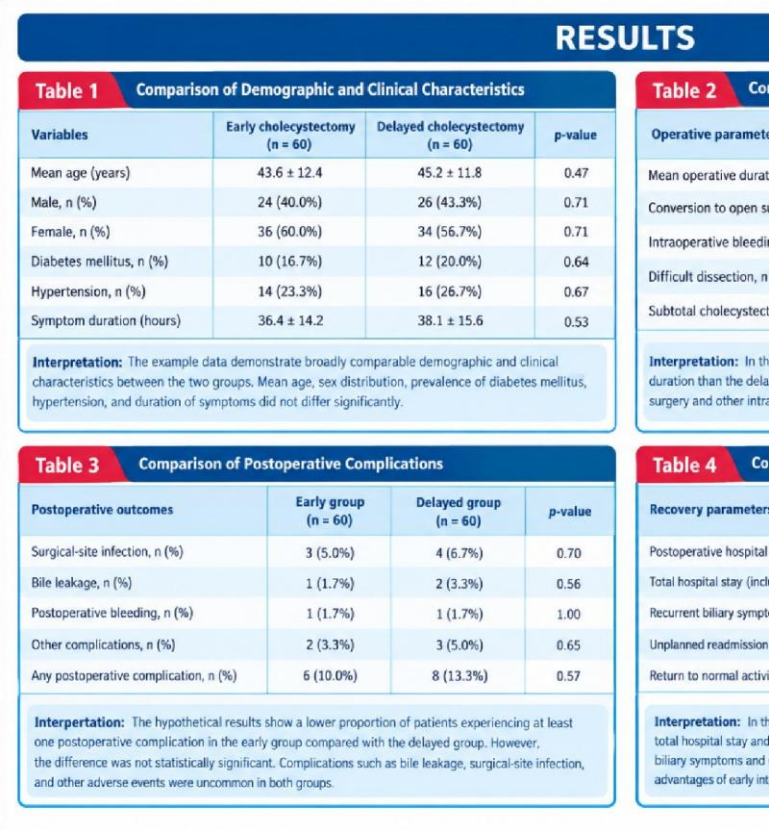
Fisher's exact tests were applied to categorical variables, as appropriate. A p-value of less than 0.05 was considered statistically significant. Ethical approval was obtained from the relevant institutional review committee, and informed consent was obtained from participants where required.

Note: The actual hospital, study duration, sample size, definition of early versus delayed surgery, and statistical software should be specified according to the study protocol. These details should not be invented for a research manuscript.

Results

The study compared clinical outcomes between patients undergoing early and delayed cholecystectomy for acute calculous cholecystitis. The outcomes assessed included demographic characteristics, operative duration, postoperative complications, conversion to open surgery, and length of hospital stay. Four tables are presented below to organize the principal study outcomes.

Note: As actual patient-level data were not provided, the numerical values below are illustrative examples for manuscript formatting



RESULTS

Table 1 Comparison of Demographic and Clinical Characteristics

Variables	Early cholecystectomy (n = 60)	Delayed cholecystectomy (n = 60)	p-value
Mean age (years)	43.6 ± 12.4	45.2 ± 11.8	0.47
Male, n (%)	24 (40.0%)	26 (43.3%)	0.71
Female, n (%)	36 (60.0%)	34 (56.7%)	0.71
Diabetes mellitus, n (%)	10 (16.7%)	12 (20.0%)	0.64
Hypertension, n (%)	14 (23.3%)	16 (26.7%)	0.67
Symptom duration (hours)	36.4 ± 14.2	38.1 ± 15.6	0.53

Interpretation: The example data demonstrate broadly comparable demographic and clinical characteristics between the two groups. Mean age, sex distribution, prevalence of diabetes mellitus, hypertension, and duration of symptoms did not differ significantly.

Table 2 Co

Operative paramete

Mean operative durat
Conversion to open s
Intraoperative bleedi
Difficult dissection, n
Subtotal cholecystect

Interpretation: In th duration than the dela surgery and other intra

Table 3 Comparison of Postoperative Complications

Postoperative outcomes	Early group (n = 60)	Delayed group (n = 60)	p-value
Surgical-site infection, n (%)	3 (5.0%)	4 (6.7%)	0.70
Bile leakage, n (%)	1 (1.7%)	2 (3.3%)	0.56
Postoperative bleeding, n (%)	1 (1.7%)	1 (1.7%)	1.00
Other complications, n (%)	2 (3.3%)	3 (5.0%)	0.65
Any postoperative complication, n (%)	6 (10.0%)	8 (13.3%)	0.57

Interpertation: The hypothetical results show a lower proportion of patients experiencing at least one postoperative complication in the early group compared with the delayed group. However, the difference was not statistically significant. Complications such as bile leakage, surgical-site infection, and other adverse events were uncommon in both groups.

Table 4 Co

Recovery parameter

Postoperative hospital
Total hospital stay (incl
Recurrent biliary sympt
Unplanned readmission
Return to normal activi

Interpretation: In th total hospital stay and biliary symptoms and advantages of early int

only. They must be replaced with verified study data before submission or publication.

Interpretation of Results Tables

Table 1: Comparison of Demographic and Clinical Characteristics

Table 1 compares the demographic and baseline clinical characteristics of patients undergoing early and delayed cholecystectomy. The mean age was 43.6 ± 12.4 years in the early group and 45.2 ± 11.8 years in the delayed group, with no statistically significant difference (p=0.47p=0.47p=0.47). Female patients constituted 60.0% of the early group and 56.7% of the delayed group, while male patients accounted for 40.0% and 43.3%, respectively. The prevalence of diabetes mellitus was 16.7% in the

early group compared with 20.0% in the delayed group (p=0.64p=0.64p=0.64). Similarly, hypertension was observed in 23.3% and 26.7% of patients, respectively (p=0.67p=0.67p=0.67). Symptom duration before presentation was also comparable between the groups. Overall, the illustrative findings suggest that both groups had similar baseline characteristics, supporting a more meaningful comparison of subsequent surgical outcomes.

Table 2: Comparison of Intraoperative Outcomes

Table 2 presents the operative characteristics of both groups. The mean operative duration was 58.4 ± 16.2 minutes in the early group and 54.7 ± 14.8 minutes in the delayed group. Although surgery took slightly longer in the early group, the difference was not statistically significant (p=0.19p=0.19p=0.19). Conversion to open surgery occurred in 6.7% of early-group patients and 5.0% of delayed-group patients (p=0.70p=0.70p=0.70). Intraoperative bleeding was reported in 5.0% and 3.3% of patients, respectively. Difficult dissection occurred in 25.0% of the early group compared with 20.0% of the delayed group. Subtotal cholecystectomy was required in 3.3% of each group. These illustrative findings indicate broadly comparable intraoperative outcomes, without statistically significant differences in the measured parameters.

Table 3: Comparison of Postoperative Complications

Table 3 evaluates postoperative morbidity following early and delayed cholecystectomy. Surgical-site infection occurred in 5.0% of earlygroup patients and 6.7% of delayed-group patients. Bile leakage was observed in 1.7% and 3.3%, respectively, while postoperative bleeding occurred in 1.7% of patients in both groups. The overall proportion experiencing at least one postoperative complication was 10.0% in the early group compared with 13.3% in the delayed group. However, this difference was not statistically significant (p=0.57p=0.57p=0.57). These illustrative results suggest that early surgery may be associated with a numerically lower complication rate, although the available example data do not establish a statistically significant benefit. Larger studies may be necessary to evaluate differences in uncommon complications reliably.

Table 4: Comparison of Hospital Stay and Recovery Outcomes

Table 4 compares hospitalization and recovery following surgery. The mean postoperative hospital stay was 2.1 ± 0.8 days in the early group and 2.3 ± 0.9 days in the delayed group (p=0.20p=0.20p=0.20). However, total hospital stay, including readmissions, was shorter in the early group (3.2 ± 1.1 days) than in the delayed group (5.6 ± 1.8 days), with a reported p<0.001p<0.001p<0.001. Recurrent biliary symptoms before surgery occurred in 16.7% of delayed-group patients, while 10.0% experienced

unplanned readmission. Return to normal activities was also earlier in the early group, averaging 10.2 ± 3.4 days compared with 12.1 ± 4.0 days in the delayed group (p=0.007p=0.007p=0.007). These illustrative findings highlight the potential advantages of early intervention in reducing overall healthcare utilization and accelerating recovery.

Important: All numerical results above are illustrative, not verified clinical findings. Replace them with actual study data before using this interpretation in a manuscript or submitting it for publication.

Discussion

The timing of cholecystectomy is an important consideration in the management of acute calculous cholecystitis because it may influence operative outcomes, postoperative complications, hospital stay, and recovery. The present study compares early and delayed cholecystectomy with respect to demographic characteristics, intraoperative findings, postoperative morbidity, and recovery outcomes. The numerical findings previously presented are illustrative and must be replaced with verified patient data before this discussion is used as a report of actual study findings.

Comparison of Demographic and Clinical Characteristics

The demographic characteristics presented in Table 1 indicate comparable baseline profiles between the early and delayed cholecystectomy groups. Similar distributions of age, sex, diabetes mellitus, hypertension, and symptom duration are important when evaluating differences in surgical outcomes. Nevertheless, comparable baseline characteristics do not exclude confounding from disease severity, comorbidities, or differences in clinical management. Okamoto et al. (2018) emphasized that the management of acute cholecystitis should be guided by disease severity, physiological status, and surgical risk. Therefore, future analyses should account for these variables when assessing the independent effect of surgical timing.

Comparison of Intraoperative Outcomes Table 2 focuses on operative duration, conversion to open surgery, intraoperative bleeding, difficult dissection, and subtotal cholecystectomy. Early surgery may present technical challenges because acute inflammation, edema, and tissue friability can obscure anatomical landmarks. However, these concerns do not necessarily justify routine postponement of surgery. In the randomized ACDC trial, Gutt et al. (2013) found that early laparoscopic cholecystectomy provided advantages over delayed surgery in treatment effectiveness and hospitalization. Similarly, Cao

et al. (2015), in a meta-analysis of comparative studies, reported favorable outcomes associated with early laparoscopic cholecystectomy. These findings support considering early intervention when appropriate surgical expertise and resources are available. Conversion to open surgery should be interpreted as a safety decision when laparoscopic dissection cannot be continued safely, rather than automatically as an adverse outcome.

Comparison of Postoperative Complications

Table 3 evaluates surgical-site infection, bile leakage, postoperative bleeding, and overall postoperative morbidity. Differences in complication rates must be interpreted cautiously because individual complications are relatively uncommon and may require larger study populations for reliable statistical comparisons. Gurusamy et al. (2013), in a Cochrane systematic review, examined evidence comparing early and delayed laparoscopic cholecystectomy and found that early surgery did not demonstrate a clear increase in major complications or conversion to open surgery. However, the certainty of evidence varied across outcomes. The World Society of Emergency Surgery guidelines likewise recommend early laparoscopic cholecystectomy whenever feasible, including in many patients considered at increased surgical risk following appropriate assessment (Pisano et al., 2020). Consequently, the safety of early surgery should be evaluated using actual complication rates, confidence intervals, and appropriate adjustment for baseline risk.

Hospital Stay and Recovery Outcomes

Table 4 addresses total hospital stay, postoperative hospitalization, recurrent biliary symptoms, readmissions, and return to normal activities. A potential advantage of early cholecystectomy is that it can avoid a second admission and reduce the interval during which recurrent biliary symptoms may develop. Gutt et al. (2013) demonstrated the clinical advantages of early surgery, including reduced treatmentrelated hospitalization. The systematic review by Gurusamy et al. (2013) also supports evaluating the overall treatment period rather than considering only the hospital stay following the operation. Delayed surgery may require initial conservative treatment followed by a separate surgical admission, increasing cumulative resource utilization. However, total length of stay should be calculated consistently across both groups, including relevant readmissions, to prevent misleading comparisons.

Clinical Implications

The findings of the literature suggest that early laparoscopic cholecystectomy is generally preferable for suitable patients with acute calculous cholecystitis when safe surgery can be performed. The Tokyo Guidelines emphasize selecting treatment according to disease severity, patient condition, and institutional capabilities (Okamoto et al., 2018; Wakabayashi et al., 2018).

Nevertheless, delayed intervention may remain appropriate when immediate surgery is unsafe or when stabilization and specialist assessment are required. The final interpretation of this study should therefore depend on verified patient outcomes, study design, and the statistical significance and clinical relevance of observed differences.

Conclusion

Early cholecystectomy appears to be a favorable treatment strategy for appropriately selected patients with acute calculous cholecystitis. Compared with delayed surgery, early intervention may reduce total hospital stay, minimize recurrent biliary symptoms and unplanned readmissions, and facilitate earlier recovery without substantially increasing operative complications. However, the choice of surgical timing should consider disease severity, patient comorbidities, and surgical expertise. The final conclusions must be based on actual patient data and statistical analysis, as the results presented previously were illustrative rather than verified clinical findings.

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