International Journal of Medicine
pISSN 1468-3814 | eISSN 2667-7008
https://theinternationalmedicine.com/

Original Researcher Article *DOI: 10.61336/im/26-08-05*

Comparative Evaluation of Early versus Delayed Laparoscopic Cholecystectomy in Acute Calculous Cholecystitis.

Dr. Abhishek Katha[1]*, Dr. Marpali Samhitha Reddy[2]

[1]Associate Professor, Department of General Surgery, Neelima Institute of Medical Sciences, Venkatapur, Ghatkesar, Telangana-500088, India.

[2]Assistant Professor, Department of General Surgery, Dr. Patnam Mahender Reddy Institute of Medical Sciences, chevella (V&M), Rangareddy(D), Telangana-501503, India.

Correspondence:
Dr. Abhishek Katha.
Associate Professor, Department of General Surgery, Neelima Institute of Medical Sciences, Venkatapur, Ghatkesar, Telangana-500088, India.

Email:
abhishek.katha1986@gmail.com

Received: 22-06-2026
Revised: 06-07-2026
Accepted: 18-07-2026
Published: 01-08-2026

Abstract

Background: Acute calculous cholecystitis is a common surgical emergency for which laparoscopic cholecystectomy is the definitive treatment. However, the optimal timing of surgery remains debated. Early laparoscopic cholecystectomy offers definitive treatment during the index admission, whereas delayed surgery is traditionally performed after resolution of acute inflammation. This study compared the clinical, operative, postoperative, effectiveness, and safety outcomes of early and delayed laparoscopic cholecystectomy. ***Aim:*** To compare the clinical and surgical outcomes of early versus delayed laparoscopic cholecystectomy in patients with acute calculous cholecystitis. ***Materials and Methods:*** This hospital-based prospective comparative observational study included 120 patients diagnosed with acute calculous cholecystitis. Patients were divided into an early laparoscopic cholecystectomy group and a delayed laparoscopic cholecystectomy group, with 60 patients in each group. Early surgery was performed during the index admission, while delayed surgery was performed after initial conservative management and resolution of acute inflammation. Baseline clinical characteristics, operative time, intraoperative blood loss, operative difficulty, conversion to open surgery, postoperative pain, complications, hospital stay, return to normal activities, recurrent biliary symptoms, readmission, and patient satisfaction were recorded. Continuous variables were compared using the independent Student's t-test, while categorical variables were analyzed using the chi-square test or Fisher's exact test. A p-value of less than 0.05 was considered statistically significant. ***Results:*** The early and delayed groups were comparable with respect to age, sex, symptom duration, fever, diabetes mellitus, disease severity, and total leucocyte count. The mean operative time was significantly longer in the early group than in the delayed group (74.6±18.7 versus 66.2±16.4 minutes, p=0.010). Intraoperative blood loss was also significantly greater in the early group (86.4±35.7 versus 69.8±30.6 mL, p=0.007). However, conversion to open cholecystectomy was comparable between the groups (6.7% versus 5.0%, p=1.000), as was the incidence of bile duct injury. The early group had significantly lower postoperative pain scores at 24 hours (3.7±1.2 versus 4.4±1.3, p=0.003), earlier resumption of oral feeding (18.6±6.4 versus 23.2±7.1 hours, p<0.001), shorter postoperative hospital stay (3.6±1.4 versus 6.8±2.1 days, p<0.001), and earlier return to normal activities (10.8±3.2 versus 16.7±4.6 days, p<0.001). The total hospital stay was significantly shorter in the early group (4.1±1.6 versus 9.2±2.8 days, p<0.001). Recurrent biliary symptoms occurred in none of the patients in the early group compared with 15.0% in the delayed group (p=0.003). Return to normal activities within 14 days and patient satisfaction were significantly higher in the early group. Overall postoperative complications were lower in the early group, although the difference was not statistically significant. No treatment-related mortality occurred in either group. ***Conclusion:*** Early laparoscopic cholecystectomy provided better overall clinical outcomes than delayed surgery by reducing postoperative pain, hospital stay, recurrent biliary symptoms, and time to functional recovery. Although early surgery was associated with a longer operative duration and greater blood loss, it did not increase major complications, conversion, bile duct injury, reoperation, or mortality. Early laparoscopic cholecystectomy should therefore be considered the preferred treatment for suitable patients with acute calculous cholecystitis.

Keywords: Acute calculous cholecystitis; Early laparoscopic cholecystectomy; Delayed laparoscopic cholecystectomy.

INTRODUCTION

Acute calculous cholecystitis is one of the most common surgical emergencies encountered in general surgical practice and accounts for a significant proportion of hospital admissions related to gallstone disease. The condition results from obstruction of the cystic duct by gallstones, leading to gallbladder distension, inflammation, bacterial colonization, and, if untreated, complications such as empyema, gangrene, perforation, and biliary peritonitis. Gallstone disease affects approximately 10–20% of the adult population worldwide, with nearly 1–3% of affected individuals developing acute cholecystitis annually. Prompt diagnosis and timely surgical intervention are therefore essential to reduce morbidity and prevent disease progression. Clinical diagnosis is based on characteristic right upper quadrant pain, fever, Murphy's sign, laboratory evidence of inflammation, and ultrasonographic findings including gallstones, gallbladder wall thickening, pericholecystic fluid, and a sonographic Murphy's sign. The Tokyo Guidelines have standardized diagnostic criteria and severity grading, facilitating uniform management across healthcare settings.[1]

Laparoscopic cholecystectomy has become the gold standard treatment for symptomatic gallstone disease and acute calculous cholecystitis due to its advantages of reduced postoperative pain, shorter hospital stay, earlier return to normal activities, lower wound complications, and improved cosmetic outcomes. However, the optimal timing of surgery in patients presenting with acute cholecystitis has remained a matter of debate. Traditionally, conservative treatment with antibiotics followed by delayed laparoscopic cholecystectomy after 6–12 weeks was advocated to allow inflammation to subside and reduce operative difficulty. Nevertheless, delayed surgery exposes patients to recurrent biliary symptoms, repeated hospital admissions, gallstone-related complications, and increased healthcare expenditure during the waiting period.[2]

In contrast, early laparoscopic cholecystectomy, usually performed within 72 hours to one week of symptom onset, has gained increasing acceptance owing to advances in laparoscopic techniques, improved perioperative care, and growing surgical expertise. Early surgery removes the diseased gallbladder before recurrent attacks occur, decreases total hospital stay, minimizes repeated admissions, and may ultimately reduce overall treatment costs. Several randomized controlled trials and meta-analyses have demonstrated that early laparoscopic cholecystectomy is safe and feasible without increasing the rates of bile duct injury, conversion to open surgery, postoperative complications, or mortality when performed by experienced surgeons. International guidelines, including the updated Tokyo Guidelines and the World Society of Emergency Surgery recommendations, now advocate early laparoscopic cholecystectomy whenever feasible.[3,4]

Despite these recommendations, delayed laparoscopic cholecystectomy continues to be practiced in many institutions because of logistical constraints, limited operating room availability, surgeon preference, and concerns regarding technical difficulty in inflamed tissues. Consequently, comparative evaluation of perioperative outcomes between early and delayed surgery remains clinically relevant, particularly in tertiary care hospitals serving diverse patient populations. Parameters such as operative time, conversion rate, intraoperative blood loss, postoperative pain, complications, duration of hospital stay, time to resume normal activities, and overall treatment outcomes provide valuable evidence to guide clinical decision-making. The present study was therefore undertaken to compare the clinical and surgical outcomes of early versus delayed laparoscopic cholecystectomy in patients with acute calculous cholecystitis and to identify the approach associated with better patient recovery and healthcare utilization.[5]

AIM

To compare the clinical and surgical outcomes of early versus delayed laparoscopic cholecystectomy in patients with acute calculous cholecystitis.

OBJECTIVES

1. To compare operative parameters including operative time, intraoperative blood loss, and conversion to open cholecystectomy between early and delayed laparoscopic cholecystectomy.
2. To compare postoperative outcomes including pain score, complications, duration of hospital stay, and time to return to normal activities between the two groups.
3. To evaluate the overall effectiveness and safety of early versus delayed laparoscopic cholecystectomy in the management of acute calculous cholecystitis.

MATERIALS AND METHODS

Source of Data

The data were collected from patients diagnosed with acute calculous cholecystitis who were admitted to the Department of General Surgery of the study institution during the study period. Clinical records, laboratory investigations, imaging findings, operative notes, and postoperative follow-up data were utilized for analysis.

Study Design
The study was conducted as a hospital-based prospective comparative observational study.
Study Location
The study was carried out in the Department of General Surgery at a tertiary care teaching hospital.

Study Duration
The study was conducted over a period of 18 months, including patient recruitment, surgical intervention, postoperative follow-up, data collection, and statistical analysis.

Sample Size
A total of 120 patients diagnosed with acute calculous cholecystitis were included in the study.
- Group A (Early Laparoscopic Cholecystectomy): 60 patients
- Group B (Delayed Laparoscopic Cholecystectomy): 60 patients

Patients were enrolled consecutively after fulfilling the eligibility criteria.

Inclusion Criteria
Patients fulfilling all of the following criteria were included:
- Age ≥18 years.
- Patients diagnosed with acute calculous cholecystitis based on clinical examination, laboratory findings, and ultrasonography.
- Patients fit for laparoscopic surgery under general anaesthesia.
- Patients willing to provide written informed consent.
- Patients scheduled for either early or delayed laparoscopic cholecystectomy.

Exclusion Criteria
The following patients were excluded:
- Acalculous cholecystitis.
- Gallbladder malignancy.
- Common bile duct stones requiring ERCP before surgery.
- Severe acute pancreatitis.
- Generalized biliary peritonitis.
- Previous upper abdominal surgery precluding laparoscopy.
- Pregnancy.
- Severe cardiopulmonary illness rendering patients unfit for surgery.
- Patients refusing participation.

Procedure and Methodology
After obtaining approval from the Institutional Ethics Committee and written informed consent, eligible patients presenting with acute calculous cholecystitis were enrolled. Detailed demographic information, presenting symptoms, duration of illness, medical history, comorbidities, and physical examination findings were recorded.
Baseline investigations included complete blood count, liver function tests, renal function tests, blood sugar, coagulation profile, serum electrolytes, ECG, chest radiograph, and abdominal ultrasonography. Diagnosis was established using clinical findings together with ultrasonographic evidence of gallstones and gallbladder inflammation.
Patients were allocated into two groups according to the timing of surgery:
- Early laparoscopic cholecystectomy group: Surgery was performed within 72 hours of hospital admission or within one week of symptom onset.
- Delayed laparoscopic cholecystectomy group: Initial conservative treatment consisting of intravenous fluids, antibiotics, analgesics, and supportive care was administered, followed by elective laparoscopic cholecystectomy after approximately 6–8 weeks once acute inflammation had subsided.

All operations were performed under general anaesthesia using the standard four-port laparoscopic technique. Operative findings including adhesions, gallbladder wall edema, difficulty in dissection, operative time, intraoperative blood loss, bile spillage, gallbladder perforation, conversion to open surgery, and intraoperative complications were documented.
Postoperatively, all patients received standard analgesics, antibiotics, and supportive treatment according to institutional protocol. Patients were monitored for pain, fever, wound infection, bile leak, bleeding, intra-abdominal collection, duration of drain placement (where applicable), duration of hospital stay, and postoperative complications. Follow-up was performed to assess recovery, return to normal daily activities, and late complications.

Sample Processing

All collected clinical information was entered into a structured case record form immediately after patient evaluation. Laboratory reports and radiological findings were verified before data entry. Operative notes were reviewed to document intraoperative variables, while postoperative observations were recorded daily until discharge. Follow-up findings were documented during scheduled outpatient visits. Data quality was ensured through regular verification and cross-checking with hospital records.

Statistical Methods

The collected data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) version 26.0.

Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequency and percentage.

Comparisons between the two groups were performed using:

- Independent Student's t-test for continuous variables.
- Chi-square test or Fisher's exact test for categorical variables.
- Relative risk (RR) or odds ratio (OR) with 95% confidence intervals were calculated where appropriate.

A p-value <0.05 was considered statistically significant.

Data Collection

Data were collected using a predesigned and pretested case record proforma. The following variables were recorded:

- Demographic profile (age, sex, BMI)
- Duration of symptoms
- Clinical presentation
- Comorbidities
- Laboratory parameters
- Ultrasonographic findings
- Timing of surgery
- Operative time
- Intraoperative blood loss
- Adhesions and operative difficulty
- Gallbladder perforation
- Bile spillage
- Conversion to open surgery
- Intraoperative complications
- Postoperative pain score
- Surgical site infection
- Bile leak
- Hospital stay
- Time to oral feeding
- Time to return to normal daily activities
- Readmission
- Overall postoperative outcome.

RESULTS

Table 1: Comparison of baseline clinical characteristics and overall surgical outcomes between early and delayed laparoscopic cholecystectomy groups (N=120)

Variable	Early laparoscopic cholecystectomy, n=60 n (%) or Mean (SD)	Delayed laparoscopic cholecystectomy, n=60 n (%) or Mean (SD)	Test of significance	Effect estimate and 95% CI	P value
Age, years	44.8 (11.6)	46.3 (12.1)	t=-0.69	MD=-1.50 (-5.79 to 2.79)	0.490
Male sex	34 (56.7)	37 (61.7)	χ^2=0.31	RR=0.92 (0.68–1.24)	0.577
Female sex	26 (43.3)	23 (38.3)	—	Reference	—
Duration of symptoms before admission, days	2.7 (1.1)	2.9 (1.2)	t=-0.95	MD=-0.20 (-0.62 to 0.22)	0.343
Fever at presentation	29 (48.3)	32 (53.3)	χ^2=0.30	RR=0.91 (0.64–1.29)	0.584

Diabetes mellitus	11 (18.3)	13 (21.7)	χ^2=0.21	RR=0.85 (0.41–1.74)	0.648
Tokyo severity grade II	9 (15.0)	8 (13.3)	χ^2=0.07	RR=1.13 (0.47–2.72)	0.793
Total leucocyte count, ×10³/mm³	13.6 (3.8)	13.1 (3.5)	t=0.75	MD=0.50 (-0.82 to 1.82)	0.455
Conversion to open cholecystectomy	4 (6.7)	3 (5.0)	Fisher's exact test	RR=1.33 (0.31–5.70)	1.000
Overall postoperative complications	7 (11.7)	14 (23.3)	χ^2=2.83	RR=0.50 (0.22–1.15)	0.093
Total hospital stay, days	4.1 (1.6)	9.2 (2.8)	t=-12.25	MD=-5.10 (-5.93 to -4.27)	<0.001*

Table 1: Baseline Clinical Characteristics and Overall Surgical Outcomes

Table 1 compared the baseline clinical characteristics and overall surgical outcomes of patients who underwent early and delayed laparoscopic cholecystectomy. The mean age of patients in the early group was 44.8±11.6 years, compared with 46.3±12.1 years in the delayed group. The mean difference was -1.50 years (95% CI: -5.79 to 2.79), and the difference was not statistically significant (t=-0.69, p=0.490). Males constituted 56.7% of the early group and 61.7% of the delayed group, while females constituted 43.3% and 38.3%, respectively. The sex distribution was comparable between the groups (χ^2=0.31, RR=0.92, 95% CI: 0.68–1.24, p=0.577). The mean duration of symptoms before admission was 2.7±1.1 days in the early group and 2.9±1.2 days in the delayed group, with no significant difference between them (t=-0.95, MD=-0.20 days, 95% CI: -0.62 to 0.22, p=0.343). Fever at presentation was observed in 48.3% of patients in the early group and 53.3% in the delayed group, which was statistically comparable (χ^2=0.30, RR=0.91, 95% CI: 0.64–1.29, p=0.584). Diabetes mellitus was present in 18.3% and 21.7% of patients in the early and delayed groups, respectively, without a statistically significant difference (χ^2=0.21, RR=0.85, 95% CI: 0.41–1.74, p=0.648). Tokyo severity grade II disease was recorded in 15.0% of the early group and 13.3% of the delayed group, and this difference was also not significant (χ^2=0.07, RR=1.13, 95% CI: 0.47–2.72, p=0.793). The mean total leucocyte count was 13.6±3.8×10³/mm³ in the early group and 13.1±3.5×10³/mm³ in the delayed group, with no statistically significant difference (t=0.75, MD=0.50×10³/mm³, 95% CI: -0.82 to 1.82, p=0.455). Conversion to open cholecystectomy occurred in 6.7% of patients in the early group and 5.0% in the delayed group, with no significant difference (Fisher's exact test, RR=1.33, 95% CI: 0.31–5.70, p=1.000). Overall postoperative complications were observed in 11.7% of patients in the early group and 23.3% in the delayed group. Although the risk of complications was approximately 50% lower in the early group, the difference did not reach statistical significance (χ^2=2.83, RR=0.50, 95% CI: 0.22–1.15, p=0.093). However, the mean total hospital stay was significantly shorter in the early group, at 4.1±1.6 days, compared with 9.2±2.8 days in the delayed group (t=-12.25, MD=-5.10 days, 95% CI: -5.93 to -4.27, p<0.001).

Table 2: Comparison of operative parameters between early and delayed laparoscopic cholecystectomy groups (N=120)

Operative parameter	**Early laparoscopic cholecystectomy, n=60 n (%) or Mean (SD)**	**Delayed laparoscopic cholecystectomy, n=60 n (%) or Mean (SD)**	**Test of significance**	**Effect estimate and 95% CI**	**P value**
Operative time, minutes	74.6 (18.7)	66.2 (16.4)	t=2.62	MD=8.40 (2.04–14.76)	0.010*
Estimated intraoperative blood loss, mL	86.4 (35.7)	69.8 (30.6)	t=2.73	MD=16.60 (4.58–28.62)	0.007*
Dense adhesions around gallbladder	23 (38.3)	14 (23.3)	χ^2=3.16	RR=1.64 (0.94–2.86)	0.076
Difficult Calot's triangle dissection	19 (31.7)	11 (18.3)	χ^2=2.87	RR=1.73 (0.91–3.29)	0.090
Gallbladder perforation	11 (18.3)	7 (11.7)	χ^2=1.05	RR=1.57 (0.65–3.78)	0.306
Intraoperative bile spillage	13 (21.7)	8 (13.3)	χ^2=1.44	RR=1.63 (0.73–3.63)	0.230
Subhepatic drain placement	17 (28.3)	9 (15.0)	χ^2=3.14	RR=1.89 (0.92–3.90)	0.076
Subtotal cholecystectomy	3 (5.0)	2 (3.3)	Fisher's exact test	RR=1.50 (0.26–8.64)	1.000

Conversion to open cholecystectomy	4 (6.7)	3 (5.0)	Fisher's exact test	RR=1.33 (0.31–5.70)	1.000
Intraoperative bile duct injury	1 (1.7)	1 (1.7)	Fisher's exact test	RR=1.00 (0.06–15.62)	1.000

Table 2 compared the operative parameters between the early and delayed laparoscopic cholecystectomy groups. The mean operative time was significantly longer in the early group, at 74.6±18.7 minutes, compared with 66.2±16.4 minutes in the delayed group. The mean difference was 8.40 minutes (95% CI: 2.04–14.76), which was statistically significant (t=2.62, p=0.010). Similarly, the mean estimated intraoperative blood loss was significantly greater in the early group, at 86.4±35.7 mL, compared with 69.8±30.6 mL in the delayed group (t=2.73, MD=16.60 mL, 95% CI: 4.58–28.62, p=0.007). Dense adhesions around the gallbladder were encountered in 38.3% of early procedures and 23.3% of delayed procedures. Although the relative risk was higher in the early group, the difference was not statistically significant (χ^2=3.16, RR=1.64, 95% CI: 0.94–2.86, p=0.076). Difficult dissection of Calot's triangle was observed in 31.7% of the early group and 18.3% of the delayed group, but this difference also failed to attain statistical significance (χ^2=2.87, RR=1.73, 95% CI: 0.91–3.29, p=0.090). Gallbladder perforation occurred in 18.3% of early procedures and 11.7% of delayed procedures (χ^2=1.05, RR=1.57, 95% CI: 0.65–3.78, p=0.306). Intraoperative bile spillage was recorded in 21.7% and 13.3% of the early and delayed groups, respectively, with no statistically significant difference (χ^2=1.44, RR=1.63, 95% CI: 0.73–3.63, p=0.230). Subhepatic drain placement was required in 28.3% of patients in the early group and 15.0% in the delayed group. Although drain placement was more frequent in the early group, the difference was not significant (χ^2=3.14, RR=1.89, 95% CI: 0.92–3.90, p=0.076). Subtotal cholecystectomy was performed in 5.0% of early cases and 3.3% of delayed cases, with no significant difference (Fisher's exact test, RR=1.50, 95% CI: 0.26–8.64, p=1.000). Conversion to open cholecystectomy occurred in 6.7% of the early group and 5.0% of the delayed group (Fisher's exact test, RR=1.33, 95% CI: 0.31–5.70, p=1.000). Intraoperative bile duct injury was rare and occurred in one patient in each group, corresponding to 1.7% in both groups (Fisher's exact test, RR=1.00, 95% CI: 0.06–15.62, p=1.000).

Table 3: Comparison of postoperative outcomes between early and delayed laparoscopic cholecystectomy groups (N=120)

Postoperative outcome	Early laparoscopic cholecystectomy, n=60 n (%) or Mean (SD)	Delayed laparoscopic cholecystectomy, n=60 n (%) or Mean (SD)	Test of significance	Effect estimate and 95% CI	P value
Postoperative pain score at 24 hours	3.7 (1.2)	4.4 (1.3)	t=-3.06	MD=-0.70 (-1.15 to -0.25)	0.003*
Time to resume oral feeding, hours	18.6 (6.4)	23.2 (7.1)	t=-3.73	MD=-4.60 (-7.05 to -2.15)	<0.001*
Postoperative hospital stay, days	3.6 (1.4)	6.8 (2.1)	t=-9.82	MD=-3.20 (-3.85 to -2.55)	<0.001*
Time to return to normal activities, days	10.8 (3.2)	16.7 (4.6)	t=-8.16	MD=-5.90 (-7.33 to -4.47)	<0.001*
Surgical-site infection	3 (5.0)	7 (11.7)	Fisher's exact test	RR=0.43 (0.12–1.58)	0.322
Postoperative bile leak	2 (3.3)	3 (5.0)	Fisher's exact test	RR=0.67 (0.12–3.85)	1.000
Intra-abdominal collection	2 (3.3)	6 (10.0)	Fisher's exact test	RR=0.33 (0.07–1.57)	0.272
Postoperative nausea or vomiting	8 (13.3)	14 (23.3)	χ^2=2.02	RR=0.57 (0.26–1.26)	0.155
Prolonged drain requirement	4 (6.7)	9 (15.0)	Fisher's exact test	RR=0.44 (0.15–1.37)	0.239
Readmission within 30 days	2 (3.3)	8 (13.3)	Fisher's exact test	RR=0.25 (0.06–1.13)	0.095
Overall postoperative complications	7 (11.7)	14 (23.3)	χ^2=2.83	RR=0.50 (0.22–1.15)	0.093

Table 3 compared postoperative recovery and complications between the two groups. The mean postoperative pain score at 24 hours was significantly lower in the early group, at 3.7±1.2, compared with 4.4±1.3 in the delayed group. The mean difference was -0.70 points (95% CI: -1.15 to -0.25), which was statistically significant (t=-3.06, p=0.003). Patients in the early group resumed oral feeding significantly earlier, with a mean duration of 18.6±6.4 hours compared with 23.2±7.1 hours in the delayed group (t=-3.73, MD=-4.60 hours, 95% CI: -7.05 to -2.15, p<0.001). The mean postoperative hospital stay was also significantly shorter in the early group, at 3.6±1.4 days, compared with 6.8±2.1 days in the delayed group (t=-9.82, MD=-3.20 days, 95% CI: -3.85 to -2.55, p<0.001). Similarly, patients undergoing early laparoscopic cholecystectomy returned to normal activities significantly earlier, at a mean of 10.8±3.2 days, compared with 16.7±4.6 days in the delayed group (t=-8.16, MD=-5.90 days, 95% CI: -7.33 to -4.47, p<0.001). Surgical-site infection occurred in 5.0% of patients in the early group and 11.7% in the delayed group, but the difference was not statistically significant (Fisher's exact test, RR=0.43, 95% CI: 0.12–1.58, p=0.322). Postoperative bile leak was observed in 3.3% of the early group and 5.0% of the delayed group, with no significant difference (Fisher's exact test, RR=0.67, 95% CI: 0.12–3.85, p=1.000). Intra-abdominal collection occurred in 3.3% of patients in the early group and 10.0% in the delayed group, although the difference was not statistically significant (Fisher's exact test, RR=0.33, 95% CI: 0.07–1.57, p=0.272). Postoperative nausea or vomiting was reported in 13.3% of the early group and 23.3% of the delayed group (χ^2=2.02, RR=0.57, 95% CI: 0.26–1.26, p=0.155). Prolonged drain requirement was recorded in 6.7% of early cases and 15.0% of delayed cases, with no significant difference (Fisher's exact test, RR=0.44, 95% CI: 0.15–1.37, p=0.239). Readmission within 30 days occurred in 3.3% of the early group and 13.3% of the delayed group. Although the risk of readmission was lower in the early group, the difference was not statistically significant (Fisher's exact test, RR=0.25, 95% CI: 0.06–1.13, p=0.095). Overall postoperative complications occurred in 11.7% of the early group and 23.3% of the delayed group, indicating a lower complication burden after early surgery; however, this difference did not reach statistical significance (χ^2=2.83, RR=0.50, 95% CI: 0.22–1.15, p=0.093).

Table 4: Comparison of overall effectiveness and safety outcomes between early and delayed laparoscopic cholecystectomy groups (N=120)

Effectiveness or safety outcome	Early laparoscopic cholecystectomy, n=60 n (%) or Mean (SD)	Delayed laparoscopic cholecystectomy, n=60 n (%) or Mean (SD)	Test of significance	Effect estimate and 95% CI	P value
Successful laparoscopic completion without major complication	53 (88.3)	46 (76.7)	χ^2=2.83	RR=1.15 (0.97–1.36)	0.093
Any perioperative complication	7 (11.7)	14 (23.3)	χ^2=2.83	RR=0.50 (0.22–1.15)	0.093
Major complication requiring intervention	2 (3.3)	6 (10.0)	Fisher's exact test	RR=0.33 (0.07–1.57)	0.272
Reoperation	1 (1.7)	2 (3.3)	Fisher's exact test	RR=0.50 (0.05–5.37)	1.000
Intensive care unit admission	2 (3.3)	4 (6.7)	Fisher's exact test	RR=0.50 (0.10–2.61)	0.679
Recurrent biliary symptoms before definitive surgery	0 (0.0)	9 (15.0)	Fisher's exact test	Risk difference=-15.0% (-24.0% to -6.0%)	0.003*
Unplanned readmission before or after surgery	2 (3.3)	8 (13.3)	Fisher's exact test	RR=0.25 (0.06–1.13)	0.095
Total hospital stay, days	4.1 (1.6)	9.2 (2.8)	t=-12.25	MD=-5.10 (-5.93 to -4.27)	<0.001*
Return to normal activities within 14 days	49 (81.7)	32 (53.3)	χ^2=11.09	RR=1.53 (1.16–2.02)	0.001*
Patient satisfaction with treatment	52 (86.7)	43 (71.7)	χ^2=4.09	RR=1.21 (1.00–1.47)	0.043*
Treatment-related mortality	0 (0.0)	0 (0.0)	Not applicable	Not estimable	

Table 4 evaluated the overall effectiveness and safety of early compared with delayed laparoscopic cholecystectomy. Successful laparoscopic completion without a major complication was achieved in 88.3% of patients in the early group and 76.7% in the delayed group. Although successful completion was more frequent in the early group, the difference was not statistically significant (χ^2=2.83, RR=1.15, 95% CI: 0.97–1.36, p=0.093). Any perioperative complication occurred in 11.7% of the early group compared with 23.3% of the delayed group. This represented a 50% lower relative risk in the early group, although the difference did not attain statistical significance (χ^2=2.83, RR=0.50, 95% CI: 0.22–1.15, p=0.093). Major complications requiring intervention occurred in 3.3% of patients in the early group and 10.0% in the delayed group (Fisher's exact test, RR=0.33, 95% CI: 0.07–1.57, p=0.272). Reoperation was required in 1.7% of the early group and 3.3% of the delayed group, with no statistically significant difference (Fisher's exact test, RR=0.50, 95% CI: 0.05–5.37, p=1.000). Intensive care unit admission was required in 3.3% of patients in the early group and 6.7% in the delayed group, which was also statistically comparable (Fisher's exact test, RR=0.50, 95% CI: 0.10–2.61, p=0.679). No patient in the early group developed recurrent biliary symptoms before definitive treatment, whereas 15.0% of patients in the delayed group experienced recurrent biliary symptoms during the waiting period. The absolute risk reduction was 15.0% (95% CI: 6.0%–24.0%), and the difference was statistically significant (Fisher's exact test, p=0.003). Unplanned readmission before or after surgery occurred in 3.3% of patients in the early group and 13.3% in the delayed group. Although the risk was markedly lower in the early group, the difference was not statistically significant (Fisher's exact test, RR=0.25, 95% CI: 0.06–1.13, p=0.095). The mean total hospital stay was significantly shorter among patients undergoing early surgery, at 4.1±1.6 days, compared with 9.2±2.8 days in the delayed group (t=-12.25, MD=-5.10 days, 95% CI: -5.93 to -4.27, p<0.001). Return to normal activities within 14 days was achieved by 81.7% of patients in the early group compared with 53.3% in the delayed group. Patients in the early group were 1.53 times more likely to resume normal activities within 14 days, and this difference was statistically significant (χ^2=11.09, RR=1.53, 95% CI: 1.16–2.02, p=0.001). Patient satisfaction was also significantly higher in the early group, at 86.7%, compared with 71.7% in the delayed group (χ^2=4.09, RR=1.21, 95% CI: 1.00–1.47, p=0.043). No treatment-related mortality was reported in either group.

DISCUSSION

The present comparative study evaluated 120 patients with acute calculous cholecystitis who underwent either early or delayed laparoscopic cholecystectomy. The principal findings were that early laparoscopic cholecystectomy was associated with a substantially shorter total hospital stay, lower postoperative pain, earlier oral feeding, faster return to normal activities, fewer recurrent biliary symptoms and greater patient satisfaction. Early surgery was technically more demanding, as reflected by longer operative time and greater intraoperative blood loss; however, it did not significantly increase conversion to open surgery, bile duct injury, postoperative complications, reoperation, intensive care admission or mortality. These observations broadly support contemporary evidence and international recommendations favouring early laparoscopic cholecystectomy in suitable patients with acute calculous cholecystitis.

Baseline clinical characteristics

In the present study, the mean age was 44.8±11.6 years in the early group and 46.3±12.1 years in the delayed group, with no statistically significant difference. Similarly, the distributions of sex, duration of symptoms, fever at presentation, diabetes mellitus, Tokyo severity grade II disease and total leucocyte count were comparable between the groups. The absence of significant baseline differences indicated that the two treatment groups had broadly similar demographic and clinical risk profiles. Therefore, the observed differences in hospitalization and postoperative recovery were less likely to be attributable to baseline imbalance.

Agrawal et al. (2015)[1] also reported comparable baseline demographic and clinical characteristics between early and delayed laparoscopic cholecystectomy groups. Their findings supported the comparability of the groups before surgery and facilitated a valid evaluation of surgical outcomes. Wu et al. (2015)[2], in a meta-analysis of randomized trials, observed that participants included in early and delayed treatment groups were generally similar with respect to age, sex and clinical severity. The authors concluded that early surgery did not increase major adverse outcomes despite being performed during the inflammatory phase.

Cao et al. (2016)[3], in a meta-analysis of case-control studies, reported that most comparative studies had similar baseline characteristics between treatment groups. Their analysis demonstrated that early laparoscopic cholecystectomy produced a shorter total hospital stay without a clinically important increase in mortality, bile duct injury or conversion. Song et al. (2016)[4] similarly reviewed discordant meta-analyses and concluded that available evidence consistently favoured early laparoscopic cholecystectomy, particularly because it reduced total hospitalization without compromising safety.

Roulin et al. (2016)[5] showed that early laparoscopic cholecystectomy remained safe even when undertaken beyond 72 hours from the onset of symptoms. Their early and delayed groups were clinically comparable, and early surgery resulted in lower overall morbidity, shorter total hospital stay, shorter antibiotic treatment and reduced cost. This finding supports

the view that rigid adherence to a 72-hour threshold may not always be necessary when an experienced surgical team and appropriate facilities are available.

Overall surgical outcomes and total hospital stay

The conversion rate in the current study was 6.7% in the early group and 5.0% in the delayed group, with no statistically significant difference. Overall postoperative complications were recorded in 11.7% and 23.3% of patients, respectively. Although the relative risk suggested a 50% reduction in complications with early surgery, the difference was not statistically significant. Importantly, the mean total hospital stay was 4.1±1.6 days in the early group compared with 9.2±2.8 days in the delayed group, representing a significant reduction of 5.10 days.

Wu et al. (2015)[2] found that early laparoscopic cholecystectomy significantly reduced total hospital stay, while rates of bile duct injury, conversion and overall complications remained comparable. Cao et al. (2016)[3] also reported a consistent reduction in total length of hospitalization following early surgery. The principal explanation is that delayed treatment requires an initial admission for conservative management followed by a second admission for definitive cholecystectomy. Song et al. (2016)[4] concluded that no convincing benefit was obtained by postponing surgery because delayed intervention did not significantly reduce operative complications but increased total treatment duration. Loozen et al. (2017)[6], in a systematic review and meta-analysis, similarly found early cholecystectomy to be safe and associated with reduced total hospital stay. These findings correspond closely with the 5.10-day reduction observed in the present study.

Gallagher et al. (2019)[7] evaluated cost-effectiveness and found early cholecystectomy economically preferable because it reduced repeat admissions, overall bed occupancy and cumulative treatment costs. Kerwat et al. (2018)[8] similarly concluded that early surgery was more cost-effective than delayed surgery. Although direct cost analysis was not performed in the present study, the reduction in hospital stay and avoidance of recurrent biliary events suggest a probable economic advantage for early intervention.

Pisano et al. (2020)[9], in the updated World Society of Emergency Surgery guidelines, recommended early laparoscopic cholecystectomy as the standard of care whenever feasible, including in selected elderly, comorbid and high-risk patients. The guideline emphasized that chronological age or stable comorbidity alone should not lead to routine postponement of definitive surgery. The present observation that diabetes, inflammatory status and Tokyo severity distribution were comparable supports the use of early surgery in appropriately selected patients.

Operative time and blood loss

In the current study, early laparoscopic cholecystectomy required a significantly longer operative time than delayed surgery: 74.6±18.7 minutes versus 66.2±16.4 minutes. Estimated intraoperative blood loss was also significantly greater in the early group, at 86.4±35.7 mL compared with 69.8±30.6 mL. These findings indicated increased technical difficulty during active inflammation.

Agrawal et al. (2015)[1] observed that early surgery could be associated with longer operative duration because acute inflammation, edema, tissue friability and distorted anatomy made gallbladder handling and Calot's triangle dissection more difficult. Reddy et al. (2019)[10] also found a slightly longer operative time in the early group, although early surgery produced a shorter overall hospital stay and comparable complication rates.

In contrast, some meta-analyses have demonstrated either no significant difference or a shorter operative time with early intervention. Cao et al. (2016)[3] noted that delayed operations may also be technically difficult because acute inflammation can be replaced by dense fibrosis and organized adhesions. Therefore, postponement does not necessarily guarantee easier surgery. Wu et al. (2023)[11] concluded that variations in operative time across studies were influenced by the definition of early surgery, severity of cholecystitis, surgeon experience, institutional volume and selection of patients.

The greater blood loss in the early group may have resulted from vascular congestion, inflamed friable tissues and bleeding from the gallbladder bed. Nevertheless, the absolute mean difference of 16.60 mL was relatively modest and was not accompanied by higher rates of major intervention, reoperation or mortality. Thus, the statistical difference in blood loss may not necessarily represent a clinically important disadvantage.

Operative difficulty and intraoperative events

Dense adhesions were present in 38.3% of early cases and 23.3% of delayed cases, while difficult Calot's triangle dissection was encountered in 31.7% and 18.3%, respectively. Gallbladder perforation, bile spillage and subhepatic drain placement were also numerically more frequent in the early group. However, none of these differences attained statistical significance.

Gupta et al. (2022)[12] reported that early laparoscopic cholecystectomy could involve greater intraoperative difficulty because of gallbladder distension, wall edema and inflammatory adhesions. However, postoperative outcomes and major complication rates remained acceptable. The authors concluded that the technical difficulty of early surgery should be balanced against the disadvantages of recurrent attacks and repeat hospitalization during delayed management.

Tuncer et al. (2023)[13] evaluated early and delayed surgery among patients with Tokyo grade II acute cholecystitis. Their study showed that timing could influence difficult cholecystectomy, but morbidity and mortality were also affected by the severity of inflammation and patient-related factors. Their observations support individualized operative planning rather than postponing every patient with moderate inflammation.

Wakabayashi et al. (2018)[14], in the Tokyo Guidelines 2018 recommendations for safe surgery, emphasized achievement of the critical view of safety and timely use of bailout techniques when anatomy cannot be clearly identified. Subtotal cholecystectomy, fundus-first dissection or conversion to open surgery should be regarded as safety strategies rather than operative failure. In the present study, subtotal cholecystectomy was required in 5.0% of early cases and 3.3% of delayed cases, while conversion was required in 6.7% and 5.0%, respectively. These comparable rates suggest that appropriate bailout procedures allowed early surgery to be performed without increased major injury.

Conversion and bile duct injury

The conversion rate was comparable between groups, and one intraoperative bile duct injury occurred in each group. The equal bile duct injury rate of 1.7% indicated that early surgery did not produce an observable increase in this serious complication, although the small number of events resulted in a wide confidence interval.

Wu et al. (2015)[2], Song et al. (2016)[4] and Cao et al. (2016)[3] found no significant difference between early and delayed surgery in bile duct injury or conversion to open surgery. These findings are important because fear of bile duct injury has historically been one of the primary reasons for delaying cholecystectomy. Contemporary evidence indicates that surgical expertise, accurate anatomical identification, use of the critical view of safety and appropriate bailout procedures are more important determinants of safety than timing alone.

Okamoto et al. (2018)[15] recommended early laparoscopic cholecystectomy for patients suitable for surgery according to physiological status, comorbidity and institutional expertise. For patients who were not initially suitable, gallbladder drainage followed by delayed surgery was advised. Therefore, the recommendation for early surgery does not imply that every patient should undergo immediate operation regardless of physiological condition.

Postoperative pain and recovery

The mean postoperative pain score at 24 hours was significantly lower in the early group than in the delayed group. Early surgery was also associated with earlier oral feeding, with a mean difference of 4.60 hours. Postoperative hospital stay was reduced by 3.20 days, while return to normal activities occurred approximately 5.90 days earlier after early cholecystectomy.

Wu et al. (2023)[11], in a systematic review and meta-analysis, observed better efficiency outcomes after early laparoscopic cholecystectomy, particularly shorter hospitalization and faster recovery. The authors found no persuasive evidence that delayed surgery produced superior overall safety.

Borzellino et al. (2021)[16] examined the timing of early laparoscopic cholecystectomy and found that restricting surgery to within 24 hours did not conclusively reduce postoperative complications compared with other early schedules. However, the broader evidence continued to favour index-admission cholecystectomy over delayed intervention because of reduced total hospitalization and avoidance of interval events. This distinction is relevant: the major benefit may arise from completing definitive treatment during the same admission rather than from operating within an extremely narrow number of hours.

The lower pain score in the early group may also reflect differences in the postoperative course, reduced prolonged inflammation and avoidance of repeated symptomatic episodes. Nevertheless, pain is influenced by analgesic protocols, operative technique, drain placement and individual pain perception. Consequently, this finding should be interpreted in relation to the standardized postoperative care used in the study.

Postoperative complications

Surgical-site infection occurred in 5.0% of early cases and 11.7% of delayed cases. Similarly, bile leak, intra-abdominal collection, nausea or vomiting, prolonged drain requirement, 30-day readmission and overall postoperative complications were numerically less frequent in the early group. However, these individual differences were not statistically significant.

The absence of significance may have resulted from the limited sample size and low frequency of individual complications. The confidence intervals around relative risks were relatively wide, indicating that the study may not have had sufficient power to detect differences in uncommon events. Nevertheless, the consistent direction of effect favoured early surgery for most postoperative complications.

Roulin et al. (2016)[5] reported significantly lower overall morbidity following early surgery, even among patients presenting beyond 72 hours. In contrast, several meta-analyses reported no significant difference in postoperative morbidity. These variations may arise from differences in definitions of complications, timing thresholds, surgeon experience and severity profiles.

Mansor et al. (2025)[17] found early laparoscopic cholecystectomy to be an effective approach with acceptable conversion and complication rates. Munir et al. (2025)[18] likewise observed that early surgery reduced hospitalization and supported definitive management during the index admission, while major safety outcomes remained comparable.

Recurrent biliary symptoms and readmission

A major advantage of early surgery in the present study was complete prevention of recurrent biliary symptoms before definitive treatment. No patient in the early group developed recurrent symptoms, whereas 15.0% of patients in the delayed group experienced recurrent biliary episodes. The absolute risk reduction was 15.0%, and the difference was statistically significant. This finding demonstrates an inherent disadvantage of delayed treatment: patients remain exposed to gallbladder-related complications while awaiting definitive surgery.

Early surgery removes the pathological gallbladder during the index admission and eliminates the interval during which recurrent cholecystitis, biliary colic, pancreatitis, cholangitis or obstructive jaundice may develop. Song et al. (2016)[4] and Roulin et al. (2016)[5] emphasized that recurrent events and unplanned admissions constitute important clinical and economic disadvantages of delayed treatment.

Although unplanned readmission was lower in the early group—3.3% versus 13.3%—the difference did not reach statistical significance. The relative risk of 0.25 nevertheless suggested a potentially important reduction. The absence of significance was likely related to the small number of events. Larger studies and pooled analyses have consistently demonstrated fewer interval admissions with early cholecystectomy.

Overall effectiveness, satisfaction and safety

Successful laparoscopic completion without a major complication was achieved in 88.3% of early cases and 76.7% of delayed cases. Any perioperative complication, major complications, reoperation and intensive care admission were numerically less frequent after early surgery, although the differences were not significant. No treatment-related mortality occurred in either group.

Return to normal activities within 14 days was significantly more frequent in the early group, at 81.7%, compared with 53.3% in the delayed group. Patients undergoing early surgery were approximately 1.5 times more likely to resume normal activities within two weeks. Patient satisfaction was also significantly higher after early surgery. These outcomes highlight that effectiveness should not be judged solely by conversion or complication rates; speed of recovery, avoidance of recurrent symptoms, total hospitalization and patient experience are also clinically important.

Pisano et al. (2020)[9] recommended early laparoscopic cholecystectomy because it provides definitive treatment, reduces healthcare utilization and does not increase mortality or major morbidity when appropriate expertise is available. Okamoto et al. (2018)[15] and Wakabayashi et al. (2018)[14] similarly supported early surgery while emphasizing patient selection and safe operative technique.

CONCLUSION

The present study concluded that early laparoscopic cholecystectomy was a safe, effective, and clinically advantageous treatment for patients with acute calculous cholecystitis. Although early surgery was associated with a significantly longer operative time and greater intraoperative blood loss, these differences did not result in a significant increase in conversion to open surgery, bile duct injury, gallbladder perforation, bile spillage, major postoperative complications, reoperation, intensive care admission, or mortality. Patients undergoing early laparoscopic cholecystectomy experienced significantly lower postoperative pain, earlier resumption of oral feeding, shorter postoperative and total hospital stay, and faster return to normal daily activities. Early surgery also prevented recurrent biliary symptoms during the waiting period and was associated with higher patient satisfaction. Therefore, early laparoscopic cholecystectomy should be preferred over delayed surgery in medically fit patients with acute calculous cholecystitis, provided that experienced surgeons, appropriate anaesthetic support, and adequate institutional facilities are available.

LIMITATIONS OF THE STUDY

The study had several limitations. First, it was conducted at a single tertiary care hospital, which may limit the generalizability of the findings to other healthcare settings and populations. Second, the sample size of 120 patients was relatively small, particularly for evaluating uncommon complications such as bile duct injury, reoperation, and mortality. Third, the allocation of patients to early and delayed laparoscopic cholecystectomy was not randomized, which may have introduced selection bias and residual confounding. Fourth, surgeon experience, operative technique, and intraoperative decision-making may have varied and influenced operative time, blood loss, conversion, and complication rates. Fifth, the definitions of early and delayed surgery were based on institutional practice and may differ from those used in other studies. Sixth, postoperative pain assessment may have been influenced by individual pain perception and analgesic use. Seventh, the follow-up period was limited and may not have detected long-term complications such as incisional hernia, post-cholecystectomy symptoms, or late biliary complications. Finally, direct cost analysis and formal assessment of quality of life were not performed, although hospital stay, return to normal activities, readmission, and patient satisfaction were evaluated.

REFERENCES

1. Agrawal R, Sood KC, Agarwal B. Evaluation of early versus delayed laparoscopic cholecystectomy in acute cholecystitis. Surg Res Pract. 2015;2015:349801.
2. Wu XD, Tian X, Liu MM, Wu L, Zhao S, Zhao L. Meta-analysis comparing early versus delayed laparoscopic cholecystectomy for acute cholecystitis. Br J Surg. 2015;102(11):1302-1313.
3. Cao AM, Eslick GD, Cox MR. Early laparoscopic cholecystectomy is superior to delayed acute cholecystitis: a meta-analysis of case-control studies. Surg Endosc. 2016;30(3):1172-1182.
4. Song GM, Bian W, Zeng XT, Zhou JG, Luo YQ, Tian X. Laparoscopic cholecystectomy for acute cholecystitis: early or delayed? Evidence from a systematic review of discordant meta-analyses. Medicine (Baltimore). 2016;95(23):e3835.
5. Roulin D, Saadi A, Di Mare L, Demartines N, Halkic N. Early versus delayed cholecystectomy for acute cholecystitis, are the 72 hours still the rule? A randomized trial. Ann Surg. 2016;264(5):717-722.
6. Loozen CS, van Ramshorst B, van Santvoort HC, Boerma D. Early cholecystectomy for acute cholecystitis in patients with a high surgical risk: a systematic review and meta-analysis. HPB (Oxford). 2017;19(1):66-74.
7. Gallagher TK, Kelly ME, Hoti E. Meta-analysis of the cost-effectiveness of early versus delayed cholecystectomy for acute cholecystitis. BJS Open. 2019;3(2):146-152.
8. Kerwat D, Zargaran A, Bharamgoudar R, Arif N, Bello G, Sharma B, et al. Early laparoscopic cholecystectomy is more cost-effective than delayed laparoscopic cholecystectomy in the treatment of acute cholecystitis. Clinicoecon Outcomes Res. 2018;10:119-125.
9. Pisano M, Allievi N, Gurusamy K, Borzellino G, Cimbanassi S, Boerna D, et al. 2020 World Society of Emergency Surgery updated guidelines for the diagnosis and treatment of acute calculous cholecystitis. World J Emerg Surg. 2020;15(1):61.
10. Reddy SS, Singh P, Kumar A. Comparison of early versus delayed laparoscopic cholecystectomy in acute cholecystitis. Int J Acad Med Pharm. 2019;1(2):65-69.
11. Wu H, Li M, Yang R, Liu J, Zhang J. Comparison of the safety and efficacy of early versus delayed laparoscopic cholecystectomy for acute cholecystitis: a systematic review and meta-analysis. World J Emerg Surg. 2023;18:49.
12. Gupta G, Sharma R, Dey S, Kumar A. Evaluation of early versus delayed laparoscopic cholecystectomy in acute calculous cholecystitis. Cureus. 2022;14(12):e32553.
13. Tuncer GK, Bayraktar A, Akgul O, Sahin TT. Effect of early versus delayed laparoscopic cholecystectomy on difficult cholecystectomy, morbidity and mortality in Tokyo grade II acute cholecystitis. Ulus Travma Acil Cerrahi Derg. 2023;29(5):567-574.
14. Wakabayashi G, Iwashita Y, Hibi T, Takada T, Strasberg SM, Asbun HJ, et al. Tokyo Guidelines 2018: surgical management of acute cholecystitis—safe steps in laparoscopic cholecystectomy for acute cholecystitis. J Hepatobiliary Pancreat Sci. 2018;25(1):73-86.
15. Okamoto K, Suzuki K, Takada T, Strasberg SM, Asbun HJ, Endo I, et al. Tokyo Guidelines 2018: flowchart for the management of acute cholecystitis. J Hepatobiliary Pancreat Sci. 2018;25(1):55-72.
16. Borzellino G, Khuri S, Pisano M, Mansour S, Allievi N, Ansaloni L, et al. Timing of early laparoscopic cholecystectomy for acute calculous cholecystitis: a meta-analysis of randomized clinical trials. World J Emerg Surg. 2021;16(1):16.
17. Mansor S, Khan M, Ahmed J, Ali S. Early laparoscopic cholecystectomy for acute cholecystitis: comparison of clinical and surgical outcomes with delayed intervention. Cureus. 2025;17(4):e82136.
18. Munir A, Ahmed S, Khan Z, Raza A, Hussain M. Comparison of outcomes of early and delayed laparoscopic cholecystectomy in patients with acute cholecystitis. Cureus. 2025;17(8):e87342.