

Early vs. Interval Cholecystectomy for Acute Calculous Cholecystitis: A Prospective Observational Study in an Indian Adult Population

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Abstract

Background: Acute calculous cholecystitis is a common surgical condition for which the optimal timing of cholecystectomy remains clinically relevant. Early cholecystectomy provides definitive treatment during the index admission, whereas interval cholecystectomy follows initial conservative management. This study compared operative, postoperative, and hospitalization-related outcomes between early and interval cholecystectomy.

Methods: A hospital-based prospective observational study was conducted among 100 patients aged 18-70 years with acute calculous cholecystitis at the Department of General Surgery, Narendra Modi Medical College and LG General Hospital, Ahmedabad, India, between February 2023 and March 2024. Only patients who ultimately underwent cholecystectomy were included. Patients were categorized according to the treating surgeon's clinical decision into early cholecystectomy, performed within 72 hours of diagnosis, or interval cholecystectomy following initial conservative management. Demographic characteristics, clinical and ultrasonographic findings, operative findings, conversion to open surgery, complications, additional interventions, operative duration, and hospital stay were assessed. Categorical and continuous variables were compared using appropriate statistical tests, with $p < 0.05$ considered statistically significant.

Results: Of the 100 patients, 38 (38.0%) underwent early cholecystectomy, and 62 (62.0%) underwent interval cholecystectomy. Age and sex distributions were comparable between groups, whereas diabetes, inflammatory parameters, bilirubin levels, BMI, and several clinical manifestations differed significantly. Icterus, Murphy's sign, right hypochondrial lump, nausea/vomiting, and fever were significantly more frequent among patients undergoing early surgery. Conversion to open surgery occurred in 20/38 (52.6%) early and 14/62 (22.6%) interval cases (Pearson $\chi^2 = 9.481$, $p = 0.002$). The unadjusted odds of conversion were higher in the early group (odds ratio = 3.81, 95% CI: 1.59-9.11). Nine bile duct injuries were verified through clinical record review and classified as Strasberg Type A ($n = 5$), Type B ($n = 2$), Type C ($n = 1$), and Type D ($n = 1$); all nine patients underwent endoscopic retrograde cholangiopancreatography with stent placement. Liver-bed bleeding and cystic artery bleeding were more frequent in converted procedures. Bile duct injury occurred in 5/38 (13.2%) early and 4/62 (6.5%) interval cases, without a statistically significant difference. Wound infection was most frequent in the early-converted group (9/20, 45.0%), compared with early-laparoscopic (2/18, 11.1%), interval-laparoscopic (1/48, 2.1%), and interval-converted procedures (3/14, 21.4%). Median total hospital stay was six days (interquartile range (IQR), 1) for early and seven days (IQR, 1) for interval surgery, while median postoperative stay was four and three days, respectively. Both differences were statistically significant ($p < 0.001$).

Conclusion: Among patients who ultimately underwent cholecystectomy, early surgery was associated with higher unadjusted conversion odds and shorter recorded cumulative hospital stay. Baseline differences, surgeon-determined treatment allocation, and incomplete capture of outcomes during initial conservative management limit causal interpretation. The findings do not establish the comparative safety or effectiveness of the two strategies.

Categories: General Surgery, Public Health, Gastroenterology

Keywords: acute calculous cholecystitis, conversion to open surgery, early cholecystectomy, interval cholecystectomy, laparoscopic cholecystectomy (lc)

Introduction

Acute calculous cholecystitis is a prevalent gastrointestinal disorder characterized by gallbladder inflammation secondary to cystic duct obstruction by gallstones or biliary sludge [1]. Clinically, it presents with right upper quadrant abdominal pain, fever, nausea, vomiting, and leukocytosis, often necessitating

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hospitalization and timely intervention [2,3]. Cholecystectomy remains the definitive treatment; however, the optimal timing of surgical intervention continues to be a topic of ongoing clinical debate. The two principal strategies, early cholecystectomy and interval cholecystectomy, have distinct implications for patient outcomes, healthcare utilization, and overall management [4-6].

Early cholecystectomy, typically performed within 72 hours of diagnosis, aims to manage the acute inflammatory process expeditiously, thereby reducing the risk of disease progression, recurrence, and associated complications, including gangrene, perforation, and empyema, with a lower recurrence rate [7].

In contrast, interval cholecystectomy involves initial conservative management comprising antibiotics, fluid resuscitation, and supportive care, allowing the inflammatory process to subside, followed by elective surgery after six to eight weeks. Although this approach may reduce intraoperative difficulty in certain cases, it carries a notable risk of recurrent cholecystitis, emergency surgical intervention, and increased healthcare costs due to prolonged follow-up and readmissions [8,9].

Multiple randomized controlled trials and meta-analyses have reported favorable outcomes with early cholecystectomy, including reduced hospitalization and healthcare utilization. The advent of advanced laparoscopic and robotic-assisted techniques has further reinforced its feasibility, minimized perioperative morbidity, and enhanced postoperative recovery [6,8,9].

Nonetheless, certain clinical scenarios, such as severe sepsis, gallbladder necrosis, or extensive pericholecystic fluid collections, may necessitate initial stabilization with conservative management followed by interval cholecystectomy.

Current guidelines, including those from the American College of Surgeons and the Tokyo Guidelines [10], advocate early laparoscopic cholecystectomy for most patients with acute calculous cholecystitis, underscoring its role in optimizing outcomes and resource utilization. However, careful patient selection remains essential to balance surgical risks with therapeutic benefits.

This study aimed to compare the observed conversion-to-open rate between patients undergoing early and interval cholecystectomy for acute calculous cholecystitis who ultimately underwent cholecystectomy at a tertiary-care hospital.

Objectives

The primary objective is to compare the association of early vs. interval cholecystectomy with conversion to open surgery among adults with acute calculous cholecystitis who ultimately underwent cholecystectomy at a tertiary-care hospital. The secondary objectives are to compare operative duration, intraoperative complications, postoperative complications, additional interventions, postoperative hospital stay, and total hospital stay between patients undergoing early and interval cholecystectomy.

Materials And Methods

Study design and setting

This hospital-based prospective observational study was conducted in the Department of General Surgery, Narendra Modi Medical College and LG General Hospital, Ahmedabad, India, from February 2023 to March 2024.

Sample size

The sample size was estimated using postoperative wound infection as a clinically relevant secondary outcome, based on the previously reported estimate of 16.9% by Masaod and Salih [11]. Assuming a 95% confidence level, 80% power, and a design effect of 1.5, the minimum required sample size was calculated to be 81 patients. Allowing for potential attrition, the final target sample size was increased to 100 patients.

Eligibility criteria

Patients were eligible for inclusion if they were aged 18-70 years and had clinical, laboratory, and radiological evidence of acute calculous cholecystitis or its sequelae, including emphysematous cholecystitis, gangrenous cholecystitis, or gallbladder mucocele, with or without gallbladder perforation. Patients were also required to be willing to undergo laparoscopic cholecystectomy and provide written informed consent. Patients receiving steroids, immunosuppressive drugs, or chemotherapy; those undergoing open or subtotal cholecystectomy or percutaneous cholecystostomy; and those with common bile duct stones, acute acalculous cholecystitis, pregnancy, breastfeeding, coronary artery disease, cerebrovascular attack, or contraindications to anesthesia were excluded. Patients who declined participation were also excluded. The inclusion and exclusion criteria are presented in Table 1.

Inclusion criteria	Exclusion criteria
Age 18-70 years	Receiving steroids, immunosuppressive drugs, or chemotherapy
Clinical, laboratory, and radiological evidence of acute calculous cholecystitis	Open or subtotal cholecystectomy or percutaneous cholecystostomy
Acute calculous cholecystitis with sequelae, including emphysematous or gangrenous cholecystitis or gallbladder mucocele, with or without perforation	Common bile duct stones or acute acalculous cholecystitis
Willingness to undergo laparoscopic cholecystectomy	Pregnancy or breastfeeding
Provision of written informed consent	Coronary artery disease, cerebrovascular attack, unfitness for anesthesia, or refusal to participate

TABLE 1: Inclusion and exclusion criteria for study participants

After obtaining written informed consent, a total of 100 eligible patients who ultimately underwent cholecystectomy were prospectively enrolled and were allocated to early or interval cholecystectomy according to the treating surgeon's clinical assessment. Factors considered included severity and duration of symptoms, clinical and laboratory evidence of inflammation, comorbidities, anesthetic fitness, imaging findings, and intra-abdominal disease characteristics. Early surgery was selected when the treating team considered the patient suitable for surgery during the index admission. Interval management was selected when initial conservative treatment was considered appropriate because of clinical condition, disease severity, comorbidities, or operative risk.

Standard preoperative care, including intravenous fluids, antibiotics, and analgesics, was provided. Patients in the early cholecystectomy group underwent surgery within 72 hours, whereas those in the interval cholecystectomy group received conservative management with surgery routinely planned at six to eight weeks. Operative techniques followed standard guidelines, and intraoperative findings and complications were recorded. The decision to convert from laparoscopic to open cholecystectomy was made intraoperatively by the operating surgeon based on technical difficulty and patient safety, including inability to safely identify the anatomy, uncontrolled bleeding, dense adhesions, or suspected bile duct injury. When required, the case was escalated to a more experienced/senior surgeon for assessment and further operative management.

Bile duct injuries were assessed through review of the available clinical records, operative reports, and relevant magnetic resonance cholangiopancreatography and endoscopic retrograde cholangiopancreatography (ERCP) findings. The anatomical site and type of injury were recorded according to the available diagnostic documentation, and Strasberg classification was assigned where supported by the documented findings [12]. ERCP with stent placement alone was not considered sufficient to establish the anatomical diagnosis.

The patient flow and allocation of participants according to the timing of cholecystectomy and operative approach are shown in Figure 1.

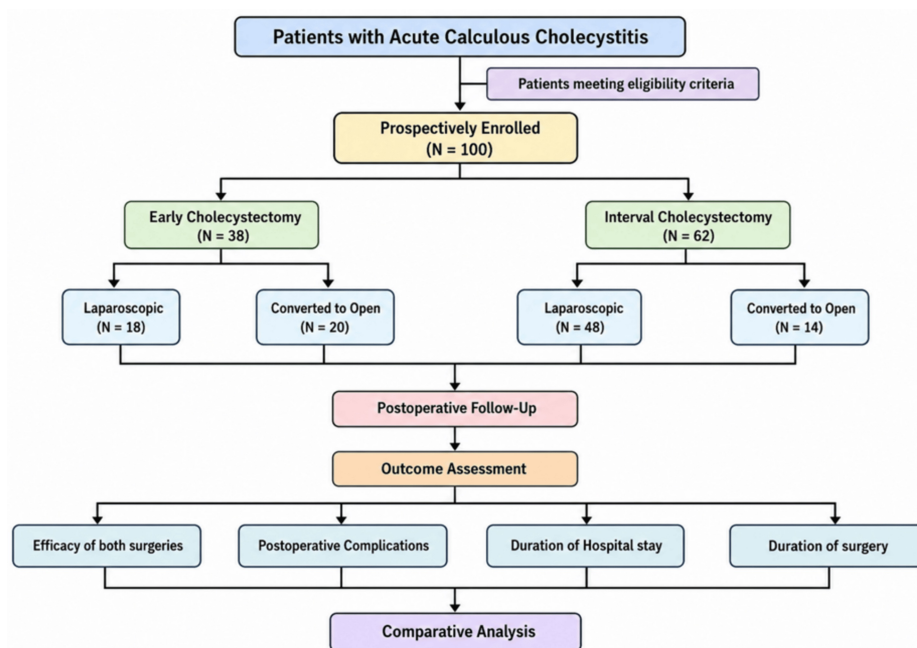


FIGURE 1: Patient flow and allocation according to timing and surgical approach

Early cholecystectomy was defined as cholecystectomy performed within 72 hours of diagnosis, whereas interval cholecystectomy was performed following initial conservative management and subsequent elective surgery.

Study parameters

The study evaluated intraoperative and postoperative outcomes, including operative time (minutes), intraoperative complications (e.g., bleeding and bile duct injury), conversion rate to open cholecystectomy, postoperative complications (e.g., infection and bile leak), duration of hospital stay (days), and need for additional interventions (ERCP and stenting). Total hospital stay was defined as the cumulative duration of hospitalization associated with the treatment strategy. For patients undergoing early cholecystectomy, this included the index hospital admission. For patients undergoing interval cholecystectomy, this included the initial admission for conservative management and the subsequent admission for elective surgery, as applicable.

Data collection and statistical analysis

Data were collected prospectively using structured case report forms. Patient demographics, clinical presentation, laboratory results, imaging findings, operative details, and postoperative course were documented. Follow-ups were conducted postoperatively to record complications and recovery status. There were no missing data for the variables included in the final analysis. Data were analyzed using statistical software Jamovi (version 2.5.3.0) and EpiInfo (version 7.2.6.0; Centers for Disease Control and Prevention (CDC), U.S. Department of Health and Human Services, Atlanta, GA). Continuous variables were summarized as median (interquartile range (IQR)) and compared using the Kruskal-Wallis test. Categorical variables were compared using Pearson's chi-square test or exact/Monte Carlo methods, as appropriate. For direct comparisons between the original early and interval treatment groups, the Mann-Whitney U test with Hodges-Lehmann location-shift estimates and corresponding 95% confidence intervals (CIs) was used. A two-sided p value of <0.05 was considered statistically significant.

Ethical considerations

The study was conducted at Narendra Modi Medical College and LG General Hospital, Ahmedabad, India. At the time of study initiation, there was no Institutional Ethics Committee at the study site; therefore, ethical approval was obtained from the Institutional Ethics Committee (Human) of PDU Medical College, Rajkot, India (IEC approval number: PDUMCR/IEC/20/2023). The study was conducted following the ethical principles of the Declaration of Helsinki (2013), and written informed consent was obtained from all participants prior to enrolment. Patient confidentiality was maintained throughout the research process.

Results

Table 2 summarizes the baseline demographic and clinical characteristics of the study participants. A total

of 100 patients with acute calculous cholecystitis were included: 18 (18.0%) in the early-laparoscopy group, 20 (20.0%) in the early-converted-to-open group, 48 (48.0%) in the interval-laparoscopy group, and 14 (14.0%) in the interval-converted-to-open group. The distribution of age groups did not differ significantly across the four groups ($\chi^2 = 2.646$, $df = 12$, Cramér's $V = 0.094$, $p = 0.998$). Similarly, sex distribution did not differ significantly across the groups ($\chi^2 = 0.659$, $df = 3$, Cramér's $V = 0.081$, $p = 0.883$), although female participants predominated in all groups.

Parameter	Early laparoscopy (n = 18)	Early converted to open (n = 20)	Interval laparoscopy (n = 48)	Interval converted to open (n = 14)	χ ²	df	Cramér's V	p value
Age group (years), n (%)								
18-29	3 (16.7%)	3 (15.0%)	6 (12.5%)	2 (14.3%)	2.646	12	0.094	0.998 [*]
30-39	3 (16.7%)	3 (15.0%)	8 (16.7%)	2 (14.3%)				
40-49	5 (27.8%)	6 (30.0%)	20 (41.7%)	5 (35.7%)				
50-59	4 (22.2%)	5 (25.0%)	9 (18.8%)	4 (28.6%)				
60-69	3 (16.7%)	3 (15.0%)	5 (10.4%)	1 (7.1%)				
Sex, n (%)								
Female	13 (72.2%)	16 (80.0%)	39 (81.3%)	11 (78.6%)	0.659	3	0.081	0.883 [*]
Male	5 (27.8%)	4 (20.0%)	9 (18.8%)	3 (21.4%)				
Diabetes mellitus, n (%)								
Yes	16 (88.9%)	18 (90.0%)	20 (41.7%)	8 (57.1%)	20.743	3	0.455	<0.001 [*]
No	2 (11.1%)	2 (10.0%)	28 (58.3%)	6 (42.9%)				
COPD, n (%)								
Yes	3 (16.7%)	6 (30.0%)	11 (22.9%)	5 (35.7%)	1.902	3	0.138	0.615 [*]
No	15 (83.3%)	14 (70.0%)	37 (77.1%)	9 (64.3%)				
WBC (×10 ⁹ /L, median (IQR))	12.84 (4.28)	14.41 (5.32)	9.23 (4.28)	8.44 (7.28)	-	-	-	<0.001
Total bilirubin, median (IQR)	3.92 (0.40)	6.20 (1.50)	1.71 (0.50)	5.59 (1.80)	-	-	-	<0.001
Direct bilirubin, median (IQR)	2.80 (0.40)	5.04 (1.50)	0.82 (0.60)	4.35 (1.90)	-	-	-	<0.001
BMI (kg/m ²), median (IQR)	21.15 (5.00)	33.51 (6.40)	21.86 (3.40)	34.52 (6.70)	-	-	-	<0.001

TABLE 2: Baseline demographic and clinical characteristics of the study participants

*Monte Carlo exact significance

Data are presented as n (%) unless otherwise specified. Continuous variables are presented as median (IQR). Monte Carlo exact significance. Categorical variables were compared using Pearson's chi-square test or Monte Carlo exact significance, as appropriate. Continuous variables were compared using the Kruskal-Wallis test. A two-sided p value of <0.05 was considered statistically significant

COPD: chronic obstructive pulmonary disease; IQR: interquartile range

Diabetes mellitus differed significantly across the groups ($\chi^2 = 20.743$, $df = 3$, Cramér's $V = 0.455$, $p < 0.001$), being present in 16 (88.9%) patients in the early-laparoscopy group and 18 (90.0%) in the early-converted-to-open group, compared with 20 (41.7%) and 8 (57.1%) in the interval-laparoscopy and interval-converted-to-open groups, respectively. The prevalence of chronic obstructive pulmonary disease did not differ significantly across the groups ($\chi^2 = 1.902$, $df = 3$, Cramér's $V = 0.138$, $p = 0.615$).

Significant differences were observed in WBC count, total bilirubin, direct bilirubin, and BMI. WBC count differed significantly across the groups ($p < 0.001$), with the highest median value observed in the early-converted-to-open group ($14.41 (5.32) \times 10^9/L$), followed by the early-laparoscopy group ($12.84 (4.28) \times 10^9/L$). Similarly, total bilirubin and direct bilirubin levels differed significantly across the groups (both $p < 0.001$), with the highest median values observed in the early-converted-to-open group ($6.20 (1.50)$ and $5.04 (1.50)$ mg/dL, respectively). BMI also differed significantly across the groups ($p < 0.001$), with higher median BMI values observed among patients requiring conversion to open surgery.

Table 3 presents the clinical presentation and ultrasonographic findings of the study participants. The distribution of several clinical manifestations differed significantly between groups, including icterus, Murphy's sign, right hypochondrial lump, nausea/vomiting, and fever. Icterus showed a very strong association with group ($\chi^2 = 85.119$, $df = 3$, Cramér's $V = 0.923$, $p < 0.001$) and was present in 18 (100.0%) patients in the early-laparoscopy group, 20 (100.0%) in the early-converted-to-open group, and 14 (100.0%) in the interval-converted-to-open group, compared with four (8.3%) in the interval-laparoscopy group. Among the 56 patients presenting with icterus (56.0%), the mean total bilirubin was 3.7 mg/dL and the mean direct bilirubin was 2.6 mg/dL. Right hypochondrial pain did not differ significantly between the groups ($\chi^2 = 3.318$, $df = 3$, Cramér's $V = 0.182$, $p = 0.365$), although it was common across all groups.

Parameter	Early laparoscopy (n = 18)	Early converted to open (n = 20)	Interval laparoscopy (n = 48)	Interval converted to open (n = 14)	χ ²	df	Cramér's V	p value
Icterus								
Yes	18 (100.0%)	20 (100.0%)	4 (8.3%)	14 (100.0%)	85.119	3	0.923	<0.001 [*]
No	0 (0.0%)	0 (0.0%)	44 (91.7%)	0 (0.0%)				
Right hypochondrial pain								
Yes	17 (94.4%)	19 (95.0%)	44 (91.7%)	11 (78.6%)	3.318	3	0.182	0.365 [*]
No	1 (5.6%)	1 (5.0%)	4 (8.3%)	3 (21.4%)				
Murphy's sign								
Yes	16 (88.9%)	18 (90.0%)	12 (25.0%)	8 (57.1%)	35.562	3	0.596	<0.001 [*]
No	2 (11.1%)	2 (10.0%)	36 (75.0%)	6 (42.9%)				
Right hypochondrial lump								
Yes	11 (61.1%)	16 (80.0%)	15 (31.3%)	9 (64.3%)	15.948	3	0.399	0.001 [*]
No	7 (38.9%)	4 (20.0%)	33 (68.8%)	5 (35.7%)				
Nausea/vomiting								
Yes	16 (88.9%)	17 (85.0%)	22 (45.8%)	3 (21.4%)	23.639	3	0.486	<0.001 [*]
No	2 (11.1%)	3 (15.0%)	26 (54.2%)	11 (78.6%)				
Fever								
Yes	18 (100.0%)	20 (100.0%)	17 (35.4%)	3 (21.4%)	45.253	3	0.673	<0.001 [*]
No	0 (0.0%)	0 (0.0%)	31 (64.6%)	11 (78.6%)				
Pericholecystic collection								
Yes	9 (50.0%)	10 (50.0%)	20 (41.7%)	6 (42.9%)	0.625	3	0.079	0.891 [*]
No	9 (50.0%)	10 (50.0%)	28 (58.3%)	8 (57.1%)				
Thickened gallbladder wall								
Yes	11 (61.1%)	17 (85.0%)	41 (85.4%)	11 (78.6%)	5.224	3	0.229	0.162 [*]
No	7 (38.9%)	3 (15.0%)	7 (14.6%)	3 (21.4%)				
Stone in cystic duct								
Yes	10 (55.6%)	14 (70.0%)	10 (20.8%)	5 (35.7%)	16.875	3	0.411	0.001 [*]
No	8 (44.4%)	6 (30.0%)	38 (79.2%)	9 (64.3%)				

TABLE 3: Distribution of clinical presentation and ultrasonographic findings of the study participants

*Monte Carlo exact significance

Data are presented as n (%). Monte Carlo exact significance was used for categorical comparisons with small expected cell counts. Categorical variables were compared using Pearson's chi-square test or Monte Carlo exact significance, as appropriate. Cramér's V was reported as the effect size. A two-sided p value of <0.05 was considered statistically significant

Murphy's sign differed significantly between the groups ($\chi^2 = 35.562$, $df = 3$, Cramér's V = 0.596, $p < 0.001$), being present in 16 (88.9%) patients in the early-laparoscopy group and 18 (90.0%) in the early-converted-to-open group, compared with 12 (25.0%) in the interval-laparoscopy group and eight (57.1%) in the interval-converted-to-open group. A right hypochondrial lump also differed significantly across the groups

($\chi^2 = 15.948$, $df = 3$, Cramér's $V = 0.399$, $p = 0.001$), occurring in 11 (61.1%), 16 (80.0%), 15 (31.3%), and nine (64.3%) patients, respectively. Nausea/vomiting differed significantly between the groups ($\chi^2 = 23.639$, $df = 3$, Cramér's $V = 0.486$, $p < 0.001$) and was reported in 16 (88.9%), 17 (85.0%), 22 (45.8%), and three (21.4%) patients, respectively. Similarly, fever differed significantly across the groups ($\chi^2 = 45.253$, $df = 3$, Cramér's $V = 0.673$, $p < 0.001$), being present in 18 (100.0%), 20 (100.0%), 17 (35.4%), and three (21.4%) patients, respectively.

Among ultrasonographic findings, pericholecystic collection did not differ significantly between the groups ($\chi^2 = 0.625$, $df = 3$, Cramér's $V = 0.079$, $p = 0.891$), nor did gallbladder wall thickening ($\chi^2 = 5.224$, $df = 3$, Cramér's $V = 0.229$, $p = 0.162$). In contrast, the presence of a cystic duct stone differed significantly across the groups ($\chi^2 = 16.875$, $df = 3$, Cramér's $V = 0.411$, $p = 0.001$), occurring in 10 (55.6%) patients in the early-laparoscopy group, 14 (70.0%) in the early-converted-to-open group, 10 (20.8%) in the interval-laparoscopy group, and five (35.7%) in the interval-converted-to-open group.

Table 4 shows that conversion to open surgery was more frequent among patients undergoing early cholecystectomy than those undergoing interval cholecystectomy. Conversion occurred in 20 (52.6%) patients in the early group compared with 14 (22.6%) patients in the interval group.

Timing of cholecystectomy	Converted to open, n (%)	Laparoscopy, n (%)	χ^2	p value	OR (95% CI)
Early (n = 38)	20 (52.6%)	18 (47.4%)	9.481	0.002	3.81 (1.59-9.11)
Interval (n = 62)	14 (22.6%)	48 (77.4%)			

TABLE 4: Comparison of conversion to open surgery between early and interval cholecystectomy

Values are presented as n (%). Percentages are calculated within each treatment group. Pearson's chi-square test was used to compare conversion rates between early and interval cholecystectomy groups. A two-sided $p < 0.05$ was considered statistically significant

OR: odds ratio; CI: confidence interval

This difference was statistically significant ($\chi^2 = 9.481$, $p = 0.002$). The unadjusted odds of conversion to open surgery were significantly higher among patients undergoing early cholecystectomy compared with interval cholecystectomy (odds ratio (OR) = 3.81, 95% CI: 1.59-9.11).

Table 5 shows the operative findings and intraoperative complications. Duration of surgery differed significantly across the four groups ($p < 0.001$), with median operative durations of 72.5 minutes in the early-laparoscopy group, 122.5 minutes in the early-converted-to-open group, 60.0 minutes in the interval-laparoscopy group, and 117.5 minutes in the interval-converted-to-open group.

Parameter	Early laparoscopy (n = 18)	Early converted to open (n = 20)	Interval laparoscopy (n = 48)	Interval converted to open (n = 14)	χ ²	df	Cramér's V	p value
Duration of surgery (minutes)	72.5 (11)	122.5 (16)	60.0 (13)	117.5 (12)	-	-	-	<0.001
Empyema of gallbladder								
Yes	2 (11.1%)	6 (30.0%)	1 (2.1%)	3 (21.4%)	11.798	3	0.343	0.007 [*]
No	16 (88.9%)	14 (70.0%)	47 (97.9%)	11 (78.6%)				
Mucocoele								
Yes	2 (11.1%)	5 (25.0%)	3 (6.3%)	1 (7.1%)	5.323	3	0.231	0.147 [*]
No	16 (88.9%)	15 (75.0%)	45 (93.8%)	13 (92.9%)				
Gangrenous gallbladder								
Yes	0 (0.0%)	1 (5.0%)	0 (0.0%)	0 (0.0%)	4.040	3	0.201	0.516 [*]
No	18 (100.0%)	19 (95.0%)	48 (100.0%)	14 (100.0%)				
Bile leak/perforation								
Yes	1 (5.6%)	2 (10.0%)	2 (4.2%)	3 (21.4%)	4.643	3	0.215	0.193 [*]
No	17 (94.4%)	18 (90.0%)	46 (95.8%)	11 (78.6%)				
Adhesions								
Yes	10 (55.6%)	16 (80.0%)	23 (47.9%)	6 (42.9%)	6.860	3	0.262	0.079 [*]
No	8 (44.4%)	4 (20.0%)	25 (52.1%)	8 (57.1%)				
Bile duct injury								
Yes	1 (5.6%)	4 (20.0%)	2 (4.2%)	2 (14.3%)	5.062	3	0.225	0.145 [*]
No	17 (94.4%)	16 (80.0%)	46 (95.8%)	12 (85.7%)				
Liver-bed bleeding								
Yes	0 (0.0%)	3 (15.0%)	0 (0.0%)	2 (14.3%)	10.226	3	0.320	0.016 [*]
No	18 (100.0%)	17 (85.0%)	48 (100.0%)	12 (85.7%)				
Cystic artery bleeding								
Yes	0 (0.0%)	3 (15.0%)	0 (0.0%)	1 (7.1%)	9.412	3	0.307	0.022 [*]
No	18 (100.0%)	17 (85.0%)	48 (100.0%)	13 (92.9%)				
Intestinal injury								
Yes	1 (5.6%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	4.602	3	0.215	0.316 [*]
No	17 (94.4%)	20 (100.0%)	48 (100.0%)	14 (100.0%)				

TABLE 5: Operative findings and intraoperative complication among the study participants

*Monte Carlo exact significance

Data are presented as n (%) for categorical variables and median (IQR) for continuous variables. Categorical variables were compared using Pearson's chi-square test or Monte Carlo exact significance, as appropriate. Continuous variables were compared using the Kruskal-Wallis test. A two-sided $p < 0.05$ was considered statistically significant. The Cramér's V values represent effect sizes for categorical comparisons

IQR: interquartile range

Among the operative findings, empyema of the gallbladder differed significantly between groups ($\chi^2 = 11.798$, $df = 3$, Cramér's $V = 0.343$, $p = 0.007$), occurring in two (11.1%), six (30.0%), one (2.1%), and three (21.4%) patients in the early-laparoscopy, early-converted-to-open, interval-laparoscopy, and interval-converted-to-open groups, respectively. The frequencies of mucocele ($\chi^2 = 5.323$, $df = 3$, Cramér's $V = 0.231$, $p = 0.147$), gangrenous gallbladder ($\chi^2 = 4.040$, $df = 3$, Cramér's $V = 0.201$, $p = 0.516$), bile leak/perforation ($\chi^2 = 4.643$, $df = 3$, Cramér's $V = 0.215$, $p = 0.193$), and adhesions ($\chi^2 = 6.860$, $df = 3$, Cramér's $V = 0.262$, $p = 0.079$) did not differ significantly between groups.

Review of the available clinical and procedural records identified nine reported bile duct injuries, and their incidence did not differ significantly across the groups ($\chi^2 = 5.062$, $df = 3$, Cramér's $V = 0.225$, $p = 0.145$). In contrast, liver-bed bleeding ($\chi^2 = 10.226$, $df = 3$, Cramér's $V = 0.320$, $p = 0.016$) and cystic artery bleeding ($\chi^2 = 9.412$, $df = 3$, Cramér's $V = 0.307$, $p = 0.022$) differed significantly between groups. Liver-bed bleeding occurred in three (15.0%) patients in the early-converted-to-open group and two (14.3%) in the interval-converted-to-open group, with no cases in either laparoscopic group. Cystic artery bleeding occurred in three (15.0%) and one (7.1%) patients in the corresponding converted-to-open groups, respectively, with no cases in either laparoscopic group. Intestinal injury was uncommon and did not differ significantly between groups ($\chi^2 = 4.602$, $df = 3$, Cramér's $V = 0.215$, $p = 0.316$).

Table 6 summarizes postoperative complications, interventions, and hospitalization duration. Postoperative collection did not differ significantly across the groups ($\chi^2 = 6.802$, $df = 3$, Cramér's $V = 0.261$, $p = 0.081$), occurring in two (11.1%), three (15.0%), zero (0.0%), and one (7.1%) patients in the early-laparoscopy, early-converted-to-open, interval-laparoscopy, and interval-converted-to-open groups, respectively.

Parameter	Early laparoscopy (n = 18)	Early converted to open (n = 20)	Interval laparoscopy (n = 48)	Interval converted to open (n = 14)	χ ²	df	Cramér's V	p value
Postoperative interventions and complications								
Postoperative collection								
Yes	2 (11.1%)	3 (15.0%)	0 (0%)	1 (7.1%)	6.802	3	0.261	0.081*
No	16 (88.9%)	17 (85.0%)	48 (100%)	13 (92.9%)				
Drain placement								
Yes	16 (88.9%)	20 (100%)	31 (64.6%)	13 (92.9%)	14.466	3	0.380	0.002*
No	2 (11.1%)	0 (0%)	17 (35.4%)	1 (7.1%)				
Wound infection								
Yes	2 (11.1%)	9 (45.0%)	1 (2.1%)	3 (21.4%)	21.066	3	0.459	<0.001*
No	16 (88.9%)	11 (55.0%)	47 (97.9%)	11 (78.6%)				
ERCP stenting								
Yes	1 (5.6%)	4 (20.0%)	2 (4.2%)	2 (14.3%)	5.062	3	0.225	0.145*
No	17 (94.4%)	16 (80.0%)	46 (95.8%)	12 (85.7%)				
Postoperative hospital stay (days)	3 (1)	4 (1)	3 (1)	3.5 (1)	-	-	-	<0.001
Total hospital stay (days)	5 (1)	6 (1)	7 (1)	7 (1)	-	-	-	<0.001

TABLE 6: Postoperative complications and hospitalization duration among the study groups

*Monte Carlo exact significance

Data are presented as n (%) for categorical variables and median (IQR) for continuous variables. Categorical variables were compared using Pearson's chi-square test or Monte Carlo exact significance, as appropriate. Continuous variables were compared using the Kruskal-Wallis test. A two-sided $p < 0.05$ was considered statistically significant. Cramér's V represents the effect size for categorical comparisons

ERCP: endoscopic retrograde cholangiopancreatography; IQR: interquartile range

Drain placement differed significantly across the groups ($\chi^2 = 14.466$, $df = 3$, Cramér's $V = 0.380$, $p = 0.002$), occurring in 16 (88.9%) patients undergoing early laparoscopy, 20 (100.0%) undergoing early converted-to-open surgery, 31 (64.6%) undergoing interval laparoscopy, and 13 (92.9%) undergoing interval converted-to-open surgery.

Wound infection showed a significant between-group difference ($\chi^2 = 21.066$, $df = 3$, Cramér's $V = 0.459$, $p < 0.001$), with the highest incidence in the early-converted-to-open group (9 (45.0%)), followed by the interval-converted-to-open group (3 (21.4%)), early-laparoscopy group (2 (11.1%)), and interval-laparoscopy group (1 (2.1%)).

All nine patients with reported bile duct injury underwent ERCP with stenting, and it did not differ significantly between groups ($\chi^2 = 5.062$, $df = 3$, Cramér's $V = 0.225$, $p = 0.145$). The cases were classified as Strasberg Type A ($n = 5$), Type B ($n = 2$), Type C ($n = 1$), and Type D ($n = 1$). The reported anatomical sites included cystic duct stump leakage, accessory bile duct leakage in the gallbladder bed, and injuries involving aberrant or major bile ducts. The case-wise anatomical sites, diagnostic evidence, treatment, and classification are presented in Table 7.

Case ID	Surgical group	Anatomical injury site	Diagnostic evidence	Treatment	Strasberg classification
1	Early-laparoscopy	Cystic duct clip slippage	MRCP and ERCP	ERCP with stent placement	Type A
2	Early-converted to open	Cystic duct clip slippage	ERCP	ERCP with stent placement	Type A
3	Early-converted to open	Accessory bile duct leak in the gallbladder bed	ERCP	ERCP with stent placement	Type A
4	Early-converted to open	Clip involving the right posterior sectoral duct	MRCP and ERCP	ERCP with stent placement	Type B
5	Early-converted to open	Injury to the right posterior sectoral duct	ERCP	ERCP with stent placement	Type C
6	Interval-laparoscopy	Cystic duct clip slippage	MRCP and ERCP	ERCP with stent placement	Type A
7	Interval-laparoscopy	Clip involving the right aberrant hepatic duct	ERCP	ERCP with stent placement	Type B
8	Interval-converted to open	Accessory bile duct leak in the gallbladder bed	MRCP and ERCP	ERCP with stent placement	Type A
9	Interval-converted to open	Lateral injury to the extrahepatic common bile duct	ERCP	ERCP with stent placement	Type D

TABLE 7: Case-wise anatomical details, diagnostic evidence, and management of reported bile duct injuries

Strasberg classification: Type A, cystic duct stump or small bile duct leak; Type B, occlusion of an aberrant right hepatic duct; Type C, transection of an aberrant right hepatic duct without ligation; Type D, lateral injury to a major bile duct. All nine patients underwent ERCP with stent placement. Anatomical sites and classifications should be interpreted according to the documented operative and imaging findings

ERCP: endoscopic retrograde cholangiopancreatography; MRCP: magnetic resonance cholangiopancreatography

Figure 2 illustrates the distribution of postoperative complications and interventions according to the timing and operative approach of cholecystectomy. Wound infection and drain placement were most frequent among patients requiring conversion to open surgery, particularly in the early-converted-to-open group.

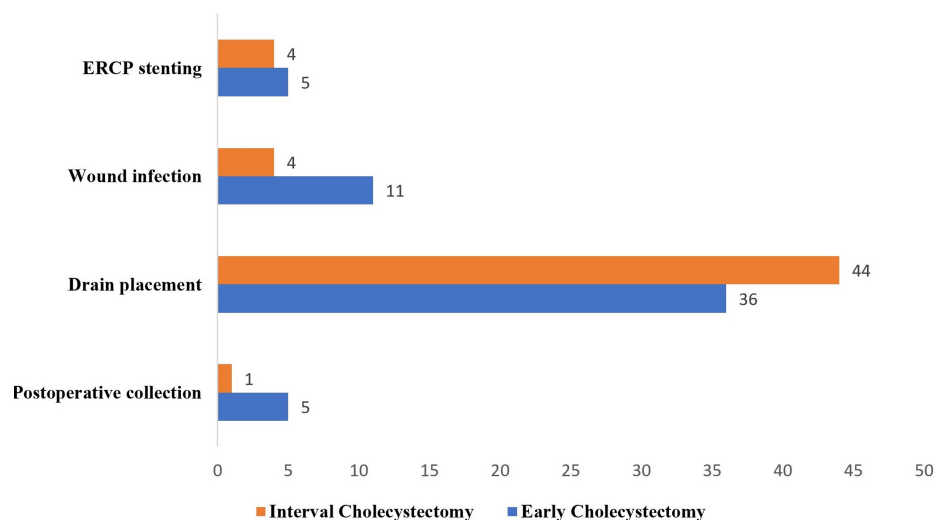


FIGURE 2: Postoperative complications and interventions in early and interval cholecystectomy groups

Data are presented as the number of patients (n). Early cholecystectomy, n = 38; interval cholecystectomy, n = 62

ERCP: endoscopic retrograde cholangiopancreatography

The median total hospital stay was six days (IQR, 1) in the early group and seven days (IQR, 1) in the interval group. The Hodges-Lehmann location-shift estimate was -1 day (95% CI: -2 to -1), with a statistically significant difference between the groups (Mann-Whitney U test, $p < 0.001$). The median postoperative hospital stay was four days (IQR, 1) in the early group and three days (IQR, 1) in the interval group. The corresponding Hodges-Lehmann location-shift estimate was +1 day (95% CI: +1 to +1), and the difference was statistically significant ($p < 0.001$) (Table 8).

Hospital stay (days)	Early (n = 38)	Interval (n = 62)	Effect estimate (95% CI)	p value
Total hospital stay	6 (1)	7 (1)	-1 (-2 to -1)	<0.001
Postoperative hospital stay	4 (1)	3 (1)	+1 (+1 to +1)	<0.001

TABLE 8: Comparison of hospitalization-related outcomes between early and interval cholecystectomy

Values are presented as median (IQR). Effect estimates are Hodges-Lehmann location-shift estimates, expressed as Early-Interval. A negative value indicates a longer stay in the interval group, whereas a positive value indicates a longer stay in the early group. p values were obtained using the Mann-Whitney U test. $p < 0.05$ was considered statistically significant

CI: confidence interval; IQR: interquartile range

Discussion

The present study compared early and interval cholecystectomy in patients with acute calculous cholecystitis and demonstrated differences in baseline characteristics, clinical presentation, operative findings, postoperative complications, and hospitalization. Acute calculous cholecystitis is a common surgical condition with a spectrum of inflammatory severity, and the clinical presentation and severity of inflammation may influence both the timing and technical difficulty of surgery [1-3]. Current evidence and international guidelines generally support early laparoscopic cholecystectomy in appropriately selected patients [10].

In the present study, patients undergoing early cholecystectomy demonstrated a more pronounced clinical and biochemical inflammatory profile. Diabetes mellitus was significantly more frequent across the study groups ($\chi^2 = 20.743$, $df = 3$, Cramér's $V = 0.455$, $p < 0.001$), being present in 16 (88.9%) patients in the early-laparoscopy group and 18 (90.0%) in the early-converted-to-open group, compared with 20 (41.7%) and 8 (57.1%) in the interval-laparoscopy and interval-converted-to-open groups, respectively. WBC count, total

bilirubin, direct bilirubin, and BMI also differed significantly across the groups (all $p < 0.001$) (Table 2). WBC count was considered a marker of acute inflammatory burden rather than an independent effect of surgical timing. Furthermore, icterus ($\chi^2 = 85.119$, $df = 3$, Cramér's $V = 0.923$, $p < 0.001$), Murphy's sign ($\chi^2 = 35.562$, $df = 3$, Cramér's $V = 0.596$, $p < 0.001$), right hypochondrial lump ($\chi^2 = 15.948$, $df = 3$, Cramér's $V = 0.399$, $p = 0.001$), nausea/vomiting ($\chi^2 = 23.639$, $df = 3$, Cramér's $V = 0.486$, $p < 0.001$), and fever ($\chi^2 = 45.253$, $df = 3$, Cramér's $V = 0.673$, $p < 0.001$) were significantly more frequent in the early groups, although several were also frequent among patients requiring conversion in the interval group (Table 3). These findings suggest that patients selected for early intervention had greater clinical disease activity. Previous randomized studies have demonstrated the feasibility of early laparoscopic cholecystectomy despite active inflammation [4-6,8]. The Tokyo Guidelines likewise recommend that treatment selection should incorporate disease severity and patient factors rather than relying solely on the duration of symptoms [10].

The ultrasonographic findings further demonstrated differences in disease characteristics. Cystic duct stones were significantly more frequent across the study groups ($\chi^2 = 16.875$, $df = 3$, Cramér's $V = 0.411$, $p = 0.001$), whereas pericholecystic collection ($\chi^2 = 0.625$, $df = 3$, Cramér's $V = 0.079$, $p = 0.891$) and gallbladder wall thickening ($\chi^2 = 5.224$, $df = 3$, Cramér's $V = 0.229$, $p = 0.162$) did not differ significantly (Table 3). Ultrasonographic evidence of inflammation and impacted stones has previously been associated with increased operative difficulty [13-15]. These findings are clinically relevant because difficult dissection of Calot's triangle and inflammatory distortion of anatomy may increase the likelihood of conversion to open surgery.

A major finding of the present study was the significantly higher frequency of conversion to open surgery among patients undergoing early cholecystectomy compared with those undergoing interval cholecystectomy (Table 4). Conversion occurred in 20 of 38 patients (52.6%) in the early group compared with 14 of 62 patients (22.6%) in the interval group (Pearson $\chi^2 = 9.481$, $df = 1$, $p = 0.002$), with an OR of 3.81 (95% CI: 1.59-9.11). This finding differs from the results of several randomized trials and meta-analyses, which have generally reported that early laparoscopic cholecystectomy is at least as safe as, and in many studies preferable to, delayed or interval surgery, without a consistent increase in conversion to open surgery [6,14-21]. Large observational studies have also suggested that early cholecystectomy can be performed safely and may be associated with favorable operative outcomes [7,22,23].

The higher conversion rate observed in our early group should therefore be interpreted in the context of the study design and patient selection. In the present study, allocation to early or interval surgery was not randomized but was determined by the treating surgical team according to clinical severity, duration of symptoms, inflammatory findings, comorbidities, anesthetic fitness, imaging findings, and perceived operative risk. Consequently, patients selected for early surgery may have had more severe or technically challenging disease. Established risk-factor studies have identified factors such as inflammatory severity, difficult operative anatomy, and patient-related characteristics as important contributors to conversion from laparoscopic to open cholecystectomy [24,25]. Thus, the observed association between early surgery and conversion in our cohort should not be interpreted as evidence that early cholecystectomy itself causes a higher risk of conversion. Rather, it may partly reflect differences in disease severity and clinical selection between the two groups.

Operative duration was also substantially longer in converted procedures, with median operative times of 122.5 minutes in the early-converted-to-open group and 117.5 minutes in the interval-converted-to-open group, compared with 72.5 and 60.0 minutes in the corresponding laparoscopic groups, respectively (Table 5). Previous meta-analyses have generally found no significant difference in conversion between early and delayed cholecystectomy [16-18]. Randomized trials similarly reported comparable conversion rates between the two strategies [6,19,20]. Thus, the higher conversion observed in our early group should be interpreted cautiously.

The apparent difference may be explained partly by confounding by indication because treatment allocation in the present study was based on the treating surgeon's clinical assessment rather than randomization. This is particularly important given the significant baseline differences in diabetes, WBC count, bilirubin levels, and BMI (Table 2). Diabetes, elevated inflammatory markers, acute inflammation, and obesity have been identified as predictors of difficult laparoscopic cholecystectomy and conversion [21-23]. More recent studies have further demonstrated associations between disease severity, necrotizing inflammation, and difficult laparoscopic surgery [26,27]. Therefore, the higher conversion rate in the early group may reflect, at least in part, the greater severity of patients selected for early surgery rather than an independent adverse effect of early surgical timing.

The operative findings support this interpretation. Empyema differed significantly across the four groups ($\chi^2 = 11.798$, $df = 3$, Cramér's $V = 0.343$, $p = 0.007$), occurring in two (11.1%) patients in the early-laparoscopy group and six (30.0%) in the early-converted-to-open group, compared with one (2.1%) and three (21.4%) patients in the interval-laparoscopy and interval-converted-to-open groups, respectively (Table 5). Mucocoele, gangrenous gallbladder, bile leak/perforation, and adhesions did not differ significantly between groups. Adhesions and bile leak/perforation were nevertheless numerically more frequent in converted procedures. Severe inflammation and fibrosis can obscure the anatomy of Calot's triangle and make achievement of the critical view of safety difficult [28]. The Tokyo Guidelines recommend conversion or

other bail-out procedures when safe laparoscopic dissection cannot be achieved [28]. Thus, conversion should be regarded as an appropriate safety measure when necessary rather than as a failure of laparoscopic management.

Among intraoperative complications, bile duct injury did not differ significantly across the four groups ($\chi^2 = 5.062$, $df = 3$, Cramér's $V = 0.225$, $p = 0.145$); however, this should not be interpreted as evidence of equivalent safety. In contrast, liver-bed bleeding ($\chi^2 = 10.226$, $df = 3$, Cramér's $V = 0.320$, $p = 0.016$) and cystic artery bleeding ($\chi^2 = 9.412$, $df = 3$, Cramér's $V = 0.307$, $p = 0.022$) differed significantly between groups. Liver-bed bleeding occurred in three (15.0%) patients in the early-converted-to-open group and two (14.3%) in the interval-converted-to-open group, with no cases in either laparoscopic group. Cystic artery bleeding occurred in three (15.0%) and one (7.1%) patients in the corresponding converted-to-open groups, respectively, with no cases in either laparoscopic group (Table 5). These findings further suggest that operative difficulty and conversion were closely associated with the occurrence of intraoperative bleeding.

Review of the available clinical and procedural records identified nine bile duct injuries, comprising five Strasberg Type A, two Type B, one Type C, and one Type D injury (Table 7). The documented anatomical sites included cystic duct stump leakage, accessory bile duct leakage in the gallbladder bed, and injuries involving aberrant or major bile ducts. Although the incidence of bile duct injury did not differ significantly across the study groups, this finding should not be interpreted as evidence of equivalent safety. The small number of events limits the precision of between-group comparisons, and the findings should be interpreted in the context of the observational study design and differences in baseline clinical characteristics.

Postoperative outcomes demonstrated a particularly notable difference in wound infection. Wound infection occurred in two (11.1%) patients in the early-laparoscopy group and nine (45.0%) in the early-converted-to-open group, compared with one (2.1%) and three (21.4%) in the corresponding interval groups ($\chi^2 = 21.066$, $df = 3$, Cramér's $V = 0.459$, $p < 0.001$) (Table 6, Figure 2). The greater frequency among converted procedures is consistent with the increased operative trauma and technical difficulty associated with conversion. However, this finding differs from randomized evidence showing that early laparoscopic cholecystectomy may have a lower, rather than higher, risk of wound infection compared with delayed surgery [17,18]. Consequently, the higher wound infection rate in the present study should again be interpreted in the context of conversion and baseline disease severity rather than attributed directly to early surgical timing.

Postoperative collection did not differ significantly across the groups ($\chi^2 = 6.802$, $df = 3$, Cramér's $V = 0.261$, $p = 0.081$). ERCP stenting also did not differ significantly ($\chi^2 = 5.062$, $df = 3$, Cramér's $V = 0.225$, $p = 0.145$) (Table 6). The relatively small number of events limits the statistical power to identify differences in these outcomes. The absence of a significant difference in biliary complications is broadly consistent with previous randomized evidence showing no significant increase in bile duct injury or bile leakage following early cholecystectomy [16-20].

Drain placement was significantly more frequent across the four groups ($\chi^2 = 14.466$, $df = 3$, Cramér's $V = 0.380$, $p = 0.002$), occurring in 16 (88.9%) patients in the early-laparoscopy group, 20 (100.0%) in the early-converted-to-open group, 31 (64.6%) in the interval-laparoscopy group, and 13 (92.9%) in the interval-converted-to-open group (Table 6, Figure 2). The high frequency of drain placement among converted procedures likely reflects intraoperative difficulty, concern regarding bile leakage or bleeding, and surgeon preference. Evidence from randomized trials suggests that routine drainage after laparoscopic cholecystectomy for acute cholecystitis does not reduce intra-abdominal complications and may increase postoperative pain or hospital stay [24,25]. Therefore, selective drainage based on intraoperative findings may be preferable.

Hospitalization outcomes showed different patterns according to the treatment strategy (Table 8). The interval group had a longer total hospital stay than the early group, with median stays of seven and six days, respectively, and a Hodges-Lehmann location-shift estimate of -1 day (95% CI: -2 to -1). In contrast, postoperative hospital stay was longer in the early group, with median stays of four and three days, respectively, and a corresponding location-shift estimate of +1 day (95% CI: +1 to +1). These findings should be interpreted in the context of the different treatment pathways, as the interval strategy involved an initial period of conservative management followed by subsequent surgery, whereas early surgery was performed during the index admission. Thus, the observed differences describe hospitalization patterns associated with the two treatment strategies and should not be interpreted as causal effects, particularly given the nonrandom treatment allocation and baseline differences between the groups. Because patients who did not ultimately undergo cholecystectomy were not systematically captured, these findings do not represent the full range of outcomes associated with the interval-management strategy. Previous randomized trials and meta-analyses have reported shorter total hospitalization with early cholecystectomy [13,16-20]. The Acute Cholecystitis-early laparoscopic surgery versus antibiotic therapy and Delayed elective Cholecystectomy randomized trial similarly reported lower morbidity, shorter hospital stay, and lower costs with early surgery [19]. Population-based studies have also reported lower healthcare utilization with early intervention [22,23]. Economic analyses have further suggested potential cost advantages of early surgery by avoiding prolonged conservative management and subsequent hospital utilization [9].

The present findings demonstrate differences in conversion rates, postoperative outcomes, and hospitalization patterns among patients who ultimately underwent cholecystectomy. The higher frequency of conversion and wound infection observed in the early group occurred alongside more pronounced clinical and biochemical disease and a higher prevalence of diabetes. These findings should be interpreted in the context of nonrandom treatment selection, baseline differences between groups, and incomplete capture of interval-management outcomes. The study does not establish the comparative safety or effectiveness of early vs. interval cholecystectomy and should not be used alone to recommend either strategy.

The limitations of this study should be acknowledged. First, this was a single-center study conducted at a tertiary care hospital, which may limit the generalizability of the findings to other healthcare settings and patient populations. Although 100 patients were included, the relatively small numbers in certain subgroups, particularly those undergoing laparoscopic cholecystectomy with conversion to open surgery, may have limited the statistical power to detect differences in less frequent outcomes. In addition, the sample size was not calculated specifically for conversion to open surgery, as the original sample size calculation was based on postoperative wound infection. Treatment allocation was based on clinical decision-making rather than randomization. Patients requiring urgent cholecystectomy because of septicemia or significant comorbidities were more likely to undergo early surgery, introducing the possibility of selection bias and confounding by disease severity. The significant differences in diabetes, inflammatory parameters, bilirubin levels, BMI, and clinical presentation between groups further support the possibility of such confounding. Multivariable adjustment for potential confounding factors was not performed; therefore, residual confounding cannot be excluded. The study cohort included only patients who ultimately underwent cholecystectomy; therefore, patients initially managed with an interval strategy who experienced recurrent symptoms, readmission, emergency surgery, and drainage, or did not ultimately undergo surgery were not systematically captured. This may have underestimated the overall burden of the interval management strategy. Surgeon seniority, individual operative experience, and operator-specific case volume were not systematically recorded and therefore could not be evaluated. Although the available clinical, operative, and procedural records were reviewed to summarize the anatomical sites and Strasberg classifications of the nine reported bile duct injuries, the completeness of the original documentation varied. Consequently, the anatomical classification and comparisons of these relatively uncommon events should be interpreted with caution. Finally, the study primarily assessed perioperative and short-term postoperative outcomes; long-term outcomes, including incisional hernia, biliary stricture, recurrent biliary symptoms, and other late complications, were not evaluated.

Conclusions

Among patients who ultimately underwent cholecystectomy, early surgery was associated with a higher unadjusted conversion rate and shorter recorded cumulative hospital stay. Baseline differences and incomplete capture of interval-management outcomes prevent conclusions about the comparative safety or effectiveness of the two strategies.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

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Drafting of the manuscript: Krishna M. Jasani, Gurubaran T

Critical review of the manuscript for important intellectual content: Krishna M. Jasani, Malay Goswami, Parth Katariya, Gurubaran T, Vidit Gadoya

Supervision: Krishna M. Jasani, Gurubaran T

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Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. Institutional Ethics Committee (Human), Pandit Dindayal Upadhyay Medical College, Rajkot, India issued approval PDUMCR/IEC/20/2023. **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other**

relationships: All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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