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Early Versus Delayed Laparoscopic Cholecystectomy in Acute Cholecystitis: A Comparative Study from a Tertiary Care Centre in India

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Abstract:
Background: The optimal timing of laparoscopic cholecystectomy (LC) in acute cholecystitis (AC) remains debated. While early laparoscopic cholecystectomy (ELC) is increasingly favored, delayed laparoscopic cholecystectomy (DLC) is still practiced in many settings.
Objective: To compare clinical outcomes, safety, and cost-effectiveness of ELC versus DLC in patients with AC.
Methods: This quasi-experimental study was conducted at a tertiary care centre over two years. A total of 78 patients diagnosed with AC were divided into two groups: ELC (n=39) and DLC (n=39). Patients were assessed based on demographic parameters, intraoperative findings, complications, conversion rates, and hospital stay. Statistical analysis was performed using SPSS v24.0.
Results: Baseline characteristics were comparable between groups. ELC was associated with a significantly shorter hospital stay and fewer readmissions. There was no significant difference in conversion rates, morbidity, or mortality between the groups. Operative time and intraoperative blood loss were slightly higher in the ELC group but not clinically significant.
Conclusion: ELC is a safe and effective treatment for AC and offers advantages in terms of reduced hospital stay and overall healthcare costs. It should be considered the preferred approach in suitable patients.

Keywords: Acute cholecystitis, laparoscopic cholecystectomy, early surgery, delayed surgery, outcomes

1. Introduction

Acute cholecystitis (AC) is a common surgical emergency resulting from obstruction of the cystic duct, most often by gallstones. Traditionally, delayed laparoscopic cholecystectomy (DLC) following conservative management was preferred due to concerns regarding operative difficulty and complications. However, with advancements in laparoscopic techniques and surgical expertise, early laparoscopic cholecystectomy (ELC), performed within 72 hours of symptom onset, has emerged as a viable alternative. [1-4] Several studies suggest that ELC reduces hospital stay and prevents recurrent biliary events. [5-8] Despite growing evidence, the timing of surgery remains controversial, particularly in resource-limited settings. [9,10] This study aims to compare the outcomes of ELC and DLC in a tertiary care setting (Figure 1).

2. Objectives of the Study

Primary Objective

- To compare the clinical outcomes, safety, and cost-effectiveness of early versus delayed laparoscopic cholecystectomy in patients with acute cholecystitis.

Secondary Objectives

- To compare the complication rates, conversion rates, and mortality between the two groups.
- To compare operative time, hospital stay, and readmissions between the two groups.

3. Materials and Methods

Study Design and Setting

A quasi-experimental study conducted at MGM Medical College and Hospital, Aurangabad, over two years.

Sample Size

A total of 78 patients (39 in each group) were included based on G*Power calculation ($\alpha = 0.05$, power = 0.8).

Inclusion Criteria

- Patients diagnosed with acute cholecystitis.
- Patients eligible for laparoscopic surgery.

Exclusion Criteria

- Patients unfit for laparoscopy.
- Lack of consent.

Grouping

- **ELC group:** Surgery during index admission.
- **DLC group:** Initial conservative management followed by interval surgery.

Diagnosis Criteria

Diagnosis of AC was based on the Tokyo Guidelines (TG18/TG13), including:

- Clinical signs (Murphy's sign, RUQ pain).
- Laboratory findings (elevated WBC, CRP).
- Imaging (ultrasound/CT findings).

Severity was classified using the TG18/TG13 severity grading for AC, as summarised in Table 1.

Table 1: TG18/TG13 severity grading for acute cholecystitis

Severity	Criteria
Grade 1—Mild	• Acute cholecystitis not meeting other severity criteria • Mild gallbladder inflammation, no organ dysfunction
Grade 2—Moderate	Acute cholecystitis with any of the following but no organ/system dysfunction: • Elevated white blood cell count (>18,000/mL) • Palpable tender mass at right upper quadrant • Duration of complaints exceeding 72 h • Marked local inflammation (such as biliary peritonitis, pericholecystic abscess, hepatic abscess, gangrenous cholecystitis, emphysematous cholecystitis)
Grade 3—Severe	Acute cholecystitis with dysfunction of any one of the following organs/systems: • Cardiovascular dysfunction (hypotension requiring treatment with dopamine > 5 mg/kg/min of body weight or any dose of norepinephrine) • Neurological dysfunction (decreased levels of consciousness) • Respiratory dysfunction (ratio of $PaO_2/FiO_2 < 300$) • Renal dysfunction (oliguria, creatine > 2.0 mg/dL)

Severity	Criteria
	• Hepatic dysfunction (PT-INR > 1.5)

3. Radiological Findings

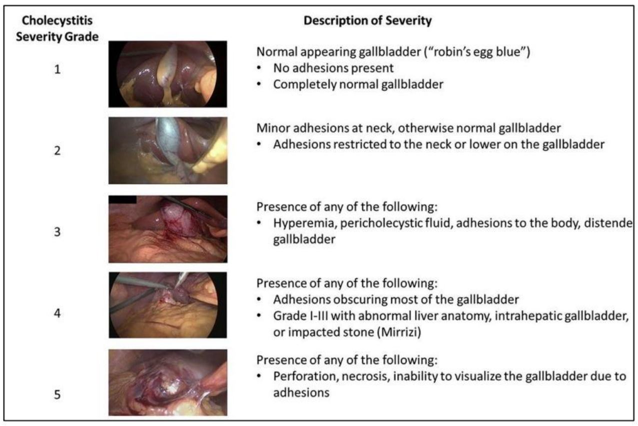
Ultrasonographic evidence characteristic of AC, including gallbladder (GB) wall thickening (≥5 mm), pericholecystic fluid, or ultrasonographic Murphy's sign (tenderness when the probe was pressed against the GB), was used. Additional ultrasound (US) findings, such as GB enlargement, presence of gallstones (GS), internal debris echoes, and gas patterns, were also noted. US images typically demonstrated features like GB swelling, wall thickening with a hypoechoic layer, significant internal debris, and impacted GS.

Contrast-enhanced computed tomography (CECT) findings suggestive of AC were reported as follows: GB distention in 41% of cases, GB wall thickening in 59%, increased pericholecystic fat density in 52%, pericholecystic fluid collection in 31%, subserosal edema in 31%, and high-attenuation GB bile in 24% of cases.

Surgical Procedure

A standard four-port laparoscopic cholecystectomy was performed by an experienced laparoscopic surgeon with the assistance of a resident medical officer. Informed and written consent was obtained from all subjects who were willing to contribute to the trial. The type of surgery, duration of operation, conversion rate to open cholecystectomy, intraoperative complications, postoperative complications, and length of hospital stay were recorded. Intraoperative difficulty was graded using the Parkland grading scale, as summarised in Table 2.

Table 2: Parkland grading scale for intraoperative difficulty during laparoscopic cholecystectomy



Cholecystitis Severity Grade	Description of Severity
1	Normal appearing gallbladder ("robin's egg blue") • No adhesions present • Completely normal gallbladder
2	Minor adhesions at neck, otherwise normal gallbladder • Adhesions restricted to the neck or lower on the gallbladder
3	Presence of any of the following: • Hyperemia, pericholecystic fluid, adhesions to the body, distende gallbladder
4	Presence of any of the following: • Adhesions obscuring most of the gallbladder • Grade I-III with abnormal liver anatomy, intrahepatic gallbladder, or impacted stone (Mirrizi)
5	Presence of any of the following: • Perforation, necrosis, inability to visualize the gallbladder due to adhesions

Outcome Measures

- **Primary:** Complications, conversion rate, mortality.
- **Secondary:** Operative time, hospital stay, cost.

Statistical Analysis

Data analyzed using SPSS v24.0. Continuous variables were expressed as mean ± SD and categorical variables as percentages. A p-value < 0.05 was considered statistically significant.

Ethical Considerations

The study was approved by the Institutional Ethics Committee. Informed and written consent was obtained from all participants prior to enrolment.

4. Results

The two groups were comparable with respect to baseline demographic parameters. The mean age of subjects in the ELC group was 54.26 ± 19.35 years, whereas in the DLC group it was 53.62 ± 17.93 years, with no statistically significant difference between the groups (p = 0.880). Females predominated in both groups (53.80% in the ELC group and 64.10% in the DLC group), with no significant difference in sex distribution (p = 0.490). Presenting symptoms were comparable between the two groups, and abdominal pain was reported by all patients. A clear distinction was observed with respect to history of previous admission: none of the patients in the ELC group had a prior admission, whereas all patients in the DLC group had been previously admitted (p < 0.001) (Table 3, Figure 2).

Table 3: Baseline demographic and clinical characteristics

Variable	ELC	DLC	p
Age			
Mean ± SD (years)	54.26 ± 19.35	53.62 ± 17.93	0.880
Sex, n (%)			
Female	21 (53.80)	25 (64.10)	0.490
Male	18 (46.20)	14 (35.90)	
Presenting symptoms, n (%)			
Pain abdomen	39 (100.00)	39 (100.00)	1.000
Vomiting / nausea	24 (61.50)	23 (59.00)	1.000

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Variable	ELC	DLC	p
Fever / chills	11 (28.20)	17 (43.60)	0.238
History of previous admission, n (%)			
Yes	0 (0.00)	39 (100.00)	< 0.001
No	39 (100.00)	0 (0.00)	

ELC = early laparoscopic cholecystectomy; DLC = delayed laparoscopic cholecystectomy; n = number of patients; SD = standard deviation; p = p-value.

In the ELC group, 25 (64.10%) patients were classified as Grade I, 8 (20.50%) as Grade II, and 6 (15.40%) as Grade III. In the DLC group, 33 (84.60%) patients were Grade I, 6 (15.40%) were Grade II, and none were Grade III. The change in grade distribution between the two groups was statistically substantial (p = 0.025), indicating a higher proportion of severe cases (Grade III) in the ELC group (Table 4).

Table 4: Distribution of disease severity grade (TG18/TG13) between groups

Grade	ELC	DLC	p
Grade I	25 (64.10)	33 (84.60)	0.025
Grade II	8 (20.50)	6 (15.40)	
Grade III	6 (15.40)	0 (0.00)	
Total	39 (100.00)	39 (100.00)	

ELC = early laparoscopic cholecystectomy; DLC = delayed laparoscopic cholecystectomy; TG = Tokyo Guidelines; n = number of patients; p = p-value.

Conversion to open surgery was required in 3 (7.70%) patients in the ELC group and 4 (10.30%) patients in the DLC group, with no statistically significant difference between the groups (p = 1.000). The mean duration of surgery was significantly shorter in the ELC group (91.92 ± 40.74 minutes) than in the DLC group (140.00 ± 40.32 minutes; p < 0.001) (Table 5, Figure 3).

Table 5: Operative parameters

Variable	ELC	DLC	p
Conversion to open surgery, n (%)			
Yes	3 (7.70)	4 (10.30)	1.000
No	36 (92.30)	35 (89.70)	
Duration of surgery (minutes)			
Mean ± SD	91.92 ± 40.74	140.00 ± 40.32	< 0.001

ELC = early laparoscopic cholecystectomy; DLC = delayed laparoscopic cholecystectomy; n = number of patients; SD = standard deviation; p = p-value.

The distribution of the Parkland grading scale between the ELC and DLC groups showed that in the ELC group, 13 (33.33%) patients were graded as 3, 12 (30.77%) as 4, and 14 (35.90%) as 5, with no patients in grade 2. In the DLC group, 1 (2.56%) patient was grade 2, 16 (41.02%) were grade 3, 15 (38.46%) were grade 4, and 7 (17.95%) were grade 5. The change in Parkland grading between the two groups was not statistically substantial ($p = 0.263$) (Table 6).

Table 6: Distribution of Parkland grading scale between groups

Parkland grading scale	ELC	DLC	p
Grade 1	0 (0.00)	0 (0.00)	0.263
Grade 2	0 (0.00)	1 (2.56)	
Grade 3	13 (33.33)	16 (41.02)	
Grade 4	12 (30.77)	15 (38.46)	
Grade 5	14 (35.90)	7 (17.95)	

Total	39 (100.00)	39 (100.00)	

ELC = early laparoscopic cholecystectomy; DLC = delayed laparoscopic cholecystectomy; n = number of patients; p = p-value.

Bile duct injury occurred in 1 (2.56%) patient in the ELC group and 5 (12.82%) patients in the DLC group; this difference was not statistically significant ($p = 0.091$). The severity of postoperative complications graded by the Clavien-Dindo classification differed significantly between the groups ($p < 0.001$), with a substantially higher proportion of high-grade complications in the DLC group. The mean postoperative hospital stay was significantly shorter in the ELC group (5.28 ± 3.10 days) than in the DLC group (13.44 ± 7.89 days; $p < 0.001$) (Table 7, Figure 4).

Table 7: Postoperative outcomes

Variable	**ELC**	**DLC**	**p**
Bile duct injury, n (%)			
Yes	1 (2.56)	5 (12.82)	0.091
No	38 (97.44)	34 (87.18)	
Clavien-Dindo classification, n (%)			
Grade 0	30 (76.92)	16 (41.03)	< 0.001
Grade I	5 (12.82)	1 (2.56)	
Grade II	1 (2.56)	8 (20.51)	
Grade III	1 (2.56)	4 (10.26)	
Grade IV	2 (5.13)	9 (23.08)	
Grade V	0 (0.00)	1 (2.56)	
Postoperative hospital stay (days)			

Variable	ELC	DLC	p
Mean ± SD	5.28 ± 3.10	13.44 ± 7.89	< 0.001

ELC = early laparoscopic cholecystectomy; DLC = delayed laparoscopic cholecystectomy; n = number of patients; SD = standard deviation; p = p-value.

5. Discussion

The present study demonstrates that early laparoscopic cholecystectomy (ELC) is a safe and effective approach for the management of acute cholecystitis (AC), with clear advantages over delayed laparoscopic cholecystectomy (DLC) in terms of reduced hospital stay and avoidance of recurrent admissions. Importantly, these benefits were achieved without a statistically significant increase in morbidity, mortality, or conversion to open surgery.

One of the key findings of this study is the significantly shorter duration of hospital stay in the ELC group. This observation is consistent with multiple randomized controlled trials and meta-analyses, which have consistently reported that ELC reduces total hospitalization time compared to DLC. [15-18] The reduction in hospital stay can be attributed not only to the avoidance of a second admission but also to early resolution of symptoms and faster recovery. In contrast, DLC inherently involves two phases of care—initial conservative management followed by interval surgery—thereby increasing cumulative hospital utilization.

Another clinically relevant finding is the absence of a significant difference in conversion rates between ELC and DLC groups. Historically, concerns regarding higher conversion rates in early surgery were a major deterrent to adopting ELC. However, contemporary evidence suggests that with improved laparoscopic expertise and better perioperative care, conversion rates are comparable between the two approaches. [13,14,20] Our findings support this evolving paradigm and reinforce that timing alone may not be a decisive factor for conversion; rather, patient selection, severity of inflammation, and surgeon experience play more critical roles.

Although operative time and intraoperative blood loss were marginally higher in the ELC group, these differences were not clinically significant. Similar trends have been reported in earlier studies, where acute inflammation was associated with increased technical difficulty during early surgery. [14,20] However, this potential drawback is offset by the advantages of operating during the early inflammatory phase, where tissue planes are edematous rather than fibrotic, potentially facilitating dissection when performed within the optimal time window. [13] Delayed surgery, on the other hand, may encounter dense adhesions and fibrosis, which can complicate the procedure.

The comparable complication rates observed in both groups further strengthen the case for ELC. Previous meta-analyses have shown no significant differences in major complications, including bile duct injury (BDI), wound infection, or mortality between early and delayed approaches. [15,16,17] In our study, the absence of a significant increase in postoperative complications in the ELC group suggests that early intervention does not compromise patient safety when performed in a controlled setting.

An important aspect highlighted by this study is the higher prevalence of comorbidities in the DLC group. This may reflect a degree of selection bias, where patients with higher surgical risk are more likely to undergo initial conservative management. While this is a pragmatic clinical approach, it may also contribute to delayed recovery and increased healthcare burden. Previous literature has similarly noted that comorbid conditions influence the decision-making process in timing of surgery and may impact outcomes. [12,19] Future studies should consider stratified analysis based on comorbidity indices such as the Charlson Comorbidity Index (CCI) to better understand outcomes in high-risk populations.

The issue of readmission is particularly relevant when comparing ELC and DLC. In the present study, all patients in the DLC group had prior admissions, underscoring the inherent disadvantage of delayed management. Previous studies have reported readmission rates ranging from 13% to 22% during the waiting period for DLC, often due to recurrent biliary events. [19] ELC effectively eliminates this risk by providing definitive treatment during the index admission.

From an economic perspective, although direct cost analysis was not extensively quantified in this study, the reduction in hospital stay and avoidance of repeat admissions strongly suggest that ELC is more cost-effective. This finding aligns with prior research demonstrating lower overall healthcare costs associated with early intervention. [18,20] In resource-limited healthcare settings, this has significant implications for optimizing resource utilization.

Despite these strengths, the study has certain limitations. The quasi-experimental design and relatively small sample size may limit the generalizability of the findings. Additionally, the absence of long-term follow-up restricts assessment of late complications and quality-of-life outcomes. Future large-scale, multicenter randomized trials with extended follow-up are warranted to validate these findings and further refine patient selection criteria.

6. Conclusion

Early laparoscopic cholecystectomy is a safe, feasible, and cost-effective approach for acute cholecystitis. It reduces hospital stay and prevents recurrent complications without increasing operative risks. Adoption of ELC should be encouraged in suitable patients.

7. Limitations of the Study

- Single-center study.
- Limited sample size.
- Lack of long-term follow-up.

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