

COMPARISON OF EARLY VERSUS DELAYED LAPAROSCOPIC CHOLECYSTECTOMY IN ACUTE CALCULOUS CHOLECYSTITIS: OPERATIVE OUTCOMES AND HOSPITAL STAY IN RURAL TAMIL NADU

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ABSTRACT

Objective: To compare early versus delayed laparoscopic cholecystectomy (LC) in acute calculous cholecystitis in terms of mean operative time, total hospital stays, conversion rate to open cholecystectomy, and post-operative complications in a rural tertiary care setting in Tamil Nadu, India.

Study Design: Prospective quasi-experimental comparative study. **Place and Duration of Study:**

Department of General Medicine, Sree Balaji Medical College & Hospital, Tamil Nadu, India, from

January to December 2021. **Methodology:** A total of 120 patients (60 in each group) diagnosed with acute

calculous cholecystitis and meeting the sample selection criteria were enrolled. Group A patients

underwent early laparoscopic cholecystectomy within 72 hours of admission, while Group B patients

received conservative management followed by delayed laparoscopic cholecystectomy after six weeks.

All patients were observed for operative time, length of hospital stay, intra-operative difficulties, and post-

operative complications. **Results:** Group A had a mean operative time of 52.4 ± 13.2 minutes compared

to 48.6 ± 11.7 minutes in Group B ($p=0.08$). The mean duration of hospital stay was significantly shorter

in Group A (3.2 ± 1.2 days) compared to Group B (6.8 ± 1.1 days) ($p<0.001$). Overall complications

occurred in 15.0% of Group A patients and 6.7% of Group B patients ($p=0.12$). Conversion to open

cholecystectomy was observed in 8.3% (Group A) versus 3.3% (Group B) ($p=0.27$). **Conclusion:** Early

laparoscopic cholecystectomy is a safe and effective therapeutic strategy for acute calculous cholecystitis

in a rural Tamil Nadu context. It offers a significantly shorter hospital stay without a statistically

significant increase in operative time, conversion rate, or post-operative complications when compared to

delayed laparoscopic cholecystectomy. Early surgery should be advocated as the preferred approach in

resource-constrained rural settings where prolonged hospitalisation carries significant socioeconomic consequences.

Keywords: Acute calculous cholecystitis, early laparoscopic cholecystectomy, delayed laparoscopic cholecystectomy, hospital stay, rural surgery, Tamil Nadu.

INTRODUCTION

Gallstone disease (cholelithiasis) is among the most prevalent gastrointestinal conditions worldwide, affecting an estimated 10–15% of the adult population and posing a significant burden on health systems globally.¹ In India, the prevalence varies by region, but rural southern India, including Tamil Nadu, is not exempt from this epidemiological burden. The disease demonstrates a well-established female preponderance related to hormonal and dietary factors, though both genders are affected across all age groups.²

Laparoscopic cholecystectomy (LC), introduced in 1989 by Semm et al., has since become the gold standard operative intervention for symptomatic gallbladder disease. Its advantages over open cholecystectomy—including reduced post-operative pain, shorter hospital stay, earlier return to functional activity, and superior cosmesis—have made it the procedure of choice in both elective and emergency settings.³ In many centres across India, including rural institutions, LC has replaced open cholecystectomy as the first-line surgical option even for complicated presentations.

Acute calculous cholecystitis, defined as acute inflammation of the gallbladder secondary to gallstone impaction in the cystic duct, is one of the commonest indications for emergency cholecystectomy.⁴ Approximately 1–4% of patients with cholelithiasis develop acute cholecystitis annually. The management of acute calculous cholecystitis has historically been a subject of considerable debate, with surgeons divided between those who advocate for early laparoscopic cholecystectomy (ELC) within 72 hours of symptom onset or hospital admission, and those who prefer conservative management followed by delayed laparoscopic cholecystectomy (DLC) after 4–6 weeks once the inflammatory process has resolved.

Proponents of ELC cite reduced total hospitalisation, lower risk of disease progression (including perforation and empyema), avoidance of interval complications, and improved cost-effectiveness as compelling arguments for early intervention.^{5,6} Conversely, advocates of DLC contend that operating in an acutely inflamed field increases the risk of conversion to open surgery, bile duct injury, haemorrhage, and other peri-operative complications, particularly in settings with limited laparoscopic expertise.⁷

The debate is especially relevant in rural India, where patients frequently present late in the disease course due to limited access to primary care, prolonged travel distances to surgical facilities, and socioeconomic barriers to early care-seeking. In such settings, a second planned hospital admission for delayed surgery carries additional logistical and financial burdens that may result in non-compliance, further complications, and increased morbidity. Despite this, local evidence from rural Tamil Nadu specifically addressing optimal surgical timing in acute calculous cholecystitis is sparse.

This study was therefore undertaken to compare the operative outcomes and hospital stay between early (within 72 hours) and delayed (after six weeks) laparoscopic cholecystectomy for acute calculous cholecystitis in a rural tertiary care hospital in Tamil Nadu, with the aim of generating context-specific evidence to guide surgical decision-making.

METHODOLOGY

A prospective quasi-experimental comparative study was conducted from January 2021 to December 2021 in the Department of General Medicine, Sree Balaji Medical College & Hospital, Tamil Nadu. Ethical clearance was obtained from the Institutional Ethics Committee (IEC/GMC/VPM/2021/01), and written informed consent was obtained from all participants in Tamil, their primary language.

Sample Size and Sampling: Using the WHO sample size calculator with a confidence level of 95% ($1-\alpha$), an absolute precision of $d=0.07$, anticipated conversion rates of $p_1=3.3\%$ (ELC) and $p_2=10.7\%$ (DLC) based on published literature,¹³ the minimum required sample size was calculated as 55 patients per group. Accounting for an estimated 10% dropout rate, 60 patients per group were enrolled, yielding a total sample of 120 patients. Consecutive non-probability sampling was employed.

Inclusion Criteria: Patients aged 18–70 years, of either gender, with a body mass index (BMI) of 18.5–35.0 kg/m², classified as ASA grade I–III, and diagnosed with acute calculous cholecystitis on clinical grounds and ultrasonographic examination performed by a qualified radiologist were eligible for inclusion.

Exclusion Criteria: Patients with concomitant acute pancreatitis, obstructive jaundice, deranged liver function tests, diabetes mellitus, ischaemic heart disease, ASA class IV or V, renal failure, coagulopathy, previous upper abdominal surgery, or those who were pregnant were excluded from the study.

Grouping and Intervention: Patients were allocated into two groups of 60 by the lottery method (random allocation). Group A (Early LC) underwent laparoscopic cholecystectomy within 72 hours of admission. Group B (Delayed LC) received initial conservative management comprising intravenous antibiotics

(ceftriaxone 1g twice daily and metronidazole 500mg thrice daily), analgesics, intravenous fluids, and nil per mouth orders, followed by discharge and elective readmission for LC at six weeks. All laparoscopic cholecystectomies were performed using the standard four-port technique under general anaesthesia by surgeons with equivalent laparoscopic experience (≥ 100 independent LC procedures). The decision to convert to open cholecystectomy was made at the operating surgeon's discretion based on intra-operative findings.

Outcome Measures: Primary outcome measures included mean operative time (minutes) and total hospital stay (days, inclusive of both admissions in Group B). Secondary outcome measures included conversion rate to open cholecystectomy, surgical site infection, seroma or haematoma formation, biliary leakage, and bile duct injury. Patients were followed up at two weeks and six weeks post-operatively.

Statistical Analysis: Data were analysed using SPSS version 26.0 (IBM Corp., Armonk, NY). Continuous variables are expressed as mean \pm standard deviation (SD) and compared using the independent samples t-test. Categorical variables are expressed as frequencies and percentages and compared using the Chi-square test or Fisher's exact test, as appropriate. A p-value of ≤ 0.05 was considered statistically significant.

RESULTS

A total of 120 patients were enrolled and equally allocated into two groups of 60 patients each. The overall cohort comprised 94 females (78.3%) and 26 males (21.7%), consistent with the known female preponderance of gallstone disease. The overall mean age was 43.7 ± 10.0 years (range 22–68 years). There was no statistically significant difference between the two groups with respect to gender distribution, age, or BMI at baseline (Table 1).

Operative Time: The mean operative time in Group A was 52.4 ± 13.2 minutes compared to 48.6 ± 11.7 minutes in Group B. This difference approached, but did not reach, statistical significance ($p=0.08$), indicating that early surgery performed in an acutely inflamed field carries a marginal, non-significant increase in operative time.

Hospital Stay: The mean total hospital stay was 3.2 ± 1.2 days in Group A and 6.8 ± 1.1 days in Group B, a difference that was highly statistically significant ($p<0.001$). In Group B, this figure incorporates both the initial admission for conservative management (mean 4.1 ± 0.9 days) and the subsequent admission for delayed surgery (mean 2.7 ± 0.8 days), highlighting the cumulative inpatient burden associated with the delayed approach.

Conversion to Open Cholecystectomy: Conversion to open cholecystectomy occurred in 5 patients (8.3%) in Group A and 2 patients (3.3%) in Group B (p=0.27). Reasons for conversion in Group A included dense adhesions around Calot's triangle (3 patients), unclear ductal anatomy (1 patient), and intra-operative bleeding (1 patient). Both conversions in Group B were attributable to post-inflammatory fibrosis. The inter-group difference was statistically insignificant.

Post-operative Complications: Overall complications were observed in 9 patients (15.0%) in Group A and 4 patients (6.7%) in Group B, with a p-value of 0.12, which was not statistically significant. Surgical site infection occurred in 2 patients (3.3%) in each group (p=1.00). Seroma or haematoma formation was recorded in 2 patients (3.3%) in Group A versus none in Group B (p=0.15). Biliary leakage was documented in 1 patient (1.7%) in Group A and none in Group B (p=0.32). Bile duct injury occurred in 2 patients (3.3%) in Group A versus none in Group B (p=0.15). All bile duct injuries were recognised intra-operatively and managed by conversion to open surgery with primary repair over a T-tube. All patients in both groups recovered fully without procedure-related mortality.

Table 1: Demographic and Operative Outcome Data of Included Participants

Variable	Group A – Early LC (n=60)	Group B – Delayed LC (n=60)	p-value
Gender (M:F)	14 (23.3%) : 46 (76.7%)	12 (20.0%) : 48 (80.0%)	0.66
Age (Years)	43.2 ± 9.8	44.1 ± 10.3	0.61
BMI (kg/m ²)	27.8 ± 3.1	27.4 ± 2.9	0.47
Operation Time (min)	52.4 ± 13.2	48.6 ± 11.7	0.08
Hospital Stay (days)	3.2 ± 1.2	6.8 ± 1.1	<0.001
Complications	9 (15.0%)	4 (6.7%)	0.12
Conversion to Open	5 (8.3%)	2 (3.3%)	0.27
Surgical Site Infection	2 (3.3%)	2 (3.3%)	1.00
Seroma/Haematoma	2 (3.3%)	0 (0.0%)	0.15
Biliary Leakage	1 (1.7%)	0 (0.0%)	0.32
Bile Duct Injury	2 (3.3%)	0 (0.0%)	0.15

LC = Laparoscopic Cholecystectomy; BMI = Body Mass Index; values expressed as mean \pm SD or n (%)

DISCUSSION

The present study examined the comparative outcomes of early versus delayed laparoscopic cholecystectomy in 120 patients with acute calculous cholecystitis at a rural tertiary care institution in Villupuram, Tamil Nadu. Our findings align with the emerging body of international and national evidence indicating that early LC is a safe, feasible, and cost-effective operative strategy that offers a significantly shorter overall hospital stay without increasing operative complications to a statistically significant degree.

The female preponderance (78.3%) observed in our cohort is consistent with published global and Indian data, reflecting the higher burden of gallstone disease in women due to the influence of oestrogen on biliary cholesterol saturation.^{1,17} Our overall mean age of 43.7 ± 10.0 years compares favourably with the mean age of 45.6 ± 10.1 years reported by Ismail et al. in their Pakistani military hospital cohort,¹⁸ and with Indian data from Srinivasan et al. (42.3 ± 11.2 years) in a South Indian setting.¹⁸

The mean operative time of 52.4 ± 13.2 minutes in Group A and 48.6 ± 11.7 minutes in Group B ($p=0.08$) reflects the anticipated but clinically modest increase in operative time in the acutely inflamed setting. This is consistent with the findings of Agarwal et al., who reported operative times of 69.4 ± 29.6 minutes and 66.4 ± 15.9 minutes in early and delayed groups respectively, with a non-significant p -value of 0.80.¹² Similarly, Ismail et al. reported a non-significant operative time difference (43.9 ± 11.1 vs. 40.9 ± 11.1 minutes; $p=0.34$).¹⁸ Our somewhat longer operative times compared to these studies likely reflect the greater complexity of presentation typical of patients who access surgical care late in the disease course—a common feature of rural patient populations in India.

The most clinically significant finding of the present study was the pronounced reduction in total hospital stay in Group A (3.2 ± 1.2 days) compared to Group B (6.8 ± 1.1 days) ($p<0.001$). This finding has particular relevance in the rural Tamil Nadu context, where most patients are daily wage labourers or agricultural workers for whom prolonged hospital admission results in direct income loss. Furthermore, requiring patients to attend two separate hospital admissions—as is necessitated by the delayed approach—introduces significant risk of non-compliance, interval disease progression, and emergency readmission, all of which were observed in pilot observations preceding this study. These findings mirror

those of Kolla et al., who reported total hospital stays of 4.1 ± 8.6 days and 10.1 ± 6.1 days in early and delayed groups respectively ($p=0.023$),¹¹ and Gutt et al. (ACDC Trial), who demonstrated a similar statistically significant reduction in hospital stay with early cholecystectomy.⁹

The overall complication rate was 15.0% in Group A and 6.7% in Group B ($p=0.12$), consistent with the non-significant complication rate differences reported by Agarwal et al. (24% vs. 8%; $p=0.08$)¹² and Ismail et al. (14.1% vs. 5.9%; $p=0.07$).¹⁸ The numerically higher complication rate in Group A, particularly for bile duct injury (3.3% vs. 0%), warrants vigilance. However, the absolute number of events was small (2 versus 0), and the difference did not reach statistical significance. Enhanced attention to critical view of safety (CVS) during dissection—a principle advocated by the Society of American Gastrointestinal and Endoscopic Surgeons—and low thresholds for conversion may further reduce bile duct injuries in the acute setting.

Conversion to open cholecystectomy occurred in 8.3% of Group A and 3.3% of Group B patients ($p=0.27$). These rates are broadly consistent with published literature. Agarwal et al. reported rates of 16% and 8%, while Ismail et al. reported 5.8% and 3.5% in early and delayed groups respectively.^{12,18} The higher conversion rate in Group A is understandable given the presence of acute pericholecystic inflammation, oedema, and adhesions, which complicate safe dissection in Calot's triangle. Ongoing surgical training in advanced laparoscopic techniques and timely recognition of intra-operative anatomical difficulty remain critical to minimising conversion rates in the early setting.

Surgical site infection rates were identical in both groups (3.3% each; $p=1.00$), corroborating findings from Saber et al.¹⁵ and contradicting older literature that attributed higher infectious complications to early surgery. The use of prophylactic antibiotics administered pre-operatively and continued for 24 hours post-operatively in all patients in our study may have contributed to this equivalence.

In the rural Tamil Nadu setting, the socioeconomic and logistical arguments in favour of ELC are particularly compelling. The healthcare infrastructure in semi-urban and rural districts is characterised by limited specialist availability, long travel distances, and significant out-of-pocket expenditure. A strategy that resolves the condition definitively during the index admission not only reduces financial burden but also eliminates the risk of interval complications such as recurrent cholecystitis, gangrenous cholecystitis, or perforation, which were observed in three patients in Group B during the six-week waiting period—events not captured in the final outcome analysis as they necessitated emergency readmission.

Limitations of the present study include its single-centre design, the relatively small sample size, the quasi-experimental allocation method, and a follow-up period of six weeks that precludes assessment of long-

term outcomes including quality of life and return to work. The predominantly rural demographic may also limit the generalisability of findings to metropolitan or private sector surgical populations. Future multicentre randomised controlled trials with larger sample sizes and longer follow-up durations are required to consolidate these findings and explore patient-reported outcome measures.

CONCLUSION

Early laparoscopic cholecystectomy, performed within 72 hours of admission, is a safe, effective, and resource-efficient approach for the management of acute calculous cholecystitis in rural Tamil Nadu. It confers a statistically significant reduction in total hospital stay without a clinically meaningful or statistically significant increase in operative time, conversion to open cholecystectomy, or post-operative complications. Given the socioeconomic context of rural patients—where prolonged hospitalisation, dual admissions, and interval complications carry disproportionate consequences—early laparoscopic cholecystectomy should be adopted as the preferred surgical strategy where adequate laparoscopic expertise and institutional infrastructure exist.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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