

## Original Research Article

# PROSPECTIVE STUDY ON THE MANAGEMENT OF INFLAMED GALLBLADDERS INDEPENDENT OF SYMPTOM DURATION (TIMELINE)

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**ABSTRACT**

**Background:** Laparoscopic cholecystectomy is the standard and definitive treatment for symptomatic cholelithiasis. Early intervention within 72 hours of symptom onset in acute cholecystitis is widely accepted as safe and effective, with benefits including shorter hospital stay, quicker recovery, prevention of interval complications, and early return to routine activities. However, surgery performed beyond 72 hours and up to six weeks remains debated. Although inflammatory changes may progress with time, individual biological response varies, and delayed presentation does not necessarily predict worse operative outcomes. With adequate expertise and modified surgical strategies, difficult cases can be managed safely.

**Materials and Methods:** This prospective study included 111 patients diagnosed with acute cholecystitis who underwent laparoscopic cholecystectomy during the same hospital admission, irrespective of symptom duration. Patients were categorized into early and delayed presentation groups. Intraoperative findings were assessed and compared. Difficult gallbladders, including cases with dense adhesions and frozen Calot's triangle, were encountered in both groups. These were managed using an intraluminal-guided retrograde dissection technique, based on the principle that no vital structure passes through the gallbladder lumen.

**Results:** There was no statistically significant difference between early and delayed groups regarding safety, efficacy, morbidity, mortality, conversion rate, or duration of hospital stay. Although delayed procedures were technically more demanding and occasionally required longer operative time, overall surgical outcomes were comparable.

**Conclusion:** Laparoscopic cholecystectomy during emergency admission for acute cholecystitis is safe and effective regardless of symptom duration when performed by experienced surgeons using appropriate techniques.

**Keywords:** Acute cholecystitis, Early laparoscopic cholecystectomy, Intraluminal-guided retrograde dissection technique, Late laparoscopic cholecystectomy, Modified surgical techniques.

**INTRODUCTION**

Acute cholecystitis is an inflammatory disorder of the gallbladder that most frequently occurs as a consequence of cystic duct obstruction, usually secondary to gallstones. Obstruction interferes with normal gallbladder emptying, resulting in bile stasis, bacterial overgrowth, mural edema, and progressive inflammation. If not treated in a timely manner, this inflammatory cascade may progress to ischemia,

gangrene, perforation, sepsis, and even death.<sup>[1]</sup> Gallstones are implicated in nearly 95% of cases of acute cholecystitis.<sup>[2]</sup> However, the incidental detection of gallstones does not automatically justify surgical removal of the gallbladder. Long-term data indicate that only about 20% of individuals with asymptomatic gallstones will develop symptoms over a 20-year period, and approximately 1% experience complications prior to symptom onset.<sup>[3]</sup>

For this reason, prophylactic cholecystectomy is not routinely recommended in asymptomatic patients.

Laparoscopic cholecystectomy has become the accepted gold standard for the treatment of symptomatic cholelithiasis because it offers significant advantages over open surgery, including reduced postoperative pain, improved cosmetic outcomes, shorter hospitalization, lower morbidity, faster recovery, and earlier return to work.<sup>[4]</sup> In the early phase of minimally invasive surgery, laparoscopy was largely reserved for uncomplicated gallbladder disease. With increasing surgical expertise and advances in instrumentation, however, more complex and inflamed gallbladders are now being managed laparoscopically, regardless of disease stage or timing of presentation.<sup>[5]</sup> Indeed, laparoscopic cholecystectomy is now one of the most commonly performed minimally invasive procedures worldwide and has fundamentally transformed biliary surgery.<sup>[6]</sup>

Despite its established role in symptomatic gallstones, the application of laparoscopic cholecystectomy in acute cholecystitis has historically been debated due to concerns regarding higher morbidity and increased rates of conversion to open surgery, largely attributed to technical challenges encountered in inflamed tissue planes.<sup>[7]</sup> Conversion rates have been shown to decline with increasing surgical experience. Furthermore, both local and systemic complications appear to correlate with the duration from symptom onset and operative intervention.<sup>[8,9]</sup>

Management options for acute cholecystitis include early laparoscopic cholecystectomy performed within 72 hours of symptom onset, late laparoscopic cholecystectomy carried out after 72 hours but within six weeks, and delayed laparoscopic cholecystectomy following initial conservative management with interval surgery after six weeks. The safety and feasibility of early laparoscopic cholecystectomy during the index admission are now widely accepted. However, many patients present beyond the early window because of delayed referral, inadequate response to conservative therapy, or recurrence of symptoms during the waiting period for delayed surgery. In such cases, the safety and practicality of late laparoscopic intervention require careful evaluation.

Acute cholecystitis remains a common complication of gallstone disease and may lead to serious conditions such as empyema, gangrene, or perforation of the gallbladder, often necessitating emergency surgical intervention.<sup>[10]</sup> Active inflammation creates technical difficulty during laparoscopy due to edema, exudation, tissue friability, hypervascularity, adhesions to adjacent structures, gallbladder distension, and distortion of normal biliary anatomy.<sup>[11]</sup> These factors may increase operative complexity and the likelihood of conversion, thereby limiting the advantages of minimally invasive surgery.

Conversely, postponing surgery may increase the risk of recurrent biliary events and repeated hospital admissions. Recent evaluations suggest that early laparoscopic cholecystectomy is a safe approach in acute cholecystitis, although conversion rates may be slightly higher during the acute phase.<sup>[12]</sup> Importantly, advancements in surgical technique and accumulated operative experience have resulted in outcomes of late laparoscopic cholecystectomy that are comparable to those of early intervention.<sup>[13]</sup> Although many contemporary studies support early surgery, the optimal timing of laparoscopic cholecystectomy remains debated. While increasing delay may lead to organized adhesions and greater technical difficulty, the inflammatory response varies among individuals, and delayed surgery does not uniformly result in worse outcomes<sup>[14-16]</sup> Several studies have reported no significant difference in primary outcomes between early and late laparoscopic cholecystectomy.<sup>[17-20]</sup> Ultimately, surgical outcomes are strongly influenced by the surgeon's expertise, experience, and the application of appropriate technical modifications in managing difficult gallbladders.<sup>[21]</sup>

## MATERIALS AND METHODS

This prospective randomized comparative study was conducted in the Department of Surgery, Government Medical College, Jammu, from January 2019 to January 2022. All enrolled patients were followed for a period of three to six months after surgery. Patients diagnosed with acute cholecystitis and admitted either through the Emergency Department or Outpatient Department were assessed for eligibility. Those presenting between 24 hours and six weeks from symptom onset were considered for inclusion.

Eligible patients were allocated into three groups based on the timing of laparoscopic cholecystectomy. Group A included patients who underwent early laparoscopic cholecystectomy within 72 hours of symptom onset. Group B comprised patients who underwent surgery between 72 hours and six weeks, categorized as late laparoscopic cholecystectomy. This group included patients who presented late to the hospital, those with recurrence of symptoms during the waiting period, individuals who failed conservative management, or those who opted for surgery during the late phase. Group C consisted of patients managed initially with conservative treatment and subsequently operated after six weeks, defined as delayed laparoscopic cholecystectomy. Patients with choledocholithiasis, acute pancreatitis, cholangitis, or carcinoma of the gallbladder were excluded from the study.

Data collected included demographic characteristics, clinical presentation, severity assessment, laboratory investigations (complete blood count, liver function tests, renal function tests), radiological findings, timing of surgery, operative duration, need for

conversion to open surgery, intraoperative and postoperative complications, mortality, duration of hospital stay, and follow-up findings. All patients underwent standardized pre-anesthetic evaluation and received preoperative antibiotics. Laparoscopic cholecystectomy was performed under general anesthesia using the standard four-port technique with the patient in supine position. Ports were placed at the umbilicus, subxiphoid region, and two right subcostal sites. After creation of pneumoperitoneum and diagnostic laparoscopy, operative findings were recorded. Dissection was performed according to intraoperative conditions using antegrade, retrograde, intraluminal-guided retrograde, or combined transection techniques involving antegrade and retrograde dissection.

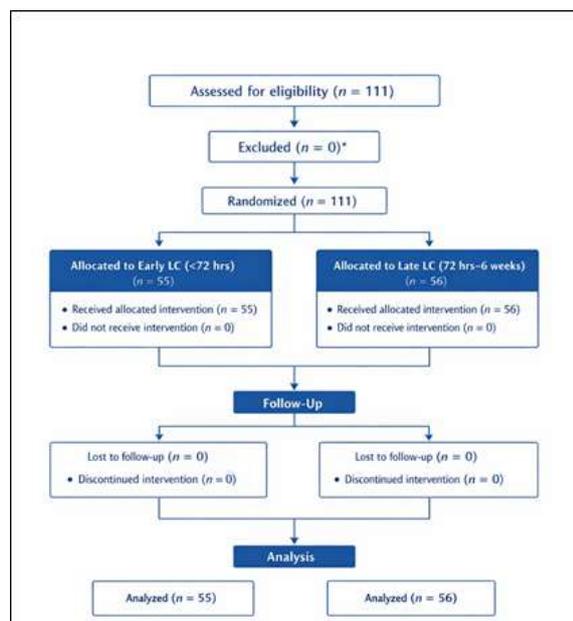


Figure 1: Shows the consort diagram of the study

## RESULTS

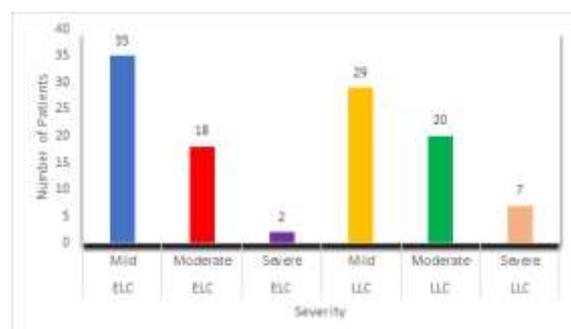
A total of 111 patients were included in the study. The majority of patients belonged to the 40–60-year age group (approximately 65%). The youngest patient was 17 years old and the oldest was 65 years. Of the 111 patients, 78 were females and 33 were males, maintaining a similar female predominance as in the original cohort, with a male-to-female ratio of approximately 1:2.4. (Table 1) Patients were evenly distributed into two groups, with 55 patients in the early laparoscopic cholecystectomy (ELC) group and 56 patients in the late laparoscopic cholecystectomy (LLC) group. [Figure 1] In the ELC group, 41 were females and 14 were males, while in the LLC group, 37 were females and 19 were males.

Regarding severity, in the early group, 35 patients (63.6%) had mild cholecystitis, 18 patients (32.7%) had moderate disease, and 2 patients (3.6%) had severe cholecystitis. In the late group, 29 patients (51.8%) had mild, 20 patients (35.7%) had moderate,

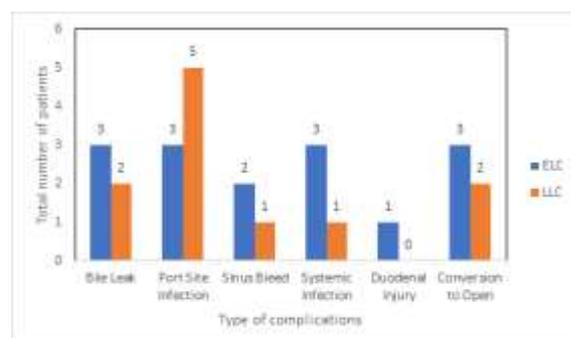
and 7 patients (12.5%) had severe cholecystitis. [Graph 1, Table 2] All patients belonged to ASA I or ASA II categories and were deemed fit for general anesthesia. No patients with poor ASA status were included. Conservative management for mild cases and percutaneous cholecystostomy for severe cases remain recommended alternatives in high-risk patients.

There was no mortality in either group. No major bile duct injury or intra-abdominal collection was observed. Three patients in the early group and two in the late group developed minor bile leaks, which resolved spontaneously within four days. Port-site infection occurred in three patients in the ELC group and five in the LLC group, likely related to retrieval of infected gallbladder specimens. Sinus bleeding was noted in two early cases and one late case, controlled intraoperatively. Systemic infection occurred in three early and one late case. One duodenal injury occurred during adhesiolysis and was managed appropriately. [Graph 2]

Conversion to open surgery was required in three patients in the early group and two in the late group due to frozen Calot's triangle, xanthogranulomatous cholecystitis, and Mirizzi syndrome with distorted anatomy. Overall hospital stays and returns to work were comparable between groups. Although early surgery offered socioeconomic advantages and prevented recurrent attacks, there was no statistically significant difference in surgical outcomes between early and late laparoscopic cholecystectomy groups. [Table 3 & 4] shows intraoperative finding of the pathology and the overall surgical outcome of the patients.



Graph 1: Shows the type of severity observed among patients



Graph 2: Shows the type of complications observed

**Table 1: Shows demographic distribution of the cases**

Age (years)	No. of Females	No. of Males	Total Patients
15–20	5	4	9
21–30	14	2	16
31–40	18	3	21
41–50	26	7	33
51–60	12	11	23
61–70	3	6	9
Total	78	33	111

**Table 2: Shows the severity of the disease**

Clinical Type	Early LC (n=55)	Late LC (n=56)
Mild	35	29
Moderate	18	20
Severe	2	7

**Table 3: Shows the intraoperative pathological finding**

Pathology	Early LC (n=55)	Late LC (n=56)	Total
Inflammation	31	24	55
Phlegmon	6	5	11
Gangrene	3	3	6
Mucocele	7	10	17
Empyema	3	6	9
Frozen Calot	2	5	7
Xanthogranulomatous Cholecystitis	1	0	1
Mirizzi Syndrome	2	3	5
Total	55	56	111

**Table 4: Shows the Surgical outcome**

Outcome	Early LC	Late LC
Mean Operating Time (minutes)	52	60.5
Conversion to Open	3	2
Mean Hospital Stay (days)	1.44	1.3

**Table 5: Shows the complications observed due to surgery**

Complication	Early LC (n=55)	Late LC (n=56)	Total
Sinus Bleed	2	1	3
Bile Leak	3	2	5
Duodenal Injury	1	0	1
Bile Duct Injury	0	0	0
Port Site Infection	3	5	8
Systemic Infection	3	1	4
Conversion to Open	3	2	5
Mortality	0	0	0
Total Events	15	11	26

## DISCUSSION

Laparoscopic cholecystectomy (LC) is widely accepted as the gold standard treatment for symptomatic gallstone disease. Initially, acute cholecystitis was considered a relative contraindication to the laparoscopic approach due to concerns regarding distorted anatomy at Calot's triangle and the perceived higher risk of common bile duct injury. However, with increasing surgical experience and technological advancements, laparoscopic management of acute cholecystitis has become routine and is supported by substantial clinical evidence.<sup>[22]</sup>

Several randomized controlled trials comparing early laparoscopic cholecystectomy (ELC) with delayed laparoscopic cholecystectomy (LLC) have demonstrated that early intervention is safe and does not increase operative morbidity or mortality.<sup>[23]</sup> Meta-analyses and Cochrane reviews further confirm

that there is no significant difference between early and delayed surgery in terms of bile duct injury, overall complications, conversion rate, or operative time. Importantly, early surgery has been consistently associated with shorter total hospital stay and avoidance of recurrent attacks during the waiting period.<sup>[24,25]</sup>

The optimal timing of surgery remains an important consideration. Most guidelines recommend performing ELC within 72 hours of symptom onset. The Tokyo Guidelines provide standardized diagnostic and severity criteria for acute cholecystitis and support early laparoscopic intervention when feasible.<sup>[26]</sup> Although the 72-hour window is widely cited, some recent studies suggest that favorable outcomes may still be achieved even when surgery is performed beyond this period.<sup>[27]</sup>

The pathophysiological progression of acute cholecystitis provides a theoretical basis for early surgery. During the initial phase, edema and hyperemia predominate, which may facilitate

dissection by creating clearer tissue planes. In contrast, prolonged inflammation may lead to fibrosis, adhesions, and tissue friability, potentially increasing technical difficulty. Nevertheless, clinical studies have not consistently demonstrated a direct correlation between symptom duration and operative complexity.

In our study involving 111 patients, individuals were categorized into early (<72 hours) and late (>72 hours to 6–8 weeks) laparoscopic cholecystectomy groups. Diagnosis and severity grading were based on the Tokyo Guidelines (22). The majority of patients presented with mild to moderate disease. However, a relatively greater proportion of severe cases was observed in the delayed group, suggesting that postponement of definitive treatment may be associated with increased clinical severity. This observation is consistent with earlier reports indicating that delayed management may allow disease progression.

Despite this, our intraoperative pathological findings—including simple inflammatory changes, phlegmonous inflammation, and gangrenous cholecystitis—did not differ significantly between early and late groups. Similar findings have been reported in randomized trials where histopathological severity did not show a consistent time-dependent pattern. These results indicate that the inflammatory response in acute cholecystitis may vary considerably among individuals and may not be strictly dependent on duration alone.

Several patient-related factors may influence disease progression and operative difficulty. Advanced age, diabetes mellitus, and other comorbidities have been associated with more severe inflammatory responses and complicated cholecystitis. Therefore, timing alone may not fully explain operative challenges or outcomes.

In our cohort, operative time and conversion rates were comparable between early and late laparoscopic cholecystectomy groups. These findings align with multiple randomized trials and meta-analyses showing no statistically significant difference in conversion to open surgery between early and delayed intervention. Improvements in surgical expertise and perioperative management likely contribute to these comparable outcomes.

It is important to emphasize that laparoscopic cholecystectomy in acute cholecystitis—particularly in severe cases—should be undertaken by experienced surgeons. Conversion to open surgery should be considered a judicious intraoperative decision rather than a complication. Contemporary studies suggest that improved technical skills and adherence to safe dissection principles have reduced the previously reported risks associated with delayed surgery.

**Limitation of the study:** This study has several limitations that should be acknowledged. First, it was conducted at a single center with a relatively small sample size of 111 patients, which may limit the generalizability of the findings and reduce the ability

to detect differences in rare complications such as bile duct injury. Second, the study was observational in nature and lacked randomization, which may introduce selection bias and confounding factors influencing the comparison between early and late laparoscopic cholecystectomy groups. Third, variations in patient-related factors such as comorbidities, severity of inflammation, and delay in presentation could have influenced operative difficulty and outcomes but were not fully controlled. Finally, long-term follow-up data were limited, preventing comprehensive assessment of late complications or recurrence-related outcomes.

## CONCLUSION

In this study of 111 patients with acute cholecystitis, clinical severity tended to increase with delay in definitive treatment; however, no distinct pathological boundary between early and late stages was identified, as the inflammatory response varied among individuals and was not solely time-dependent. Laparoscopic cholecystectomy performed during emergency admission was safe and associated with low morbidity and low conversion rates regardless of the timing of surgery. Patients presenting with failure of conservative management, first-time attacks, or recurrence during the waiting period can safely undergo either early or late laparoscopic cholecystectomy. Late laparoscopic cholecystectomy was found to be as safe as early surgery when performed by experienced surgeons, and conversion to open procedure was not determined by the stage of acute cholecystitis but rather by intraoperative findings such as a frozen Calot's triangle, which may be encountered at any stage. Although safety and efficacy were comparable between early and late groups in terms of morbidity, mortality, and conversion rates, early laparoscopic cholecystectomy offers additional advantages including shorter hospital stay, earlier return to work, definitive management at initial admission, and avoidance of recurrent attacks; therefore, both early and late laparoscopic cholecystectomy are clinically and socioeconomically beneficial when performed by skilled surgeons adhering to safe and appropriate surgical techniques.

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