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Original Research Article

Comparative Analysis of Clinical Outcomes in Early versus Delayed Laparoscopic Cholecystectomy for Acute Cholecystitis

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Abstract:

Background: Acute cholecystitis is a frequent cause of emergency abdominal admissions, with the standard treatment being LC. The best timing of the surgery, early versus delay remains open to question.

Aim: To compare the clinical outcomes between early laparoscopic cholecystectomy and delayed laparoscopic cholecystectomy in patients diagnosed with acute cholecystitis.

Materials and Methods: A total of 160 patients aged between 18 and 70 years suffering from acute calculous cholecystitis presenting to ANMMCH, India, were prospectively subjected to ELC within 72 hours (n = 80) or DLC ≥6 weeks after initial conservative management (n = 80). Intraoperative and postoperative outcomes such as operative time, conversion to open surgery, complications, and hospital stay were recorded prospectively and analyzed using SPSS.

Results: The mean operative time was significantly shorter in the ELC group: 58.6 ± 11.8 min versus DLC, 72.3 ± 14.1 min, $p<0.001$. Conversion rates, intraoperative bleeding, and bile duct injuries were comparable. Postoperatively, ELC was associated with significantly shorter hospital stay (3.0 ± 1.0 versus 5.4 ± 1.3 days, $p<0.001$) and a trend toward fewer complications. The readmission rates and specific postoperative complications were lower for ELC but did not reach statistical significance.

Conclusion: Early laparoscopic cholecystectomy is safe, decreases operative time and hospital stay, has comparable complication rates to delayed surgery, and thus will remain the preferred approach in acute cholecystitis.

Keywords: Acute Cholecystitis, Laparoscopic Cholecystectomy, Early Surgery, Delayed Surgery, Operative Outcomes, And Hospital Stay.

Introduction

Acute cholecystitis is one of the most common reasons for emergency admission to the hospital due to abdominal pain and still causes a high burden on healthcare systems worldwide [1]. As one of the most common complications of gallstone disease, it accounts for a substantial proportion of urgent and elective laparoscopic procedures. The condition most often arises from obstruction of the cystic duct by gallstones, leading to impaired bile drainage, gallbladder distention, and subsequent inflammation of the gallbladder wall. This inflammatory cascade may advance from mild, localized swelling to severe infection, gangrene, or perforation, depending on the duration and severity of the obstruction. Clinically, patients usually present with right upper quadrant pain, fever, leukocytosis, and a positive Murphy's sign, although the severity of presentation can vary between individuals. Because of its prevalence and morbidity potential, acute cholecystitis remains a clinically important condition that requires diagnosis and appropriate management in a timely manner.

Laparoscopic cholecystectomy has become the standard of care for acute cholecystitis, replacing

open cholecystectomy in most settings because of reduced postoperative pain, short recovery time, improved cosmetic results, and reduced complication rates [2]. However, the timing for performing LC in acute inflammation has been highly debated. Traditionally, a delayed or interval surgical approach is one that is usually performed some weeks following initial conservative management. Such a preference was based on the belief that performing surgery in the acute phase of inflammation may result in increased difficulty during the operation and enhance the risk of complications such as bile duct injury, bleeding, or conversion to an open procedure [3]. Conventionally, surgeons believe that delay in surgery allows resolving inflammation and therefore facilitates a safer and less technically challenging operation.

Over the last two decades, however, significant advances in laparoscopic instrumentation, improved surgeon training, and better perioperative care have redefined clinical perceptions. Early laparoscopic cholecystectomy, generally defined as surgery performed within 72 hours of symptom onset, has gained popularity as a viable-and in many instances preferable-alternative to DLC [4]. Many reports have identified that ELC may offer several clinical and economic benefits, including a reduced overall hospital stay, lower risk of recurrent biliary symptoms during waiting for the operation, and avoidance of complications related to repeated gallbladder inflammation [5,6] ,. Early intervention also ensures that definitive management is provided during the index admission, which may enhance patient satisfaction and reduce healthcare costs resulting from multiple hospital visits or readmissions.

However, despite these reported advantages, controversy persists in clinical practice. Several studies have reported that early surgery can still be fraught with increased operative difficulty due to edema, adhesions, or distorted anatomy from acute inflammation. This might increase the risk for higher conversion rates to open surgery, longer operative times, or higher postoperative complications such as bile leaks or surgical site infections [7]. Moreover, the decision for early versus delayed surgical intervention often depends on institutional and surgical team preferences, given operating room availability, staffing, surgeon experience, and institutional protocols. In resource-challenged situations or in smaller health settings, limitations on operating room scheduling or limited access to skilled laparoscopic surgeons might warrant a need for delayed intervention even when an early approach is clinically indicated.

Another challenge includes factors related to patients, such as age, comorbid conditions, severity of inflammation, complications like empyema, or gangrenous cholecystitis, which could influence operative difficulty and, by extension, perioperative outcomes. Further, the selection of appropriate candidates for early surgery remains a finely nuanced clinical decision. With global variability in healthcare infrastructure and practice patterns, comparative effectiveness may differ substantially between regions; this further complicates the generalization of previous findings on the comparison between ELC versus DLC.

These are the complexities surrounding the issue, and therefore, there is a further need for continuous comparative analysis of the evidence on the relationship between timing and clinical outcome, resource use, and safety. Many studies have indeed compared the benefits and risks of early versus delayed LC, but differences in study design, patient populations, and outcome measures suggest that more good-quality comparisons are in order. Such data from various institutions and patient populations may help refine clinical guidelines and inform evidence-based decisions.

The present multicenter prospective cohort study will compare the differences in perioperative outcomes and postoperative complications, as well as overall hospital resource use, associated with early versus delayed laparoscopic cholecystectomy in patients with a confirmed diagnosis of acute cholecystitis. In determining these outcomes across diverse clinical settings, this study attempts to provide valuable input into the current debate on optimal timing of surgery. This research ultimately strives to drive standardized clinical practice that is aimed at enhancing patient outcomes, streamlining healthcare operations, and enabling safer, evidence-based practice in acute cholecystitis management.

Materials And Methods

Study Design: This was a prospective observational cohort study comparing clinical outcomes of Early Laparoscopic Cholecystectomy (ELC) versus Delayed Laparoscopic Cholecystectomy (DLC) in patients diagnosed with acute calculous cholecystitis.

Study Setting: The study was conducted in the Department of General Surgery, Anugrah Narayan Magadh Medical College and Hospital (ANMMCH), Gaya ji, Bihar, India.

Study Duration: The study was carried out over a period of five months.

Study Population: A total of 160 patients, aged 18–70 years, diagnosed with acute cholecystitis based on clinical presentation, laboratory parameters, and ultrasonography findings, were enrolled.

Patients were divided into two groups:

- Group A (Early Laparoscopic Cholecystectomy, n = 80): Underwent LC within 72 hours of symptom onset.

- Group B (Delayed Laparoscopic Cholecystectomy, n = 80): Underwent LC ≥6 weeks after initial conservative management.

Inclusion Criteria

- Age 18–70 years
- Acute calculous cholecystitis diagnosed according to Tokyo Guidelines (TG) clinical, laboratory, and ultrasonographic criteria
- Hemodynamically stable and fit for laparoscopic surgery
- Provided informed consent to participate in the study

Exclusion Criteria

- Acalculous cholecystitis
- Suspected or confirmed gallbladder malignancy
- Common bile duct (CBD) stones requiring ERCP
- Severe comorbidities precluding surgery (e.g., uncontrolled coagulopathy, severe cardiopulmonary disease)
- Pregnancy
- Refusal to participate or inability to attend follow-up visits

Sampling Method and Sample Size: All eligible patients presenting during this period were enrolled using a consecutive sampling technique. The sample size in our study was 160, with a distribution of 80 patients each based on timing of surgery (early vs delayed). Patients were grouped according to the timing of presentation and institutional protocol, rather than randomized.

Data Collection: Data were prospectively collected using a structured and prevalidated proforma. Demographic details for each participant were noted, including age and gender, along with relevant clinical information in the form of presenting symptoms, duration of abdominal pain, fever, and associated gastrointestinal complaints. Laboratory investigations in the form of complete blood count, liver function tests, and inflammatory markers were noted at the time of admission. Ultrasonographic findings were reviewed to confirm acute calculous cholecystitis, with particular attention being paid to gallbladder wall thickness, presence of gallstones, pericholecystic fluid, and sonographic Murphy's sign. Intraoperative details regarding operative time, intraoperative findings, dissection difficulty, adhesions, cystic duct anatomy, bile duct injury, and need for conversion to open were diligently noted. Postoperative details included duration of hospital stay, analgesic requirement, time to oral intake, postoperative complications in the form of wound infection, bile leak, intra-abdominal abscess, or postoperative biliary complications, need for re-intervention, and 30-day morbidity or mortality. Follow-up for all patients was done for 30 days in the post-surgical period either in outpatient clinics or on telephonic communication.

Procedure: All patients underwent laparoscopic cholecystectomy, carried out by a standardized four-port technique under general anesthesia. After the induction of pneumoperitoneum using a Veress needle or open (Hasson) method, four ports were placed in conventional positions: one 10-mm umbilical port for the camera, one 10-mm epigastric port for dissection, and two 5-mm ports in the right hypochondrium and right flank for assistance. Dissection of Calot's triangle was performed in order to achieve the so-called Critical View of Safety (CVS), with clear identification of the cystic duct and cystic artery before clipping and dividing them. Thereafter, the gallbladder was separated from the hepatic bed with electrocautery and retrieved in an endobag through the umbilical port. Intraoperative decisions regarding conversion to open cholecystectomy were made based on the surgeon's assessment of dense adhesions, uncontrolled bleeding, distorted anatomy, or suspected bile duct injury. Routine postoperative care was provided, including analgesia, early ambulation, and initiation of oral intake once tolerated.

Statistical Analysis: Quantitative data was entered into a structured database and analyzed using IBM SPSS Statistics version 26.0. Continuous variables, including age, operative time, and duration of hospital stay, were reported as mean ± standard deviation. Comparisons between groups were carried out by the independent sample t-test. Categorical variables such as gender distribution, intraoperative complications, conversion rates, and postoperative morbidity were summarized as frequencies and percentages and tabulated and analyzed using the Chi-square test or Fisher's exact test when appropriate. A p-value of < 0.05 was regarded as significant. All results were presented in tables, charts, and descriptive statistics to facilitate comparison among early and delayed laparoscopic cholecystectomy groups".

Result

Table 1 compares intraoperative outcomes between patients undergoing early versus delayed laparoscopic cholecystectomy (LC). The mean operative time was significantly shorter in the early LC group (58.6 ± 11.8 minutes) compared to the delayed LC group (72.3 ± 14.1 minutes, $p < 0.001$). Conversion to open surgery occurred in 6.3% of early LC cases versus 13.8% of delayed LC cases, although this difference was not statistically significant ($p = 0.186$). Intraoperative bleeding was observed in 3.8% of early LC patients and 8.8% of delayed LC patients ($p = 0.328$). Bile duct injury was rare, occurring in 1.3% of early LC and 2.5% of delayed LC cases, with no significant difference between groups ($p = 1$). Overall, early LC was associated with a significantly shorter operative time, while other intraoperative outcomes were comparable.

Table 1: Comparison of Intraoperative Outcomes Between Groups			
Parameter	**Group A (Early LC)**	**Group B (Delayed LC)**	**p-value**
Operative time (minutes)	58.6 ± 11.8	72.3 ± 14.1	<0.001
Conversion to open (%)	6.3% (5/80)	13.8% (11/80)	0.186
Intraoperative bleeding (%)	3.8% (3/80)	8.8% (7/80)	0.328
Bile duct injury (%)	1.3% (1/80)	2.5% (2/80)	1

Table 2 compares postoperative outcomes between early and delayed laparoscopic cholecystectomy (LC) groups. The early LC group had a significantly shorter hospital stay (3.0 ± 1.0 days) compared to the delayed LC group (5.4 ± 1.3 days, $p < 0.001$). Total complications occurred in 11.3% of early LC patients versus 20.0% of delayed LC patients, though this difference was not statistically significant ($p = 0.191$). Wound infection was seen in 5.0% of early LC and 10.0% of delayed LC cases ($p = 0.369$), while bile leak occurred in 2.5% versus 6.3% ($p = 0.443$), respectively. Similarly, 30-day readmissions were 2.5% in early LC and 6.3% in delayed LC ($p = 0.443$). Overall, early LC was associated with a significantly shorter hospital stay, while other postoperative outcomes were comparable between groups.

Table 2: Comparison of Postoperative Outcomes Between Groups			
Parameter	**Group A (Early LC)**	**Group B (Delayed LC)**	**p-value**
Hospital stays (days)	3.0 ± 1.0	5.4 ± 1.3	<0.001
Total complications (%)	11.3% (9/80)	20.0% (16/80)	0.191
Wound infection (%)	5.0% (4/80)	10.0% (8/80)	0.369
Bile leak (%)	2.5% (2/80)	6.3% (5/80)	0.443
Readmission (30 days) (%)	2.5% (2/80)	6.3% (5/80)	0.443

Discussion

The current study revealed that, in patients with acute cholecystitis, early LC has certain perioperative and postoperative advantages over delayed intervention. As part of our analysis, we found that the mean operative time in the early group was significantly shorter (58.6 ± 11.8 minutes) compared to that in the delayed group (72.3 ± 14.1 minutes, $p < 0.001$). This echoes other literature, which has shown consistently that an early intervention allows for a faster procedure owing to a relative lack of dense adhesions and fibrosis that characterize prolonged inflammation. This is reiterated by various studies (Janjic et al., 2020; Bundgaard et al., 2021) [1,3]. In line with this, Chang et al. (2009) [4] related operative times of 60 ± 15 minutes for early LC versus 75 ± 20 minutes for delayed LC. Indeed, these results agree with ours and introduce technical difficulties presented by chronic inflammation in cases that are performed late. Similarly, Kohga et al. (2019) [5] showed that fibrosis and adhesions during the procedure in delayed surgery may lead to difficulty in dissection and often longer operative times, a tendency seen in our cohort as well."

Conversion to open surgery was higher in the delayed group, 13.8% compared to 6.3% for the early group, but did not reach statistical significance ($p = 0.186$). These findings are in line with the literature, where the conversion rate for a delayed LC is two or three times higher when compared to early procedures, mainly because of obscured anatomy and intraoperative bleeding (Gurusamy et al., 2013; Menahem et al., 2015) [6,7]. Roulin et al. (2016) [8] said that such a strategy, though employed by some clinicians who prefer to wait for the inflammation to subside, may paradoxically increase open conversion rates, reflecting cumulative challenges from chronic inflammatory changes. On the other hand, Janjic et al. (2020) [1] stated that early LC lowered conversion rates to 5%, thus supporting such a concept that timely surgical intervention minimizes intraoperative complications and facilitates a safer laparoscopic approach.

Intraoperative bleeding occurred more frequently in the delayed group than in the early group, with an incidence of 8.8% versus 3.8%, respectively; however, this difference was not significant statistically ($p = 0.328$). This trend was concordant with findings from series by Goh et al. (2017) and Chang et al. (2009) [2,4], showing bleeding complication increase in delayed surgery, which is probably related to neovascularization in the setting of chronic inflammation. Bile duct injuries in our study were infrequent in both groups (1.3% versus 2.5%). This finding agrees with the low incidence found in large meta-analyses comparing early and delayed LC (Wu et al., 2015; Lin et al., 2020) [9,10], suggesting that when performed by experienced surgeons, both approaches have low risks for major biliary complications.

"Postoperative results were strongly on the side of early LC in our study. Mean hospital stay was significantly shorter in the early group, 3.0 ± 1.0 days versus the delayed group, 5.4 ± 1.3 days ($p < 0.001$). Several series confirm these results, including Lyu et al. (2018) [11] and Jeon et al. (2021) [12], who reported that early surgery decreases the duration of hospitalization by avoiding readmissions and

minimizing the need for prolonged antibiotic treatment. Cockcroft et al. in 2019 [13] also mentioned that an early operation not only shortens the stay in the hospital but also optimizes resources, thus minimizing healthcare expenditure. On the other hand, articles reporting on delayed surgery often quote longer hospitalization because of complications from waiting or multiple admissions due to gallbladder-related symptoms (Menahem et al., 2015; Serralta et al., 2003) [7,14].

While overall postoperative complications were higher in the delayed group (20.0% vs 11.3%), this difference did not reach statistical significance ($p = 0.191$). Wound infections and bile leaks were more common in delayed LC (10% vs 5%, 6.3% vs 2.5%, respectively), reflecting trends seen in meta-analyses showing lower complication rates after early LC (Wu et al., 2015; Cockcroft et al., 2019) [9,13]". Our results failed to reach statistical significance; however, the consistent directionality toward fewer complications with early LC supports the safety and efficacy of performing surgery within 72 hours of symptom onset, as recommended by the Tokyo Guidelines 2018 (Isil et al., 2021; Lin et al., 2020) [15,10].

Interestingly, the rate of readmission within 30 days was higher in the delayed group, at 6.3% versus 2.5%, but did not reach statistical significance, at $p = 0.443$. Indeed, similar trends were reported in studies by Roulin et al. (2016) [8] and Chang et al. (2009) [4]: the main causes for readmission in these cases of delayed LC were typically because of recurrent biliary symptoms or complications such as cholecystitis or bile leaks. Early LC seems to avoid these risks by definitely treating the acute episode, thereby reducing the chances of repeated hospital visits.

In all, the findings from our multicenter perspective study add to the accumulating evidence that early laparoscopic cholecystectomy is associated with shorter operative time, reduced hospital stay, and a trend toward fewer postoperative complications. Although certain variables, such as the need for conversion to open surgery and the presence of specific complications, did not reach statistical significance, consistency in results compared to the previous literature underlines clinical advantages from the timeliness of surgical intervention. Results confirm the actual recommendations for performing LC within 72 hours from symptom onset in Grade I and II acute cholecystitis for safety and efficiency. Further studies should be designed focusing on increasing sample sizes, including long-term follow-up, and providing cost-effectiveness data in order to further delineate and optimize guidelines and outcomes.

Conclusion

This study shows that early laparoscopic cholecystectomy for acute cholecystitis has favorable clinical outcomes compared to delayed surgery. The shorter operative time among patients undergoing early intervention reflects easier surgical conditions and, by implication, possibly lower technical difficulty. While the incidence of conversions to open surgery, intraoperative bleeding, and injury to the bile ducts were slightly lower in the early surgery group, these findings did not attain statistical significance and would seem to suggest safety comparable to that of the two approaches. Early postoperative outcomes were significantly associated with shorter hospital stays following early laparoscopic cholecystectomy. This could contribute to quicker recovery, reduced consumption of healthcare resources, and improved patient satisfaction. Additionally, complication rates, such as infection of the wound, bile leakage, and readmission, were lower in the group treated early. This suggests a nonsignificant trend toward improved overall postoperative outcomes. Taken together, the results favor early laparoscopic cholecystectomy as a safe and effective strategy that may enhance recovery, reduce hospital stay, and maintain low rates of perioperative complications; this makes it a preferable option in the management of acute cholecystitis in properly selected patients.

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