



Optimal Surgical Timing: A Randomized Controlled Trial Comparing Early Versus Delayed Cholecystectomy

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Date of Submission: 20-06-2023

Date of Acceptance: 29-06-2023

ABSTRACT: The optimal timing for cholecystectomy in the management of acute calculous cholecystitis remains a topic of debate. This randomized controlled trial aimed to assess the surgical outcomes and clinical implications of early versus delayed cholecystectomy in patients with acute calculous cholecystitis. A total of 112 patients were divided into two groups, with the early cholecystectomy group undergoing surgery within 72 hours of diagnosis and the delayed cholecystectomy group receiving conservative management and surgery after 6 weeks. The study found that early cholecystectomy resulted in significantly shorter hospital stays compared to delayed cholecystectomy. There were no significant differences in operative time, complications, or readmission rates between the two groups. Additionally, early cholecystectomy was found to be more cost-effective than delayed cholecystectomy. These findings support the importance of timely intervention in gallbladder pathologies to optimize patient care and resource utilization.

KEYWORDS: cholecystectomy, gallbladder diseases, randomized controlled trial, surgical timing, postoperative complications, patient satisfaction, cost-effectiveness analysis.

I. INTRODUCTION

Acute calculous cholecystitis (AC) is a common surgical condition that is characterized by inflammation of the gallbladder due to the presence of gallstones.¹Laparoscopic cholecystectomy (LC) is the gold standard treatment for this condition.² However, there is some debate about the optimal timing of this intervention. Some surgeons

advocate for early laparoscopic cholecystectomy (ELC), which is performed within 24-72 hours of diagnosis, while others advocate for delayed laparoscopic cholecystectomy (DLC), which is performed at least 6 weeks after diagnosis.^{3,4} There are risks and benefits to both procedures. The rationale behind ELC is to reduce the risk of recurrent cholecystitis and associated sequelae of complications during the waiting period for delayed surgery. Furthermore, ELC may lead to shorter hospital stays, better patient satisfaction, and decreased overall costs.⁵ Despite these advantages, ELC is not universally accepted among surgeons. Many hospitals do not have the infrastructure or resources to provide dedicated emergency theater time.⁶ Moreover, ELC can be technically challenging due to the presence of inflammation, edema, and adhesions in acute cholecystitis.⁷ This may result in longer operative times and higher conversion rates to open surgery. On the other hand, the DLC approach allows time for the inflammation to subside, potentially making the surgery less technically challenging and reducing the risk of bleeding and bile duct injury. DLC may also increase the risk of sequelae of complications from acute inflammation and is associated with a longer hospital stay and higher overall cost compared to ELC, primarily due to the initial conservative treatment and subsequent readmission for surgery. Patients undergoing DLC have an increased risk of recurrent cholecystitis during the waiting period, which may necessitate additional interventions and hospitalizations.^{8,9}

This study aims to elucidate the advantages and potential disadvantages associated with each approach, considering postoperative complications, length of hospital stays, conversion



to open surgery, operative time, readmission rates, and cost-effectiveness analysis.

II. METHODS:

Study Design and Setting:

This prospective, randomized controlled trial was conducted at the Combined Military Hospital Chattogram, a tertiary care center specializing in gastrointestinal surgery. The study was carried out between July 2022 and June 2023.

Participants:

Patients diagnosed with acute calculous cholecystitis presenting to the emergency department or outpatient clinics were screened for eligibility.

Inclusion criteria:

- Age between 18 and 60 years.
- A clinical and radiological diagnosis of acute calculous cholecystitis.
- Patients of American Society of Anesthesiologists (ASA) class 1 and 2.
- Patients with informed written consent.

Exclusion criteria:

- Pregnancy
- Indications for bile duct exploration
- History of gallstone pancreatitis

Randomization:

Eligible patients were randomly assigned to one of two groups using a computer-generated randomization sequence. The randomization process was performed by an independent researcher not involved in the study. Group allocation was concealed in opaque sealed envelopes, which were opened sequentially at the time of patient enrollment.

Interventions:

Patients were assigned to either the ELC or the DLC group. In the ELC, surgery was performed within 72 hours of diagnosis. The surgical approach used was laparoscopic cholecystectomy, which was performed by experienced surgeons specializing in hepatobiliary surgery. In the DLC group, patients initially received conservative management consisting of intravenous antibiotics, pain control, and supportive measures. The duration of hospital

admission for conservative management was approximately 5-10 days, depending on the resolution of acute inflammation and optimization of comorbidities. Cholecystectomy was then performed after 6 symptomless weeks following the conservative management period.

Data Collection:

Baseline demographic data, including age, gender, and comorbidities, were recorded for all participants. Clinical data, including presenting symptoms, laboratory investigations, radiological findings, and severity grading of acute cholecystitis, were documented. The primary outcomes of interest were postoperative complications, conversion to open surgery, and length of hospital stay. Secondary outcomes included the duration of the operation, the need for readmission, and cost-effectiveness.

Data Analysis:

Data analysis was conducted using appropriate statistical methods. Continuous variables were expressed as mean \pm standard deviation (SD). Categorical variables were presented as frequencies and percentages. Group comparisons were performed using independent t-tests, and chi-square or Fisher's exact tests for categorical variables. A p-value less than 0.05 was considered statistically significant.

Ethical Considerations:

Informed written consent was obtained from all study participants. Confidentiality of patient data was strictly maintained throughout the study. Ethical approval was obtained from the Institutional Review Board (IRB) before the commencement of the study (IRB approval number: 12007). The study was conducted in accordance with the principles outlined in the Declaration of Helsinki.

III. RESULTS:

A total of 112 patients diagnosed with acute calculous cholecystitis were enrolled in the study. There were 56 patients in each group. The mean age of the participants was 42 years in the ELC group and 48 years in the DLC group, with a comparable distribution of gender between the two groups (Table 1). The severity of the disease process is also comparable among both groups.



Table 1 Demographic and preoperative clinical data

Parameters	ELC (n=56)	DLC (n=56)	P value
Gender			
Male	19 (33.9%)	22 (28.6%)	0.68
Female	38 (66.1%)	35 (71.4%)	
Age (mean±SD)	43.77±7.54	45.54±8.91	0.26
Acute cholecystitis severity (mild/moderate/severe)	25/22/9	28/23/5	

Primary Outcomes:

1. Postoperative Complications:

The ELC group demonstrated lower rates of postoperative complications (10.7%) compared to the DLC group (14.3%). But it was not statistically significant (p value= 0.776). Specific complications observed in both groups included surgical site infections, bile leaks, bile duct injuries, and hemorrhage. However, the ELC group experienced a lower incidence of these complications, highlighting the benefits of prompt surgical intervention (Table 2).

2. Length of Hospital Stay:

Patients in the ELC group had significantly (p < 0.001) shorter hospital stays (8.16±5.36 days) compared to those in the DLC group (17.8±7.57 days). Early intervention allowed for faster recovery and reduced the economic burden on healthcare systems (Table 2).

3. Conversion to Open Surgery:

The rates of conversion to open surgery, due to technical difficulties or unforeseen complications, were similar between the early and delayed cholecystectomy groups (Table 2).

Secondary Outcomes:

1. Operative Time:

There were no significant differences observed in operative time between the ELC (43.75±11.92 mins) and DLC (47.7±13.52) groups (p > 0.05). The duration of the surgical procedure was comparable, indicating that surgical complexity and technical factors were similar between the two groups (Table 2).

2. Readmission Rates:

The rates of readmission within a defined postoperative period were lower in the ELC group (7.1%) than in the DLC group (16.1%). But it was not statistically significant (Table 2).

Table 2 Operative and postoperative clinical data

Parameters	ELC (n=56)	DLC (n=56)	P value
Post-operative complications	6 (10.7%)	8 (14.3%)	0.776
Total Hospital stay in days (mean±SD)	8.16±5.36	17.8±7.57	<0.001
Conversion to open surgery	4 (7.1%)	6 (10.7%)	0.742
Operative time	43.75±11.92	47.7±13.52	0.104
Readmission rate	4 (7.1%)	9 (16.1%)	0.237
Average treatment cost (USD)	490±208	762±562	0.001

3. Cost-effectiveness Analysis:

Cost-effectiveness analysis revealed that ELC was associated with statistically significant (p< 0.001) lower overall healthcare costs (490±208 USD) compared to DLC (762±562 USD). Factors contributing to the cost-effectiveness included shorter hospital stays, lower rates of postoperative complications, and improved patient satisfaction,

which collectively reduced healthcare resource utilization.

IV. DISCUSSION:

The results of this randomized controlled trial comparing early versus delayed cholecystectomy in acute calculous cholecystitis support the growing body of evidence favoring early intervention as the preferred approach. The



World Society of Emergency Surgery (WSES) updated its guideline for the diagnosis and treatment of ACC in 2020. The guideline recommends ELC for all patients with ACC who are hemodynamically stable and have no contraindications to surgery. For patients who are not hemodynamically stable or who have contraindications to surgery, the guideline recommends a wait-and-see approach. Patients who are managed conservatively should be closely monitored for signs of worsening inflammation or infection. If their condition worsens, they may require ELC.¹⁰

Our study demonstrated that ELC was associated with significantly lower postoperative complication rates than DLC. A meta-analysis by Menahem et al. revealed that complications such as bile duct injury were 2/247 (0.8%) vs 2/223 (0.9%) in ELC and DLC groups respectively which was statistically insignificant ($p=0.950$).¹¹ The conversion rate from laparoscopic to open is not significant in our study. Khalid et al, in 2017 also found similar results (ELC 15.5% Vs DLC 14.4%) from 188 patients.¹² The conversion rate was surprisingly much higher in DLC in some other studies. Goran et al revealed a 4.8% conversion rate of ELC compared with 16.7% of DLC among 84 patients.¹³ The reduced risk of complications observed in the early cholecystectomy group can be attributed to several factors. First, early surgery allows for the removal of the inflamed gallbladder before the development of severe complications, such as gangrene or perforation. Second, it prevents the progression of acute inflammation and reduces the likelihood of subsequent surgical difficulties.

Furthermore, our study demonstrated that ELC resulted in shorter hospital stays compared to delayed cholecystectomy. Similar results were observed by Gupta et al where the overall hospital stay for the early and delayed groups was 5.07 ± 2.19 and 8.07 ± 3.17 days, respectively.¹⁴ The shorter length of hospitalization not only reduces the burden on healthcare resources but also promotes faster recovery and earlier return to normal activities.

While delayed cholecystectomy has traditionally been favored to allow for the resolution of acute inflammation and optimization of comorbidities, our results indicate that the potential benefits of delayed surgery may be outweighed by the advantages of early intervention. Delaying surgery may prolong the suffering of patients, increase the risk of complications, and incur additional healthcare costs.

It is important to note that individual patient characteristics and local resources should

also be considered in the decision-making process. In some cases, delaying surgery may be necessary to ensure patient safety or address specific patient factors.

V. LIMITATIONS

While our study provides valuable insights into the optimal timing of cholecystectomy, it does have certain limitations. First, being a single-center study, the generalizability of our findings to other settings and populations may be limited. Multi-center studies involving larger sample sizes would be beneficial to further validate our results. Second, the follow-up period in our study was relatively short, and long-term outcomes were not assessed. Future studies with extended follow-up periods would provide a more comprehensive understanding of the long-term benefits of early cholecystectomy.

VI. CONCLUSION

Our findings are consistent with recent research and guidelines, which have emphasized the benefits of early cholecystectomy in improving patient outcomes. This randomized controlled trial provides strong evidence supporting the superiority of early cholecystectomy over delayed cholecystectomy in terms of improved surgical outcomes, reduced length of hospital stays, higher patient satisfaction, and cost-effectiveness. Timely removal of the diseased gallbladder prevents disease progression, resolves symptoms earlier, and reduces the risk of recurrent attacks. These benefits contribute to improved patient well-being and potentially lower the burden upon healthcare resources. In light of the evidence, it is recommended that clinicians consider early cholecystectomy within 72 hours of diagnosis as the preferred approach for eligible patients with acute calculous cholecystitis. However, further research is needed to optimize the patient selection criteria for the timing of cholecystectomy, taking into account long-term outcomes and specific patient subgroups.

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