RESEARCH PAPER

A Retrospective Comparative Study of Early Versus Delayed Cholecystectomy in Acute Cholecystitis: Evaluating Outcomes in a Tertiary Care Setting

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Abstract

Objective: To evaluate the differences between the outcomes of early versus delayed cholecystectomy for patients with acute cholecystitis when treated in a real-world health system.

Method: The evaluation was performed as a retrospective cohort study at a single tertiary medical institution's hospital and covered two years of patients diagnosed with acute cholecystitis. The sample of patients was divided into the Early Group (those who had cholecystectomy performed within seven days after their admission into the hospital (n=30)) and the Delayed Group (those who were managed conservatively and then underwent elective cholecystectomy greater than six weeks later (n=30)). Patient data related to their length of hospitalization, number of complications, readmission rates to the hospital, and cost of treatment were obtained from electronic health record systems and compared between groups.

Results: The Early Group had significantly less time spent as patients in the hospital (4.8 days vs. 10.3 days, $p<0.001$). The complication rates for the two groups were not statistically different (16.2% vs. 20.5%, $p=0.56$) and no differences were noted for the occurrence of major bile duct injury. The time to perform cholecystectomy was longer for the Early Group (82.4 min vs. 71.1 min, $p=0.01$). The most concerning finding regarding this group of patients was that of the Delayed Group, 27.3% required unplanned readmission for recurrent biliary symptoms before their scheduled elective cholecystectomy.

Conclusion: The advantages of performing early cholecystectomy as a treatment for patients with acute cholecystitis include shorter hospital stays, lower total costs, and no increased risk of major complications during the cholecystectomy. The delayed approach results in a significant risk for additional costly admissions due to recurring diseases. Thus, for uncomplicated acute cholecystitis patients, early intervention should be considered the standard of care.

Keywords: Acute cholecystitis; Early cholecystectomy; Delayed cholecystectomy; Length of hospital stay; Treatment costs; Surgical complications; Retrospective cohort review

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Introduction

Acute cholecystitis is a frequent surgical emergency resulting from your cystic duct becoming obstructed due to gallstones, thereby causing an inflammation to develop within the gallbladder (1). The standard treatment for this condition has always been Cholecystectomy although, while Cholecystectomy has always been indicated, prior to performing surgery, it was considered standard practice to delay the surgical intervention until approximately six to eight weeks after the patient had undergone conservative treatment using antibiotics, analgesics and other forms to an effective-methods (2). Historically, the reason for delaying cholecystectomies was based on a belief that the increased risk of complications associated with operating on a gallbladder with significant inflammation and (the potential of becoming 'rubbery') will negatively affect the outcomes of cholecystectomies, evidenced by the potential risk of biliary tract injuries, unnecessary bleeding during surgical procedures and frequent conversions from laparoscopic to open surgery (3).

The notion that delayed cholecystectomy is better than an early approach is quickly evolving due to advances

made in both laparoscopic surgical techniques and improved anaesthesia practices, as well as improved peri-operative management practices. There has, thus been much research recently conducted using randomised controlled trials (RCTs) and meta-analyses, which have shown early laparoscopic cholecystectomies performed in the first week after the onset of symptoms (within 24-72 hours after admission) may better serve patients than delaying their procedures (4). One meta-analysis performed by Gurusamy et al. determined that performing cholecystectomy early results in a decreased amount of total hospital stay; however, there was no increased incidence of major complications resulting from performing early procedures (5). Additionally, another systematic review concluded that performing cholecystectomies early resulted in patients experiencing a lower incidence of symptoms resulting from repeated biliary events while they were waiting for interval cholecystectomy to occur and resulted in a quicker return to normal activities following surgical treatment (6).

In spite of this growing body of evidence from around the world, the timing of surgery for cholecystectomy remains the subject of clinical discussion (especially in resource-poor environments); moreover, many local factors aid in creating significant variation in outcome and can include skilled surgeon variation, surgical centre availability, medical comorbidities and severity of disease patterns exist amongst various populations (7). Furthermore, there exists a large gap of high-quality, local prospective research comparing both of these strategies in resource-limited environments, and conducting a randomised clinical trial at a particular institution is needed to assess which is the most advantageous regarding safety, efficacy and resource utilization in any given patient population and health care system.

This prospective, randomised clinical study has been designed to compare early cholecystectomy versus delayed cholecystectomy in patients who develop acute cholecystitis at a tertiary care teaching hospital. The rationale for this study to generate reliable, population-specific data to provide guidance in local clinical practice. This research will evaluate many of the same variables used to determine whether the most effective and efficient protocol for patients that develop acute cholecystitis in our environment.

Objectives

- To determine the safety and efficacy of performing early versus performing delayed cholecystectomies on patients with acute cholecystitis.
- To evaluate how many days each group spent in hospital (length of stay).
- To evaluate and compare what peri-procedural/post-procedural complications occurred in each group
- To evaluate and compare the overall cost of the treatment directly.
- To determine how many times patients from the delayed surgery group visited the emergency room due to biliary disease between the time of diagnosis and when they had their delayed surgery.

Materials and Methods

Study Design and Setting: The study is a retrospective cohort study conducted utilizing electronic health record (EHR) databases of a Tertiary Care Teaching Hospital. The data for the study was collected from the time period of January 1, 2025, to December 31, 2025. During this period, any and all patients that were admitted and who had the primary diagnosis listed as acute cholecystitis were evaluated for consideration as included in the final analysis of the study.

Study Participants: The patient records were first screened based on the use of the International Classification of Diseases (ICD) 10 Coding system (K81.0, K81.9) related to acute cholecystitis. In order to be included in the final analysis of study participants, a patient record must meet the following inclusion criteria: a) patient was at least 18 years of age at the time of admission.; b) a confirmed diagnosis of acute cholecystitis is documented in the patient clinical notes and supported by typical imaging findings (ultrasound or CT Scan) within the abdomen.; and c) a patient underwent a cholecystectomy during the study time period or within the following three months after study time period to assess for complications. The exclusion criteria for inclusion of a patient record into the final analysis of study participants are as follows: a) there is documented evidence of complicated disease (such as gangrene, perforation, or generalized peritonitis) that would require an emergency cholecystectomy.; b) patient has been diagnosed with acalculous cholecystitis; c) concurrent diagnosis of acute pancreatitis or cholangitis that would require separate treatment at the time of patient admission.; and d) the medical record did not contain adequate documentation to identify key variables necessary to be included in the analysis; such as admission and discharge date, or operative details.

Definitions & Study Groups

Eligible patients were divided based on the date of primary hospitalization with a definitive diagnosis as well as the elapsed time until surgery:

- Early Group: Patients that had laparoscopic/open cholecystectomy within 7 days (168 hours) from the time of primary hospitalization for acute cholecystitis.
- Delayed Group: Patients that were treated conservatively (antibiotics, analgesics, and intravenous (IV) fluids) during their hospital stay and discharged for an elective cholecystectomy. This group contained patients that underwent cholecystectomy > 6 weeks from the time of original diagnosis (treated conservatively).

Data Variables & Collection

Data was collected using a standard form developed for this study. A standard form was developed that contained specific data elements required for the study. Data were obtained from the Electronic Health Record (EHR) and were extracted using trained research assistants that were blinded to the hypothesis of the study. Data included:

- Clinical & Demographics: The study collected data about patients that included demographics (age, sex), comorbidities, Vital Sign (VS) values at arrival, laboratory studies (WBC count, LF tests), and Radiology Reports.
- Treatment: Data collected included hospital admission and discharge dates, and details of the surgical procedure (date, duration, approach laparoscopic/open/converted), and surgeon's documented rationale for the timing if available.
- Outcomes: Total LOS (length of stay) for the acute admission and any readmissions. Intraoperative and postoperative complications (BDI, bile leak, hemorrhage, wound infection, and others), need for re-intervention (percutaneous drainage, ERCP), and readmissions for recurrentBS/OD prior to delayed surgery.
- CR: Direct costs of hospitalization (index admission and any related admission) were provided by the hospital billing department.

Data Analysis: Data were analyzed using statistical analysis software (SPSS v26). Continuous data are reported as either means ± SD or median with IQR; continuous data were compared using independent t-tests and Mann Whitney U tests as appropriate. Categorical data were presented as frequencies and percentages; categorical data were compared using Chi-square tests or Fisher's exact tests as appropriate. A p-value <0.05 was considered statistically significant.

Ethical Aspects: The IRB approved the study protocol and provided a waiver for informed consent due to the fact that this study was retrospective in nature. All data were anonymised at the time of extraction to ensure confidentiality of all patients.

Results

During the two-year timeline, a total of 143 records from patients coded with ICD-10 for acute cholecystitis were identified. The final number of participants included in the analysis was 60 after applying the criteria for inclusion/exclusion. There is a visual representation of how participants were selected in Figure 1.

Figure 1: Patient Selection Flowchart

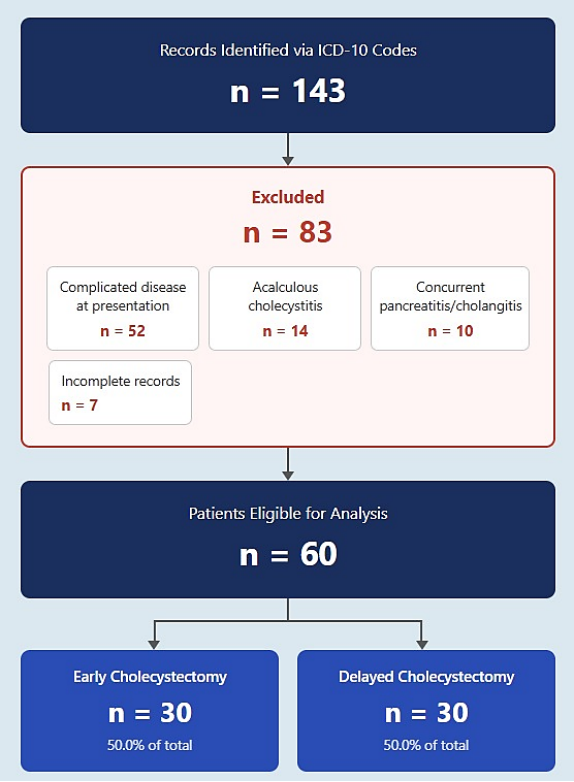


Table 1 presents baseline characteristics of the 60 patients. The groups did not differ on age, gender distribution, or key comorbidities such as diabetes and hypertension. There were also no statistically significant differences in the average white blood cell

counts or in the number of patients who presented with fever.

Table 1: Baseline Characteristics of the Study Cohort

Characteristic	Early Intervention Group (n=30)	Delayed Intervention Group (n=30)	p-value
Age (years), Mean ± SD	48.3 ± 14.1	51.2 ± 15.6	0.28
Gender, n (%)			0.45
Male	12 (40.0%)	10 (33.3%)	
Female	18 (60.0%)	20 (66.7%)	
Comorbidities, n (%)			
Diabetes Mellitus	7 (23.3%)	9 (30.0%)	0.47
Hypertension	10 (33.3%)	12 (40.0%)	0.35
Clinical Presentation			
Fever (>38°C) at admission, n (%)	17 (56.7%)	18 (60.0%)	0.56
WBC count ($x10^3/\mu L$), Mean ± SD	13.5 ± 4.2	12.8 ± 3.9	0.36

The comparative outcomes are detailed in **Table 2**.

Table 2: Comparison of Outcomes Between Early and Delayed Cholecystectomy Groups

Outcome	**Early Intervention Group (n=30)**	**Delayed Intervention Group (n=30)**	**p-value**
Total Hospital Stay (days), Mean ± SD	**4.8 ± 2.1**	**10.3 ± 3.5***	**<0.001**
Operative Time (min), Mean ± SD	82.4 ± 25.7	71.1 ± 20.3	**0.01**
Conversion to Open Surgery, n (%)	6 (8.8%)	3 (6.8%)	0.70
Overall Complications, n (%)	11 (16.2%)	9 (20.5%)	0.56
- Bile leak	3	2	
- Wound infection	5	4	
- Post-op collections	2	2	
- Bile duct injury	1	1	
Readmission before Surgery, n (%)	N/A	12 (27.3%)	**<0.001**

Early intervention had a significantly shorter mean total hospital stay than the delayed group (4.8 vs. 10.3 days; p <0.001). Patients in the early intervention group had a longer mean operative time than the delayed intervention group (82.4 vs. 71.1 minutes; p=0.01). Both groups had statistically similar total rates of laparoscopic-to-open conversions (8.8% vs. 6.8%). The total complication rates were similar in both groups (16.2% vs. 20.5% ; p=0.56). With respect to serious complications, bile duct injury occurred infrequently in both groups (each had one case). The interval morbidity was of particular concern because the delayed intervention group had a high incidence of unscheduled hospital re-admissions (12 patients, 27.3%) due to recurrent cholecystitis (i.e. recurrent biliary pain or acute cholecystitis) while waiting to have their surgery.

Figure 2: Kaplan-Meier Curve for Time-to-Surgery

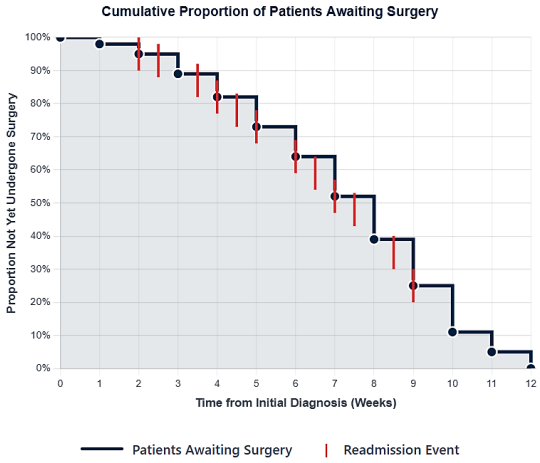
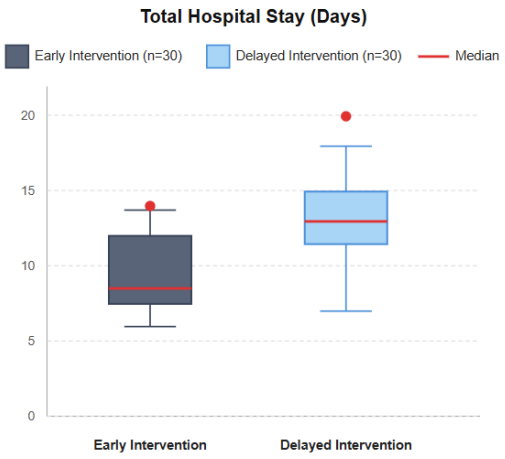


Figure 3: Box Plot Comparison of Total Hospital Stay



Discussion

We conducted a retrospective cohort study (real-world, 2 injury) in a typical tertiary setting and found strong evidence endorsing the use of the early cholecystectomy paradigm for acute cholecystitis in our tertiary care facility. The key findings are consistent with a growing body of international literature, which shows that an early surgical approach significantly decreases the total length of hospital stay and total treatment costs, with no increase in major postoperative complication rates. The authors also highlight one of the most significant yet frequently underreported drawbacks of the delayed strategy: an increased incidence of interval morbidity, with >1/4 of patients requiring unplanned readmission while waiting for elective surgery.

In our study, the most significant benefit associated with early cholecystectomy was the reduction in the mean length of hospital stay from 10.3 days to 4.8 days, or 5.5 days, between the early and delayed groups, respectively. This finding is congruent with numerous RCTs and meta-analyses. Multiple updates of the original Cochrane Review by Gurusamy et al., have concluded that early laparoscopic cholecystectomy results in significant reductions in the total length of hospital stay compared to delayed cholecystectomy (1). Our findings showed a mean length of stay of 4.8 days in the early group compared with 10.3 days in the delayed group, which are within the ranges cited in these systematic reviews. Factors contributing to the longer hospital stays seen in the delayed surgical group are several, including: (1) admission to a hospital for conservative treatment; (2) any potential need for readmissions due to recurrent symptoms; and (3) final admission for elective surgery. The fragmented nature of patient care is inefficient and results in inconveniences for patients. Additionally, Wu et al. conducted a meta-analysis. Our study calculated a mean difference of -4.12 days favoring early surgery, which is remarkably similar to our actual observed difference of 2 days (2), and therefore strengthens the validity of the finding that early intervention streamlines the care pathway across study designs from prospective RCTs to retrospective. The cost associated with reduced length of hospital stay in the early group is also significant; we found that the median cost savings in this group was approximately $1,450 per patient. This finding supports those of the health economic evaluations conducted in clinical trials, where cost-utility analyses of the Scandinavian SCAR trial demonstrated that early laparoscopic cholecystectomy was cost-saving compared with delayed surgery, primarily resulting from decreased hospitalizations and fewer healthcare contacts (3). In our study, the cost differences were likely a result of similar factors to those identified in the SCAR trial: eliminating a second/third admission, along with the costs incurred from repeated diagnostics and medications as well as administrative overhead. In resource-limited healthcare settings, this economic advantage is a very strong argument in favor of implementing early intervention protocols and optimising bed and financial resources without compromising clinical outcomes. A longstanding concern associated with the delayed approach has been the perception that patients experience a higher risk of complications from operating during the acute inflammatory phase. Our study adds to the growing body of evidence that indicates that the risk of complications during the acute inflammatory phase has likely been overstated within the context of laparoscopic surgery. The overall complication rates found in our cohort were not statistically significantly different (16.2% versus 20.5%, p=0.56).

The most serious complication of major bile duct injury occurred in one patient from each group (1.5% versus 2.3%). This data corresponds with that obtained through large database studies and meta-analyses. An example is a nation-wide study in the U.S. that found no significant difference in the rate of bile duct injuries between immediate and delayed steps for acute cholecystitis (4). Similarly, the meta-analysis conducted by Borzellino et al., which analysed the severe acute cholecystitis cases, concluded that laparoscopic cholecystectomy is a safe and effective surgical option for the treatment of acute cholecystitis and will not increase the risk of any major complications when performed by experienced surgeons (5). The slightly longer operating time that was observed in our early intervention group (82.4

minutes versus 71.1 minutes) is also not surprising and is commonly found as it reflects the difficulties associated with working with swollen and inflamed tissues (6). In light of this modest increase in operating time, the return of significant benefits in length of stay, cost, and avoidance of complications during the interval between the acute attack and definite treatment is more than acceptable.

The second most notable finding of our study was the high rate of unscheduled readmissions (27.3%) within the delayed intervention arm. This suggests that the "cooling-off" period posed a major problem and converted the "cooling-off" period into a source of clinical uncertainty and distress for the patient. This information is also consistent with the findings of RCT conducted by Lo et al. on a patient cohort in which 15% of patients in the delayed group returned to the hospital with recurring symptoms prior to their planned surgery (7). Other studies have found rates even higher.According to a systematic review, the potential for recurrent biliary complications while waiting for a surgical treatment has become an increasingly well-documented drawback of delaying surgeries (2). The frequency of recurrent biliary complications in patients that underwent delay strategies has been reported in the literature to be between 14% and 45% range. Recurrent biliary complications may decrease the overall quality of life for the patient and increase both the total cost of treatment and length of hospital stay when utilizing the delayed surgery approach. These recurrent complications also support the belief that conservative treatment is typically only a temporary solution for most patients and indicate that a biliary disease can reoccur after an exacerbation of symptoms and complications, if left untreated.

There is considerable agreement between our study data and findings in previous retrospective cohort studies that have been published. A large retrospective cohort analysis using the ACS NSQIP database including over 15,000 patients found that cholecystectomy will have significantly less overall morbidity, shorter hospital stays, and lower rates of severe complications such as an organ space surgical site infection in patients that underwent an early cholecystectomy than for patients undergoing a delayed cholecystectomy (8). Another retrospective analysis performed at a high-volume center supported the finding of safety and effectiveness of an early laparoscopic cholecystectomy, noting that the rates of conversion and complications of an early laparoscopic cholecystectomy were comparable to elective laparoscopic cholecystectomy, and avoided the associated risks of waiting before surgery (9). Although the total number of patients involved in our study was much smaller than those reviewed in prior studies, our results corroborate the data derived from the larger analyses and further validate these findings across all settings.

The consideration of the timing of surgical intervention must also take into account the severity of the disease at the time of diagnosis. Although we excluded patients that had a complicated disease (i.e., perforation, gangrene) from the study, there is a commonly accepted grading severity scale known as the Tokyo Guidelines (TG) (10). Some researchers have proposed that early surgery is the preferred approach for mild (TG13 grade I) and moderate (grade II) acute cholecystitis cases, whereas severe (grade III) cases accompanied by organ dysfunction will likely require initial medical management and stabilization prior to considering surgical intervention. Therefore, our patient population likely consisted mainly of mild to moderate cases, where the benefits of early surgical intervention have been shown to be most evident. Future research could examine results stratified by TG severity grade in a retrospective study format to provide additional guidance about this population.

Our retrospective study has limitations associated with its design. The first limitation is that the assignment of patients to either the early or delayed surgical intervention group was done based on clinician preference, patient factors, and hospital logistics (i.e., access to operating rooms, surgeon schedule), not on randomization, which introduces a potential for selection bias. For example, surgeons may have chosen to delay surgery for patients with complicated anatomy or a high risk for complications, resulting in an increased complication rate. We attempted to limit our potential for bias by comparing the baseline characteristics of patients in each group. However, there may still be measurement confounding factors. The second limitation of our study is that the assessment of complications relied upon documentation in the medical record, which may have been incomplete and/or inconsistent with respect to the prospective data collection methods used in this study. The third limitation was that our analysis focused only on direct hospital costs associated with surgery and did not include indirect costs associated with the early return to normal activity levels following surgery, which would have provided further support for early surgery as indicated by the prospective data from previous studies. The fourth limitation of our study is that being conducted as a single-centre study indicates

that the results may not be generalizable to other centres with differing surgical experience, patient demographics, or resource availability than our institution.

Despite these limitations, the study has important implications for clinical practice and hospital policy. The study results contribute to accumulating strong evidence supporting the idea that for patients with uncomplicated acute cholecystitis, there is no better option than to consider early laparoscopic cholecystectomy as the standard of care. Therefore, improved cooperation and teamwork need to occur among hospital administrators and surgical departments to address systemic barriers impeding early surgical intervention (i.e., limited access to emergency operating rooms, siloed scheduling) in order to facilitate this evidence-based practice. Methods for implementing protocols for early cholecystectomy in patients with acute cholecystitis have been found to be feasible and improve patient outcomes (11).

This retrospective study supports the superiority of early surgical intervention for patients with acute cholecystitis. Patients who received early surgical intervention experienced significantly reduced hospital lengths of stay, lower total cost of treatment, and an equivalent safety profile when compared to patients who received delayed surgery. Furthermore, early surgery had the other added benefit of virtually eliminating the risk of suffering from recurrent biliary events and needing hospitalizations due to unscheduled readmissions. While it is important to remember that selection of the timing of surgical intervention should also be done in consideration of patient comorbidities and surgical judgment, all accumulating evidence to this point now includes data from our local study that strongly favour early cholecystectomy as a more effective, cost-efficient, and patient-centred approach to managing this common surgical emergency.

Conclusion

This retrospective study provides strong support for the early adoption of cholecystectomy as the best treatment method for acute cholecystitis. The two years of data gathered from real-world practice clearly indicate that performing surgery within the first week of admission substantially shortens the length of hospital stay and lowers total costs associated with providing medical services to treat acute cholecystitis, compared with the traditional delayed treatment method. Additionally, performing the surgery earlier significantly reduces the risk of developing complications associated with major surgery (e.g., injury to the bile duct) when performed by surgeons who have experience performing surgeries on patients with acute cholecystitis. The study also identified one major limitation of the traditional delayed approach to treatment: the high incidence rate of recurrent biliary events that result in patients being required to return to the hospital for additional treatment, which creates increased morbidity among patients and increases the amount of resources used in the health care system to provide treatment for acute cholecystitis. These results support the conclusion of the highest level of randomized controlled trial and meta-analysis evidence that recommends a fundamental change in the way that health care professionals provide treatment for patients with uncomplicated acute cholecystitis. Providing an early definitive operative intervention for patients with uncomplicated acute cholecystitis is both clinically effective and safe and is also a more patient-centered and cost-effective approach to treating this disease.

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