

Comparison of Operative Time and Outcomes Between Early and Delayed Laparoscopic Cholecystectomy in Patients with Acute Cholecystitis

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Received: 25th Aug, 2026 | Revised: 1st Sep, 2026 | Accepted: 5th Sep, 2026 | Available Online: 12th Sep, 2026

Abstract

Background: Acute cholecystitis is one of the commonest surgical emergencies of the upper abdomen, and laparoscopic cholecystectomy is its definitive treatment. The timing of surgery, however, remains contested. Operating early, while the tissues are freshly inflamed, is thought to be technically cleaner than waiting for the acute episode to settle, but the evidence from different settings has not been consistent.

Objective: Comparing the mean operative time between early laparoscopic cholecystectomy and delayed laparoscopic cholecystectomy in patients suffering from acute cholecystitis, and comparing the duration of hospitalization, conversion rate to open surgery and difficulty during surgery in both types of surgery.

Methods: Non-randomized control study was carried out in the Department of Surgery, Capital Development Authority Hospital, Islamabad for three months subsequent to synopsis acceptance. (June 11, 2026 to August 11, 2026) Sixty patients from 18 to 70 years with acute cholecystitis were included by consecutive sampling and divided into group of early laparoscopic cholecystectomy within 72 hours of presentation (n=30) and delayed cholecystectomy 7 to 14 days post presentation following conservative treatment (n=30). All operations used a standard four-port technique performed by a consultant surgeon. Operative time from induction of anaesthesia to shifting to the postoperative ward was the primary outcome. Data were analysed in SPSS v25 using the independent-samples t-test and the chi-square test, with p<0.05 taken as significant.

Results: The two groups were well matched for age, body mass index, symptom duration, gender and ASA grade. Mean operative time was significantly shorter in the early group than the delayed group (62.2 ± 10.9 versus 71.9 ± 9.1 minutes; $t=-3.73$, $p<0.001$). Post-operative hospital stay was also shorter after early surgery (2.9 ± 1.1 versus 5.3 ± 0.8 days; $t=-9.89$, $p<0.001$). Conversion to open surgery (1/30 versus 3/30, $p=0.605$) and difficult dissection at Calot's triangle (7/30 versus 3/30, $p=0.299$) did not differ significantly between the groups.

Conclusion: Early laparoscopic cholecystectomy for acute cholecystitis was faster on the table and sent patients home sooner than delayed surgery, with no increase in conversion or dissection difficulty. Where the patient is fit and the presentation is early, there is little reason to wait.

Keywords: Cholecystitis, Acute; Cholecystectomy, Laparoscopic; Operative Time; Length of Stay; Gallstones; Conversion to Open Surgery; Treatment Outcome; Pakistan

How to cite this article: Aleena Shahid¹ Dr. Syed Shams Ud Din² Dr. Danish Ali Haider³ Dr. Syed Danyal Ali Shah Jillani⁴ Dr. Afifa Mehmood⁵ Dr. Eimaan Shahid⁶. Comparison of Operative Time and Outcomes Between Early and Delayed Laparoscopic Cholecystectomy in Patients with Acute Cholecystitis. Int J Drug Deliv Technol. 2026;16(82s):1471-1478. DOI: 10.25258/ijddt.16.82s.166.

Introduction

Acute cholecystitis is an inflammatory condition of the gallbladder that most commonly follows obstruction of the cystic duct by a gallstone.

Once the duct is blocked, the gallbladder becomes distended, pressure inside it rises, and an acute inflammatory response is set in motion

(Gallaher and Charles, 2022). The disease is common and appears to be becoming more so in many countries, including Pakistan, largely on the back of a rising burden of gallstone disease (Li et al., 2023; Wang et al., 2024). Gallstones are the dominant risk factor and are present in more than nine out of ten cases; obesity, older age, female sex and a diet heavy in fat and cholesterol all add to the risk, as do diabetes, cirrhosis and a family history of stones (Ali et al., 2024). Within our population, there is an increase in gallstones, and consequently, acute cholecystitis, which occurs due to dietary habits revolving around foods that are fried and fatty.

Management of acute cholecystitis can be done through either a medical or surgical management approach. Within the initial stages, there is the use of antibiotic therapy to resolve the episode of acute cholecystitis; however, it is non-curative. The curative measure involves removal of the gallbladder, and currently, laparoscopic cholecystectomy has been adopted widely as the procedure of choice in order to decrease pain, decrease length of stay in hospitals and get back to one's daily activities faster compared to the traditional surgical method (Mannam et al., 2023). The uncertainty lies in the timing of the procedure. An early cholecystectomy done after about 72 hours from the time the patient had symptoms involves the removal of the gallbladder before inflammation occurs. It may shorten the hospitalization period, reduce the complications involved and lower cost; however, when there is a severe inflammation of the gallbladder, the procedure may become difficult, with increased risk of bile duct injury or even need for open cholecystectomy (Borzellino et al., 2021). Delaying the cholecystectomy takes the other route, where the process begins by reducing the inflammation and proceeding after a few weeks to perform the operation. The latter option could be easier technically, yet it comes with a price too because it may involve repeated hospitalization due to recurring symptoms and an increased chance of developing recurrent inflammation, gangrene, or infection during the waiting period (Güneş et al., 2023a).

The debate continues in the literature without any conclusion. While some studies show a significant difference between the two options favoring early surgery in terms of operation duration and hospitalization period, others indicate no significant difference between them and sometimes a difference moving in the other direction (Vidyadharan et al., 2023; Ismail et al., 2021). The local conditions create another challenge for comparison as patients tend to

delay their visit to the hospital, the condition could vary in severity, and the surgical resources may not be available uniformly making results from elsewhere not applicable to hospitals in Islamabad. Evidence drawn from our own patients is therefore useful in its own right, both for guiding day-to-day decisions and for shaping local protocols (Wani et al., 2023). This study was conducted to compare the mean operative time between early and delayed laparoscopic cholecystectomy in patients with acute cholecystitis at a tertiary care hospital, and to compare hospital stay, conversion to open surgery and intraoperative difficulty between the two approaches.

Materials and Methods

This non-randomised controlled trial was conducted in the Department of Surgery, Unit II, Capital Development Authority Hospital, Islamabad, a tertiary care teaching hospital, (June 11, 2026 to August 11, 2026), over three months following approval of the research synopsis. The study was approved by the hospital's ethics committee before recruitment began, and written informed consent was obtained from every participant. The sample size of 60, thirty patients per group, was calculated using the WHO sample size calculator with a 95% confidence level, 90% power, a population standard deviation of 9.915, a test value of the population mean for early cholecystectomy of 61.63 minutes and an anticipated mean for delayed cholecystectomy of 71.13 minutes, drawn from previously published data (Vidyadharan et al., 2023). Non-probability consecutive sampling was used, and eligible patients presenting during the study period were enrolled sequentially until the target was reached.

Patients of either sex, aged 18 to 70 years, who presented with acute cholecystitis and were planned for laparoscopic cholecystectomy were eligible. Acute cholecystitis was diagnosed clinically in patients with sudden, severe right upper quadrant or epigastric pain lasting more than six hours, often radiating to the right shoulder or back and commonly accompanied by nausea, vomiting and fever, with a positive Murphy's sign supporting the diagnosis. A raised C-reactive protein more than 1.0 mg/dL and ultrasound evidence of a thickened gallbladder wall of more than 4 mm, peri-cholecystic fluid, sonographic Murphy's sign, and the presence of gallstones or gallbladder sludge confirmed the diagnosis. Subjects having American Society of Anesthesiologists grade of four or more, hyperbilirubinemia or severe liver dysfunction, presence of malignancy, and prior upper

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abdominal surgery were excluded because such cases would make it difficult to compare the two groups due to altered surgical environment.

Demographic and clinical data were collected from all patients included in the study using a pre-designed proforma. In addition, history and physical examination was done in all patients. The allocation of patients to one of the two groups was done using lottery technique; each patient had to draw his paper himself. Group A patients had to undergo cholecystectomy surgery within 72 hours of admission. Patients in Group B were managed conservatively during their acute attack. Both groups received the same initial supportive care with intravenous antibiotics and fluids. Every operation used the same four-port technique and was performed by a consultant general surgeon with at least three years of laparoscopic teaching experience. The abdomen was insufflated with carbon dioxide at a constant pressure, a Hasson trocar was placed at the sub-umbilical position for the laparoscope, and operating ports of 10 mm and 5 mm were placed in the epigastrium and right hypochondrium. The gallbladder fundus was grasped through a 5-mm right iliac fossa port; where a tense, thick-walled gallbladder was difficult to hold, it was decompressed with an aspiration needle. Where adhesions and inflammation were dense, suction dissection was used to keep the field clean. The cystic artery and cystic duct were dissected at Calot's triangle, and intraoperative cholangiography was performed where a critical view of safety could not be established. A drain was routinely placed in the foramen of Winslow and removed on the first postoperative day. Operative time, defined as the interval from induction of anaesthesia to shifting the patient to the postoperative ward, was recorded for every patient on the structured proforma.

Data were analysed using SPSS version 25. Numerical variables, namely age, body mass index, duration of symptoms, operative time and hospital stay, were summarised as mean $\pm$ standard deviation. Categorical variables, including gender, ASA grade, conversion to open surgery and difficulty of dissection, were summarised as frequencies and percentages. The mean operative time of the two groups was compared using the independent-samples t-test, and categorical outcomes were compared using the chi-square test. Effect modifiers, including age, ASA grade, body mass index, gender and duration of symptoms, were controlled by stratification, with a post-stratification independent-samples t-test applied. A two-tailed

p-value below 0.05 was considered statistically significant.

Results

Sixty patients were included in the final analysis, thirty in each arm. The two groups were well matched at baseline. The mean age was 42.7 ± 10.9 years in the early group and 43.8 ± 11.5 years in the delayed group ($p=0.705$), and body mass index was almost identical between them (27.4 ± 3.3 versus 27.2 ± 3.3 , $p=0.877$). The duration of symptoms before presentation, gender distribution and ASA grade were also comparable across the two groups. Table 1 sets out the baseline characteristics in full. This even distribution matters, because it means the difference in operative time that follows cannot easily be explained away by the two groups being different kinds of patients.

Table 1. Baseline demographic and clinical characteristics by group (N=60)

Characteristic	Early LC (n=30)	Delayed LC (n=30)	p-value
Age (years), mean $\pm$ SD	42.7 ± 10.9	43.8 ± 11.5	0.705
BMI (kg/m ²), mean $\pm$ SD	27.4 ± 3.3	27.2 ± 3.3	0.877
Symptom duration (hours), mean $\pm$ SD	35.1 ± 12.2	38.0 ± 11.4	0.343
Gender, Female / Male	13 / 17	10 / 20	0.426
ASA grade I / II / III	13 / 11 / 6	13 / 12 / 5	0.919

LC, laparoscopic cholecystectomy; BMI, body mass index; ASA, American Society of Anesthesiologists; SD, standard deviation. Comparisons by independent-samples t-test (continuous) and chi-square test (categorical).

The intraoperative findings are summarised in Table 2. Both groups underwent the same four-port procedure. A drain was placed in 18 of 30 early patients and 21 of 30 delayed patients. The condition of the gallbladder at operation differed in pattern between the groups: an actively inflamed gallbladder was the commonest finding in the early group, whereas dense adhesions were seen more often in the delayed group, matching what one would expect when the operation is postponed and the inflammatory process has had time to organise into fibrous tissue.

Table 2. Operative and intraoperative findings by group

Finding	Early LC (n=30)	Delayed LC (n=30)
Surgical technique	Standard 4-port	Standard 4-port

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Drain placed, n	18	21
Gallbladder inflamed, n	18	13
Gallbladder distended, n	8	6
Dense adhesions, n	4	11

The primary outcome, mean operative time, was significantly shorter in the early group. Early laparoscopic cholecystectomy took 62.2 ± 10.9 minutes against 71.9 ± 9.1 minutes for delayed surgery, a difference of roughly ten minutes that was statistically significant ($t=-3.73$, $p<0.001$). (Table 3 and Figure 2).

Table 3. Primary outcome: operative time by group

Group	n	Mean operative time (min) $\pm$ SD	t	p-value
Early LC	30	62.2 ± 10.9	-3.73	<0.001
Delayed LC	30	71.9 ± 9.1		

Post-operative hospital stay, a secondary outcome, showed an even larger and clearer separation between the groups. Patients undergoing early surgery stayed a mean of 2.9 ± 1.1 days, while those in the delayed group stayed 5.3 ± 0.8 days ($t=-9.89$, $p<0.001$). Table 4 and Figure 3 present this comparison. It is worth remembering that the delayed group's total time in hospital, counting the initial conservative admission and the later operative admission, is in practice longer still than this single figure suggests.

Table 4. Secondary outcome: post-operative hospital stay by group

Group	n	Mean hospital stay (days) $\pm$ SD	t	p-value
Early LC	30	2.9 ± 1.1	-9.89	<0.001
Delayed LC	30	5.3 ± 0.8		

Two markers of technical difficulty were compared, and neither differed significantly between the groups (Table 5). Conversion from laparoscopic to open surgery was needed in 1 of 30 early patients and 3 of 30 delayed patients ($\chi^2=0.27$, $p=0.605$). A difficult dissection at Calot's triangle was recorded in 7 of 30 early cases and 3 of 30 delayed cases ($\chi^2=1.08$, $p=0.299$). The numbers here are small, and the study was not powered to detect a difference in these outcomes, so the absence of a significant difference should be read as a lack of evidence of harm from early surgery rather than as proof that

the two approaches are identical on these measures.

Table 5. Intraoperative difficulty and conversion rates by group

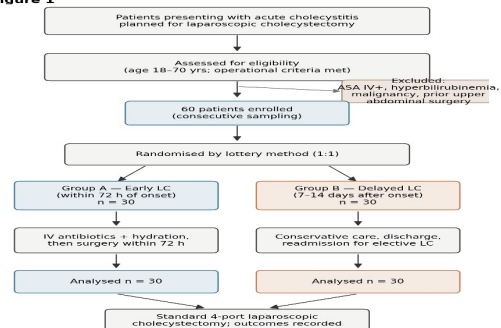
Outcome	Early LC (n=30)	Delayed LC (n=30)	χ^2	p-value
Conversion to open surgery, n (%)	1 (3.3%)	3 (10.0%)	0.27	0.605
Difficult Calot's dissection, n (%)	7 (23.3%)	3 (10.0%)	1.08	0.299

The frequency of the status of the gall bladder during the operation is presented in its entirety in Table 6 below. As can be seen from the above data, inflamed gall bladders were common in the earlier period while adhesion was common in the later period, with almost one-third of the gall bladders being in dense adhesions.

Table 6. Gallbladder condition at operation by group

Gallbladder condition	Early LC (n=30)	Delayed LC (n=30)
Inflamed, n (%)	18 (60.0%)	13 (43.3%)
Distended, n (%)	8 (26.7%)	6 (20.0%)
Dense adhesions, n (%)	4 (13.3%)	11 (36.7%)

Figure 1



LC, laparoscopic cholecystectomy.

Figure 1. Study flow diagram. Patients presenting with acute cholecystitis and planned for laparoscopic cholecystectomy were assessed against the eligibility criteria; those with ASA grade IV or higher, hyperbilirubinaemia, malignancy or previous upper abdominal surgery were excluded. Sixty eligible patients were enrolled by consecutive sampling and allocated 1:1 by the lottery method to early laparoscopic cholecystectomy within 72 hours or delayed cholecystectomy after conservative management, with thirty patients analysed in each arm.

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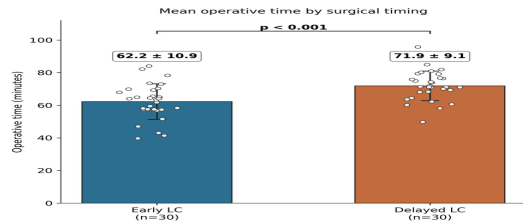


Figure 2. Mean operative time by surgical timing. Bars show the mean operative time in minutes for the early and delayed groups, with error bars representing one standard deviation and individual patient values overlaid. Early laparoscopic cholecystectomy was significantly faster than delayed surgery (62.2 ± 10.9 versus 71.9 ± 9.1 minutes; $p < 0.001$).

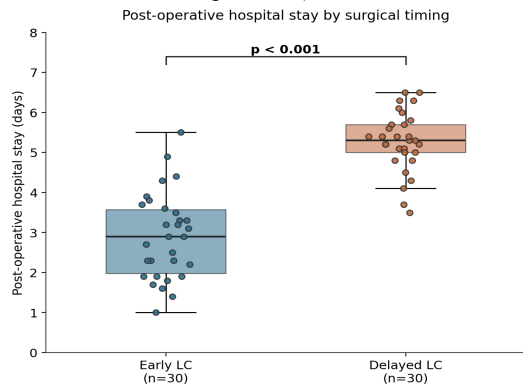


Figure 3. Post-operative hospital stay by surgical timing. Box plots show the median, interquartile range and range of post-operative hospital stay in days for each group, with individual patient values overlaid. Stay was significantly shorter after early surgery (2.9 ± 1.1 versus 5.3 ± 0.8 days; $p < 0.001$).

Discussion

The main conclusion of this study is quite simple. For patients who underwent surgical treatment earlier than seven days after the development of acute cholecystitis, the procedure lasted ten minutes less, and patients were discharged from the hospital almost three days earlier compared to those whose operation was postponed to a later period. And there were no differences in terms of converting the procedure to an open one or problems with dissection at Calot's triangle. Both groups of patients were almost similar initially, so it seems that differences can be explained only by the time of surgery.

The results of the operative time are consistent with other literature findings. According to Vidyadharan et al. (2023), in comparing early and delayed cholecystectomy procedures, the mean operative time in the former was 61.63 ± 3.64 minutes and in the latter one was 71.13 ± 16.19 minutes, a statistically significant

difference ($p = 0.001$). The results of this study, 62.2 minutes early and 71.9 minutes delayed, practically coincide with theirs. It should be noted that despite the fact that the two studies were conducted in different countries, this is encouraging. The primary reason usually suggested in this regard is anatomical. During the first days of an attack, the planes of tissues near the gallbladder become edematous but still distinguishable, and therefore the procedure of separation goes faster. When delaying the operation, the acute edema turns into organized fibrous adhesions, and separating the gallbladder from these fibrotic tissues is more time-consuming. The results related to the condition of the gallbladder in this study confirm this conclusion since dense adhesions were almost three times more common in the delayed group than in the early group (Toppo et al., 2024).

The hospital stay results are also well-supported by existing literature. Ismail et al. (2021) found a statistically significant shorter hospital stay among patients with acute calculous cholecystitis who had early laparoscopic cholecystectomy compared to those with delayed procedure, a result that was consistently demonstrated in other studies on the matter (Alenezi et al., 2024; Iftikhar et al., 2025). Our difference between 2.9 and 5.3 days is likely an underestimate, as our comparison includes the delay in the surgery period starting from the date of admission for the operation itself, but not from the time when the conservative treatment began and when the delay before elective procedure took place. Wani et al. (2023), in their review of the literature about the timing of the surgery, concluded that laparoscopic cholecystectomy for acute cholecystitis could be performed at any stage, using the phrase "any time is a good time"; our findings would make the statement more accurate, saying "if any time is a good time, then early time is the most effective".

On the safety measures, the absence of a significant difference deserves careful interpretation rather than celebration. The meta-analysis by Borzellino et al. (2021) on the timing of early laparoscopic cholecystectomy for acute calculous cholecystitis concluded that early surgery does not increase the risk of conversion or of bile duct injury when performed by experienced surgeons, and our small series is consistent with that conclusion in that neither conversion nor difficult dissection was significantly more common in the early group. Güneş et al. (2023a), in a single-centre study of operative timing, reached a similar view. Our study, with thirty patients per arm, was powered

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to detect a difference in operative time, not in the relatively rare event of conversion, so the correct reading of our conversion and dissection data is that we found no signal of harm from operating early, not that we have proven the two approaches equivalent on these outcomes. The higher frequency of difficult dissection seen in the early group, which is statistically insignificant, serves as a reminder that a newly inflamed tight gall bladder could be difficult to manage despite having favorable anatomical planes (Kadirvel et al., 2024; Kumar et al., 2025).

Set against the broader case for laparoscopic surgery, these findings fit an established picture. Mannam et al. (2023), reviewing laparoscopic against open cholecystectomy in acute cholecystitis, confirmed the advantages of the laparoscopic approach in pain, stay and recovery that make it the standard of care; the present study takes that as its starting point and addresses the narrower question of when, within the laparoscopic approach, the operation is best done. Taken together with the studies above, our results support a policy of offering early laparoscopic cholecystectomy to fit patients who present within the acute window (Pisano et al., 2020; Şahin and Alçı, 2025), reserving the delayed approach for those who present late, who are unfit for early surgery, or in whom the acute inflammation is so severe that a period of cooling is judged safer.

This study has several strengths. The two groups were well matched on every baseline variable measured, which strengthens the attribution of the operative-time and hospital-stay differences to surgical timing. The operation was standardised to a single four-port technique performed by consultant surgeons with defined experience, removing much of the operator-to-operator variability that clouds comparisons of this kind. These outcomes were predefined and prospectively recorded using a structured proforma, with the sample size being determined through calculation rather than convenience sampling.

Limitations need to be addressed. The study was performed at a single center with a relatively small number of sixty patients, which restricts the generalizability of the results obtained and renders the study inadequate in power to detect rarer outcomes like conversion and bile duct injury. Allocation was by a lottery method within a non-randomised trial design rather than by concealed randomisation, which introduces the possibility of allocation bias. Follow-up ended with the operative admission, so we cannot

report on longer-term outcomes such as readmission, delayed complications or recurrence in the interval before delayed surgery. The results also reflect the surgical expertise of one institution, and centres with different case mixes or levels of laparoscopic experience may not reproduce them exactly (Güneş et al., 2023b). A larger, multicentre randomised trial with longer follow-up would be the natural next step for confirming these findings and settling the residual questions around safety.

Conclusion

In patients with acute cholecystitis, early laparoscopic cholecystectomy performed within 72 hours of symptom onset was faster to perform and led to a shorter hospital stay than delayed surgery, without any significant increase in conversion to open surgery or difficulty of dissection. For the fit patient who reaches hospital early, operating during the first attack appears to be the more efficient course, and delaying surgery should be reserved for those who present late or are otherwise unsuited to early operation.

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Abbreviations

AC: Acute Cholecystitis. ASA: American Society of Anesthesiologists. BMI: Body Mass Index. CO₂: Carbon Dioxide. CRP: C-Reactive Protein. DLC: Delayed Laparoscopic Cholecystectomy. ELC: Early Laparoscopic Cholecystectomy. LC: Laparoscopic Cholecystectomy. SD: Standard Deviation. SPSS: Statistical Package for the Social Sciences. WHO: World Health Organization.

Declarations

Ethics Approval and Consent to Participate

The study was approved by the ethics committee of Capital Development Authority Hospital, Islamabad, and by the Research, Training and Monitoring Cell of the College of Physicians and Surgeons Pakistan. Written informed consent was obtained from all participants before enrolment.

Consent for Publication

Not applicable; no identifying patient information is presented in this manuscript.

Funding

This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Conceptualisation, methodology and supervision were carried out jointly by the authors. Data curation, formal analysis, investigation and writing of the original draft were carried out by the corresponding author, with review and editing contributed by the supervising author. Both authors approved the final manuscript.

Data Availability

The dataset analysed during the current study is available from the corresponding author on reasonable request.

Acknowledgements

The authors thank the theatre and nursing staff of the Department of Surgery, Capital Development Authority Hospital, Islamabad, for their assistance during the conduct of this study.