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Original Research Article

Changing paradigms in management of acute calculous cholecystitis

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ABSTRACT

Background: The term "acute calculous cholecystitis" indicates inflammation of the gall bladder caused by gallbladder stones. Usually the patients diagnosed with acute cholecystitis are advised to undergo laparoscopic cholecystectomy within 72 hours of onset of symptoms or electively after 6 to 12 weeks.
Methods: This is a retrospective study carried out at Department of Minimal Access and General Surgery, Max Hospital, Gurugram, India aimed at evaluating the ideal timing for undertaking surgery for managing acute calculous cholecystitis. This study of 1004 patients was carried out from July 2022 to August 2025 after having obtained due approval from the institutional authorities. For purposes of this study we included all patients presenting to our department for management of calculous cholecystitis during the period of this study. Out of these 1004 patients, a total of 491 were diagnosed as acute calculous cholecystitis and their clinical data was analyzed deploying standard statistical tools for purposes of this research.
Results: Out of the 1004 patients who underwent laparoscopic cholecystectomy from a period of July 2022 to August 2025, 491 patients were diagnosed as having acute cholecystitis. 223 patients were taken up for surgery with prior written consent within 0-3 days after getting diagnosed with symptomatic calculous cholecystitis (early surgery group). Operation for the remaining 268 patients had to be delayed for a variety of reasons which included co-morbid medical conditions besides personal preferences (delayed surgery group).
Conclusions: Acute calculous cholecystitis continues to be a common surgical condition with evolving management strategies. The findings of the present study demonstrate that early laparoscopic cholecystectomy within 72 hours of the onset and also as soon as technically possible is both a safe and advantageous approach in the management of these patients.

Keywords: Acute calculous cholecystitis, Laparoscopic cholecystectomy, Cholecystokinin, Biliary dyskinesia, Ejection fraction, Microlithiasis

INTRODUCTION

Gallstone disease (GSD) is widespread globally. The prevalence rates vary from an estimated global pooled prevalence of 6.1% to regional estimates showing significant variation across continents ranging from 5.1% to 11.2%. Similarly, India also displays noticeable regional and gender-based variation for GSD. Studies from North India, including the Gangetic basin and Kashmir, reported an overall prevalence of 4.2% and 6.1%, respectively. Female population showed a 2–3 times higher prevalence than males in both the studies. Historical data also suggest patterns of regional differences, indicating that gallstone incidence was nearly seven times more common in northern India compared with the south. Collectively, these findings highlight a persistent pattern of geographic and gender-related disparities in gallstone burden across the country as well as globally.[1,2]

The term gall stones refer to non-crumbling concretions more than 2 mm. If the size is less than 2 mm then the term microlithiasis is used.

The term sludge refers to suppression of cholesterol monohydrate crystals or calcium bicarbonate granules which are commonly found along with gall stones. Most instances of GB stones have been linked to biliary dyskinesia, which refers to cholecystokinin (CCK) infusion induced gall bladder ejection fraction (EF) of <40%. Gall bladder dis-mobility is diagnosed if the EF is less than 35%.[3]

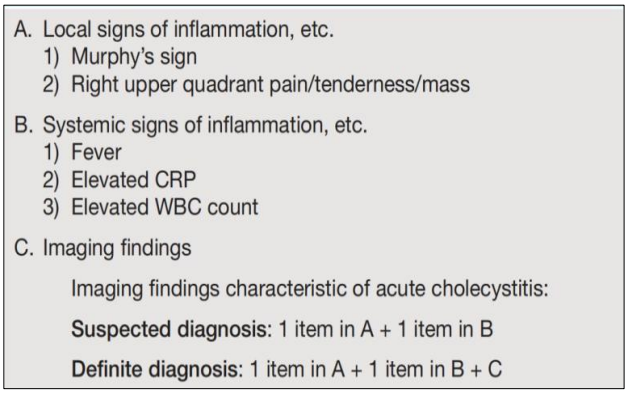

Figure 1: Tokyo guidelines for diagnostic criteria for acute cholecystitis.[5]

Grade III (severe) acute cholecystitis	
Associated with dysfunction of any one of the following organs/ systems:	
1 Cardiovascular dysfunction	Hypotension requiring treatment with dopamine ≥5 μg/kg/min, or any dose of epinephrine
2 Neurological dysfunction	Decreased level of consciousness
3 Respiratory dysfunction	PaO_2/F_iO_2 ratio <300
4 Renal dysfunction	Oliguria; creatinine >2.0 mg/dL
5 Hepatic dysfunction	Prothrombin time (PT-INR) >1.5
6 Haematological dysfunction	Platelet count <100 000/mm^3
Grade II (moderate) acute cholecystitis	
Associated with any one of the following conditions:	
1 Elevated white cell count (>18 000/mm^3)	
2 Palpable tender mass in the right upper abdominal quadrant	
3 Duration of complaint >72 hours	
4 Marked local inflammation (gangrenous cholecystitis, pericholecystic abscess, hepatic abscess, biliary peritonitis, emphysematous cholecystitis)	
Grade I (mild) acute cholecystitis	
Does not meet the criteria of grade II or grade III acute cholecystitis. Grade I can also be defined as acute cholecystitis in a healthy person with no organ dysfunction and mild inflammatory changes in the gallbladder, making cholecystectomy a safe and low-risk operative procedure	

Figure 2: Tokyo guidelines for severity grading of acute cholecystitis.[5]

In a significant majority (about 90-95%) of cholecystitis patients, the problem can be attributed to gall bladder stones. Out of those about 20 % of patients present with clinical symptoms suggestive of acute cholecystitis. The genesis of gallbladder stones is attributed to non-functionality or compromised functionality of gallbladder which stems from aberrations in the production of the hormone cholecystokinin (CCK). This hormone, which acts directly upon gall bladder smooth muscle, is synthesized by duodenal entero-endocrine cells in response to gastric emptying. It causes the gallbladder to contract and empty the bile stored in it. Insufficient CCK production leads to gallbladder non-contractility and bile stasis and accumulation, which in turn results in components of bile getting crystallized which is the precursor of formation of gallstones.[4]

The present study was carried out to evaluate, determine and enunciate the most appropriate timing for performing surgery for managing acute calculous cholecystitis.

METHODS

This is a retrospective study carried out at Department of Minimal Access and General Surgery, Max Hospital, Gurgaon, India aimed at evaluating the ideal timing for undertaking surgery for managing acute calculous cholecystitis. This study comprising of 1004 patients was carried out from July 2022 to August 2025 after having obtained due approval from the institutional authorities. The study consisted of a cohort of 1004 patients presenting to our department for management of calculous cholecystitis during the period of this study. Out of these 1004 patients a total of 491 were diagnosed as acute calculous cholecystitis and their clinical data was analyzed deploying standard statistical tools for purposes of this research.

Study population

All patients presenting to the department with symptomatic gallstone disease and requiring surgical management during the study period were screened for inclusion. A total of 1004 patients with calculous gallbladder disease underwent evaluation and treatment during the study duration. Among these, 491 patients fulfilled the diagnostic criteria for acute calculous cholecystitis and were included in the final analysis.

Inclusion criteria

Patients were included in the study if they fulfilled the following criteria: presence of gallstones confirmed on ultrasonography or cross-sectional imaging, clinical diagnosis of acute calculous cholecystitis based on: right upper abdominal pain and tenderness, fever and/or leukocytosis, positive Murphy's sign, and radiological evidence suggestive of acute cholecystitis including gallbladder wall thickening, pericholecystic fluid, gallbladder distension, or impacted calculus.

Exclusion criteria

The following patients were excluded from the study: symptomatic cholecystitis, gallbladder malignancy, choledocholithiasis requiring primary biliary intervention before cholecystectomy, and incomplete medical records or inadequate follow-up data.

Diagnostic evaluation

All patients presenting with suspected acute cholecystitis underwent detailed clinical assessment including history taking and physical examination. Baseline laboratory investigations included complete blood count, liver function tests, renal function tests, coagulation profile, serum electrolytes, and inflammatory markers wherever indicated.

Radiological evaluation was primarily performed using abdominal ultrasonography. Findings suggestive of acute cholecystitis included: gallstones, gallbladder wall thickness >3 mm, pericholecystic fluid collection, distended gallbladder, sonographic Murphy's sign, and impacted calculus at the gallbladder neck or cystic duct.

Computed tomography or magnetic resonance cholangiopancreatography was performed selectively in patients with diagnostic uncertainty or suspicion of biliary complications.

For analytical purposes, patients were categorized according to timing of surgery from onset of symptoms/admission into groups such as: early laparoscopic cholecystectomy, and delayed laparoscopic cholecystectomy.

Surgical procedure

All surgeries were performed by experienced laparoscopic surgeons using a standard four-port laparoscopic cholecystectomy technique under general anesthesia.

Data collection

Clinical records, operative notes, discharge summaries, laboratory reports, and radiological investigations were reviewed retrospectively from the hospital medical record.

RESULTS

For purpose of this study the data was analysed under four heads: duration of surgery, length of stay in hospital, post-operative pain, and one week follow up.

Out of the 1004 patients who underwent laparoscopic cholecystectomy from a period of July 2022-August 2025, 491 patients were diagnosed as having acute cholecystitis.

223 patients were taken up for surgery (early surgery group) with prior written consent within 0-3 days after getting diagnosed with symptomatic calculous cholecystitis.

Operation for the remaining 268 patients had to be delayed for a variety of reasons which included co-morbid medical conditions besides personal preferences (delayed surgery group).

Statistical analysis

A total of 491 patients out of 1004 were included in the study.

The overall mean age of the study population was 47.4±16.4 years ($p<0.001$). Males constituted 45.8% (n=225; p value 0.394) while 54.2% (n=266, p value) were females in the study.

In the early surgery group (n=223) surgery in 65.9% of patients (n=147) was completed in less than one hour whereas in delayed surgery group (n=268) it took more than one hour to complete the operation in 94.04% patients (n=252).

The length of hospital stay was one day or less in 81.9% (n=402) of all the patients studied.

Antibiotic prophylaxis was administered using injection cefuroxime sodium 1500 mg given intravenously to all patients enrolled in the study (n=491). Post operatively antibiotics had to the continued in 19.1% patients (n=94) out of which 40% (n=43) were in early group and 47% (n=51) were in the delayed group. These patients had presented with empyema (collection of pus) and/or evidence of biliary pancreatitis in which empyema was noted in 31% (n=29) and biliary pancreatitis was noted in 28% (n=26). Comparatively empyema of gall bladder was noted in early surgery group due to acute state and inflammatory changes along with peri-cholecystitis fluid.

Out of all the patients studied, immediate post-operative pain was common in 45.4% (n=223) of patients reporting pain scores <5 and 45.0% (n=221) reporting scores >5. Only 9.6% (n=47) reported no pain. Clinically significant pain relief was more evident in early surgery group.

Regarding co-morbidities, 21.6% (n=106) had diabetes mellitus (DM), 6.5% (n=32) had coronary artery disease (CAD) and 42.3% (n=207) had a history of COVID-19 infection.

Most patients had either no comorbidity (43.8%, n=215) or one comorbidity (45.4%, n=223), while 10.8% (n=53) were having multiple co-morbidities.

Timing of surgery (early versus delayed)

Patients were stratified by whether they underwent early surgery (n=223) or delayed the procedure (n=268).

Demographics

The early surgery group was significantly younger (35.7±8.6 years) compared to the delayed surgery group (61.7±11.6 years), with a highly significant difference ($p<0.001$, students t-test). Gender distribution did not differ significantly between groups (p=0.394, Chi-squared test).

Surgical characteristics

Surgery duration differed significantly between groups (p<0.001, Chi-squared test). Majority of the delayed surgeries 94.0% (n=252) were undergone for more than one hour, whereas 65.9% (n=147) of early surgeries underwent within one hour.

Length of hospital stay was significantly associated with timing of surgery (p≤0.001, Chi-squared test). A one-day stay was more frequent in the early group (91.5%, n=204) compared to the delayed surgery group (73.9%, n=198).

Clinical characteristics

Antibiotic requirement was observed to all the patients. Intra operative antibiotics were administered to all the patients irrespective of the surgery group, while 35.1% (n=94) patients of delayed surgeries required postoperative antibiotics.

Post-operative pain distribution differed significantly between groups (p<0.001, simulated Fisher exact test). The early group predominantly reported pain scores <5 (100.0%, n=223), whereas the delayed surgery group had a higher proportion of patients with pain scores >5 (82.5%, n=221).

DM and CAD were found significantly more prevalent in the delayed surgery group compared to the early group (DM; delayed group: 104 (38.8%) versus early group: 2 (0.9%), p<0.001, Chi-squared test, CAD; delayed group: 22 (8.2%) versus early group: 10 (4.5%), p=0.139, Chi-squared test). COVID-19 history did not differ significantly (delayed group: 113 (42.2%) versus early group: 94 (42.2%), p=1.000, Chi-squared test). The delayed surgery group was observed to have more prevalent co morbidities.

Patients were further stratified into four timing intervals: 0-3 days (n=223), 4-6 days (n=48), 7-10 days (n=173), and >10 days (n=47).

Table 1: Demographics.

Demographics		Early surgery group (n=223)	Delayed surgery group (n=268)	P value
Age; mean±SD		35.9±8.7	56.9±15.1	<0.001[1]
Gender	Male	97 (43.5%)	128 (47.8%)	0.394[4]
	Female	126 (56.5%)	140 (52.2%)	

[1]Students t-test; [4]-Chi-squared test

Table 2: Duration of surgery and length of stay in hospital.

Surgical characteristics	Early surgery group (n=223)	Delayed surgery group (n=268)	P value
Duration of surgery; N (%)			
<1 hour	147 (65.9)	16 (6.0)	<0.001[4]
>1 hour	76 (34.1)	252 (94.0)	
Length of stay in hospital; N (%)			
1 day	204 (91.5)	198 (73.9)	<0.001[4]
>1 day	19 (8.5)	70 (26.1)	

[4]Chi-squared test

Table 3: Clinical characteristics which were found in our study.

Clinical characteristics	Early surgery group (n=223)	Delayed surgery group (n=268)	P value
Need of antibiotics; N (%)			
Intraoperative	223 (100.0)	268 (100.0)	NA
Postoperative	0 (0.0)	94 (35.1)	NA
Postoperative pain; N (%)			
No pain	0 (0.0)	47 (17.5)	<0.001[3]
<5	223 (100.0)	0 (0.0)	
>5	0 (0.0)	221 (82.5)	
Comorbidities; N (%)			
Diabetes mellitus	2 (0.9)	104 (38.8)	<0.001[4]
CAD	10 (4.5)	22 (8.2)	0.139[4]
COVID-19	94 (42.2)	113 (42.2)	1.000[4]

Continued.

Clinical characteristics	Early surgery group (n=223)	Delayed surgery group (n=268)	P value
Comorbidities quantified; N (%)			
No comorbidity	125 (56.1)	90 (33.6)	<0.001[3]
One comorbidity	90 (40.4)	133 (49.6)	
Two comorbidities	8 (3.6)	29 (10.8)	
Three comorbidities	0 (0.0)	16 (6.0)	
Comorbidities categorized; N (%)			
No comorbidity	125 (56.1)	90 (33.6)	<0.001[4]
Mono-comorbid	90 (40.4)	133 (49.6)	
Multi-comorbid	8 (3.6)	45 (16.8)	

P value less than 0.05 ($p<0.05$) indicates that the observed difference or correlation is statistically significant. (1=student's t-test, 2=ANOVA test, 3=simulated Fisher exact test , 4=Chi-squared test)

Demographics

Age differed significantly across timing intervals ($p<0.001$, ANOVA test), increasing with surgical delay. Sex distribution did not show a statistically significant difference ($p=0.622$, Chi-square test).

Surgical characteristics

Duration of surgery varied significantly across groups ($p<0.001$, simulated Fisher exact test). All surgeries beyond 7 days were completed within one hour.

Length of hospital stay was significantly associated with timing ($p<0.001$). A one-day stay was most common in the 0-3 days and 7-10 days groups, whereas all patients in the >10 days group had hospital stays exceeding one day.

Antibiotic use

Intra operative antibiotics were universally administered in all the patients, while postoperative antibiotics predominated in surgeries delayed beyond 7 days 46.8% (n=81) and 27.7% (n=27.7%).

Post-operative pain

Post-operative pain distribution showed a strong association with surgical timing ($p<0.001$). Patients operated within 0-3 days predominantly reported pain scores <5, whereas those in the 4-10 day window reported higher pain scores. Notably, all patients operated after >10 days reported no pain.

Co morbidities

DM prevalence increased significantly with surgical delay ($p<0.001$), with the highest prevalence observed in the >10 days group (51.1%). CAD also showed significant variation ($p=0.014$). COVID-19 status remained non-significant ($p=0.631$).

Both quantified and categorized comorbidity burden differed significantly across timing groups ($p<0.001$), with multi-comorbidity becoming more frequent as surgical delay increased.

Statistical notes

The continuous variables were summarized as mean±standard deviation (SD), while categorical variables were expressed as frequencies and percentages.

Continuous variables were analysed using t-test or ANOVA. Categorical variables were analysed using Chi-square tests when expected counts were adequate and simulated Fisher exact tests were used when contingency tables contained small expected counts or zero cells. Statistical significance was assessed at a two-sided p value <0.05.

DISCUSSION

Acute calculous cholecystitis remains one of the most common surgical emergencies encountered in general surgical practice. Over the past few decades, the management strategy for acute calculous cholecystitis has evolved significantly with the widespread application of laparoscopic techniques as the standard modality of treatment. Traditionally, patients were managed conservatively during the acute phase and underwent interval cholecystectomy after 4–6 weeks. However, increasing clinical evidence has shifted the paradigm toward early laparoscopic cholecystectomy, preferably within 72 hours of symptom onset.[7]

The present study evaluated 491 patients diagnosed with acute cholecystitis out of 1004 patients who underwent laparoscopic cholecystectomy over a three-year period from July 2023-August 2025. Patients were categorized into early surgical group (0–3 days) and delayed surgical groups (4-10 days or more) to determine the impact of surgical timing on operative duration, hospital stay, post-operative pain, and antibiotic requirement.

The demographic profile in the present study demonstrated a slight female predominance (54.2%), which is consistent with the well-established higher incidence of gallstone disease in females due to hormonal and metabolic factors.

The mean age of patients was 47.4±16.4 years, with a significantly younger population observed in the early surgery group compared with the delayed surgery group. This age disparity may be partly due to the higher burden and time taken to stabilize co-morbidities observed among patients who underwent delayed surgery.[8]

In terms of operative parameters, early laparoscopic cholecystectomy was associated with shorter operative duration, with 60.1% of surgeries lasting less than one hour compared to longer duration of surgery in the delayed group. This observation can be attributed to the acute inflammatory changes, like oedema, adhesions, and the consequent difficulty in dissection of Calot triangle. Despite the longer operative duration, early surgery demonstrated several clinical advantages.[9]

One of the most significant findings of the present study was the reduction in hospital stay among patients undergoing early surgery.

Prophylactic antibiotics were administered in all patients, while post operatively antibiotics had to be continued in 94 patients (19%). This was necessitated because of empyema of gall bladder and biliary pancreatitis in 40% and 47% of the patients respectively. Patchy gangrenous areas of gallbladder wall were encountered in some of the patients having diabetes mellitus.[10]

86.3% of patients in the early surgery group were discharged within one day, compared to 76.4% in the delayed surgery group. Longer hospital stay in the delayed surgery group was attributed to time needed to manage the co-morbid conditions, post-operative pain especially where the surgical duration had been prolonged due to intra-operative anatomical difficulties.[11]

Patients undergoing early surgery reported pain scores less than 5, whereas the delayed surgery group demonstrated a higher proportion of pain scores greater than 5. This may be related to continuing inflammatory process, fibrosis, and recurrent biliary colic episodes occurring during the waiting period before delayed surgery.

We observed a greater prevalence of co-morbidities like diabetes mellitus and coronary artery disease in the delayed surgery group. 47.3% of these patients had diabetes mellitus, compared to only 0.7% in the early surgery group. Patients with multiple co-morbidities often require stabilization before surgical intervention, which may explain the delay in operative management. However, these co-morbid conditions may also contribute to increased postoperative discomfort and delayed recovery.[12]

Patients operated within 0–3 days had the shortest hospital stay and lower postoperative pain scores, supporting the current recommendations favouring early intervention. Conversely, surgeries performed between 4–10 days showed higher pain scores and greater postoperative antibiotic requirement, likely reflecting progression of inflammatory changes and tissue oedema during this period.[11]

The findings of this study support the evolving consensus that early laparoscopic cholecystectomy is both safe and beneficial for patients with acute cholecystitis. Early intervention prevents recurrent attacks, reduces repeated hospital admissions, and minimizes the risk of complications such as empyema, gangrenous cholecystitis, or gallbladder perforation.

Moreover, early surgery avoids the technical challenges associated with dense adhesions and fibrosis that may develop during the delayed phase.[10,12]

These observations align with the recommendations of the Tokyo guidelines, which advocate early laparoscopic cholecystectomy as the preferred management strategy in patients with mild to moderate acute cholecystitis.

Certain factors such as surgeon experience, intra-operative difficulty grading, and long-term complications were not evaluated in this study.

The large sample size and comprehensive analysis provide valuable insights into the changing paradigms in the management of acute cholecystitis.

CONCLUSION

Acute calculous cholecystitis continues to be a common surgical condition with evolving management strategies. The findings of the present study demonstrate that early laparoscopic cholecystectomy within 72 hours of the onset and as soon as technically possible is both a safe and advantageous approach in the management of these patients.

Early intervention was associated with significantly improved clinical outcomes, including lower postoperative pain scores ($p<0.001$) and a reduced duration of hospital stay ($p=0.006$), indicating faster postoperative recovery.

Furthermore, delayed surgery was associated with a higher burden of co-morbidities, particularly diabetes mellitus ($p<0.001$) and coronary artery disease ($p=0.023$), which may have contributed to increased postoperative discomfort and prolonged recovery. Subgroup analysis further reinforced that surgery performed within 0–3 days resulted in the most favourable outcomes in terms of hospital stay and pain scores ($p<0.001$).

Overall, the results of this study show a statistically significant advantage of early laparoscopic cholecystectomy over delayed intervention, supporting current guidelines that advocate early surgical management. Early surgery not only provides symptomatic relief but also prevents adverse

complications which can be fatal and enhances hospital resource utilization and reduces overall healthcare burden.

These findings provide robust evidence to support a shift toward surgical intervention as early as possible after the onset of symptoms as the standard of care in managing acute cholecystitis.

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