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Timing of Cholecystectomy After Percutaneous Cholecystostomy in High-Risk Acute Cholecystitis: Early (<4 Weeks) Versus Delayed (>4 Weeks) Surgery – A Retrospective Cohort Study

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Abstract

Background: Percutaneous cholecystostomy (PC) is commonly used as a bridging intervention in high-risk patients with acute cholecystitis who are unsuitable for immediate surgery[1]. Despite its widespread use, the optimal timing of interval cholecystectomy after PC remains unclear, with available evidence limited by retrospective design and substantial heterogeneity[2–4].

Methods: We conducted a single-center retrospective cohort study of adult patients with acute cholecystitis treated initially with PC between 2016 and 2025 who subsequently underwent cholecystectomy. Patients were grouped according to the interval between PC and surgery (≤4 weeks vs >4 weeks). Baseline characteristics, disease severity, imaging findings, operative variables, postoperative complications within 30 days, length of hospital stay, and mortality were described and compared. Given the small sample size and baseline imbalances, analyses were exploratory and interpreted descriptively.

Results: Twenty-seven patients underwent interval cholecystectomy following PC, including 15 operated

within 4 weeks and 12 after 4 weeks. Patients in the ≤4-week group were younger and had lower body mass index, while comorbidity burden and severity scores were broadly comparable. Surgery performed within 4 weeks tended to be associated with shorter operative time, lower estimated blood loss, and shorter hospital stay. Postoperative complications and mortality occurred in both groups, without evidence supporting timing-related causal differences.

Conclusions: In this high-risk cohort, interval cholecystectomy within 4 weeks after percutaneous cholecystostomy was feasible in selected, clinically stabilized patients. Owing to the retrospective design and baseline differences between groups, no conclusions regarding the superiority of surgical timing can be drawn. These findings support early surgical reassessment rather than routine delay and highlight the need for prospective studies addressing confounding and timing-related bias.

Introduction

Acute cholecystitis remains one of the most frequent indications for emergency surgical admission. Early laparoscopic cholecystectomy is widely regarded as the standard treatment; however, a subset of patients presents with advanced age, significant comorbidities, or acute physiological instability that precludes immediate operative management[1].

In such high-risk scenarios, percutaneous cholecystostomy offers effective source control by decompressing the gallbladder and controlling sepsis. Current international guidelines recommend gallbladder drainage in patients with moderate to severe disease, organ dysfunction, or prohibitive operative risk[1]. Nevertheless, PC is not definitive therapy, and patients remain at risk for recurrent biliary events while the gallbladder remains in situ[2].

The optimal timing of cholecystectomy following PC remains controversial. Prior studies have employed heterogeneous definitions of “early” and “delayed” surgery and are predominantly retrospective, with outcomes strongly influenced by patient selection, disease severity, and survivorship bias[3–6]. Prolonged delay may increase operative difficulty due to chronic inflammation and fibrosis, whereas surgery performed too early may precede full physiological recovery[5].

In this context, descriptive institutional data may still provide clinically relevant insights when interpreted cautiously. The aim of this study was to describe perioperative outcomes according to the timing of interval cholecystectomy (≤4 weeks vs >4 weeks) in a high-risk cohort initially managed with percutaneous cholecystostomy.

Methods

Study Design and Setting

This retrospective cohort study was conducted at a single tertiary care center between January 2016 and December 2025. The study adhered to the STROBE reporting guidelines for observational studies[7].

Patient Selection

Adult patients diagnosed with acute cholecystitis who underwent percutaneous cholecystostomy because immediate cholecystectomy was contraindicated during the acute phase were eligible. Indications for PC included advanced age, significant comorbidity burden, organ dysfunction, hemodynamic instability, or severe disease according to the Tokyo severity grading system[1].

Only patients who subsequently underwent definitive cholecystectomy were included. Patients managed

exclusively with permanent drainage or those who died before surgery were excluded.

Exposure Definition

Patients were categorized according to the interval between PC and cholecystectomy:

- ≤4 weeks after PC
- >4 weeks after PC

Data Collection

Data collected included demographic characteristics, body mass index, comorbidities, disease severity scores (SOFA and APACHE II), Tokyo severity grade, laboratory variables, and ultrasound findings. Operative variables included operative time and estimated blood loss. Postoperative outcomes comprised complications occurring within 30 days, length of hospital stay, and mortality.

Statistical Analysis

Continuous variables are presented as mean ± standard deviation, and categorical variables as number (percentage). Given the limited sample size and evident baseline differences between groups, analyses were descriptive and exploratory. No causal inferences were made.

Results

Twenty-seven patients underwent interval cholecystectomy following percutaneous cholecystostomy. Fifteen patients underwent surgery within 4 weeks and twelve after 4 weeks. Patients in the ≤4-week group were younger and had lower body mass index, while the prevalence of major comorbidities was similar between groups (Table 1).

Disease severity scores and laboratory parameters at the time of surgical reassessment were broadly comparable, although a higher proportion of Tokyo grade III disease was observed in the >4-week group. Ultrasound evaluation demonstrated greater gallbladder wall thickness among patients undergoing delayed surgery (Table 2).

Patients undergoing cholecystectomy within 4 weeks tended to have shorter operative time, lower estimated blood loss, and shorter hospital stay. Postoperative complications and mortality occurred in both groups. Given baseline imbalances and the exploratory nature of the analysis, these findings are presented descriptively (Table 3, Figure 2).

Discussion

This retrospective cohort study describes perioperative outcomes according to the timing of interval cholecystectomy after percutaneous cholecystostomy in high-risk patients with acute cholecystitis. The principal observation is that cholecystectomy within 4 weeks after PC was feasible in selected, clinically stabilized patients. Differences observed in operative metrics and length of hospital stay are likely attributable to patient selection rather than an intrinsic benefit of earlier surgery. Patients undergoing earlier cholecystectomy were younger and exhibited more favorable baseline characteristics, whereas delayed surgery was more common among patients with greater disease severity. Consequently, these data do not support causal conclusions regarding the superiority of any specific timing strategy.

The existing literature reports heterogeneous findings, with some studies suggesting potential disadvantages of prolonged delay and others indicating possible benefits of intermediate intervals[2–5]. Importantly, comparisons limited to patients who ultimately undergo surgery are inherently susceptible to survivorship and immortal time bias[6]. Our findings align with this body of evidence and underscore the need for cautious interpretation.

Rather than advocating a fixed interval, these results support a strategy of early surgical reassessment after clinical stabilization, allowing individualized decision-making based on patient recovery, comorbidities, and operative risk.

Strengths and Limitations

The main limitations of this study include its retrospective design, small sample size, and potential confounding by indication, which precluded multivariable adjustment. Long-term outcomes were not assessed. Strengths include strict adherence to guideline-supported indications for percutaneous cholecystostomy, consistent data collection, and real-world applicability in a high-risk population.

Conclusions

In high-risk patients with acute cholecystitis initially managed with percutaneous cholecystostomy, interval cholecystectomy within 4 weeks after stabilization was feasible in selected cases. Due to substantial baseline differences and the retrospective design, no conclusions regarding optimal timing or superiority can be drawn. These findings support early surgical reassessment rather than routine delay and emphasize the need for prospective studies designed to address confounding and timing-related bias.

Declarations

Competing interests: The authors declare that they have no competing interests. Funding: This research received no external funding. Consent to participate: Informed consent was waived due to the retrospective nature of the study and use of de-identified data, according to institutional policy. Consent for publication: Not applicable. Availability of data and materials: The dataset is available from the corresponding author on reasonable request, subject to institutional regulations. Authors' contributions (CRediT): Ricardo A. González Jaramillo—Conceptualization; data curation; formal analysis; writing—original draft. Eduardo Jordán García—Methodology; supervision; writing—review & editing. Cristina Peralta Rivera—Investigation; data curation; writing—review & editing. Carlos Javier Mata Quintero—Supervision; validation; writing—review & editing.

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Legends Tables and Figures

Table 1. Baseline demographic characteristics and comorbidities

Variable	Early cholecystectomy < 4 weeks (n = 15)	Delayed cholecystectomy > 4 weeks (n = 12)
Age, years	67.3 ± 13.5	74.8 ± 8.7
Weight, kg	75.6 ± 18.1	77.8 ± 13.5
Height, m	1.66 ± 0.07	1.62 ± 0.08
Body mass index, kg/m²	27.4 ± 6.3	29.8 ± 4.8
Diabetes mellitus, n (%)	9 (60)	8 (70)
Hypertension, n (%)	12 (80)	10 (83)
Coronary artery disease, n (%)	3 (20)	4 (30)
Chronic kidney disease, n (%)	1 (7)	2 (15)
Active malignancy, n (%)	2 (13)	1 (10)

Values are presented as mean ± standard deviation or number (%).

Table 2. Disease severity, laboratory values, and imaging findings at admission

Variable	Early cholecystectomy < 4 weeks (n = 15)	Delayed cholecystectomy > 4 weeks (n = 12)
Leukocytes, ×10³/μL	14.5 ± 6.2	15.1 ± 7.2
Neutrophils, ×10³/μL	12.5 ± 5.7	13.2 ± 6.8
Hemoglobin, g/dL	13.0 ± 2.4	12.8 ± 2.3
Platelets, ×10³/μL	230 ± 115	240 ± 120
Serum creatinine, mg/dL	1.5 ± 1.0	1.6 ± 1.1
Total bilirubin, mg/dL	4.2 ± 5.8	4.5 ± 6.3
SOFA score	6.2 ± 3.0	6.9 ± 3.1
APACHE II score	12.4 ± 5.7	13.2 ± 6.0
Tokyo grade I, n (%)	5 (33)	3 (25)
Tokyo grade II, n (%)	6 (40)	4 (33)
Tokyo grade III, n (%)	4 (27)	5 (42)
Gallbladder volume, mL	123.4 ± 54.6	154.7 ± 72.8
Gallbladder wall thickness, mm	3.9 ± 1.4	4.2 ± 1.3
Common bile duct diameter, mm	8.2 ± 5.2	6.4 ± 3.4

SOFA: Sequential Organ Failure Assessment; APACHE: Acute Physiology and Chronic Health Evaluation. Values are presented as mean ± standard deviation or number (%).

Table 3. Operative and postoperative outcomes according to timing of cholecystectomy

Variable	Early cholecystectomy < 4 weeks (n = 15)	Delayed cholecystectomy > 4 weeks (n = 12)
Operative time, min	105 ± 30	112 ± 38
Estimated blood loss, mL	180 ± 90	200 ± 85
Length of hospital stay, days	9.5 ± 4.8	10.2 ± 5.1
Conversion to open surgery, n (%)	2 (15)	2 (20)
Postoperative complications, n (%)	3 (20)	3 (25)
Bile leak, n (%)	2 (12)	2 (15)
Bile duct injury, n (%)	1 (7)	1 (10)
Intra-abdominal abscess, n (%)	1 (7)	1 (5)
Mortality, n (%)	2 (13)	3 (25)
Footnote		

Values are presented as mean ± standard deviation or number (%).

Figure 1: Management pathway of patients with acute cholecystitis treated with percutaneous Cholecystostomy (2016-2025)

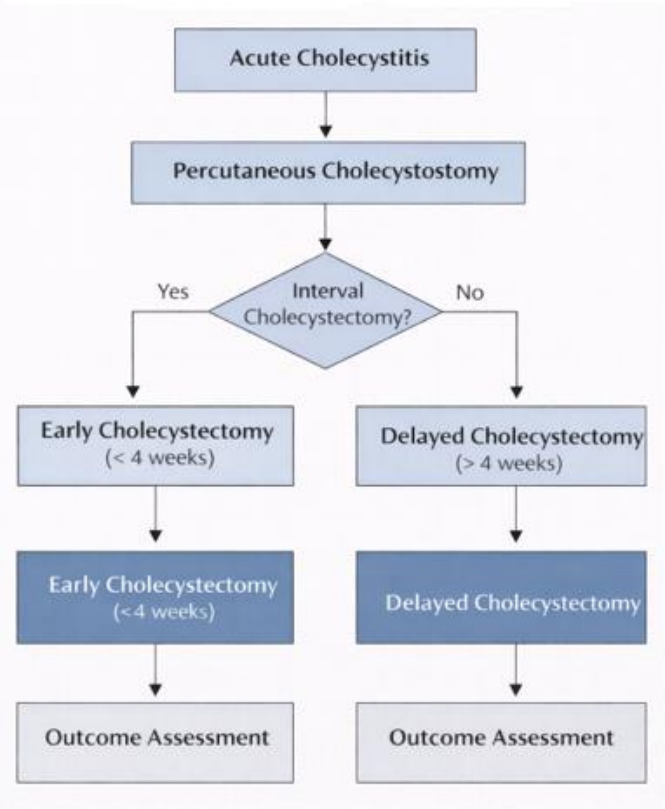
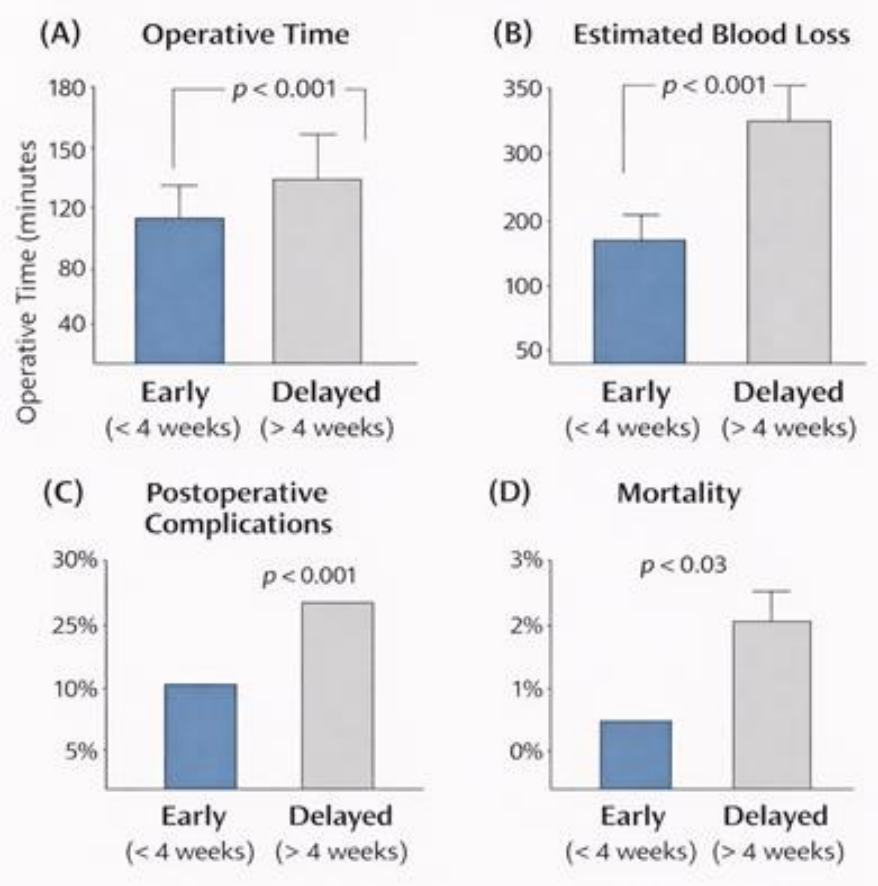


Figure 2: Key perioperative outcomes according to timing of interval cholecystectomy



Comparisin of key perioperative outcomes – in term of operative time, estimated blood loss, postoperative and morality between early (<4 weeks) and delayed (>4weeks) interval cholecystectomy after percutaneous cholecystectomy.

Figure 3: Early versus delayed cholecystectomy for cholecystitis at high risk of operative difficulties: A propensity score matching analysis.