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Evaluation of Readmission and Cholecystectomy Requirement After Percutaneous Cholecystostomy in Acute Cholecystitis

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Abstract

Background

This study aimed to evaluate the necessity of routine interval cholecystectomy by examining biliary-related readmission rates after catheter removal and postoperative complication rates among high-risk comorbidity patients who underwent surgical intervention following percutaneous cholecystostomy (PC) for acute calculous cholecystitis (ACC). Predictive clinical and laboratory markers for readmission were also analyzed.

Methods

A retrospective analysis was performed on 201 high-risk patients who underwent PC for ACC between January 2019 and January 2024, successfully completed drainage therapy, and demonstrated cystic duct patency on cholecystocholangiography at the time of catheter removal. Demographic data, Charlson Comorbidity Index (CCI) scores, Tokyo Guidelines 2018 (TG18) severity grades, laboratory markers on admission, readmission patterns and surgical outcomes/complications were evaluated over a 1-year follow-up period.

Results

The mean age of the study cohort was 71.80 ± 12.42 years, and the median CCI score was 5.0. According to TG18 severity grading, 11.4% were classified as Grade I, 61.1% as Grade II, and 27.4% as Grade III. Biliary-related readmission within 1 year occurred in 23.9% (n = 48) of patients, at a mean of 4.53 ± 3.27 months, with 77.08% of recurrences happening within the first 6 months. Triggers for readmission included recurrent cholecystitis (58.3%), choledocholithiasis (31.3%), and acute cholangitis (10.4%). A total of 50 patients (24.8%) underwent subsequent cholecystectomy, yielding a remarkably high postoperative complication rate of 42.0% (n = 21), including two mortalities from postoperative hemorrhage. Complication rates did not significantly differ between patients operated on electively and those operated on following a readmission event (36.4% vs. 52.9%; p = 0.261). Shorter duration of catheterization was significantly associated with higher readmission rates (p = 0.045). In multivariate logistic regression, gamma-glutamyl transferase (GGT) was isolated as an independent risk factor for readmission (OR: 1.002, 95% CI: 1.001–1.004, p = 0.048).

Conclusion

PC serves as an effective definitive treatment option rather than just a temporary bridge for elderly, high-risk comorbidity patients presenting with acute cholecystitis. Given the manageable readmission rates along with an exceedingly high complication profile associated with delayed surgery, routine interval

cholecystectomy is unnecessary and should not be systematically recommended in this specific patient population.

Background

Acute cholecystitis (AC) represents an inflammatory disease typically triggered by gallstone obstruction of the gallbladder neck or cystic duct, leading to bile stasis, mucosal ischemia, inflammation, and secondary infection [1]. It constitutes one of the most common causes of emergency department visits and surgical consultations worldwide. Currently, definitive management for fit patients remains early laparoscopic cholecystectomy (LC), which provides prompt resolution of the inflammatory state and eliminates the risk of future biliary events[2].

However, in elderly patients presenting with advanced physiological frailty, substantial medical comorbidities, or severe organ dysfunction, immediate surgical intervention is associated with substantially increased perioperative morbidity and mortality rates [3–6]. For these high-risk cohorts, alternative treatment modalities are vital. First described by Radder in 1980, percutaneous cholecystostomy (PC) has emerged as a reliable, minimally invasive drainage option performed under ultrasound or computed tomography guidance [7]. PC serves to decompress the gallbladder, thereby breaking the obstructive-inflammatory loop, mitigating local sepsis, and stabilizing the patient's systemic status with low procedure-related mortality [8].

While percutaneous cholecystostomy is considered a safe procedure with high clinical success, debate persists regarding its long-term outcomes [9], and conclusive evidence supporting its role as a definitive treatment remains limited [10].

This study evaluates the 1-year clinical follow-up data of 201 high-risk patients who successfully completed PC termination to define long-term readmission kinetics, identify specific biochemical and clinical predictors of recurrence, and evaluate the complication landscape of subsequent surgical interventions to optimize patient-centered management pathways.

Materials and Methods

Study Design and Ethical Approval

This retrospective, single-center study was conducted at the Department of General Surgery, University of Health Sciences, Ankara Bilkent City Hospital. Institutional review board approval was obtained from the local Clinical Research Ethics Committee (Date: 11/12/2024, Decision No: TABED 2-24-711) prior to study initiation, adhering to the ethical tenets of the Declaration of Helsinki.

Patient Selection and Exclusion Criteria

Data from 514 patients who underwent PC placement between January 2019 and January 2024 were screened. The primary inclusion criteria comprised: age > 18 years; diagnosis of acute calculous cholecystitis based on Tokyo Guidelines 2018 (TG18) diagnostic criteria [11]; successful technical and clinical resolution of the acute inflammatory index episode; and documented confirmation of absolute cystic duct patency via cholecystocholangiography performed by the interventional radiology team at the time of catheter removal.

Rigorous exclusion criteria were implemented to prevent bias. Patients with acute acalculous cholecystitis (n = 3), underlying gallbladder or biliary tract malignancies (n = 14), and concurrent choledocholithiasis at the index presentation (n = 3) were excluded. Postoperative pathology reporting gallbladder malignancy resulted in the exclusion of 2 cases. Furthermore, patients who died before catheter removal (n = 52), experienced accidental or spontaneous catheter dislodgement prior to completion (n = 37), or had no interventional radiological assessment of the biliary tree at catheter removal (n = 59) were omitted. Patients with persistent cystic duct obstruction (n = 5), those operated on before catheter removal (n = 4), and individuals lost to 1-year clinical follow-up (n = 134) were also excluded. Consequently, a total of 201 patients met all eligibility criteria and were included in the final analysis.

Clinical Management and Variables

Baseline demographic variables (age, sex), Charlson Comorbidity Index (CCI) scores [12], and TG18 severity grading (Grades I, II, III) were recorded. Baseline laboratory parameters measured at emergency admission included white blood cell count (WBC), C-reactive protein (CRP), aspartate aminotransferase (AST), alanine aminotransferase (ALT), alkaline phosphatase (ALP), gamma-glutamyl transferase (GGT), and total bilirubin. Follow-up data spanning 1 year post-catheter removal captured all biliary-related readmissions, exact time to recurrence, primary triggers driving readmission, secondary intervention modalities (e.g., repeat PC, Endoscopic Retrograde Cholangiopancreatography (ERCP)), subsequent cholecystectomies, conversion to open surgery, surgical complications, and all-cause mortality.

Statistical Analysis

Categorical variables are presented as absolute numbers (n) and percentages (%). Continuous data distribution and normality profiles were evaluated using graphical methods and the Shapiro-Wilk test. Accordingly, continuous parameters are described as Mean ± Standard Deviation (SD) or Median (Minimum–Maximum). Categorical data comparisons were conducted using the Chi-square test or Fisher's exact test. Differences in continuous parameters between readmitted and non-readmitted cohorts were analyzed utilizing the non-parametric Mann-Whitney U test. Potential clinical and biochemical risk factors for biliary-related readmission were examined through multivariate logistic regression analysis, with results reported as Odds Ratios (OR) and 95% Confidence Intervals (CI). All statistical computations were conducted via IBM SPSS Statistics v21.0, setting the significance threshold at $p < 0.05$.

Results

Baseline Cohort Characteristics

The patient population was characterized by advanced age (Mean: 71.80 ± 12.42 years; range: 26–97) and high systemic comorbidity, indicated by a median CCI score of 5.0 (range: 0–11). Males represented 57.7% (n = 116) of the cohort. Severity classification according to TG18 criteria distributed the patients into Grade I (11.4%), Grade II (61.1%), and Grade III (27.4%). Out of the 201 patients, 151 (75.2%) were managed non-operatively without subsequent surgical intervention during follow-up, largely driven by the high risk profile, patient preferences, or conditions surrounding the COVID-19 pandemic. A total of 50 patients (24.8%) underwent subsequent surgical intervention.

Table 1
Demographic and Clinical Characteristics of the Study Cohort (n = 201)

Parameters	Metric / Category	Value (n = 201)
Age (years)	Mean ± SD	71.80 ± 12.42
	Median (Range)	73.0 (26–97)
Sex, n (%)	Female	85 (42.3%)
	Male	116 (57.7%)
CCI	Mean ± SD	4.56 ± 1.69
	Median (Range)	5.0 (0–11)
Severity Grade, n (%)	Grade I	23 (11.4%)
	Grade II	123 (61.1%)
	Grade III	55 (27.4%)
Readmission, n (%)	No	153 (76.1%)
	Yes	48 (23.9%)
Time to Readmission (months)	Mean ± SD	4.53 ± 3.27
	Median (Range)	4.0 (1–12)
Causes for Readmission, n (%)	Cholecystitis	28 (58.3%)
	Cholangitis	5 (10.4%)
	Choledocholithiasis	15 (31.3%)
Operation Status, n (%)	Operated	50 (24.8%)
	Not Operated	151 (75.2%)

Readmission Analysis and Associated Risk Factors

Within the 1-year follow-up period post-catheter removal, 48 patients (23.9%) required readmission for biliary-related indications. The mean duration to readmission was 4.53 ± 3.27 months. Analysis of the recurrence distribution revealed that 77.08% of all readmissions clustered within the first 6 months following catheter removal, with 43.8% occurring within the first 3 months (Table 2).

Table 2
Distribution of Readmission Time Intervals

Readmission Intervals (months)	Patients (n)	Percentage (%)
0–3	21	43.8%
3–6	16	33.3%
6–9	5	10.4%
9–12	6	12.5%
Total	**48**	**100.0%**

Comparative analysis between patients with and without readmissions showed no statistically significant differences in age, gender distribution, baseline CCI scores, initial TG18 severity grade, or cholecystostomy-related complications ($p > 0.05$) (Table 3, Table 6). However, the duration of index cholecystostomy catheterization was significantly shorter in the readmission group compared to the non-readmission group (25.04 ± 9.31 days vs. 29.59 ± 14.82 days; $z = 2.008$, $p = 0.045$) (Table 4).

Table 3
Comparison of Demographic and Clinical Characteristics by Readmission Status

Parameters	Readmission No (n = 153)	Readmission Yes (n = 48)	Test Statistic	p-value
Age (years)				
Mean ± SD	71.84 ± 12.48	71.67 ± 12.37	z = 0.142	0.887
Median (Range)	73.0 (26–97)	74.0 (27–90)	—	—
Sex, n (%)				
Female	59 (38.6%)	26 (54.2%)	χ^2 = 3.645	0.056
Male	94 (61.4%)	22 (45.8%)		
CCI				
Mean ± SD	4.63 ± 1.75	4.33 ± 1.49	z = 1.137	0.256
Median (Range)	5.0 (0–11)	4.0 (1–7)	—	—
Severity Grade, n (%)				
Grade I	18 (11.8%)	5 (10.4%)	χ^2 = 0.139	0.933
Grade II	94 (61.4%)	29 (60.4%)		
Grade III	41 (26.8%)	14 (29.2%)		

Table 4
Comparison of Length of Stay and Catheterization Duration by Readmission Status

Variables	Readmission No (n = 153)	Readmission Yes (n = 48)	Test Statistic (z)	p-value
Length of Stay (days)				
Mean ± SD	6.39 ± 8.02	8.00 ± 9.24	0.603	0.546
Median (Range)	4.0 (1–61)	4.0 (1–37)		
Catheter duration (days)				
Mean ± SD	29.59 ± 14.82	25.04 ± 9.31	2.008	0.045
Median (Range)	26.0 (10–117)	24.0 (10–71)		

Evaluation of emergency laboratory findings identified significant differences in cholestasis-associated biochemical parameters. Admission serum values of AST (p = 0.033) and GGT (p = 0.035) were significantly elevated in patients who subsequently developed a disease relapse (Table 5). In the final

multivariate logistic regression model, serum GGT concentration at index admission was isolated as an independent risk factor for biliary-related readmission (OR: 1.002, 95% CI: 1.001–1.004, p = 0.048) (Table 7).

Table 5
Comparison of Admission Laboratory Parameters by Readmission Status

Parameters	Readmission No (n = 153)	Readmission Yes (n = 48)	Test Statistic (z)	p-value
WBC (x10⁹/L)				
Mean ± SD	14.94 ± 9.01	15.80 ± 6.43	1.109	0.267
Median (Range)	14.0 (3.3–93.0)	15.9 (4.9–36.0)		
CRP (mg/L)				
Mean ± SD	154.41 ± 105.05	180.49 ± 91.69	1.829	0.067
Median (Range)	150.0 (6–380)	190.0 (6–370)		
AST (U/L)				
Mean ± SD	70.12 ± 149.17	73.63 ± 90.48	2.135	**0.033**
Median (Range)	28.0 (8–1200)	34.0 (9–464)		
ALT (U/L)				
Mean ± SD	61.79 ± 116.88	68.71 ± 76.78	0.989	0.323
Median (Range)	25.0 (2–960)	30.0 (8–275)		
ALP (U/L)				
Mean ± SD	147.69 ± 120.21	156.27 ± 143.66	0.323	0.747
Median (Range)	101.0 (11–604)	105.5 (11–853)		
GGT (U/L)				
Mean ± SD	114.92 ± 160.13	154.58 ± 197.45	2.112	**0.035**
Median (Range)	49.0 (0–940)	101.0 (10–1070)		
Bilirubin (mg/dL)				
Mean ± SD	1.24 ± 1.17	1.48 ± 1.17	1.370	0.171
Median (Range)	0.9 (0.13–6.3)	1.1 (0.25–4.6)		

Table 6
Readmission Status by Cholecystostomy Complication

Cholecystostomy Complication	Readmission No (n = 153)	Readmission Yes (n = 48)	p-value*
No, n (%)	142 (92.8%)	48 (100.0%)	0.070
Yes, n (%)	11 (7.2%)	0 (0.0%)	

*Fisher's Exact test results are presented.

Table 7
Multivariate Logistic Regression Analysis of Risk Factors for Readmission

Variables	β	Standard Error	Wald	p-value	OR	95% CI Lower	95% CI Upper
Constant	-2.687	1.387	3.749	0.053	0.068	—	—
Sex	-0.660	0.363	3.319	0.068	0.517	0.254	1.051
Age	0.022	0.018	1.396	0.237	1.022	0.986	1.059
CCI	-0.136	0.139	0.957	0.328	0.873	0.664	1.146
Grade (overall)	—	—	0.999	0.607	—	—	—
Grade II	-0.475	0.596	0.634	0.426	0.622	0.193	2.001
Grade III	-0.152	0.644	0.055	0.814	0.859	0.243	3.035
WBC	0.010	0.020	0.227	0.634	1.010	0.970	1.050
CRP	0.003	0.002	3.340	0.068	1.003	1.000	1.007
AST	-0.002	0.003	0.614	0.433	0.998	0.992	1.004
ALT	0.003	0.004	0.477	0.490	1.003	0.995	1.010
GGT	**0.002**	**0.001**	**3.908**	**0.048**	**1.002**	**1.001**	**1.004**

Surgical Intervention and Postoperative Outcomes

Fifty patients (24.8%) underwent subsequent delayed cholecystectomy at a mean interval of 115.44 days (range: 8–350) post-catheter removal. Of these, 17 operations were performed reactively following readmission, while 33 were elective operations performed in patients without prior readmission. The overall surgical complication rate was remarkably high at 42.0% (n = 21). Specific complications included surgical site infection (n = 6), severe respiratory/pulmonary complications (n = 6), postoperative intra-abdominal hemorrhage (n = 4), major bile duct injury (n = 3), hepatic artery injury (n = 1), and acute

cardiac events (n = 1). Two patients died due to uncontrollable postoperative hemorrhage (one emergency case with secondary perforation; one elective case).

Extensive inflammatory adhesions and altered anatomy within Calot's triangle necessitated conversion to open surgery in 14 cases (28.0%), and subtotal cholecystectomy was performed in 2 cases. One patient required an emergency pancreaticoduodenectomy (Whipple procedure) due to the discovery of concomitant destructive Mirizzi Syndrome Type V. Crucially, no statistically significant difference in surgical complication rates was found between patients operated on reactively after a readmission episode and those operated on electively (52.9% vs. 36.4%; p = 0.261) (Table 8).

Table 8
Comparison of Surgical Complications by Readmission Status (Operated Patients, n = 50)

Surgical Complication Status	Operated Without Readmission (n = 33)	Operated After Readmission (n = 17)	Test Statistic (χ^2)	p-value
No, n (%)	21 (63.6%)	8 (47.1%)	1.266	0.261
Yes, n (%)	12 (36.4%)	9 (52.9%)		

Discussion

Percutaneous cholecystostomy (PC) has emerged as a life-saving, minimally invasive alternative for the management of acute cholecystitis (AC) in patients deemed unfit for immediate surgery. Although early laparoscopic cholecystectomy remains the gold standard for the definitive management of AC, perioperative risk is exceedingly high in elderly individuals or those with severe comorbid conditions. In this context, PC offers an effective option for controlling sepsis and stabilizing the patient with a low procedure-related mortality rate (< 1%) [13]. This indicates that PC serves as a safe and effective bridge therapy for guiding high-risk patients through the acute phase of AC; as recommended by the Tokyo Guidelines, it can be utilized as the first-line option in patients with severe AC who have surgical contraindications. However, at the core of the ongoing debate lies the question of whether routine interval cholecystectomy is truly necessary once the acute episode has been brought under control.

The risk of readmission due to gallbladder-related events following PC is one of the most crucial considerations. In this study, the overall readmission rate following catheter removal was found to be 23.9%. Among those readmitted, the etiology was cholecystitis in 58.3% (n = 28), cholangitis in 10.4% (n = 5), and choledocholithiasis in 31.3% (n = 15) (Table 1). This rate falls well within the broad range (4%–40%) reported in the literature; Wang et al. reported a 1-year readmission rate of 9.2% in patients undergoing successful PC [14], Li et al. reported 4.1% [15], while Sanjay et al. and Park et al. reported rates around 20%–22% [9, 16]. In the study by Cortázar García et al., this rate reached up to 40% [17]. Our findings demonstrate that readmission is not inevitable in high-risk patients; the fact that 76.1% of patients did not require readmission indicates that PC can provide a definitive solution. Furthermore, concordant with other studies, the majority of readmissions occurred during the early follow-up period

(43.8% within the first 3 months and 77.1% within the first 6 months following catheter removal) (Table 2). This indicates that closer surveillance is warranted during the first months following PC.

Among the numerous clinical and biochemical parameters investigated to predict readmission, achieving statistically significant findings is difficult, consistent with the existing literature. For instance, Hsieh et al. associated parameters such as catheter retention exceeding 2 weeks and CRP > 15 mg/dL with readmission [18]. Wang et al. demonstrated that more severe presentations of cholecystitis (gangrenous, complicated), WBC ≥ 18,000/μL, antibiotic usage longer than 10 days, and catheter duration exceeding 32 days increased the risk of recurrent attacks [14]. Bergman et al. reported that male sex was associated with higher readmission rates [19]. In our study, however, no statistically significant association was identified between readmission and conventional parameters such as age, sex, Charlson Comorbidity Index, baseline WBC, or CRP. These findings parallel several reports in the literature. For example, Hsieh et al. likewise found no significant relationship between readmission and demographic variables such as age or CCI [18]. This represents an important negative finding, suggesting that predicting which patients will experience recurrent attacks based solely on general frailty or baseline systemic inflammatory levels is not feasible.

In our study, the mean duration of cholecystostomy catheterization in readmitted patients was found to be significantly shorter than that in non-readmitted patients (25.04 ± 9.31 days vs. 29.59 ± 14.82 days; p = 0.045) (Table 4). This finding suggests that premature catheter removal increases the risk of readmission. Nonetheless, differing perspectives exist in the literature on this topic. Wang et al. reported that a catheter duration of 32 days or longer increased the risk of recurrent episodes [14]. However, it must be borne in mind that catheter duration should be tailored to individual patient clinical conditions.

Nevertheless, our data revealed that certain specific clinical parameters were significantly associated with readmission. Serum GGT levels were significantly higher in readmitted patients (p = 0.035) (Table 5). The mean GGT level in the readmission group was approximately 155 U/L, compared to 115 U/L in the non-readmitted cohort. This finding suggests that baseline cholestatic involvement or unrecognized partial common bile duct stones may predispose patients to recurrent attacks during long-term follow-up. Serum AST levels were also slightly higher in the readmission cohort (p = 0.033), whereas other liver enzymes showed no significant differences (Table 5). Taking these values into consideration at the time of catheter removal, or waiting for them to regress prior to removal, may prove meaningful in reducing readmission rates. Nevertheless, the general lack of robust, easily measurable biomarkers makes it challenging to predict which patients will experience recurrence, indicating that close clinical monitoring for all patients remains the safest strategy.

Determining how many patients require surgery following PC and evaluating the surgical outcomes constitutes another critical dimension of our investigation. In our series, 50 of 201 patients (24.8%) underwent cholecystectomy. A subset of these patients was operated on due to readmission, whereas the remainder underwent elective surgery following initial clinical recovery. This proportion aligns closely with findings across multiple studies. For example, data from Sanjay et al. and Hsieh et al. demonstrate

that fewer than one-third of PC-treated patients proceed to surgery, while the remainder are managed with medical therapy or drainage alone [9, 18]. Our findings confirm that in high-risk patients, PC frequently provides definitive treatment and non-operative management is often sufficient.

The Tokyo Guidelines 2018 recognize that PC is not merely a temporizing measure, but can serve as definitive therapy in selected patients. Our study strongly reinforces this paradigm: in patients who do not suffer recurrent attacks, surgery offers no additional clinical benefit and simply imposes unnecessary perioperative risk. Furthermore, a substantial proportion of readmitted patients were successfully managed without surgical intervention, utilizing antibiotics, ERCP, or repeat PC drainage. In particular, 6 patients were successfully managed with repeat percutaneous cholecystostomy following a second acute cholecystitis episode. This demonstrates that even in readmitted patients, emergency surgery is not universally required, and conservative or minimally invasive modalities remain frequently sufficient. McGillicuddy et al. likewise advocate restricting post-PC cholecystectomy exclusively to patients who experience a second attack [20]. Consequently, individuals who remain symptom-free can safely be spared from surgical intervention. Our results align with the body of literature questioning the necessity of "routine" interval cholecystectomy across all PC patients. As long as the gallbladder remains asymptomatic, the theoretical advantages of prophylactic surgery do not outweigh its substantial operative hazards.

The outcomes of patients undergoing surgery following PC further clarify this clinical dilemma. In this cohort, the surgery-related complication rate was remarkably high—42% of operated patients developed complications, including hemorrhage, surgical site infection, bile leakage, and cardiopulmonary adverse events. Two patients were lost due to postoperative hemorrhage. In the literature, the complication rate for elective laparoscopic cholecystectomy is generally below 10% [21]; however, in patients undergoing cholecystectomy following PC, this rate is markedly elevated. Sanjay et al. reported that 67% of patients undergoing interval cholecystectomy required conversion to open surgery, which in turn increased the postoperative complication rate [9]. These findings indicate that delayed surgery following PC is inherently high-risk and that the operation itself may often be more dangerous than the underlying pathology in this fragile group.

During the 1-year follow-up period in our study, a total of 22 patients (10.9%) died. Two of these patients died due to postoperative complications, and one patient died from a bile duct injury sustained during ERCP performed for choledocholithiasis during follow-up. The vast majority of the remaining patients died due to severe comorbid conditions that contributed to their initial high-risk surgical profile and PC indication. This indicates that patients undergoing PC for acute cholecystitis generally harbor severe systemic comorbidities, and their long-term prognosis is primarily dictated by these underlying systemic diseases. In light of these findings, planning routine interval cholecystectomy in this patient population is unlikely to provide a meaningful survival gain relative to their overall life expectancy and anticipated surgical benefit, and may instead incur additional morbidity and mortality.

One of the most critical findings of our study is that there was no statistically significant difference in surgical complication rates between patients operated on electively without readmission and those operated on following a readmission event ($p > 0.05$) (Table 8). This suggests that performing proactive surgery offers no distinct safety advantage over an expectant strategy of operating only if readmission occurs. This observation is exceptionally valuable for clinical decision-making. Waiting for a potential readmission does not worsen subsequent surgical outcomes; on the contrary, it holds the potential to spare many patients from unnecessary, high-risk surgery. However, given that numerous factors may influence surgical complications, prospective studies are warranted to substantiate this conclusion. Taken together, restricting surgery following PC strictly to patients who genuinely require it represents a safe and advantageous clinical strategy.

The strengths of our study include its large sample size and complete 1-year follow-up period. However, its retrospective design, inability to fully differentiate all non-biliary causes of mortality, and the exclusion of patients lost to follow-up represent inherent limitations.

Conclusion

Percutaneous cholecystostomy provides excellent definitive therapeutic utility rather than a temporary bridge for elderly, high-risk comorbidity patients presenting with acute calculous cholecystitis. Biliary recurrences occur in less than a quarter of patients and can be safely managed via conservative or repeat minimal-access approaches. Given the exceedingly high morbidity, technical open conversion rates, and mortality associated with delayed cholecystectomy in this specific population, routine interval cholecystectomy should be abandoned in favor of a personalized, symptom-driven watch-and-wait management strategy.

Declarations

Ethics approval and consent to participate

This study was approved by the Ankara Bilkent City Hospital Clinical Research Ethics Committee No. 2 (Date: 11/12/2024, Decision No: TABED 2-24-711). The study was performed in accordance with the Declaration of Helsinki. The requirement for written informed consent was waived by the institutional review board due to the retrospective nature of the study.

Consent for publication

Not applicable. This manuscript contains no individual person’s data, personal identifiers, or identifiable images in any form.

Competing interests

The authors declare that they have no competing interests.

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Author Contribution

AMT and SGT conceived and designed the study. AMT, MÖ, OG, and RTM acquired and curated the clinical data. AMT performed the statistical analyses. AMT and SGT drafted the manuscript. MÖ, OG, and RTM critically revised the manuscript for important intellectual content. SGT supervised the study. All authors read and approved the final manuscript.

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Availability of data and materials

The datasets generated and/or analyzed during the current study are not publicly available due to patient confidentiality regulations but are available from the corresponding author upon reasonable academic request.

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Figures

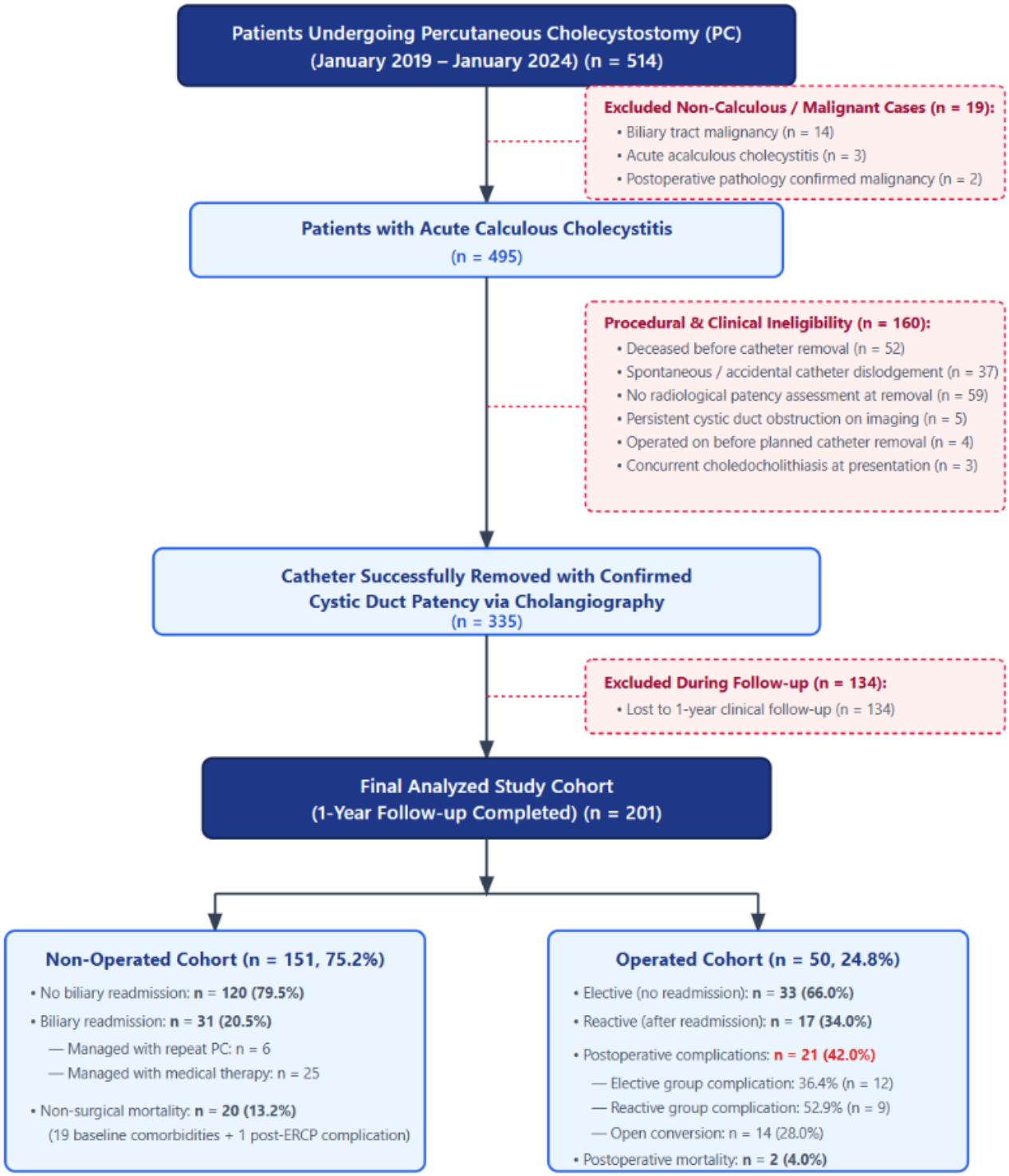


Figure 1

Flowchart of patient screening, inclusion, exclusion, and final cohort selection.