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Comparison of Intraoperative and Postoperative Outcomes of Interval Laparoscopic Cholecystectomy with and without Prior Percutaneous Cholecystostomy in Patients with Acute Cholecystitis

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ABSTRACT

Background: Acute cholecystitis (AC) is a common surgical emergency in Pakistan. Laparoscopic cholecystectomy (LC) is the standard treatment, but percutaneous cholecystostomy (PC) is often used in high-risk patients as a temporizing measure before interval LC. The impact of prior PC on operative and postoperative outcomes in our setting remains unclear. The study aimed to compare intraoperative and postoperative outcomes of interval LC performed with and without prior PC in patients with AC.

Methods: This comparative observational study at CMH Lahore (Dec 2024–July 2025) included 120 patients: Group A (LC without prior PC, n = 60) and Group B (LC with prior PC, n = 60). Outcomes included operative time, adhesion severity, subtotal cholecystectomy rates, conversion rates, recovery parameters, and postoperative complications. Statistical analyses used Chi-square and Mann–Whitney U tests, with $p < 0.05$ considered significant.

Results: Group B patients were significantly older (58.3 ± 10.5 vs 45.6 ± 11.2 years, $p < 0.001$) and had a higher proportion of ASA II–III status (60.0% vs 33.3%, $p = 0.004$) compared to Group A. Operative time was shorter in Group B (65.4 ± 12.5 vs 78.9 ± 15.6 minutes, $p < 0.001$), with fewer cases of severe adhesions (6.7% vs 33.3%, $p < 0.001$) and a lower rate of subtotal cholecystectomy (3.3% vs 13.3%, $p = 0.048$). Recovery was faster in Group B, with earlier oral intake, shorter hospital stays (2.8 ± 1.0 vs 4.5 ± 1.4 days, $p < 0.001$), and lower—but not statistically significant—overall complication rates (5.0% vs 13.3%, $p = 0.098$).

Conclusion: Prior PC in AC patients was associated with reduced operative difficulty, fewer severe adhesions, shorter operative time, faster postoperative recovery, and fewer complications, although differences in complication rates were not statistically significant. PC remains a safe and effective bridging intervention for selected high-risk patients when immediate LC is not feasible.

Keywords: Cholecystectomy, Laparoscopic, Percutaneous, Acute Cholecystitis, Postoperative Complications, Surgical Outcomes.

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INTRODUCTION

Acute cholecystitis (AC) is a common surgical emergency worldwide and constitutes a significant proportion of emergency general surgery admissions in Pakistan[1,2]. The Tokyo Guidelines 2018 (TG18) provide internationally recognized diagnostic criteria and treatment algorithms for AC, recommending laparoscopic cholecystectomy (LC) as the gold-standard definitive management for most patients[3]. However, in high-risk surgical candidates, particularly those with severe inflammation, multiple comorbidities, or poor physiological reserve, percutaneous cholecystostomy (PC) has emerged as a temporizing, minimally invasive drainage procedure to control sepsis before considering interval LC[4,5].

PC is widely adopted in developed healthcare systems, but its role and timing relative to definitive LC in resource-constrained settings, such as Pakistan, remain poorly defined[6,7,8,9]. Local surgical units often face additional challenges, including late patient presentation, higher rates of complicated cholecystitis (e.g., gangrene, empyema), limited access to advanced imaging, and varying levels of laparoscopic expertise[9,10,11]. Consequently, decisions on whether to proceed directly to interval LC or to perform prior PC are influenced by both clinical and infrastructural considerations, potentially impacting operative difficulty and postoperative outcomes.

Some studies have examined intraoperative and postoperative outcomes of interval LC with and without prior PC, reporting mixed findings on operative time, adhesion severity, conversion to open surgery, complication rates, and length of hospital stay[12,13,14,15]. However, there is limited data from South Asian or Pakistani cohorts, where differences in patient demographics, disease severity at presentation, and perioperative care pathways could alter these outcomes. Additionally, studies from high-income countries may not directly translate to Pakistan due to variations in surgical training, availability of advanced energy devices, and postoperative monitoring facilities[16].

The novelty of the present study lies in being, to our knowledge, one of the first from Pakistan to prospectively compare intraoperative and postoperative outcomes of interval LC in patients with AC, stratified by whether they underwent prior PC or not. By employing standardized surgical techniques and outcome measures aligned with TG18, this study aimed to generate locally relevant evidence that can guide clinical decision-making in both tertiary referral and district-level hospitals.

The findings will help clarify whether prior PC in Pakistani patients leads to significantly increased operative complexity or postoperative morbidity, or whether it remains a safe bridging option for high-risk individuals. Furthermore, by highlighting differences in baseline characteristics, intraoperative parameters, and recovery profiles between the two groups, this research could inform the development of national protocols on AC management tailored to Pakistan's healthcare infrastructure.

METHODS

Ethical approval for this study was obtained from the Research Institutional Review Board of Combined Military Hospital (CMH) Lahore (Approval Reference No: 593/2024; 12/24). Written informed consent was obtained from all patients prior to their inclusion in the study. Confidentiality and anonymity were strictly maintained.

This comparative observational study was conducted in the Department of General Surgery at CMH Lahore over a period of 8 months from December 2024 to July 2025. A total of n = 120 patients meeting the inclusion criteria were enrolled, with 60 patients in each group. Patients admitted with acute calculous cholecystitis, diagnosed in accordance with the Tokyo Guidelines 2018 criteria through clinical examination, laboratory evaluation, and imaging confirmation, were evaluated for inclusion.[3]

The study population was divided into two groups. Group A comprised patients who underwent interval laparoscopic cholecystectomy without any prior PC, whereas Group B comprised patients who had undergone PC during the index admission followed by interval laparoscopic cholecystectomy. The interval between the initial episode and surgery was standardized to approximately 6–12 weeks for both groups to minimize variability due to timing of intervention.

The study was powered to detect a difference between groups in a binary primary outcome (planned a priori as the rate of subtotal cholecystectomy). Required sample size per group for two proportions was computed using the following equation.

$$n = \frac{[Z_{\frac{a}{2}}\sqrt{2\overline{p}\,(1-p)} + Z_b\sqrt{p1\,(1-p1) + p2(1-p2)}\,]^2}{(p1-p2)^2}$$

Where p1 and p2 = expected event rates in Groups A and B, $\overline{p}$ =(p1+p2)/2, $Z\alpha/2=1.96$ for two-sided $\alpha=0.05$, and $Z\beta=0.84$ for 80% power. Putting values in the equation gives ≈ 100 patients in both groups. We add 15% for attrition/missing data and the final sample was 120 patients (60 per group).

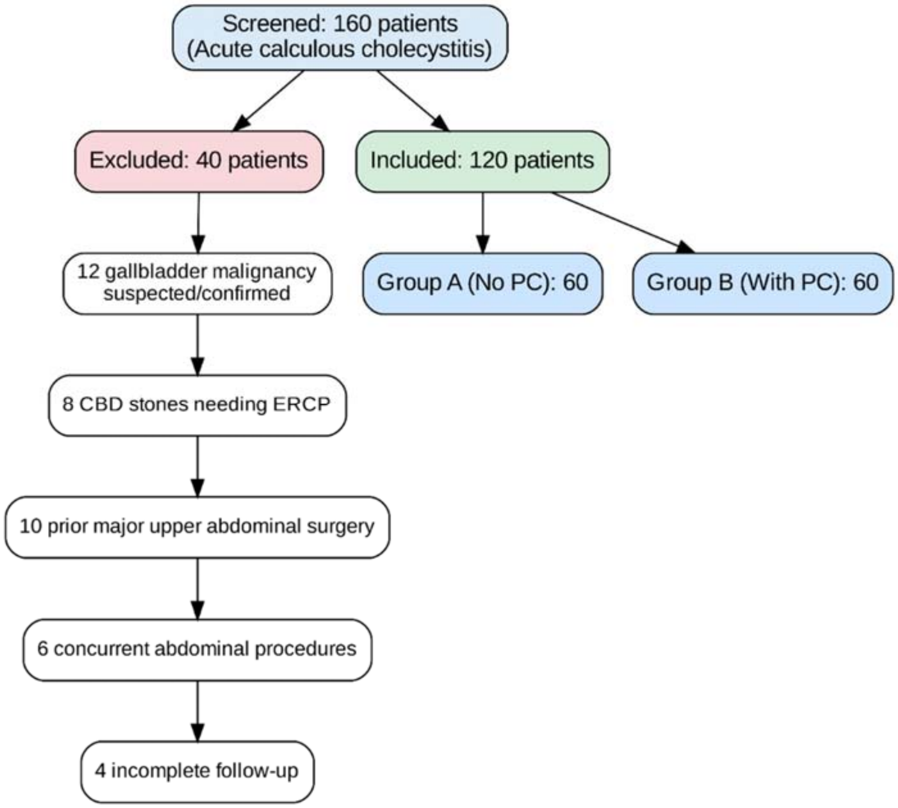

Figure 1: Patient Enrollment and Allocation Diagram Depicting Study Flow from Screening to Final Analysis.

Patients were included if they were aged 18 years or older, had imaging-confirmed acute calculous cholecystitis, and subsequently underwent interval laparoscopic cholecystectomy. Exclusion criteria included suspicion or confirmation of gallbladder malignancy, presence of common bile duct stones requiring endoscopic retrograde cholangiopancreatography (ERCP) before surgery, concurrent abdominal procedures during the same operation, and prior major upper abdominal surgery other than cholecystostomy. Patients with incomplete medical records or lost to follow-up were also excluded to ensure data completeness.

All enrolled patients underwent standard preoperative evaluation, including a detailed history focusing on the duration and severity of symptoms, prior interventions, comorbidities, and functional status. Laboratory workup included complete blood count, liver function tests, serum amylase/lipase, coagulation profile, and baseline renal function tests. Abdominal ultrasonography was performed using a GE Logiq P9 high-resolution ultrasound system with a 3–5 MHz convex probe, and contrast-enhanced CT (when indicated) was performed on a Philips Brilliance 64-slice CT scanner. MRCP studies, if required, were obtained on a Siemens Magnetom Aera 1.5 Tesla MRI unit. For patients in Group B, PC was carried out under ultrasound or combined ultrasound–fluoroscopic guidance using a Cook Medical 8–10 Fr pigtail drainage catheter via transhepatic or transperitoneal route under local anesthesia and sedation. Detailed documentation included route of insertion, catheter size/type, total drainage duration, procedure-related complications, and timing of tube removal before surgery.

The surgical technique was standardized to a four-port laparoscopic cholecystectomy under general anesthesia, performed by consultant surgeons with at least five years of independent laparoscopic experience. A Karl Storz Image 1 S laparoscopic tower with a 30° high-definition camera and xenon light source was used in all cases. Pneumoperitoneum was created using either the Veress needle technique or Hasson open technique, based on surgeon preference, with a Stryker high-flow insufflator maintaining intra-abdominal pressure at 12–14 mmHg. Standard reusable 10 mm optical trocars and 5 mm secondary ports were employed. Dissection was carried out using monopolar hook cautery or an Ethicon Harmonic Scalpel, depending on intraoperative conditions. Gallbladder retrieval was performed using a sterile endoscopic retrieval bag to prevent port site contamination.

Operative details recorded included skin incision to closure time, conversion to open surgery (including reason), degree of adhesions graded as mild, moderate, or severe on visual and tactile assessment, presence of gallbladder perforation during dissection, ease of Calot's triangle identification and dissection, requirement for subtotal cholecystectomy, and placement of intra-abdominal drains. Adhesion severity was graded using a standardized subjective scale adapted from prior surgical literature to ensure interobserver consistency.

Postoperative management included standard analgesia with patient-controlled analgesia pumps (B. Braun Perfusor Space), intravenous fluids, early mobilization, and deep vein thrombosis prophylaxis. All patients were initially monitored in a high-dependency surgical unit using Philips IntelliVue MP30 patient monitors for the first 6–12 hours postoperatively. Time to initiation of oral fluids and solids was documented. Postoperative complications including bile leak, wound infection, and intra-abdominal collections were actively monitored and classified according to the Clavien–Dindo grading system. Total length of hospital stay was calculated from the date of surgery until discharge. Follow-up was performed for 30 days postoperatively through outpatient visits or telephone interviews to document readmissions and late complications.

All collected data were entered into a secure electronic database and analyzed using IBM SPSS (version 27). Categorical variables were presented as frequencies and percentages, while continuous variables were expressed as mean ± standard deviation or median with interquartile range, depending on distribution. Chi-square tests were used for categorical variables, while Mann–Whitney U tests were applied for continuous variables. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Table 1: Demographic Profile and Comorbidity Distribution in Patients Undergoing Interval Laparoscopic Cholecystectomy, Stratified by Prior PC Status.

Variable	Group A (n=60)	Group B (n=60)	Statistical Test Values	P-Value
Age, years (mean ± SD)	58.3 ± 10.5	45.6 ± 11.2	Mann–Whitney U=986.5 (z=−5.02)	<0.001
Sex, male (%)	30 (50.0)	28 (46.7)	$\chi^2(1, N=120)=0.13$	0.72
BMI, kg/m² (mean ± SD)	27.1 ± 3.8	26.5 ± 3.4	Mann–Whitney U=1604.0 (z=−0.94)	0.35
ASA II–III (%)	20 (33.3)	36 (60.0)	$\chi^2(1, N=120)=8.21$	0.004
Diabetes mellitus (%)	14 (23.3)	18 (30.0)	$\chi^2(1, N=120)=0.75$	0.39
Hypertension (%)	16 (26.7)	22 (36.7)	$\chi^2(1, N=120)=1.38$	0.24
Ischemic heart disease (%)	4 (6.7)	8 (13.3)	$\chi^2(1, N=120)=1.51$	0.22

Patients in Group B (those who had undergone percutaneous cholecystostomy before interval laparoscopic cholecystectomy) were significantly older than those in Group A (58.3 ± 10.5 vs 45.6 ± 11.2 years, Mann–Whitney U = 986.5, $p < 0.001$) and had a higher proportion of ASA II–III status (60.0% vs 33.3%, $\chi^2 = 8.21$, $p = 0.004$). No statistically significant differences were found between groups for sex distribution, BMI, diabetes, hypertension, or ischemic heart disease (all $p > 0.05$) **Table 1**.

Table 2: Operative Characteristics, Including Dissection Difficulty, Adhesion Grade, Energy Device Used, And Need for Conversion or Subtotal Resection.

Parameter	Group A	Group B	Test (statistic)	P-Value
Operative time, min (mean ± SD)	78.9 ± 15.6	65.4 ± 12.5	Mann–Whitney U=1014.0 (z=−4.86)	<0.001
Adhesions: Mild	10 (16.7%)	38 (63.3%)	Overall adhesion grade: $\chi^2(2, N=120)=32.4$	<0.001
Adhesions: Moderate	30	18		

	(50.0%)	(30.0%)		
Adhesions: Severe	20 (33.3%)	4 (6.7%)	χ²(1, N=120)=3.91	0.048
Subtotal cholecystectomy (%)	8 (13.3)	2 (3.3)		
Conversion to open (%)	4 (6.7)	1 (1.7)	χ²(1, N=120)=1.87	0.17
Energy device (Hook vs Harmonic)	35/25	42/18	χ²(1, N=120)=1.54	0.21

Mean operative time was longer in Group A compared to Group B (78.9 ± 15.6 vs 65.4 ± 12.5 minutes, Mann–Whitney U = 1014.0, $p < 0.001$). Adhesion severity differed markedly, with severe adhesions more frequent in Group A (33.3% vs 6.7%) and mild adhesions more common in Group B (63.3% vs 16.7%), $\chi^2 = 32.4$, $p < 0.001$. Subtotal cholecystectomy was also more frequent in Group A (13.3% vs 3.3%, $\chi^2 = 3.91$, $p = 0.048$), while conversion to open surgery and energy device choice showed no significant differences ($p > 0.05$), **Table 2**.

Figure 2: Box-Plot Visualization of Operative Time Differences, Highlighting Median Values and Interquartile Ranges for Each Group.

The median operative time was notably higher in Group A (79 minutes, IQR 72–86) compared to Group B (65 minutes, IQR 60–72), with a Mann–Whitney U = 1014.0 and $p < 0.001$, reflecting the greater surgical complexity in patients without prior PC.

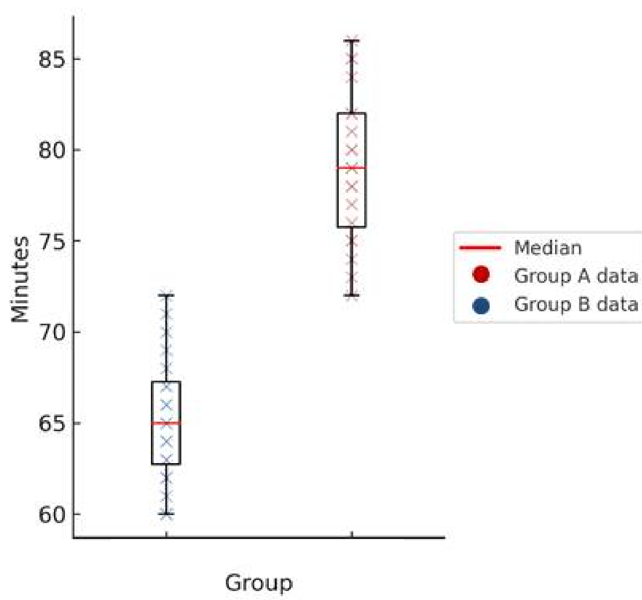

Table 3: Postoperative Recovery Parameters and Short-Term Outcomes, Including Return to Oral Intake, Hospital Stay, And Readmission Frequency.

Parameter	Group A	Group B	Test (statistic)	p-value
Time to oral fluids, h (mean ± SD)	9.8 ± 2.4	8.2 ± 2.1	Mann–Whitney U=1326.5 (z=−3.11)	0.002
Time to soft diet, h (mean ± SD)	24.7 ± 4.2	20.5 ± 3.6	Mann–Whitney U=1032.0 (z=−4.75)	<0.001
Length of stay, days (mean ± SD)	4.5 ± 1.4	2.8 ± 1.0	Mann–Whitney U=874.0 (z=−5.44)	<0.001
Readmission ≤30 days (%)	4 (6.7)	2 (3.3)	χ^2(1, N=120)=0.71	0.40

Group A had a longer time to oral fluids (9.8 ± 2.4 vs 8.2 ± 2.1 hours, Mann–Whitney U = 1326.5, $p = 0.002$) and to soft diet (24.7 ± 4.2 vs 20.5 ± 3.6 hours, Mann–Whitney U = 1032.0, $p < 0.001$). Hospital stay was significantly prolonged in Group A (4.5 ± 1.4 vs 2.8 ± 1.0 days, Mann–Whitney U = 874.0, $p < 0.001$). Readmission rates within 30 days were low and not statistically different between groups ($p = 0.40$).

Table 4: Breakdown of Specific Postoperative Complications and Their Severity According to The Clavien-Dindo Classification.

Outcome	Group A	Group B	Test (statistic)	p-value
Any complication (%)	8 (13.3)	3 (5.0)	χ^2 (1, N=120)=2.73	0.098
Bile leak (%)	3 (5.0)	1 (1.7)	χ^2 (1, N=120)=1.04	0.31
Wound infection (%)	5 (8.3)	2 (3.3)	χ^2 (1, N=120)=1.38	0.24
Intra-abdominal collection (%)	2 (3.3)	0 (0)	Fisher's exact, two-tailed	0.15
Clavien–Dindo I–II (%)	6 (10.0)	3 (5.0)	χ^2 (1, N=120)=1.08	0.29
Clavien–Dindo III–IV (%)	2 (3.3)	0 (0)	Fisher's exact, two-tailed	0.15

Complication rates were higher in Group A compared to Group B (13.3% vs 5.0%), although this difference was not statistically significant ($\chi^2 = 2.73$, $p = 0.098$). Specific postoperative complications—including bile leak, wound infection, and intra-abdominal collection—were infrequent in both groups, with no significant intergroup differences (all $p > 0.05$). Similarly, the distribution of complications according to Clavien–Dindo grades I–II and III–IV did not differ significantly between the groups **(Table 4)**.

DISCUSSION

Our study found significantly lower operative times and decreased adhesion severity in patients who underwent interval LC after prior PC. This contrasts with findings from a recent retrospective cohort study, which reported that 77% of patients treated with PC experienced prolonged LC (>60 minutes) when operated on after eight weeks, reflecting increased surgical complexity[17].

The current literature supports that the timing of interval LC post-PC does not significantly impact key outcomes when comparing early (<30 days) versus late (≥30 days) surgery. A systematic review and meta-analysis reported no significant differences in conversion rates, 90-day morbidity, or mortality between early and late interval LC[18]. Early PC (within 48 h compared to 3–6 days) seems to decrease the likelihood of delayed LC conversion rates, regardless of the time interval to delayed LC[19]. This suggests that while adhesions may be more pronounced, outcome implications are mitigated by operative expertise and patient selection.

Meta-analyses comparing PC followed by cholecystectomy (CC) versus CC alone indicate that CC is associated with significantly lower mortality (OR = 0.26; 95% CI = 0.14–0.48) and readmission rates (OR = 0.37; 95% CI = 0.18–0.75)[20]. A recent study reported that patients undergoing PC alone had markedly higher mortality (48% vs. 9%) than those receiving subsequent CCY, with CCY reducing mortality risk by 85% and most specimens showed persistent inflammation, underscoring PC as only a short-term solution[21]. This contrasts our findings of more complex intraoperative scenarios without decreased adverse postoperative outcomes, suggesting that LC remains safe as a staged intervention, particularly when early surgery is not feasible.

Our results support expert consensus recommendations for PC as a temporary bridge to surgery in high-risk populations. A recent Delphi-based guideline advises that patients with moderate to severe acute cholecystitis and high surgical risk should receive PC followed by LC at least six weeks later once stabilization is achieved[20,22]. This strategy appears reflected in our cohort: though adhesions and operative time were decreased, postoperative recovery and complication profiles remained acceptable.

A 10-year population-based analysis demonstrated substantially higher mortality among PC patients—ranging from 1.45- to 34-fold greater depending on the subgroup—along with increased recurrence and readmission rates[23]. Early placement of PC, within the first three days of hospitalization, has been associated with reduced hospital stay[24]. Another study found that the PC group experienced significantly higher mortality and longer hospitalizations compared with the CC group[19]. The findings indicate that incorporating LC after PC, despite decreasing perioperative complexity, may confer a prognostic advantage over PC alone by ultimately providing the benefits of definitive surgical management.

The study demonstrated significant associations between patient age, various covariates, and postoperative outcomes in LC, with complication rates of 6% for wound infections and 2.5% for bile duct injuries, emphasizing the importance of thorough assessment and targeted interventions[25]. In high-risk AC patients (mean age 73 years), PC performed within three days proved safe and effective, showing a 22.2% readmission rate and few cases requiring cholecystectomy, although persistent cases may benefit from interval surgery and confirmation through larger studies[26]. In contrast, our postoperative complication rates were low and statistically comparable between groups, suggesting that advances in surgical techniques and perioperative care have mitigated risks associated with interval procedures, supporting LC after PC as a viable option when direct LC is not feasible.

This study has several notable strengths. It addresses a clinically relevant gap by evaluating whether prior PC increases operative complexity or postoperative morbidity in Pakistani patients, with the potential to inform national protocols for acute cholecystitis management. The use of standardized surgical timing (6–12 weeks between the initial episode and LC) minimized variability related to the interval before surgery, while comprehensive, prospectively collected intraoperative and postoperative data ensured accuracy and completeness. Diagnostic confirmation was based on the Tokyo Guidelines 2018 with combined clinical, laboratory, and imaging criteria, enhancing reliability. Furthermore, all procedures were performed by consultant surgeons with at least five years of independent laparoscopic experience, reducing variability due to operator skill.

However, certain limitations must be acknowledged. The single-center, observational design may limit generalizability to other healthcare settings with different patient populations, resources, or surgical expertise, and the absence of randomization introduces the potential for selection bias. While the sample size was adequate for the primary endpoint, subgroup analyses may have been underpowered to detect smaller differences. The follow-up period of 30 days was sufficient for early complications but may not capture late events such as recurrent biliary symptoms or long-term morbidity. Additionally, unmeasured confounding factors, despite standardized protocols, could have influenced outcomes. These considerations should be taken into account when interpreting the findings.

CONCLUSION

Prior PC before interval laparoscopic cholecystectomy is associated with reduced intraoperative difficulty, shorter operative times, and faster postoperative recovery, without a significant increase in complication rates. PC remains a valuable bridging intervention for selected high-risk patients, enabling safe, delayed definitive surgery when immediate LC is not feasible. National surgical protocols should incorporate these findings to guide patient selection and operative planning in both tertiary and peripheral hospitals.

LIST OF ABBREVIATIONS

AC: Acute Cholecystitis

LC: Laparoscopic Cholecystectomy

PC: Percutaneous Cholecystostomy

ASA: American Society of Anesthesiologists

CT: Computed Tomography

MRI/MRCP: Magnetic Resonance Imaging / Magnetic Resonance Cholangiopancreatography

USG: Ultrasonography

ERCP: Endoscopic Retrograde Cholangiopancreatography

TG18: Tokyo Guidelines 2018

DM: Diabetes Mellitus

HTN Hypertension

IHD: Ischemic Heart Disease

COPD: Chronic Obstructive Pulmonary Disease

CKD: Chronic Kidney Disease

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None

CONFLICT OF INTEREST

None

ETHICAL APPROVAL

The Ethical approval for this study was obtained from the Research Institutional Review Board of Combined Military Hospital (CMH) Lahore (Approval Reference No: 593/2024; 12/24). Written informed consent was obtained from all patients prior to their inclusion in the study. Confidentiality and anonymity were strictly maintained.

AUTHORS' CONTRIBUTION

All authors contributed equally as per ICMJE policy

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