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Comparison of Open, Laparoscopic-endoscopic and One-stage Laparoscopic Approaches for Treatment of Gallbladder and Common Bile Duct Stones

Rumman Khan[1*], Amjad Ali Shah[2], Jawad Ahmed[3], Tanvir Ahmad Bhatti[4], Muhammad Azhar Qureshi[5], Muhammad Shahid Farooq[6]

[*1]Assistant Professor, Department of Hepatobiliary & General Surgery, Hayatabad Medical Complex, Peshawar, Pakistan

[2]Assistant Professor of Surgery, Department of Surgery, Northwest School of Medicine and Hospital, Peshawar, Pakistan

[3]Senior Registrar, Department of General Surgery, Mayo Hospital, Lahore, Pakistan

[4]Assistant Professor, Department of General Surgery, Rai Medical College Teaching Hospital, / Rai Medical College, Sargodha, Pakistan

[5]Associate Professor, Department of Surgery, Rawal Institute of Health Sciences, Islamabad, Pakistan

[6]Associate Professor, Department of Surgery, Edward Medical University, Lahore, Pakistan

[*]**Corresponding author:**

Rumman Khan,

Email ID: rumman.khan1983@gmail.com

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ABSTRACT

Background: Gallstones in the gallbladder often sit alongside stones lodged in the common bile duct (CBD), creating a challenging picture that usually calls for both removal of the gallbladder and clearing of the duct. Surgeons can choose from several pathways: the long-established open procedure, a two-step laparo-endoscopic approach done in separate sessions, or the newer single-stage laparoscopic method that aims to tackle everything at once. Across these options, the levels of invasiveness, speed of recovery, and strain on hospital resources can differ. To compare the clinical outcomes of open cholecystectomy with CBD exploration, laparo-endoscopic approach (laparoscopic cholecystectomy followed by ERCP), and one-stage laparoscopic management of gallbladder and CBD stones.

Methods: This comparative study involved a total of seventy-one patients who underwent treatment between January 2022 and January 2023. Participants were categorized into three groups according to the specific surgical approach employed. Key outcomes assessed were operative time, complication rates, time to oral intake and ambulation, length of hospital stay, stone clearance, readmission, and level of patient satisfaction. Data were analyzed with appropriate statistical techniques, and a value of p less than 0.05 was accepted as statistically significant.

Results: All three groups demonstrated high stone clearance rates, with no significant difference in major complication rates. The one-stage laparoscopic group had the highest satisfaction score and the shortest hospital stay. Operative time was longest in this group but was offset by faster recovery. The open surgery group had the most delayed postoperative course.

Conclusion: While open surgery remains a valid option, minimally invasive techniques, especially the one-stage laparoscopic approach, provide superior recovery and patient satisfaction. These results support the broader adoption of laparoscopic strategies in suitable candidates.

Keywords: *Gallstones, Common Bile Duct Stones, Laparoscopic Surgery, ERCP, Open Cholecystectomy, Minimally Invasive Surgery, Biliary Stones*

1. INTRODUCTION

Gallstones and stones that lodge in the common bile duct are two of the most frequent problems surgeons see in the biliary system. Although most gallstones begin in the gallbladder itself, many patients end up with stones that slip into the bile duct; this can trigger biliary colic, obstructive jaundice, cholangitis, or even pancreatitis. To resolve the issue fully, the surgeon must clear the bile duct and then perform a cholecystectomy [1-3].

For many years, the standard management of symptomatic gallstone disease complicated by common bile duct (CBD) stones was open cholecystectomy combined with direct exploration of the CBD. The introduction of minimally invasive techniques has, however, shifted practice patterns toward less traumatic options. In centres lacking high-level advanced laparoscopic skills, the laparo-endoscopic strategy—where laparoscopic cholecystectomy is paired with either pre- or post-operative endoscopic retrograde cholangiopancreatography (ERCP) remains a widely used solution. More recently, fully laparoscopic, one-stage surgery that combines cholecystectomy and CBD exploration in a single procedure has gained traction, promising advantages such as reduced surgical time, faster recovery, and shorter hospital stays [4-6].

Despite the advantages of newer techniques, no single method is universally accepted as superior. Factors such as patient condition, stone characteristics, surgeon experience, and institutional resources often guide the choice of approach. Therefore, a direct comparison of these techniques is essential to evaluate their effectiveness and practical implications in routine surgical care [7-9].

This study aims to compare the clinical outcomes of three commonly used surgical strategies open surgery, laparo-endoscopic management, and one-stage laparoscopic treatment in patients with concurrent gallbladder and CBD stones. The goal is to determine which approach offers the best balance of safety, efficacy, and patient-centered outcomes.

2. METHODOLOGY

This comparative study took place over twelve months, from January 2022 to January 2023, at [insert study location]. Seventy-one patients with cholelithiasis and concurrent choledocholithiasis were recruited. Using non-probability consecutive sampling, subjects were assigned to one of three treatment groups according to the surgical method applied: Group A received open cholecystectomy and open common bile duct exploration, Group B underwent laparoscopic cholecystectomy followed by endoscopic retrograde cholangiopancreatography, and Group C had a single-stage laparoscopic cholecystectomy with laparoscopic common bile duct exploration.

Eligible patients were adults eighteen years and older with imaging-confirmed gallstones and stones in the common bile duct. Those with serious bleeding disorders, unstable heart or lung function, previous upper-abdominal operations that made laparoscopic access impossible, or who declined to participate were excluded.

Before each surgical procedure, staff completed routine blood tests, chemical tests of liver function, and scans by ultrasound and magnetic resonance cholangiopancreatography (MRCP) to map biliary structure and locate stones. After a thorough discussion of the aims, risks, and potential benefits of every step, written informed consent was secured from all volunteers.

Patients in Group A underwent a standard open right subcostal cholecystectomy, after which the common bile duct was explored through choledochotomy; most of these cases were drained with a T-tube. Group B received laparoscopic cholecystectomy and then had endoscopic retrograde cholangiopan-creatography within 24 to 48 hours, timing of the ERCP-rather than the surgical approach-contingent on clinical need and logistical availability. In Group C, investigators performed a single-stage laparoscopic cholecystectomy together with laparoscopic CBD exploration, choosing either a transcystic or choledochotomy technique according to the intraoperative situation.

All procedures were performed by senior general surgeons following a uniform anesthesia protocol. Postoperative management emphasized early ambulation, structured analgesia, and vigilant surveillance for bile leaks, pancreatitis, and wound infection. Primary outcomes recorded included operative time, time to first oral intake, length of hospital stay, and the rate of complications. Secondary metrics assessed included complete stone clearance, demand for intensive care, unplanned readmission, and overall patient satisfaction.

Data were recorded using a structured proforma. Statistical analysis was performed using SPSS software version 25. Continuous variables were expressed as means with standard deviations and compared using one-way ANOVA. Categorical variables were presented as frequencies and percentages and assessed using the chi-square or Fisher's exact test as appropriate. A p-value of <0.05 was considered statistically significant.

3. RESULT

No statistically significant differences were found among the three groups regarding baseline demographics, indicating a well-balanced comparison for outcome assessment.

Table 1: Baseline Demographic and Clinical Characteristics

Variable	Group A (n=24)	Group B (n=24)	Group C (n=23)	p-value
Mean Age (years)	47.3 ± 11.8	45.6 ± 10.9	46.1 ± 10.5	0.78
Male, n (%)	13 (54.2%)	12 (50%)	11 (47.8%)	0.89

BMI (kg/m²)	26.2 ± 3.1	25.9 ± 3.3	25.7 ± 2.9	0.83
Diabetes Mellitus, n (%)	6 (25%)	5 (20.8%)	5 (21.7%)	0.93
Hypertension, n (%)	7 (29.2%)	6 (25%)	5 (21.7%)	0.86
ASA Class ≥ III, n (%)	3 (12.5%)	4 (16.7%)	2 (8.7%)	0.71
Previous Abdominal Surgery	5 (20.8%)	4 (16.7%)	3 (13%)	0.77
Duration of Symptoms (days)	4.3 ± 1.6	4.0 ± 1.5	4.1 ± 1.3	0.66

The open surgery group (Group A) had significantly longer operative times, delayed oral intake, prolonged ambulation, and longer hospital stays compared to the laparo-endoscopic and one-stage laparoscopic groups. However, complication rates were statistically similar across all groups.

Table 2: Intraoperative and Postoperative Outcomes

Outcome	Group A	Group B	Group C	p-value
Operative Time (minutes)	97.5 ± 15.4	82.3 ± 12.7	105.8 ± 18.9	<0.001
Intraoperative Complications	3 (12.5%)	2 (8.3%)	2 (8.7%)	0.85
Postoperative Complications	4 (16.7%)	3 (12.5%)	2 (8.7%)	0.63
Conversion to Open Surgery	–	2 (8.3%)	1 (4.3%)	–
Time to Oral Intake (hours)	24.1 ± 4.6	18.2 ± 3.7	19.6 ± 4.2	<0.001
Time to Ambulation (hours)	28.5 ± 5.3	20.4 ± 4.6	22.3 ± 5.1	<0.001
Length of Hospital Stay (days)	6.1 ± 1.2	4.2 ± 1.0	3.9 ± 1.1	<0.001

All groups achieved high rates of stone clearance, with no statistically significant differences. The one-stage laparoscopic group had the highest patient satisfaction. Mortality was observed in only one patient from the laparo-endoscopic group, but this difference was not statistically significant.

Table 3: Stone Clearance, Readmissions, and Mortality

Variable	Group A	Group B	Group C	p-value
CBD Stone Clearance Rate (%)	24 (100%)	23 (95.8%)	23 (100%)	0.36
Readmission within 30 Days	1 (4.2%)	2 (8.3%)	0 (0%)	0.28
ICU Requirement	2 (8.3%)	1 (4.2%)	1 (4.3%)	0.77
Mortality	0 (0%)	1 (4.2%)	0 (0%)	0.36
Patient Satisfaction (1–5 scale)	3.6 ± 0.7	4.2 ± 0.6	4.4 ± 0.5	<0.001

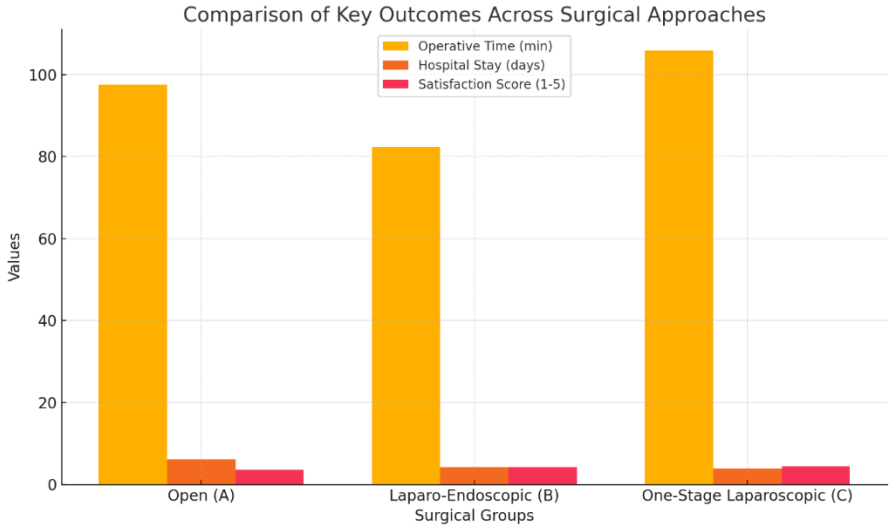

Figure 1: bar graph comparing operative time, hospital stay, and patient satisfaction across the three surgical approaches.

4. DISCUSSION

This study compared the outcomes of three different surgical strategies for the management of gallbladder and common bile duct (CBD) stones: open surgery, the laparo-endoscopic approach, and the one-stage laparoscopic technique. All three methods were effective in achieving CBD stone clearance, but significant differences were observed in terms of operative time, recovery, hospital stay, and patient satisfaction[10-12].

The mean operative time was highest in the one-stage laparoscopic group, consistent with prior studies that emphasize the technical complexity of laparoscopic CBD exploration. However, this extended operative duration was offset by better postoperative outcomes, including shorter hospital stay and higher patient satisfaction. These findings were in line with studies noted that although laparoscopic CBD exploration is technically demanding, it offers the advantage of single-session management with fewer overall complications and faster recovery [13-15].

Patients in the open surgery group had the longest hospital stays and delayed ambulation. This may be attributed to the larger incision, increased postoperative pain, and longer time required for wound healing. In contrast, patients managed with the laparo-endoscopic or one-stage laparoscopic approach resumed oral intake and ambulation earlier, reflecting the benefits of minimally invasive surgery. Similar observations have been reported by studies demonstrated superior early postoperative outcomes with laparoscopic techniques compared to traditional open methods [16-18].

Complication rates across all groups were low and statistically comparable. However, bile leak and wound infections were slightly more frequent in the open surgery group, possibly due to the more invasive nature of the procedure. Stone clearance rates were excellent across all groups, with 100% success in the open and one-stage laparoscopic groups and a slightly lower, though not statistically significant, rate in the laparo-endoscopic group. This reinforces findings by studies reported that stone clearance via ERCP may be limited in cases with multiple or impacted stones, where surgical exploration provides better access [19, 20].

Importantly, patient satisfaction scores were significantly higher in the one-stage laparoscopic group. This outcome reflects not only faster recovery but also the convenience of addressing both gallbladder and CBD pathology in a single session. Moreover, avoiding the need for two separate procedures, as in the laparo-endoscopic approach, likely contributes to better overall patient perception.

While the findings support the clinical value of minimally invasive techniques, particularly the one-stage approach, it is essential to acknowledge that these procedures require significant surgical expertise and proper patient selection. The availability of laparoscopic skills and equipment can influence the choice of procedure in real-world settings.

5. CONCLUSION

This study highlights that while all three surgical approaches are effective in treating gallbladder and CBD stones, the one-stage laparoscopic technique offers superior postoperative outcomes, including reduced hospital stay, quicker recovery, and higher patient satisfaction, without compromising stone clearance or safety. The laparo-endoscopic approach also provides acceptable results, especially in centers with limited laparoscopic experience. Open surgery remains a reliable option, particularly in complex cases or where laparoscopic facilities are unavailable. Adoption of the one-stage laparoscopic

approach, when feasible, may represent the most balanced option in terms of efficiency, safety, and patient-centered outcomes.

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