RESEARCH PAPER

Early versus Interval Laparoscopic Cholecystectomy Following ERCP in Patients with Concurrent Cholelithiasis and Choledocholithiasis: A Prospective Observational Study

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ABSTRACT

Background

Concurrent cholelithiasis with choledocholithiasis is a common hepatobiliary condition managed by endoscopic retrograde cholangiopancreatography (ERCP) for ductal clearance followed by laparoscopic cholecystectomy (LC). However, the optimal timing of LC after ERCP remains controversial, with considerable variation in clinical practice.

Aim

To compare intraoperative and postoperative outcomes of early laparoscopic cholecystectomy (within 72 hours of ERCP) versus interval laparoscopic cholecystectomy (6–8 weeks after ERCP) in patients with successful bile duct clearance.

Methods

This prospective observational study was conducted over six months at a tertiary care centre. A total of 94 patients with confirmed cholelithiasis and choledocholithiasis who underwent successful ERCP were included and allocated into two groups: early LC (Group A, n = 47) and interval LC (Group B, n = 47). Outcomes assessed included operative time, intraoperative adhesion grade, conversion to open surgery, drain requirement, postoperative complications, and length of hospital stay. Statistical analysis was performed using independent-samples t-test and chi-square test, with $p < 0.05$ considered statistically significant.

Results

Early laparoscopic cholecystectomy demonstrated significantly improved outcomes compared to interval surgery. The mean operative time was significantly shorter in the early group (52.4 ± 10.6 minutes vs 74.8 ± 12.3 minutes; $p < 0.001$). Moderate-to-severe adhesions were less frequent in the early group (19.1% vs 55.3%; $p < 0.001$). Conversion to open surgery was lower (4.2% vs 12.8%), and the mean postoperative hospital stay was significantly reduced (2.8 ± 0.9 days vs 5.6 ± 1.4 days; $p < 0.001$). Postoperative complications were comparable or lower in the early group (8.5% vs 17.0%).

Conclusion

Early laparoscopic cholecystectomy following ERCP is a safe, feasible, and clinically advantageous approach associated with reduced operative difficulty, shorter hospital stay, and comparable complication rates. It should be considered the preferred strategy in haemodynamically stable patients after successful ERCP.

Keywords: Cholelithiasis; Choledocholithiasis; Endoscopic retrograde cholangiopancreatography; Early laparoscopic cholecystectomy; Interval cholecystectomy; Biliary surgery

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INTRODUCTION

Gallstone disease is one of the most prevalent gastrointestinal disorders worldwide, contributing substantially to surgical workload and healthcare expenditure. Epidemiological studies indicate that approximately 10–15% of adults in developed countries are affected, with a rising trend observed in developing regions due to increasing urbanization, dietary changes, and the growing burden of metabolic risk factors such as obesity and diabetes mellitus [1,2]. Laparoscopic cholecystectomy has become the standard treatment for symptomatic cholelithiasis, offering advantages including reduced postoperative pain, shorter hospital stay, and faster recovery compared to open surgery [1].

A significant proportion of patients with gallstone disease develop choledocholithiasis, a condition characterized by the presence of stones within the common bile duct (CBD), which can lead to serious complications such as obstructive jaundice, acute cholangitis, and biliary pancreatitis [2,3]. The clinical importance of choledocholithiasis lies in its potential to cause life-threatening sequelae if not promptly diagnosed and treated. Advances in diagnostic modalities have improved the detection of CBD stones, with imaging techniques such as ultrasonography and intraoperative assessment playing an essential role in identifying affected patients [6].

Over the past few decades, the management of CBD stones has undergone a paradigm shift, with endoscopic retrograde cholangiopancreatography (ERCP) combined with endoscopic sphincterotomy emerging as the preferred initial therapeutic approach for ductal clearance [3,4]. ERCP is associated with high success rates exceeding 90% and has demonstrated a favorable safety profile when performed by experienced operators [5]. Consequently, a two-stage treatment strategy consisting of ERCP for bile duct clearance followed by laparoscopic cholecystectomy for definitive management of the gallbladder has gained widespread acceptance [4,5]. Comparative evidence suggests that endoscopic approaches are as effective as surgical exploration for CBD stones, with the added benefit of reduced invasiveness and faster recovery [7,8].

Despite successful ductal clearance, leaving the gallbladder in situ after ERCP has been associated with a substantial risk of recurrent biliary events. Randomized controlled trials have demonstrated that patients managed without subsequent cholecystectomy exhibit higher rates of recurrent symptoms, including biliary colic, cholangitis, and pancreatitis [9,10]. The “wait-and-see” approach has been shown to increase morbidity and healthcare utilization, thereby supporting the need for definitive cholecystectomy following ERCP [11,12]. Long-term follow-up studies further reinforce this recommendation, indicating that persistence of the gallbladder predisposes to recurrent stone formation and repeated hospital admissions [13]. Systematic reviews and meta-analyses have consistently concluded that cholecystectomy significantly reduces the risk of recurrent biliary complications and should be routinely performed after endoscopic clearance of CBD stones [14]. Additionally, prophylactic cholecystectomy has been advocated in selected patients, given the unpredictable natural history of gallstone disease after sphincterotomy [15].

While the indication for cholecystectomy after ERCP is well established, the optimal timing of surgery remains a matter of ongoing clinical debate. Early laparoscopic cholecystectomy, typically performed within 72 hours of ERCP, has been proposed as a strategy to minimize the risk of recurrent biliary events and reduce the overall duration of hospitalization. From a pathophysiological standpoint, early intervention may be advantageous because it precedes the development of dense fibrotic adhesions in the hepatocystic triangle, thereby facilitating safer dissection and reducing operative difficulty. In contrast, interval cholecystectomy, usually performed after a delay of 6–8

weeks, has traditionally been favored under the assumption that resolution of inflammation may decrease intraoperative complications.

However, emerging evidence challenges this traditional perspective, suggesting that delayed surgery may be associated with increased operative difficulty due to fibrosis and adhesion formation during the healing phase. Furthermore, deferring surgery exposes patients to a period of vulnerability during which recurrent biliary events may occur, leading to unplanned hospital readmissions and increased healthcare costs. These concerns are particularly relevant in resource-limited settings, where delayed access to surgical care may further compound patient morbidity.

Despite numerous studies addressing this issue, there remains considerable heterogeneity in the literature with respect to patient selection, timing definitions, and outcome measures. Additionally, data from tertiary care centers in developing countries are relatively limited, and regional variations in patient characteristics and healthcare infrastructure necessitate context-specific evidence.

In this context, the present prospective observational study was designed to compare the intraoperative and postoperative outcomes of early laparoscopic cholecystectomy performed within 72 hours of ERCP with those of interval cholecystectomy performed after 6–8 weeks. By evaluating parameters such as operative time, adhesion severity, conversion rates, and postoperative complications, this study aims to provide clinically relevant evidence to guide optimal timing of cholecystectomy following ERCP in patients with concurrent cholelithiasis and choledocholithiasis.

MATERIALS AND METHODS

This prospective observational study was conducted in the Department of General Surgery at SRM Medical College Hospital and Research Centre, a tertiary care referral centre in Tamil Nadu, India, over a period of six months following approval from the Institutional Ethics Committee. The study was carried out in accordance with the ethical principles outlined in the Declaration of Helsinki, and written informed consent was obtained from all participants prior to enrolment.

The study population comprised 94 adult patients diagnosed with cholelithiasis and concurrent choledocholithiasis, confirmed by ultrasonographic and biochemical evaluation, who underwent successful endoscopic retrograde cholangiopancreatography (ERCP) with complete clearance of common bile duct (CBD) stones. Patients were consecutively recruited to minimize selection bias and were allocated into two groups based on the timing of laparoscopic cholecystectomy. Group A (early laparoscopic cholecystectomy) included 47 patients who underwent surgery within 72 hours following ERCP, whereas Group B (interval laparoscopic cholecystectomy) comprised 47 patients who underwent surgery after a delay of six to eight weeks.

Patients aged above 18 years with confirmed cholelithiasis and choledocholithiasis, who had undergone technically successful ERCP with complete ductal clearance and were planned for laparoscopic cholecystectomy as definitive management, were included in the study. Only those who provided valid written informed consent were enrolled. Patients were excluded if they had significant cardiopulmonary comorbidities that contraindicated laparoscopic surgery, active cholangitis or multiorgan dysfunction at presentation, post-ERCP pancreatitis requiring active medical or interventional management, or known or suspected hepatobiliary malignancy. Patients who declined surgical intervention were also excluded from the study.

A comprehensive set of intraoperative and postoperative parameters was prospectively recorded and analyzed for both groups. Intraoperative variables included the degree of adhesions encountered during surgery, categorized as absent, mild, moderate, or severe; conversion to open cholecystectomy; occurrence of iatrogenic biliary tract injury; significant intraoperative hemorrhage requiring blood transfusion; and the need for abdominal drain placement. Operative time was recorded in minutes from skin incision to closure. Postoperative parameters included the occurrence of complications such as surgical site infection, bile leak, paralytic ileus, or other adverse events, as well as the total duration of postoperative hospital stay measured in days.

Statistical analysis was performed using SPSS software version 25.0 (IBM Corporation, Armonk, NY, USA). Continuous variables were expressed as mean with standard deviation and compared between groups using the independent-samples t-test. Categorical variables were presented as frequencies and percentages and analyzed using the chi-square test or Fisher's exact test, as appropriate. A two-tailed p-value of less than 0.05 was considered statistically significant for all comparisons.

RESULTS

Demographic Characteristics

Both groups were comparable in terms of baseline demographic and clinical parameters. The mean age in

Group A was 41.8 ± 12.6 years compared with 43.2 ± 11.9 years in Group B (p = 0.56). The sex distribution, presenting symptoms, duration of illness, and pre-ERCP laboratory values did not differ significantly between groups, indicating baseline comparability.

Table 1: Baseline Demographic and Clinical Characteristics

Parameter	Group A – Early LC (n = 47)	Group B – Interval LC (n = 47)	p-value
Mean age (years)	41.8 ± 12.6	43.2 ± 11.9	0.56
Male : Female ratio	18 : 29	20 : 27	0.68
Mean bilirubin (mg/dL)	2.6 ± 1.1	2.8 ± 1.3	0.47
Alkaline phosphatase (IU/L)	312 ± 95	328 ± 102	0.39
Number of CBD stones	1.6 ± 0.8	1.7 ± 0.9	0.62
ASA Physical Status (I / II / III)	22 / 19 / 6	20 / 21 / 6	0.81

Intraoperative Findings

Early laparoscopic cholecystectomy was associated with a statistically significant reduction in the severity of intraoperative adhesions compared with interval cholecystectomy. The mean operative time was significantly shorter in Group A (52.4 ± 10.6 minutes) than in Group B (74.8 ± 12.3 minutes; p < 0.001). Conversion to open surgery was required in 2 patients (4.2%) in Group A versus 6 patients (12.8%) in Group B (p = 0.04). No case of major bile duct injury was recorded in either group. Drain placement was required in 8 patients (17.0%) in Group A compared to 19 patients (40.4%) in Group B (p = 0.01).

Table 2: Intraoperative Parameters – Group A vs Group B

Parameter	Group A – Early LC	Group B – Interval LC	p-value
Mean operative time (min)	52.4 ± 10.6	74.8 ± 12.3	<0.001
Adhesion grade (none/mild/mod/severe)	12 / 26 / 7 / 2	4 / 17 / 18 / 8	<0.001
Conversion to open surgery – n (%)	2 (4.2%)	6 (12.8%)	0.04
Intraoperative haemorrhage – n (%)	1 (2.1%)	3 (6.4%)	0.30
Biliary tract injury – n (%)	0 (0%)	0 (0%)	—
Drain placement – n (%)	8 (17.0%)	19 (40.4%)	0.01

Postoperative Outcomes

The mean postoperative hospital stay was significantly shorter in Group A (2.8 ± 0.9 days) compared with Group B (5.6 ± 1.4 days; p < 0.001). The overall postoperative complication rate was lower in the early surgery group, with 4 patients (8.5%) experiencing at least one complication versus 8 patients (17.0%) in the interval group. No mortality was recorded in either group during the study period.

Table 3: Postoperative Outcomes – Group A vs Group B

Parameter	Group A – Early LC	Group B – Interval LC	p-value
Mean hospital stay (days)	2.8 ± 0.9	5.6 ± 1.4	<0.001
Wound infection – n (%)	2 (4.2%)	5 (10.6%)	0.23
Bile leak – n (%)	1 (2.1%)	2 (4.2%)	0.56
Paralytic ileus – n (%)	1 (2.1%)	3 (6.4%)	0.30
Readmission within 30 days – n (%)	1 (2.1%)	5 (10.6%)	0.09
Mortality – n (%)	0 (0%)	0 (0%)	—

DISCUSSION

The present prospective observational study demonstrates that early laparoscopic cholecystectomy (LC) performed within 72 hours following ERCP is associated with significantly improved intraoperative and postoperative outcomes compared to interval LC. In our study population (n = 94), early LC resulted in a 29.9% reduction in operative

time (52.4 ± 10.6 vs 74.8 ± 12.3 minutes; $p < 0.001$), a 65.5% reduction in moderate-to-severe adhesions (19.1% vs 55.3%; $p < 0.001$), a 67.2% reduction in conversion rates (4.2% vs 12.8%), and a 50% reduction in postoperative hospital stay (2.8 ± 0.9 vs 5.6 ± 1.4 days; $p < 0.001$). Postoperative complications were also lower in the early group (8.5% vs 17.0%), indicating that early LC is both effective and safe.

The marked reduction in adhesion formation observed in our study represents a key determinant of improved surgical outcomes. Patients undergoing interval LC demonstrated nearly threefold higher rates of moderate-to-severe adhesions, directly contributing to operative difficulty. Qi et al. reported in their meta-analysis that delayed cholecystectomy significantly increases operative difficulty due to progressive fibrosis and adhesion formation [16]. Similarly, Goel et al. demonstrated that early LC is associated with reduced intraoperative difficulty and improved surgical outcomes compared to delayed surgery [17]. Friis et al. further confirmed that delayed cholecystectomy is associated with dense adhesions in approximately 50–60% of cases, closely reflecting our findings [18]. Sahoo et al. quantified this difference by demonstrating significantly higher adhesion scores in delayed groups, supporting the mechanistic basis of fibrosis and tissue distortion over time [19].

Operative time in our study was significantly reduced by approximately 22 minutes in the early LC group, reflecting improved surgical efficiency. Aziret et al. reported that early LC significantly reduces operative time and intraoperative complications [20]. El Nakeeb et al., in a randomized controlled trial, demonstrated mean operative times of 54 ± 15 minutes in early LC compared to 72 ± 18 minutes in delayed LC ($p < 0.05$), closely aligning with our findings [21]. Reinders et al. attributed this improvement to reduced inflammatory distortion and easier identification of anatomical landmarks [22]. In contrast, Salman et al. reported significantly prolonged operative times in delayed LC due to dense adhesions and difficult dissection [23].

The conversion rate to open surgery in our study was significantly lower in the early group, with a nearly threefold increase observed in the interval group. Zang et al. reported similar findings, with conversion rates of 3–5% in early LC compared to 10–15% in delayed LC [24]. Beliaev et al. demonstrated that delayed cholecystectomy increases the risk of difficult dissection and bile duct injury, thereby increasing conversion rates [25]. Reinders et al. further showed that laparoscopic cholecystectomy becomes more technically demanding after ERCP when surgery is delayed, contributing to higher conversion rates [26]. Ahn et al. also reported that preoperative ERCP followed by delayed surgery is associated with increased operative difficulty and poorer outcomes [27].

Postoperative recovery in our study was significantly improved in the early LC group, as evidenced by a 50% reduction in hospital stay. Ricci et al., in a network meta-analysis, demonstrated that early intervention strategies are associated with improved overall outcomes and reduced morbidity [28]. Vettoretto et al. further showed that delayed surgery is associated with increased risk of recurrent biliary events and complications [29]. Gurusamy et al. also emphasized that delayed definitive management increases the likelihood of recurrent cholangitis, pancreatitis, and biliary colic, thereby increasing overall morbidity [30].

Importantly, our study demonstrated that early LC does not increase postoperative complications, with a lower complication rate observed in the early group. These findings are consistent with the broader literature and reinforce that early intervention is both safe and effective. The avoidance of a waiting period between ERCP and cholecystectomy eliminates the risk of recurrent biliary events and prevents progression of inflammatory changes, thereby improving both surgical and clinical outcomes.

Overall, the findings of the present study, supported by a strict forward progression of evidence from meta-analyses, randomized trials, and systematic reviews, consistently demonstrate that early laparoscopic cholecystectomy offers reduced adhesion formation, shorter operative time, lower conversion rates, decreased hospital stay, and comparable complication rates. The strong concordance between our results and existing literature establishes early LC as the optimal timing strategy following ERCP in patients with concomitant cholelithiasis and choledocholithiasis.

CONCLUSION

This prospective observational study demonstrates that laparoscopic cholecystectomy performed within 72 hours following ERCP-guided biliary ductal clearance is a safe, feasible, and technically advantageous approach in patients with concomitant cholelithiasis and choledocholithiasis. Early cholecystectomy was associated with a significant reduction in operative time, lower incidence of moderate-to-severe intraoperative adhesions, reduced conversion rates to open surgery, and a shorter postoperative hospital stay, without any increase in perioperative morbidity. These findings indicate that early intervention not only enhances surgical efficiency but also improves overall clinical outcomes while maintaining safety. In addition, early surgery eliminates the interval risk of recurrent biliary

events, further strengthening its clinical utility. Therefore, early laparoscopic cholecystectomy should be considered the preferred treatment strategy in haemodynamically stable patients following successful ERCP, provided that appropriate surgical expertise and institutional resources are available.

LIMITATIONS

- The single-centre design may limit the external validity and generalisability of the findings.
- The relatively short study duration (six months) may not adequately capture rare or long-term postoperative outcomes.
- The moderate sample size (n = 94) may reduce statistical power for subgroup or sensitivity analyses.
- Non-randomised allocation of patients introduces the potential for selection bias.

ETHICAL CONSIDERATIONS

The study protocol was approved by the Institutional Ethics Committee of SRM Medical College Hospital and Research Centre prior to patient enrolment. All procedures were conducted in accordance with the principles of the Declaration of Helsinki. Written informed consent was obtained from all participants. Patient data were anonymised and securely stored, and confidentiality was strictly maintained throughout the study.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest. No external funding was received for this study.

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