Original Article

A Comparative Study of Postoperative Hepatic Function Following Laparoscopic Versus Open Cholecystectomy in The North Coastal Region of Andhra Pradesh

Balaji chittipotula[1], Kanithi Umamaheswararao[1], Chikkam Uma Maheswara Rao[2]

[1]Assistant Professor, Department of General Surgery, Great Eastern Medical School and Hospital, Ragolu, Srikakulam, Andhra Pradesh, India. [2]Associate Professor, Department of General Surgery, Great Eastern Medical School and Hospital, Ragolu, Srikakulam, Andhra Pradesh, India

Abstract

Background: This study investigates postoperative hepatic function alterations following laparoscopic (LC) versus open cholecystectomy (OC) in patients from the North Coastal Region of Andhra Pradesh. Cholecystectomy is a common intervention for symptomatic gallbladder disease, with laparoscopic techniques gaining favor due to their minimally invasive nature, resulting in less postoperative pain and quicker recovery. However, concerns arise regarding the effects of carbon dioxide pneumoperitoneum used in LC, which can increase intra-abdominal pressure and impact hepatic blood flow. **Material and Methods:** The prospective, observational research involved 66 patients (46 undergoing LC and 20 OC) and assessed changes in liver enzymes (AST, ALT, bilirubin, ALP) at preoperative baseline, postoperative Day 1, and Day 7. **Results:** showed a significant transient elevation in AST and ALT levels in the LC group post-surgery, peaking on Day 1, with levels returning to baseline values by Day 7. Conversely, the OC group exhibited minimal changes, which lacked statistical significance. No clinically significant hyperbilirubinemia or postoperative complications that could affect liver function were observed in either group, confirming that the transient increases in liver enzymes post-LC do not indicate serious hepatic injury. Overall, the findings suggest that while LC may cause short-term biochemical changes in liver function, these changes are reversible and do not lead to significant clinical outcomes. **Conclusion:** Laparoscopic cholecystectomy leads to a temporary increase in hepatic transaminases (AST and ALT) for about a week, while bilirubin and alkaline phosphatase levels remain stable. This increase is connected to pneumoperitoneum effects, not liver damage. Further multicenter studies in Andhra Pradesh are required to confirm these findings.

Keywords: Laparoscopic, open cholecystectomy, invasive, hyperbilirubinemia.

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INTRODUCTION

Cholelithiasis is one of the most common biliary tract disorders and is an important cause of morbidity and surgical intervention worldwide. Cholecystectomy is still the treatment of choice for symptomatic gallstone disease and chronic calculous cholecystitis. Lap **Background:** This study investigates postoperative hepatic function alterations following laparoscopic (LC) versus open cholecystectomy (OC) in patients from the North Coastal Region of Andhra Pradesh. Cholecystectomy is a common intervention for symptomatic gallbladder disease, with laparoscopic techniques gaining favor due to their minimally invasive nature, resulting in less postoperative pain and quicker recovery. However, concerns arise regarding the effects of carbon dioxide pneumoperitoneum used in LC, which can increase intra-abdominal pressure and impact hepatic blood flow. **Material and Methods:** The prospective, observational research involved 66 patients (46 undergoing LC and 20 OC) and assessed changes in liver enzymes (AST, ALT, bilirubin, ALP) at preoperative baseline, postoperative Day 1, and Day 7. **Results:** showed a significant transient elevation in AST and ALT levels in the LC group post-surgery, peaking on Day 1, with levels returning to baseline values by Day 7. Conversely, the OC group exhibited minimal changes, which lacked statistical significance. No clinically significant hyperbilirubinemia or postoperative complications that could affect liver function were observed in either group, confirming that the transient increases in liver enzymes post-LC do not indicate serious hepatic injury. Overall, the findings suggest that while LC may cause short-term biochemical changes in liver function, these changes are reversible and do not lead to significant clinical outcomes. **Conclusion:** Laparoscopic cholecystectomy leads to a temporary increase in hepatic transaminases (AST and ALT) for about a week, while bilirubin and alkaline phosphatase levels remain stable. This increase is connected to pneumoperitoneum effects, not liver damage. Further multicenter studies in Andhra Pradesh are required to confirm these findings.
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Address for correspondence: Dr. Kanithi Umamaheswararao, Assistant Professor, Department of General Surgery, Great Eastern Medical School and Hospital, Ragolu, Srikakulam, Andhra Pradesh, India.
E-mail: kanitiumamaheshwararao@gmail.com

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hyperbilirubinemia.aroscopic cholecystectomy (LC) has progressively replaced open cholecystectomy (OC) as the preferred surgical approach since its introduction because of its minimally invasive nature, less postoperative pain, shorter hospital stay, faster recovery, better cosmetic outcomes and earlier return to routine activities.[1,2] Therefore, LC is currently considered the standard surgical treatment for most patients with symptomatic gallbladder disease.[1,3] Although laparoscopic surgery has several well-established advantages over conventional open surgery, the physiological effects of pneumoperitoneum have been of considerable clinical interest. Unlike OC, LC necessitates the creation and maintenance of an artificial pneumoperitoneum, most commonly with carbon dioxide (CO2), to ensure adequate visualisation and working space. Pneumoperitoneum raises intra-abdominal pressure, which may affect venous return, systemic haemodynamics, splanchnic circulation and hepatic blood flow. Experimental and clinical studies have shown that increased intra-abdominal pressure may lead to reduced portal venous flow and hepatic microcirculation leading to transient hepatic hypoperfusion. One clinical implication of this change in physiology is a transient elevation in serum liver enzymes postoperatively.[4-6] There have been multiple reports of raised levels of alanine aminotransferase (ALT) and aspartate aminotransferase (AST), especially within the first 24–48 hours post-LC.[4,7] Tan et al. compared the postoperative increase in serum ALT and AST values between LC and OC in a total of 286 and 40 patients, respectively, and found that the increase after LC was statistically significant, however, the increase after OC was much smaller and not statistically significant. The liver dysfunction that accompanies laparoscopic cholecystectomy is usually transient, with the levels of enzymes usually approaching the pre-operation values by the seventh day after the operation.[7] The exact mechanism responsible for postoperative elevation of hepatic enzymes after LC has not been fully established. One of the major contributors is considered to be the CO2 pneumoperitoneum. Increased intraabdominal pressure may reduce portal venous and hepatic arterial perfusion. 5[7] Other possible mechanisms include transient hepatic ischaemia and reperfusion, mechanical trauma to the liver and gallbladder, effects of positioning of the patient, use of electrocautery, and changes in splanchnic circulation associated with general anesthesia.[7-9] The magnitude of these changes may also be dependent on the duration and the pressure of neumoperitoneum. The effects of varying pressures of pneumoperitoneum have been studied and it has been shown that increased intra-abdominal pressures may be associated with more marked postoperative alterations in hepatic enzymes, thus providing evidence for a possible pressure-dependent effect on hepatic perfusion.[8,10] Changes in postoperative liver function tests (LFTs) are important because elevated AST, ALT, bilirubin, alkaline phosphatase (ALP), and gamma-glutamyl transferase (GGT) may sometimes raise concern about biliary obstruction, bile duct injury, hepatic injury, or other postoperative complications. Transient elevations of these parameters can occur even after an uncomplicated LC and do not necessarily represent clinically relevant hepatic injury.[11,12] In a comparison between LC and OC, elevations of bilirubin, AST and ALT after surgery were more pronounced after LC, but most of the changes were transient and trended toward normal within several days.[11] Similarly, recent data show that elevations of liver enzymes after LC are mostly transient and are rarely associated with negative clinical consequences in the absence of pre-existing liver disease or surgical complications.[12] The distinction between a benign transient postoperative biochemical change and clinically significant hepatic dysfunction is therefore important in postoperative management. Unnecessary investigations or interventions based on isolated postoperative elevations may increase patient anxiety, healthcare costs and hospital utilisation. Alternatively, a persistent or excessive rise in liver function parameters may warrant evaluation for biliary obstruction, retained common bile duct stones, bile duct injury, hepatic ischaemia or other complications. Thus, knowledge of the expected pattern and degree of postoperative hepatic biochemical changes after different surgical approaches has clinical applicability.[11-13] Several studies have compared postoperative hepatic function after LC and OC, but the magnitude and pattern of changes reported in the literature have not been completely consistent. Differences among studies may be accounted for by differences in patient characteristics, indications for surgery, pneumoperitoneal pressure, duration of surgery, anaesthetic techniques, timing of postoperative blood sampling, and laboratory methods.[10,13] In addition, the available evidence has been mainly from populations outside the North Coastal region of Andhra Pradesh. Clinical and demographic characteristics of the local population may differ from those reported from other populations and underline the importance of generating region-specific evidence.

The North Coastal Region of Andhra Pradesh has a large population served by tertiary and secondary healthcare institutions where both laparoscopic and open cholecystectomy are still being performed depending on patient characteristics, disease severity, surgical expertise and resources available. A comparative assessment of postoperative liver function in this population could therefore provide useful evidence for the biochemical effects of the two surgical approaches in routine clinical practice. Given the common use of LC and the possible effect of pneumoperitoneum on liver blood flow, a systematic comparison of postoperative liver function between LC and OC is clinically important. The present study was undertaken to compare the changes in hepatic functions following laparoscopic and open cholecystectomy in patients of North Coastal Region of Andhra Pradesh with special reference to post operative change of serum bilirubin, AST, ALT, ALP and other biochemical parameters. The aim of the study was to determine if the laparoscopic approach is associated with greater transient postoperative hepatic functional changes than the conventional open surgery and to determine the clinical significance and temporal pattern of these changes.

Materials and Methods

This study was a prospective, hospital-based comparative observational research conducted at the Department of General Surgery, Great Eastern Medical School and Hospital (GEMS) in

Srikakulam, Andhra Pradesh, over 23 months from February 2024 to December 2025. It aimed to compare the postoperative changes in hepatic biochemical parameters between patients undergoing laparoscopic cholecystectomy (LC) and those undergoing open cholecystectomy (OC). The study received ethical approval from the Institutional Research Committee and the Institutional Ethics Committee of GEMS, adhering to ethical principles for human participant research. Participants were informed about the study's purpose and procedures, and written informed consent was collected, ensuring that participation was voluntary and that patients could withdraw without impacting their medical care.

A total of 66 consecutive eligible patients scheduled for elective cholecystectomy were enrolled based on predefined inclusion and exclusion criteria. Among these, 46 patients underwent LC and 20 patients underwent OC, with the surgical choice determined by the treating surgical team based on clinical considerations rather than randomization.

Sample Size Calculation: The sample size for the study was calculated based on the primary outcome: the change in serum alanine aminotransferase (ALT) levels from preoperative baseline to postoperative Day 1 in laparoscopic versus open cholecystectomy groups. Data from Tan et al. showed a significant increase in ALT from 23.3 ± 11.6 U/L to 38.8 ± 15.2 U/L post-laparoscopic surgery, while open surgery's increase was from 21.8 ± 16.7 U/L to 28.2 ± 13.7 U/L. The estimated difference in change between groups was about 9.1 U/L with a pooled standard deviation of 14.5 U/L, resulting in a standardized effect size (Cohen's d) of approximately 0.63. To achieve a significance level of 0.05 and 80% power with a 2.3:1 allocation ratio, the estimated minimum sample size required was about 95 participants (66 in the LC group and 29 in the OC group). After accounting for a 10% attrition rate, the target recruitment was adjusted to around 106 participants. Ultimately, 66 eligible patients were recruited: 46 in the LC group and 20 in the OC group. The results should be viewed as exploratory, indicating limited statistical power, and interpreted using effect estimates and confidence intervals instead of relying solely on statistical significance.

Inclusion & Exclusion Criteria

Patients eligible for the study were aged 18 to 60, undergoing elective cholecystectomy for gallbladder disease, with normal preoperative liver function tests, and willing to provide informed consent. Exclusion criteria included liver failure, significant chronic liver disease, cirrhosis, previous major abdominal surgeries that could affect outcomes, abnormal liver function tests, recent endoscopic biliary interventions, suspected bile duct obstruction, severe systemic infections, conversion from laparoscopic to open cholecystectomy, and major postoperative complications that could impact hepatic parameters.

Methods: The preoperative assessment involved a comprehensive clinical evaluation of all participants, documenting demographic and clinical variables such as age, sex, presenting symptoms, medical history, and the reason for surgery using a standard data collection form. Baseline liver function was assessed preoperatively, measuring total bilirubin, direct bilirubin, alanine aminotransferase (ALT), aspartate aminotransferase (AST), and alkaline phosphatase (ALP). Only patients with values within reference ranges were included. Surgical procedures included laparoscopic cholecystectomy (LC) and open cholecystectomy (OC). LC was performed under general anesthesia using a four-port technique, maintaining pneumoperitoneum with carbon dioxide, while OC followed a conventional approach. Data on surgery duration, intraoperative findings, and complications were documented.

Assessment of hepatic function involved blood samples collected at three time points: preoperative, postoperative Day 1, and postoperative Day 7, analyzing ALT, AST, total and direct bilirubin, and ALP with absolute and percentage changes from baseline calculated.

The primary outcome focused on the difference in serum ALT changes from baseline to postoperative Day 1, with secondary outcomes including changes in other liver function parameters, comparisons of LC and OC groups, and assessing the return of biochemical values toward preoperative levels by Day 7. Also examined were associations between surgical characteristics and postoperative hepatic changes and the documentation of complications that could impact liver function.

Postoperative follow-up included monitoring for complications such as fever, infection, bile leakage, and injuries, followed by clinical reevaluation and repeat liver function tests around Day 7. Data were prospectively collected by investigators using a standardized form, systematically entered into a password-protected database, and subject to quality control, employing consistent laboratory procedures and calibrated instruments throughout the study.

Statistical Analysis: Statistical analysis utilized R to summarize continuous variables as mean ± standard deviation for normal distributions, and median with interquartile range for non-normal ones, while categorical variables were expressed as frequencies and percentages. Comparisons between the LC and OC groups were made using t tests for normal continuous variables, Mann–Whitney U tests for non-normal ones, and chi-square or Fisher's exact tests for categorical data. Repeated measures analyses tracked liver function changes over time, with evaluations of differences between surgical approaches at various time points. A two-sided p value of <0.05 was considered significant, and effect size was emphasized due to a smaller-than-expected sample size. Missing data were managed transparently, and participant confidentiality was maintained through the use of unique identifiers and secure storage, presenting findings in aggregate to protect identities.

Results

Study Population and Baseline Characteristics: There were 66 patients who underwent an elective cholecystectomy in the current analysis. Of these, 46 (69.7%) were treated with laparoscopic cholecystectomy (LC) and 20 (30.3%) with open cholecystectomy (OC). 39 females (59.1%) and 27 males (40.9%) constituted the study population. The median age of the study population was 48 years (IQR: 38-57 years). Baseline demographics and clinical characteristics of the two groups are presented in Table 1. There were no significant differences in age and sex distribution between the LC and OC groups. The median time of surgery was shorter in the LC group than in the OC group. The median postoperative hospital stay was shorter in patients who had laparoscopic cholecystectomy. All patients included in the primary analysis had normal pre-operative liver function tests. Baseline levels of AST, ALT, total bilirubin and alkaline phosphatase were not significantly different between the two groups, suggesting that the hepatic biochemical status prior to surgery was similar.

Postoperative Changes in Liver Function: A transient postoperative increase in serum transaminases was observed after laparoscopic cholecystectomy. The most significant changes occurred on postoperative Day 1. In the LC group, median AST increased from 27 U/L (IQR: 22-36 U/L) at baseline to 51 U/L (IQR: 38-69 U/L) on postoperative Day 1. The median AST decreased to 29 U/L on postoperative Day 7 (IQR 24–35 U/L), approaching the preoperative value. Likewise, median ALT increased from 27 U/L (IQR 20–34 U/L) preoperatively to 49 U/L (IQR 36–68 U/L) on POD1. Median ALT was lower on day 7 (29 U/L, IQR: 22–37 U/L). Conversely, the postoperative changes of AST and ALT were less pronounced in the OC group. Median AST was slightly elevated on postoperative day 1 and returned toward baseline by day 7. ALT showed a similar pattern. The greatest difference in the change of transaminase levels between the groups was on postoperative day 1. There was a statistically significant difference in change from baseline in AST and ALT between the two surgical groups on Day 1 . However, these differences were no longer statistically significant by postoperative Day 7.

Changes in Serum Bilirubin: Serum bilirubin changes were relatively mild after either procedure. In the LC group, total bilirubin increased modestly on postoperative Day 1 compared with the preoperative value and returned toward baseline by Day 7. The OC group followed a similar pattern but the magnitude of change was less. Bilirubin change between groups was not statistically significant at either post-operative assessment. None of the patients included in the primary analysis developed clinically significant postoperative hyperbilirubinemia suggestive of biliary obstruction or bile duct injury.

Changes in Alkaline Phosphatase: Alkaline phosphatase showed a different pattern than transaminases. There was no clinically significant postoperative rise in ALP in either group. In the LC group, the median ALP was relatively stable on the postoperative Day 1 and decreased slightly on the Day 7. A similar trend was observed in the OC group. There was no statistically significant difference in ALP change between the two surgical groups at either postoperative time point.

Comparison of Hepatic Biochemical Parameters Between Surgical Groups: [Table 2] shows the detailed post-operative changes of hepatic biochemical parameters.

The primary outcome analysis showed a significant interaction between surgical approach and time postoperatively for AST and ALT, with greater increases after laparoscopic cholecystectomy in the immediate postoperative period. The greatest difference between groups was on postoperative Day 1. By postoperative Day 7, the AST and ALT values in the LC group were significantly decreased and similar to the corresponding values in the OC group. The group-by-time interaction was not as pronounced for bilirubin and ALP. Hepatic biochemical parameters change from baseline is summarised in Table 3.

Repeated-Measures Analysis: Repeated-measures analysis showed that time significantly affected the AST and ALT levels at the three measurement points. Significant time interaction with a large surgery group effect was also seen for these parameters, indicating a different post-operative trajectory for the LC and OC groups. Post-hoc analysis revealed the main difference was between the preoperative and postoperative Day 1 measure in the LC group. AST and ALT then decreased by postoperative Day 7. No significant group by time interaction was seen for bilirubin or ALP.

Operative Duration and Postoperative Hospital Stay: The median duration of surgery was about 90 minutes in the entire study population. The duration was longer in patients who underwent open cholecystectomy. Postoperative hospital stay was shorter in the LC group compared with the OC group. The difference was statistically significant, in line with the expected advantage of the minimally invasive approach for postoperative recovery.

Postoperative Complications: No major bile duct injuries were noted in the patients analysed in the primary analysis. According to the predetermined analytical protocol, patients with clinically important postoperative complications that could independently affect the liver function were excluded from the primary biochemical analysis and separately registered. At postoperative day 7, no patient had persistent elevation of hepatic biochemical parameters requiring further hepatobiliary intervention.

Summary of Outcomes: To summarise, a laparoscopic cholecystectomy led to a transient elevation in serum AST and ALT after surgery, with the peak observed on postoperative Day 1. These biochemical changes regressed significantly by postoperative Day 7 and were not associated with clinically evident hepatic dysfunction. In contrast, the changes in AST and ALT after open cholecystectomy were relatively minor. Differences between the two groups were most striking in the immediate postoperative period and were no longer statistically significant by the end of the first postoperative week. The data suggest that there may be a short-term biochemical change in hepatic function after laparoscopic cholecystectomy that may be related to the physiologic effects of carbon dioxide pneumoperitoneum, but that these changes are transient and reversible.

Table 1: Baseline demographic and clinical characteristics

Variable	LC (n=46)	OC (n=20)	Total (n=66)	P value
Age, years, median (IQR)	47 (37–55)	51 (41–59)	48 (38–57)	0.28
Male, n (%)	19 (41.3)	8 (40.0)	27 (40.9)	0.92
Female, n (%)	27 (58.7)	12 (60.0)	39 (59.1)	
Operative duration, min, median (IQR)	85 (70–105)	105 (90–125)	90 (75–110)	0.004
Hospital stay, days, median (IQR)	3 (3–4)	5 (4–6)	4 (3–5)	<0.001
Preoperative AST, U/L	27 (22–36)	28 (23–37)	27 (22–36)	0.71

Preoperative ALT, U/L	26 (20–34)	28 (21–35)	27 (20–34)	0.64
Preoperative bilirubin, mg/dL	0.76 (0.62–0.88)	0.79 (0.64–0.91)	0.77 (0.63–0.89)	0.57
Preoperative ALP, U/L	69 (54–87)	72 (55–91)	70 (54–88)	0.62

Table 2: Liver function parameters at baseline and during the first postoperative week

Parameter	Time	LC (n=46)	OC (n=20)	P value
AST (U/L)	Preoperative	27 (22–36)	28 (23–37)	0.71
	Day 1	51 (38–69)	35 (29–45)	0.003
	Day 7	29 (24–35)	30 (25–36)	0.64
ALT (U/L)	Preoperative	26 (20–34)	28 (21–35)	0.64
	Day 1	49 (36–68)	34 (28–43)	0.006
	Day 7	29 (22–37)	30 (24–36)	0.73
Total bilirubin (mg/dL)	Preoperative	0.76 (0.62–0.88)	0.79 (0.64–0.91)	0.57
	Day 1	0.81 (0.66–1.02)	0.79 (0.65–0.94)	0.69
	Day 7	0.75 (0.61–0.87)	0.76 (0.62–0.89)	0.83
ALP (U/L)	Preoperative	69 (54–87)	72 (55–91)	0.62
	Day 1	67 (52–86)	70 (54–88)	0.68
	Day 7	59 (47–74)	61 (48–76)	0.71

Table 3: Change in hepatic biochemical parameters from baseline.

Parameter	LC: Day 1 − baseline	OC: Day 1 − baseline	P value	LC: Day 7 − baseline	OC: Day 7 − baseline	P value
AST (U/L)	+24	+7	0.002	+2	+2	0.91
ALT (U/L)	+23	+6	0.004	+3	+2	0.78
Bilirubin (mg/dL)	+0.05	0.00	0.52	−0.01	−0.03	0.68
ALP (U/L)	−2	−2	0.94	−10	−11	0.82

Table 4: Repeated-measures analysis

Parameter	Effect of time	Effect of surgical group	Group × time interaction
AST	<0.001	0.18	0.004
ALT	<0.001	0.21	0.007
Bilirubin	0.18	0.74	0.62
ALP	0.11	0.69	0.81

Discussion

The aim of the present study was to evaluate the postoperative changes in liver biochemical parameters after laparoscopic cholecystectomy (LC) as compared to open cholecystectomy (OC) with special emphasis on the immediate postoperative period and the recovery by the end of the first postoperative week. The primary finding of this study was that LC was associated with a greater transient increase in serum aminotransferases, especially AST and ALT, during the first postoperative day, but these abnormalities regressed substantially by postoperative Day 7. By contrast, the changes in bilirubin and alkaline phosphatase were relatively small and were not significantly different between the two surgical approaches. The results are reported in [Table 2 and 3].

Baseline characteristics comparison The two surgical groups were broadly similar in terms of age, sex distribution and pre-operative hepatic biochemical parameters [Table 1]. Importantly, all patients included in the primary analysis had normal pre-operative liver function tests. This is important as pre-existing hepatic dysfunction could independently influence postoperative enzyme levels and confound the distinction of the effects of the surgical approach from the underlying liver disease. The comparable baseline liver function in the groups further supports the interpretation that the differences in AST and ALT on postoperative day 2 were mainly attributable to perioperative factors and not preoperative hepatic dysfunction. Similar methods have been employed in earlier comparative studies in which patients with normal preoperative liver function were investigated to specifically evaluate the effect of laparoscopic pneumoperitoneum on postoperative hepatic biochemical variations.[14,15]

Transient rise of AST and ALT after laparoscopic cholecystectomy: The most important finding of the present study was the significant postoperative rise of AST and ALT after LC. As seen in [Table 2], median AST increased from 27 U/L at baseline to 51 U/L on postoperative Day 1 in the LC group, and median ALT increased from 26 U/L to 49 U/L. These increases were far higher than in the OC group. Table 3 shows the baseline-adjusted changes. Differences between the groups were statistically significant on postoperative Day 1 as shown in [Table 2].

This is in agreement with the observations of Tan et al. who studied 286 patients undergoing LC and 40 undergoing OC and found significant increases in AST and ALT during the first 48 hours after LC, while no significant postoperative changes were observed after OC . The enzyme levels had returned to normal by the seventh postoperative day.[14] The authors suggested that the carbon dioxide pneumoperitoneum was an important factor for this transient elevation of the hepatic enzymes.[14]

Similar results were seen in a prospective comparative study by Sabre et al. who demonstrated a significantly greater postoperative increase in AST and ALT in patients undergoing LC than in patients undergoing OC. The peak elevations were at 24 hours and then fell, suggesting that the hepatic biochemical disturbance following LC is usually transient and self limiting.[15] Our results exhibit a similar pattern of time. The results are also in accord with the study by Singal et al. who compared postoperative liver function after LC and OC and found a significantly higher proportion of patients with elevated ALT and AST after LC. Importantly, total bilirubin, ALP, GGT and other biochemical parameters showed much smaller or insignificant changes supporting the observation that the postoperative biochemical effect is predominantly hepatocellular, rather than cholestatic.[16]

Possible mechanisms for the postoperative rise in hepatic enzymes: The transient elevation in AST and ALT after LC is most likely associated with the physiologic effects of carbon dioxide pneumoperitoneum. Pneumoperitoneum raises intraabdominal pressure, which may decrease portal venous flow and alter hepatic perfusion. Therefore, systemic haemodynamic and splanchnic circulation changes may result in transient hepatic hypoperfusion.Experimental and clinical data support the association of pneumoperitoneal pressure with postoperative alterations of liver enzymes.[16,17] Gupta et al. compared high-pressure and low-pressure pneumoperitoneum during LC and showed significantly greater postoperative elevation of AST, ALT and bilirubin in patients exposed to higher intra-abdominal pressure.[17] Their results suggest that the pressure of pneumoperitoneum may influence the degree of hepatic perfusion impairment. The duration of pneumoperitoneum may also play a role in postoperative hepatic biochemical alterations. Increased intra-abdominal pressure for prolonged periods may lead to a more sustained decrease in hepatic blood flow. Other suggested mechanisms involve transient hepatic ischemia-reperfusion, effects of carbon dioxide absorption, changes in venous return, anesthetic-related haemodynamic changes, and mechanical manipulation of the liver during surgery.[16-18]

There was, however, no evidence of clinically significant hepatic injury in the present study. Postoperative increases were small and transient and approached baseline by postoperative Day 7. Therefore, the observed biochemical changes should not be interpreted as clinically important hepatic dysfunction.

Liver enzymes are back to normal by day 7 post-op

An important finding was a significant regression of AST and ALT by the postoperative Day 7. As shown in Table 2, AST in the LC group decreased from a median of 51 U/L on postoperative Day 1 to 29 U/L on Day 7, and ALT decreased from 49 U/L to 29 U/L. Likewise, differences in the change from baseline between groups were no longer statistically significant by Day 7 [Table 3]. The repeated-measures analysis indicated significant effects of time and group-by-time interaction for AST and ALT [Table 4]. This implies a different pattern of postoperative hepatic enzyme change between the two surgical approaches with the main difference in the immediate postoperative period. This temporal trend is in agreement with previous literature. Tan et al. reported that the postoperative increases in AST and ALT after LC were transient and returned to the preoperative values by approximately the seventh postoperative day.[14] Also, Singal et al. noticed that the postoperative period was related to a decrease in abnormal liver enzymes after the initial postoperative period.[16] More recent evidence also points to the transient nature of post-operative transaminase elevations after LC, with the majority of abnormalities resolving in about one week.[19] By Day 7, the normalisation or near normalisation of transaminases is reassuring from a clinical standpoint, and supports the interpretation that the observed elevations in enzymes represent a transient physiologic response rather than ongoing hepatic injury.

Alkaline phosphatase and bilirubin: In the present study, relatively minor changes in bilirubin and ALP were observed as compared to AST and ALT. Bilirubin was relatively stable in the two groups and there was no significant difference between the two groups as shown in [Table 2]. Similarly, there was no clinically significant postoperative increase in ALP. These results are in agreement with previous comparative studies. Bilirubin and ALP did not change as much as AST and ALT after LC as shown by Singal et al.[16] In a randomised study evaluating different pneumoperitoneal pressures, significant postoperative changes were found in AST and ALT, while ALP remained relatively unchanged.[17] The relative stability of ALP and bilirubin in the present study is important because a marked or persistent elevation of these parameters in the postoperative period may raise concern for biliary obstruction, retained common bile duct stones, bile duct injury or other hepatobiliary complications. The absence of such a pattern in the present study and the exclusion of patients with clinically significant biliary complications from the primary biochemical analysis support the interpretation that the transaminase elevations after surgery were transient physiological changes rather than evidence of obstructive hepatobiliary disease.

Clinical relevance of the observed biochemical alterations: An important clinical implication of the present findings is that transient postoperative AST and ALT elevations after LC should be interpreted in light of the timing of surgery and the clinical condition of the patient. An isolated elevation of transaminases in the first postoperative day, without jaundice, abdominal deterioration, biliary obstruction or other clinical disturbances, may be a transient physiological response to pneumoperitoneum and not a surgical complication.

Similar conclusions were drawn before in previous studies that transient postoperative liver enzyme elevations after uncomplicated LC do not generally lead to adverse clinical outcomes.[14,16,19] Thus, knowledge of this expected biochemical pattern may help to avoid unnecessary investigations and interventions in otherwise clinically stable patients.

However, the finding should not be used to dismiss significant postoperative liver test abnormalities. Complications should be evaluated appropriately in the setting of persistent or progressively rising transaminases, particularly when accompanied by elevated bilirubin or ALP, clinical jaundice, abdominal pain, fever or other signs of biliary pathology.

Length of operation and post-operative recovery: In this study, the median operative duration and postoperative hospital stay were less in the LC group than in the OC group [Table 1]. This reduced length of postoperative stay is in line with the well-known recovery benefits of minimally invasive cholecystectomy. Although the current study was designed mainly to assess the biochemical changes in the liver rather than the recovery outcomes, the results confirm the general clinical benefits of LC. But the shorter hospital stay should be interpreted cautiously, because postoperative length of stay may be influenced by several factors including institutional discharge practices, patient characteristics, surgical complexity, and postoperative complications.

The relationship between operative time and changes in hepatic enzymes is also biologically plausible. Prolonged duration of pneumoperitoneum may contribute to prolonged altered hepatic perfusion. Previous studies have shown that the pneumoperitoneal pressure and duration of the laparoscopic surgery may affect the postoperative liver enzyme changes.[17,19] However, given the relatively small sample size of this study, any association between operative time and biochemical changes should be considered as exploratory.

Comparison with prior studies: The overall pattern observed in the present study is in accordance with the literature. Significant postoperative elevations of AST and ALT were reported by Tan et al after LC but not OC, with recovery by Day 7.14 Similarly, Sabre et al. in their comparative study showed more postoperative changes in liver enzymes after LC than after OC.15Signal et al. also reported significantly more frequent postoperative elevation of AST and ALT after LC with relatively stable bilirubin and ALP levels.[16]

Further support for the mechanism comes from the study by Gupta et al. who demonstrated that higher pneumoperitoneal pressure is associated with greater postoperative changes in liver function tests.[17] This suggests that the observed biochemical changes may not simply be a consequence of laparoscopic surgery itself but may be related specifically to the physiological effects of pneumoperitoneum.

published in 2024 also reported significant increases in AST, ALT and bilirubin after LC, whereas ALP and prothrombin time did not show significant changes.[18] These findings further support the concept that transient biochemical changes after surgery are mainly represented by hepatocellular enzymes and not by persistent cholestatic dysfunction.

A recent extensive review of the literature came to a similar conclusion that post-operative elevations of AST and ALT are common after LC and usually return toward baseline by approximately Day 7, but clinically important adverse outcomes are infrequent in patients without underlying hepatic disease or post-operative complications.[19]

Strengths& Limitations: The study presents strengths including a prospective assessment of liver function at key time points (preoperatively, Day 1, and Day 7 postoperatively) and the exclusion of patients with pre-existing liver dysfunction, which minimized confounding variables. Multiple hepatic parameters were evaluated, aiding in the differentiation of biochemical changes. However, limitations include a small sample size, particularly in the OC group, and the study's single-centre design, limiting generalizability. The lack of randomization raises potential selection bias. Additionally, the limited follow-up period restricts understanding of long-term biochemical changes. The findings indicate that mild elevations in AST and ALT post-LC may be transient in patients with normal preoperative hepatic function. Future multicentre studies should explore various factors affecting postoperative liver function and compare different pneumoperitoneal pressures.

Conclusion

Laparoscopic cholecystectomy is associated with transient postoperative elevation of hepatic transaminases especially AST and ALT during the first postoperative day in comparison to open cholecystectomy. Most of these biochemical changes return to preoperative levels by the end of the first postoperative week, with bilirubin and alkaline phosphatase remaining relatively stable. The results suggest that transient rise in liver enzymes after laparoscopic cholecystectomy is probably due to physiologic effects of pneumoperitoneum rather than clinically significant hepatic injury. Further adequately powered multicentre studies are required to confirm these findings in the North Coastal Region of Andhra Pradesh.

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Conflicts of interest

There are no conflicts of interest.

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