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Effect of Cholecystectomy on Serum Lipid Profile in Patients with Cholelithiasis: A Prospective Study

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Abstract
Background: Cholelithiasis is frequently associated with dyslipidaemia, suggesting a metabolic association. Cholecystectomy is the definitive treatment, but its effect on lipid profile remains debated.
Objectives: To evaluate changes in serum lipid profile pre- and post-operatively in patients undergoing cholecystectomy for cholelithiasis.
Methods: A prospective longitudinal study was conducted on 40 patients undergoing cholecystectomy for ultrasonography diagnosed cholelithiasis. Serum total cholesterol (TC), low-density lipoprotein (LDL), high-density lipoprotein (HDL), very low-density lipoprotein (VLDL), and triglycerides (TG) were measured preoperatively and one month postoperatively. Statistical significance was assessed using paired t-tests.
Results: Postoperatively, there was a statistically significant reduction in mean serum TC, LDL, and TG levels ($p < 0.001$). HDL levels increased significantly. VLDL also showed a significant reduction. Cholesterol stones were most common (51%), followed by mixed (43%) and pigment stones (6%).
Conclusion: Cholecystectomy in patients with cholelithiasis leads to significant improvement in serum lipid profiles. This suggests metabolic benefits beyond symptom relief and supports routine lipid monitoring in such patients.

Keywords: Cholelithiasis, Cholecystectomy, Dyslipidaemia, Lipid profile, Metabolic syndrome

Introduction

Cholelithiasis remains one of the most prevalent gastrointestinal disorders globally, contributing significantly to surgical workload and healthcare expenditures. It is characterized by the presence of gallstones within the gallbladder, which can be cholesterol, pigment, or mixed types. These stones often form silently and are frequently diagnosed incidentally during imaging for unrelated conditions. However, symptomatic gallstones can lead to acute complications including biliary colic, cholecystitis, pancreatitis, and cholangitis, necessitating surgical intervention.

Cholelithiasis is increasingly being recognized not only as a local hepatobiliary pathology but also as a manifestation of underlying systemic metabolic derangements. Several studies have established a strong association between gallstone formation and dyslipidaemia. Commonly observed alterations in the lipid profile of patients with gallstones include elevated total cholesterol (TC), triglycerides (TG), low-density lipoprotein cholesterol (LDL-C), and very low-density lipoprotein (VLDL), along with decreased high-density lipoprotein cholesterol (HDL-C). These changes are also elements of the broader metabolic syndrome, which encompasses insulin resistance, central obesity, hypertension, and dyslipidaemia — all recognized risk factors for cardiovascular disease.

The pathogenesis of cholesterol gallstone formation is multifactorial, involving hepatic hypersecretion of cholesterol into bile, altered bile acid metabolism, gallbladder stasis, and increased mucin secretion. These pathophysiological processes are often influenced by factors such as genetics, gender (with women affected more than men), obesity, diet, and hormonal influences like oestrogen and oral contraceptives.

Cholecystectomy, the surgical removal of the gallbladder, is the definitive treatment for symptomatic cholelithiasis. While it effectively relieves symptoms and prevents complications, its effect on the systemic metabolic milieu — particularly lipid metabolism — remains a subject of active investigation. Several researchers, including Kumar *et al.* (2020) [2], have reported statistically significant improvements in serum lipid profiles following cholecystectomy, suggesting that removal of the gallbladder may influence

cholesterol homeostasis and bile acid circulation.

Despite these findings, data on the impact of cholecystectomy on lipid profiles among Indian patients remain limited and somewhat inconsistent, especially when stratified by stone type (cholesterol vs. mixed vs. pigment). Furthermore, most previous studies have been short-term or have not accounted for confounding factors like diet, weight changes, or metabolic disorders.

Therefore, the present study was undertaken to evaluate the changes in serum lipid profile in patients with cholelithiasis undergoing cholecystectomy, with a focus on pre- and post-operative levels. By identifying potential improvements in lipid parameters post-surgery, this study also aims to explore whether cholecystectomy may have additional metabolic benefits beyond the resolution of biliary symptoms.

Materials and Methods

Study Design and Setting

This was a prospective, longitudinal observational study conducted over a period of 24 months in the Department of General Surgery, Sri Siddhartha Medical College and Hospital, Tumkur, Karnataka, India, affiliated to SSAHE. Ethical clearance was obtained from the Institutional Ethics Committee prior to the commencement of the study. Informed consent was obtained from all patients participating in the study.

Study Population

The study included patients aged 20 to 60 years who were diagnosed with cholelithiasis and scheduled to undergo elective cholecystectomy. The diagnosis was confirmed pre-operatively using ultrasonography (USG) and, where required, computed tomography (CT) scans.

Inclusion Criteria

- Patients aged 20–60 years with ultrasonography confirmed cholelithiasis.
- Patients undergoing elective cholecystectomy (either open or laparoscopic).
- Patients willing to participate and provide informed consent.

Exclusion Criteria

- Patients with comorbid conditions known to influence lipid metabolism such as:
- Diabetes mellitus.
- Nephrotic syndrome.
- Chronic liver disease or cirrhosis.
- Renal failure.
- Pancreatitis.
- Hypothyroidism.
- Morbid obesity.
- Sickle cell disease and other hemoglobinopathies.
- Pregnant women.
- Patients on lipid-lowering agents or antidiabetic medications.
- Patients unwilling or unable to provide informed consent or comply with follow-up.

Sample Size and Sampling Method

A total of 40 patients who met the eligibility criteria were recruited by convenience sampling. All patients were followed up for a period of one month post-operatively.

Data Collection and Variables

Detailed history, clinical examination findings, and demographic data were recorded. Blood samples were collected after an overnight fast of at least 10 hours.

Biochemical Parameters Measured

- Total Cholesterol (TC)
- Low-Density Lipoprotein (LDL)
- High-Density Lipoprotein (HDL)
- Very Low-Density Lipoprotein (VLDL)
- Triglycerides (TG)

These parameters were evaluated:

- Pre-operatively (within 24 hours prior to surgery).
- Post-operatively at 1 month following cholecystectomy.

Lipid levels were analysed using standard enzymatic colorimetric methods on an automated analyser.

Stone analysis was also performed post-operatively to classify the type of gallstones (cholesterol, pigment, or mixed).

Surgical Technique: All patients underwent standard cholecystectomy (laparoscopic) as per the surgeon's discretion. Post-operative care was uniform for all patients and included dietary advice and mobilization protocols.

Statistical Analysis

Data were compiled using Microsoft Excel and analysed using SPSS (version 20.0). Continuous variables were presented as mean ± standard deviation (SD). A paired Student's t-test was used to compare pre- and post-operative lipid profile parameters. A p-value of less than 0.05 was considered statistically significant.

Results

Demographic Profile

A total of 40 patients diagnosed with cholelithiasis and planned for elective cholecystectomy were enrolled in the study. The majority of the patients (40%) were in the age group of 41–50 years, followed by 25% in the 31–40 years group. The male-to-female ratio was approximately 1:1.2, with a slight female preponderance.

Gallstone Composition

Upon chemical analysis of retrieved gallstones:

- Cholesterol stones were the most common, found in 51% of cases.
- Mixed stones were identified in 43% of patients.
- Pigment stones accounted for 6% of cases.

Pre-Operative Lipid Profile

Pre-operative evaluation revealed deranged lipid profiles in a significant number of patients:

- Elevated total cholesterol (>200 mg/dL) in 76% of cases.
- Elevated LDL (>130 mg/dL) in 66%.
- Elevated triglycerides (>150 mg/dL) in 86%.
- Low HDL (<40 mg/dL) in 42%.
- Elevated VLDL was noted in correlation with raised triglycerides.

This pattern was more pronounced in patients with cholesterol and mixed stones compared to those with pigment stones.

Post-Operative Lipid Profile (1 Month After Surgery):
Significant changes in the lipid profile were observed one month after cholecystectomy.

Table 1: Comparison of Pre- and Post-Operative Lipid Profile Parameters

Parameter	Pre-operative (mean ± SD)	Post-operative (mean ± SD)	p-value
Total Cholesterol (mg/dL)	215.6 ± 24.7	185.4 ± 22.2	< 0.001
LDL (mg/dL)	155.3 ± 21.9	130.6 ± 18.5	< 0.001
HDL (mg/dL)	45.1 ± 8.4	55.2 ± 7.8	< 0.001
Triglycerides (mg/dL)	175.8 ± 26.3	100.2 ± 19.6	< 0.001
VLDL (mg/dL)	35.2 ± 5.6	28.4 ± 4.3	< 0.001

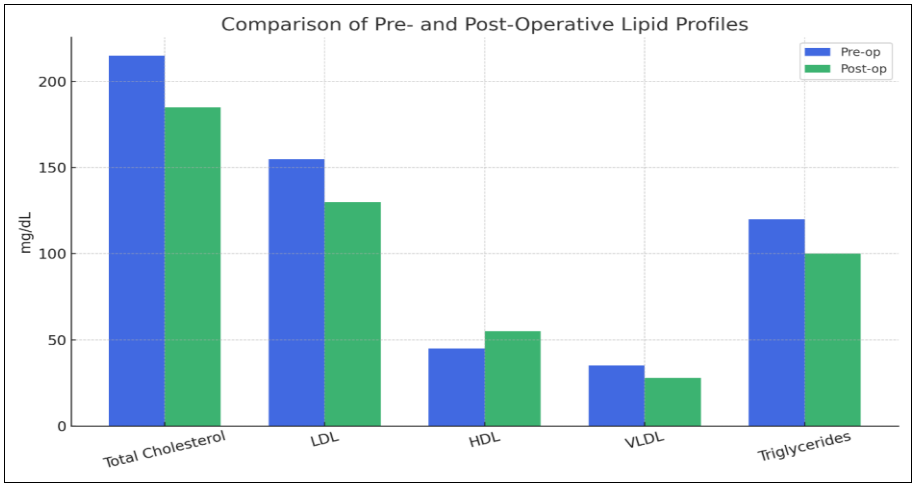

Fig 1: Comparison of pre- and post- operative lipid profile.

These differences were found to be statistically significant using the paired Student's t-test.

Stone Type–Wise Lipid Response

- Cholesterol Stone Group: Showed the most significant reduction in TC, LDL, TG, and VLDL levels, with notable improvement in HDL.
- Mixed Stone Group: Demonstrated similar trends, although slightly less pronounced.
- Pigment Stone Group: Showed relatively modest lipid profile changes, though HDL increase was still evident.

Graphical Representation

A comparative bar chart demonstrated clear improvement in lipid parameters across all groups, with the most profound changes seen in patients with cholesterol stones.

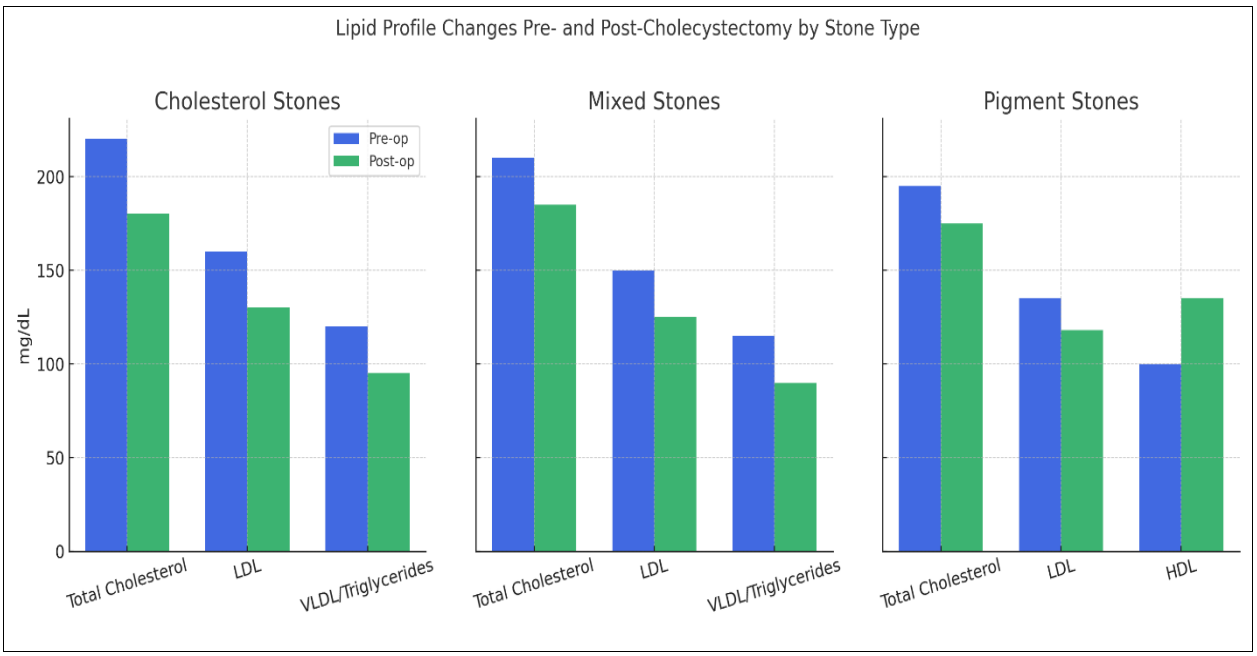

Fig 2: Comparison of pre- and post-operative lipid profile changes as per stone type

Discussion

Gallstone disease is well-established as a common hepatobiliary disorder, often associated with metabolic syndrome and dyslipidaemia. The current study evaluated the changes in lipid profile parameters before and after cholecystectomy in patients with cholelithiasis, highlighting the metabolic implications of gallstone disease and its surgical treatment.

Our findings reveal that patients with gallstones commonly present with significantly deranged lipid profiles. Elevated total cholesterol, LDL, triglycerides, and VLDL, along with decreased HDL levels, were frequently observed pre-operatively. These findings are consistent with previous studies by Ahmed *et al*., Jindal *et al*., and Kumar *et al*., which suggested that gallstone formation is intricately linked with abnormal lipid metabolism.

One month following cholecystectomy, we observed a statistically significant decrease in total cholesterol, LDL, VLDL, and triglyceride levels, along with a significant increase in HDL levels. This pattern suggests a partial normalization of lipid metabolism post-surgery, potentially attributed to the restoration of bile acid dynamics, improved enterohepatic circulation, and altered hepatic cholesterol secretion. HDL, known for its anti-atherogenic properties, showed a consistent post-operative rise, which may indicate a reduced long-term risk of cardiovascular events in these patients.

Patients with cholesterol and mixed stones demonstrated more pronounced lipid abnormalities and post-operative improvements compared to those with pigment stones. This supports the hypothesis that cholesterol stones are more directly linked to lipid dysregulation.

Notably, all lipid parameters improved significantly even within a short 1-month postoperative follow-up. However, the degree of change may continue to evolve over time, which longer follow-up studies could confirm.

Our study did not include patients with diabetes, obesity, or thyroid dysfunction to eliminate confounding factors known to affect lipid metabolism. While this strengthens internal validity, it also limits the generalizability of findings to patients with comorbidities.

Limitations

- The sample size was relatively small and drawn from a single tertiary care centre.
- The follow-up period was limited to 1 month; longer-term metabolic outcomes remain unassessed.
- Other components of metabolic syndrome, such as insulin resistance and BMI changes, were not evaluated.

Despite these limitations, the study provides robust evidence that cholecystectomy may have metabolic benefits in addition to relieving biliary symptoms. Monitoring lipid profiles in patients with cholelithiasis, both before and after surgery, may help guide cardiovascular risk reduction strategies.

Conclusion

This study demonstrates that cholelithiasis is commonly associated with significant derangements in serum lipid profiles, particularly elevated total cholesterol, LDL, VLDL, and triglycerides, with decreased HDL levels. Cholecystectomy not only resolves the symptoms of gallstone disease but also leads to significant improvement in these lipid parameters within one-month post-surgery. These findings suggest a potential cardiometabolic benefit of cholecystectomy in appropriately selected patients. Routine assessment of serum lipid profiles in cholelithiasis patients, followed by post-operative re-evaluation, should be considered as part of comprehensive surgical and metabolic care. Further large-scale, multi-centre studies with longer follow-up are warranted to better understand the long-term metabolic effects of cholecystectomy and to explore whether such changes translate into reduced cardiovascular morbidity and mortality.

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Conflict of Interest: The authors declare no conflicts of interest.

Ethical Approval: Approved by the Institutional Ethics Committee.

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