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RESEARCH ARTICLE

COMPARATIVE STUDY OF PRE AND POST-OPERATIVE SERUM LIPID PROFILES IN PATIENTS OF GALL STONE DISEASES

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Abstract

Background: Cholelithiasis is a common gastrointestinal disorder treated primarily by cholecystectomy. While the procedure effectively addresses gallstone-related symptoms, its impact on serum lipid profiles remains a subject of ongoing research.

Aim: To evaluate the effects of cholecystectomy on serum lipid profiles in patients with symptomatic cholelithiasis.

Methodology: This prospective study included 56 patients (30 females, 26 males) aged 20-80 years undergoing cholecystectomy for symptomatic cholelithiasis. Serum lipid parameters, including very-low-density lipoprotein (VLDL), triglycerides (TG), high-density lipoprotein (HDL), low-density lipoprotein (LDL), total cholesterol (TC) and TC: HDL ratio, were measured preoperatively and one month postoperatively. Paired sample t-tests used to compare pre- and postoperative values.

Results: Significant improvements were observed across all lipid parameters one-month post-cholecystectomy. VLDL decreased from 37.63±12.3 to 31.36±8.7 mg/dL ($p<0.001$), TC from 195.70±59.842 to 158.4±44.0 mg/dL ($p<0.001$), TG from 202.02±199.752 to 148.86±105.011 mg/dL ($p<0.001$), and LDL from 110.23±41.0 to 87.30±32.0 mg/dL ($p<0.001$). HDL increased from 37.75±10.9 to 48.04±13.7 mg/dL ($p<0.001$). The TC: HDL ratio improved from 4.96±1.52 to 3.44±0.99 ($p=0.003$).

Conclusion: Cholecystectomy benefits serum lipid profiles in patients with symptomatic cholelithiasis, potentially offering additional metabolic benefits beyond gallstone symptom resolution. These findings suggest broader health implications of gallbladder removal and highlight the need for long-term follow-up studies to understand its impact on cardiovascular risk fully.

Introduction:-

Gallstone disease, or cholelithiasis, affects millions worldwide, with a prevalence of 6-9% in India's adult population [1]. Gallstone formation is linked to bile supersaturation, impaired gallbladder motility, and metabolic syndrome, which includes obesity, high blood pressure, and abnormal lipid levels [2]. Cholesterol supersaturation in bile is a

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key factor in gallstone formation, and lifestyle changes have increased the incidence of both gallstone disease and dyslipidaemia [3].

Cholecystectomy, the surgical removal of the gallbladder, is the standard treatment for symptomatic gallstones. Studies show it reduces total cholesterol, LDL, and triglycerides while increasing HDL, potentially reducing cardiovascular risk [4]. Post-surgery changes in bile flow and composition affect cholesterol absorption and hepatic lipid synthesis, influencing overall lipid metabolism [5].

This study aims to compare pre- and postoperative lipid profiles, including HDL, triglycerides, total cholesterol, LDL, and the Chol/HDL ratio, in patients undergoing cholecystectomy. The findings will help optimize postoperative care and improve long-term cardiovascular health outcomes.

Methodology:-

Patients aged 18 and above diagnosed with gall stones disease admitted to the Department of General Surgery at Ramaiah Medical college hospital who were planned for elective cholecystectomy were included for this study. The diagnosis was based on clinical picture, supported by ultrasonography confirmed pre-operatively. Informed consent was taken prior to the study. The patients suffering from the condition which are known to alter the lipid levels e.g., diabetes mellitus, renal failure, hypothyroidism, nephritic syndrome were excluded from the study. Complete lipid profile (which includes total serum lipids, serum cholesterol, serum triglycerides, HDL cholesterol, LDL cholesterol) were evaluated pre-operatively and post-operatively after one month.

Materials and Method:-

Source Of Data:

Study design-Prospective observational study
Study place- Tertiary hospital , Bangalore
Study period- From August 2022 to August 2024

Method Of Collection

Inclusion criteria-

Patients of age 18-60 who were diagnosed with symptomatic cholelithiasis and undergoing cholecystectomy.

Exclusion criteria-

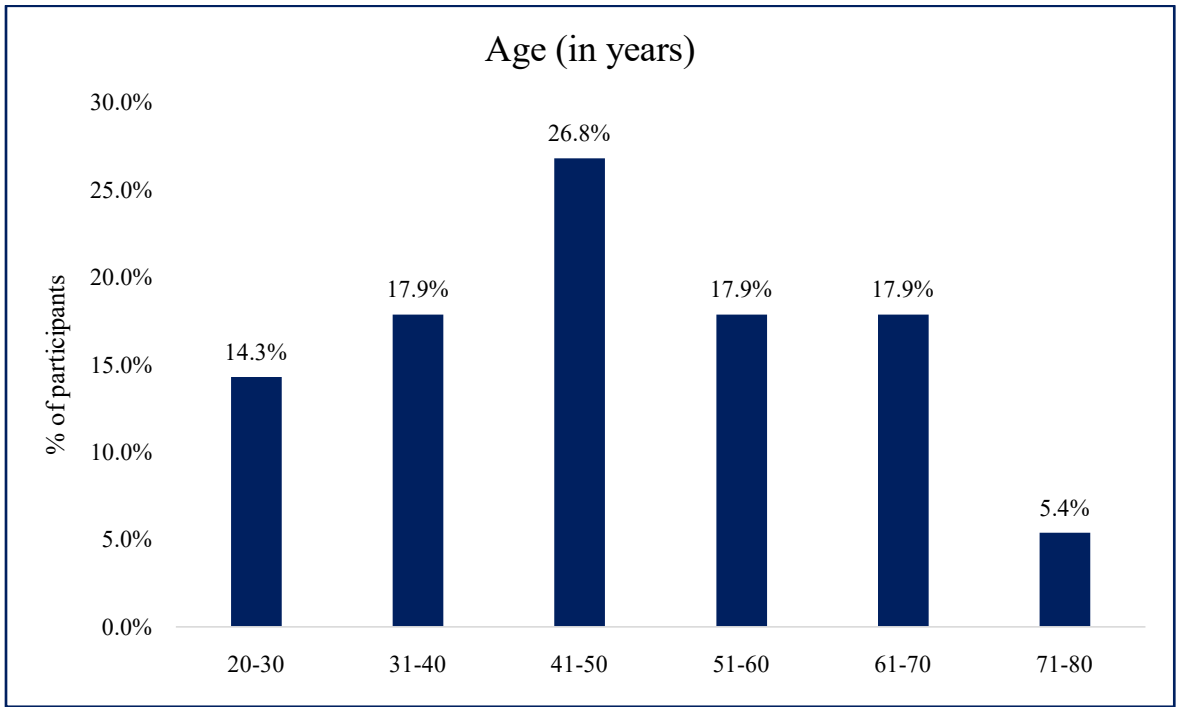
1)Patients on lipid lowering agents and
2)Patients with renal failure, nephrotic syndrome,
3)Pancreatitis,
4)Cardiac failure,
5)Morbid obesity,
6)Hypothyroidism,
7)Sickle cell disease,
8)Hemoglobinopathies,
9)Pregnancy,
10)Patients with intrahepatic calculi not undergoing cholecystectomy.

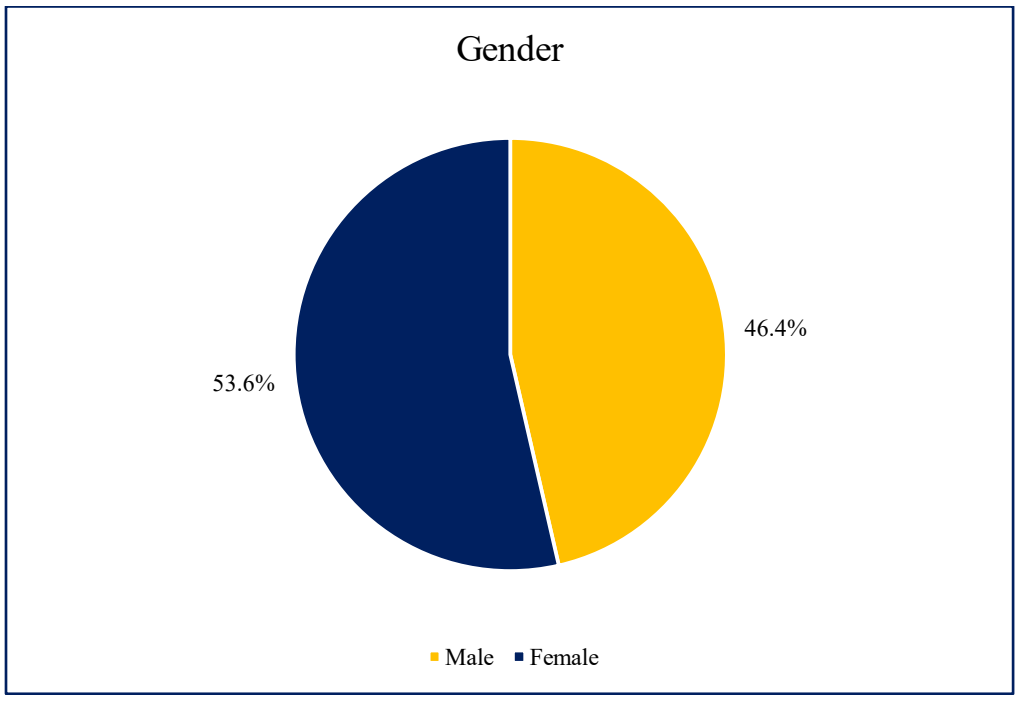
Statistical Analysis:

Data was entered into Excel 2019, and data analysis was performed using SPSS version 26, licensed to the institution. Descriptive statistics, including means and standard deviations, were calculated for all serum lipid profile parameters (VLDL, total cholesterol, triglycerides, HDL, LDL, and TC: HDL ratio) pre-operatively and one month post-operatively.

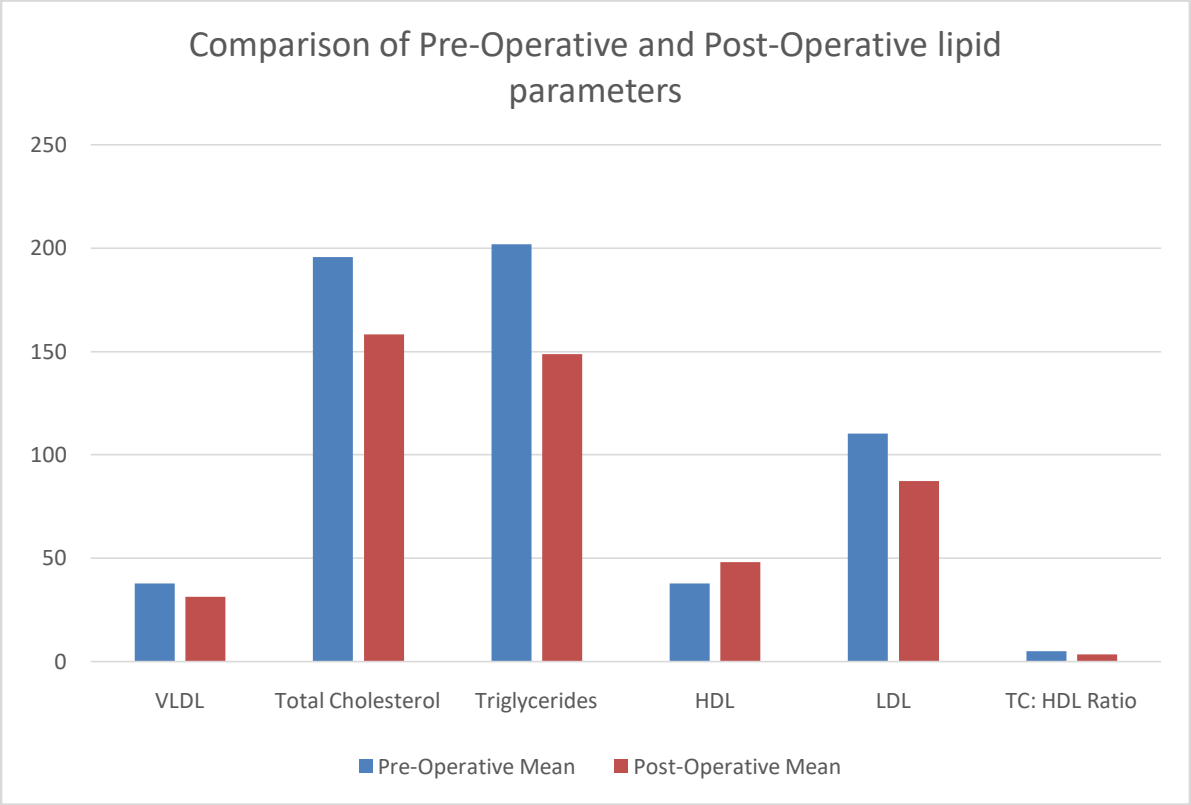
Before conducting inferential statistics, the normality of the data was assessed using the Shapiro-Wilk test, which indicated a normal distribution for all parameters. Consequently, paired sample t-tests were employed to compare pre-operative and post-operative values for each parameter. The mean differences, t-values, and associated p-values were calculated to determine statistical significance, with a p-value of less than 0.05 indicative of statistical significance.

Results:-


Age (in years)
% of participants
30.0%
25.0%
20.0%
15.0%
10.0%
5.0%
0.0%
14.3%
17.9%
26.8%
17.9%
17.9%
5.4%
20-30
31-40
41-50
51-60
61-70
71-80


Gender
46.4%
53.6%
Male
Female

Lipid Parameter	Pre-Operative Mean	Std. Deviation	Post-Operative Mean	Std. Deviation	Mean Difference	p-value
VLDL	37.63	12.3	31.36	8.7	6.268	<0.001
Total Cholesterol	195.70	59.842	158.4	44.0	37.25	<0.001
Triglycerides	202.02	199.752	148.86	105.011	53.16	<0.001
HDL	37.75	10.9	48.04	13.7	-10.29	<0.001
LDL	110.23	41.0	87.30	32.0	22.93	<0.001
TC: HDL Ratio	4.96	1.52	3.44	0.99	1.51	0.003



The study analyzed data from 56 patients who underwent cholecystectomy for gallstone disease. The age distribution of the patients showed that the most common age group was 41-50 years (26.8%), followed by the 31-40, 51-60, and 61-70 age groups, each representing 17.9% of the sample. The least affected age group was 71-80 years (5.4%). Gender analysis revealed that 53.6% of the patients were female, while 46.4% were male, suggesting that gallstone disease is slightly more prevalent in females.

The lipid profile of patients was measured pre-operatively and one month post-operatively to evaluate the effect of cholecystectomy. **VLDL levels** significantly decreased after surgery, with a pre-operative mean of 37.63 mg/dL (SD 12.3) compared to 31.36 mg/dL (SD 8.7) post-operatively. The mean difference of 6.268 mg/dL was statistically significant ($p < 0.001$).

Total cholesterol levels also showed a substantial reduction, with the mean decreasing from 195.70 mg/dL (SD 59.842) pre-operatively to 158.4 mg/dL (SD 44.0) post-operatively. The mean difference was 37.25 mg/dL, and this decrease was highly significant ($p < 0.001$).

Triglycerides followed a similar trend, dropping from 202.02 mg/dL (SD 199.752) to 148.86 mg/dL (SD 105.011), with a mean difference of 53.16 mg/dL and a significant t-value of 3.91 ($p < 0.001$).

HDL levels, on the other hand, increased after surgery. The pre-operative mean was 37.75 mg/dL (SD 10.9), while the post-operative mean was 48.04 mg/dL (SD 13.7). The increase of 10.29 mg/dL was statistically significant ($p < 0.001$), suggesting that cholecystectomy has a beneficial effect on HDL, which is often referred to as "good cholesterol."

Similarly, **LDL levels** decreased significantly from 110.23 mg/dL (SD 41.0) to 87.30 mg/dL (SD 32.0), with a mean difference of 22.93 mg/dL ($p < 0.001$).

Lastly, the **total cholesterol to HDL ratio** improved significantly. The pre-operative ratio was 4.96 (SD 1.52), which dropped to 3.44 (SD 0.99) post-operatively, with a mean difference of 1.51 ($p = 0.003$), indicating a reduced cardiovascular risk after surgery.

These results demonstrate that cholecystectomy leads to significant improvements in lipid profiles, reducing overall cholesterol, triglycerides, LDL, and VLDL while increasing HDL, potentially lowering the risk of coronary artery disease in patients.

Discussion:-

This study evaluates the impact of cholecystectomy on serum lipid profiles in patients with symptomatic cholelithiasis. It analyzes multiple lipid markers, including VLDL, total cholesterol (TC), triglycerides (TG), HDL, LDL, and the TC:HDL ratio, revealing significant post-operative changes. These findings provide valuable insights into the metabolic consequences of gallbladder removal.

The highest prevalence of gallstone disease was observed in the 41-50 years age group (26.8%), followed by a similar distribution across the 31-40, 51-60, and 61-70 age groups (17.9%). This distribution aligns with prior studies, such as Patel et al. (2022) in Central India and Mondal et al. (2016) in West Bengal, which reported similar age-related trends [6]. The study also found a slight female predominance (53.6% f emale vs. 46.4% male), consistent with other research showing gallstone disease is more common in females due to factors like estrogen levels, pregnancy, and oral contraceptive use (Stinton and Shaffer, 2012)[7]. However, this gender disparity was smaller than in studies by Sodhi et al. (2014) and Satheesha and Soumya (2020), suggesting possible regional or cohort differences [8,9].

VLDL and Cholesterol

A significant post-operative decrease in VLDL levels was observed, from 37.63 ± 12.3 mg/dL pre-operatively to 31.36 ± 8.7 mg/dL ($p < 0.001$). This reduction is consistent with Gill and Gupta (2017), who also noted a VLDL drop after cholecystectomy[10]. The underlying mechanism could be the alteration of bile acid metabolism, which affects fat metabolism enzymes like cholesterol 7α-hydroxylase and hepatic lipase (Staels and Fonseca, 2009)[11]. The continuous bile flow after gallbladder removal increases VLDL particle breakdown. Moreover, cholecystectomy improves insulin sensitivity, which may reduce VLDL production in the liver (Chen et al., 2012)[12].

Total cholesterol levels also significantly decreased, from 195.70 ± 59.842 mg/dL pre-operatively to 158.4 ± 44.0 mg/dL ($p < 0.001$). This reduction aligns with studies by Osman et al. (2020) and Ikram et al (2020), where post-cholecystectomy patients exhibited significant drops in total cholesterol[13,14]. The reduction may result from increased bile acid production post-surgery, which depletes cholesterol reserves in the liver, thus lowering serum cholesterol levels. Additionally, continuous bile acid flow may enhance cholesterol elimination and reduce its intestinal absorption (Di Ciaula and Portincasa, 2018)[15]. Furthermore, gallbladder removal eliminates a major cholesterol accumulation site, which could contribute to lower cholesterol levels (Wang et al., 2009)[16].

Triglycerides

Triglyceride levels also saw a substantial reduction post-surgery, from 202.02 ± 199.752 mg/dL to 148.86 ± 105.011 mg/dL ($p < 0.001$). This finding aligns with studies by Aydin and Öztürk (2022) and Singh et al. (2019), who also observed significant drops in triglycerides post-cholecystectomy[17,18]. The reduction in triglycerides is likely due to enhanced activity of lipoprotein lipase, an enzyme responsible for triglyceride breakdown, and increased insulin sensitivity following gallbladder removal (Smelt, 2010; Chen et al., 2012)[12,19]. Insulin resistance is linked to higher triglyceride production, so improved sensitivity can lower triglyceride levels. Additionally, removing the

gallbladder reduces chronic inflammation associated with gallstones, which likely improves triglyceride metabolism (Di Ciaula et al., 2018)[4].

HDL and LDL

A significant increase in HDL levels was recorded, from 37.75 ± 10.9 mg/dL pre-operatively to 48.04 ± 13.7 mg/dL post-operatively ($p < 0.001$). This finding is consistent with studies by Malik et al. (2011), which also reported a rise in HDL post-surgery[20]. However, other studies, such as Gill and Gupta (2017), reported no significant change in HDL levels[10]. The increase in HDL could result from modified bile acid metabolism following cholecystectomy, which may improve HDL synthesis and efficiency. Bile acids regulate HDL metabolism through nuclear receptors like Farnesoid X Receptor (FXR) (Di Ciaula et al., 2018)[4]. Improved insulin sensitivity post-cholecystectomy could also contribute to higher HDL levels, as insulin resistance typically lowers HDL levels (Chen et al., 2012)[3].

LDL levels decreased significantly, from 110.23 ± 41.0 mg/dL pre-operatively to 87.30 ± 32.0 mg/dL post-operatively ($p < 0.001$). This reduction aligns with research by Osman et al. (2020) and Ikram et al. (2020), who also observed significant LDL reductions post-cholecystectomy[13,14]. The reduction in LDL may be attributed to enhanced cholesterol catabolism and increased LDL receptor activity in the liver, driven by the heightened need for cholesterol to produce bile acids (Di Ciaula and Portincasa, 2018)[15]. Reduced cholesterol absorption post-surgery further lowers LDL levels, as bile acids regulate cholesterol balance through FXR and Liver X Receptor (Staels and Fonseca, 2009)[5].

The observed LDL reduction in this study (around 20.8%) was more pronounced than in other studies, possibly due to differences in initial LDL levels or patient characteristics. This suggests cholecystectomy may have a more significant impact on LDL reduction than previously thought, offering additional cardiovascular benefits.

TC: HDL Ratio

A significant improvement in the TC: HDL ratio was observed, from 4.96 ± 1.52 pre-operatively to 3.44 ± 0.99 post-operatively ($p = 0.003$). The TC: HDL ratio is considered a better predictor of cardiovascular risk than individual lipid markers (Linton et al., 2000)[18]. The improvement in this ratio reflects the concurrent reduction in total cholesterol and increase in HDL levels. This suggests that cholecystectomy not only alleviates gallstone-related symptoms but also enhances the overall lipid balance, potentially reducing cardiovascular disease risk. The improvement in the TC: HDL ratio likely results from changes in bile acid metabolism, increased reverse cholesterol transport, and enhanced insulin sensitivity (Di Ciaula et al., 2018)[4].

Implications and Limitations

The findings of this study suggest that cholecystectomy improves the lipid profile in patients with symptomatic gallstones, reducing cardiovascular risk. The significant reductions in VLDL, total cholesterol, triglycerides, LDL, and the increase in HDL indicate a more favorable lipid profile post-surgery. However, this study only evaluated lipid changes one month post-surgery, and further long-term studies are necessary to determine if these beneficial changes persist over time.

Additionally, while cholecystectomy appears to improve lipid profiles, it should not be considered a treatment for dyslipidemia. The decision to perform the surgery should be based on clear clinical indications for gallstone disease, not solely to improve lipid levels.

Healthcare providers should consider monitoring lipid profiles in patients post-cholecystectomy to assess potential improvements and identify patients who may need further cholesterol-lowering therapies. This approach could enhance long-term cardiovascular outcomes for these patients.

Conclusion:-

This study presents strong evidence of notable enhancements in serum lipid profiles after cholecystectomy in patients with symptomatic cholelithiasis. The observed alterations, encompassing decreases in VLDL, total cholesterol, triglycerides, and LDL levels, coupled with an elevation in HDL levels and enhancement in the TC: HDL ratio, indicate that cholecystectomy may yield advantageous outcomes beyond the alleviation of symptoms associated with gallstones.

Strengths
This study investigated many lipid parameters, offering a comprehensive understanding of the changes in lipid profile after cholecystectomy.

The observed changes in all lipid measures were statistically significant, which adds confidence to the findings.

Our findings are consistent with earlier investigations, strengthening our results' validity.
The observed enhancements in lipid profiles indicate potential advantages for cardiovascular health, which could impact the care of patients after surgery.

Limitations
Immediate postoperative monitoring: The study solely investigated alterations in lipid profiles one month after the surgery, therefore restricting our comprehension of the enduring consequences.

The investigation was carried out at a solitary establishment, perhaps constraining the applicability of the findings to different demographics.

A control group of patients who did not have cholecystectomy was not included in the study, making it difficult to ascribe the observed alterations only to the surgical intervention conclusively.
Possible confounding variables: The study did not account for variables such as dietary habits, level of physical activity, or medication usage, which could impact lipid profiles.

Although sufficient for statistical analysis, a greater sample size could have yielded more reliable results and enabled the examination of specific subgroups.

Recommendation:-
Subsequent investigations should assess alterations in lipid profile over prolonged durations (e.g., 6 months, 1 year, 5 years) to ascertain the durability of the reported enhancements.

Multi-centre studies involve similar investigations across numerous centres and populations, improving the findings' generalizability.

To better understand the impact of surgery on lipid profiles, including a control group of individuals with gallstones who do not have cholecystectomy would be beneficial.
Mechanistic investigations: Additional research is required to clarify the exact mechanisms responsible for the observed alterations in the lipid profile, namely the elevation in HDL levels.

Future investigations should explore whether age, gender, BMI, or pre-existing metabolic problems impact the degree of lipid profile enhancements following cholecystectomy.

Healthcare professionals should include the monitoring of lipid profiles in their postoperative care for patients following cholecystectomy.

It is necessary to conduct long-term studies to determine if the improvements shown in lipid profiles indeed lead to a decrease in cardiovascular risk among this group of patients.

Future studies should carefully consider and analyse the possible impact of nutrition, physical activity, and other lifestyle factors on changes in lipid profile after cholecystectomy while also taking steps to minimize any external influences.

Comparative research examining the changes in lipid profile after different gallstone treatments, such as cholecystectomy versus medical care, could offer significant insights for determining treatment decisions.

Create informative materials for patients undergoing cholecystectomy, including information on prospective enhancements in lipid profiles and promoting compliance with postoperative care and follow-up.

In conclusion, this study offers the prospective metabolic advantages of cholecystectomy. However, it also emphasizes the need for further extensive and prolonged research. The results indicate that cholecystectomy may have broader health consequences beyond removing gallstones, potentially providing extra cardiovascular advantages. However, it is essential to use caution when interpreting these findings, and it is recommended to proceed with cholecystectomy based on well-established clinical indications for gallstone disease. It is essential to conduct further studies to address the limitations and recommendations mentioned earlier. This research will help us understand the long-term metabolic effects of cholecystectomy and improve patient treatment.

Summary
This study examined the impact of cholecystectomy on the levels of lipids in the blood of patients with symptomatic cholelithiasis. The study included 56 participants, consisting of 30 females and 26 males, ranging in age from 20 to 80 years. The age group with the highest incidence of gallstone disease was 41-50 years. The study evaluated six crucial lipid parameters: very-low-density lipoprotein (VLDL), total cholesterol (TC), triglycerides (TG), high-density lipoprotein (HDL), low-density lipoprotein (LDL), and the ratio of total cholesterol to HDL (TC: HDL ratio). The measurements of these parameters were taken before the operation and one month after the operation. Cholecystectomy significantly improved all lipid indices, as determined by statistical analysis. The levels of VLDL, TC, LDL and TG showed a significant drop, but the high-density lipoprotein (HDL) levels increased. The ratio between total cholesterol and HDL also significantly improved. The results indicate that cholecystectomy may improve lipid profiles in patients with symptomatic cholelithiasis, even after eliminating symptoms linked to gallstones.

However, the study highlights the importance of conducting extended follow-up and more extensive research to understand the metabolic effects of cholecystectomy and its possible influence on cardiovascular risk. This study helps the current discourse regarding the wider health consequences of gallbladder removal and can potentially guide future strategies for postoperative care and patient supervision.

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