CASUAL ASSOCIATIONS BETWEEN LIPID PROFILES AND RISK OF GALLSTONE DISEASE

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ABSTRACT

INTRODUCTION

Gallstone disease (GSD) is a significant global health concern with multifactorial etiology. Dyslipidemia, characterized by altered levels of triglycerides (TGs), high-density lipoprotein (HDL), low-density lipoprotein (LDL), and total cholesterol (TC), is hypothesized to play a critical role in gallstone formation. So, this study aims to explore how changes in lipid profiles affect the risk of gallstone disease, focusing on the role of altered lipid metabolism in gallstone formation.

MATERIAL AND METHODS

This prospective observational study was conducted at UCMS-TH in 100 patients with GSD confirmed with ultrasonography of abdomen and pelvis, between May 2024 to October 2024. Lipid profiles were assessed, and demographic and clinical data were collected. Patients were grouped based on the presence of single or multiple gallstones for comparative analysis.

RESULTS

The mean levels of TGs, HDL, LDL, and TC in the study population were 156.85 mg/dL, 40.68 mg/dL, 115.14 mg/dL, and 190.11 mg/dL respectively. Patients with multiple gallstones exhibited slightly higher TGs, TC and LDL levels compared to those with single gallstones.

CONCLUSION

Elevated TGs, LDL and TC levels were strongly associated with GSD, supporting their role as potential risk factors. Further research is needed to establish causality and evaluate the impact of lipid management in gallstone prevention.

KEYWORDS

Gallstone disease, Lipid profile, Triglycerides, HDL, LDL

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INTRODUCTION

Gallstone disease, a prevalent gastrointestinal disorder, involves the formation of solid particles in the gallbladder, ranging from asymptomatic gallstones to severe complications like biliary colic and pancreatitis. Recent research focuses on the link between lipid profiles and gallstone risk, particularly the roles of cholesterol, triglycerides and HDL in gallstone formation. Cholesterol supersaturation in bile is crucial to this process, with dyslipidemia potentially increasing gallstone risk. Gallstone pathogenesis is complex, influenced by genetic, metabolic and environmental factors, with the main types being cholesterol stones and pigment stones.[1-5]

Cholesterol gallbladder stone formation is primarily influenced by three significant mechanisms: (i) the cholesterol supersaturation of bile (ii) reduced gallbladder motility (iii) the presence of kinetic, pro-nucleating protein factors.[1]

Cholesterol Supersaturation in Bile:
Cholesterol, soluble in water, becomes soluble in bile through mixed micelles with bile salts and phospholipids. Supersaturation can result from hypersecretion of cholesterol, possibly due to abnormalities in hepatic cholesterol metabolism. Dietary origin accounts for over 80% of biliary cholesterol and in gallstone patients, cholesterol secretion increases. Elevated plasma levels of bile acid indicators suggest a link to bile salt loss.[1,3-6]

Reduced gallbladder motility:
Supersaturated bile flushes microcrystals from the gallbladder during postprandial contractions, while cholesterol gallstone patients with altered emptying show increased lipid concentrations. Impaired gallbladder motility is common in risk groups like diabetes, total parenteral nutrition and weight loss. Patients with efficient emptying have a higher risk of developing gallstone disease. Prevention strategies include CCK injections and weight-reducing diets.[4,7,8]

Kinetic factors:
Microcrystal formation in supersaturated bile is influenced by kinetic protein factors, with mucin being a consistent crystallization-promoting protein. The role of inhibitory proteins in gallstone formation is unclear and cholesterol saturation does not correlate with mucin or total proteins. No clear relationship exists between serum lipids and biliary cholesterol saturation index and comparing lipid profiles between cholesterol and pigment gallstones is essential to understand the development of compositionally distinct gallstones.[9]

Gallstone disease is a global health concern caused by solid particles in the gallbladder. Despite advancements in understanding risk factors, there is a knowledge gap regarding the causal associations between lipid profiles and gallstone development. This gap hinders effective management and preventive measures. Understanding the causal pathways and temporal sequences of lipid profile changes is crucial for public health initiatives and clinical management.[10]

Gallstone disease is a global health concern with severe consequences like cholecystitis and pancreatitis. Understanding the link between lipid profile changes and gallstone risk is crucial for public health strategies, identifying specific alterations contributing to gallstone formation and developing targeted preventive strategies. This knowledge also helps clinicians identify individuals at higher risk and implement early interventions to prevent complications.[11]

MATERIAL AND METHODS

This prospective observational study was conducted in Department of Surgery of Universal College of Medical Sciences Teaching Hospital (UCMS-TH), Bhairahawa, Nepal over a period of 6 months from May 2024 to October 2024. A total of 100 patients diagnosed with gallstone disease (GSD) via ultrasonography were enrolled with verbal and written consent. This study was carried out after ethical clearance from Institutional review committee of UCMS-TH with reference number UCMS/IRC/055/24.

The sample size was calculated using the Cochran formula with a disease prevalence of 7% and a margin of error of 5%.[2,12]

Eligible participants were adults aged over 18 years who consented to participate. Pediatric patients (<18 years) and those on lipid-lowering therapy or with significant comorbidities affecting lipid metabolism were excluded.

Data collection involved recording demographic information (age, sex, and clinical history) and lipid profiles, including serum triglycerides (TGs), high-density lipoprotein (HDL), low-density lipoprotein (LDL) and total cholesterol (TC). gallstone characteristics, such as the number and size of stones, were determined through ultrasonography.

Statistical analysis was performed using SPSS v19.0. Mean values and standard deviations were calculated; t test was used.

RESULTS

Table 1. Baseline characteristics

Baseline characteristics	Value
Gender	75% Female, 25% Male
Mean Age (years)	48.5 (Range: 19–78)
Single Stones	41%
Multiple Stones	59%
Mean Largest Stone Size (mm)	13.35 (Range: 2.1–82)
Mean TG	156.85 mg/dL
Mean LDL	115.14 mg/dL
Mean HDL	40.68 mg/dL
Mean Total Cholesterol	190.11 mg/dL

The study included 100 patients (75% female, 25% male), with a mean age of 48.5 years. Single stone found in 41%, remaining were multiple stone. The mean size of largest stone was 13.35 mm.

Table 2. Lipid profile

Lipid profile	Stone number	Mean ± SD	*p* value
Total Cholesterol	Single	182.42±35.52	0.041
	Multiple	195.46±37.42	
HDL	Single	42.78±6.51	0.718
	Multiple	39.22±5.58	
LDL	Single	105.81±31.83	0.002
	Multiple	121.63±21.96	
TG	Single	147.25±41.22	0.022
	Multiple	163.52±38.95	

Patients with multiple stones exhibited slightly higher TG, LDL and total cholesterol levels compared to those with single stones, and the difference was statistically significant.

DISCUSSION

Our research reveals elevated TGs were found in both single and multiple gallstone groups, aligning with findings from multiple studies. Kumar et al (2016) reported significantly higher TG levels in all age groups and genders among gallstone patients, emphasizing TG elevation as a consistent risk factor for cholesterol stone formation.[13] Similarly, in a study done by Hayat et al. (2019) found TG levels significantly elevated in gallstone patients compared to controls, corroborating the role of TGs in bile supersaturation and gallstone formation.[14] Also, in a study conducted by Welegedara et al. (2014) they highlighted that patients with cholesterol stones had significantly higher TG levels compared to those with pigment stones, suggesting the association of TGs with cholesterol gallstones specifically.[15] Our result supports these observations, indicating that TG elevation is a strong marker for gallstone disease across patient demographics.

In present srudy found that a mean HDL level was 40.68 mg/dL. Reduced HDL levels were consistent across the single and multiple gallstone groups but the result was not statistically significant. This aligns with observations from several studies. Hayat et al (2019) found that HDL levels were significantly lower in gallstone patients suggesting a protective role of HDL in maintaining bile homeostasis through reverse cholesterol transport.[14] Also, in a study done by Welegedara et al (2014) it was noted that HDL levels in gallstone patients, though the study emphasized that HDL reductions were not specific to stone type.[16]

Our findings reinforce HDL's protective role, as reductions in HDL may contribute to increased cholesterol deposition in bile.[15]

In our result, the mean LDL level is 115.14 mg/dL, and total cholesterol averages 190.11 mg/dL, with slightly higher levels observed in patients with multiple stones. This shows variability compared to existing literature. Kumar et al. (2016) identified significantly elevated LDL and total cholesterol levels in male patients with gallstones, especially in those above 20 years. This aligns closely with our result, which reports higher LDL and total cholesterol values.[13]

Similarly, Hayat et al (2019) did not find any significant difference in LDL or total cholesterol levels between gallstone patients and controls, suggesting that these parameters may not always be reliable indicators.[14]

The discrepancy between studies highlights the need for population-specific analyses as variations in dietary patterns, genetic predispositions and comorbidities may influence lipid levels.

Limitations of the study are this study is done in single center UCMS-TH and study has small sample size. Also, the study design is observational type and exclusion of patients on lipid-lowering therapy.

CONCLUSION

The study reveals significant associations between lipid profile alterations and gallstone disease, with elevated total cholesterol, LDL, TG levels being consistent risk factors and HDL being a protective factor. These findings suggest that population-specific factors like diet, genetics, and comorbidities may influence the influence of lipid dysregulation. The study emphasizes the importance of lipid profile evaluation in GSD patients and suggests further research to validate these associations and improve patient outcomes.

CONFLICT OF INTEREST

None

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