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MEAN SERUM CALCIUM AND LIPID PROFILES IN SYMPTOMATIC GALLSTONE DISEASE

Original Research

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ABSTRACT

Background: Gallstone disease remains a prevalent gastrointestinal condition with varying regional and metabolic associations. Differences in dietary patterns, genetics, and environmental exposures contribute to the geographic variation in gallstone prevalence and related biochemical abnormalities. Despite global research, limited data exists regarding lipid and calcium profiles among gallstone patients in local populations. Understanding these associations in a specific population is essential for guiding early screening, risk stratification, and preventive strategies in clinical practice.

Objective: To determine the frequency of deranged lipid profile in patients with symptomatic gallstone disease and to evaluate mean serum levels of calcium, triglycerides, total cholesterol, low-density lipoprotein (LDL), and high-density lipoprotein (HDL).

Methods: A descriptive cross-sectional study was conducted in the Department of Surgery, Khyber Teaching Hospital, Peshawar, from April 23, 2024, to October 22, 2024. A total of 149 patients aged 18 to 60 years with symptomatic gallstones confirmed by ultrasound were enrolled through consecutive non-probability sampling. Patients with comorbidities or on interfering medications were excluded. After informed consent, fasting blood samples were collected to measure serum calcium and lipid profiles. Data were analyzed using SPSS version 25.0.

Results: The mean age of participants was 50.81 ± 5.08 years, with 123 patients (82.6%) above 40 years and 79 females (53.0%). Deranged lipid profile was identified in 68 patients (45.6%). Among these, the mean serum calcium level was 8.26 ± 0.81 mg/dl, total cholesterol 233.95 ± 23.53 mg/dl, triglycerides 169.06 ± 17.06 mg/dl, LDL 111.44 ± 13.50 mg/dl, and HDL 39.01 ± 5.39 mg/dl.

Conclusion: A considerable proportion of patients with symptomatic gallstones demonstrated dyslipidemia and elevated serum calcium levels. These findings emphasize the role of metabolic assessment in the clinical evaluation of gallstone disease.

Keywords: Calcium, Cholesterol, Cross-Sectional Studies, Gallstones, HDL, LDL, Triglycerides.

INTRODUCTION

Gallstone disease is a significant global public health concern, affecting a considerable portion of the adult population. It is often incidentally diagnosed during abdominal ultrasonography performed for unrelated indications, as the majority of cases remain asymptomatic. However, approximately 20% of individuals with gallstones become symptomatic within a ten-year period (1). The overall burden of gallstone disease, along with its potentially serious complications such as acute pancreatitis and cholangitis, is steadily increasing (2). These complications not only contribute to substantial healthcare expenditures but also result in prolonged interruptions to daily productivity and quality of life (3). The clinical spectrum of gallstone disease varies widely. While most patients harbor asymptomatic stones, others present with recurrent biliary colic, and a subset progresses to life-threatening complications such as gallstone pancreatitis or ascending cholangitis (4). Diagnosis remains primarily radiological, with ultrasonography serving as the first-line and most sensitive imaging modality. Computed tomography (CT) scans are reserved for selected cases, and plain abdominal radiographs are of limited utility due to their low sensitivity, particularly since only calcified stones are typically visualized (5).

Several risk factors have been implicated in the pathogenesis of gallstone formation, including advancing age, female gender, obesity, and ethnicity. Multiparous women in their fourth decade of life, particularly those of Asian descent with elevated body mass index (BMI), have a higher likelihood of developing gallstones (6). Women are up to four times more likely to develop gallstones than men, and the incidence is significantly lower among younger individuals. Pregnancy further exacerbates this risk by promoting gallbladder stasis and altered bile composition (7). Gallstone formation is a multifactorial process that occurs in three distinct stages: supersaturation of bile with cholesterol, nucleation of crystals, and their subsequent aggregation into stones. The ratio of bile salts to cholesterol plays a crucial role in maintaining bile solubility, and any imbalance—either through a reduction in bile salts or an increase in cholesterol—can lead to bile supersaturation and precipitation of gallstones (8). This imbalance is often linked to disturbances in lipid metabolism, involving both synthesis and degradation pathways, ultimately altering the physicochemical composition of bile (9).

Gallstones are broadly classified into cholesterol and pigment stones, based on their chemical composition. Cholesterol stones are predominantly composed of cholesterol monohydrate crystals, whereas pigment stones primarily consist of calcium bilirubinate, along with varying proportions of other minerals and organic components (10,11). Dyslipidemia has been frequently associated with gallstone disease. Several studies have examined the lipid profiles of patients with cholelithiasis, revealing variable patterns. One study reported a mean triglyceride (TG) level of 123.30 ± 40.5 mg/dl, total cholesterol (TC) of 185.89 ± 48.88 mg/dl, and high-density lipoprotein (HDL) of 60.86 ± 35.09 mg/dl (12). Another study observed a mean TC of 165.6 ± 59.66 mg/dl, TG of 184.2 ± 146.20 mg/dl, HDL of 35.50 ± 13.29 mg/dl, and low-density lipoprotein (LDL) of 95.86 ± 47.86 mg/dl (13). Furthermore, elevated serum calcium levels have also been reported in association with gallstone formation, with one study noting a mean calcium level of 13.1 ± 0.77 mg/dl among affected individuals (14). Notably, deranged lipid profiles were documented in up to 95% of patients with cholelithiasis in a study by Saldanha et al. (15).

Despite the growing body of evidence linking lipid abnormalities and gallstone disease, limited data are available from local populations. Considering the known geographic and ethnic variations in the incidence and biochemical profile of gallstone disease, there remains a gap in understanding how these factors manifest in our specific setting. Therefore, the present study aims to determine the frequency of deranged lipid profiles in patients with symptomatic gallstone disease and to assess the mean serum levels of calcium, triglycerides, total cholesterol, LDL, and HDL in these individuals. This research seeks to generate locally relevant data that may guide future diagnostic and preventive strategies, as well as lay the groundwork for further research into the metabolic underpinnings of gallstone disease in the regional population.

METHODS

This cross-sectional study was conducted in the Department of Surgery at Khyber Teaching Hospital, Peshawar, over a six-month period from April 23, 2024, to October 22, 2024. Male and female patients aged between 18 and 60 years with a confirmed diagnosis of symptomatic gallstone disease were enrolled. Symptomatic gallstones were defined as the presence of typical biliary pain—colicky in nature, localized to the right hypochondrium or epigastrium, with a visual analogue scale (VAS) score greater than 4, demonstrating a

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crescendo-decrescendo pattern and relieved by analgesics—alongside ultrasonographic findings showing echogenic foci within the gallbladder with posterior acoustic shadowing. Exclusion criteria included patients with a history of renal failure, endocrine disorders, malignancy, use of steroids, lipid-lowering agents, or calcium supplements within the past six months (2,3). These criteria were applied to eliminate potential confounding factors that could affect serum lipid or calcium levels.

The primary aim of the study was to assess the frequency of deranged lipid profiles in patients with symptomatic gallstones. A deranged lipid profile was defined as having any of the following: serum triglycerides >150 mg/dl, total cholesterol >200 mg/dl, HDL <40 mg/dl, or LDL >130 mg/dl. Using the WHO sample size calculator and assuming a 95.0% anticipated frequency of lipid abnormalities in symptomatic gallstone patients (15), with a 3.5% margin of error and 95% confidence level, a sample size of 149 was determined. Sampling was conducted through consecutive non-probability sampling. Informed written consent was obtained from all participants after clearly explaining the purpose, procedures, benefits, and risks of the study. Ethical approval was obtained from the Institutional Review Board (IRB) of Khyber Teaching Hospital. Baseline demographic and clinical data, including age (years), gender, BMI (kg/m²), residence (urban/rural), education level, occupation, and socioeconomic status, were collected using a structured data collection form.

For biochemical assessment, participants were instructed to fast overnight for at least eight hours. The following morning, a 10 mL venous blood sample was drawn from the antecubital fossa of the non-dominant arm and transported to the hospital laboratory within 30 minutes. All samples were processed by an experienced pathologist blinded to clinical information. Serum calcium and lipid profile levels were measured using standard laboratory techniques and documented as per operational definitions. Data were entered and analyzed using SPSS version 25.0. The Shapiro-Wilk test was used to evaluate the normality of quantitative variables. Normally distributed data such as age, BMI, serum calcium, total cholesterol, triglycerides, HDL, and LDL were expressed as mean ± standard deviation (SD), while non-normally distributed data were reported as median (interquartile range, IQR). Categorical variables including gender, residence, education, profession, socioeconomic status, and deranged lipid profile were summarized using frequencies and percentages. Stratification was performed based on age, gender, and BMI to control for potential confounders. Post-stratification, the chi-square test was applied to assess associations, with a p-value <0.05 considered statistically significant.

RESULTS

The study included a total of 149 patients diagnosed with symptomatic gallstone disease, with ages ranging from 18 to 60 years. The mean age was 50.81 ± 5.08 years, and the mean body mass index (BMI) was 21.68 ± 1.10 kg/m². A significant majority of participants (82.6%) were above 40 years of age. Gender distribution showed 79 females (53.0%) and 70 males (47.0%). Most patients (89.9%) had a BMI of 24.0 kg/m² or less. Regarding residential status, 78 (52.3%) belonged to rural areas and 71 (47.7%) were from urban areas. Educationally, 80 patients (53.7%) had education up to matric level or below, while 69 (46.3%) had education beyond matric. In terms of occupation, 62 patients (41.6%) were involved in business, 45 (30.2%) were salaried employees, and 42 (28.2%) were unemployed. Socioeconomic status revealed that 86 patients (57.7%) belonged to the poor category, while 63 (42.3%) were classified as having a fair socioeconomic status.

Deranged lipid profile, defined as any abnormality in serum triglycerides, cholesterol, HDL, or LDL, was observed in 68 out of 149 patients, yielding a frequency of 45.6%. Among these 68 patients, the mean serum calcium level was 8.26 ± 0.81 mg/dl. The mean total cholesterol was found to be 233.95 ± 23.53 mg/dl, while the mean serum triglycerides were 169.06 ± 17.06 mg/dl. The average LDL level was 111.44 ± 13.50 mg/dl, and the mean HDL level was 39.01 ± 5.39 mg/dl. Post-stratification analysis was performed to explore the association between deranged lipid profiles and potential confounding variables including age, gender, and BMI. A statistically significant association was observed between age group and deranged lipid profile, with patients older than 40 years showing a higher frequency of lipid abnormalities ($p < 0.001$). Similarly, gender was significantly associated with lipid profile derangement, with female patients being more affected compared to males ($p < 0.001$). BMI also showed a statistically significant relationship with deranged lipid profiles, as patients with a BMI ≤24 kg/m² demonstrated a higher proportion of abnormalities compared to those with higher BMI values ($p < 0.001$). These findings underline the importance of age, gender, and BMI as influential factors in the metabolic profile of patients with symptomatic gallstone disease.

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Table Mean and standard deviation of patients according to age and BMI (N = 149)

Parameters	Mean	Std. Deviation
Age (years)	50.81	5.084
BMI (kg/m^2)	21.679	1.1044

Table 2 Frequency and %age of patients according to baseline demographics and clinical parameters (n = 149)

Parameter	Subgroups	Frequency	Percent
Age (years)	40 or below	26	17.4
	More than 40	123	82.6
Gender	Female	79	53.0
	Male	70	47.0
BMI (kg/m^2)	24.0 or below	134	89.9
	More than 24.0	15	10.1
Residence	Rural	78	52.3
	Urban	71	47.7
Education	Matric or below	80	53.7
	Above matric	69	46.3
Profession	Salaried	45	30.2
	Business	62	41.6
	Jobless	42	28.2
SE status	Fair	63	42.3
	Poor	86	57.7

Table 3 Frequency and %age of patients according to deranged lipid profile (N = 149)

Parameter	Subgroups	Frequency	Percent
Deranged lipid profile	Yes	68	45.6
	No	81	54.4
	Total	149	100.0

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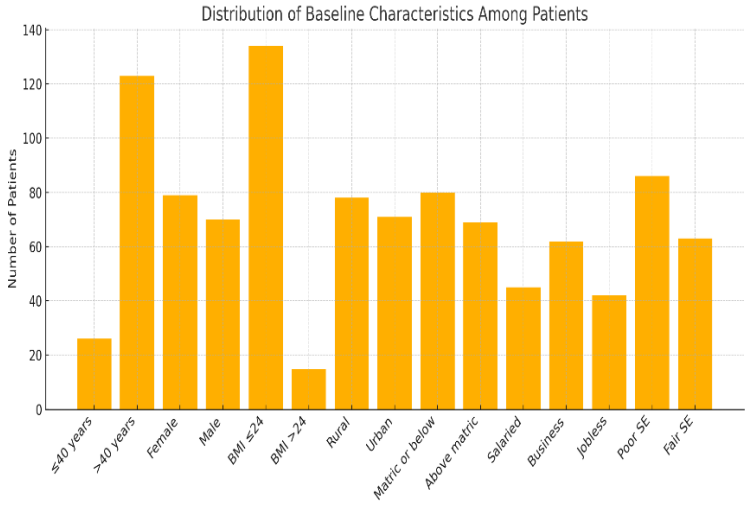
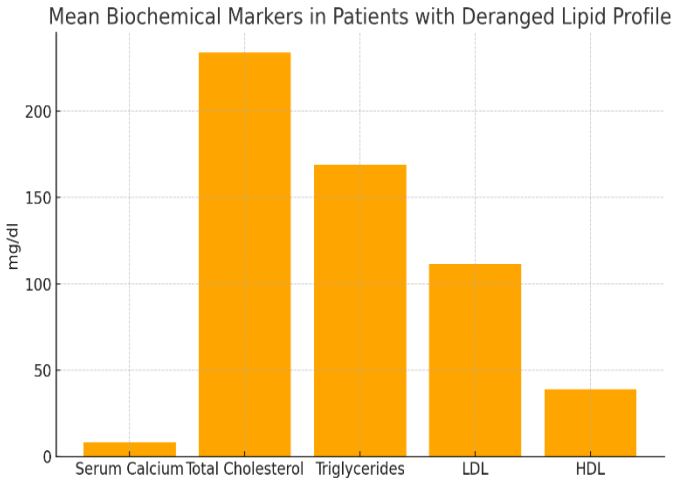
Table 4 Mean serum calcium, total cholesterol, triglyceride, LDL and HDL in patients with deranged lipid profile

Parameters	Mean	Std. Deviation
Serum calcium(mg/dl)	8.255	0.809
Cholesterol (mg/dl)	233.951	23.532
Triglyceride (mg/dl)	169.060	17.0560
LDL (mg/dl)	111.440	13.503
HDL (mg/dl)	39.006	5.3851

Table 5 Post-Stratification Chi-Square Analysis

Variable	Chi-square Value	p-value	Significance
Age Group (≤ 40 vs >40)	34.90981	3.45E-09	Yes
Gender (Female vs Male)	107.3938	3.65E-25	Yes
BMI Group (≤ 24 vs >24)	12.03149	0.000523	Yes





DISCUSSION

The present study investigated the association between lipid profile disturbances and symptomatic gallstone disease in a local population. The mean age of participants was 50.81 ± 5.08 years, with the majority being over 40 years of age. This age distribution aligns with existing literature suggesting increased prevalence of gallstones in older individuals, although some studies have reported a younger age profile with mean ages in the early 40s (16,17). The age distribution in this study was more comparable to research conducted in similar demographic settings, where the mean age was also observed to be in the early 50s (18). This reinforces the notion that advancing age plays a significant role in the pathophysiology of gallstone formation. Gender distribution revealed a higher proportion of female participants, which is consistent with the well-established trend of increased gallstone prevalence among women. This finding is

supported by multiple studies highlighting the role of hormonal factors, particularly estrogen, in altering bile composition and gallbladder motility, thereby promoting stone formation (16,17).

Dyslipidemia was identified in 45.6% of patients with symptomatic gallstones. However, the association between gallstone disease and lipid abnormalities did not reach statistical significance when analyzed as a composite outcome. This aligns with findings from previous studies that also reported non-significant differences in serum lipid levels between gallstone and non-gallstone groups (19). Nonetheless, other research has demonstrated elevated lipid profile parameters, particularly total cholesterol and triglycerides, among patients with gallstones when compared to controls (20). These discrepancies highlight the complex and multifactorial nature of gallstone pathogenesis. While bile supersaturation with cholesterol is a recognized mechanism, elevated serum lipid levels alone may not serve as a standalone predictor for gallstone formation. Factors such as gender, age, ethnicity, dietary habits, and genetic predisposition also contribute significantly. Among patients with deranged lipid profiles, the mean triglyceride level was 169.06 ± 17.05 mg/dl. This finding is consistent with previous studies that reported higher triglyceride levels in gallstone patients (16,20). Elevated triglycerides may reduce gallbladder motility, contributing to bile stasis and subsequent stone formation. On the other hand, studies have also found significant differences in triglyceride levels between gallstone and non-gallstone groups, indicating a potential role of hypertriglyceridemia in the disease mechanism (16,17). The current study did not find a strong statistical association in this regard, suggesting the need for larger studies with controlled comparisons to validate this relationship.

The mean HDL level among patients with dyslipidemia was 39.01 ± 5.38 mg/dl, which is below the recommended threshold for protective cardiovascular and biliary health. Lower HDL levels in gallstone patients have also been reported in several studies, possibly due to its role in reverse cholesterol transport and bile composition regulation (10,19). However, some studies have not identified significant differences in HDL levels, reflecting ongoing debate regarding the extent to which low HDL influences gallstone formation. Post-stratification analysis in this study revealed statistically significant associations between deranged lipid profiles and age, gender, and BMI. Patients over 40 years, females, and individuals with a BMI ≤24 kg/m² demonstrated higher frequencies of lipid abnormalities. These findings are important as they emphasize the interplay between demographic and metabolic factors in gallstone disease, which may not always be captured through univariate analysis alone.

A key strength of this study lies in its focus on a local population, contributing valuable data that can inform region-specific health strategies. The use of defined operational criteria and fasting biochemical evaluations ensured standardized data collection. However, several limitations must be acknowledged. The cross-sectional design restricts causal inference, and the absence of a control group limits comparisons between patients with and without gallstones. Additionally, reliance on single-time-point biochemical measurements may not fully capture lipid profile variability over time. The study also lacked data on dietary patterns, hormonal profiles, and genetic predispositions, which are important variables influencing gallstone risk. Future research should aim to incorporate longitudinal designs with larger sample sizes and control groups, allowing for better clarification of causative relationships. Inclusion of additional variables such as bile composition analysis, hormonal assays, and detailed dietary histories may further enhance understanding of gallstone pathogenesis. Despite its limitations, the current study provides relevant insights into the biochemical profile of symptomatic gallstone patients and underscores the importance of individualized risk assessment in clinical practice.

CONCLUSION

This study concluded that a notable proportion of patients with symptomatic gallstone disease exhibited dyslipidemia, along with elevated serum calcium, cholesterol, LDL, and triglyceride levels. The findings highlight the relevance of metabolic disturbances in the clinical profile of gallstone patients and emphasize the need for comprehensive biochemical assessment in their management. The study also reaffirmed the higher vulnerability of women, particularly in middle age, to symptomatic gallstones. These insights contribute to a better understanding of the metabolic aspects of gallstone disease and support the integration of lipid profile monitoring into routine evaluation and preventive strategies in at-risk populations.

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Author Contribution

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Ahmad Wazir*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Umar Wazir	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Hania Salman	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published

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