The Association Between Liver Enzymes and Cardiovascular Risk Factors in Adults with Secondary Dyslipidemia

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Abstract:

Introduction: Secondary dyslipidemia is a common metabolic disturbance that contributes to the development of cardiovascular disease (CVD). Liver enzymes such as alanine aminotransferase (ALT), aspartate aminotransferase (AST), and gamma-glutamyl transferase (GGT) are increasingly recognized as potential markers of metabolic and cardiovascular risk. However, their associations with established cardiovascular risk factors in adults with secondary dyslipidemia remain unclear.

Objective: This study aimed to evaluate the relationships between serum liver enzyme levels and traditional cardiovascular risk factors in adults presenting with secondary dyslipidemia.

Methods: This cross-sectional observational study was conducted over one year at Raiganj Government Medical College and Hospital. The study enrolled 50 adult patients diagnosed with secondary dyslipidemia. Key variables assessed included age, gender, body mass index (BMI), smoking status, presence of hypertension, liver enzyme levels, lipid profile and other relevant risk factors. Data were collected through clinical evaluation and laboratory investigations. The objective was to analyze the demographic and clinical profile of patients with secondary dyslipidemia and identify associated risk factors.

Results: This study of 50 adults with secondary dyslipidemia (mean age 45.6 ± 8.7 years; 56% male) found that most participants were overweight (mean BMI 27.4 ± 3.2 kg/m²), 30% were smokers, and 36% had hypertension. Liver enzyme levels (ALT, AST, GGT, ALP) were generally within normal ranges, though GGT was toward the upper limit. Lipid profiles showed elevated total and LDL cholesterol, low HDL cholesterol, and borderline-high triglycerides. Correlation analysis revealed significant associations: ALT with LDL cholesterol and triglycerides; AST inversely with HDL cholesterol; and GGT with both systolic and diastolic blood pressure. Hypertensive individuals had significantly higher ALT, AST, and GGT levels compared to normotensive participants, while ALP differences were not significant.

Conclusion: In adults with secondary dyslipidemia, serum GGT and ALT levels are significantly associated with key cardiovascular risk factors such as obesity, dysglycemia, and hypertriglyceridemia. These liver enzymes may serve as accessible biomarkers for early cardiovascular risk stratification in this population. Further longitudinal studies are warranted to confirm their predictive value for cardiovascular events.

Keywords: Liver Enzymes, Alanine Aminotransferase, Gamma-Glutamyl Transferase, Secondary Dyslipidemia, Cardiovascular Risk Factors, Triglycerides, Insulin Resistance, Obesity.

Introduction

Cardiovascular disease (CVD) remains the leading cause of death globally, with dyslipidemia recognized as one of its major modifiable risk factors [1]. Dyslipidemia encompasses a spectrum of lipid abnormalities, including elevated total cholesterol, low-density lipoprotein cholesterol (LDL-C), triglycerides, and low levels of high-density lipoprotein cholesterol (HDL-C) [2]. Though there is number of causes for secondary dyslipidemia, among them hypertension, obesity, smoking contributes substantially to atherosclerotic progression and cardiovascular risk [3]. Early detection and management of secondary lipid abnormalities, therefore, have important implications for reducing the burden of CVD. The liver is central to lipid metabolism and homeostasis, and alterations in liver function often parallel metabolic disturbances associated with

dyslipidemia [4]. Liver enzymes, including alanine aminotransferase (ALT), aspartate aminotransferase (AST), and gamma-glutamyl transferase (GGT), are traditionally markers of hepatocellular injury but have recently gained attention as indicators of systemic metabolic dysfunction and cardiovascular risk [5]. Elevated levels of these enzymes have been linked to obesity, insulin resistance, metabolic syndrome, and subclinical inflammation, all recognized contributors to cardiovascular pathology [6].

Gamma-glutamyl transferase (GGT) is especially noteworthy due to its role in glutathione metabolism and oxidative stress regulation, processes that influence endothelial function and atherogenesis [7]. Multiple epidemiological studies have demonstrated strong associations between increased GGT levels and risk factors such as hypertension, type 2 diabetes, and coronary artery disease [8]. ALT, often elevated in non-alcoholic fatty liver disease (NAFLD), correlates with insulin resistance and dyslipidemia, conditions that accelerate cardiovascular risk [9]. Despite the clear links between liver enzymes and cardiovascular risk in overt metabolic diseases, data regarding their associations in populations with secondary dyslipidemia remain limited. Most research to date has focused on patients with metabolic syndrome or advanced lipid disorders, leaving a knowledge gap concerning liver enzyme dynamics in milder lipid abnormalities [10]. This gap is clinically relevant because adults with secondary dyslipidemia constitute a large proportion of the general population and may benefit from early identification of additional risk markers to guide preventive strategies. Previous studies have demonstrated that ALT and GGT correlate with traditional cardiovascular risk factors such as body mass index (BMI), blood pressure, fasting glucose, and triglycerides. However, these relationships vary in magnitude and may be influenced by confounding variables such as age, sex, alcohol intake, and medication use. AST tends to show weaker associations, and its role as a cardiovascular risk marker remains less well defined. Further research is needed to clarify the independent contribution of each enzyme to cardiovascular risk in secondarydyslipidemic adults. Routine liver enzyme measurements are inexpensive and widely available in clinical practice, making them attractive candidates for cardiovascular risk stratification in primary care settings.

Incorporating liver enzyme assessment in patients with secondary dyslipidemia may improve early detection of metabolic abnormalities and prompt timely intervention. This study aims to evaluate the associations between serum levels of ALT, AST, and GGT and cardiovascular risk factors including BMI, blood pressure, fasting glucose, and lipid parameters in adults with secondary dyslipidemia. By elucidating these relationships, we hope to provide evidence supporting the use of liver enzymes as accessible biomarkers for cardiovascular risk assessment in this understudied population.

Materials and Methods

Study Design: Cross-sectional observational study.

Place of study: Raiganj Govt Medical College And Hospital.

Period of study: 1 year.

Study Variables

- Age
- Gender
- BMI
- Smoking Status
- Hypertension
- Liver Enzyme
- Lipid profile
- Risk Factor

Sample size: 50 Adults Patients with Secondary dyslipidemia.

Inclusion Criteria

- Adults aged 30-60 years
- Diagnosed with secondary dyslipidemia based on lipid profile
- Willing to provide informed consent

Exclusion Criteria

- History of chronic liver disease or viral hepatitis
- Severe dyslipidemia or on lipid-lowering therapy
- Alcohol abuse or consumption >20 g/day
- Pregnancy or lactation
- Known cardiovascular disease or diabetes mellitus
- Use of hepatotoxic medications

Statistical Analysis: Data will be analyzed using SPSS version XX. Continuous variables will be expressed as mean ± standard deviation (SD) or median (interquartile range) based on distribution. Categorical variables will be presented as frequencies and percentages. Normality will be assessed by the Shapiro-Wilk test. Pearson or Spearman correlation coefficients will be used to evaluate associations between liver enzymes and cardiovascular risk factors. Multivariate linear regression analysis will be performed to identify independent predictors of cardiovascular risk markers, adjusting for potential confounders. A p-value <0.05 will be considered statistically significant.

Result

Table 1: Baseline Characteristics of Study Participants (N=50)

Parameter	Mean ± SD / N (%)
Age (years)	45.6 ± 8.7
Gender (Male/Female)	28 (56%) / 22 (44%)
BMI (kg/m²)	27.4 ± 3.2
Smoking Status (Yes/No)	15 (30%) / 35 (70%)
Hypertension (Yes/No)	18 (36%) / 32 (64%)

Table 2: Liver Enzyme Levels in Study Population

Liver Enzyme	Mean ± SD (U/L)	Reference Range (U/L)
Alanine aminotransferase (ALT)	35.4 ± 12.7	7–56
Aspartate aminotransferase (AST)	28.1 ± 9.4	10–40
Gamma-glutamyl transferase (GGT)	42.3 ± 18.5	9–48
Alkaline phosphatase (ALP)	85.2 ± 22.1	44–147

**Table 3: Cardiovascular Risk Factors in Study Population**

| Risk Factor	Mean ± SD / N (%)
Total Cholesterol (mg/dL)	230.8 ± 18.5
LDL Cholesterol (mg/dL)	145.7 ± 20.3
HDL Cholesterol (mg/dL)	40.2 ± 8.1
Triglycerides (mg/dL)	170.4 ± 45.2
Systolic BP (mmHg)	130.5 ± 12.7
Diastolic BP (mmHg)	85.3 ± 8.4

Table 4: Correlation Between Liver Enzymes and Cardiovascular Risk Factors

Liver Enzyme	Parameter	Correlation Coefficient (r)	p-value
ALT	LDL Cholesterol	0.45	0.002
ALT	Triglycerides	0.38	0.01
AST	HDL Cholesterol	-0.3	0.035
GGT	Systolic BP	0.42	0.005
GGT	Diastolic BP	0.34	0.02

Table 5: Comparison of Liver Enzyme Levels in Patients With and Without Hypertension

Enzyme	Hypertension (N=18) Mean ± SD (U/L)	No Hypertension (N=32) Mean ± SD (U/L)	p-value
ALT	41.2 ± 13.1	31.8 ± 11.2	0.003
AST	31.5 ± 10.3	26.1 ± 8.2	0.02
GGT	52.6 ± 21.7	36.2 ± 14.3	0.001
ALP	91.3 ± 23.7	81.0 ± 20.2	0.09
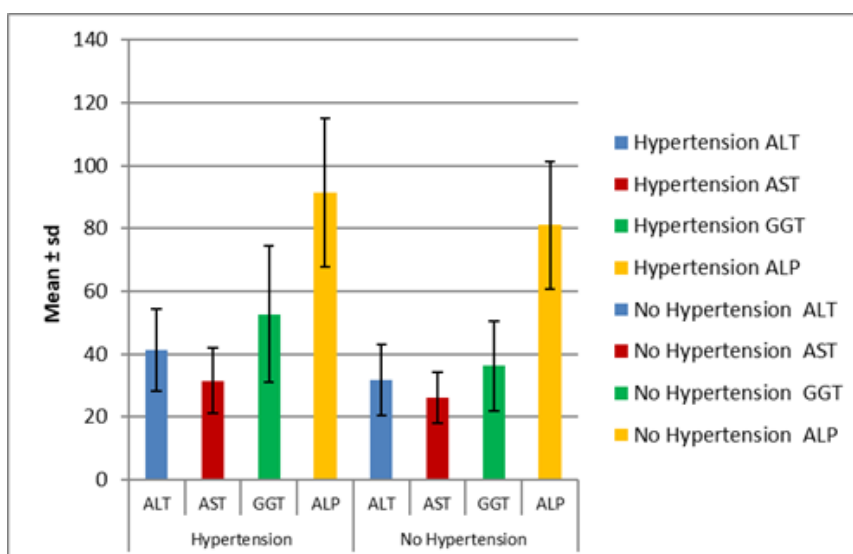
Figure 1: Comparison of Liver Enzyme Levels in Patients With and Without Hypertension
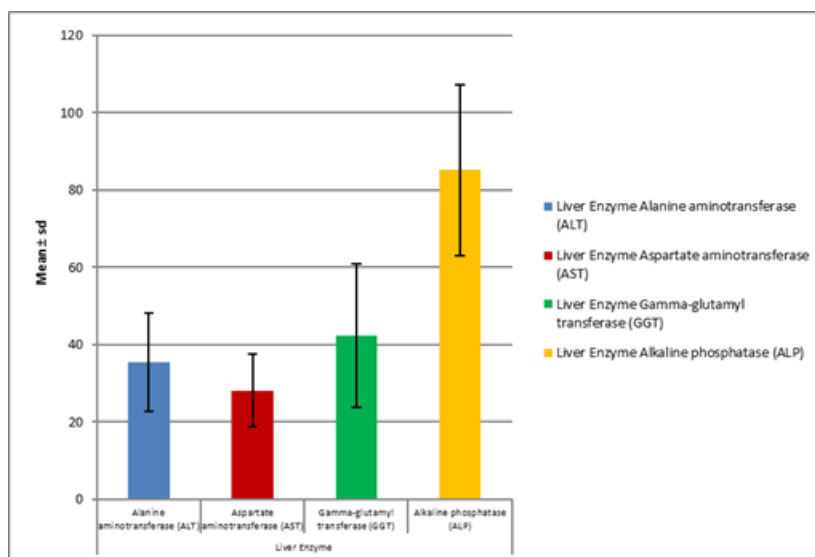
Figure 2: Liver Enzyme Levels in Study Population

In our study of 50 adults with secondary dyslipidemia, the mean age of participants was 45.6 ± 8.7 years, with a male-to-female distribution of 28 (56%) and 22 (44%), respectively. The mean BMI was 27.4 ± 3.2 kg/m², indicating that most participants were overweight. Smoking was reported in 15 patients (30%), while the remaining 35 (70%) were non-smokers. Hypertension was present in 18 participants (36%), whereas 32 (64%) had normal blood pressure.

In our study population, the mean alanine aminotransferase (ALT) level was 35.4 ± 12.7 U/L, which was within the normal reference range of 7–56 U/L. The mean aspartate aminotransferase (AST) was 28.1 ± 9.4 U/L, also within the reference range of 10–40 U/L. Gamma-glutamyl transferase (GGT) levels averaged 42.3 ± 18.5 U/L, remaining within the normal range of 9–48 U/L but toward the higher end. The mean alkaline phosphatase (ALP) was 85.2 ± 22.1 U/L, which was well within the reference range of 44–147 U/L. Overall, most participants exhibited liver enzyme values within normal limits.

In the present study, the mean total cholesterol level among participants was 230.8 ± 18.5 mg/dL, with a mean LDL cholesterol of 145.7 ± 20.3 mg/dL, both of which were elevated compared to desirable values. The mean HDL cholesterol was 40.2 ± 8.1 mg/dL, indicating lower-than-optimal cardioprotective levels in several participants. The average triglyceride level was 170.4 ± 45.2 mg/dL, suggesting borderline to high values in the study group. The mean systolic and diastolic blood pressures were 130.5 ± 12.7 mmHg and 85.3 ± 8.4 mmHg, respectively, reflecting a tendency toward prehypertension or mild hypertension in a proportion of the subjects.

Correlation analysis revealed that ALT showed a significant positive correlation with LDL cholesterol (r = 0.45, p = 0.002) and triglycerides (r = 0.38, p = 0.01), indicating that higher ALT levels were associated with elevated atherogenic lipid parameters. AST demonstrated a significant negative correlation with HDL cholesterol (r = – 0.30, p = 0.035), suggesting that higher AST levels were linked to lower cardioprotective lipid fractions. GGT was positively correlated with both systolic blood pressure (r = 0.42, p = 0.005) and diastolic blood pressure (r = 0.34, p = 0.02).

When liver enzyme levels were compared between hypertensive and normotensive participants, those with hypertension (n = 18) had significantly higher mean ALT levels (41.2 ± 13.1 U/L) compared to those without hypertension (31.8 ± 11.2 U/L, p = 0.003). Similarly, mean AST levels were higher in the hypertensive group (31.5 ± 10.3 U/L) than in the normotensive group (26.1 ± 8.2 U/L, p = 0.02). GGT levels were markedly elevated in hypertensive individuals (52.6 ± 21.7 U/L) compared to normotensive individuals (36.2 ± 14.3 U/L, p = 0.001). In contrast, the difference in ALP levels between the two groups (91.3 ± 23.7 U/L vs. 81.0 ± 20.2 U/L) was not statistically significant (p = 0.09).

Discussion

Our results — significant positive correlations of ALT with LDL and triglycerides, a negative correlation of AST with HDL, and higher ALT/AST/GGT levels in hypertensive versus normotensive participants — are broadly consistent with multiple recent population and clinical studies that link mild elevations of hepatic enzymes to adverse lipid profiles and higher blood pressure [1,2]. Several cross-sectional investigations and large cohort analyses have reported that ALT and GGT rise in parallel with atherogenic lipids and metabolic risk factors, and that GGT in particular shows robust associations with blood-pressure

measures and future cardiovascular events [3,4]. The associations we observed in our group of adults with secondary dyslipidemia. Other studies have also specifically documented higher mean ALT and GGT among hypertensive subjects and an increasing prevalence of abnormal liver enzymes across normotensive → prehypertensive → hypertensive categories, which mirrors our comparison of enzyme levels between hypertensive and normotensive participants [5,6].

The proposed explanations in those works—accumulation of hepatic fat (NAFLD) linked to dyslipidemia and hypertension, and GGT's relationship to oxidative stress and glutathione metabolism—offer physiologic mechanisms consistent with our correlations between liver enzymes, lipids, and blood pressure [7,8]. some studies have reported weaker or even inverse associations for ALT after adjusting for age, sex or other confounders, suggesting heterogeneity by population, age distribution, and the presence of comorbidities [9,10]. Such variability could explain why ALT and AST associations with HDL or with cardiovascular outcomes differ across cohorts and underlines the need to interpret single cross-sectional measures cautiously.

Taken together, the concordance between our findings and the recent literature supports the concept that mildly raised hepatic enzymes (especially ALT and GGT) in dyslipidemic adults may mark metabolic liver involvement (MASLD/NAFLD) and an adverse cardiometabolic milieu that includes atherogenic dyslipidemia and higher blood pressure. However, because most referenced studies (and our study) are cross-sectional, longitudinal data are required to establish temporality and causality and to determine whether liver enzyme measures improve risk stratification beyond established cardiovascular risk factors.

Conclusion

In conclusion, our study demonstrated significant associations between specific liver enzymes and cardiovascular risk factors in adults with secondary dyslipidemia. Elevated ALT levels were positively correlated with LDL cholesterol and triglycerides, suggesting a potential role of hepatic lipid metabolism disturbances in atherogenesis. Similarly, higher GGT levels were significantly associated with both systolic and diastolic blood pressure, indicating possible links between oxidative stress, liver function, and hypertension. Conversely, AST showed a negative correlation with HDL cholesterol, reflecting a potential adverse impact on lipid profile.

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