A biochemical approach to cardiac risk: association of AST & ALT levels with myocardial infarction in Type 2 Diabetes Mellitus

Enfoque bioquímico del riesgo cardiaco: asociación de los niveles de AST y ALT con el infarto de miocardio en la Diabetes Mellitus Tipo 2

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Abstract

Background: The presence of Type 2 Diabetes Mellitus raises the likelihood of suffering from cardiovascular morbidity and mortality. Scientific evidence increasingly points to a possible relationship between AST and ALT liver enzymes and the threat of cardiovascular diseases among people with diabetes. The purpose of this study was to determine the function of AST, ALT, and RBS in patients who had experienced MI and had T2DM.

Methods: The study was a prospective one that involved joint collaboration at the LPS Institute of Cardiology and School of Health Sciences of Chhatrapati Shahu Ji Maharaj University Kanpur N. agar, U.P., India. The study population consisted of 300 people, including 150 with Type 2 Diabetes Mellitus and Myocardial Infarction as cases and another 150 who were matched in age and gender and were healthy as controls. Both AST, ALT, and RBS in serum samples were assessed and analyzed by t-tests.

Results: Those in the cases group had a mean age of 56.41 years, noticeably more than the controls' mean age of 37.11 years. RBS levels were much higher in the cases group (276.05 mg/dL) as compared to the controls ($p < 0.001$). Participants in the cases group had much greater AST and ALT levels at 97.49 U/L and 45.64 U/L, respectively, when compared to 23.49 U/L and 31.35 U/L in the control group ($p<0.001$). Our results indicate that elevated liver enzymes are strongly associated biochemically with myocardial infarction in diabetic people.

Conclusion: An elevation in serum AST and ALT is strongly related to myocardial infarction in people with T2DM. Targeting these enzymes as part of a comprehensive control of blood sugar improves health professionals' ability to discover diabetic patients most at risk of heart complications.

Keywords: Alanine Aminotransferase (ALT); Aspartate Aminotransferase (AST); Cardiovascular Risk; Myocardial Infarction; Type 2 Diabetes Mellitus.

Resumen

Introducción: La Diabetes Mellitus Tipo 2 (DM2) es un problema de salud pública significativo asociado con una mayor morbilidad y mortalidad cardiovascular. Estudios recientes sugieren una posible relación entre las enzimas hepáticas—Aspartato Aminotransferasa (AST) y Alanina Aminotransferasa (ALT)—y el riesgo cardiovascular, especialmente en individuos diabéticos.

Objetivo: El objetivo de este estudio fue evaluar el papel de los niveles séricos de AST, ALT y glucosa en sangre aleatoria (RBS) en pacientes con infarto de miocardio (IM) y DM2, y analizar su posible relación con el riesgo cardiovascular.

Metodología: Se realizó un estudio prospectivo en el Instituto de Cardiología LPS, Kanpur Nagar, U.P., India, y en la Escuela de Ciencias de la Salud, Universidad Chhatrapati Shahu Ji Maharaj, Kanpur Nagar, U.P., India. Un total de 300 participantes fueron inscritos, incluyendo 150 pacientes con DM2 y IM y 150 controles saludables. Los niveles séricos de AST, ALT y RBS fueron medidos y analizados utilizando pruebas t.

Resultados: La edad media del grupo de casos fue significativamente mayor (56,41 años) en comparación con el grupo de controles (37,11 años). Los niveles de RBS fueron significativamente más altos en el grupo de casos (276,05 mg/dL) que en los controles (105,41 mg/dL) ($p < 0,001$). Los niveles de AST y ALT también fueron significativamente más elevados en el grupo de casos (97,49 U/L y 45,64 U/L, respectivamente) en comparación con los controles (23,49 U/L y 31,35 U/L, respectivamente) ($p < 0,001$).

Discusión: Estos resultados demuestran una fuerte correlación bioquímica entre los niveles elevados de enzimas hepáticas y el infarto de miocardio en pacientes diabéticos. El monitoreo de los niveles de AST y ALT podría proporcionar información útil para evaluar el riesgo cardiovascular en personas con DM2.

Conclusión: Los niveles elevados de AST y ALT en suero están significativamente asociados con el infarto de miocardio en individuos con DM2. El monitoreo regular de estas enzimas, junto con el control glucémico, puede ayudar a identificar a los pacientes diabéticos de alto riesgo y mejorar la evaluación del riesgo cardiovascular.

Palabras clave: alanina aminotransferasa (ALT); aspartato aminotransferasa (AST); riesgo cardiovascular; infarto de miocardio; diabetes mellitus tipo 2.

Introducción

T2DM is becoming a serious global public health issue as it is associated with severe complications, especially those affecting the large and small vessels, including heart disease[1,2]. One of the major cardiac risks for individuals with T2DM is Myocardial infarction (MI)[3]. Patients with T2DM have a risk of coronary artery disease that is two to four times higher than that of non-diabetics[4]. In recent years, the research community has redirected its focus from the "more traditional risk factors, such as cholesterol, blood pressure, and blood sugar control," to explore other, lesser-known markers that might predict heart disease[5]. Of these enzymes, there has been a special interest in the liver enzymes AST and ALT. Although AST and ALT are common indicators of liver injury, new studies suggest they may also disclose metabolic issues and increase the risk of heart disease. Although within the normal reference range, elevated AST and ALT values might indicate an underlying inflammation, insulin resistance, or even a metabolic syndrome, all of which increase the likelihood of atherosclerosis and cardiovascular issues[6]. Abnormally high AST and ALT levels are associated with increased risk of heart attacks, especially in people diagnosed with diabetes[7], and this has been evidenced by many wide scope studies. The enzymes are also highly correlated with non-alcoholic fatty liver disease (NAFLD), a condition commonly found in patients with metabolic syndrome and a known independent heart disease risk factor[8]. NAFLD also has a strong association with these enzymes, and it is often present among people who have metabolic syndrome and is now established Bygone beneath this association are processes in common like insulin resistance, oxidative stress, chronic inflammation, dyslipidemia and endothelial dysfunction that manifests to cell and tissue blockage and damage of the arteries and heart[9]. Despite the attention given to this field, there are a few regionally specific studies that have explored the relationship between AST and ALT levels and the risk of MI among T2DM patients. Researchers hope to fill the existing gap in the body of research through this study by determining the relationship between transaminase levels and MI incidence among diabetics, demonstrating the possible clinical relevance of these enzymes as cost-effective cardiovascular risk prognosticators.

Methods

Study Design

The aim of the present prospective study was to establish the significance of certain biochemical markers in patients with myocardial infarction and Type 2 Diabetes Mellitus (T2DM). During a set period of time, the research followed the participants to find out the relationship between serum AST, ALT, and RBS levels.

Setting

The research was conducted in two centers: the two research centers supporting the study included LPS Institute of Cardiology, Kanpur Nagar, Uttar Pradesh and School of Health Sciences, Chhatrapati Shahu Ji Maharaj University, Kanpur, Uttar Pradesh, India. These institutions provided the necessary resources and fit the study population for the study, which was supported by the research institutions.

Participants

All in all, 300 participants were chosen, and divided into two equally sized cohorts. Group I included 150 patients, diagnosed with concomitant myocardial infarction and Type 2 Diabetes Mellitus. Group II (Controls) consisted of 150 subjects who were normative of any history of diabetes or cardiovascular diseases. The participants were recruited to mimic the target population permitting the comparison of biochemical markers between compounds of both conditions to a healthy group of control.

Inclusion Criteria

Interested information users had to be included in this study under specific inclusion criteria. Only people aged between 30 and 60 were eligible for the study. Group I was composed of patients diagnosed with myocardial infarction where the diagnosis was confirmed by ECG anomalies, an increase in cardiac enzymes or a correct estimate by a healthcare provider. In addition, for Group I, participants had to have a documented diagnosis of Type 2 Diabetes Mellitus diagnosed by HbA1c or blood glucose levels taken with fasting. On the contrary, Group II consisted of participants who do not have any history of diabetes and cardiovascular disease. Participation in the study was conditional upon willingness to participate by all the subjects on written consent after the entire research procedures have been explained to them.

Exclusion Criteria

Some participants had to be excluded to ensure homogeneity in the group and avoid factors that may make the results hard to understand. Those with preset chronic liver, kidney or thyroid disease or on treatment concerning lipid-lowering reactors or insulin were excluded. For the sake of the safety of the participants, pregnant or breastfeeding women were also not part of the study. Also, subjects with other acute or chronic health disorders that may interfere with the study results were omitted from the study.

Data Collection Process

Study participants were selected by using purposive sampling techniques, and the eligible individuals were informed about the study aims, objective and procedures. Before demographic, clinical data and blood sample collections, written informed permission from was collected from all participants. Data was collected through using a structured proforma and blood sampling done by antiseptic venipuncture techniques by median cubital vein, and blood sample transfer in Plain vial for AST, ALT and Sodium fluoride for RBS. MI patients, diagnosis was confirmed through clinical history, ECG findings, and biochemical reports. For controls, screening was done to confirm their healthy status and absence of T2DM or cardiovascular conditions. “All data were recorded confidentially and managed in a secured database.

Statistical Analysis

The data were systematically entered, cleaned, and coded using Microsoft Excel before being imported into IBM SPSS Statistics for Windows, Version 26.0 (IBM Corp., Armonk, NY) for comprehensive statistical analysis. Descriptive statistics were employed to summarize demographic and clinical characteristics of the study population. Continuous variables, including age, serum alanine aminotransferase (ALT), aspartate aminotransferase (AST), and random blood sugar (RBS), were expressed as mean ± standard deviation (SD), while categorical variables such as gender were reported,” as frequencies and percentages.

Before inferential analysis, the normality of continuous variables was assessed using the Shapiro–Wilk test. For group comparisons involving “normally distributed continuous data, the independent samples t-test was conducted to evaluate mean differences between two distinct groups (e.g., case vs. control). Homogeneity of variances was assessed using Levene’s test. A two-tailed p-value < 0.05 was considered statistically significant, indicating a less than 5% probability that the observed differences occurred by chance. All analyses adhered to standard assumptions of parametric tests to ensure the robustness and validity” of the findings

This study included a total of 300 participants, equally divided into two groups: Cases and Controls. Table 1 summarizes the demographic characteristics, including frequencies, percentages, and mean age. In Group I (Cases), 65.3% were male (n = 98) and 34.7% were female (n = 52), whereas in Group II (Controls), 70% were male (n = 105) and 30% were female (n = 45) as shown in Figure 1 and Figure 2.

Figure 1. Gender Distribution of Participants in Group I (Cases)

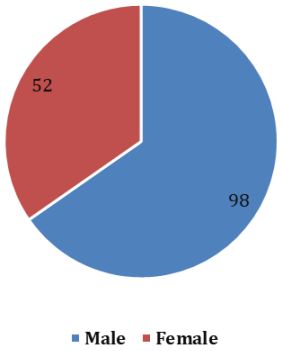
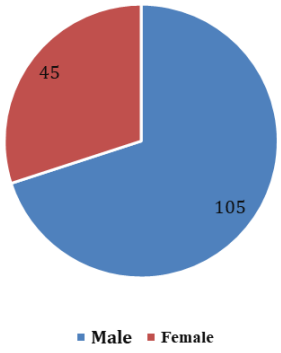


Figure 2. Gender Distribution of Participants in Group II (Controls)



The mean age of males and females in Group I was 48 and 42 years, "respectively, while in Group II, it was 46 years for males and 40 years for females.

Table 1. Descriptive Statistics and of the Demographic Variables

Gender			
	Variables	Male N (%)	Female N (%)
	Group-1	98 (32.7%)	52 (17.3%)
	Group-II	105 (35%)	45 (15%)
Age			
	Variables	Gender N (%)	Mean Age (Years)
	Male	203 (67%)	48
	Female	97 (32.3%)	46

N: Number; %: Percentage, Group I; patients of Myocardial Infarction with type 2 diabetes mellitus, Group II; Control,

Table 2. Statistical Comparison of Biochemical Parameters Between Group I (Cases) and Group II (Controls)

Parameter	Group I (Mean ± SD)	Group II (Mean ± SD)	*t*-value	*p*-value
RBS (mg/dL)	276.05 ± 69.01	105.41 ± 20.32	-29.05	<0.001**
ALT (U/L)	45.64 ± 21.84	31.35 ± 14.69	-6.66	<0.001**
AST (U/L)	97.49 ± 37.05	23.49 ± 9.00	-23.50	<0.001**

All vales were Mean and SD, Sd; standard deviations, RBS ; Random Blood Sugar, ALT; Alanine Aminotransferase, AST; Aspartate Aminotransferase, mg/dL; milligram per deciliter, U/L ; Unit Per Liter, Group I; patients of Myocardial Infarction with type 2 diabetes mellitus, Group II; Control, An Independent Student's t-test was run for comparison, A p-value of <0.05 was considered statistically significant.

Figure 3. Age Distribution of Participants in Group I (Cases) and Group II (Controls)

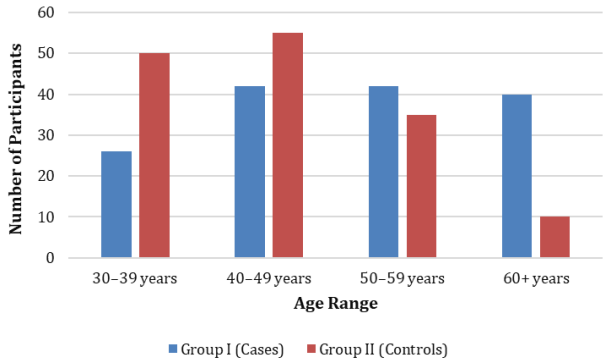


Figure 3 illustrates the age distribution of participants in both groups. The highest number of participants in Group I (Cases) is found in the 40–49 years age range, while Group II (Controls) has the highest number in the 30–39 years age range. The number of participants decreases as age increases, with fewer individuals in the 50–59 years and 60+ years categories, particularly in the control group. This distribution highlights the demographic variations between the two groups."

From an independent Student's t-test for biochemical markers; ALT, AST, and RBS in the two groups, the results are presented in table 2. Group I experienced much higher mean RBS values (276.05 ± 69.01 mg/dL) compared with Group II (105.41 ± 20.32 mg/dL) on t = -29.05 and p = <0. ALT values were significantly higher for group I (45.64 ± 21.84 U/L) than for group II (31.35

± 14.69 U/L) (t = -6.66; p < 0.001). The AST levels in Group I (97.49 ± 37.05 U/L) were significantly elevated as compared to Group II of (23.49 ± 9.00 U/L) with a t-value of -23.50 and p-value. The statistics show that it is possible to talk about statistically significant differences in biochemical markers in subjects with MI and T2DM as compared with the healthy subjects.

Figure 4. Comparison of Mean Levels of AST, ALT, and RBS Between Group I (Cases) and Group II (Controls)

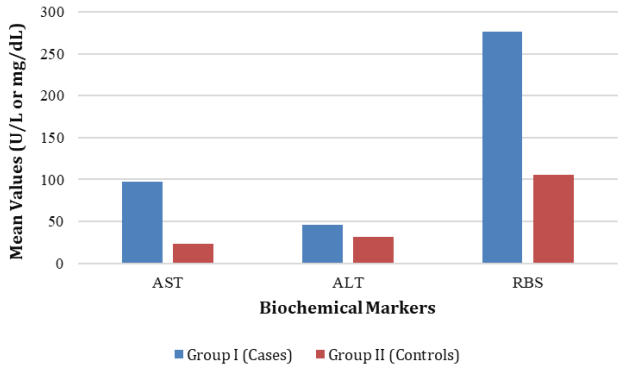


Figure 4 illustrates the significant differences in the mean levels of AST, ALT, and RBS between the two groups. Group I (cases) showed markedly elevated levels of AST (97.49 U/L), ALT (45.64 U/L), and RBS (276.05 mg/dL) compared to Group II (controls), where the mean values were 23.49 U/L, 31.35 U/L, and 105.41 mg/dL, respectively. These differences highlight the biochemical disturbances associated with myocardial infarction and Type 2 diabetes.

Discussion

We performed a comparative analysis between randomly selected healthy individuals as the control group and admitted patients at LPU Institute as the cases group. We compared and examined the demographic, and biochemical biomarkers to identify key differences and their possible clinical relevance. The gender ratio revealed that the control group had more males (105) than females (45), while the case group had a higher number of males (98) compared to females (52). This excess of males in both groups is consistent with previous research, which has shown that males tend to have higher rates of metabolic disorders, "including diabetes mellitus and cardiovascular diseases, compared to females. Group II had a mean age of 46 years, while Group I had a mean age of 48 years for males and 42 years for females. This variance in mean age is significant, as older age is commonly associated with an increased risk of metabolic disturbances and related complications. "This finding aligns with previous research, such as that of Bhowmik et al. 2018 and Kumar et al. 2019," who reported similar trends of age-related increases in the risk of metabolic disorders[10,11]. Our study confirmed a statistically significant difference between the RBS values of both groups. Group I had a mean RBS of 105.41 mg/dL, while the cases group had a significantly higher mean of 276.05 mg/dL, so the p-value of <0.001** indicates the high significance of the RBS concentrations in both groups. This finding is consistent with previous research, which reported significantly higher glucose values in diabetic subjects compared to healthy controls[12]. The mean value of ALT was significantly higher in the case group (45.64 ± 21.84 U/L) compared to the control group (31.35 ± 14.69 U/L). Similarly, Aspartate Aminotransferase (AST) levels were significantly higher in the case group (97.49 ± 37.05 U/L) compared to the control group (23.49 ± 9.00 U/L)". The p-values for both comparisons were <0.001, confirming the statistical significance of these differences. These results suggest hepatic impairment among the cases group, consistent with previous studies that have reported alterations in liver function tests in patients of T2DM[13]. Elevated liver enzymes among diabetic patients are commonly attributed to insulin resistance, hepatic steatosis, and oxidative stress, which are prevalent in metabolic syndrome and diabetes mellitus. Our findings are in line with those from earlier studies, such as the one by Mandal et al. (2018), who reported similar alterations in liver function among diabetic patients[14]. According to Alam et al. (2021)[15], "in Framingham cohort study elevated levels of ALT and AST liver enzymes" in patients with diabetes are associated with cardiovascular and metabolic risk factors. Our data support the pattern found in recent literature that involved raised liver enzymes appearing much of

the times in people suffering from diabetes or metabolic syndrome. For example, Bhowmik et al. (2018) reported a strong association between lipid disorders and glucose intolerance, while Kumar et al. (2019) identified differences in terms of lipid and enzyme profiles between type 2 diabetes patients and controls[10,11]. Additionally, Kones (2011) has emphasized the residual cardiovascular risks associated with abnormal lipid profiles and liver function in diabetic populations[16]. Our study reinforces the importance of liver function abnormalities as a marker of metabolic and cardiovascular risk in diabetes.

Limitations: With such a low sample size obtained from one hospital base by means of non-probability sampling, the conclusion of the study is not necessarily generalisable. Moreover, major confounding components – the diet, the physical activity, the medication intake and the duration of diabetes were not taken into account, which might have had an influence on the results at the end. To validate these conclusions future investigations should take into account that studies should be conducted in different population for long durations.

Conclusions

The analysis showed significant variations with the cases group having a significantly higher mean age, elevated random blood sugar and greatly elevated ALT and AST liver enzymes. These results show the effects of diabetes mellitus on metabolic abnormalities and liver health. The data implies that monitoring of the liver enzymes in addition to the blood sugar should be the standard in the management of diabetes. By showing the importance of biochemical markers in metabolic assessments, the study shows a potential means to greater clinical management and quality of life amongst the afflicted individuals.

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Conflict of Interest: The authors declare no conflicts of interest related to this study.

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