Relationship of HbA1c with Mean Platelet Volume and Leucocyte Count in Patients with Type 2 Diabetes Mellitus

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ABSTRACT

Objective: To determine the relationship between mean platelet volume (MPV), leucocyte count, and HbA1c levels in patients with type 2 diabetes mellitus (DM).

Study Design: Observational study.

Place and Duration of the Study: Bahcesehir Family Healthcare Centre (FHC), Adana, Turkiye, from January 2023 to 2024.

Methodology: This study included 101 controls and 106 patients with Type 2 diabetes mellitus (DM). Age, gender, body mass index (BMI), duration of diabetes, smoking, type of diabetic medication, and presence of chronic diseases were all assessed in relation to the patients. Analysis of leucocyte count, MPV, and HbA1c was conducted retrospectively. IBM SPSS version 25.0 was utilised for the statistical analysis, with p <0.05 being considered as the significance threshold.

Results: The DM group exhibited significantly higher levels of HbA1c (7.8 ± 1.5%), MPV (9.2 ± 1.3 fL), and leucocyte count (7.1 ± 1.8 x10^3/μL) in comparison to the control group (p <0.001). There was a positive and statistically significant association found between the leucocyte count, MPV, and HbA1c. In the control group, there was no significant link onserved.

Conclusion: In patients with Type 2 DM, a favourable connection between HbA1c, MPV, and leucocyte count was observed. These results point to a higher risk of thrombosis and inflammation in DM patients. Patients with HbA1c values above 7 showed increased leucocyte counts and MPV, which indicated that these patients were at a higher risk of vascular problems. Leucocyte counts and MPV may serve as useful biomarkers to gauge the likelihood of vascular problems in DM.

Key Words: Type 2 diabetes mellitus, HbA1c, Mean platelet volume, Leucocyte count, Inflammation, Vascular complications.

INTRODUCTION

There are 1.5 million diabetes-related fatalities annually, and 422 million people worldwide—the majority of whom reside in low- and middle-income nations—have the disease. In recent years, there has been a steady rise in the number of diabetes cases.[1] The prevalence of diabetes among adults aged over 20 years was 7.8% in the Turkiye Diabetes, Hypertension, Obesity and Endocrinologic Diseases Prevalence Study (TURDEP I), and it was 13.7% in the TURDEP II results from 2010, with at least 10% of the population in the 40-44 age group also having the disease. Sufficient management of diabetes, a condition whose incidence is rising quickly both domestically and globally, guarantees that the illness is controlled, and complications are avoided.[2]

Diabetes mellitus (DM) is a long-term, multifaceted metabolic disease that affects many organs and results in multisystemic involvement. It is characterised by hyperglycaemia, which is brought on by either absolute or relative insulin deficiency or insulin resistance developed against insulin action in peripheral tissues.[3] The connection between Type 2 DM and inflammation has been highlighted by recent researches.[4,5] Insulin resistance has an impact on haematopoiesis, which happens through interactions with blood cells as well as endothelial dysfunction. Pro-inflammatory cytokines and chemokines, along with an active inflammatory response, have been linked to chronic hyperglycaemia and β cell loss in the pathophysiology of Type 2 DM.[6]

The most significant pathogenetic characteristic of platelets, which are essential components of atherothrombosis, is their interaction with leucocytes in the injured endothelium. Large-volume platelets are more reactive blood components that contribute more to inflammatory processes. In this regard, mean platelet volume (MPV) and leucocyte count can be regarded as affordable and realistic haemogram measures that could be helpful in DM diagnosis, vascular complications severity assessment, and treatment response evaluation.[7]

The possible correlations between MPV, leucocyte count, and HbA1c levels in patients with DM have been investigated in this study. Developing a more effective strategy for managing

diabetes may be aided by knowing how HbA1c affects diabetes control and the potential impact of leucocyte count and MPV on disease progression and complication risk. The information gathered can help researchers and physicians manage diabetes more effectively and individually. The main objective of the study was to reveal the relationships between MPV, leucocyte count, and HbA1c levels in patients with Type 2 DM.

METHODOLOGY

The Adana City Training and Research Hospital Scientific Research Evaluation Commission granted ethical approval (Meeting Number: 142, Dated: 21.12.2023, Decision Number: 3017) and the Adana Provincial Health Directorate granted approval (Number: E-11289099-050.04-237991169, Date: 29.02.2024) prior to the commencement of this retrospective study.

In family health centres that offer primary healthcare, there are typically 3,500 patients per doctor. In the family health centre where the study was conducted, the average population density was also 3,500 people per unit. The study included 106 Type 2 DM patients who applied to the Family Health Centre (FHC), Adana, Turkiye, between January 2023 and 2024 and whose examinations were conducted there. There was an average of 300 Type 2 DM patients registered in the unit. Individuals having a history of cancer, anaemia, steroid or insulin usage, platelet dysfunction, atherosclerotic heart disease, leucocytosis or leucopaenia, and pregnancy were not included. The study also included 101 control patients who were of the same age group and gender. Patients with missing or inconsistent data in the patient database and those with diseases that could affect MPV and leucocyte count numbers, such as active infection or haematological diseases, were not included in the study.

Patients' record forms were produced ahead of time for each patient and included information on the patient's age, gender, BMI, duration of diabetes, smoking status, type of diabetic medication, and status of chronic diseases. The following parameters were examined retrospectively: Leucocyte counts, MPV, haemoglobin, haematocrit, and fasting blood glucose.

Blood glucose levels were measured by glucose oxidase method using Advia 2400 Chemistry System (Siemens Healthcare Diagnostics, NY, USA). HbA1c levels were measured by ion exchange chromatography HPLC using Bio-Rad Variant II Turbo HbA1c analyzer (Bio-Rad Laboratories, Hercules, CA, USA).

For both numerical and categorical variables, including age, gender, BMI, duration of diabetes, smoking, diabetes therapy, and status of chronic illness, frequency, mean and standard deviation values were computed. The significance of the difference between the control and DM groups was assessed using the Chi-Square test for categorical variables (the categorical variables were expressed as counts and percentages). To determine if there was a significant difference in leucocyte counts and MPV between patients with HbA1c over 7 (Group 2) and control patients with HbA1c below 7 (Group 1), the Mann-Whitney U test was employed. The statistical software IBM SPSS version 25.0 was utilised to analyse the data. For all statistical tests, the accepted significance limit was p <0.05.

RESULTS

The study subjects included 101 control participants and 106 patients with Type 2 DM. Participants were selected based on their gender and age. Records were kept on age, gender, BMI, duration of diabetes, smoking status, type of diabetic medication, and status of chronic diseases. Retrospective analyses were performed on leucocyte counts, fasting blood glucose, haematocrit, platelets, MPV, and haemoglobin.

In this study, the DM group's median age was 53.0 (IQR = 13.0) years, while the control group's median age was 50.0 (IQR = 10.0) years (p = 0.072). In the DM group, 60.4% (n = 64) of the patients were male compared to 58.5% (n = 59) in the control group (p = 0.758). The DM group had a median BMI of 30.0 (IQR = 6,8), while the control group had a median BMI of 28.7 (IQR = 4.7). This difference in BMI was statistically significant (p = 0.003). Table I shows that although the habit of smoking was present in 33.0% (n = 35) of DM patients, and in 22.8% (n = 23) of the control group (p = 0.132).

The median HbA1c level of the patients in the DM group in this study was 6.3 (IQR = 1.4), whereas the control group's value was 5.5 (IQR = 0.4). This difference was statistically significant (p <0.001). The DM group's median MPV was 9.6 fL (IQR = 1.5), while the control group was 9.6 fL (IQR=1.4). This difference was also statistically significant (p <0.001). Additionally, the DM group's median leucocyte count was 7.2x10^3/µL (IQR = 2.1), while in the control group, it was 8.1x10^3/µL (IQR = 2.5), with a statistically significant difference (p <0.001). These results show that DM patients have higher leucocyte counts, MPV, and HbA1c than the control group. These variations might be connected to DM's worsened inflammation and poorer glucose regulation (Table II).

Leucocyte counts and MPV increased in tandem with increases in HbA1c levels. In the DM group, a statistically significant and positive connection was found between leucocyte counts and MPV and HbA1c. In the control group, there was no significant link observed. Compared to patients with an HbA1c above 7 (Group 2), control patients with an HbA1c below 7 (Group 1) had significantly greater leucocyte counts and MPV.

Table I: Demographic and clinical characteristics.

Description	Control Group (n = 101)	DM Group (n = 106)	p-value
Age (median (IQR))	50.0 (10.0)	53.0 (13.0)	0.072
Gender (male, n (%))	59.0 (58.5%)	64.0 (60.4%)	0.758*
BMI (median (IQR))	28.7 (4.7)	30.0 (6,8)	0.003
Duration of diabetes (years) (median (IQR))	-	5.45 (5.57)	-
Smoking (n (%))	23.0 (22.8%)	35.0 (33.0%)	0.132*

*Mann-Whitney U test, *Chi-square test, IQR: Interquartile range.*

Table II: Comparison of HbA1c, MPV, and leucocyte count in Type 2 DM patients.

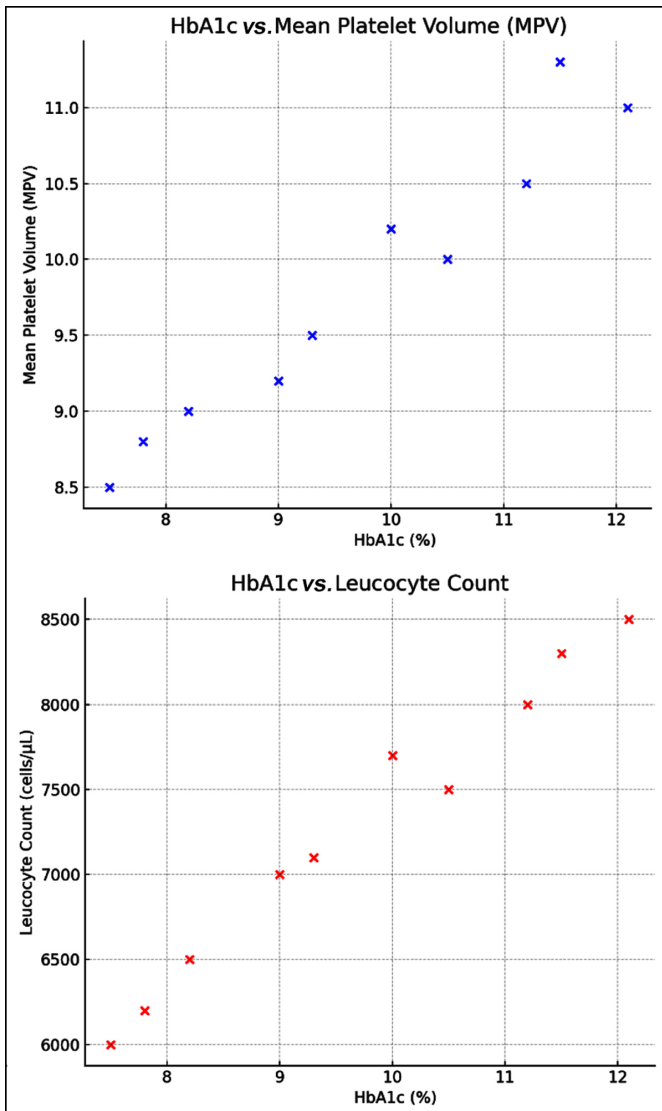| Characteristics	Control Group	DM Group	p-value
HbA1c (%) (median (IQR))	5.5 (0.4)	6.3 (1.4)	<0.001
MPV (fL) (median (IQR))	9.6 (1.4)	9.6 (1.5)	<0.001
Leucocyte count (x10^3/µL) (median (IQR))	7.2 (2.1)	8.1 (2.5)	<0.001

Mann-Whitney U test.

Figure 1: Scatter plots illustrating the relationship between HbA1c levels, MPV, and leucocyte count in Type 2 DM patients.

Figure 1 shows the relationship between HbA1c and MPV, indicating that MPV values rise in tandem when HbA1c levels rise. The scatter plot illustrating the association between HbA1c, and leucocyte count indicates that an increase in the HbA1c levels is accompanied by an increase in the leucocyte count.

DISCUSSION

This study examines the association between HbA1c levels, MPV, and leucocyte counts in patients with Type 2 DM. It also offers novel insights into the risk of inflammation and thrombosis in diabetic patients. The results demonstrate that MPV and leucocyte counts rise as HbA1c levels rise in Type 2 DM patients. This implies that a significant part of the pathophysiology of diabetes is played by inflammation and platelet activation.

It is well-recognised that larger platelets are more reactive, and MPV is a metric used to assess platelet function. According to research, MPV was considerably higher in DM patients than in the control group, suggesting that diabetes patients have higher levels of platelet activation. High MPV values in DM patients were linked to microvascular problems in a research by Cassano et al.[8] Chu et al. also found that in DM patients, elevated MPV values were linked to microalbuminuria and retinopathy.[9] These results corroborate the study's findings and imply that patients with DM may be more susceptible to vascular problems because of the elevated platelet activation.[10]

Leucocyte count plays a key part in the pathophysiology of Type 2 DM and is thought to be an indication of chronic inflammation. According to this research, the leucocyte count in Type 2 DM patients was considerably greater than in the control group, suggesting that inflammation is elevated in this condition. In a study by Ebrahim et al. leucocyte count and MPV values were shown to be greater in DM patients than in the control group patients.[11] High leucocyte counts in patients with DM are indicative of inflammation, according to additional research in the literature.[12-17]

HbA1c is utilised as a long-term measure of diabetes control, and this study demonstrated a positive association between HbA1c, MPV, and leucocyte counts. This result implies that as the diabetes control deteriorates, platelet activation and inflammation rise. According to the research, patients with HbA1c levels above 7 may also be at a higher risk of vascular problems due to the higher MPV and leucocyte counts.[18-25] This result raises the possibility that more stringent glycaemic management and antithrombotic therapy are required.

There are several limitations on this investigation. The results, which were limited to Type 2 DM patients, could not be extrapolated to other forms of DM because the study was retrospective in nature and no causal association could be demonstrated. It will be possible to extrapolate these results to a larger population in subsequent research by using prospective designs and comparable analyses on various forms of diabetes.

The interpretation and evaluation of this laboratory test, which primary care physicians frequently employ, may be enhanced by the identification of HbA1c, MPV, and leucocyte count assessed in the outpatient setting as risk factors for Type 2 DM in addition to other recognised risk factors. Clinically, patients with HbA1c values above 7 may require more stringent glucose management and antithrombotic treatment approaches to reduce their risk of vascular problems. Moreover, new therapeutic approaches and a deeper understanding of the role of inflammation in DM are also required. Such studies may aid in the creation of more individualised and successful DM management strategies.

CONCLUSION

These results showed that the patients with HbA1c values above 7 showed greater MPV and leucocyte counts, indicating a possible increased risk of vascular problems. These results highlight the connection between platelet activation, inflammation,

and glucose regulation in diabetes mellitus (DM), and they imply that leukocyte counts and MPV, in addition to HbA1c, may serve as useful biomarkers for determining the likelihood of vascular problems in the disease.

ETHICAL APPROVAL:
Ethical approval was obtained from The Adana City Training and Research Hospital Scientific Research Evaluation Commission (Meeting number: 142, Dated: 21.12.2023, Decision Number: 3017) and the Adana Provincial Health Directorate (Number: E-11289099-050.04-237991169, Dated: 29.02.2024).

PATIENTS' CONSENT:
Since it was a retrospective study, the data were collected from the hospital's archive following the approval of the Ethics Committee. Informed consent was obtained from all the patients before the procedure.

COMPETING INTEREST:
The authors declared no conflict of interest.

AUTHORS' CONTRIBUTION:
OK: Conception of the idea, literature search, data collection, and manuscript writing.
IF: Manuscript writing, analysis, and interpretation of the results.
Both authors approved the final version of the manuscript to be published.

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