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Original Research Article

An Analytical Cross-Sectional Study Assessing Correlation of MPV with Fasting Blood Glucose, Glycosylated Hemoglobin (Hba1c) and Duration of Diabetes in the Diabetic Patients

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Abstract

Aim: The aim of the present study was to determine the correlation of MPV with fasting blood glucose, glycosylated hemoglobin (HbA1c) and duration of diabetes in the diabetic patients.

Material & Methods: This was a cross-sectional study carried out in Department of Pathology, including 200 patients who were already diagnosed to have Type 2 DM and 200 nondiabetic subjects without known coronary artery disease in between the duration of 12 months

Results: There were more male as compared to females in both groups. MPV was significantly raised in the diabetic population in comparison to controls. Similarly, we also observed significantly higher MPV among diabetics with vascular complications in comparison to those without vascular complications. Among diabetics with microvascular complications, MPV showed a significant association with Diabetic Nephropathy and Diabetic retinopathy. Similarly, among those with macrovascular complications, MPV showed a significant association with Peripheral Artery Disease. MPV showed significant positive correlation with HbA1C, fasting blood sugar, and duration of diabetes in our study. All three correlations are reflected by their positive "r" values.

Conclusion: Results showed significantly higher MPV in diabetic patients than in the nondiabetic subjects. This indicates that elevated MPV could be either the cause for or due to the effect of the vascular complications. Hence, platelets may play a role and MPV can be used as a simple parameter to assess the vascular events in diabetes.

Keywords: Diabetes Mellitus, Hyperglycemia, Mean Platelet Volume

Introduction

One of the platelet indices used by a hematology analyzer to quantify the size of platelets and, consequently, their activity, is known as mean platelet volume (MPV). [1] Patients with Type 2 Diabetes Mellitus are more likely to experience micro-vascular and macro-vascular problems. [2] Proangiogenic factors including serotonin and thromboxane A2 are released in greater quantities by large activated platelets than by smaller ones. [3] Hyperglycemia, insulin resistance, oxidative stress, hyperlipidemia, and other metabolic disorders all play a significant part in the onset of endothelial damage and excessive platelet activation. Large activated platelets stick to the damaged endothelial cells and aggregate there because of reduced sensitivity of the platelets to nitric oxide, increased synthesis of von Willebrand factors by the damaged endothelial cells, and elevated levels of advanced glycation end products. This leads to thrombus formation and microcapillary embolization resulting in the development of vascular lesions. It implies a relationship between platelet activity and vascular damage in diabetes patients, the primary factor causing morbidity and even fatality in this condition. [4]

The increased platelet activity is emphasized to play a role in the development of vascular complications of this metabolic disorder. [5] Platelet volume, a marker of the platelet function and activation, is measured as mean platelet volume (MPV) by hematology analyzers. Diabetic patients have an increased risk of developing micro- and macrovascular disease, and platelets may be

involved as a causative agent with respect to altered platelet morphology and function. [6,7]

Therefore Platelet volume, a marker of the platelet function and activation, is measured as mean platelet volume (MPV) by hematology analyzers It implies a relationship between platelet activity Mean platelet volume (MPV), an important morphological parameters of platelets and an easily accessible indices in routine blood test, could reflect the size and activity of platelet. [8] Higher MPV level indicates larger platelets, which are metabolically and enzymatically more active. [3] In the National Health and Nutrition Examination Survey the researchers reported that MPV was strongly and independently associated with the presence and severity of diabetes in study participants with diabetes. [9]

The aim of the present study was to determine the correlation of MPV with fasting blood glucose, glycosylated hemoglobin (HbA1c), body-mass index, and duration of diabetes in the diabetic patients.

Material & Methods

This was a cross-sectional study carried out in Department of Pathology, Government Medical College and Hospital, Bettiah, West Champaran, Bihar, India including 200 patients who were already diagnosed to have Type 2 DM and 200 nondiabetic subjects without known coronary artery disease in between the duration of 12 months.

Exclusion Criteria

- Male patients with hemoglobin below 13 gm% and female patients below 12 gm% were excluded from the study because nutritional anemias can be a cause for reactive thrombocytosis and hence, increased MPV.
- Nondiabetic subjects with coronary artery disease and diabetics on antiplatelet drugs such as aspirin and clopidogrel were also excluded.
- Subjects with any diagnosed malignancy were also excluded.

After baseline evaluation, diabetic patients were divided into two groups according to their HbA1c levels:

Group A consisted of patients with HbA1c levels < 6.5% and

Group B consisted of patients with HbA1c levels ≥ 6.5%.

The latest HbA1c cut-off for diabetic range according to American Diabetic Association 2010 criteria is ≥ 6.5%.

Methodology

All the diabetic and nondiabetic subjects underwent a complete clinical evaluation with specific reference to any associated macro- or microvascular complications as well as any drugs taken. Height and weight of all the subjects were recorded. The MPV and platelet counts was measured in the above target groups who had a complete blood count done using an automatic blood counter (Beckman Coulter Act5Diff). Venous blood samples were collected in dipotassium EDTA and tested within 1 hour of collection to minimize variations due to sample aging. Samples were maintained at room temperature. Samples for plasma glucose estimation and HbA1c were collected in sodium fluoride and dipotassium EDTA, respectively. The estimation of plasma glucose levels (fasting plasma glucose and postprandial plasma glucose) was carried out by the glucose oxidase method in the auto analyzer (Johnson and Johnson vitros 250) and that of HbA1c by the high-performance liquid chromatography method.

Statistical Analysis

Statistical evaluation was performed by statistical package for the social sciences (SPSS) version 14 (Chicago, IL) for Windows statistics program using Student's independent sample two-tailed t-test and Pearson correlation test (r value as the coefficient). Data were expressed as mean ± standard deviation. A P value <0.05 was considered statistically significant.

Results

Table 1: Patient data

Gender	Diabetic cases	Non-diabetic controls
Male	115	120
Female	85	80
Mean age	56.04	53.07
Mean platelet Volume		
Diabetes with complications	12.07	12.48
Diabetes without complications	8.52	10.32
Mean platelet Volume with microvascular complication		
Nephropathy	12.68	11.69
Retinopathy	12.88	11.84
Neuropathy	12.64	12.02

Mean platelet Volume with macrovascular complication		
Coronary artery disease	12.10	11.94
Peripheral artery disease	13.26	12.03
Diabetic foot	13.64	12.08

There were more male as compared to females in both groups. MPV was significantly raised in the diabetic population in comparison to controls. Similarly, we also observed significantly higher MPV among diabetics with vascular complications in comparison to those without vascular complications. Among diabetics with microvascular complications, MPV showed a significant association with Diabetic Nephropathy and Diabetic retinopathy. Similarly, among those with macrovascular complications, MPV showed a significant association with Peripheral Artery Disease.

Table 2: Correlation of MPV with duration of diabetes, HbA1C & FBS

		Duration of Diabetes (years)	Mean Platelet Volume	Fasting Blood Sugar	HbA1C
Mean Platelet Volume	Pearson Correlation	.365	1	.490	.585
	Sig. (2-tailed)	.000		.000	.000
	N	200	200	200	200

MPV showed significant positive correlation with HbA1C, fasting blood sugar, and duration of diabetes in our study. All three correlations are reflected by their positive "r" values.

Discussion

Proangiogenic factors including serotonin and thromboxane A2 are released in greater quantities by large activated platelets than by smaller ones. [3] Hyperglycemia, insulin resistance, oxidative stress, hyperlipidemia, and other metabolic disorders all play a significant part in the onset of endothelial damage and excessive platelet activation. Diabetes mellitus (DM) is a rapidly growing global health issue, which is a result of a problem with insulin secretion or its effect on the body. [10,11] DM is characterized by chronic hyperglycemia due to the lack of insulin or its function, which causes endothelial dysfunction and negatively impacts vascular structures over the long term. [12] Atherosclerosis is one of the main causes of early mortality in DM, microvascular complications in DM like nephropathy and retinopathy are major contributors to chronic kidney disease and blindness worldwide. [13]

There were more male as compared to females in both groups. MPV was significantly raised in the diabetic population in comparison to controls. MPV showed significant positive correlation with HbA1C, fasting blood sugar, and duration of diabetes in our study. All three correlations are reflected by their positive "r" values. The prevalence of diabetic microvascular complications is higher in people with poor glycemic control, longer duration of DM, associated hypertension, and obesity. [7] This leads to increased morbidities and mortalities in DM. Diabetes and its vascular complications can cause a financial havoc, become a burden to a country's national economy and dent its growth. India, having the highest number of diabetics, faces such issues. MPV can be used as a simple economical test in the monitoring of DM and thereby help curb the morbidity and mortality. This indicates that these large hyperactive platelets are formed due to chronic hyperglycemia. In one study, hyperglycemia has been shown to reduce membrane fluidity and promote platelet activation by increasing the non–enzymatic glycation of proteins on the platelet surface. Persistent hyperglycemia encourages glucose to enter platelets, which are ultimately used for the synthesis of Glycogen in platelets and also results in increased MPV. [14]

Similarly, we also observed significantly higher MPV among diabetics with vascular complications in comparison to those without vascular complications. Among diabetics with microvascular complications, MPV showed a significant association with Diabetic Nephropathy and Diabetic retinopathy. Similarly, among those with macrovascular complications, MPV showed a significant association with Peripheral Artery Disease. This suggests that, in the development of vascular complications, a higher activity of platelets plays an important role. Due to the increased production of thromboxane A2 resulting from procoagulant effects that lead to thrombotic vascular complications, larger platelets are hyperactivity and more aggregable than smaller platelets. [4] This was in contrast with a few studies [3,15] in which no significant difference was observed in MPV between patients with diabetic complications and without complications. In our study, we also found significantly increased MPV in patients with diabetic nephropathy which is in concordance with the majority of studies carried out similarly as ours. [16-19]

In our study, diabetic foot also showed an insignificant rise in MPV which is in contrast to

Buch A. et al [20] where they found a significant rise in MPV in patients with diabetic foot as compared to those without diabetic foot. The possible reason for this could be a very less number of participants with diabetic foot in our study, as mostly, they present to Surgery OPD. If we had more patients with diabetic foot, the results could have been different. It was shown that the mean platelet volume and FBS had a significant positive association in our study. In one study [21] it was found that the improvement in glycaemic control normalized the MPV values. This indicates the importance of glycaemic control in platelet reactivity. Nevertheless, a small number of studies [22] found no connection between glycaemic variables and MPV. [23]

Conclusion

Our study showed that variations in mean platelet volume are significantly related to diabetes and its consequences. It is inexpensive, accessible, and straightforward to read, making it a promising marker for spotting thromboembolic events and reducing vascular injury in type 2 diabetes patients. However, to monitor the possibility of reversal of dysfunction in platelets with glycaemic management over time, a study of this type with a bigger sample size and longer duration that includes sample follow-up will be more helpful.

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