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Correlation Between Mean Platelet Volume and Retinopathy in Type 2 Diabetes Mellitus-An Observational Study

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ABSTRACT

Background: Diabetes mellitus (DM) is a metabolic disorder associated with microvascular and macrovascular complications. Mean platelet volume (MPV) is a marker of platelet activity, which plays a major role in the development of vascular complications of DM. Higher MPV values indicate larger platelets, which are metabolically and enzymatically more active, with a greater prothrombotic potential. This study compares mean platelet volume with diabetic retinopathy in type 2 diabetes mellitus.

Materials and Methods: This was a cross-sectional study; data was collected with the help of patients visiting the outpatient department (OPD) /Patients admitted in the department of general medicine. The data was analyzed by SPSS software version 20

Results: 75 patients with type 2 diabetes mellitus (T2DM) were included in the study along with 75 controls without diabetes. MPV in persons with diabetes was 10.16+2.01fl, and control was 7.27+1.18 fl. Among 75 diabetic patients, 37 cases were males and 38 were females. Most of the study population was in the age group of 51-60 years. Among 75 diabetic patient the majority had a duration of diabetes 2-5 years. Among persons with diabetes 58 patients (77.3%) found to have an MPV of ≤ 11.7 fl and 17patients (22.6%) had an MPV of >11.7fl. In diabetic population 53 patients (70.7%) had presence of diabetic retinopathy (DR) and 22 patients (29.3%) with no DR. In population with DR (70.7%) 29 patients (38.6%) had non proliferative diabetic retinopathy (NPDR) and 24 patients (32%) had proliferative diabetic retinopathy (PDR). Mean MPV of those patients with DR was 11.2±1.1fl and those without DR was 7.7±1.14fl, which was statistically significant (p value <0.05)Diabetes patients with no DR(29.3%), mean platelet volume was 7.7±1.14fl.Diabetic patients with mild NPDR had an MPV of 9.99±0.81 fl, moderate NPDR and severe NPDR had an MPV 10.37±0.91 and 11.1± 0.74 fl whereas in patients with PDR ,MPV was found to be 12.14±0.97fl, the difference was statistically significant(p<0.05)

Conclusion. In this study high MPV was noted in diabetic population with DR and also MPV value varied according to the severity of DR; higher the MPV higher the degree of DR.

Keywords: *Diabetes; diabetic retinopathy; nonproliferative diabetic retinopathy; proliferative diabetic retinopathy.*

INTRODUCTION

Diabetes mellitus (DM) is a group of metabolic disorders of carbohydrate metabolism in which glucose is both underutilized as an energy source and overproduced due to inappropriate gluconeogenesis and glycogenolysis, resulting in hyperglycemia (1). The metabolic dysregulation associated with DM causes secondary pathophysiologic changes in multiple organ systems that impose a tremendous burden on the individual with diabetes and on the health care system[2].

The prevalence of diabetes is increasing rapidly, with an onset at a lower body mass index (BMI) and younger age, greater visceral adiposity, and reduced insulin secretory capacity.

The increased platelet activity may play a role in the development of vascular complications of this metabolic disorder[3].It is being found that MPV values are high in patients with DM more so in uncontrolled diabetes. Platelet volume, a marker of the platelet function and activation, is proposed as to be involved as a causative agent with respect to altered platelet morphology and function. The mean platelet volume (MPV) is an indicator of the average size and activity of platelets. Larger platelets are younger and exhibit more activity[3] and more is the risk for thrombosis and are associated with increased risk for hyperglycemic complications.

Mean platelet volume (MPV), an important, simple, effortless, and cost-effective tool measured by hematology analyzer assess the volume and function of platelets and thus has potential to be used as prognostic indicator in type 2 diabetes mellitus (T2DM) and indicator of presence of vascular complications.

OBJECTIVES

To evaluate the correlation between MPV and diabetic retinopathy (DR) in T2DM patients.

MATERIALS AND METHODS

This was a hospital based prospective cross-sectional study for a period of 2 months from February 2023 to April 2023.This study conducted using clinical and biochemical parameters of the patients visiting the outpatient (OPD) /patients admitted in department of general medicine of a tertiary care centre. A total of 75 diabetic patients and 75 controls (age and sex matched non diabetic patients who visited OPD as well as inpatients after applying exclusion criteria) were analyzed for the study.

Venous samples were collected after 12 hours of overnight fasting at 8:30 am for Mean Platelet Volume, Hemoglobin (Hb) and glycated hemoglobin (HbA1c) was measured by High Performance Liquid Chromatography. Measurement of MPV was done using an automatic hematology analyzer (Beckman Coulter Act5Diff).

Inclusion Criteria

Patients with type 2 diabetes mellitus and for comparison group age and sex matched nondiabetic patients were included in the study.

Exclusion Criteria

Patients with Type 1 diabetes mellitus,Gestational Diabetes Mellitus,Male patients with Hb<12 g/dl and female with Hb <11g/dl,Patients with bleeding disorders, diagnosed malignancy, known chronic kidney disease ,chronic liver diseases.cardiac failure,Recent blood transfusion,Patients on erythropoietin and Patients on antiplatelets and antithrombotics were excluded from the study.

Ethical approval

Ethical approval was obtained from Mysore medical college research institute Ethics Committee and the ethical protocols of the declaration of Helsinki (1967) including the ethical principles of informed consent, voluntary participation and withdrawal, privacy and confidentiality, were followed.

Sample size calculated using the formula $n = 4pq/d^2$ (p-prevalence, q-1-p, d-desired level of precision) with 95% confidence interval and 5% level of significance of (Standard Deviation) =35.95 and absolute allowable error of 7%. The sample size is 100.

Data analysis and statistics

Data obtained from the study has been entered in excel sheets and analyzed using SPSS (Statistical package for social sciences) software version 20. and has been presented as descriptive statistics in the form of frequency, tables, figures and graphs.

Descriptive statistics of the explanatory and outcome variables were calculated by mean, Standard deviation for quantitative variables, frequency and proportions for qualitative variables. Inferential statistics like- Chi-square test was applied for qualitative variables. Independent sample t test will be applied to compare the quantitative variables between the groups. The level of significance is set at 5%. A 'p' value of <0.05 is considered statistically significant

RESULTS

75 patients with type 2 diabetes mellitus were included in the study along with the 75 controls (age and sex matched nondiabetics). Among 75 diabetic patients 37 cases were males and 38 were females. Majority of the study population was in the age group of 51-60 years. Among 75 diabetic patients majority had a diabetic duration of 2-5 year.

Table :1 Distribution of Mean Platelet Volume (MPV) In Patients with Diabetes and Without Diabetes

DIABETICS	NONDIABETICS	p VALUE
MEAN MPV(fl)	MEAN MPV (fl)	<0.001
10.16+2.01	7.27+1.18	

*fl-femtolitre, *MPV-mean platelet volume

Diabetic patients had an MPV 10.16+2.01fl and nondiabetics had an MPV of 7.27+1.18fl, the difference was statistically significant. (p<0.001)

Table :2 Distribution of Mean Platelet Volume (MPV) In Patients With Diabetes

MPV ≤ 11.7fl	MPV >11.7fl
58(77.3%)	17(22.6%)

*fl-femtolitre, *MPV-mean platelet volume

Among diabetic patients 58 patients (77.3%) found to have an MPV of ≤ 11.7fl and 17 patients (22.6%) had an MPV of >11.7fl.

Table :3 Distribution of Retinopathy in Patients with Diabetes

RETINOPATHY	NO:	PERCENTAGE
PRESENT	53	70.7%
ABSENT	22	29.3%

In diabetic population 53 patients (70.7%) had presence of retinopathy and 22 patients (29.3%) with no retinopathy.

Table :4 Correlation Between MPV And Retinopathy

RETINOPATHY	PRESENT	ABSENT
MPV± S.D(fl)	11.2±1.1	7.7±1.14

*MPV-mean platelet volume,S.D-standard deviation

Mean MPV of those patients with retinopathy (53(70%)) was 11.2±1.1fl and those without retinopathy (22(29%)) was 7.7±1.14fl, this difference was statistically significant(p<0.046)

Table :5 Correlation Between MPV And Stages of Retinopathy

FUNDUS	NO:	%	MPV(MEAN)fl
NO CHANGES	22	29.3%	7.7±1.14
MILD NPDR	8	10.6 %	9.99±0.81
MOD.NPDR	12	16 %	10.37±0.91
SEV.NPDR	9	12 %	11.1± 0.74
PDR	24	32 %	12.14±0.97

*MPV-mean platelet volume ,NPDR-non proliferative diabetic retinopathy ,PDR- proliferative diabetic retinopathy.

Diabetic patients with no retinopathy had a mean platelet volume of 7.7±1.14 fl and in those with mild non-proliferative diabetic retinopathy had an MPV of 9.99±0.81fl, moderate non-proliferative diabetic retinopathy had an MPV of 10.37±0.91, severe non-proliferative diabetic retinopathy had an MPV of 11.1± 0.74 fl whereas in patients with proliferative diabetic retinopathy MPV was found to be 12.14±0.97fl, the difference was statistically significant(p<0.004)

DISCUSSION

Our results demonstrated statistically significantly higher MPV values in patients with diabetic retinopathy (DR) compared with patients having type 2 diabetes mellitus (T2DM) without retinopathy. Furthermore, MPV showed a positive correlation with the severity of retinopathy, indicating that increasing platelet activation may be associated with progressive retinal microvascular damage.

aThe present observational study evaluated the relationship between mean platelet volume (MPV) and diabetic retinopathy (DR) in patients with type 2 diabetes mellitus (T2DM). Our findings demonstrated significantly higher MPV values in diabetic patients with retinopathy compared to diabetic patients without retinopathy and healthy controls. Furthermore,

MPV levels increased progressively with increasing severity of retinopathy, suggesting a positive association between platelet activation and the progression of retinal microvascular disease.

Diabetic retinopathy is one of the most common microvascular complications of diabetes mellitus and remains a leading cause of preventable blindness among working-age adults worldwide. Chronic hyperglycemia induces endothelial dysfunction, oxidative stress, inflammation, and abnormalities in platelet function, which collectively contribute to the development of diabetic microangiopathy.[1,2] The retina is particularly susceptible to these microvascular changes, resulting in capillary non-perfusion, microaneurysm formation, vascular leakage, and ultimately vision-threatening complications.
Platelets have been identified as important contributors to diabetic vascular complications. Experimental studies have demonstrated that platelets possess functional insulin receptors capable of insulin binding and autophosphorylation. Under physiological conditions, insulin inhibits platelet activation by reducing responsiveness to agonists such as adenosine diphosphate (ADP), collagen, thrombin, and platelet-activating factor.[3,4] However, insulin resistance and chronic hyperglycemia impair this inhibitory effect, resulting in enhanced platelet activation and aggregation. Such alterations promote a prothrombotic state that may accelerate microvascular injury in diabetic patients.

Mean platelet volume is a simple hematological parameter that reflects platelet size and activity. Larger platelets contain greater numbers of dense granules, exhibit increased thromboxane A_2 production, and possess enhanced aggregatory potential compared with smaller platelets.[5] Consequently, elevated MPV is regarded as a marker of platelet activation and thrombotic tendency. Previous studies have reported increased MPV levels in patients with diabetes mellitus and have suggested its association with both microvascular and macrovascular complications.[6,7]

In the present study, MPV values were significantly higher among diabetic patients than among healthy controls. More importantly, patients with diabetic retinopathy exhibited significantly elevated MPV levels compared to diabetic patients without retinopathy. These findings support the hypothesis that platelet activation contributes to the pathogenesis of retinal microvascular damage.

The pathophysiological basis for this observation may be explained by the characteristic vascular changes occurring in diabetic retinopathy. Retinal capillary basement membrane thickening, endothelial dysfunction, impaired microcirculation, and microthrombus formation are established features of diabetic retinal disease.[8] Larger and more reactive platelets may exacerbate these abnormalities through increased adhesion, aggregation, and release of pro-inflammatory mediators, thereby contributing to retinal ischemia and progression of retinopathy. The positive correlation observed between MPV and retinopathy severity in our study further supports this mechanism.

Our findings are in agreement with previous studies. Kodiatte et al. reported significantly higher MPV levels in diabetic patients with vascular complications compared to those without complications.[9] Demirtunc et al. observed increased platelet activation markers, including MPV, in patients with T2DM and suggested a role for platelet dysfunction in diabetic vascular disease.[10] Similarly, Zuberi et al. demonstrated a significant association between elevated MPV and diabetic retinopathy, proposing MPV as a potential marker for identifying patients at risk of retinal complications.[11] A meta-analysis conducted by Ji et al. further confirmed that MPV is significantly elevated in diabetic patients and correlates with the presence of diabetic vascular complications.[12]

The clinical implications of these findings are noteworthy. MPV is inexpensive, readily available, and routinely measured as part of a complete blood count. Therefore, it may serve as a practical adjunctive biomarker for identifying diabetic patients at higher risk of developing retinopathy and for monitoring disease progression. Early identification of such patients could facilitate timely ophthalmological evaluation and intervention, thereby reducing the risk of vision loss.

Nevertheless, several limitations of the present study should be acknowledged. First, the relatively small sample size may limit the generalizability of the findings. Second, the cross-sectional design precludes establishing a causal relationship between elevated MPV and the development of diabetic retinopathy. Third, factors known to influence platelet function, including glycemic control, duration of diabetes, smoking status, obesity, and medications such as statins, metformin, and antiplatelet agents, were not analyzed comprehensively. These factors may have contributed to variability in MPV values and should be addressed in future studies. Large multicentric prospective studies are required to validate the role of MPV as a predictive biomarker for diabetic retinopathy.

CONCLUSION

In our study mean platelet volume was reported to be raised in diabetic patients and variation in MPV was directly proportional to degree of diabetic retinopathy. We recommend that MPV can be used as a simple and cost-effective tool to monitor the progression of diabetic retinopathy. So along with monitoring other parameters we should also consider testing diabetic patients for MPV also. Taking account of the limits in this study, more rigorous and high-quality researches need to be implemented to further confirm our conclusions.

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Author's contribution: First author conceived and designed the methods, extracted the original data and drafted the manuscript. The second and third author performed statistical analysis and interpreted results. The first author revised the manuscript and had full access to all data in the study and took responsibility for the integrity of the data and the accuracy of data analysis. All authors read and approved the final manuscript.

Conflicts of interest: There are no conflicts of interest.

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