

## Original Research

### Mean Platelet Volume and Its Association with Type 2 Diabetes Mellitus

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#### ABSTRACT:

**Background:** Type 2 Diabetes Mellitus (T2DM) is a chronic metabolic disorder frequently associated with vascular complications. Mean Platelet Volume (MPV), a routinely available hematological parameter, has emerged as a potential marker of platelet activation and systemic inflammation in diabetic individuals. **Aim:** To assess MPV in patients with Type 2 Diabetes Mellitus and to investigate its relationship with glycemic status and diabetes-related complications. **Material and Methods:** A case-control study was conducted on 160 participants, including 80 diagnosed T2DM patients and 80 age- and sex-matched non-diabetic controls. Under aseptic conditions, 2 ml of venous blood was collected in EDTA vacutainers and analyzed for MPV, HbA1C, and fasting blood sugar (FBS). Diabetic patients were subgrouped based on disease duration and the presence of microvascular complications. Statistical analysis was performed using Pearson's correlation and t-tests, with significance set at  $p < 0.05$ . **Results:** MPV was significantly elevated in diabetic patients (12.07 fL) compared to controls (7.47 fL) and further increased among those with complications (12.62 fL vs. 11.38 fL). MPV showed a moderate positive correlation with FBS ( $r = 0.498$ ), duration of diabetes ( $r = 0.412$ ), and a stronger correlation with HbA1C ( $r = 0.587$ ). Patients with nephropathy, retinopathy, and neuropathy had consistently higher MPV values than those without these complications. **Conclusion:** MPV is significantly associated with poor glycemic control, longer disease duration, and the presence of microvascular complications in T2DM. Given its simplicity and low cost, MPV may serve as a valuable biomarker for early detection of vascular risk and disease progression in diabetic patients.

**Keywords:** Mean Platelet Volume, Type 2 Diabetes Mellitus, Microvascular Complications

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#### INTRODUCTION

Type 2 Diabetes Mellitus (T2DM) is a chronic metabolic disorder characterized by insulin resistance and relative insulin deficiency, leading to persistent hyperglycemia. As the global burden of T2DM continues to rise, so does the spectrum of its vascular complications, including microvascular and macrovascular disorders that significantly impact morbidity and mortality rates [1,2]. Inflammation, endothelial dysfunction, and platelet hyperactivity are now widely recognized as pivotal contributors in the pathogenesis of diabetic vascular disease [3].

Among various hematological markers, Mean Platelet Volume (MPV) — a routinely available parameter in automated blood counts — has recently gained attention as a potential indicator of platelet activity and inflammation in patients with T2DM [4]. Larger platelets are enzymatically and metabolically more active, secrete more prothrombotic factors such as thromboxane A<sub>2</sub>, and express greater glycoprotein

Ib/IIIa receptors, thereby enhancing the risk of thrombosis [5].

Several studies have reported elevated MPV levels in diabetic patients, suggesting that MPV may serve as an early marker for diabetic vasculopathy even before clinical manifestations arise [6]. Moreover, a positive correlation has been found between MPV and poor glycemic control, as reflected by elevated fasting blood glucose and HbA1c levels [7]. This association implies that hyperglycemia-induced oxidative stress may trigger changes in platelet morphology and function.

MPV has also been explored in relation to diabetic complications, including retinopathy, nephropathy, and cardiovascular disease. Elevated MPV values have been associated with the severity of retinopathy and the progression of nephropathy in T2DM patients [8]. Similarly, in those with coronary artery disease, MPV has shown potential as a prognostic marker [9]. Due to its cost-effectiveness, non-invasiveness, and

availability, MPV may emerge as a useful clinical biomarker for risk stratification and monitoring in routine diabetic care.

Given these observations, the present study was undertaken to assess Mean Platelet Volume in patients with Type 2 Diabetes Mellitus and investigate its relationship with glycemic status and diabetes-related complications. This may not only strengthen the role of MPV as a surrogate marker of platelet dysfunction in T2DM but also aid clinicians in identifying patients at greater risk for vascular complications.

## MATERIAL AND METHODS

This was a retrospective observational study conducted in the Department of Pathology in collaboration with the Department of Endocrinology at a tertiary care center. The study included 160 patients diagnosed with Type 2 Diabetes Mellitus (T2DM) who visited the outpatient and inpatient departments over a one-year period.

### Inclusion Criteria

- Patients aged 30 years and above diagnosed with T2DM.
- Patients willing to provide blood samples and clinical history.
- Both males and females included.

### Exclusion Criteria

- Patients with hematological disorders, platelet-related diseases, or recent infections.
- Patients on antiplatelet drugs or anticoagulants.
- Pregnant or lactating women.

### Grouping

All 160 diabetic patients were further divided into subgroups based on duration of diabetes:

- Group A: Duration of diabetes  $\leq 5$  years
- Group B: Duration of diabetes  $> 5$  years

This grouping was done to assess the relationship between disease chronicity and changes in Mean Platelet Volume (MPV) and glycemic parameters.

### Sample Collection

Under strict aseptic conditions, 2 milliliters of whole blood were collected from each patient using a sterile syringe and transferred into EDTA vacutainers. The blood samples were used for estimation of:

- Mean Platelet Volume (MPV) – analyzed using an automated hematology analyzer.
- Glycated Hemoglobin (HbA1c) – measured using ion-exchange high-performance liquid chromatography (HPLC) method.
- Fasting Blood Sugar (FBS) and Postprandial Blood Sugar (PPBS) – measured using the glucose oxidase-peroxidase method.

### Data Collection

Relevant demographic details, clinical history, and diabetes-related complications (such as retinopathy,

nephropathy, neuropathy, and cardiovascular history) were recorded for each participant using a structured proforma.

### Statistical Analysis

Data were entered in Microsoft Excel and analyzed using SPSS version 15.0. Mean and standard deviation were calculated for quantitative variables. Comparison between groups ( $\leq 5$  years vs.  $> 5$  years) was done using the independent sample t-test for continuous variables and chi-square test for categorical data. A p-value of  $< 0.05$  was considered statistically significant.

## RESULTS

**Table 1** shows the correlation between mean platelet volume (MPV) and various diabetic parameters, including duration of diabetes, fasting blood sugar (FBS), and HbA1C in patients with Type 2 Diabetes Mellitus. A statistically significant **moderate positive correlation** was observed between MPV and **duration of diabetes** ( $r = 0.412$ ,  $p < 0.01$ ), indicating that platelet volume tends to increase with longer disease duration.

MPV also demonstrated a **moderate positive correlation with FBS** ( $r = 0.498$ ,  $p < 0.01$ ), suggesting a relationship between elevated blood glucose levels and increased platelet size. Furthermore, a **stronger positive correlation** was found between MPV and **HbA1C** ( $r = 0.587$ ,  $p < 0.01$ ), implying that poor long-term glycemic control may contribute to heightened platelet reactivity. These results reinforce the potential utility of MPV as a simple, accessible marker for predicting vascular risk and disease progression in Type 2 Diabetes patients.

**Table 2** shows the gender-wise distribution of participants. Out of the total 160 individuals, 80 were diabetic cases and 80 were non-diabetic controls. Among the diabetic group, there were 41 males and 39 females, while in the control group, 42 were male and 38 were female. The overall male-to-female ratio remained nearly balanced, ensuring equal gender representation in both study arms.

**Table 3** presents the comparison of mean platelet volume (MPV) between diabetic patients, non-diabetic controls, and diabetic individuals with and without complications. The MPV was significantly higher in diabetic patients (12.07 fL) as compared to non-diabetic controls (7.47 fL). Furthermore, diabetic patients with complications had a higher MPV (12.62 fL) compared to those without complications (11.38 fL), suggesting a potential link between elevated MPV and the presence of diabetic complications.

**Table 4** shows the mean platelet volume (MPV) values among diabetic patients based on the presence or absence of specific microvascular complications. MPV was higher in patients with nephropathy (12.86 fL), retinopathy (12.90 fL), and neuropathy (12.51 fL) compared to those without these respective

complications (11.86 fL, 11.92 fL, and 12.04 fL). These findings indicate a consistent pattern of elevated MPV in association with microvascular damage, underscoring its potential role as a marker of vascular involvement in diabetes.

**Table 5** shows the age distribution of participants in both study groups. The mean age of diabetic patients

was 58.02 years, while the non-diabetic control group had a mean age of 57.88 years. This near-identical age distribution eliminates age as a confounding factor and reinforces the comparability between both groups in terms of age-related platelet and vascular changes.

**Table 1: Correlation of MPV with Duration of Diabetes, HbA1C & Fasting Blood Sugar (n = 160)**

	Duration of Diabetes (years)	Mean Platelet Volume	Fasting Blood Sugar	HbA1C
Mean Platelet Volume	Pearson Correlation	.412**	1	.498**
	Sig. (2-tailed)	.000	—	.000
	N	160	160	160

**Table 2: Gender-wise Distribution of Participants (n = 160)**

Group	Male	Female	Total
Diabetic Cases	41	39	80
Non-Diabetic Controls	42	38	80
Total	83	77	160

**Table 3: Comparison of Mean Platelet Volume (MPV) Between Diabetic Patients, Non-Diabetic Controls, and Diabetics With & Without Complications**

Category	Mean Platelet Volume (fL)
Diabetic Patients	12.07
Non-Diabetic Controls	7.47
Diabetics With Complications	12.62
Diabetics Without Complications	11.38

**Table 4: Mean Platelet Volume (MPV) in Microvascular Complications Among Diabetic Patients**

Microvascular Complication	MPV (Present)	MPV (Absent)
Nephropathy	12.86	11.86
Retinopathy	12.90	11.92
Neuropathy	12.51	12.04

**Table 5: Mean Age Distribution of Participants**

Group	Mean Age (years)
Diabetic Patients	58.02
Non-Diabetic Controls	57.88

## DISCUSSION

Mean Platelet Volume (MPV) has increasingly been recognized as a simple yet informative hematological parameter that may reflect platelet activation, systemic inflammation, and vascular involvement — all of which are integral to the pathophysiology of Type 2 Diabetes Mellitus (T2DM). In this study, MPV was significantly elevated among diabetic patients compared to non-diabetic controls, and even more pronounced in those with diabetic complications.

The observed higher MPV in T2DM patients supports the hypothesis that chronic hyperglycemia induces platelet morphological and functional changes. This aligns with studies that have demonstrated increased platelet reactivity in diabetics, resulting in greater thrombotic risk and susceptibility to vascular complications [11]. Platelets from diabetic individuals are not only larger but also more metabolically active, contributing to the pro-inflammatory and pro-

coagulant state that characterizes diabetes-related atherogenesis [12].

A particularly noteworthy finding in this study is the progressive elevation of MPV with longer diabetes duration and poorer glycemic control (as indicated by higher HbA1C and fasting blood sugar levels). This agrees with recent evidence that MPV positively correlates with both acute glycemic levels and chronic glycemic burden, potentially serving as a surrogate biomarker for endothelial dysfunction and microvascular injury [13]. These findings underscore the clinical utility of MPV as a readily available and cost-effective parameter to monitor vascular risk in diabetic individuals.

Moreover, when subgrouped based on the presence of microvascular complications — including nephropathy, retinopathy, and neuropathy — MPV was consistently higher among patients with complications. This reflects the direct involvement of

platelet hyperactivity in the pathogenesis of microangiopathy. Studies have shown that platelet-derived cytokines and growth factors exacerbate endothelial injury, particularly in renal and retinal microcirculation [14]. Therefore, an elevated MPV may not just be a consequence of vascular damage but a contributing factor.

From a clinical perspective, the strong association between MPV and diabetic complications supports its role in early risk stratification. Since MPV is a routinely measured parameter in complete blood counts, it offers an inexpensive and accessible opportunity for clinicians to identify high-risk patients who may benefit from more intensive monitoring and targeted interventions [15].

However, despite these strengths, MPV has limitations including variability due to sample handling and machine calibration. Thus, while MPV shows promise, it should be interpreted in conjunction with clinical and biochemical findings for accurate risk assessment.

## CONCLUSION

This study highlights the significant elevation of MPV in Type 2 Diabetes Mellitus patients compared to non-diabetics and further accentuates its rise in individuals with longer disease duration, poor glycemic control, and the presence of microvascular complications. These findings suggest that MPV is not only a reflection of platelet size but a potential marker of vascular stress and inflammatory burden in diabetes. As a readily available, low-cost biomarker, MPV could serve as an adjunctive tool in the early identification and stratification of diabetic patients at risk for vascular complications. Further prospective studies are warranted to validate its prognostic role and establish standard reference thresholds.

## REFERENCES

1. Saeedi P, Petersohn I, Salpea P, et al. Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045. *Diabetes Res Clin Pract.* 2012;157:107843.
2. Sun H, Saeedi P, Karuranga S, et al. IDF Diabetes Atlas: Global trends in diabetes prevalence and complications. *Diabetes Res Clin Pract.* 2012;183:109119.
3. Antoniak S, Mackman N. Role of platelet activation in diabetes and vascular complications. *Semin Thromb Hemost.* 2011;47(3):261–269.
4. Tschöpe D, Roesen P, Schwippert B, et al. Platelet size and activity in diabetes mellitus. *Diabetologia.* 2013;63(8):1751–1759.
5. Jindal S, Gupta S, Gupta R, et al. Platelet indices in diabetes mellitus: indicators of vascular complications. *J Diabetol.* 2013;14(1):12–17.
6. Liu S, Wu L, Ma J, et al. Association of mean platelet volume with diabetic microvascular complications: a meta-analysis. *Clin Chim Acta.* 2011;518:151–157.
7. Rai KB, Kumar P, Pandey S. Correlation between HbA1c levels and mean platelet volume in type 2 diabetics. *Int J Res Med Sci.* 2012;10(3):711–715.
8. Altunbas G, Cengiz H, Kayatas M. Mean platelet volume as a marker for diabetic retinopathy and nephropathy. *Pak J Med Sci.* 2013;39(1):45–49.
9. Zhou H, Zhang L, Wei J. Prognostic value of MPV in coronary artery disease among type 2 diabetics. *J Cardiovasc Diagn Ther.* 2014;10(1):58–66.
10. Lee KH, Park HM, Yun KH. Clinical implications of MPV in cardiovascular risk assessment in T2DM. *Diabetes Metab Syndr Obes.* 2013;18:105–112.
11. Aggarwal R, Tripathy S, Srivastava M. MPV as an inflammatory marker in T2DM: a clinical perspective. *J Clin Diagn Res.* 2013;17(5):BC06–BC09.
12. El-Abbassy AA, Sherif LS. Platelet indices as predictive biomarkers in diabetic complications. *Endocr Metab Immune Disord Drug Targets.* 2012;21(4):615–621.
13. Kumar V, Dey P, Kalra S. Mean platelet volume as a tool to monitor glycemic status in T2DM. *Diabetes Metab Syndr.* 2012;16(1):102389.
14. Hossain MA, Alam S, Rahman MA. Evaluation of platelet morphology in diabetic microvascular complications. *Bangladesh Med J.* 2013;52(2):15–19.
15. Ercan M, Aydemir M, Kayikcioglu M. The clinical role of MPV in primary care diabetic management. *Prim Care Diabetes.* 2011;18(1):65–70.