

Correlation between Glycosylated Hemoglobin and Platelet Activity among patients with Type 2 Diabetes Mellitus

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ABSTRACT

Introduction: Diabetes mellitus is globally increasing due to improper life style and non-healthy diet. The poor control of diabetes is attributed to various vascular complications and endothelial dysfunction. One of factors is increased thromboembolic events in small or large vessels. The poor control is also related to increased activity of platelets.

The increased platelet activity is related to endothelial dysfunction. The mean platelet volume (MPV) is an indicator of the average size and activity of platelets. The increased HbA1c aggravates the MPV.

Objective: To observe the association of glycosylated hemoglobin and mean platelet volume in type 2 diabetic patients.

Study Design: Descriptive Cross sectional study

Setting: Department of Medicine - Liaquat University of Medical & Health Sciences, Jamshoro, Hyderabad

Duration of study: 06 months from June 29, 2022 to December 30, 2022.

Methodology: Fifty-five patients with T2DM aged 18–60 years were consecutively enrolled. Demographic and clinical data were recorded. HbA1c and MPV levels were measured in the institutional laboratory. Data were analyzed using SPSS version 21. Pearson correlation coefficient was applied to determine the association between HbA1c and MPV. A p-value ≤ 0.05 was considered statistically significant

Results: The mean age of participants was 43.47 ± 11.20 years. There were 28 (50.9%) males and 27 (49.1%) females. The mean BMI was 25.19 ± 5.42 kg/m². The mean HbA1c level was $6.92 \pm 0.51\%$, and the mean MPV was 8.01 ± 0.85 fL. A weak but statistically significant positive correlation was observed between HbA1c and MPV ($r = 0.281$, $p = 0.038$).

Conclusion: A statistically significant positive association was found between HbA1c and MPV in patients with T2DM. MPV may serve as a simple and cost-effective marker of platelet activity in diabetic patients.

Keywords: Glycosylated Hemoglobin, Platelet activity, Diabetes Mellitus.

INTRODUCTION

Over the past few decades, diabetes Mellitus is considered as a cause of financial and public health concern. Its prevalence is now reported to be as high as It is estimated that 537 million (10.5%) individuals (aged 20–79 years) worldwide are currently managing the disease¹. According to a recent report, there is an urgent need for precise, targeted data to drive the development of effective initiatives aimed at addressing these problems²

In the last decade, diabetes increased enormously in Pakistan, 26.7% of adults are affected by diabetes and estimated more than 33 million are known diabetic now in country³. Age-related diabetes prevalence in the world was 13.9% for women and 14.3% for men⁴

Type 2 diabetes mellitus is typically dysregulation of insulin demand and release. The impaired control of hyperglycemia is highlighted by increased HbA1c and increased in mean platelets volume. The impaired diabetes status is connected with micro and macro complications, platelets size contributed in all these insults of diabetes⁵

Mean Platelet Volume refers to the average size of platelets in the blood. It is determined by analyzing the distribution of platelet sizes in each sample. MPV is measured in femto liters (fL) and is often included as part of a complete blood count. The normal range is 7 to 9 femto litres.

Hyperglycemia results in larger platelet size due to decreased cyclic adenosine monophosphate (cAMP) levels. In chronic diabetes patients, platelet intracellular calcium levels are elevated, leading to heightened platelet reactivity and aggregation even at lower levels of agonist activation.

The increased in mean platelet volume was observed with high hemoglobin A1c in various studies⁶

A study reported that MPV is significantly higher in patients with DM than in controls (8.7 ± 0.8 fl vs. 8.2 ± 0.7 fl, $P = .002$). In diabetic patients, there was a significant positive correlation between MPV and HbA1c levels ($r = .39$, $P = .001$). However, comparison amongst diabetic patient with a normal and elevated HbA1c is scarce in literature⁸

Mean platelets volume offer deep insight into the health of an individual. Large platelets are more active than smaller platelets and produce more pro-thrombotic factors such as thromboxane A₂.

Mean platelets volume has gained clinical significance as a potential marker of platelet activation. MPV increase is associated with platelet hyperactivity, as larger platelets tend to be more reactive and have a higher thrombotic potential.⁹

MATERIAL AND METHODS

This Descriptive Cross sectional study was conducted at Department of Medicine - Liaquat University hospital, Jamshoro, Hyderabad from 6 months from June 29, 2022 to December 30, 2022. The sample size was estimated to 55, Type 2 diabetic patients. The Sampling Technique was Non-probability, consecutive sampling.

Type 2 diabetes Mellitus patients met the inclusion criteria presenting to the outpatient department of Medicine - Liaquat University of Medical & Health Sciences, Jamshoro, Hyderabad were enrolled in the study. Prior to inclusion, the purpose, procedure risks and benefits of the study was explained and written informed consent was taken. History was taken for age, duration of diabetes, educational status, residential status, occupation, family monthly income. Weight was measured in Kg using weighing machine without shoes and heavy clothes whereas height was also noted. Body mass index (BMI) was calculated by dividing the weight in kg with height in meter square. Among the investigations glycosylated hemoglobin and platelet activity in terms of MPV was advised. HbA1c was measured immunoassay

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available at LUMHS laboratory. MVP was above 8.2 considered abnormal.

Inclusion Criteria:

- Patients with T2DM
- Age 18–60 years
- Either gender
- Willing to provide informed consent

Exclusion Criteria:

- Patients using antiplatelet medications (aspirin, clopidogrel)
- Patients on hemodialysis
- Patients with active malignancy
- Anemic patients (Hb <12.5 g/dL in males, <11.5 g/dL in females)
- Current or former smokers

Data were analyzed using Microsoft Excel 2019 and SPSS v. 21.0. Qualitative data like gender, educational status, residential status and occupation were expressed as number and percentage. The normality of the data was assessed via the Kolmogorov Smirnov test. Quantitative data like age, weight, height, BMI, duration of diabetes, HbA1c and MPV were expressed as mean & standard deviation or median (IQR) as appropriate. Pearson correlation coefficient was calculated for HbA1C and MPV. Stratification was done to deal with the effect modifiers like age, gender, BMI, educational status, residential status and occupation, post stratification, Pearson correlation coefficient was applied to see the effect of these on HbA1c and MPV correlation. P value of ≤ 0.05 was considered significant.

RESULTS

Fifty five patients selected, mean age of the patients was 43.47 ±11.20 years. (Table 1) There were 28 (50.9%) patients with ≤45 years and 27 (49.1%) with >45 years of age. Gender distribution showed that 28 (50.9%) patients were males and 27 (49.1%) were females. (Figure 1). The mean weight, height, and BMI of the patients were 60.49 ±5.31 kg, 1.55 ±0.06 m, and 25.19 ±5.42 kg/m² respectively. The mean HbA1c level and MPV level were 6.92 ±0.51 and 8.01 ±0.85 respectively. (Table 2)

There were 34 (61.8%) patients with normal BMI and 21 (38.2%) with >25 kg/m² of BMI. The mean time with diabetes was 1.41 ±0.38 years.

There were 30 (54.5%) patients with ≤1.4 years of duration of diabetes and 25 (45.5%) with >1.4 years of duration of diabetes. Most of the patients had less than equal to matric educational status, i.e., 21 (38.2%). (Figure 2)

Table 1: Age of 55 patients, mean and standard deviations in years

Mean ±SD	Lower limit	Upper limit
43.47 ±11.20	19	58

Table 2: General Characteristics Of 55 Patients

VARIABLE	Mean ±SD	Minimum	Maximum
Weight	60.49 ±5.31	53	66
Height in meters	1.55 ±0.06	1.50	1.63
BMI kg/m ²	25.19 ±5.42	18.70	33.00
DURATION years	2.5 ±2.2	2	2
HbA1c%	6.92 ±0.51	6.10	7.80
Mean platelets volume fL	8.02 ±1.85	8.20	9.18

Table 3: Correlation of with MPV with different characteristics (n=55)

	r	p-value
bA1c	0.281	0.038
Age ≤45	0.475	0.011
>45	0.111	0.581
Male	0.279	0.150
Female	0.302	0.125
BMI ≤25	0.387	0.024
>25	0.062	0.789
Duration of diabetes ≤2.0	0.216	0.252
>2.0	0.373	0.066

Stratified analysis showed stronger correlation in patients aged ≤45 years (r = 0.475, p = 0.011) and in patients with BMI ≤25 kg/m² (r = 0.387, p = 0.024).

Chart 1: Gender distribution of the patients (n=55)

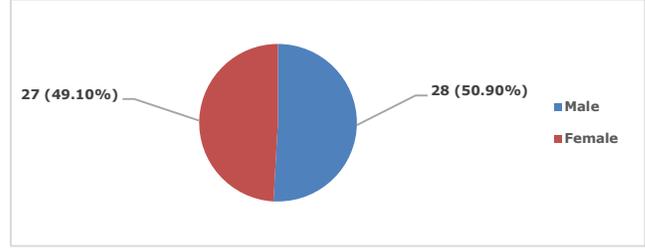
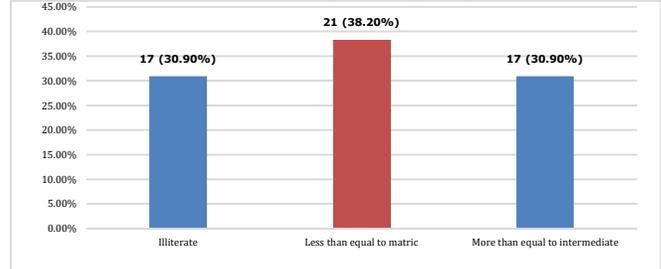


Chart 2: Educational status of the patients (n=55)



Rural residence was found in 19 (34.5%). Thirty five (63.6%) were employed.

A weak but significant positive correlation was observed in between HbA1c level and MPV level (r=0.281, p-value 0.038). (Table 3), r = 0.281 = weak to low-moderate correlation, it explains only 7.8% of variance (r² ≈ 0.079)

DISCUSSION

Diabetes is increasing globally and associated with several organ dysfunction. Multiple researches and innovations are aiming to reverse or treat diabetes effectively. New diagnostic parameters, noninvasive techniques and strategies to control diabetes, overwhelming the literature and same time makes diabetes is one of most expensive disease to treat.

This study is a unique one which correlated mean platelets volume to HbA1c and assess the future complication in type 2 diabetes in a tertiary care hospital of Sindh which caters poor population of patients. Prolonged hyperglycemia generates reactive oxygen species (ROS), which enhance platelet reactivity and megakaryocyte proliferation, leading to larger, more active platelets.

Advanced glycation end products alters platelet membrane proteins, increasing adhesiveness and aggregation potential. This mechanistic pathway supports the clinical correlation between MPV and glycemic control.

A weak but positive correlation (r=0.281) was seen between MPV and HbA1c, suggesting that poor glycemic control is associated with increased platelet activity. This has been also observed by another study where mean platelets volume was significantly higher in patients with poor glycemic control as measured by increased HbA1c¹⁰

In our study, normal BMI also demonstrated a significant correlation (r=0.387, *p=0.024), whereas overweight/obese patients (BMI >25) did not (r=0.062, *p=0.789), this has matched with other study published in renowned journals that there was not significantly link of MPV with duration of Diabetes and BMI¹¹

In clinical setting we can use MPV as a Potential Biomarker and it is a simple, cost-effective test, it could serve as an auxiliary marker for assessing diabetic thrombotic risk, especially in resource-limited settings.

Early Intervention in younger patients with elevated MPV may benefit from aggressive glycemic control and antiplatelet therapy to mitigate cardiovascular risks.

One demonstrated a significant positive correlation between MPV and HbA1c levels, suggesting that platelet size and activity may be associated with glycemic control in T2DM patients¹²

Elevated MPV may precede thrombotic events eventually related to increased nephropathy or retinopathy, offering a window for preventive care. MPV trends could help assess response to antidiabetic therapies, particularly GLP-1 agonists known to have pleiotropic effects on platelets.

However, the cross-sectional nature of the study limits causal inference. Additionally, the small sample size and single-center design restrict generalizability.

CONCLUSION

A statistically significant but weak positive correlation was observed between HbA1c and MPV in patients with type 2 diabetes mellitus. These findings suggest that poor glycemic control may be associated with increased platelet activity.

MPV may serve as a simple and cost-effective adjunct marker in the assessment of thrombotic risk among diabetic patients. Larger, longitudinal studies are required to validate these findings and explore their clinical implications.

LIMITATION OF STUDY:

- Small sample size
- Single-center study
- Cross-sectional design
- No non-diabetic control group

REFERENCES

- 1 Magliano D, Boyko EJ. IDF diabetes atlas. 10th edition. Brussels: International Diabetes Federation; 2021.

- 2 Dunachie S, Chamnan P. The double burden of diabetes and global infection in low and middle-income countries. *Trans R Soc Trop Med Hyg.* 2019;113(2):56–64.
- 3 Pakistan [Internet]. Brussels: International Diabetes Federation; [cited 2026 Feb 12]. Available from: <https://idf.org/our-network/regions-members/middle-east-and-north-africa/members/43-pakistan.html>
- 4 Pharmacologic approaches to glycemic treatment: standards of care in diabetes-2024. *Diabetes Care.* 2024;47(Suppl 1):S158–78.
- 5 Carrizzo A, Izzo C, Olivetti M, Alfano A, Virtuoso N, Capunzo M, et al. The main determinants of diabetes mellitus vascular complications: endothelial dysfunction and platelet hyperaggregation. *Int J Mol Sci.* 2018 Sep 28;19(10):2968.
- 6 Pretorius L, Thomson GJ, Adams R, Nell T, Laubscher WA, Pretorius E. Platelet activity and hypercoagulation in type 2 diabetes. *Cardiovasc Diabetol.* 2018 Dec;17(1):141.
- 7 Demirtunc R, Duman D, Basar M, et al. The relationship between glycemic control and platelet activity in type 2 diabetes mellitus. *J Diabetes Complications.* 2009 Mar 1;23(2):89–94.
- 8 Shilpi K, Potekar RM. A study of platelet indices in type 2 diabetes mellitus patients. *Indian J Hematol Blood Transfus.* 2018 Jan;34(1):115–20.
- 9 Rodriguez BA, Johnson AD. Platelet measurements and type 2 diabetes: investigations in two population-based cohorts. *Front Cardiovasc Med.* 2020 Jul 10;7:118.
- 10 Kodiatte TA, Manikyam UK, Rao SB, Jagadish TM, Reddy M, Lingaiah HK, et al. Mean platelet volume in type 2 diabetes mellitus. *J Lab Physicians.* 2012 Jan;4(1):5–9.
- 11 Hekimsoy Z, Payzinb B, Ornek T, Kandogan G. Mean platelet volume in Type 2 diabetic patients. *J Diabetes Complications.* 2004;18(3):173–6.
- 12 Yogappanavar SH, Chaitra. Study the correlation between mean platelet volume and hba1c in type 2 diabetes mellitus. *Int J Med Public Health.* 2024 Jul–Sep;14(3):[page numbers not provided].

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