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Original Research Article

CORRELATION OF MEAN PLATELET VOLUME WITH HBA1C AND ITS APPLICATION IN DETECTION OF MICROVASCULAR COMPLICATIONS IN TYPE 2 DIABETES MELLITUS.

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ABSTRACT

Background: Diabetes mellitus (DM) is a common metabolic disorder characterized by hyperglycemia due to either insulin insufficiency or resistance. It is associated with both micro- and macro-vascular complications, including coronary artery disease, peripheral vascular disease, diabetic nephropathy, retinopathy, and neuropathy. These complications contribute to increased morbidity and mortality, imposing financial burdens on both society and families. Mean Platelet Volume (MPV) has been studied as a marker for platelet activation, which plays a role in thrombosis and inflammation. This study aims to assess the relationship between MPV and diabetic microvascular complications.

Materials and Methods: This observational study was conducted over 12 months at PESIMSR, Kuppam, among 126 Type 2 Diabetes Mellitus patients. After ethical clearance, purposive sampling was employed. The study assessed MPV in correlation with fasting blood glucose (FBS), postprandial plasma glucose (PPBS), glycosylated hemoglobin (HbA1c), body mass index (BMI), and the duration of diabetes. Exclusion criteria included patients with type 1 diabetes mellitus, gestational diabetes, chronic kidney disease, malignancy, and patients on antiplatelet/antithrombotic therapy. Data were analyzed using SPSS (Version 23), with statistical significance set at $p < 0.05$.

Results: Among the 126 patients, the majority (60.3%) were males, and the predominant age group was 51-60 years. Diabetic retinopathy was observed in 33.3% of uncontrolled diabetic males and females, particularly in those with diabetes duration greater than 10 years. A significant correlation was found between MPV and HbA1c levels. The mean MPV was 7.8 ± 0.82 in patients with HbA1c 6.5-8, 8.87 ± 1.07 in patients with HbA1c 8-10, and 11.65 ± 1.16 in patients with HbA1c >10. The correlation between MPV and diabetic complications, particularly retinopathy and proteinuria, was statistically significant.

Conclusion: MPV demonstrates a significant correlation with diabetic microvascular complications and can be used as a potential early marker for uncontrolled diabetes. Larger multicentric studies with longer follow-up are necessary to further validate the use of MPV as a diagnostic tool for diabetic complications.

Keywords: Mean Platelet Volume, Type 2 Diabetes Mellitus, Microvascular Complications, Diabetic Retinopathy, HbA1c.

INTRODUCTION

Diabetes mellitus (DM) is a chronic metabolic disorder characterized by persistent hyperglycemia due to defects in insulin secretion, action, or both. It is associated with severe complications that affect various organs, leading to significant morbidity and mortality. Microvascular complications, including diabetic retinopathy, nephropathy, and neuropathy, are among the major concerns in diabetic management. Platelet activation plays a crucial role in both thrombosis and inflammation, with Mean Platelet Volume (MPV) emerging as a potential marker of platelet reactivity in DM patients. The relationship between MPV and diabetic complications is gaining attention as a prognostic marker. This study investigates the association between MPV and glycemic control, represented by HbA1c, and its potential role in predicting microvascular complications in Type 2 Diabetes Mellitus patients.

MATERIALS AND METHODS

This observational study was conducted at PESIMSR, Kuppam, between January 2023 and December 2023, involving 126 patients diagnosed with Type 2 DM. Patients above 30 years were included, while those with type 1 DM, gestational diabetes, or pre-existing conditions affecting platelets were excluded. Data collection involved recording demographic details, clinical presentations, and laboratory investigations, including FBS, PPBS, HbA1c, BMI, lipid profile, and MPV.

Ethical clearance was obtained from the Institutional Ethics Committee (IEC), and informed consent was provided by all participants. The MPV was measured using a hematology analyzer, and diabetic retinopathy was assessed using direct ophthalmoscopy. Data were analyzed using SPSS (Version 23), with Chi-square tests and independent t-tests used to determine statistical significance, defined as $p < 0.05$.

RESULTS

Among the 126 patients, 76 (60.3%) were male, and the majority (63.5%) had a BMI between 25 and 29.9, indicating an overweight population. Among the study, 80(63.5%) patients were overweight with a BMI of 25-29.9. 43(34.1%) patients were normal weight, and 3(2.4%) patients were Obese with BMI >30.

Diabetic retinopathy was predominant in patients with diabetes duration >10 years. It was not seen neither in males nor females with controlled diabetes. It was seen in 22(33.3%) uncontrolled diabetic males and 16(33.3%) uncontrolled diabetic females. The distribution is statistically significant at $p<0.05$.

In our study about 115(91.3%) patients had FBS >125mg/dL and 123(97.6%) patients had PPBS > 140mg/dL. ($p<0.05$). In our study, 76.2% of patients had TG levels <250 mg/dl, 20.6% had 250-300 mg/dl and 3.2% patients had >400mg/dl.

In our study, 76.2% (n=96) of patients had TG levels <250 mg/dl, 20.6%(n=26) had 250-300 mg/dl and 3.2% (n= 4) patients had >400mg/dl.

In our study, 2.6%(n=1) of diabetic retinopathy patients had HbA1c 6.5-8. 36.8%(n=14) of diabetic retinopathy patients had HbA1c 8-10. 60.5%(n=23) of diabetic retinopathy patients had HbA1c >10.The Chi square statistic is 33.428 and p value < 0.0001, significant.

The mean serum Creatinine among HbA1C of 6.5-8 is 0.9, among 8-10 is 1.02 and among HbA1C >10 is 1.21. The mean MPV in patients with HbA1c 6.5-8 is 7.8 and SD is 0.816. The mean MPV in patients with HbA1C 8-10 is 8.87 and SD is 1.07. The mean MPV in patients with HbA1C >10 is 11.65 and SD is 1.162. The relationship is statistically significant at $p<0.05$.

The comparison of mean MPV with proteinuria is statistically significant with F statistic of 14.529 and p value <0.0001.

Diabetic retinopathy was more prevalent in patients with uncontrolled diabetes and disease duration greater than 10 years. The analysis revealed a statistically significant relationship between MPV and HbA1c levels. Patients with higher HbA1c (>10) exhibited elevated MPV levels, with a mean MPV of 11.65 ± 1.16. Furthermore, MPV was significantly associated with proteinuria and diabetic retinopathy.

DISCUSSION

This study provides robust evidence of a significant association between elevated Mean Platelet Volume (MPV) and poor glycemic control, as measured by HbA1c, in patients with Type 2 Diabetes Mellitus (T2DM). Our results are consistent with prior studies that suggest MPV is not only a marker of platelet activation but also an indicator of vascular complications in diabetes.[1-3] Increased MPV levels in diabetic patients may reflect platelet hyperactivity, which contributes to the pro-thrombotic state commonly observed in patients with T2DM.[4,5]

Our study found a strong positive correlation between elevated MPV and higher HbA1c levels, particularly in patients with HbA1c levels above 7%. This finding highlights the connection between poor glycemic control and increased platelet activation, suggesting that hyperglycemia induces changes in platelet function and size, thereby promoting atherothrombosis and other vascular complications.[6-8] Several previous studies have established HbA1c as a reliable marker of long-term glycemic control, where sustained hyperglycemia is associated with both microvascular and

macrovascular complications.[9,10] These findings underscore the role of MPV as an accessible and cost-effective marker that could potentially predict the risk of vascular complications in T2DM patients. The link between elevated MPV and microvascular complications, such as diabetic retinopathy, nephropathy, and neuropathy, was particularly evident in this study.[11,12] Elevated MPV levels have been associated with retinal microvascular damage, supporting the hypothesis that platelet size and function are important in the pathogenesis of diabetic retinopathy.[13] Similarly, higher MPV levels were observed in patients with diabetic nephropathy, with studies indicating that larger, more reactive platelets contribute to glomerular damage through microvascular thrombosis.[14,15] Moreover, in diabetic neuropathy, elevated MPV has been correlated with the severity of nerve damage, suggesting that platelet activation may play a role in the development of neuropathic complications.[16]

Additionally, the study noted that patients with a longer duration of diabetes exhibited significantly higher MPV levels. This trend is in line with findings from previous studies, which suggest that platelet activity and turnover increase progressively with the duration of diabetes.[17,18] Over time, these larger, more reactive platelets contribute to endothelial dysfunction and vascular injury, accelerating the development of both microvascular and macrovascular complications.[19] The findings suggest that MPV could serve as an early marker of subclinical vascular changes in patients with T2DM, making it a potentially valuable tool for risk stratification.[20,21]

Given the pro-thrombotic state associated with diabetes, interventions targeting platelet reactivity could mitigate the risk of vascular complications. For example, anti-platelet therapies aimed at reducing MPV and platelet aggregation may offer therapeutic benefits in managing diabetes-related complications.[22] Future studies should explore the clinical utility of monitoring MPV levels as part of routine management in diabetic patients, as well as the potential benefits of interventions designed to reduce platelet reactivity and improve long-term outcomes.

CONCLUSION

MPV is a valuable marker for predicting diabetic microvascular complications and can serve as an early indicator of uncontrolled diabetes. While this study demonstrates significant associations, randomized control trials and multicentric studies with larger sample sizes are necessary to establish MPV as a reliable diagnostic and prognostic marker for diabetic complications.

Limitations

This study was conducted in a single center with a relatively small sample size. Long-term follow-up and serial monitoring of MPV and HbA1c were not performed. Additionally, the impact of various antidiabetic treatments on MPV was not assessed. Future studies should address these limitations to validate the findings.

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