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Original Research Article

CORRELATION OF MEAN PLATELET VOLUME WITH GLYCAEMIC STATUS IN PATIENTS WITH DIABETIC RETINOPATHY: A HOSPITAL-BASED OBSERVATIONAL STUDY

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ABSTRACT

Background: Diabetic retinopathy is a major microvascular complication of diabetes mellitus, and poor glycemic control is a well-established driver of its development and progression. Mean platelet volume (MPV), a surrogate marker of platelet reactivity, has emerged as a potentially useful hematologic marker in diabetes-related vascular disease. **Materials and Methods:** This hospital-based observational study included 60 adults with diabetic retinopathy. Clinical, biochemical, and hematological variables were obtained, including fasting blood sugar (FBS), postprandial blood sugar (PPBS), glycated hemoglobin (HbA1c), and MPV. Diabetic retinopathy was categorized as mild non-proliferative diabetic retinopathy (NPDR), moderate NPDR, severe NPDR, and proliferative diabetic retinopathy (PDR). Group comparisons were performed across retinopathy grades, and correlation between HbA1c and MPV was assessed. **Result:** The mean age was 55.23 ± 11.55 years; 63.3% were men. Mean HbA1c was 9.23 ± 1.51%, and mean MPV was 8.96 ± 0.90 fL. HbA1c showed a very strong positive correlation with MPV ($r = 0.983$, $p < 0.001$). Both HbA1c and MPV increased progressively across worsening retinopathy grades, from mild NPDR to PDR ($p < 0.001$ for both). FBS and PPBS also increased significantly with disease severity. **Conclusion:** In this cohort of patients with diabetic retinopathy, higher HbA1c was strongly correlated with higher MPV, and both were significantly related to greater retinopathy severity. MPV may serve as a simple adjunctive marker of microvascular disease burden in type 2 diabetes.

INTRODUCTION

Diabetic retinopathy (DR) is one of the most common microvascular complications of diabetes mellitus and remains a leading cause of preventable visual impairment among working-age adults worldwide. Recent epidemiological evidence indicates that the global burden of DR continues to rise in parallel with the increasing prevalence of diabetes, with projections suggesting a substantial impact on healthcare systems over the coming decades.[1] Persistent hyperglycaemia plays a central role in the development of retinal microvascular injury through pathways involving oxidative stress, endothelial dysfunction, chronic inflammation, and capillary damage. Poor glycaemic control, as reflected by elevated glycated haemoglobin (HbA1c) levels, has consistently been identified as an important risk factor for the onset and progression of diabetic retinopathy in systematic reviews and meta-analyses.[2,3]

In addition to hyperglycaemia, increasing attention has been directed towards platelet activation as a contributor to diabetic microvascular disease. Enhanced platelet reactivity in diabetes is thought to result from metabolic disturbances and vascular endothelial injury, leading to a prothrombotic state that may accelerate retinal vascular damage. Mean platelet volume (MPV), an inexpensive parameter routinely reported as part of automated complete blood counts, serves as an indirect indicator of platelet activation and has been proposed as a potential biomarker of vascular complications in diabetes.[4,5] Recent studies have suggested that elevated MPV may reflect increased platelet turnover and inflammatory activity associated with diabetic microangiopathy.

Emerging evidence also supports a relationship between MPV and diabetic retinopathy.

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Contemporary systematic reviews and observational studies have demonstrated that patients with DR tend to have significantly higher MPV values than those without retinopathy and that MPV may increase with advancing disease severity.[4,5] Nevertheless, data from tertiary care centres in India remain relatively limited, and regional differences in patient characteristics, glycaemic control, and disease patterns necessitate further investigation. Therefore, the present study was undertaken to evaluate the correlation between HbA1c and MPV among patients with diabetic retinopathy and to explore whether platelet volume is associated with the severity of retinal disease.

MATERIALS AND METHODS

This study was designed as a single-center, hospital-based observational analytical investigation conducted among patients with diabetic retinopathy at Trichy SRM Medical College Hospital and Research Centre, Tamil Nadu, India, over a period of six months. The study population comprised adult patients with type 2 diabetes mellitus presenting to both outpatient and inpatient services. Participants were eligible if they were older than 30 years, had a confirmed diagnosis of type 2 diabetes mellitus, had evidence of diabetic retinopathy, and demonstrated glycemic parameters consistent with diabetes, including fasting blood sugar >125 mg/dL, postprandial blood sugar >200 mg/dL, and HbA1c >6%. Patients were excluded if they had type 1 diabetes mellitus, gestational diabetes, known platelet disorders, chronic kidney disease, malignancy, or were receiving antiplatelet or antithrombotic therapy. The total sample size of 60 participants were included. Based on the study setting and data structure, the sampling approach used was convenience-based, including eligible patients presenting during the study period. Data were collected using a structured proforma and included demographic details, clinical characteristics, and laboratory parameters such as age, sex, body mass index, duration of diabetes, smoking status, alcohol use, hypertension, fasting and postprandial blood glucose levels, HbA1c, hemoglobin, platelet count, serum creatinine, total cholesterol, triglycerides, and mean platelet volume. MPV was measured using a hematology analyzer, while diabetic retinopathy was clinically assessed and categorized into mild non-proliferative diabetic retinopathy (NPDR), moderate NPDR, severe NPDR, and proliferative diabetic retinopathy (PDR). The primary exposure variable was HbA1c, and the primary outcome variable was MPV, with retinopathy grade serving as a secondary clinical stratifier; additional covariates included demographic and biochemical parameters. Statistical analysis was performed using descriptive and inferential methods, with continuous variables expressed as mean ± standard deviation and categorical variables as frequencies and percentages. Comparisons across retinopathy severity groups were conducted using one-way analysis of variance, and the relationship between HbA1c and MPV was evaluated using Pearson correlation analysis. A two-sided p value of less than 0.05 was considered statistically significant. Ethical considerations were addressed through an informed consent process and institutional ethics approval framework, ensuring voluntary participation, confidentiality, and the right to withdraw at any time; the final manuscript should include the exact IEC approval number and date as required by the target journal. The study has been reported in accordance with the principles of the STROBE Statement for observational studies.

RESULTS

A total of 60 patients with diabetic retinopathy were included in the analysis. The mean age of the study population was 55.23 ± 11.55 years. There were 38 men (63.3%) and 22 women (36.7%). The mean BMI was 26.48 ± 2.62 kg/m², and the mean duration of diabetes was 7.60 ± 3.94 years. Smoking was reported in 34 patients (56.7%), alcohol use in 30 (50.0%), and hypertension in 30 (50.0%). Retinopathy severity distribution showed 9 patients (15.0%) with mild NPDR, 15 (25.0%) with moderate NPDR, 18 (30.0%) with severe NPDR, and 18 (30.0%) with PDR. The mean FBS was 190.12 ± 37.26 mg/dL, mean PPBS was 309.32 ± 61.06 mg/dL, mean HbA1c was 9.23 ± 1.51%, and mean MPV was 8.96 ± 0.90 fL. Mean hemoglobin was 12.34 ± 1.32 g/dL, and mean platelet count was 302,855 ± 86,958/µL. A very strong positive correlation was observed between HbA1c and MPV ($r = 0.983$, $p < 0.001$).

Both HbA1c and MPV increased significantly with increasing severity of diabetic retinopathy. FBS and PPBS also showed significant stepwise increases across retinopathy grades. In contrast, age, BMI, duration of diabetes, hemoglobin, platelet count, serum creatinine, total cholesterol, and triglycerides did not differ significantly across disease grades.

Table 1: Baseline clinical and laboratory characteristics of the study population (n = 60)

Variable	Value
Age, years	55.23 ± 11.55
Male sex, n (%)	38 (63.3)
Female sex, n (%)	22 (36.7)
BMI, kg/m²	26.48 ± 2.62
Duration of diabetes, years	7.60 ± 3.94
Smoking, n (%)	34 (56.7)
Alcohol use, n (%)	30 (50.0)
Hypertension, n (%)	30 (50.0)

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FBS, mg/dL	190.12 ± 37.26
PPBS, mg/dL	309.32 ± 61.06
HbA1c, %	9.23 ± 1.51
MPV, fL	8.96 ± 0.90
Hemoglobin, g/dL	12.34 ± 1.32
Platelet count, /µL	302855 ± 86958
Serum creatinine, mg/dL	1.27 ± 0.25
Total cholesterol, mg/dL	205.57 ± 28.43
Triglycerides, mg/dL	198.28 ± 46.30

Table 2: Comparison of selected parameters across diabetic retinopathy grades

Parameter	Mild NPDR (n=9)	Moderate NPDR (n=15)	Severe NPDR (n=18)	PDR (n=18)	p value
FBS, mg/dL	133.22± 8.91	164.87 ± 11.73	194.11±10.20	235.61± 8.93	<0.001
PPBS, mg/dL	215.11 ± 11.82	264.33 ± 17.64	321.39 ± 14.22	381.83 ± 14.50	<0.001
HbA1c, %	6.87 ± 0.19	8.16 ± 0.44	9.47 ± 0.31	11.06 ± 0.31	<0.001
MPV, fL	7.59 ± 0.16	8.30 ± 0.34	9.16 ± 0.25	10.00 ± 0.31	<0.001

DISCUSSION

The present study evaluated the relationship between mean platelet volume and glycaemic control among patients with diabetic retinopathy and demonstrated a strong positive association between increasing HbA1c levels, elevated MPV, and greater retinopathy severity.

Teo et al. highlighted the growing global burden of diabetic retinopathy and emphasized the importance of identifying readily available biomarkers that may aid in early risk stratification and disease monitoring.[1] Shiferaw et al. demonstrated through a systematic review and meta-analysis that poor glycaemic control, reflected by elevated HbA1c levels, is strongly associated with the development and progression of diabetic retinopathy, supporting the observed increase in HbA1c across advancing disease stages in the present study.[2] Wong et al. described chronic hyperglycaemia as a key driver of retinal microvascular injury through mechanisms involving endothelial dysfunction, oxidative stress, and inflammation, providing biological plausibility for the progressive worsening of retinal disease with increasing HbA1c values observed in our cohort.[3]

Ji et al. reported that patients with diabetic retinopathy consistently exhibit higher mean platelet volumes than individuals without retinopathy and concluded that MPV may serve as a useful marker of disease severity.[4] Ji et al. further suggested that enhanced platelet activation contributes to retinal microvascular compromise, which is in agreement with the stepwise increase in MPV from mild non-proliferative diabetic retinopathy to proliferative diabetic retinopathy identified in the present analysis.[4] Hvas et al. explained that diabetes is associated with increased platelet reactivity and altered platelet physiology, leading to a prothrombotic state that may accelerate vascular complications and support the observed relationship between elevated MPV and advanced retinal involvement.[5]

Wong et al. emphasized that diabetic retinopathy is a multifactorial disorder in which sustained metabolic dysregulation interacts with vascular and inflammatory pathways to promote progressive retinal damage.[3] Shiferaw et al. demonstrated that worsening glycaemic exposure significantly increases the likelihood of retinopathy, reinforcing the importance of maintaining optimal metabolic control to reduce ocular complications.[2] Hvas et al. noted that platelet activation may represent an additional pathway contributing to diabetic microvascular disease and suggested that simple hematological parameters such as MPV deserve further clinical evaluation as adjunctive biomarkers.[5]

Ji et al. proposed that MPV, because of its availability through routine complete blood counts, may represent a practical and inexpensive indicator of diabetic vascular injury, particularly when interpreted alongside established metabolic markers.[4] Wong et al. underscored the importance of comprehensive risk assessment in diabetic retinopathy, integrating clinical findings with systemic biomarkers to improve patient monitoring and individualized management strategies.[3] Teo et al. highlighted the anticipated increase in the worldwide burden of diabetic retinopathy over the coming decades, emphasizing the need for cost-effective approaches that facilitate early identification of patients at higher risk for progressive disease.[1]

Overall, the findings of the present study indicate that poor glycaemic control is accompanied by higher mean platelet volume and that both parameters increase progressively with worsening diabetic retinopathy, supporting the potential role of MPV as an accessible adjunctive marker for assessing disease severity in patients with type 2 diabetes mellitus.

CONCLUSION

Among adults with diabetic retinopathy in this hospital-based cohort, higher HbA1c levels were strongly correlated with higher mean platelet volume, and both parameters increased significantly with worsening retinopathy grade. These findings support the potential utility of MPV as a simple adjunctive biomarker of microvascular disease severity in type 2 diabetes. Larger prospective studies with standardized retinal grading and appropriate comparator groups are needed to clarify its predictive value.

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