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Platelet Indices as a Predictive Marker in Type 2 Diabetes Complications: Micro Versus Macro Vascular

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A B S T R A C T

Background: Platelet dysfunction is implicated in the pathogenesis of diabetic complications. This study investigated the potential of platelet indices as predictive markers for complications in type 2 diabetes mellitus (T2DM). ***Methods****:* In this prospective observational study, 95 T2DM patients were followed for one year. Platelet indices, including Mean Platelet Volume (MPV), Platelet Distribution Width (PDW), and Plateletcrit (PCT), were measured at baseline and every three months. The development of microvascular and macrovascular complications was monitored. ***Results***: Significant increases in all platelet indices were observed over the study period ($p < 0.05$). MPV showed the strongest correlation with HbA1c ($r = 0.42$, $p < 0.01$). ROC curve analysis revealed that MPV had the highest predictive value for both microvascular (AUC 0.76, $p < 0.001$) and macrovascular complications (AUC 0.79, $p < 0.001$). In multivariate analysis, MPV was an independent predictor of microvascular (OR 1.82, 95% CI 1.35-2.45, $p < 0.01$) and macrovascular complications (OR 2.13, 95% CI 1.56-2.91, $p < 0.01$). ***Conclusion***: Platelet indices, particularly MPV, show promise as predictive markers for complications in T2DM, with a slightly stronger association with macrovascular complications. These findings suggest that platelet indices could potentially enhance risk stratification in diabetic patients.

Keywords: Type 2 diabetes mellitus; Mean platelet volume; Platelet distribution width; Plateletcrit; Microvascular complications; Macrovascular complications; Predictive markers.

INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a chronic metabolic disorder characterized by hyperglycemia resulting from insulin resistance and relative insulin deficiency. The global prevalence of T2DM has reached epidemic proportions, with an estimated 463 million adults living with the condition in 2019, and projections suggesting this number could rise to 700 million by 2045 [1]. The burden of T2DM extends beyond hyperglycemia, as it is associated with numerous complications that significantly impact patients' quality of life and pose substantial challenges to healthcare systems worldwide.

Diabetic complications are broadly categorized into microvascular and macrovascular complications. Microvascular complications include retinopathy, nephropathy, and neuropathy, while macrovascular complications encompass cardiovascular diseases such as coronary artery disease, peripheral arterial disease, and cerebrovascular disease [2]. These complications are the primary sources of morbidity and mortality in individuals with T2DM, underscoring the critical need for early detection and intervention strategies.

The pathophysiology of diabetic complications is multifaceted, involving complex interactions between metabolic dysregulation, oxidative stress, inflammation, and vascular dysfunction. Among the various factors contributing to the development and progression of these complications, platelet dysfunction has emerged as a significant

player. Platelets, small anucleate blood cells crucial for hemostasis and thrombosis, exhibit altered function and reactivity in the diabetic milieu [3].

Recent research has focused on platelet indices as potential biomarkers for predicting and monitoring diabetic complications. Platelet indices, which include mean platelet volume (MPV), platelet distribution width (PDW), and plateletcrit (PCT), provide information about platelet size, heterogeneity, and overall platelet mass. These parameters are routinely available as part of complete blood count analyses, making them cost-effective and easily accessible markers for clinical use [4].

Mean platelet volume, in particular, has garnered significant attention as a marker of platelet activation and function. Increased MPV is associated with enhanced platelet reactivity and a prothrombotic state. Several studies have reported elevated MPV in patients with T2DM compared to non-diabetic controls, suggesting that MPV could serve as an early indicator of platelet dysfunction in diabetes [5]. Furthermore, MPV has been linked to both microvascular and macrovascular complications of diabetes, albeit with varying degrees of association and predictive value.

In the context of microvascular complications, studies have explored the relationship between MPV and diabetic retinopathy, nephropathy, and neuropathy. A meta-analysis by Wang *et al*., demonstrated that patients with diabetic retinopathy had significantly higher MPV values compared to those without retinopathy, suggesting that MPV could be a useful marker for assessing retinopathy risk in diabetic patients [6]. Similarly, elevated MPV has been associated with the presence and severity of diabetic nephropathy, with some studies reporting a positive correlation between MPV and albuminuria levels [7].

The role of platelet indices in macrovascular complications of T2DM has also been extensively investigated. Cardiovascular disease remains the leading cause of death in diabetic patients, and identifying reliable predictors of cardiovascular risk is crucial for improving outcomes. Several studies have reported associations between elevated MPV and increased risk of cardiovascular events in patients with T2DM. For instance, a prospective study by Papanas*et al*., found that MPV was an independent predictor of myocardial infarction in diabetic patients without prior cardiovascular disease [8].

While MPV has been the most widely studied platelet index, other parameters such as PDW and PCT have also shown promise as potential markers of diabetic complications. PDW, which reflects the variability in platelet size, has been associated with both microvascular and macrovascular complications in some studies. However, the evidence for PDW is less consistent compared to MPV, and further research is needed to elucidate its clinical utility [9].

The potential of platelet indices as predictive markers for diabetic complications lies in their ability to reflect the underlying pathophysiological processes contributing to vascular damage. Chronic hyperglycemia, oxidative stress, and inflammation in diabetes lead to endothelial dysfunction and platelet activation. Activated platelets undergo morphological changes, including an increase in size, which is reflected in elevated MPV values. These larger platelets are more reactive and have a higher thrombotic potential, contributing to the development and progression of vascular complications [3].

Moreover, the differential association of platelet indices with micro- and macrovascular complications may provide insights into the distinct pathogenic mechanisms involved in these complications. While both types of complications share some common pathways, such as endothelial dysfunction and inflammation, there are also unique features that distinguish their development and progression. For instance, microvascular complications are more closely linked to long-term glycemic control, while macrovascular complications are influenced by a broader range of cardiovascular risk factors, including hypertension and dyslipidemia [2].

Understanding the relationship between platelet indices and specific diabetic complications could help clinicians tailor their approach to risk assessment and management. For example, if certain platelet indices show a stronger association with microvascular complications, they could be used to identify patients at higher risk of developing retinopathy, nephropathy, or neuropathy, prompting more intensive monitoring and earlier intervention. Conversely, indices more closely linked to macrovascular complications could guide decisions regarding cardiovascular risk management and preventive strategies.

Despite the promising evidence supporting the use of platelet indices as predictive markers in diabetic complications, several challenges and limitations need to be addressed. First, there is a lack of standardization in the measurement and reporting of platelet indices across different laboratories and studies, which can lead to variability in results and hinder comparisons between studies. Establishing standardized protocols and reference ranges for these parameters is crucial for their widespread clinical adoption [4].

Second, the specificity of platelet indices as markers for diabetic complications remains a concern. Alterations in platelet indices can occur in various other conditions, including inflammatory disorders, hematological diseases, and other cardiovascular risk factors. Therefore, the confounding effects of these factors need to be carefully considered when interpreting platelet indices in the context of diabetic complications [10].

Third, while numerous studies have demonstrated associations between platelet indices and diabetic complications, the causal relationship and underlying mechanisms are not fully elucidated. Further research is needed to determine whether changes in platelet indices precede the development of complications or are a consequence of the vascular damage associated with these complications.

In conclusion, platelet indices, particularly MPV, show promise as potential predictive markers for both micro- and macrovascular complications in patients with T2DM. These easily accessible and cost-effective parameters reflect the complex interplay between platelet dysfunction, vascular damage, and the development of diabetic complications. However, further research is needed to address the current limitations and establish the clinical utility of platelet indices in risk stratification and management of diabetic complications. Large-scale, prospective studies with standardized measurement protocols and careful consideration of confounding factors are essential to validate the predictive value of platelet indices and determine their optimal use in clinical practice. As our understanding of the relationship between platelet function and diabetic complications continues to evolve, platelet indices may emerge as valuable tools in the comprehensive management of patients with T2DM, potentially improving outcomes and quality of life for millions of individuals affected by this chronic condition.

Aims and Objectives

The primary aim of this study was to investigate the potential of platelet indices as predictive markers for complications in patients with type 2 diabetes mellitus (T2DM). Specifically, the study sought to evaluate the relationship between platelet indices and the development of both microvascular and macrovascular complications over a one-year period. The objectives of the study were twofold: firstly, to assess the efficacy of platelet indices, including mean platelet volume (MPV), platelet distribution width (PDW), and plateletcrit (PCT), as predictive markers for diabetic complications; and secondly, to determine the sensitivity of these platelet indices in distinguishing between microvascular and macrovascular complications in patients with T2DM.

Materials and Methods

Study Design and Setting

This prospective, observational study was conducted over a period of one year at a tertiary care hospital. The study protocol was approved by the institutional ethics committee, and written informed consent was obtained from all participants prior to enrollment. The study adhered to the principles of the Declaration of Helsinki and followed good clinical practice guidelines.

Study Population and Sample Size

A total of 95 patients with previously diagnosed T2DM were recruited for the study. The sample size was determined based on previous studies and statistical power calculations, aiming to detect a moderate effect size with 80% power and a 5% significance level. Patients were recruited from the outpatient diabetes clinic of the hospital using a consecutive sampling method.

Inclusion and Exclusion Criteria

Inclusion criteria for the study were: (1) patients aged 18 years or older with a confirmed diagnosis of T2DM for at least one year; (2) willingness to participate in the study and provide informed consent; and (3) ability to attend regular follow-up visits for the duration of the study. Exclusion criteria were: (1) patients with type 1 diabetes mellitus; (2) pregnant women; (3) patients with known hematological disorders or malignancies; (4) patients on antiplatelet or anticoagulant therapy; (5) patients with acute infections or inflammatory conditions at the time of enrollment; (6) patients with a history of recent surgery (within the past three months); and (7) patients with end-stage renal disease or severe hepatic impairment.

Data Collection and Clinical Assessment

At baseline, comprehensive demographic and clinical data were collected from all participants. This included age, gender, duration of diabetes, body mass index (BMI), blood pressure, and current medications. A detailed medical history was obtained, focusing on existing micro- and macrovascular complications. All participants underwent a thorough physical examination, including assessment of peripheral neuropathy using monofilament testing and vibration perception threshold.

Laboratory Investigations

Blood samples were collected from all participants at baseline and at three-month intervals throughout the study period. Samples were analyzed for glycatedhemoglobin (HbA1c), fasting plasma glucose, lipid profile, renal function tests, and liver function tests. Platelet indices, including MPV, PDW, and PCT, were measured using an automated hematologyanalyzer (Sysmex XN-3000, Sysmex Corporation, Kobe, Japan). To ensure accuracy and reproducibility, all blood samples were processed within two hours of collection, and the platelet indices were measured in triplicate, with the mean value used for analysis.

Assessment of Diabetic Complications

Microvascular complications were assessed as follows: diabetic retinopathy was evaluated through comprehensive ophthalmological examination, including fundus photography and optical coherence tomography; diabetic nephropathy was assessed by measuring urinary albumin-to-creatinine ratio and estimated glomerular filtration rate; and diabetic neuropathy was evaluated using nerve conduction studies and quantitative sensory testing. Macrovascular complications were assessed through electrocardiography, echocardiography, carotid doppler ultrasonography, and ankle-brachial index measurement. All participants underwent these assessments at baseline and at the end of the one-year study period.

Follow-up and Monitoring

Participants were followed up at three-month intervals throughout the study period. At each visit, clinical examinations were performed, blood samples were collected for platelet indices and other laboratory parameters, and adherence to diabetes management was assessed. Any new symptoms or complications reported by the participants were thoroughly evaluated and documented.

Statistical Analysis

Statistical analysis was performed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation or median with interquartile range, depending on the distribution of data. Categorical variables were expressed as frequencies and percentages. The Kolmogorov-Smirnov test was used to assess the normality of data distribution. Comparisons between groups were made using Student's t-test or Mann-Whitney U test for continuous variables, and chi-square test or Fisher's exact test for categorical variables, as appropriate. Correlation analyses were performed using Pearson's or Spearman's correlation coefficients. Receiver operating characteristic (ROC) curve analysis was conducted to evaluate the predictive value of platelet indices for diabetic complications. Multivariate logistic regression analysis was performed to identify independent predictors of micro- and macrovascular complications. A p-value of less than 0.05 was considered statistically significant.

Ethical Considerations

The study protocol was reviewed and approved by the Institutional Ethics Committee (IEC) of the hospital. All participants were provided with detailed information about the study in their preferred language, and written informed consent was obtained. Participants were assured of confidentiality and were informed of their right to withdraw from the study at any time without affecting their routine medical care. All data collected were anonymized and stored securely, with access restricted to authorized research personnel only.

RESULTS

The study included 95 participants with type 2 diabetes mellitus, with a mean age of 58.3 ± 9.7 years and a slight male predominance (55%). The average duration of diabetes was 8.5 ± 5.2 years, and the mean HbA1c at baseline was 7.8 ± 1.4%. Baseline characteristics and initial platelet indices are presented in Table 1. At the study's outset, 19% of participants had retinopathy, 16% had nephropathy, 23% had neuropathy, 13% had cardiovascular disease, and 8% had peripheral artery disease.

Over the course of the one-year study period, all three platelet indices showed significant increases (Table 2). Mean Platelet Volume (MPV) increased from 10.2 ± 1.1 fL at baseline to 10.8 ± 1.3 fL at one year ($p = 0.003$). Platelet Distribution Width (PDW) rose from 16.8 ± 2.3% to 17.6 ± 2.5% ($p = 0.012$), and Plateletcrit (PCT) increased from 0.28 ± 0.05% to 0.30 ± 0.06% ($p = 0.041$).

The incidence of new complications during the study period was noteworthy, with 25 participants (26.3%) developing new microvascular complications and 9 participants (9.5%) developing new macrovascular complications (Table 3). Participants who developed new complications showed significantly higher platelet indices compared to those who remained complication-free. For instance, those who developed retinopathy had a mean MPV of 11.3 ± 1.2 fL, compared to 10.1 ± 1.0 fL in those without complications ($p < 0.01$). Similar patterns were observed for PDW (18.2 ± 2.4% vs. 16.5 ± 2.2%, $p < 0.05$) and PCT (0.31 ± 0.05% vs. 0.27 ± 0.04%, $p < 0.05$).

Correlation analysis revealed significant positive associations between platelet indices and measures of glycemic control (Table 4). MPV showed the strongest correlation with HbA1c ($r = 0.42$, $p < 0.01$) and fasting plasma glucose ($r = 0.38$, $p < 0.01$). PDW and PCT also demonstrated significant, albeit slightly weaker, correlations with both glycemic parameters ($p < 0.01$ for PDW, $p < 0.05$ for PCT).

Receiver Operating Characteristic (ROC) curve analysis was performed to assess the predictive value of platelet indices for both microvascular and macrovascular complications (Table 5). MPV demonstrated the highest predictive value for both types of complications, with an Area Under the Curve (AUC) of 0.76 for microvascular complications and 0.79 for macrovascular complications (both $p < 0.001$). The optimal cut-off value for MPV in predicting microvascular complications was 10.7 fL, yielding a sensitivity of 72% and specificity of 68%. For macrovascular complications, the optimal cut-off was 11.0 fL, with a sensitivity of 75% and specificity of 71%. PDW and PCT also showed significant predictive value, albeit lower than MPV, with AUCs ranging from 0.65 to 0.74 (all $p < 0.05$).

Multivariate logistic regression analysis was conducted to identify independent predictors of microvascular and macrovascular complications (Table 6). After adjusting for other factors, MPV emerged as the strongest platelet index predictor for both types of complications. For microvascular complications, each 1 fL increase in MPV was associated with an 82% increase in the odds of complication development (OR 1.82, 95% CI 1.35-2.45, $p < 0.01$). The association was even stronger for macrovascular complications, with each 1 fL increase in MPV linked to a 113% increase in odds (OR 2.13, 95% CI 1.56-2.91, $p < 0.01$). PDW and PCT also remained significant independent predictors in the multivariate model, although with lower odds ratios compared to MPV.

Other significant predictors in the multivariate model included HbA1c, duration of diabetes, and systolic blood pressure. For microvascular complications, each 1% increase in HbA1c was associated with a 45% increase in odds (OR 1.45, 95% CI 1.22-1.72, $p < 0.01$), while for macrovascularcomplications, the increase was 38% (OR 1.38, 95% CI 1.15-1.65, $p < 0.01$). Each year of diabetes duration increased the odds of microvascular and macrovascular complications by 8% and 10%, respectively ($p < 0.01$ for both). Systolic blood pressure also showed a significant association, with each 10 mmHg increase raising the odds of microvascular complications by 21% (OR 1.21, 95% CI 1.08-1.36, $p < 0.01$) and macrovascular complications by 29% (OR 1.29, 95% CI 1.14-1.46, $p < 0.01$).

In summary, these results demonstrate significant increases in platelet indices over time in patients with type 2 diabetes, with higher values associated with the development of both microvascular and macrovascular complications. MPV emerged as the most potent predictor among the platelet indices, showing slightly higher predictive value for macrovascular compared to microvascular complications. The findings suggest that platelet indices, particularly MPV, may serve as valuable predictive markers for diabetes complications, independent of traditional risk factors.

Table 1: Baseline Characteristics and Platelet Indices of Study Participants

Characteristic	**Value (n=95)**
Age (years)	58.3 ± 9.7
Gender (Male/Female)	52/43 (55/45%)
Duration of diabetes (years)	8.5 ± 5.2
BMI (kg/m²)	28.7 ± 4.3
HbA1c (%)	7.8 ± 1.4
Systolic BP (mmHg)	135 ± 15
Diastolic BP (mmHg)	82 ± 9
Mean Platelet Volume (fL)	10.2 ± 1.1
Platelet Distribution Width (%)	16.8 ± 2.3
Plateletcrit (%)	0.28 ± 0.05
Existing Microvascular Complications:	
- Retinopathy	18 (19%)
- Nephropathy	15 (16%)
- Neuropathy	22 (23%)
Existing Macrovascular Complications:	
- Cardiovascular Disease	12 (13%)
- Peripheral Artery Disease	8 (8%)

Table 2: Changes in Platelet Indices over the Study Period

Platelet Index	Baseline	6 Months	1 Year	p-value*
MPV (fL)	10.2 ± 1.1	10.5 ± 1.2	10.8 ± 1.3	0.003
PDW (%)	16.8 ± 2.3	17.2 ± 2.4	17.6 ± 2.5	0.012
PCT (%)	0.28 ± 0.05	0.29 ± 0.05	0.30 ± 0.06	0.041

*p-value for trend over time (repeated measures ANOVA)

Table 3: Incidence of New Complications and Associated Platelet Indices

Complication	Incidence	MPV (fL)	PDW (%)	PCT (%)
Microvascular:				
- Retinopathy	8 (8.4%)	11.3 ± 1.2**	18.2 ± 2.4*	0.31 ± 0.05*
- Nephropathy	7 (7.4%)	11.1 ± 1.1*	18.0 ± 2.3*	0.30 ± 0.05
- Neuropathy	10 (10.5%)	11.2 ± 1.2**	18.1 ± 2.4*	0.31 ± 0.06*
Macrovascular:				
- CVD	5 (5.3%)	11.5 ± 1.3**	18.5 ± 2.5**	0.32 ± 0.06*
- PAD	4 (4.2%)	11.4 ± 1.2*	18.3 ± 2.4*	0.31 ± 0.05*
No Complications	61 (64.2%)	10.1 ± 1.0	16.5 ± 2.2	0.27 ± 0.04

*p<0.05, **p<0.01 compared to No Complications group (ANOVA with post-hoc Tukey's test)

Table 4: Correlation between Platelet Indices and Glycemic Control

Platelet Index	HbA1c	Fasting Plasma Glucose
MPV	r = 0.42**	r = 0.38**
PDW	r = 0.37**	r = 0.33**
PCT	r = 0.28*	r = 0.25*

*p<0.05, **p<0.01 (Pearson's correlation coefficient)

Table 5: Sensitivity and Specificity of Platelet Indices for Predicting Complications

Complication	Index	AUC	Cut-off	Sensitivity	Specificity	p-value
Microvascular	MPV	0.76	10.7 fL	72%	68%	<0.001
	PDW	0.71	17.5%	68%	65%	0.003
	PCT	0.65	0.29%	63%	62%	0.018
Macrovascular	MPV	0.79	11.0 fL	75%	71%	<0.001
	PDW	0.74	17.8%	70%	68%	0.002
	PCT	0.68	0.30%	65%	64%	0.010

AUC: Area Under the Curve (Receiver Operating Characteristic analysis)

Table 6: Multivariate Analysis: Predictors of Microvascular and Macrovascular Complications

Predictor	Microvascular	Macrovascular
	OR (95% CI)	OR (95% CI)
MPV (per 1 fL)	1.82 (1.35-2.45)**	2.13 (1.56-2.91)**
PDW (per 1%)	1.24 (1.07-1.44)*	1.31 (1.12-1.53)**
PCT (per 0.1%)	1.18 (1.02-1.36)*	1.22 (1.05-1.42)*
HbA1c (per 1%)	1.45 (1.22-1.72)**	1.38 (1.15-1.65)**
Duration of DM (per year)	1.08 (1.03-1.13)**	1.10 (1.05-1.16)**
Systolic BP (per 10 mmHg)	1.21 (1.08-1.36)**	1.29 (1.14-1.46)**

DISCUSSION

This study investigated the potential of platelet indices as predictive markers for complications in patients with type 2 diabetes mellitus (T2DM). The results demonstrated significant increases in Mean Platelet Volume (MPV), Platelet Distribution Width (PDW), and Plateletcrit (PCT) over the one-year study period, with higher values associated with the development of both microvascular and macrovascular complications.

The observed increase in platelet indices over time aligns with findings from previous studies. Demirtunc*et al*., reported significantly higher MPV values in diabetic patients compared to healthy controls (8.7 ± 0.8 fL vs. 7.9 ± 0.7 fL, $p < 0.001$) [11]. Similarly, Jindal *et al*., found elevated MPV (9.5 ± 0.83 fL vs. 7.4 ± 0.58 fL, $p < 0.001$) and PDW (16.8 ± 0.64% vs. 15.9 ± 0.37%, $p < 0.001$) in diabetic patients compared to controls [12]. These findings support the notion that platelet activation and altered function are common in T2DM.

The present study found significant correlations between platelet indices and glycemic control, with MPV showing the strongest association ($r = 0.42$ for HbA1c, $p < 0.01$). This relationship has been corroborated by several studies. Ulutas*et al.*, reported a positive correlation between MPV and HbA1c ($r = 0.403$, $p < 0.001$) in a study of 201 T2DM patients [13]. Conversely, Hekimsoy*et al.*, found no significant correlation between MPV and HbA1c in their study of 145 diabetic patients [14], highlighting the need for further research to elucidate this relationship.

A key finding of this study was the predictive value of platelet indices for diabetic complications. MPV emerged as the strongest predictor, with slightly higher predictive value for macrovascular compared to microvascular complications (AUC 0.79 vs. 0.76). This aligns with the results of Papanas*et al.*, who found that MPV was an independent risk factor for myocardial infarction in T2DM patients (OR 1.45, 95% CI 1.12-1.89, $p = 0.005$) [15]. However, Buch*et al.*, reported that while MPV was significantly higher in diabetics with microvascular complications compared to those without (8.99 ± 0.74 fL vs. 8.28 ± 0.74 fL, $p < 0.001$), it was not a significant predictor in multivariate analysis [16]. This discrepancy underscores the complexity of the relationship between platelet indices and diabetic complications.

The multivariate analysis in our study revealed that MPV was an independent predictor of both microvascular (OR 1.82, 95% CI 1.35-2.45, $p < 0.01$) and macrovascular complications (OR 2.13, 95% CI 1.56-2.91, $p < 0.01$), even after adjusting for traditional risk factors. This finding is supported by Cucuianu*et al.*, who proposed that increased platelet volume and activity in diabetes may contribute to the development of vascular complications [17].

The stronger association of MPV with macrovascular complications observed in this study is intriguing. It may reflect the more direct role of platelets in atherothrombotic events compared to microvascular pathology. This hypothesis is supported by Dindar*et al.*, who found that MPV was significantly higher in diabetic patients with coronary artery disease compared to those without (9.3 ± 1.5 fL vs. 8.7 ± 1.3 fL, $p = 0.002$) [18].

While our study provides valuable insights, it has limitations. The relatively small sample size and short duration of follow-up may limit the generalizability of the findings. Additionally, the observational nature of the study precludes definitive conclusions about causality. Larger, prospective studies with longer follow-up periods are needed to confirm these results and establish the clinical utility of platelet indices in predicting diabetic complications.

Despite these limitations, the findings of this study have important clinical implications. The use of platelet indices, particularly MPV, as predictive markers for diabetic complications could potentially improve risk stratification and guide more targeted preventive strategies. Future research should focus on establishing standardized cut-off values for these indices and investigating their integration into existing risk assessment tools for diabetic complications.

CONCLUSION

This study demonstrates that platelet indices, particularly Mean Platelet Volume, have significant potential as predictive markers for both microvascular and macrovascular complications in patients with type 2 diabetes mellitus. The observed associations were independent of traditional risk factors, suggesting that these indices may provide additional prognostic information. MPV showed a slightly stronger association with macrovascular complications, which may reflect the central role of platelets in atherothrombotic events.

The findings underscore the complex interplay between platelet function, glycemic control, and vascular complications in diabetes. The increase in platelet indices over time and their correlation with glycemic parameters highlight the importance of considering platelet activation in the pathophysiology of diabetic complications.

While these results are promising, further research is needed to validate these findings in larger, more diverse populations and to establish standardized cut-off values for clinical use. Prospective studies with longer follow-up periods would be valuable in determining the long-term predictive value of platelet indices.

If confirmed by further research, the use of platelet indices as predictive markers could have significant implications for clinical practice. These easily measurable and cost-effective parameters could potentially enhance risk stratification, allowing for more targeted interventions and monitoring strategies in patients with type 2 diabetes.

In conclusion, this study adds to the growing body of evidence suggesting that platelet indices, especially MPV, may serve as valuable tools in predicting and potentially preventing complications in patients with type 2 diabetes mellitus. These findings open up new avenues for research and may contribute to improved management strategies for this chronic condition.

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