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PLATELET INDICES - A CONCEIVABLE INDEX FOR VASCULAR INTRICACIES IN PATIENTS WITH TYPE 2 DIABETES

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ABSTRACT: -
Introduction: Diabetes mellitus (DM) is a prothrombotic condition characterized with increased inflammation and accelerated atherosclerosis. Platelet hyperactivity, a key contributor to vascular dysfunction in DM, facilitates development of microvascular occlusions and atherosclerotic plaque. Platelet indices, including plateletcrit (PCT), mean platelet volume (MPV), platelet distribution width (PDW), and platelet count, increasingly recognized as potential indicators of diabetes related vascular complications. Given the hypercoagulable state associated with diabetes, alterations in platelet indices may reflect the underlying pathophysiological changes contributing to microvascular and macrovascular complications. This study seeks to find out the role of platelet indices as potential indicators of vascular complications in diabetic patients.
Methods: An investigative study was conducted on T2DM patients, categorized into two by presence or absence of vascular complications. Platelet indices, including PCT, MPV, PDW, platelet large cell ratio (P-LCR) and platelet count, were analyzed and set side by side amongst categories.
Results: Patients with vascular complications exhibited significantly higher platelet indices compared to those without complications. A negative correlation was observed between platelet count and vascular complications, suggesting increased platelet activation and consumption. The findings indicate that alterations in platelet indices may aid to be an early hematological indicator for vascular risk-stratification in diabetic patients.
Conclusion: Platelet indices could serve as cost-effective and easily accessible markers for assessing vascular complications in DM. Unifying these parameters into everyday clinical appraisals could aggrandize the primal revelation and management of vascular compromise associated with diabetes.

INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a long-term disease marked by insulin resistance, chronic hyperglycemia, and a pro-inflammatory state. These factors collectively predispose individuals to a wide spectrum of vascular complications, including both microvascular such as retinopathy, nephropathy, and neuropathy and macrovascular like coronary artery disease, peripheral arterial disease, and stroke(1–3).

Hyperglycemia endows a central key in vascular compromise by triggering oxidative burden, endothelial dysregulation, and sustaining long-term low-grade inflammation(4). Persistent hyperglycemia promotes advanced glycation end-products that disrupt normal functioning endothelium and promote blood vessel stiffness, resultant atherosclerosis(5). Moreover, chronic inflammation in diabetes contributes to platelet activation and endothelial injury, further exacerbating vascular compromise. Additionally, insulin resistance is associated with dyslipidemia, increased thrombotic risk, and an imbalance in vasoactive factors, further predisposing diabetic individuals to vascular complications(6).

A growing evidence suggests that altered platelet function is a key contributor to the vascular complications seen in T2DM(7). Platelet hyperactivity is a key contributor to vascular dysfunction in T2DM. Platelet indices, including mean platelet volume (MPV), platelet distribution width (PDW), platelet large cell ratio (P-LCR), and platelet count, have emerged as potential biomarkers reflecting platelet activation and reactivity. Increased MPV and PDW have been associated with enriched platelet aggregation that bequeaths prothrombotic state and endothelial dysfunction, accelerating vascular compromise(8).

Several researchers found a higher MPV and PDW correlate with worsening vascular complications in T2DM, whereas a declining platelet count may indicate increased platelet consumption due to ongoing endothelial

damage(9,10). However, despite the growing body of evidence, the clinical utility of early index of platelet indices for vascular compromise is under-explored.

This study intended to appraise platelet indices as potential indicators of vascular complications in T2DM. By assessing the correlation between platelet parameters and the presence of vascular complications, we seek to determine whether these hematological markers can aid in early risk stratification and clinical decision-making.

MATERIALS AND METHODS: -

This prospective investigative research was adopted and data collected over a 1 year period at our Department of Pathology at Saveetha Medical College and Hospital. We included 140 patients with type 2 diabetes mellitus (T2DM), divided into two groups of 70 patients each with and without vascular complications. Institutional Ethics Committee approval was accomplished.

Patients diagnosed based on the American Diabetes Association (ADA) criteria(11). Demographic details, clinical history, and pertinent microvascular and/or macrovascular complications were retrieved from the archived database and recorded in a structured pro forma. The values of the following platelet indices: Platelet count (PC), Plateletcrit (PCT), Mean platelet volume (MPV), Platelet distribution width (PDW), and Platelet large cell ratio (P-LCR) were cataloged onto the pro forma.

RESULTS: -

Patient Characteristics:

The study samples consisted of 140 respondents (70 each with and without vascular complications). The majority of the patients, 60% (42/70) were within 51 - 60 years old. The age of the diabetic patients who had and who had no complications ranged from 21 years - 75 years with mean ± SD of 53.30 ± 10.04 years and 51.29 ± 8.89 years, respectively. 82 (58.6%) of the respondents were male, with an overall male to female ratio of 1.4 : 1 (Table 1).

Table 1 - Age and Gender-wise allotment of DM patients

Variable	**Category**	**DM with complications**	**DM without complications**
		No. (%)	**No. (%)**
Age (Years)	21 - 30	5 (7.1)	4 (5.7)
	31 - 40	6 (8.6)	6 (8.6)
	41 - 50	12 (17.1)	22 (31.4)
	51 - 60	19 (27.1)	23 (32.9)
	61 - 70	16 (23.0)	7 (10.0)
	71 - 75	12 (17.1)	8 (11.4)
	Mean ± SD (Yrs)	53.30 ± 10.04	51.29 ± 8.89
Gender	Male	44 (62.9)	38 (54.3)
	Female	26 (37.1)	32 (45.7)

	Total	70 (100)	70 (100)

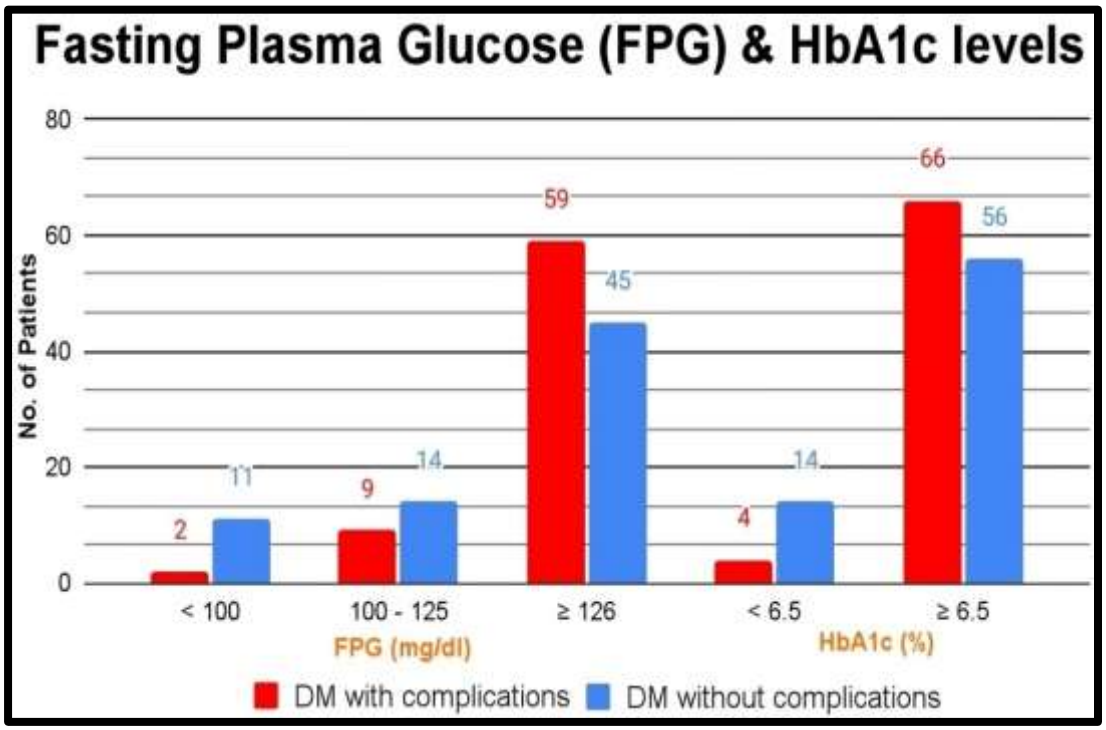
Among the 70 cases of DM with vascular complications, 82.9% (58/70) had macrovascular complications and 17.1% (12/70) had microvascular compromise. Among patients with macrovascular compromise, 51.8% (30/70) patients had cardiovascular complications, 33% (19/70) patients had peripheral arterial diseases and 15.2% (9/70) patients had cerebrovascular complications. Among patients with microvascular complications, 75% (9/70) patients had Diabetic nephropathy, 16.7% (2/70) patients had Diabetic neuropathy and 8.3% (1/70) patients had Diabetic retinopathy.

FPG and HbA1c levels of Diabetic patients with and without vascular complications:-

As depicted in figure 1, among respondents with vascular complications, 2.9% (2/70) had FPG of <100 mg/dl, 12.8% (9/70) had FPG between 100-126 mg/dl and 84.3% (59/70) had FPG ≥126 mg/dl with a mean FPG of 209.55 ± 79.67. Among the respondents without complications, 15.7% (11/70) had FPG of <100 mg/dl, 20% (14/70) had FPG between 100-126 mg/dl and 64.3% (45/70) had FPG ≥126 mg/dl with a mean FPG of 172.32 ± 79.83.

Among those with complications; 94.3% (66/70) had HbA1c levels of ≥6.5% and 5.7% (4/70) had HbA1c levels of <6.5% with a mean HbA1c level of 10.56 ± 2.0. Among DM without complications, 80% (56/70) had HbA1c levels of ≥6.5% and 20% (14/70) had HbA1c levels of <6.5% with a mean HbA1c level of 8.35 ± 2.20, as represented in figure 1 .

Figure 1 - Fasting Plasma Glucose (FPG) & HbA1c parameters of DM patients



Platelet indices:-

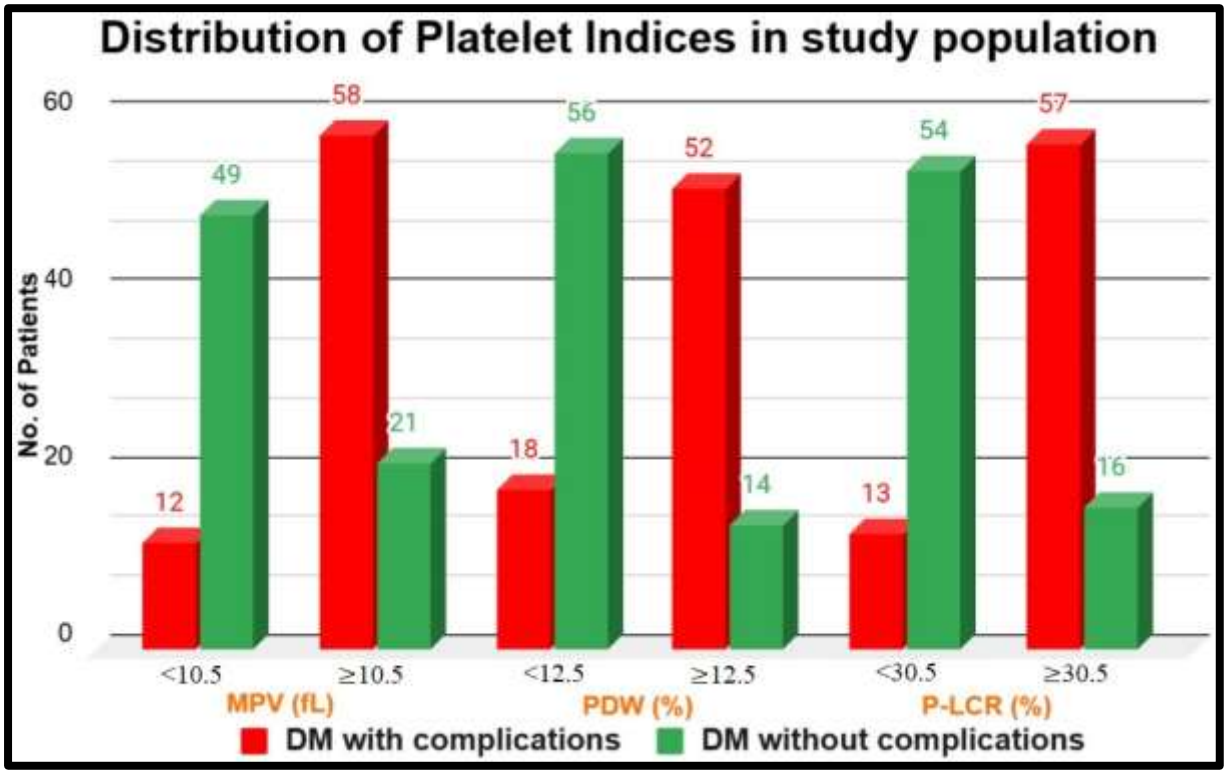
As illustrated in figure 2, among respondents with vascular complications, 82.9% (58/70) patients had a mean platelet volume of ≥10.5 fL and 17.1% (12/70) patients had an MPV of <10.5 fL with a mean MPV of 12.39 ± 1.20. Among the respondents without complications, 70% (49/70) patients had MPV of <10.5 fL and 30% (21/70) patients had MPV of ≥10.5 fL with a mean MPV of 10.16 ± 0.74.

Among the respondents with complications, 74.3% (52/70) patients had PDW of ≥12.5% and 25.7% (18/70) patients had a PDW of <12.5% with a mean PDW of 13.85 ± 2.98. Among the DM without complications,

80% (56/70) patients had PDW <12.5% and 20% (14/70) patients had PDW of ≥12.5% with a mean PDW of 11.27 ± 1.54, as portrayed in figure 2.

Among the study population with complications, 81.4% (57/70) patients had P-LCR of ≥30.5% and 18.6% (13/70) patients had a P-LCR of <30.5% with a mean P-LCR of 34.63 ± 9.37. Among the study population without complications, 77.1% (54/70) patients had P-LCR <30.5% and 22.9% (16/70) patients had P-LCR of ≥30.5% with a mean P-LCR of 25.12 ± 5.77, as displayed in figure 2.

Figure 2 - Platelet indices among DM patients



The comparative analysis of various study variables and their statistical significance, is portrayed in Table 2.

Table 2 - Comparative analysis of study variables among DM patients with and without vascular complications

Study variable	DM with complications	DM without complications	p - value
Age (Years)	53.30 ± 10.04	51.29 ± 8.89	0.05
DM Duration (Years)	14.97 ± 4.42	12.36 ± 3.04	0.448
FPG (mg/dl)	209.55 ± 79.67	172.32 ± 79.83	0.009*
HbA1c (%)	10.56 ± 2.0	8.35 ± 2.20	0.001*
MPV (fL)	12.39 ± 1.20	10.16 ± 0.74	0.0001*
PDW (%)	13.85 ± 2.98	11.27 ± 1.54	0.0001*
P-LCR (%)	34.63 ± 9.37	25.12 ± 5.77	0.0001*

** Significant*

DISCUSSION

Persistent hyperglycemia induces oxidative stress and promotes biochemical alterations that enhance platelet reactivity. This heightened platelet activity contributes to a prothrombotic environment, thereby accelerating the development of atherosclerosis and increasing the likelihood of microvascular and macrovascular complications(10). Consequently, evaluating platelet activation markers such as MPV, PDW, and P-LCR may offer valuable insights into the risk stratification and primal revelation of vascular events in diabetic patients.

In our study, diabetes mellitus epidemiologically substantially higher in males (58.6%) than females (41.4%), with male preponderance of 1.4:1, comparable to findings by Borah et al(12) and Bahendeka et al(13). The highest prevalence of diabetes in the age bracket of 51–60 years, parallel with observations made by Whardani et al(14), Koç et al(15) and Awan et al(16), whereas in disagreement with Asiimwe et al(17).

In the present research, MPV was substantially raised in those with complications (12.39 ± 1.20 versus 10.16 ± 0.74) with a statistical significance. Concordant results exist in earlier reserches(18–20). These results are in disagreement with Demirtunc et al(21) and Mowafy et al(22).

DM patients with vascular problems revealed significantly increased mean platelet distribution width (PDW), than DM patients without complications ($p < 0.05$), which aligns by work of Taderegew et al(23) and Chawla et al(19). The results are antagonistic to results with Shilpi et al(24) and Demirtas et al(25).

In current research, the mean Platelet-Large Cell Ratio (P-LCR) showed a substantial increase in DM patients with vascular complications compared to that of DM patients without complications ($p < 0.05$). The results are analogous to other similar studies(26,27). These results contradict the findings by Buch et al(28).

CONCLUSION

Diabetes mellitus is a prothrombotic disorder marked by increased inflammation with accelerated atherosclerosis. MPV, PDW, and P-LCR are key beacons of platelet activation, resulting from hyperglycemia, which triggers increased platelet activity, marking the onset of a procoagulant state that can be conveniently assessed using simple complete blood count. Due to their accessibility and low cost, these parameters serve as practical and efficient tools for predicting and monitoring vascular compromise.

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