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Original Research Article

COMPARISON OF PLATELET PARAMETERS IN SUBJECTS WITH TYPE 2 DIABETES MELLITUS AND NON-DIABETIC PATIENTS

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ABSTRACT

Background: Type 2 diabetes mellitus (T2DM) is associated with a prothrombotic state that contributes to microvascular and macrovascular complications. Platelet indices are simple and routinely available haematological parameters that may reflect platelet activation. This study aimed to compare platelet parameters in subjects with T2DM and non-diabetic controls and to assess their correlation with glycaemic control.
Materials and Methods: This cross-sectional study was conducted in the Department of Pathology from 2023 to 2025 and included 250 adults (148 T2DM patients and 102 non-diabetic controls). Glycaemic status was assessed using HbA1c. Platelet count, mean platelet volume (MPV), platelet distribution width (PDW), platelet large cell ratio (P-LCR), and plateletcrit (PCT) were analyzed using automated haematology analyzers. Group comparisons were performed using the independent Student's t-test, with one-way ANOVA applied for subgroup analysis by glycaemic control. A p-value of <0.05 was considered statistically significant.
Results: PDW was significantly elevated in patients with T2DM compared to non-diabetic controls (p=0.001), indicating increased platelet heterogeneity and activation. Other platelet parameters, including platelet count, MPV, P-LCR, and PCT, did not show statistically significant differences between the two groups (p>0.05). No significant correlation was observed between platelet indices and levels of glycaemic control among diabetic patients.
Conclusion: Platelet distribution width appears to be a significant marker of platelet activation in type 2 diabetes mellitus and may serve as a useful prognostic indicator for vascular complications.
Keywords: Type 2 diabetes mellitus; Platelet distribution width; Platelet indices.

INTRODUCTION

The World Health Organization (WHO) defines diabetes mellitus (DM) as a metabolic disorder of multiple aetiology characterized by chronic hyperglycaemia with disturbances in carbohydrate, fat, and protein metabolism resulting from defects in insulin secretion, insulin action, or both.[1] Type 2 diabetes mellitus (T2DM), which accounts for approximately 90–95% of all diabetes cases, results from progressive β-cell dysfunction on a background of insulin resistance.[2]

Diabetes mellitus represents a major global public health challenge, affecting over 285 million individuals worldwide and projected to reach 439 million adults by 2030.[3] In India, the burden is particularly high, with an estimated 77 million individuals affected in 2019, a figure expected to rise to over 134 million by 2045; notably, nearly 57% of cases remain undiagnosed.[4]

In addition to hyperglycaemia, altered platelet morphology and function play a critical role in the pathogenesis of diabetic vascular complications. Diabetes is associated with increased platelet activation, reactivity, and dysfunction, contributing to a pro-thrombotic state and increased vascular morbidity and mortality.[5] Platelets are increasingly recognized as key contributors to the development of both microvascular and macrovascular complications in diabetes.[3] Larger platelets are metabolically and enzymatically more active, contain denser granules, and possess greater thrombotic potential, making platelet size an important marker of platelet activity.[6]

Platelet indices such as mean platelet volume (MPV), platelet distribution width (PDW), and platelet large cell ratio (P-LCR) are simple, cost-effective parameters obtained from routine haematological analysis. Several studies have demonstrated increased MPV in metabolic syndrome, stroke, and diabetes, with higher values observed in patients with proliferative diabetic retinopathy.[7] Early identification of pro-thrombotic changes using platelet parameters may provide valuable insight into the risk of vascular complications in patients with type 2 diabetes mellitus.[7]

The present study aims to evaluate platelet parameters—including platelet count (PLT), mean platelet volume (MPV), platelet distribution width (PDW), platelet large cell ratio (P-LCR), and plateletcrit (PCT)—in subjects with type 2 diabetes mellitus, and to assess the correlation between platelet parameters and HbA1c levels.

MATERIALS AND METHODS

This cross-sectional study was conducted in the Department of Pathology over a period of two years (2023-2025) after approval from the Institutional Ethics Committee. The study population comprised 250 adult subjects. Inclusion criteria encompassed adults aged ≥18 years with available HbA1c and complete blood count (CBC) reports. Subjects with HbA1c values greater than 6.5% were classified as having type 2 diabetes mellitus, while those with HbA1c values less than 6% were considered non-diabetic controls. Exclusion criteria included individuals with type 1 diabetes mellitus, gestational diabetes, HbA1c values between 6.0% and 6.5%, known haematological disorders, acute infections, inflammatory conditions, malignancies, and those receiving antiplatelet or anticoagulant therapy.

HbA1c was used to assess glycaemic status and was measured using the automated analyzers. The platelet indices evaluated included platelet count (PLT), mean platelet volume (MPV), platelet distribution width (PDW), platelet large cell ratio (P-LCR), and plateletcrit (PCT).

All data was recorded in Microsoft Excel statistical analysis was done using SPSS 22.0 (trial version). Continuous variables were expressed as mean ± standard deviation. Comparisons between diabetic and non-diabetic groups were performed using appropriate parametric statistical tests. A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 250 participants were included in the study. Of these, 148 individuals (59.2%) constituted the diabetic group, while 102 individuals (40.8%) served as controls.

The HbA1c values in the diabetic group ranged from 6.6% to 15%, and in control group ranged from 4.6% to 6%. The mean HbA1c level in the diabetic group was 9.06 ± 2.04%, and in control group was 5.48 ± 0.41%. The age distribution of cases indicated diabetes seen in elderly, and gender distribution of the study participants showed male preponderance in cases with a ratio of 1:0.89 while female majority was seen in controls with a ratio of 1:1.21.

PDW was significantly higher in diabetic subjects (12.53±2.78 fL) compared to controls (11.44±2.38 fL), and this difference was statistically significant (p=0.001) [Table 1]. When cases were classified into good (HbA1c 6.6–7%), fair (7.1–8%), and poor (>8%) glycaemic control groups, no statistically significant differences were observed in platelet count, MPV, PDW, P-LCR, or PCT across the three categories (p>0.05 for all parameters).

Table 1: Comparison of platelet parameters between cases and controls

Platelet Parameters	Mean±S.D		T-test	P-value
	Cases (n=148)	Controls (n=102)		
Platelet count (lacs/µl)	2.70±1.35	2.88±1.17	-1.092	0.2
MPV (fl)	10.28±1.03	10.13±1.08	1.109	0.2
PDW (fl)	12.53±2.78	11.44±2.38	3.22	0.001
P-LCR (%)	27.37±8.02	26.05±8.77	1.23	0.2
PCT (%)	0.284±0.132	0.286±0.087	-0.14	0.8

(Independent Student's t-test applied)

DISCUSSION

Diabetes mellitus is recognized as a hypercoagulable condition due to platelet activation and altered platelet morphology, endothelial dysfunction, and chronic hyperglycaemia, which together contribute to both micro- and macro-vascular complications.[3,7] The morbidity associated with long-standing diabetes arises primarily from macrovascular and microvascular complications. Macrovascular disease accelerates atherosclerosis, increasing the risk of myocardial infarction, stroke, and peripheral vascular disease.[8] Individuals with T2DM have a two- to four-fold increased risk of thrombotic events and premature cerebral, coronary, and peripheral vascular disease.[3] Common diabetes-related complications include peripheral neuropathy, chronic kidney disease, cardiovascular disease, stable angina, and heart failure.[9] Elevated HbA1c levels are strongly associated with the development of microvascular complications such as retinopathy, nephropathy, and neuropathy.[8]

The mean age of diabetic subjects in the present study was 55.2±15 years compared to 41.19±14.7 years in controls, reflecting the increasing burden of diabetes in middle-aged adults. Comparable findings were noted by Shilpi K et al,[1] who reported a mean age of 53±5.7 years in diabetics and 54.1±5.2 years in controls, and by Swaminathan A et al,[3] who reported mean ages of 49±7.34 years and 48±6.11 years in diabetics and controls respectively. A male predominance among diabetic subjects (n=78, 53%) was observed in present study, similar to findings reported by Buch A et al,[10] (n=66% diabetic male) and Shilpi K et al,[1] (n=144, 51.43%).

The present study showed a slightly lower mean platelet count in the diabetic group (2.70±1.35 lacs/µl) compared to controls (2.88±1.17 lacs/µl), which was statistically insignificant (p=0.2). In contrast, Gokul R et al,[11] reported a higher mean platelet count in diabetics (2.81±0.93 lacs/µl) than controls (2.68±1.03 lacs/µl); p=0.61. Similarly, Swaminathan A et al,[3] observed mean platelet counts of 3.01±0.81 lacs/µl in diabetics and 2.741±0.47 lacs/µl in controls (p=0.08). In contrast, Akinsegun A et al,[12] reported a statistically significant higher mean platelet count in diabetics (2.81±0.93 lacs/µl) compared to controls (2.68±1.03 lacs/µl) with p=0.03.

MPV in present study was slightly higher in diabetics (10.28±1.03 fl) compared to controls (10.13±1.08 fl), but was statistically insignificant (p=0.6). Similar findings were reported by Gokul R et al,[11] (8.32±1.23 fl vs 8.28±0.81 fl; p=0.9). However, several studies demonstrated significantly higher MPV in diabetics, including Shilpi K et al,[1] (11.7±1.0 fl vs 11.1±1.2 fl; p=0.02), Jindal S et al,[7] (12.08±1.54 fl vs 11.42±1.40 fl; p=0.015), and Swaminathan A et al,[3] (10.2±0.77 fl vs 9.816±0.4 fl; p=0.023). In contrast, Akinsegun A et al,[12] reported a lower MPV in diabetics (8.69±0.67 fl) compared to controls (8.91±0.80 fl), though statistically insignificant (p=0.059). Joshi AA et al. [8] observed significantly lower MPV in diabetics (7.27±2.42 fl) compared to controls (10.03±1.1 fl), a finding contradictory to most other studies.

In the present study, mean PDW was significantly higher in diabetics (12.53±2.78 fl) than controls (11.44±2.38 fl), with p=0.001. Similar statistically significant elevations in PDW were reported by Joshi AA et al,[8] (16.66±2.98 fl vs 10.03±1.16 fl; p<0.00005), Shilpi K et al,[1] (14.3±2.4 fl vs 13.5±2.7 fl; p=0.022), and Jindal S et al. [7] (17.25±3.56 fl vs 15.34±3.14 fl; p=0.002). Gokul R et al,[11] also observed higher PDW in diabetics (17.22±0.75 fl) than controls (16.91±0.44 fl), though without statistical significance, which was discordant with the present study.

Mean P-LCR in present study was marginally higher in diabetics (27.37±8.02%) than controls (26.05±8.77%), though statistically significant (p=0.9). Similar non-significant findings were reported by Swaminathan A et al,[3] (p=0.46). In contrast, Jindal S et al,[7] demonstrated significantly higher P-LCR in diabetics (42.31±10.78%) compared to controls (36.93±9.47%; p=0.004). PCT did not differ significantly between diabetics (0.284±0.13%) and controls (0.286±0.08%) in the present study (p=0.1), findings consistent with Swaminathan A et al,[3] (p=0.11) and Gokul R et al,[11] (p=0.9).

In the present study, PDW is the only platelet parameter showing statistical significance. Other parameters including platelet count, MPV, P-LCR, and PCT were statistically non-significant. Most previous studies, including Shilpi et al,[1] and Jindal et al,[7] reported multiple platelet indices such as MPV, PDW, and P-LCR as statistically significant. In contrast, Gokul R et al,[11] found most platelet parameters to be statistically non-significant, while Swaminathan A et al,[3] reported only MPV as significant.

On stratification by glycaemic control, no statistically significant differences were observed in platelet count, MPV, PDW, P-LCR, or PCT across good, fair, and poor glycaemic control groups in the present study. Similar findings were reported by Swaminathan A et al,[3] for platelet count and by Reddy KS et al,[13] for MPV. However, Swaminathan A et al,[3] demonstrated a significant increase in MPV with poor glycaemic control (p=0.008). Likewise, Reddy KS et al,[13] and Swaminathan A et al,[3] reported significantly higher PDW in poorly controlled diabetics, findings that contrast with the present study. No significant association of P-LCR or PCT with glycaemic control was observed in the present study, consistent with Swaminathan A et al,[3] though Reddy KS et al,[13] reported a significant correlation for P-LCR.

CONCLUSION

The present study demonstrates that platelet distribution width shows a significant association with type 2 diabetes mellitus, suggesting its potential utility as a simple and reliable prognostic marker for assessing the risk of microvascular and macrovascular complications in diabetic patients. Other platelet parameters may also be useful as screening tools, but further studies are needed to confirm their role. The study is limited by the absence of age-, sex-, and body mass index–matched controls and by the exclusion of other components of metabolic syndrome from the analysis.

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