

Variation of platelet indices among patients with type 2 diabetes mellitus**Veena Venkatesh^{1*}, Shiva Priya R², Abinaya Sundari A³, T. M. Karthikeyan⁴, Riyana R. Thaj⁵, Manickam⁶**¹Associate Professor, Department of Pathology, KMCHHSR, Coimbatore, Tamil Nadu, India²Assistant Professor, Department of Pathology, KMCHHSR, Coimbatore, Tamil Nadu, India³Assistant Professor, Department of Pathology, KMCHHSR, Coimbatore, Tamil Nadu, India⁴Professor and Head, Department of Pathology, KMCHHSR, Coimbatore, Tamil Nadu, India⁵Postgraduate, MD(Pathology), Department of Pathology, KFMSR, Coimbatore, Tamil Nadu, India⁶Lab Technician, Department of Pathology, KMCHHSR, Coimbatore, Tamil Nadu, India

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Abstract

Diabetes Mellitus (DM) is a global pandemic disease with high prevalence as well as increased morbidity. Platelet function plays an important role in the pathogenesis of atherothrombosis in type 2 Diabetes Mellitus. Altered platelet parameters have been reported in patients with Diabetes Mellitus and have been associated with increased risk of vascular complications in these individuals. A hospital-based prospective study was conducted over a period of 12 months from January 2020 to December 2020. The study population was divided into two groups: Cases (n=200) and Controls (n=200). Detailed history, complete clinical evaluation and relevant investigations were obtained, and the results were compared. It was found that Mean Platelet Volume (MPV) and Platelet Distribution Width (PDW) were significantly increased in diabetic patients than in non-diabetic individuals. It was also observed that elevated MPV and PDW were seen in diabetic patients with complications. There was no significant difference in platelet count between the two groups. Hence, MPV and PDW are cost-effective platelet parameters which can be used as markers in predicting the vascular complications in DM.

Keywords: Diabetes Mellitus, Platelet parameters, vascular complications, HbA1C

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Introduction

Diabetes mellitus (DM) is perhaps one of the oldest known diseases with diverse terminologies. It is emerging as one of the dominant public health concerns globally with a prevalence increasing in middle and low-income countries. International Diabetes Federation (IDF) indicate that 425 million had DM in 2018 and is expected to further aggravate to 642 million by the year 2040. It is also recognized as one of four priority non-communicable diseases (NCDs). World Health Organization (WHO, 2013) devised targets with a vision of 25% reduction in mortality from NCDs by 2025. The Sustainable Development Goals (SDG) also comprised a target of one-third reduction in the premature deaths caused due to NCDs including diabetes by 2030. Especially in Asian countries like India, the unprecedented economic growth and rapid urbanization led to the transition in health concerns from communicable to NCDs[1]. Among the NCDs, DM and cardiovascular diseases are the leading health problems[1]. An alarming surge in diabetic subjects from 26 million in 1990 to 65 million in 2016 was recorded in India. The prevalence in Indian adults aged 20 years or older escalated from 5.5% in 1990 to 7.7% in 2016. The prevalence in 2016 was highest in Tamil Nadu and Kerala. Untreated type II DM (T2DM) is ultimately leading to macro vascular and micro vascular complications. It is well known that T2DM is known for its expression after 40 years of age.

However, it is now becoming more apparent in young individuals even at the age of ten. Young-onset T2DM prevalence has been reported in many countries with different ethnic and cultural backgrounds with increasing prevalence of the sedentary life style and obesity. It has more aggressive phenotype with adverse impact on quality of life augmenting the possibility of future public health catastrophe[2].

DM is a growing health problem associated with increased risk of micro vascular and macro vascular complications[3]. Diabetic patients have large platelets that are young, more reactive with increased tendency to aggregate. They contain denser granules, secrete more serotonin, betathromboglobulin and thromboxane A₂ than smaller and less active platelets. This suggests an association between the platelet functions and diabetic vascular complications. Thus, indicating changes in mean platelet volume (MPV) and platelet distribution width (PDW) reflect the state of thrombogenesis[4]. Therefore, MPV and PDW can be considered as predictive markers for vascular complications of Diabetes Mellitus. Identification of such patients can be easily made by simple routine haematological analysis which helps in easy detection of prothrombotic state of the patients. It is a cost-effective tool that could possibly benefit the diabetic patients by preventive actions as a large number suffer from preventable vascular complications. Analysing the platelet parameters can act as an alarm for diagnosing and progression of complications of DM. Hence in view of this, we studied and compared the platelet parameters in diabetic patients and healthy controls.

Materials and methods

A total of 200 subjects who were known diabetic patients and 200 control subjects who had normal blood sugar were taken in this study. The study was conducted in the Department of Pathology, KMCH Institute of Health Science and Research over a period of one year from January 2020 to December 2020 ,after obtaining approval in

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institutional ethics committee.

Inclusion criteria

1. 200 diagnosed cases of type II DM, as per guidelines of American Diabetic Association. (Diabetes is diagnosed if HbA1C is >6.5%, Fasting glucose >126mg/dl, Post Prandial glucose>200 mg/dl)
2. 200 controls with normal blood glucose levels.

Exclusion criteria

1. Male patients with Hemoglobin <12gm and female patients with hemoglobin < 10gm
2. Non diabetic subjects with coronary artery disease.
3. Subjects with any diagnosed malignancy, thrombocytopenia or thrombotic disorders.
4. Patients on anti-platelet drugs such as aspirin and clopidogrel.
5. Pregnant women

This hospital-based study was carried out fulfilling the inclusion and exclusion criteria attending either out-patient or in-patient clinic. They were compared with 200 controls who had normal blood glucose levels.

Detailed history was taken from both cases and control subjects and complete clinical evaluation was done regarding any associated macro or micro vascular complications. Relevant investigations were obtained like blood glucose levels and HbA1C levels and complete blood count analysis was done using Beckman coulter.

Values of platelet indices like Platelet Distribution Width (PDW), Mean Platelet Volume (MPV) and platelet count were noted.

Statistical analysis

Statistical analysis was performed using SPSS version 16.0.

Comparison between different groups regarding categorical variables was performed using the student's t-test and Pearson's correlation test (r value as the coefficient) and Probability (p-value).

Results

200 samples of diabetic cases and 200 samples of non-diabetic healthy controls were studied. We studied age distribution and platelet parameters.

Platelet parameters such as MPV, PDW and Platelet count were studied in

- a) Diabetic cases and non-diabetic healthy controls
- b) Diabetics under glycemc control (Group A) and not under glycemc control (Group B)
- c) Diabetics with complications (Group C) and without complications (Group D)

In this study, among the diabetics, 3 patients were less than 40 years, 28 patients were between 41 and 50 years, 45 patients were between 51 and 60 years and 24 cases were above 60 years. Among the control population, 12 individuals were below 40 years, 36 individuals were between 41 and 50 years, 45 individuals were 51 - 60 years and 7 individuals were above 60 years. (Figure 1)

It is observed that the median MPV (mean platelet volume) among the diabetic population was 15fl and it is found to be increased than the median MPV among the control population which was 9fl (Figure 2). 76% of diabetic patients in the study had increased median platelet volume and 24% of diabetic patient had median platelet volume within normal range where as 19% of control population had increased mean platelet volume and 81% of control population had mean platelet volume within normal range. There was a statistically significant difference of between diabetic and non-diabetic population. (p < 0.001)

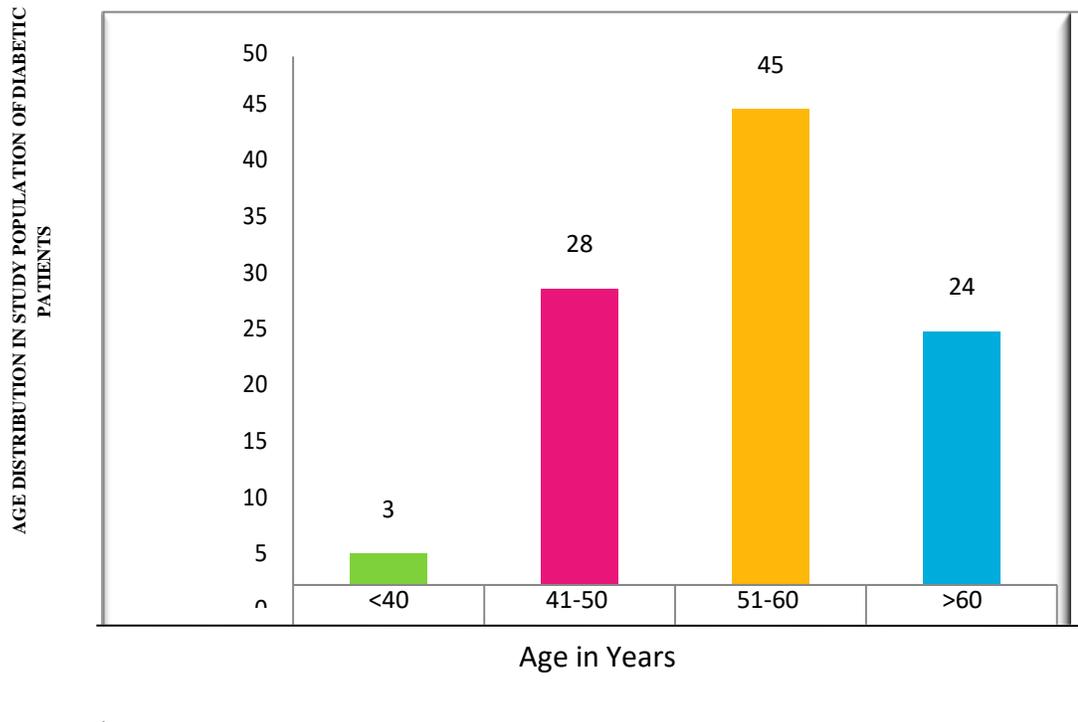


Fig 1:Age distribution in study population of diabetic patients

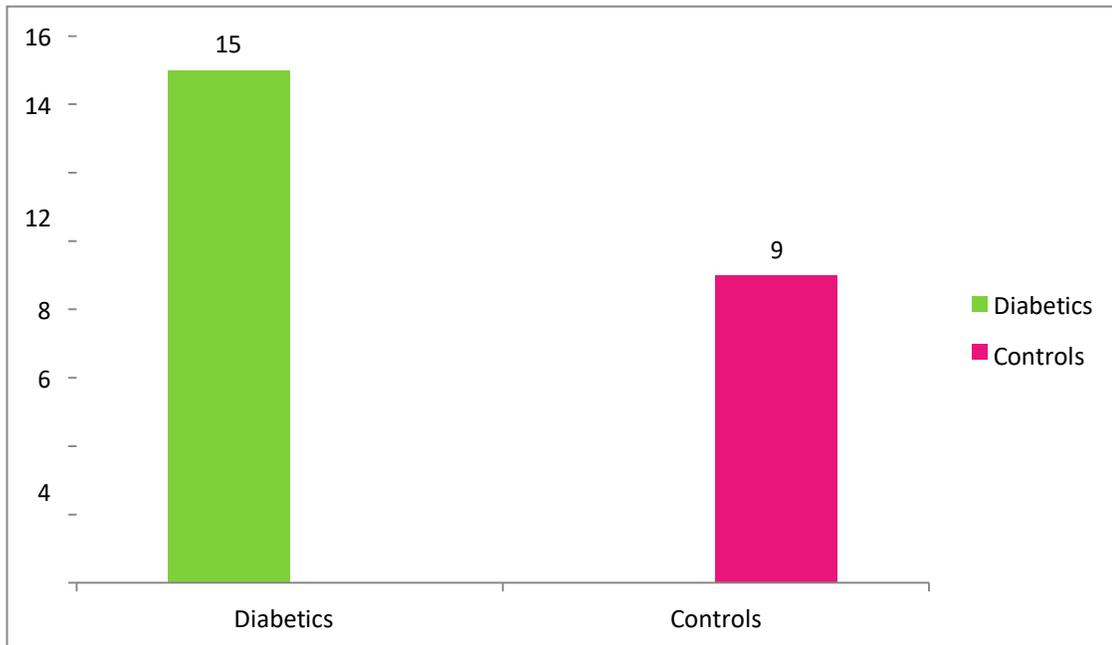


Fig 2: Comparison of median values of MPV between diabetic cases and non-diabetic controls

The median platelet distribution width (PDW) was reported to be higher in diabetic population (21%) when compared to the median platelet distribution width in control population (11%) (Figure 3). The platelet distribution width was found to be increased in diabetic population than non-diabetic and there was a statistically significant difference between them. ($p < 0.001$).

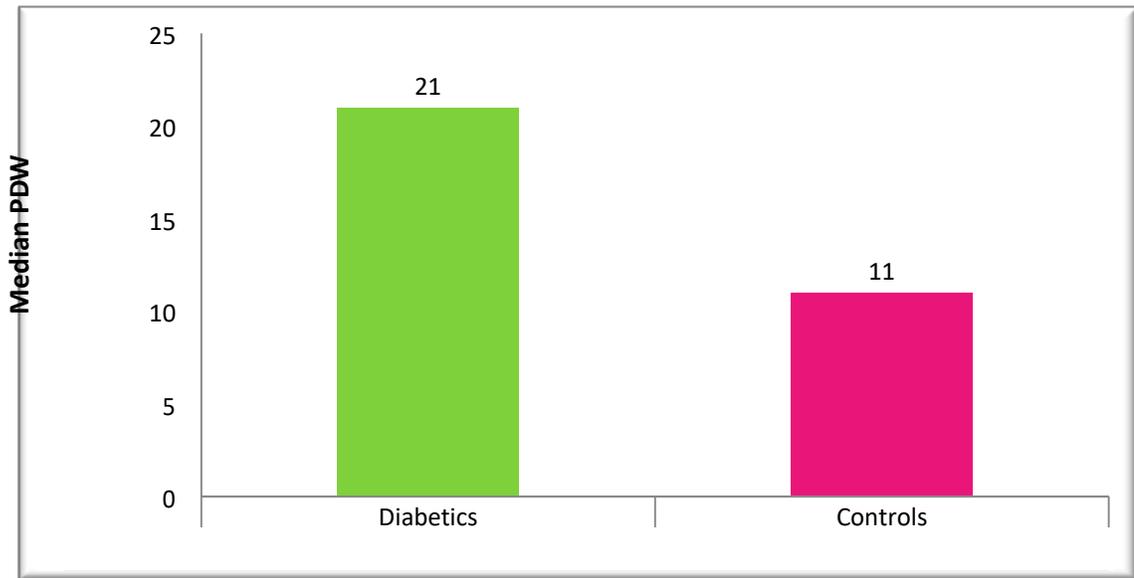


Fig 3: Comparison of median PDW values between diabetics and controls

Median platelet count of diabetic population was $2.66 \times 10^9/L$ and that of normal. Among the diabetic population, 7% had decreased platelet count, 90% had normal platelet count and 3% had increased platelet count. In case of normal healthy individuals, 1% had decreased platelet count, 97% had normal platelet count and 2% had increased platelet count. There was no statistically significant difference of platelet count between diabetics and non-diabetic individuals. ($p = 0.207$) Platelet parameters were compared between diabetics and healthy controls and statistically significant difference of MPV and PDW values were obtained. (Table 1).

Table 1: Comparison of Median values of platelet parameters between diabetic cases and non-diabetic controls

PARAMETERS	GROUP	NUMBER	MEDIAN	p VALUE
MPV (fl)	Cases	200	15.0	<0.001
	Controls	200	9.0	
PDW (%)	Cases	200	21.0	<0.001
	Controls	200	11.0	
PLATELET COUNT (x10 ⁹ /L)	Cases	200	2.77	0.207
	Controls	200	2.60	

Diabetic patients were divided into two groups based on HbA1C levels (glycemic control):

Group A: Diabetics under glycemic control (HbA1C < 6.5) - 33%

Group B: Diabetics not under glycemic control. (HbA1C ≥ 6.5) - 67%

Patients with complications were categorized as group C and without complications were categorized as group D.

The mean value of mean platelet volume in Group C (14.2) was found to be higher than the mean platelet volume in Group D (9.5fl).

Among group C patients, 96% were found to have increased mean platelet volume and 3% had normal mean platelet volume. Among group D patients, 67% had increased mean platelet volume and 33% had normal mean platelet volume. There was a statistically significant difference between the two-population group C and group D (p<0.001).

The mean platelet count in Group C patients was 2.45x10⁹/L and it was found to be little decreased than the mean platelet counts in Group D (2.66x10⁹/L). There was no statistically significant difference of platelet count between Group C and Group D (p= 0.244).

Platelet parameters are compared between Group C and Group D. (Table 2). A statistically significant difference of MPV and PDW values are obtained.

Table 2: Comparison of platelet parameters between diabetics with and without complications

PARAMETERS	COMPLICATIONS	MEDIAN	p VALUE
MPV (fl)	PRESENT (group C)	14.2	<0.0001
	ABSENT (group D)	9.55	
PDW (%)	PRESENT (group C)	18.6	<0.001
	ABSENT (group D)	11.8	
PLATELET COUNT(x10 ⁹ /L)	PRESENT (group C)	2.45	0.244
	ABSENT (group D)	2.66	

Discussion

Diabetes Mellitus (DM) refers to a group of common metabolic disorders which share the phenotype of hyperglycemia. The etiology of DM includes reduced insulin secretion and decreased glucose utilization. The metabolic dysregulation associated with DM causes secondary pathophysiologic changes in multiple organ systems which impose a tremendous burden on the individual with DM and on the health care system[5].

The common feature in all the complications of diabetes is vasculopathy both "micro" and "macro", characterized by progressive narrowing of lumen as well as abnormal permeability to proteins[6]. Macro and microvascular diseases are currently the principal causes of morbidity and mortality in patients with type I and type II DM. Loss of the modulatory role of the endothelium may be an initiating and a critical factor in the development of diabetic vascular disease[7].

In our study, platelet parameters such as mean platelet volume (MPV), platelet distribution width (PDW) and platelet count were compared between diabetic population and normal healthy individuals. Platelet volume is a marker of the platelet function and activation. Platelet distribution width (PDW) is an indicator of the distribution of platelet size and also a marker of platelet activation.

In our study, the median platelet volume values were higher in diabetic patients as compared to non-diabetic population and there was a statistically significant difference between diabetic and non-diabetic population. (p < 0.001). Same observations were found in the study conducted by Buchet al[8], Bhattacharjee et al[9], Yilmaz et al[10], Dermatas et al[11], Gupta AV et al[12] which revealed that mean platelet volume was significantly raised in diabetics than non-diabetic healthy individuals.

In our study, median platelet distribution width levels were higher in diabetic population when compared with non-diabetic subjects. There was a statistically significant difference between diabetic population and non-diabetic healthy controls (p <0.001). Observation in our study correlated with study conducted by Alhadaset al[13], Jabeen et al[14], Buch et al[8].

There was no statistically significant difference of platelet count between diabetic and non-diabetic healthy individuals (p=0.207) in this study. Similar results were found in the study done by Buchet al[8], Yilmaz et al[10], Jabeen et al[14] and Kodiattae et al[15].

In our study, there was a statistically significant differences of median platelet volume between diabetics with and without complications. (p <0.001). Similar higher values of mean platelet volume were seen in the study done by Papanas et al¹⁶ and Buch et al[8].

There was also a significant differences of mean platelet distribution width between diabetics with and without complications in our study (p <0.001). Similar results were observed in the study done by Buchet et al[8].

In case of platelet count there was no significant difference in our study and similar finding was seen in the study conducted by Dermatas et al[11].

Conclusion

Platelet parameters such as Mean Platelet Volume (MPV), Platelet Distribution Width (PDW) and Platelet count were compared between 200 diabetic cases and 200 non diabetic healthy controls. It was found that median Platelet Volume and Platelet Distribution Width were significantly increased in diabetic patients than non-diabetic healthy individuals. Similarly, elevated MPV and PDW were seen in diabetic patients with complications compared to diabetic patients without

complications. Mean Platelet Volume and platelet distribution width are indicators of platelet activity. Increased MPV and PDW are associated with increased risk of thrombotic events leading to vascular complications of diabetes mellitus. Our study indicates that Mean Platelet Volume (MPV) and Platelet Distribution Width (PDW) are increased in diabetic patients and they can be used as a cost-effective marker in predicting the vascular complications in diabetes mellitus.

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