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RESEARCH ARTICLE

Evaluation of mean platelet volume and other platelet parameters in subjects with Type-2 diabetes mellitus

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ABSTRACT

Background: Diabetes mellitus (DM) is a global health problem with increased risk of vascular disease. Platelets may contribute to the development of vascular complications in subjects with diabetes. Larger platelets are more reactive than smaller ones; therefore, mean platelet volume (MPV) can be used as a marker for platelet activity. **Aim and Objectives:** To compare the platelet parameters between diabetics and non-diabetics and to determine the effect of glycemic control and duration of diabetes on platelet parameters. **Materials and Methods:** This cross-sectional study involved 100 Type-2 diabetic patients attending the Diabetology Outpatient Department of SRM Medical College Hospital and Research Centre aged between 30 and 60 years and 100 age-matched non-diabetic subjects as controls. Subjects with acute illness, those on antiplatelet medications and smokers were excluded. After history taking and clinical examination, glycosylated hemoglobin (HbA1c), fasting and postprandial blood glucose levels, platelet parameters such as platelet count, platelet distribution width (PDW), MPV, platelet-large cell ratio, and plateletcrit were determined. **Results:** MPV was significantly increased among diabetics when compared to non-diabetics. MPV and PDW showed a significant increase in diabetics with HbA1c >7%, and MPV was increased in diabetics with >10 years duration of diabetes. **Conclusion:** MPV was found to be higher in subjects with Type-2 diabetes and significantly increased in diabetics with poor glycemic control and having a longer duration of diabetes. MPV can be used as a prognostic marker of vascular complications in patients with DM.

KEY WORDS: Type-2 Diabetes Mellitus; Mean Platelet Volume; Glycosylated Hemoglobin

INTRODUCTION

Diabetes mellitus (DM) is a metabolic disorder that affects more than 285 million people in the world and an estimated 439 million adults by 2030.[1] The risk of premature cerebral, coronary, and peripheral vascular disease and thrombotic events in subjects with Type-2 DM is increased 2- to 4-fold, and these vascular lesions can be life-threatening.[2]

In addition to cardiovascular disease, the prognosis of the patients with diabetes during major ischemic vascular events is poorer when compared to the non-diabetic. In the diabetics, the balanced normal hemostasis is shifted to favor thrombosis. Platelets from subjects with diabetes show hyper-reactivity (i.e., easily triggered by a stimulus) which may play a pivotal role in the development of diabetic complications.[3] Mean platelet volume (MPV) is a reliable index of platelet size. MPV correlates well with the functional status of platelets. It can be used as an emerging risk marker of platelet activation. An increased MPV, which is an indicator of hyper-reactive platelets, may result from an increased platelet turnover. It

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may, therefore, represent a risk factor for overall vascular mortality such as myocardial infarction. Some studies have reported the relationship between MPV and DM. The MPV can be measured by hematology analyzers. The aim of our study was to compare the platelet parameters between the subjects with diabetes and controls and to determine the effect of glycemic status and the duration of diabetes on the platelet parameters.

MATERIALS AND METHODS

In this cross-sectional study, we included 100 subjects with Type 2 diabetes mellitus as study group and 100 non-diabetic subjects as controls, all in the age range of 30-60 years. The subjects were recruited from the Diabetology Outpatient Department, Medicine Department and Master Health Checkup scheme, SRM Medical College and Hospital. Institutional Ethical Committee approval and permission obtained. Written informed consent was obtained from all the subjects. All the subjects underwent a complete clinical examination. The height and weight of the subjects were recorded. Subjects suffering from coagulation disorder, hyperlipidemia, hypertension, peripheral vascular disease, chronic renal disease, any debilitating illness, those who are on antiplatelet medications and those with the habit of smoking, tobacco chewing, and alcohol intake were excluded from the study.

After an overnight fasting, the following tests were undertaken: Blood pressure examination to rule out hypertension, estimation of the serum lipid profile to rule out hyperlipidemia, evaluation of the fasting, postprandial blood glucose levels, glycosylated hemoglobin (HbA1c), and platelet parameters such as platelet count (PLT), plateletcrit (PCT), MPV, platelet distribution width (PDW), and platelet-large cell ratio (P-LCR) were estimated using Sysmex II Autoanalyzer. MPV was calculated by the following formula: MPV (fL) = [(PCT (%)/platelet count ($\times 10^9$/l)] $\times$ 10^5. PCT was the ratio of the platelet volume to the whole blood volume. PDW and P-LCR were analyzed from a histogram of platelet size distribution. The distribution width at the level of 20% (the peak of the histogram is 100%) was defined as PDW, and the percentage of platelets with a size of more than 12 fL was defined as P-LCR.[4]

To assess the relationship between glycemic control and platelet parameters, the diabetic subjects were divided into two groups according to their HbA1c levels: With HbA1c levels ≤7% (n = 56) and with HbA1c levels >7% (n = 44). We selected this cutoff point because it is usually selected in clinical practice to discriminate between appropriate and inappropriate control.[5]

To determine the effect of duration of diabetes on platelet parameters, the diabetic subjects were divided into two subgroups: One with diabetes duration <10 years (n = 61) and another group with diabetes duration >10 years (n = 11).

All the results of laboratory investigations were loaded in computerized SPSS 16 programer, and statistical significance was analyzed by unpaired Student's *t*-test. Results were expressed as mean ± standard deviation. The $P < 0.05$ has been considered as significant.

RESULTS

The anthropometric parameters between controls (Group I) and diabetics (Group II) were compared and shown in Table 1. Table 1 shows that there is no significant difference between the two groups. Table 2 compares the platelet parameters between the two groups and shows a statistically significant increase in MPV in diabetics. Table 3 compares the platelet parameters between the diabetics with HbA1c ≤7 and HbA1c >7 and shows that the MPV and PDW were significantly increased in diabetics with HbA1c >7. Table 4 compares the platelet parameters between the diabetics with diabetic duration ≤10 years and those with diabetic duration >10 years and shows that MPV was significantly increased in diabetics with duration of the disease >10 years.

Table 1: Comparison of physical characteristics between controls and diabetics

Variables	Group I control (n=100)	Group II diabetics (n=100)	*t* value	*P* value
Age (years)	48.1±6.116	49±7.34	0.956	0.34
Height (m)	1.65±0.11	1.66±0.13	1.812	0.072
Weight (kg)	63.4±8.8	64.4±11.5	1.82	0.07
BMI	23.51±3.2	23.7±3.37	0.101	0.9204

Statistically significant. SD: Standard deviation, BMI: Body mass index

Table 2: Comparison of platelet parameters between controls and diabetics

Platelet parameters	Mean±SD		*t* value	*P* value
	Group I controls (n=100)	Group II DM (n=100)		
PLT	2.741±0.47	3.010±0.81	1.748	0.0837
PDW	11.729±0.86	11.988±1.78	0.682	0.496
MPV	9.816±0.4	10.2±0.77	2.299	0.023*
P-LCR	25.50±2.98	26.366±5.43	0.730	0.46
PCT	0.27±0.04	0.294±0.07	1.586	0.11

*Statistically significant. SD: Standard deviation, PLT: Platelet count, PDW: Platelet distribution width, MPV: Mean platelet volume, P-LCR: Platelet-large cell ratio, PCT: Plateletcrit, DM: Diabetes mellitus

Table 3: Comparison of platelet parameters between diabetics with HbA1c ≤7 and HbA1c >7

Platelet parameters	Mean±SD		*t* value	*P* value
	Diabetics with HbA1c ≤7 (*n*=56)	Diabetics with HbA1c >7 (*n*=44)		
PLT	2.92±0.79	3.09±0.84	−0.83	0.41
PDW	11.37±1.01	12.42±1.48	−2.67	0.01*
MPV	10.01±0.70	10.54±0.85	−2.73	0.008*
P-LCR	26.04±5.14	26.73±5.74	0.49	0.62
PCT	0.29±0.06	0.3±0.09	−0.57	0.56

*Statistically significant. SD: Standard deviation, PLT: Platelet count, PDW: Platelet distribution width, MPV: Mean platelet volume, P-LCR: Platelet-large cell ratio, PCT: Plateletcrit

Table 4: Comparison of platelet parameters between diabetics with diabetic duration ≤10 years and >10 years

Platelet parameters	Mean±SD		*t* value	*P* value
	Duration of diabetes ≤10 years (*n*=61)	Duration of diabetes >10 years (*n*=39)		
PLT	2.88±0.83	2.93±0.79	−0.19	0.85
PDW	11.56±1.33	12.27±1.62	−1051	0.13
MPV	10.20±0.76	10.65±0.7	−2.09	0.04*
P-LCR	27.14±4.68	27.28±5.94	0.55	0.58
PCT	0.28±0.06	0.30±0.08	−0.75	0.45

*Statistically significant. SD: Standard deviation, PLT: Platelet count, PDW: Platelet distribution width, MPV: Mean platelet volume, P-LCR: Platelet-large cell ratio, PCT: Plateletcrit

DISCUSSION

In our study, we compared platelet parameters between 100 diabetic subjects and 100 non-diabetic controls. Table 1 shows that there is no significant difference in the anthropometric data between the two groups, and the two groups were comparable. Our study has several important findings. Table 2 shows that all the platelet parameters were increased in Group II (diabetics) when compared to the controls, but only the increase in MPV in the diabetics was statistically significant. The results of our study were consistent with results of Kodiatte et al.,[6] Papanas et al.,[7] Sharpe and Trinick,[8] etc.

In our study, the mean platelet count in the diabetic group was higher than the non-diabetic group but not statistically significant, but in the study by Demirtunc et al.,[9] the mean platelet count in the diabetic group was significantly higher than that of the non-diabetic group.

In our study, MPV and PDW were significantly higher in the diabetics with HbA1c >7% when compared to diabetics with HbA1c ≤7% as shown in Table 3. This agreed with the findings of the studies done by Kodiatte et al.[6] and Zuberi et al.[10]

The larger platelets being hyper-reactive produce more prothrombotic factors. Platelet activation causes changes in platelet morphology and formation of pseudopodia. The enlarged platelets with lots of pseudopodia differ in the size, possibly affecting the platelet distribution. In our study, there is a significant increase in both MPV and PDW in diabetic subjects with poor glycemic control which shows platelet hyperactivity. Our results are similar to the results of Jindal et al.[11] According to Bancroft et al.,[12] these changes in platelet show a disturbed hemostatic system and prothrombotic state in DM.

Due to hyperglycemia, the proteins on the surface of the platelets undergo non-enzymatic glycation which decreases platelet membrane fluidity and increases platelet reactivity.[13] In hyperglycemic conditions, the osmotic effect of glucose can also increase platelet reactivity.[14] There is increased expression of the surface glycoproteins Ib and IIb/IIIa in subjects with diabetes which mediate platelet adhesion and adherence and studies have shown that the expression of these adhesion proteins correlates with hyperglycemia indicated by HbA1c levels.[15] Furthermore, hyperglycemia increases the production of glycoproteins by megakaryocytes and promotes platelet activity.[16]

We also found that the MPV was significantly increased in diabetics with diabetic duration >10 years as shown in Table 4 which was in contrast to study result of Kodiatte et al., who showed no association between MPV and duration of diabetes. Yenigün et al.[17] found increased MPV in diabetics but no association between MPV and HbA1c, fasting blood glucose, patient age, and duration of diabetes.

In patients with Type-2 diabetes, the diabetic duration is independently associated with the risk of macrovascular and microvascular complications.[18] Yeom et al.[19] had found that

the longer diabetic duration causes endothelial dysfunction resulting in high platelet aggregation and variations in hemorheological properties.

Poor glycemic control and longer duration of DM may lead to increased morbidities and mortalities in DM and studies[9,20] have shown that glycemic control may prevent or delay possible diabetic vascular complications by improving platelet activity and function. Thus, MPV can be used as a useful prognostic marker and a simple, economical tool to monitor the progression and control of DM and thus in preventing complications in primary health care.

CONCLUSION

Our study shows increased MPV in subjects with diabetes when compared with non-diabetics and that an increase in HbA1c concentration, which indicates poor glycemic control, was accompanied by increased MPV and PDW values. Longer duration of diabetes also increases the MPV. As the diabetic subjects have higher baseline platelet reactivity, assessment of MPV, a simple and cost-effective laboratory test would be a useful prognostic marker of cardiovascular complications in diabetes and thereby help hold the morbidity and mortality.

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