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Original research article

Association of mean platelet volume between diabetic and non-diabetic patients

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Abstract

Background: Platelet function plays an important role in the pathogenesis of atherothrombotic 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.

Aim: Association of the mean platelets volume (MPV) with type 2 diabetics and non-diabetics population in our areas.

Materials and Methods: This case-control study was conducted on 150 Type 2 diabetics and 150 non-diabetics participants. Detailed history and examination of the entire participant was done. Platelets counts, MPV, Fasting blood glucose (FBS), post prandial blood sugar (PPBS), HbA1c was calculated by using automated cell counter and biochemistry analyzer.

Results: Mean platelet volume was significantly (p<0.05). Higher in diabetic participants as compared to non-diabetic and also high in those which HbA1c level >6.5% as compared to HbA1c<6.5%. Platelet count was decreased in diabetics group. MPV was significantly associated with the FBS and PPBS levels. No significant association was found between MPV and duration of diabetes mellitus.

Conclusion: MPV was significant associated with the diabetes mellitus (mainly in poor glycemic control) and predictive biomarkers of diabetic vascular complications.

Keywords: Diabetes, platelet counts, mean platelet volume, FBS, PPBS

Introduction

Diabetes mellitus (DM) is a complex metabolic disorder characterized by hyperglycemia. It is a major public health problem globally [1]. DM causes micro vascular and macro vascular complications, the micro vascular complications are Diabetic neuropathy, nephropathy and retinopathy. The macrovascular complications are cerebrovascular disease; cardiovascular disease and peripheral vascular disease [2]. The prevalence of the complications was depending on hyperglycemia and duration of diabetes mellitus, more in patients with poor glycemic control [3]. Platelets play a major role in homeostasis. Platelets seal the vascular defect by forming primary plug thus required phospholipid surface for the recruitment and activation of coagulation factors. In response to stimuli from the endothelium, platelets change shape, adhere to sub endothelial surfaces, secrete the contents of intracellular organelles, and aggregate to form a thrombus. Thus, platelets may assume an important role in signaling of the development of advanced atherosclerosis in diabetes [4] Platelet volume, a marker of the platelet function and activation is measured as mean platelet volume (MPV) by hematology analyzers. Platelets express procoagulant proteins such as P-select in and glycoprotein IIIa on their surfaces [5]. Mean platelet volume (MPV) reflects the average size of platelets present in a person's blood sample [6]. It is found that hyperglycemia causes larger platelets. Larger platelets have higher MPV. Hence increased mean platelet volume (MPV) and platelet distribution width (PDW) might be associated with increased thrombotic potential [7] Increased MPV plays a role in myocardial infarction, thromboembolism, and stroke. The prevalence of cardiovascular complication in type 2 DM may be associated with HbA1c and MPV. In patients with diabetes, MPV was found higher when compared to normal glycemic controls [8].

Platelet function is of path physiological importance in atherothrombotic disease and there is strong support for platelet dysfunction with platelet hyper reactivity in both type 1 and type 2 DM. Platelets play a key role in the development of diabetic angiopathy [9].

Objective of the our study to determine the MPV in diabetics compared to non-diabetics

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Materials and Methods

This was a cross-sectional and prospective study carried out in collaboration with the department of pathology and biochemistry in government medical college, datia, India. A total of 300 participants, 150 were previously diagnosed type 2 diabetic and 150 was non diabetic were enrolled in our study. Blood samples were collected from all the participants in the pathology and biochemistry department and investigated for fasting blood sugar (FBS), postprandial blood sugar (PPBS), HbA1c, and MPV (from complete blood count [CBC]) CBC was done by automated hematology analyzer. FBS and PPBS were done by automated bio-analyzer method and HbA1c by liquid chromatography. The study participants was categorized into two groups, i.e. diabetic and non-diabetic using their blood glucose parameters. All the subjects underwent a complete clinical examination. The height and weight of the subjects were recorded.

Inclusion criteria

- **Group A:** Patients already diagnosed with Type 2 DM.
- **Group B:** Non-diabetic patients without known coronary artery disease, cerebrovascular disease, and peripheral vascular disease.
- Age between 20-80yrs

Exclusion criteria

- Age below 20 and more than 80yrs.
- Male patients with hemoglobin below 13g% and female patients below 12g% (nutritional anemias can increased MPV).
- Patients with abnormal haematocrit and/or abnormal white blood cell count and/or abnormal platelet number or any coagulation disorder or any malignancy.
- Non-diabetics with coronary artery disease, Cerebrovascular disease, peripheral vascular disease and diabetics on antiplatelets drugs like aspirin and clopidogrel.

Statistical analysis

Written informed consent was obtained from all the subjects. The data was expressed as Mean ± and p value was derived and a value ≤ 0.05 was considered significant.

Results

A total of 300 study participants were included after meeting the inclusion and exclusion criteria. The study participant included two groups; one was diabetic (150) and other non-diabetic group (150). The mean age of the diabetic group was 47.5±8.63 whereas in non-diabetics group 45.37±9.27. Among 150 diabetic patients 81 (54%) were male and 69 (46%) were female, whereas among non-diabetic group 78 (52%) were male and 72 (48%) were female. The mean BMI in the diabetics was 25.05±6.36 kg/ m2, whereas it was 22.57±4.28 kg/m2 in non-diabetics. The mean FBS was 146.49±42.61mg/dl and PPBS was 249.6±82.27 mg/dl in diabetic group whereas among non- diabetic the mean FBS was 83.71±10.73 mg/dl and mean PPBS was 148.43±27.24 mg/dl. Among the diabetic group mean HbA1c was 8.75±2.6% whereas it was 5.60±0.57 in non-diabetic. The mean platelet count was 254±0.7× 10^9/L and the mean platelet volume was 9.89±1.28 fl in diabetic group whereas MPC was 261±0.9× 10^9/L and MPV was 8.82±1.15 fl in non-diabetic group [Table: 1].

Table 1: Comparison of various parameters between the diabetic and non-diabetic group

Characteristic	Diabetic group (N=150)	Non-diabetic group (N=150)	p-value
Mean Age (years)	47.5±8.63	45.37±9.27	
Male (%)	81 (54%)	78 (52%)	>0.05
Female (%)	69 (46%)	72 (48%)	
BMI (kg/m^2)	25.05±6.36	22.57±4.28	>0.05
FBS (mg/dl)	146.49±42.61	83.71±10.73	< 0.05
PPBS (mg/dl)	249.60±82.27	148.43±27.24	< 0.05
HbA1c (%)	8.75±2.56	5.60±0.57	< 0.05
MPV (fl)	9.89±1.28	8.82±1.15	< 0.05
MPC (× 109/L)	254±0.7	261±0.9	> 0.05

MPV: Mean platelet volume, FBS: Fasting blood sugar, PPBS: Postprandial blood sugar, BMI: Body mass index, HbA1c: Glycated hemoglobin.

Among the diabetic subjects, a positive statistical correlation was seen between MPV and HbA1c levels (p<0.001), FBS levels (p<0.001) and PPBS levels (p=0.002). However, no statistical correlation was seen between MPV and the duration of DM & BMI [Table 2].

Table 2: Correlation of MPV to the various parameters studied

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Characteristic	Parameter	p-value
MPV (fl)	Duration of DM	0.42
MPV (fl)	BMI	0.36
MPV (fl)	HbA1c	< 0.05
MPV (fl)	FBS	< 0.05
MPV (fl)	PPBS	< 0.05

We also divided the diabetic group based on the HbA1c levels into group A (HbA1c < 6.5%) and group B (HbA1c ≥ 6.5%). Out of 150 DM patients, there were 25 patients in group A and 125 patients in group B. The mean BMI in group A (23.1±2.89 kg/m2) was significantly lower than that of group B (25.19±4.2 kg/m2; p=0.026). The mean FBS level in group A was 83.13±18.16 mg/dL while that of group B was 161.7±72.31 mg/dL (p<0.005). The mean platelet count in group A (290.11±66 × 109/L) was higher than that of group B (276.1±84 × 109/L) but was not statistically significant. The mean MPV in group A (7.89±0.69 fl) was significantly lower than group B (8.15±0.73 fl; p=0.005) [table: 3].

Table 3: Comparison of diabetic study population between group A and group B

Characteristic	Diabetic Population		p-value
	Group A (HbA1c<6.5%)	Group B (HbA1c>6.5%)	
Total patients	25	125	—
MPV(fl)	7.89±0.69	8.15±0.73	0.005
BMI (kg/m2)	23.1±2.89	25.19±4.2	0.026
Platelets ($X10^9$/L)	290.11±66	276.1±84	0.41
HbA1c	6.58±0.41	9.13±3.1	—
FBS(mg/dl)	83.13±18.16	161.7±72.31	< 0.005
PPBS(mg/dl)	149.9±46.8	270.1±89.11	< 0.005

Discussion

In our study, we compared platelet parameters between diabetic and non-diabetic subjects.

The mean age in the diabetic group was 47.5 ± 8.63 years and 45.37±9.27 years in the non-diabetic group; concordance with the Goyal, *et al.* [10] observed mean age in the diabetic group was 49±7.34 years and 48.1±6.116 years among non-diabetic group. Akinsegun, *et al.* [11] reported higher mean age in diabetics (62.35 ± 9.84 years) but lower age in non-diabetic (32.38 ± 66.44 years) than the present study

Male: female distribution was 54% and 46% in the diabetic group and 52%, 48% in the non- diabetic group (statistically no significant difference), slightly male predominance was noted in both the groups, comparable with the Kodiatte *et al.* [12] also reported male predominance in both the group, in contrast to that Pradhan, *et al.* [13] found female predominance in diabetic group and male predominance in non-diabetic group.

In present study no significant difference of BMI was observed in both the groups, which was similar to the Anandhalakshmi, *et al.* [14], dissimilar to that Ravindra MK, *et al.* [15] observed significant difference in BMI of both group

In our study statistically significant difference was noted in Fasting blood sugar and Post prandial blood sugar of the diabetic and non-diabetic groups (P value <0.05), accordance to the Rabbani S *et al.* [16] and Ashim Manta *et al.* [17].

There was no statistically significant difference found in the Mean platelets counts (MPC) of diabetic and non-diabetic group (p>0.05), concordance with the study conducted by Bayoumi M, *et al.* [18].

We found that platelet count was decreased in diabetic patients as compared to non-diabetic group, similar finding also reported by Buch, *et al.* [19].

The current study shows that the MPV values were significantly increased in diabetic patients when compared to non-diabetic participants (p-value <0.05) which coincides with the results of other researchers Abhijeet S, *et al.* [20], Prasad, *et al.* [21] Venkatesh, *et al.* [22] and Umarani MK, *et al.* [23].

In our study, MPV was significantly higher in diabetics with HbA1c levels > 6.5% than in diabetics with HbA1c levels < 6.5%. There was also a significant association between HbA1c and MPV (Mean platelet volume was higher in uncontrolled diabetes), which was also observed in the studies done by Madhavan K, *et al.* [24], Patidar, *et al.* [25], Dubey I, *et al.* [26] and Agarwal K *et al.* [27].

MPV in the present study was not associated with duration of diabetes and Body mass index our findings are similar to the Zubair Hasan, *et al.* [28] and Yenigün, *et al.* [29].

A significant positive relationship between the MPV and glycemic control (FBS/PPBS) was observed in the present study, comparable to the TR Prabhu, *et al.* [30] and Shah, *et al.* [31].

Conclusion

Mean platelet volume in diabetic mellitus type 2 patients was significantly higher than non-diabetic group. We also found that the mean platelet volume in uncontrolled diabetic group (HbA1c > 6.5%) was significantly higher than controlled diabetic group (HbA1c < 6.5%). Hence MPV along with HbA1c can be a useful diagnostic test as well as prognostic marker of early detection of vascular complications in

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diabetic patients.

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