

A Study on Mean Platelet Volume (MPV) in Patient with Type 2 Diabetes Mellitus and its Relation with Microvascular Complications and HbA1c Level

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Abstract: Vascular complications are one of the important causes of morbidity and mortality in type 2 diabetes mellitus. Platelets have a major role in development of these vascular complications. Platelet activity is found to be increased in cases of diabetes. Platelet index, MPV is an indicator of platelet activity and size. The aim of our study is to find out the role of platelet activity in diabetes and its relation to vascular complications by measuring the mean platelet volume in diabetics and comparing with that of non diabetics and its correlation with HbA1c, FBS, PPBS, LDL, HDL, TG, TC and duration of diabetes. An institutional study was conducted comprising of 210 diabetics study group and 210 non diabetic age and sex matched control group. The study group was divided into two groups, with and without vascular complications. The counts were done in anticoagulated blood using automated hematology analyser (Sysmex XT 2000i). The mean platelet volume was found to be significantly increased in patients with complications than those without complications and non diabetics. Also there was a significant correlation between the MPV and HbA1c, FBS, PPBS and duration of diabetes. Our study suggested a significant association between mean platelet volume and development of vascular complications in diabetic patients. So the mean platelet volume can be used as a better prognostic marker for assessing development of vascular complications in type2 diabetes mellitus.

Keywords: Diabetes mellitus mean platelet volume, vascular complications.

INDROUCTION

Diabetes is one of the largest global health emergencies of the 21st century. In 2015, the world prevalence of diabetes was 8.8%, affecting 415 million adults (aged 20-79yrs) and is expected to increase to 10.4% i.e. 642 million adults by 2040 [1]. According to World Health Organization (WHO) 2016 statistics, one in 11 adults suffer from diabetes [2]. In India, the number of diabetics is expected to increase from 69.2 million in 2015 to 123.5 million by 2040[3].

Mean Platelet Volume (MPV) is a determinant of platelet function and platelet size[3]. It reflects changes in either platelet stimulation or the rate of platelet production [4]. Large platelets are hemostatically more active and are a risk factor for vascular complications [5,6].

DM is considered as a prothrombotic state with enhanced platelet activity[7]. DM is also responsible for the increased destruction of platelets which in turn release larger platelets from the bone marrow. The platelet activation may alter platelet

morphology and function which may result in the development of microvascular and macrovascular complications of this metabolic disorder [3,4]. Large platelets, that contain more dense granules, are metabolically and enzymatically more active than small platelets and they have a higher thrombotic potential.

In most of the laboratories, automated cell counters have made the platelet count and platelet indices like Mean Platelet Volume (MPV) routinely available but are underutilized. This test is simple, inexpensive, and easily available in routine laboratories and is done nearly for every patient admitted to the emergency room via a routine CBC test. Hence there is scope to make better use of the platelet parameters generated by automated haematology analyser in detection of diabetic complications, which would reduce the morbidity and health care costs in patients with diabetes.

MATERIALS AND METHODS

A prospective cross-sectional study was conducted in the Department of Pathology, MKCG

Medical College Hospital, and Berhampur for the period of October 2015 to September 2017.

- **Inclusion criteria:** All type 2 diabetics attending the institute who gave consent for the study.
- **Exclusion criteria:**
 - All non-consenting individuals.
 - Patients having other co-morbid conditions.
 - Patients on antiplatelet drugs.
 - Type 1 diabetic.

210 type 2 diabetics attending the Endocrinology OPD and Department of Pathology, MKCG Medical College Hospital Berhampur were included in the study.

- Equal number of age and sex matched non-diabetics were taken as control.

- A detailed clinical history from each individual was collected and evaluated for the following mentioned parameters and results were recorded.
 - Hematology – CBC using 5 part automated hematology analyser [Sysmex XT 2000i] & Peripheral smear evaluation.
 - Biochemistry – FBG, 2 hr PPBG, Serum Lipid profile [Total cholesterol, Serum HDL, Serum LDL], Glycosylated Hb [HbA1c].

RESULTS

Among 210 patients, 146 were males (69.52%) and 64 were females (30.48%). There were 142 non diabetic males and non diabetic 68 females in the control (210 in total). The overall age of diabetes patient ranged from 29-82 years with the average age being 57.7 ± 10.95 whereas that of non diabetic population was 51.0 ± 7.06 .

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

Characteristic	Diabetes	Non-Diabetics	P value
Mean Duration of Diabetes (years)	5±4.30	-	-
Microvascular complications (No of patients)	157 (74.7%)	-	-
Fasting Blood Glucose (mg/dl)	160±78.3	78.0 ± 4.76	≤0.05
Postprandial blood Glucose (mg/dl)	252.5±81.9	126.7±4.6	≤0.05
HbA1c (%)	8.68 ±1.84 %	5.91±0.31	≤0.05
Hemoglobin (gm%)	12.8±1.19	14.1±0.58	≤0.05
Platelets(×10 ⁹ /l)	257 ± 75.6	249.5±30.5	0.14

* Statistically significant (p < 0.05)

Out of 210 diabetic patients, 157(74.7%) were suffering from microvascular complications. Diabetic neuropathy was found to be the commonest complication in the study group. The FBS in diabetes with complication was 170.4 ± 83.46 mg/dl & without complication was 128.7 ± 48.83 mg/di .The PPBS level in diabetes with complication was 258.579 ± 2.19 mg/di & without complication was 250.46 ± 78.39 mg/dl. The Hb A1C was higher in DM with complication ($8.9 \pm 1.37\%$) than without complication ($7.82 \pm 63\%$). The MPV was significantly higher in complicated DM (10.87 ± 1.20 fl) than DM without complication (7.62 ± 1.14). Among various parameters which were compared between diabetic patients with microvascular complications and without microvascular

complications, it was observed that males are found to be more prone to develop complications. Age was not found to have a role in the development of the complications Parameters like duration of diabetes, FBG level, HbA1c and Lipid Profile were found to be positively correlated with the development of complications. Hemoglobin level does not show any statistically significant correlation between the two groups. Among the platelet indices studied, statistically significant high MPV value was observed in patients with microvascular complications whereas the Platelet count does not have any statistically significant correlation [Table2].

Table-2: Comparison of all the variables in diabetic patients with and without Micro vascular Complications

Variables		MICROVASCULAR COMPLICATIONS		t test	p value
		Absent	Present		
No: of Patients		53	157		
Age		58.1±11.09	57.5±10.94	0.288	0.744
Sex	M	30 (56.6%)	116 (73.9%)	5.585	0.018*
	F	23(43.4%)	41(26.1%)		
Duration		3.1±4.72	5.6±3.96	3.846	<0.05*
Fasting Blood Glucose		128.7±48.83	170.4±83.46	3.445	0.001*
PPBS		250.46±78.39	258.57±92.19	0.622	0.53
HbA1c status		7.8±2.63	8.9±1.37	4.010	<0.05*
Total Cholesterol		137.9±44.39	173.7±66.80	3.550	<0.05*
HDL		41.2±10.82	30.2±8.28	2.719	0.007*
LDL		88.3±34.69	111.2±57.78	7.706	<0.05*
Triglyceride		112.9±40.78	175.7±93.55	4.734	<0.05*
Hemoglobin		12.8±1.19	12.9±1.15	0.283	0.777
Platelet Count		265.4±71.84	254.4±76.58	0.908	0.364
MPV		7.62 ± 1.14	10.87 ± 1.20	16.8	<0.05*

* Statistically significant (p < 0.05)

The present study observed a positive statistical correlation between MPV and the following parameters [i] Duration of Diabetes Mellitus (r = 0.49, p ≤ 0.5), [ii] FBG (r = 0.55, p ≤ 0.5), [iii] PPBG (r = 0.53,

p ≤ 0.5) and [iv] HbA1c (r = 0.70, p ≤ 0.5)(Table 2) However, no statistically significant correlation was seen between the MPV and the platelet count in the diabetic group[Table3].

Table-3: Correlation of MPV to the various parameters studied

Characteristic	Parameters	r value	P value
MPV	Duration of DM	0.49	≤0.05
MPV	FBG	0.55	≤0.05
MPV	PPBG	0.53	≤0.05
MPV	HbA1c	0.70	≤0.05
MPV	Platelet Count	0.02	0.67

* Statistically significant (p < 0.05)

DISCUSSION

Diabetes mellitus is the most common endocrine disorder characterized by metabolic abnormalities leading to long term complications involving heart, nerves, eyes, CNS, kidneys, gastrointestinal tract and blood vessels, thereby causing increased mortality and morbidity. India is the country with the second largest population of people living with diabetes. India has become the capital of diabetes in recent years [1,8].

The etiology of diabetes mellitus is multifactorial. Studies have linked the role of platelets, especially large platelets in the pathogenesis of diabetes and the development of complications [9, 10]. Larger platelets have large volume and are functionally active which can be assessed by the platelet index MPV [4].

In the present study, the observed mean value of MPV of 10.0 ± 1.57 in the diabetic group was statistically significantly higher to the observed value of 7.39 ± 0.64 in the controls. This observation was in concordance with the studies done by Jindal *et al*,

Kodiatte *et al*, Shah *et al*, Sharpe *et al* and Demintun R *et al*. [5, 4, 12, 13, 14].

On comparing platelet index MPV between patients with micro vascular complications and without complications, they were higher in the former and the difference was statistically significant. This finding was in concordance with that of the studies done by Sharpe *et al*. [14]. Study done by Jindal *et al*. Hekimsoy *et al*. who also concluded though the platelet index (MPV) were higher in patients with complications than in patients without complications however in their study p value was not statistically significant for MPV. Their possible explanation was centered on the rapid consumption of activated platelets in diabetic with complications [5,17].

The best possible explanation for the above observation made in the present study was, “Poor glycaemic control in diabetic patients results in hyperactivity of platelets directly as well as through glycation of platelet membrane proteins which cause early destruction of platelets and increased

thrombopoiesis, which in turn results in higher platelet index (MPV) in patients with complications". Enhanced platelet activity and platelet aggregation have been associated with the development of microvascular complications [4,18].

There was also a significant correlation between MPV and FBG, PPBG, HbA1c, which was again seen in the studies by Kodiatte *et al.* Shimodaira M *et al.* Shah B *et al.* and Demirtunc R *et al.* [4,19,12,13]. Therefore, It may concluded that glycemic control decreases the hyperactivity of the platelets and thus may prevent or delay possible diabetic vascular complications.

When the platelet indices were compared with glycemic control, we found that patients with HbA1c > 6.5% had higher platelet index (MPV) [10.3±1.21fl] than patients with HbA1c < 6.5 % [8.0±2.29 fl]. This difference between the groups was statistically significant (p value <0.05). This finding was in concordance with the findings published by Kodiatte *et al.*, Demirtunc *et al.* [8.35±0.72 fl vs 7.95±0.72 fl], [9.0±0.7 fl vs 8.4±0.8 fl] respectively [4,13]. The reason for poor glycemic control in our study could be because of poor dietary practices and lack of knowledge about the glycemic control among the diabetic patients [4, 20].

The results of this study might help in predicting the possibility of development of microvascular complications in diabetics and thus in turn will help in preventing them thereby increasing the quality of life of the individuals.

CONCLUSION

Platelets in diabetes are larger and more active & they have higher thrombogenic potential. Thus, patients with higher platelet index (MPV) can easily be identified during routine hematological analysis and possibly be benefited from anti-platelet treatment and the disease progression can be prevented.

In this study, we concluded that platelet index (MPV) is the cost effective and easily available tool to assess the control of diabetes mellitus, progression of disease as well as thromboembolic events.

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