Research Article

A comparison of platelet parameters in type-2 diabetics, pre-diabetics and normal subjects

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Abstract

Introduction: Diabetes Mellitus is a global pandemic disease. The increased platelet activity is emphasized to play a role in the development of vascular complications of the metabolic disorder. Mean platelet volume (MPV) is an indicator of average size and activity of platelets. This study is conducted to compare the platelet parameters in diabetics, pre-diabetics and normal subjects and to find correlation between glycemic control determinants (fasting plasma glucose) and platelet parameters (MPV, platelet count, platelet distribution width) in all the three groups and to correlate the duration of diabetes with MPV. **Material and Methods:** Total of 300 subjects (100 subjects in each group) were enrolled in the study. Sample for glucose estimation and platelet parameters were collected and estimation was carried out by the auto-analyzers. The statistical evaluation is done using SPSS version 22. Analysis of variance (ANOVA) and Pearson's correlation test are used to compare the variables and to see the correlation between the different variables respectively. **Result:** MPV a marker of platelet function and activation, is significantly higher in patients with type-2 diabetes mellitus than in control and pre-diabetic group with p- value <0.001 which is highly significant. FPG shows no correlation with platelet count and platelet distribution width. Also no correlation was seen between MPV and duration of diabetes. **Conclusion:** MPV can be used as a simple and cost effective tool to monitor the progression and control of diabetes and thereby preventing impending acute vascular events in health care centres.

Keywords: Diabetic mellitus, Pre-diabetics, Mean platelet volume

Introduction

Diabetes Mellitus is a global pandemic disease. It is a chronic metabolic syndrome principally characterized by persistent hyperglycemia [1]. Impaired fasting glucose is probably a frequent glycemic disorder in the general population and is considered as a pre-diabetic state [2]. As of 2014 estimated 387 million people have diabetes worldwide [3]. Diabetes caused 4.9 million deaths in 2014. Every seven seconds a person dies from diabetes with type 2 diabetes making up about 90% of the cases [4]. This is equal to 8.3% of the adult population, with equal rates in both men and women. Mostly involving people with an age group of 40 to 59 years. Diabetes at least doubles the risk of death [5]. The number of people with diabetes is expected to rise to 592 million by 2035. India is having highest burden of the diabetic subjects. The increased platelet activity is emphasized to play a role in the development of vascular complications of the metabolic disorder[5]. Large platelets are hemostatically more active and are a risk factor for developing coronary thrombosis, leading to myocardial infarction [6]. The prevalence of diabetic micro-vascular complication is higher in people with poor glycemic control and with long duration of diabetes mellitus [7].

An increased platelet activity has been reported in diabetics as demonstrated by increase in GPIIb/IIIa, Ib-IX and Ia/IIIa [8]. CD62 and CD 63 [9] with increasing availability of blood cell analyzers related to platelets are being estimated most important parameters among them are platelet count, platelet distribution width [10] and mean platelet volume, MPV is the most commonly used measure of platelet size is a potential markers of

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platelet reactivity [11]. It's a new emerging risk factor for atherosclerosis [12]. Patient with larger platelets can be easily identified during routine hematological analysis and could possibly benefit from the treatment for predicting the possibility of impending acute events [13]. This study is conducted to compare the platelet parameters in diabetics, pre-diabetics and normal subjects and to find correlation between glycemic control determinants (fasting plasma glucose) and platelet parameters (Mean platelet volume (MPV), platelet count, platelet distribution width) in all the three groups to correlate the duration of diabetes with MPV.

Methodology

This prospective comparative study was conducted at the J. K hospital associated with L. N Medical College and research centre, Bhopal during the period of 1 year from 1 April 2015 to 31 March 2016. Diagnosis of diabetic patient was established using 2014 ADA criteria [14].

a) A fasting plasma glucose of >126 mg/dl were considered as diabetics.

b) Fasting plasma glucose level between 100-125 mg/dl was allocated an impaired fasting glucose.

c) Those with Fasting plasma glucose <100 mg/dl were taken as normal subjects (controls) or non-diabetic group.

The total of 300 subjects (100 subject in each group) were enrolled in the study.

Sample for glucose estimation and platelet parameters were collected in sodium fluoride and tri-potassium salt of EDTA respectively. Glucose estimation was carried out by the auto-analyzers using enzymatic hexokinase oxidation reference method for plasma glucose levels, where as the platelet count and platelet parameters in the above groups were done by collecting venous blood samples for complete blood count using automated blood cell count analyzers (NIHON KOHDEN). All tests were conducted within 1 hour of sample collection to minimize variation due to sample aging. Sample size include of 300 cases with hundred cases in each group of diabetic, pre-diabetic and normal subject. Informed consent was taken from all the subjects. Subjects having anemia (<13 gm % in males) and (12 gm % in females), malignancy, chronic renal failure, cynotic heart disease, inflammatory conditions (rheumatoid arthritis, S.L.E), thrombocytopenia, hypo / hyperthyroidism were excluded from studies. The statistical software namely statistical package for the social sciences (SPSS) version 22 is used for analysis of data. Analysis of variance (ANOVA) is used to compare the variables. Data is expressed as mean ± standard deviation. A P-value of <0.05 is considered statistically significant. Pearson's correlation test was used to see the correlation between the different variables.

Results

Table-1: Comparison of various parameters between the 3 groups.

Characteristics	Type-2 Diabetes	Pre-Diabetic (IFG)	Control (Normal)	P-value
Number of cases	100	100	100	--------
Age (years)	51 ± 10.07	49.94 ± 12.09	44 ± 12.54	--------
Male:Female	51 : 49	62 : 38	54 : 46	--------
Fasting plasma glucose(mg/dl)	189.51± 56.86	111.42 ±8.04	86.66 ± 7.85	<0.001, Highly significant
Mean platelet volume(MPV) fl	9.16 ± 0.84	6.79 ± 0.63	4.89 ± 0.65	<0.001 Highly significant
Platelet distribution width (PDW) %	19.20 ±14.11	18.50 ±9.93	16.80 ± 1.54	0.348 Not significant
Platelet count (lakhs/cumm)	2.48 ± 0.78	2.56 ± 0.72	2.70 ± 0.79	0.373 Not significant
Duration of diabetes(yrs)	8 ± 4.78	---------	--------	--------

The mean age of the diabetic group is 51±10.07 years and of the subject in pre-diabetic group is 49.94 ± 12.09 years with control group the mean age is 44 ± 12.54. Ages of the groups were not significantly correlated. The mean duration of diabetes is 8 ± 4.78 years. The mean fasting plasma glucose in the diabetic group is found to be 189.51 ± 58.86 mg/dl, in pre-diabetic group it is 111.42 ± 8.04 mg/dl with control group it is 86.66 ± 7.85 mg/dl. (P-value < 0.001, highly significant).

The mean platelet count in diabetic group is 2.48 ± 0.78 lakhs/cumm as compared to pre-diabetic group and control group showing 2.56 ± 0.72 lakhs/cumm and 2.70 ± 0.79 lakhs/cumm platelet count respectively. (P-value of 0.373; not significant).

Mean platelet volume(MPV) in the diabetic group is 9.16 ± 0.84 fl as compared to the pre-diabetic and control group having MPV of 6.79 ± 0.63 fl and 4.89 ± 0.65 fl .(p-value <0.001; statistically significant).

Platelet distribution width (PDW) in the diabetic group is 19.20 ± 14.11% compared to pre-diabetic 18.50 ± 9.93 % where as in control group it is 16.80 ± 1.54 % (p- value 0.348, not significant), but the mean PDW is higher in diabetics than for the control group though the correlation is not statistically significant.

Table 2: Showing correlation of various parameters in diabetics.

		R- Value	P- value
Fasting plasma glucose (FPG)	Mean platelet volume (MPV)	0.3391	0.001
Fasting plasma glucose (FPG)	Platelet count	-0.134	0.521
Fasting plasma glucose (FPG)	Platelet distribution width(PDW)	-0.029	0.153
Mean platelet volume (MPV)	Duration	-0.073	0.290

R- Value - correlation is a statistical technique that is used to measure and describe the strength and direction of relationship between two variables. Range between - 1 to + 1.

P- value - or calculated probability is a number between 0 and 1 and is interpreted in the following way : A small p - value (typically ≤0.05) indicates strong evidence against the null hypothesis, so it is rejected. A large p -value (> 0.05) indicates weak evidence against the null hypothesis (fail to reject).

Discussion

Diabetes mellitus is a complex metabolic syndrome characterized by chronic hyperglycemia resulting in complication involving both macro and micro-vasculature structures. Total of 300 subjects (100 subjects in each group) were enrolled in the study. General characteristics and lab data enrolled in the study are shown in table 1. In our study there were no significant differences in platelet counts among the three groups. This was in consonance with the finding of Hekimsoy et al. However study done by zuberi et al [15] which concluded that mean platelet count is higher in diabetics than for the control.

In our study of platelet distribution width is 0.348 among the three groups which is statistically not significant but the mean PDW is higher in diabetics than for the control group though the correlation is not statistically significant. Our study revealed some important findings. MPV a marker of platelet function and activation, is significantly higher in patients with type-2 diabetes mellitus than in control and in subject with impaired fasting glucose (IFG) with p-value <0.001 which is highly significant. This agreed with the findings seen in studies done by Hekimsay et al [15], Demirtune et al [2], Zuberi et al [15], Atea et al [17], Jindal et al [18] and Papanas et al [6]. Other platelet parameters (platelet count and platelet distribution width) have shown no correlation and statistical significance differences with fasting plasma glucose in all the 3 groups.

A study by zuberi et. al [15] reported that there is significant stepwise increase in MPV from a non-diabetic to, impaired fasting glucose (IFG) and further to a diabetic population. Thomax Alex Kodiatte et. Al [1] documented that MPV was significantly higher in diabetics than non - diabetics which was similar to present study.

Binita Shah et. al [19] conducted a large study to correlate MPV with diabetes and they conclude that MPV is higher in diabetic population and in particular in those with poor glycemic control.

In the present study Fasting plasma glucose shows a statistical correlation with mean platelet volume and is highly significant also, where as FPG shows no correlation with platelet count and platelet distribution width and shows no significance between them. (Table-2)

If vascular damage was only due to increased number of large and reactive platelets, then the rate of damage would have been constant for the duration of disease and independent of diabetic control. This clearly shows that Platelet reactivity alone cannot explain the progression of vascular complication in diabetes mellitus, since there are other vascular risk factors that may be influenced by degree of control of diabetes [16,20]. This is supported by non -significant statistical correlation between MPV and duration of diabetes in our study. (Table 2).

Our studies showed, there is positive correlation between fasting plasma glucose level and MPV and no correlation was found between MPV and duration of diabetes. Similar findings were seen in other studies except to the study done by Ates et al [17]. MPV was positively correlating with degree of retinopathy in their cases.

Mean platelet volume is an indicator of average size and activity of platelets. Larger platelets are younger, more reactive and aggregable. Hence, they contain denser granules, secrete more serotonin and thromboglobulins and produce more thromboxane A2 than smaller platelets [16, 17, 20, 21]. All these produce pro-coagulant effect and cause thrombotic vascular complication. This suggest a relationship between platelet function especially MPV and diabetic vascular complications, High MPV is emerging as a new risk factor for vascular complication of diabetes mellitus of which atherosclerosis plays a major role [15].

Platelet hyperactivity and increased baseline activation in patients with diabetes is multifactorial. Hypergylcemia can increase platelet reactivity by inducing non - enzymatic glycation of proteins on the surface of the platelets, by the osmotic effect of glucose and activation of protein kinase C such glycation decrease membrane fluidity and increase the propensity of platelet to activate. Platelet function is directly regulated by insulin via a functional insulin receptor found on human platelet. Platelets from patient with diabetes express more surface P-selectin and glycoprotein IIb/IIIa receptors and are more sensitive to agonist stimulation than platelets from patients without diabetes [20, 22, 23, 24, 25]. Platelet in diabetes mellitus have dysregulated signaling pathway that lead to an increased activation and aggregation in response to a given stimulus, thus triggering thrombus formation and causing microcapillary embolization with release of constritive, oxidative and mitogenic substances such as PDGF and VEGF that accelerate progression of local vascular lesion like the neovascularization of lens in diabetic retionpathies [23].

Conclusion

MPV can be used as a simple and cost effective tool to monitor the progression and control of diabetes and thereby preventing impending acute vascular events in health care centers. Our studies propose that MPV can be a useful prognostic marker of macro and micro-vascular complication in diabetics.

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