Original Article

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Relationship of Mean Platelet Volume and HbA1c in Predicting the Level of Diabetes Control in Type 2 Diabetes Mellitus

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ABSTRACT

Background: MPV is an indicator of platelet size and MPV is increased in DM as compared to non-diabetics, more so in presence of complications. There are few studies evaluating the association between MPV and HbA1c and its role in predicting glycaemic control with conflicting results. The present study was planned to determine the relationship between MPV and HbA1c in predicting the level of diabetes control in type 2 DM.

Methodology: Cross sectional observational study including 100 consecutive cases of type 2 DM . Mean platelet volume (MPV), platelet distribution width (PDW) and platelet count were obtained from fully automated haematology analyser Sysmex KX-21. Glycosylated haemoglobin (HbA1c) was analysed by automated haemoglobin analyser.

Results: The mean age among 100 type 2 DM cases was 49.58 ± 14.49 years. The mean value of MPV and HbA1c was 10.25±0.90fl and 5.66± 1.17% respectively. There was no significant correlation found between MPV and HbA1c (r=0.110, p=0.275). Similarly, there were no significant association between MPV and three levels of glycaemic control.

Conclusion: MPV is not a reliable marker for determining glycaemic control in type 2 DM.

Keywords: *HbA1c, Diabetes Mellitus, Mean Platelet Volume, Platelet Parameters, Predicting*

Introduction

Diabetes Mellitus (DM) is a complex metabolic disorder characterized by high blood glucose levels over a long period of time. India is facing an epidemic of diabetes with an estimated prevalence of 62 million. [1]

Vascular complications are the leading cause of morbidity and mortality occurring in patients with poor glycaemic control. Platelet hyperactivity leading to endothelial dysfunction, enhanced coagulation and defective fibrinolysis is implicated in pathogenesis of thrombotic events and eventually vascular complication in diabetes. [2]

HbA1c (glycosylated haemoglobin) is an indicator of chronic glycaemia reflecting serum glucose over three months' duration. It is considered gold standard in monitoring the disease and initiating and titrating the drugs. However, the test is not available in rural areas with limited laboratory resources.[3]

Mean platelet volume (MPV) is a platelet parameter easily obtained along with whole blood count in haematology analyser. MPV is an indicator of platelet size and several studies have established that MPV is increased in DM as compared to non-diabetics, more so in presence of complications. [4,5]

However, there are few studies evaluating the association between MPV and HbA1c and its role in predicting glycaemic control with conflicting results.

In view of limited number of studies and conflicting results, the present study was planned to determine the relationship between MPV and HbA1c in predicting the level of diabetes control in type 2 DM.

Material and Methods

This was a cross sectional observational study conducted in the department of pathology at a tertiary care hospital. Objectives of the study were to determine mean platelet volume and HbA1c in patients diagnosed with type 2 diabetes mellitus and to determine the relationship of mean platelet volume and HbA1c in predicting the level of glycaemic control.

Sampling method was convenient sampling wherein 100 consecutive cases diagnosed with type 2 diabetes mellitus between 30 and 60 years of age, from the hospital were included in the study. Patients with anaemia were excluded as nutritional anaemia may cause reactive thrombocytosis, Similarly, patients on antiplatelet drugs like aspirin and clopidogrel, cases with idiopathic thrombocytopenic purpura or malignancy were also excluded from the

study. Institutional ethical committee (IEC) clearance was obtained from the institutional human ethical committee.

Definition of variables: Diabetes Mellitus was diagnosed based on the criteria laid down by American diabetes association in 2014 as fasting blood glucose or 2-hour plasma glucose ≥ 200 mg/dl during an oral glucose tolerance test (using 75gm of anhydrous glucose in water) or HbA1c ≥ 6.5%

The data of 100 cases of type 2 diabetes mellitus patients was recorded and analysed. Platelet parameters like mean platelet volume (MPV), platelet count and platelet distribution width (PDW) were obtained from fully automated haematology analyser Sysmex kx 21.

HbA1c was analysed by automated haemoglobin analyzer-Biorad Variant II using cation exchange high performance liquid chromatography method.

The cases were divided in three groups based on the level of diabetes control as [6] good control: 6.0-7.0%, fair control: 7.1-8.2%, poor control: above 8.2%.

Statistical analysis was done using statistical package for social sciences software version 18. Data was expressed as mean, standard deviation and percentages. Unpaired student's *t*-test was used to analyse difference in variables among two groups. Pearson's correlation was used to analyse the correlation between HbA1c and various platelet parameters like MPV, PDW and platelet count. Comparison of MPV values among three levels of glycaemic control was done by one-way Analysis of variance (ANOVA) test. p value < 0.05 was considered as statistically significant.

Results

The study included 100 cases of type 2 diabetes mellitus. Maximum number of the cases were in the age group of 41 to 50 years (48%). The youngest patient was 19 years old and oldest was 85 years old. 57% were males and 43% were females.

According to table no 1, mean MPV value in the study population was 10.25 ± 0.90 fL. Mean HbA1c level in the study population was 5.66 ± 1.17 %.

When all the 100 cases of type 2 DM were divided into two groups based on HbA1c levels, as shown in table 2, there was no significant difference in the mean values of haemoglobin, platelet count, PDW and MPV among the two groups.

As seen in table no.3, Pearson's correlation was applied to determine the relationship between HbA1c, MPV, platelet count and platelet distribution width (PDW). Correlation at the p value of 0.05 was considered as significant. There was no significant correlation between HbAIc and MPV (r =0.110, p =0.275) Similarly, there was no significant correlation between HbA1c and other platelet parameters like platelet count (r= 0.075, p=0.458) and PDW (r=0.059, p=0.558).

Out of total 100 cases of type 2 DM in the study, 32 had HbA1c levels > 6% who were divided into three groups based on the level of glycaemic control as good control: 6.0 -7.0%, fair control: 7.1% to 8.2 %, poor control: > 8.2%. (Table no. 4)

The one-way Analysis of variance (ANOVA) test was applied to analyse the association in the mean values among these three groups. As seen in the table 4, that there was no statistically significant difference between mean values of platelet count, PDW and MPV in three levels of diabetes control.

Discussion

Diabetes mellitus (DM) is a complex metabolic disorder characterized by high blood glucose levels over a long period of time. The prevalence of DM is on the rise throughout the world. India with 69.1 million DM patients, tops the list followed by China. Around 415 million people

Table 1: Shows Mean, standard deviation values of age, haemoglobin, MPV, platelet count, platelet distribution width (PDW) and HbA1c in all the cases of diabetes mellitus.

Variables	N	Mean	Standard Deviation
Age (Years)	100	49.58	14.59
Hb(g/dL)	100	13.71	1.51
MPV(fL)	100	10.25	.909
Platelet count (10^3/dL)	100	286.3	91.72
PDW(fL)	100	13.10	2.22
HbA1c (%)	100	5.66	1.17

Table 2: Shows Mean, Standard deviation values of haemoglobin, platelet count, PDW and MPV in cases with HbA1c <7% and >7%.

HbA1c group		N	Mean	Std. Deviation	Std. Error Mean	p value
Haemoglobin (g/dL)	<7.0	91	13.62	1.53	0.16	0.289*
	>7.0	9	14.61	0.97	0.32	
Platelet count (10^3/dL)	<7.0	91	292.13	91.31	9.57	0.691*
	>7.0	9	227.44	77.62	25.87	
PDW(fL)	<7.0	91	13.00	2.08	0.22	0.259*
	>7.0	9	14.16	3.35	1.12	
MPV(fL)	<7.0	91	10.22	0.91	0.10	0.786*
	>7.0	9	10.59	0.86	0.29	

Unpaired Student's* t-*test

Table 3: Correlation of MPV, platelet count, PDW and HBA1c in 100 cases of diabetes mellitus.

		Platelet count(*103/dL)	PDW(fL)	MPV(fL)	HbA1c
Platelet count (*103/dL)	Pearson Correlation	1	-.444**	-.425**	.075
	Sig. (2-tailed)		.000	.000	.458
	N	100	100	100	100
PDW(fL)	Pearson Correlation	-.444**	1	.791**	.059
	Sig. (2-tailed)	.000		.000	.558
	N	100	100	100	100
MPV(fL)	Pearson Correlation	-.425**	.791**	1	.110
	Sig. (2-tailed)	.000	.000		.275
	N	100	100	100	100
HbA1c (%)	Pearson Correlation	.075	.059	.110	1
	Sig. (2-tailed)	.458	.558	.275	
	N	100	100	100	100

****. Correlation is significant at the 0.05 level (2-tailed).***

Table 4: Shows mean values and standard deviation of platelet count, PDW and MPV in three levels of glycaemic control.

	HbA1c	N	Mean	Std. Deviation	p value
Platelet count(*103/dL)	6.0-7.0	24	312.25	108.40	0.702*
	7.1-8.2	03	260.33	80.10	
	>8.2	05	307.40	43.24	
	Total	32	306.63	98.01	
PDW(fL)	6.0-7.0	24	13.071	2.65	0.424*
	7.1-8.2	03	11.667	0.15	
	>8.2	05	14.020	1.47	
	Total	32	13.088	2.41	

	HbA1c	N	Mean	Std. Deviation	p value
MPV(fL)	6.0-7.0	24	10.113	1.01	0.221*
	7.1-8.2	03	9.933	0.32	
	>8.2	05	10.880	0.48	
	Total	32	10.216	0.93	

**** Analysis of variance (ANOVA) test. Statistical significance was set at p<0.05***

were diagnosed with diabetes in 2015 with a projected increase to 642 million by 2040 worldwide. [7] The high morbidity and mortality associated with DM is attributed to the vascular complications which occur frequently in patients with poor glycaemic control. [8]

One of the best ways to estimate blood glucose levels in diabetes patients is the measurement of HbA1c (glycosylated haemoglobin). It gives a picture of glycaemic control over a period of 2.5 to 3 months. It is the standard diagnostic and prognostic marker used in type 2 DM. However, it is comparatively expensive and is not readily available in several rural hospitals in India.

Platelets play a major role in normal haemostasis. Platelet functions are altered in DM. Hyperglycaemia, dyslipidaemia and oxidative stress in DM damage the vascular endothelium leading to adherence of platelets at the damaged site and activation which thereby promote thrombogenesis. Stand alone, hyperglycaemia leads to platelet activation by several mechanisms like non-enzymatic glycosylation & protein kinase activation. [9]

Platelet count, mean platelet volume (MPV), platelet distribution width (PDW) and platelet large cell ratio are important platelet parameters which reflect increased platelet activity and are readily obtained in automated haematology analysers.

Studies have been done to determine the role of platelet parameters in diagnosing and predicting vascular complication in diabetes mellitus. The present study was conducted to determine the correlation of MPV with HbA1c and its role in assessing the glycaemic control in DM.

MPV is a measure of the average size and activity of platelets in the blood. Increase in the MPV is linked with thrombotic potential. Several researchers have reported the increase in MPV values in diabetics as compared to non-diabetics. [4, 10,11] When MPV was compared among diabetics with HbA1c levels less than and more than 7%, MPV was found to be higher in the latter group. [8,12,13] In the present study, there was no significant difference in MPV in diabetic patients with HbA1c more or less than 7%. This was in accordance with the study by Unubol et al who did not find any significant difference in MPV among two groups of diabetic patients with HbA1c values less than or more than 7%. [14] The exact role of MPV as a biomarker for detecting vascular complications in DM is still unclear. Papanas et al in their study observed significantly higher MPV values in type 2 DM patients with microvascular complications. [11] In contrast, Demirtunc et al, did not report any variance in MPV values in diabetic patients with or without vascular complications. [12] The authors attributed the reason for this lack of difference, to the rapid consumption of platelets in diabetics with vascular complications and development of platelet dysfunction prior to the occurrence of complications.

Very few studies have attempted to correlate the MPV values with the level of glycaemic control. If at all MPV values are found to correlate with glycaemic control in diabetics, it can be routinely used as a surrogate marker for predicting diabetic complications. Some studies have found a significant linear positive correlation between MPV values and HbA1c levels, which indicates the usefulness of MPV in determining the level of glycaemic control. [4, 6, 12] These studies indicate that MPV can be used as an alternative marker for glycaemic control in type 2 DM. In the present study there was no correlation between MPV and HbA1c. This was in agreement with several other studies in the literature. [11, 14-17] To study the in vivo platelet activity, Tschoepe et al performed flow cytometric analysis using platelet markers CD 63 and CD 62 in diabetics. Though authors observed higher levels of these markers in diabetics, they did not find any correlation between these platelet activation markers and HbA1c levels. They speculated that the time lag of platelet turnover and megakaryocyte thrombopoiesis to be the reason for their finding. [18] It is recognized that MPV values increase in the initial phase of diabetes and remains the same thereafter. Since the degree of platelet activation was not related to the level of glycaemic control, Hekimsoy et al in their study speculated that factors other than platelet activation may be involved in vascular complications in

diabetics. [16] Absence of association between MPV and HbA1c strengthens the datum that platelet activity is not influenced entirely by glycaemic control. Furthermore, the control of glycaemic state does not lead to reduction in MPV values in in-vitro studies and in type 1 diabetics. However, Demirtunc et al have found a reduction in MPV after 3 months of glycaemic control. [12]

In the present study we did not find any correlation between PDW and HbA1c. This was in consonance with Bhanukumar et al, who did not observe any correlation between PDW and HbA1c.[15] However, in contrast to this, Jabeen et al reported a significant positive correlation between PDW and HbA1c. [10]

Platelet counts show variable trend in DM. Some studies have found increase in platelet count in DM as compared to controls. [4, 12] In disagreement to this, other authors have described low platelet counts in diabetics. [16] In the present study, there was no difference in the platelet count in patients with HbA1c levels higher or lower than 7%. This was consistent with the findings of Bhanukumar et al and Jaman et al.[6,15] Similarly, in the present study there was no significant correlation between platelet count and HbA1c which was in accordance with the study by Jabeen et al. [14] The capricious nature of platelet count in DM is due to the fact that platelet count in peripheral blood is influenced by several other factors like mean platelet survival, platelet production rate and platelet turnover.

The present study shows that there is no positive correlation between MPV and HbA1c and hence does not help in predicting glycaemic control. There was no significant correlation found between HbA1c and other platelet parameters like PDW and platelet count. Due to conflicting results from various studies, further studies with a larger sample size will help in gaining clarity about the relationship between HbA1c and MPV.

Conclusion

MPV is not a reliable parameter in predicting the glycaemic control in type 2 DM. Similarly, platelet count and PDW are also not useful in predicting the level of glycaemic control. Further large-scale studies would help in bringing more clarity about the relationship between MPV, PDW, platelet count and HbA1c.

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