Original Research Article

Mean Platelet Volume in Patients with Type 2 Diabetes Mellitus and Its Correlation with Albuminuria and HbA1c Levels

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Abstract:

Diabetes mellitus is a heterogeneous group of disorders that have in common the metabolic defect of hyperglycemia. The mechanisms by which this hyperglycaemia is produced vary, and they may be acquired, genetic or environmental. This ultimately results in impaired pancreatic insulin secretion, impaired peripheral utilization of glucose, and enhanced hepatic glucose production. The prevalence of diabetes according to the WHO criteria was 5.6% among the urban areas and 2.7% among rural areas. The mean platelet volume is one of the hematological parameters used to assess platelet function and activity. The purpose of this study is to determine the correlation between platelet activity (as assessed by mean platelet volume), and diabetic complications, specifically diabetic nephropathy (as assessed by daily urine albumin excretion), and glycemic control (as assessed by HbA_{1C}). The HbA_{1C} is then compared with the mean platelet volume, to study its correlation. We included 150 diabetic and coronary artery disease patients comprising of 100 confirmed type 2 diabetic patients and 50 controls from Medical OPD of Department of Medicine, JLN Medical College, Ajmer, during Jan 2020 to June 2021. In diabetes mellitus patients, Mean platelet volume is significantly higher in micro-albuminuria and macro-albuminuria when compared with patients having normal albuminuria. It suggests platelet may have a role in causing the vascular complications of diabetes particularly diabetic nephropathy. Mean platelet volume is a simple, easy and affordable investigation. In our study there is a positive correlation exists between MPV and BMI. Further larger studies are needed to show its correlation in the future.

Keywords: Diabetes, MPV, HbA1c.

Introduction

Diabetes mellitus is a syndrome of altered carbohydrate metabolism characterized by deficiency of endogenous insulin production or defect in insulin secretion or peripheral resistance to insulin action. The altered mechanism of hypo/hyper glycaemia could be due to multifactorial disorders showing the effect on pancreatic insulin secretion, impaired peripheral utilization of glucose, and enhanced hepatic glucose production [1].

The prevalence of diabetes according to the WHO criteria was 5.6% among the urban areas and 2.7% among rural areas [2]. The estimated number of cases of diabetes worldwide was 382 million people with a projected increase to 592 million by 2035, according to the International Diabetes Federation [3].

Diagnosis involves the hematological parameters to estimate the mean platelet volume to assess platelet function and activity. The HbA_{1C} levels in patients is determined according to the ADA criteria [4] either less than or equal to 6.5%, and those with

levels more than 6.5% and these are further compared with the mean platelet volume, to study its correlation. Therefore, the purpose of this study is to estimate the mean platelet volume in an uncomplicated type 2 diabetes mellitus and to compare with normal controls.

Methodology

This cross sectional study was conducted on total 150 patients (include 100 diabetic and 50 controls) who was attend the Medical OPD of Department of Medicine, JLN Medical College, Ajmer, Rajasthan during Jan 2020 to June 2021 after consent was taken from participants. All patients were explained about the diabetes and its complications. They were informed about the study proceedings and the usefulness of the study in their own language.

Inclusion criteria consisted of confirmed cases of type 2 diabetes mellitus 100 patients and non-diabetic controls without coronary artery disease 50 patients.

All the patients demographical, clinical details, abnormalities associated due to diabetes were obtained such as, cardiovascular, respiratory, central nervous system and abdomen. Laboratory reports on fasting blood glucose, post prandial blood glucose, urine albumin creatinine ratio, mean platelet volume, complete blood count, glycosated haemoglobin levels (HbA1c) and urine albumin creatinine ratio were estimated.

Further data obtained was subjected to appropriate statistical analysis using SPSS software.

Results

A total number of 150 patients participated in our study that includes 100 (75%) type 2 diabetes mellitus patients and 50 (25%) age matched healthy controls. Among them 94(63 %) are males and 56 (37 %) are females. They are distributed in age group of 40 to 70 years. Sex wise distribution of diabetes patients includes 61 (61%) males and 39 (39%) females. In the study group 32% belongs to the age group 40-50 years, 64% belongs to age group 51-60 years and 4% belongs to more than 60 year age groups. The mean platelet volume showed a positive correlation (p value- 0.042 with BMI (kg/m^2) in our study. The correlation coefficient calculated by person correlation coefficient showed only weak correlation (0.215). The mean platelet volume in diabetes group (8.8±0.36) is significantly higher than the control group (7.93±0.24) and independent sample test shows a significant correlation (P<0.0001).

MPV was significantly higher (8.8±0.36) in the diabetes patients when compared to control (7.93±0.24) group and is statically significant (P<0.0001) by independent sample t test. The mean BMI in control group (26.48±1.37) was also lower than the diabetes group (30.93±2.43) and also statically significant. The mean fasting blood sugar and post prandial blood sugar in the control group was 89.6±9.73 and 129.68±9.75 while in the diabetes group it was 168.56±53 and 242.53±84.58 respectively.

The mean total cholesterol level in control group was 180.54±19 while in the diabetes group it was 218.92±56. The mean age of patients in control group was 52.58±4.3 while in the diabetes group it was 51.62±4.49. The mean platelet count in diabetic group was 3.81±0.49 while in the control group it was 3.60±0.44.

Table 1: Demographic and clinical variables of patients

Variables		Cases	Controls	p-value
Study participants		100	50	
Gender	Males	61	-	
	Females	39	-	
Age (Years)	40-50	32	-	
	51-60	64	-	
	61-70	4	-	
Correlation of mean platelet volume with BMI	BMI (kg/m^2)	MPV Mean (fl)		
	<30	8.76		
	30-35	8.81		<0.042
	>35	9.25		
Correlation of mean platelet volume		MPV of DM	MPV of controls	
Comparison of various parameters between the diabetic and non-diabetic control (Mean±SD)		8.8±0.36	7.93±0.24	<0.0001
	Age(Years)	51.62±4.49	52.58±4.3	<0.069
	Duration of DM(Years)	5.46±2		<0.648
	BMI(Kg/m^2)	30.93±2.43	26.48±1.37	<0.042
	MPV (fl)	8.80±0.4	7.93±0.24	P<0.0001
	Urine albumin creatinine(mg/g) ratio	219.82±188.8		P<0.0001
	Platelet (Lakh)	3.60±0.44	3.81±0.49	P<0.122
	Hb (g/dL)	12.33±0.78	12.65±0.85	P<0.688
	Total Cholesterol (mg/dL)	218.92±56	180.54±19	p<0.402
	Serum Creatinine (mg/dL)	1.47±0.3	1.20±0.34	p<0.145
	FBS (mg/dL)	168.56±53	89.6±9.73	p<0.236
	PPBS (mg/dL)	242.53±84.58	129.68±9.75	p<0.124
	HbA1c	6.98±0.7		P<0.174

Discussion

150 patients participated in the current study. Among them, 100 were diabetic patients and 50 were controls. In study group 32% belongs to the age group 40-50 years, 64% belongs to age group 51-60 years and 4% belongs to more than 60 year age groups. The mean age in diabetic patients was 51.62 years. There is no significant difference in age between cases and controls in the current study (P<0.069). Among 150 patients, 63% were males and 37% were females. 61% diabetic patients were males. Thomas Alex's study (2012) [5] included 456 patients. They were divided into cases and control groups. The mean age of cases was 55 years. 65% cases were males. Suman Raj's study (2017-18) [6] included 100 patients. They were divided into cases and control groups. The mean age of cases was 54 years. 64% cases were males. The study assessed the correlation between MPV and HbA1C, in our study no correlation found between HbA1c and MPV level (P<0.174).

Glycaemic status and BMI

In our study mean platelet volume show a positive correlation (control mean ± SD, 26.48±1.37 and diabetes mean ± SD, 30.93±2.43 and statically significant with BMI. The mean FBG was 168.56mg/dl and the mean PPBG was 242.53 g/dl in diabetes group. The mean HbA1c was 6.8% in the current study. The mean BMI was 30kg/m2. There is no significant difference in FBG (P<0.2), PPBG (P<0.12), HbA1c (P<0.17) and significant difference in BMI (p<0.042) between cases and controls in the current study.

In the study of Suman Raj [6], the mean FBG was 156 mg/dl. The mean PPBG was 231 mg/dl. The mean BMI was 27.8kg/m2. There is significant difference in FBG and PPBG between cases and controls, like the current study. There is no significant difference in BMI (P= 0.67), unlike the current study

Nephropathy status

The mean UACR (urine albumin Creatinine ratio) was mean±SD, 219.82±188.8mg/g. The mean±SD serum creatinine is 1.47±0.3 mg/dl. There is significant difference (P<0.0001) in UACR in between cases and controls and no significant difference in serum creatinine between cases and controls in the current study (p<0.145).

In the diabetes patients it was significantly higher in patient with group A2 i.e. called micro-albuminuria and group A3 i.e. called micro-albuminuria, when compared to patients with group A1 i.e. normal albuminuria. In the study of Suman Raj [6], proteinuria was seen in 25 patients out of 50 patients. Proteinuria was more in patients who are diabetics compared to healthy controls. In the study of Manal Khudder (2019) [7], Albumin creatinine

ratio was assessed and 42% had normal levels, 37% patients had moderately increased ACR and 21% had severely increased ACR. There was a statistically significant positive correlation between MPV and albuminuria, similar to the current study. In Muhammad Bilal's study (2018)8, there was significant association between microalbuminuria and HBA1C status.

In our study negative correlation between MPV and Creatinine explained by the fact we excluded patient with low GFR.

MPV and its Relation with various parameters

The mean platelet volume in diabetes group was significantly higher (mean±SD, 8.8±0.36) than the control group. Mean platelet volume shows a positive correlation (P<0.042) with BMI in current study. There is no correlation between MPV with duration of diabetes (mean±SD,5.46±2) (P<0.648), cholesterol levels (mean±SD,218.92±56) (P<0.402) haemoglobin levels(mean±SD,12.33±0.78) (P<0.688), FBG (mean±SD,168.56±53) (P<0.236), PPBG (mean±SD,242.53±84.58) (P<0.124), and HbA1c (mean±SD,6.98±0.7) (P<0.174) levels and platelet count (mean±SD,3.60±0.44) (P<0.122) in the current study.

In the study of Hiroyouki (2020) [9], 215 patients were included. They were divided into three groups. 56 patients were controls, 44 were pre-diabetic, and 115 were type 2 diabetic patients. MPV was compared in these three groups. The study found there was a significant difference in MPV in the type 2 diabetes mellitus control group, similar to the current study (P<0.0001). MPV was positively correlated with FBG and HbA1c levels, which is in contrast with the current study. There was no positive relationship between MPV and the type of antidiabetic medication. In the current study, we didn't assess the relation with antidiabetic medications. The study that is in contrast with our study with respect with glycemic status and MPV was Manoj Saluja's study [10], in which 160 patients were included.

In Thomas Alex's study [5], there is significant correlation between MPV and FBG, PPBG and HbA1C. This is not in contrast to the current study findings. But there is no correlation between BMI with MPV, which is found in contrast to the current study. In our study mean platelet volume in diabetes group (8.8±0.36) is significantly (P<0.0001) higher than the control group (7.93±0.24). In the studies done by Demirtunc (2009) [11] and Zuberi (2008) [12], the mean platelet count in the diabetic cases was higher than that of the health controls. The study done by Hekimsoy (2004) [13] identified less platelet counts in the diabetic group compared to healthy control group. Platelet count may be depending on various other parameters like survival rate, production and turnover rate in diabetic

patients. MPV was significant more in diabetic patient compared to controls, similar to our study. In the study of Kalpit [14] (2020), the mean platelet volume was significant more in type 2 diabetic patients compared to controls, similar to the our study, the mean platelet volume was significantly more in uncontrolled diabetic group compared to controlled diabetic group because platelet gets activated mean platelet volume tends to increase and also changes its disc shape into swollen spheres, Larger platelet have tendency to be more adhesive and aggregative then the smaller ones, Increase in MPV may be either due to osmotic swelling of megakaryocytes or due to effect of insulin which forces the platelet to change its structure. In the meta-analysis of ShuaiFei Ji (2019)15, results proved that MPV values were significantly more in diabetic cases compared to healthy controls and MPV were higher in diabetic patients with retinopathy.

Conclusion

Platelet may have a role in causing the vascular complications of diabetes particularly diabetic nephropathy. Mean platelet volume is a simple, easy and affordable investigation. In our study there is a positive correlation exists between MPV and BMI. Further larger studies are needed to show its correlation in the future.

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