

Mean Platelet Volume- Correlation with HbA1c and Its Association with Microvascular Complications In Type II Diabetes Mellitus

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Abstract

BACKGROUND:

Diabetes mellitus (DM) is a global pandemic. Increased platelet activation has been suggested to be involved in the pathogenesis of vascular complications. Platelet volume, a marker of the platelet function and activation, is proposed to be involved as a causative factor with respect to altered platelet morphology and function. Mean platelet volume (MPV), an important, simple, effortless, and cost-effective tool and thus has potential to be used as an indicator of presence of vascular complications.

AIM: The aim of the study is to compare MPV in type 2 Diabetes Mellitus patients with good glycemic control with that of poor glycemic control and to investigate the association between MPV and microvascular complications of diabetes.

MATERIALS AND METHODS: This is a cross sectional study carried out on 100 cases of Type 2 Diabetes mellitus patients. Their BMI was calculated and SBP, DBP measured. Venous samples were collected after 12 hours of overnight fasting at 8:30 am for Mean Platelet Volume, HbA1C, FBS, PPBS, Hb, triglyceride (TG) and serum creatinine levels. Complications were assessed based on spot ACR and direct ophthalmoscopic examination. The patients were divided into 2 groups based on HbA1C levels and all the parameters and complications were compared between both the groups.

RESULTS: Mean platelet volume is higher in diabetics with poor glycemic control (10.01-12.00 fL) than those with good glycemic control (≤ 8.00 fL). It is still higher in those with diabetic complications (10.01-12.00 fL). MPV shows a strong correlation with FBS, PPBS, HbA1c, and presence of hypertension and duration of diabetes.

CONCLUSION: Our results showed significantly higher MPV in poorly controlled diabetics, and still higher in those with microalbuminuria and retinopathy. Hence, MPV can be used as an indicator of presence of microvascular complications.

Key Words: Diabetes Mellitus, Mean Platelet Volume, microvascular complications.

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I. Introduction

Diabetes mellitus (DM) is a global pandemic. Estimates by the International Diabetes Federation (IDF) states that 387 million people have diabetes worldwide in 2014 and by 2035 this number is expected to rise to 592 million. China (98.4 million) and India (65.1 million) were the countries topping the list with the largest number of individuals with diabetes in 2013. T2DM accounts for 90% of cases of diabetes globally.

Diabetes Mellitus is a state of metabolic dysregulation and can lead to secondary pathophysiologic changes in various organ systems leading to microvascular and macrovascular complications². This will impose a remarkable burden on the diabetics as well as on the health care system. Therefore it is of utmost importance to detect the complications early in a cost effective way to control and treat them. DM will likely be a leading cause of morbidity and mortality in the future.

Increased platelet activation has been suggested to be involved in the pathogenesis of vascular complications. It is being found that MPV values are high in patients with diabetes mellitus, more so in uncontrolled diabetes. Platelet volume, a marker of the platelet function and activation, is proposed to be

involved as a causative factor with respect to altered platelet morphology and function. The higher the MPV, the larger and younger the platelets are, and more is the risk for thrombosis and is associated with increased risk for microvascular complications.

Mean platelet volume (MPV), an important, simple, effortless, and cost-effective tool measured by hematology analyzer assess the volume and function of platelets and thus has potential to be used as indicator of presence of vascular complications .

CRITERIA FOR THE DIAGNOSIS OF DIABETES MELLITUS³

- Symptoms of diabetes with random blood glucose concentration ≥ 200 mg/dL (or)
- Fasting plasma glucose ≥ 126 m g / d L (or)
- Haemoglobin A1c $\geq 6.5\%$ (or)
- 2-h plasma glucose ≥ 200 mg/dL during an oral glucose tolerance test

AIM

1. To compare Mean Platelet Volume in type 2 Diabetes Mellitus patients with good glycemic control with that of poor glycemic control.
2. To investigate the association between mean platelet volume and microvascular complications of diabetes. (retinopathy and nephropathy)
3. To assess the relation between mean platelet volume, glycemic control, sex, BMI, duration of diabetes, hypertension, hypertriglyceridemia and abdominal circumference.

OBJECTIVE:

To investigate the association between mean platelet volume and microvascular complications of diabetes.

II. Materials And Methods

STUDY AREA

This study was carried out in the General medicine OPD and General medicine wards of Government Stanley Medical college and Hospital, Chennai, Tamilnadu.

STUDY POPULATION

Type 2 DM patients attending medicine OPD and admitted in medicine wards of Government Stanley Medical college and Hospital

STUDY PERIOD

April 2017 to September 2017

SAMPLE SIZE - 100

INCLUSION CRITERIA

- Known type II diabetes mellitus patients on treatment with OHA/Insulin.
- Male and female patients of age >30 years.
- Newly detected type II diabetes mellitus patients.

EXCLUSION CRITERIA

- Type I diabetes mellitus
- Gestational Diabetes Mellitus
- Male patients with Hb <12 mg% and female with Hb <11 mg%
- Patients on antiplatelet and antithrombotic drugs.
- Patients with diagnosed malignancy.
- Patients with known chronic kidney disease.
- Patients with UTI, cardiac failure.

STUDY DESIGN - Cross sectional study

STUDY TOOLS

All the patients underwent a detailed clinical evaluation. Body weight and height were measured in all subjects and BMI was calculated as weight(kg) divided by height² (metres²).

Systolic and diastolic blood pressures (SBP and DBP) were measured after a 5 min rest in a semisitting position. BP was determined at least 3 times from the right upper arm for analysis, the mean of the 3 was used. Patients with mean blood pressure levels $\geq 140/90$ mm of Hg or patients already on antihypertensive medications were diagnosed as having hypertension.

Venous samples were collected after 12 hours of overnight fasting at 8:30 am for Mean Platelet Volume, HbA1C, FBS, PPBS, Hb, triglyceride (TG) and serum creatinine levels. HbA1c was measured by High Performance Liquid Chromatography. Measurement of MPV was done using an automatic blood counter

(Beckman Coulter Act5Diff). Plasma glucose estimation (FBS and PPBS) was carried out by the glucose oxidase method in the autoanalyzer. Hypertriglyceridemia was defined as having triglyceride levels >150 mg/ dl.

Microalbuminuria was examined using spot urine albumin creatinine ratio (ACR). Patients with ACR of <20 mg/g for men and <30 mg/g for women were categorized as microalbuminuria negative and those with >20mg/g and >30mg/g respectively as microalbuminuria positive.

Diabetic Retinopathy was defined by direct ophthalmoscopic examination. Patients with at least 2 microaneurysms and/or retinal hemorrhage, and/or other signs of retinal damage were diagnosed as having retinopathy.

Creatinine clearance was calculated with the cockroft-Gault formulae as $(140 - \text{age}) * \text{weight} / 72 * \text{serum creatinine}$. Multiplication of the result by 0.85 was done for female patients.

After baseline evaluation, the patients were divided into 2 groups based on HbA1C levels. Diabetics with good glycemic control (patients with HbA1c <7%) and those with poor glycemic control (patients with HbA1c >7%). All the parameters were compared between both the groups. These groups were further sub grouped based on the presence or absence of complications. The MPV in each group were compared.

III. Statistical Analysis

Descriptive statistics was done for all data and suitable statistical tests of comparison were done. Continuous variables were analysed with the Unpaired t test/single factor ANOVA and categorical variables were analysed with chi square test/ Fisher Exact Test. Regression analysis done and odds ratio with confidence interval calculated. Statistical significance was taken as $P < 0.05$. The data was analysed using SPSS Version 16. Microsoft Excel 2010 was used to generate charts.

IV. Results

Table 1: Distribution of Demography and baseline details

	Good glycemic control	Poor glycemic control	P value Unpaired t test
AGE DISTRIBUTION			
Mean	50.84	52.73	0.3806
SD	10.79	10.12	
GENDER STATUS			
Male	50%	45.16%	0.6382
Female	50%	54.84%	
BMI DISTRIBUTION			
Mean	27.30	28.11	0.3507
SD	4.77	3.83	
FBS DISTRIBUTION			
Mean	121.63	161.21	<0.0001
SD	23.32	30.54	
PPBS DISTRIBUTION			
Mean	170.47	239.58	<0.0001
SD	45.00	53.76	
DURATION OF DIABETES DISTRIBUTION			
Mean	6.53	7.35	0.2632
SD	3.71	3.49	
HYPERTRIGLYCERIDEMIA STATUS			
Yes	34.21%	20.97%	0.1437
No	65.79%	79.03%	
ABNORMAL ABDOMINAL DIAMETER STATUS			
Yes	36.84%	38.71%	0.8522
No	63.16%	61.29%	
HYPERTENSION STATUS			
Yes	36.84%	37.10%	0.9801
No	63.16%	62.90%	

It was observed that majority in good glycemic control group belonged to 51-60 years age class interval (31.58%) with a mean age of 50.84 years and majority in poor glycemic control group belonged to same age class interval (35.48%) with a mean age of 52.73 years

With respect to gender, good glycemic control group males and females were equally distributed (50.00%) and majority in poor glycemic control group were females (54.84%) .

While analyzing BMI distribution, it was observed that, majority in good glycemic control group belonged to overweight BMI class interval (42.11%) with a mean BMI of 27.30 and majority in poor glycemic control group belonged to same BMI class interval (54.84%) with a mean BMI of 28.11.

Good glycemic control group had a mean FBS of 121.63 mg/dl and PPBS of 170.47 mg/dl and poor glycemic control group had a mean FBS of 161.21 mg/dl and PPBS of 239.58 mg/dl .Good glycemic control

group had a mean duration of diabetes of 6.53 years. Poor glyceimic control group had a mean duration of diabetes of 7.35 years.

While analyzing hypertriglyceridemia status, it was observed that, 34.21% of patients in good glyceimic control group and 20.97% of patients in poor glyceimic control group had hypertriglyceridemia. It was observed that, 36.84 % of patients in good glyceimic control group and 38.71% of patients in poor glyceimic control group had abnormal abdominal circumference. With regard to hypertension status, it was observed that, 36.84% of patients in good glyceimic control group and 37.10% of patients in poor glyceimic control group had hypertension.

Table 2: Distribution of microvascular complications

	Good glyceimic control	Poor glyceimic control	P value
PROTEINURIA STATUS			
Yes	26.32%	51.61%	0.0132
No	73.68%	48.39%	
RETINOPATHY STATUS			
Yes	13.16%	59.68%	<0.0001
No	86.84%	40.32%	

The data subjected to statistical chi squared test reveals the existence of statistically significant association between proteinuria status and glyceimic control and also between retinopathy status and glyceimic control.

There is an increased incidence of proteinuria in poor glyceimic control group compared to good glyceimic control group (25.30 percentage points increase, 34% higher) and an increased incidence of retinopathy in poor glyceimic control group compared to good glyceimic control group (46.52 percentage points increase, 78% higher) .

Table 3: Distribution of Mean platelet volume Vs Other parameters

	Good glyceimic control group	Poor glyceimic control group	P value
MEAN PLATELET VOLUME DISTRIBUTION			
Mean	7.82	10.21	<0.0001
SD	0.48	0.85	
MEAN PLATELET VOLUME Vs PROTEINURIA DISTRIBUTION			
	Proteinuria (+) group	Proteinuria (-) group	P value
Mean	10.26	8.62	<0.0001
SD	1.08	1.14	
MEAN PLATELET VOLUME Vs RETINOPATHY DISTRIBUTION			
	Retinopathy (+) group	Retinopathy (-) group	P value
Mean	10.50	8.79	< 0.0001
SD	0.95	1.20	
MEAN PLATELET VOLUME Vs GENDER DISTRIBUTION			
	Male	Female	P value
Mean	9.23	9.37	0.6146
SD	1.41	1.36	
MEAN PLATELET VOLUME Vs BMI DISTRIBUTION			
	Normal BMI	Overweight/obese	P value
Mean	8.90	9.45	0.0752
SD	1.37	1.36	
MEAN PLATELET VOLUME Vs HYPERTENSION STATUS			
	Hypertensive	Non hypertensive	P value
Mean	9.77	8.06	<0.0001
SD	1.25	0.81	

Majority in good glyceimic control group had a mean MPV of 7.82 fL and majority in poor glyceimic control group had a mean MPV of 10.21 fL .

The data subjected to statistical unpaired t test reveals the existence of statistically significant association between MPV distribution and proteinuria and also between MPV and retinopathy status.

Male group had a mean MPV of 9.23 fl, female group had a mean MPV of 9.37 fl . Mean MPV was higher in overweight/ obese group than in normal BMI group. It is also shown that there is increased mean MPV levels in hypertension +ve group compared to hypertension -ve group (1.71 fL increase, 18% higher).

CORRELATION:

HbA1C Vs MPV	
Pearson's R	0.75
R square	0.56
P value ANOVA	<0.0001

There is a strong positive correlation between Hba1c levels and MPV levels. This is indicated by the Pearson's R Correlation value of 0.75 with a p-value of <0.0001.

V. Discussion

Type 2 diabetes mellitus (T2DM) is a chronic disease which is posing as one of the major public health problems facing mankind. Increased platelet activation has been suggested to be involved in the pathogenesis of vascular complications. It is being found that MPV values are high in patients with diabetes mellitus, more so in uncontrolled diabetes. Platelet volume, a marker of the platelet function and activation, is proposed as to be involved as a causative agent with respect to altered platelet morphology and function. The higher the MPV, the larger and younger the platelets are and more is the risk for thrombosis and are associated with increased risk for hyperglycemic complications.

Age, gender, BMI, duration of diabetes, hypertriglyceridemia, abdominal circumference and hypertension status had no statistically significant role to play on mean platelet volume while correlating it with HbA1c and studying its association with microvascular complications in type 2 diabetes mellitus.

On internal comparisons between good and poor glycemic control patient groups, there is higher fasting blood sugar levels and post prandial blood sugar levels, higher incidence of proteinuria and retinopathy and high mean platelet volume levels in poor glycemic control patients

Higher mean platelet volume levels are found in patients with proteinuria, retinopathy and with hypertension

Correlation analysis results revealed that

- For every 1% increase in Hba1c level there is a 5.1 fl increase in MPV
- For every 1 year increase in duration of diabetes there is a 9.0 fl increase in MPV
- For every 100mg/dl increase in FBS there is a 7.96 fl increase in MPV
- For every 100mg/dl increase in FBS there is a 7.69 fl increase in MPV

VI. Conclusion

Our results showed significantly higher MPV in poorly controlled diabetics, and still higher in those with micro albuminuria and retinopathy. Hence, from this study, we can safely conclude that Mean platelet volume (MPV) is an important, simple, effortless, and cost-effective tool measured by hematology analyzer to assess the volume and function of platelets and thus has potential to be used as indicator of presence of vascular complications.

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