Original Article

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# Study on Mean Platelet Volume and Platelet Count in Diabetes Mellitus Type 2

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## ABSTRACT

**Background:** Most Diabetes Mellitus related deaths are due to increased risk of micro- and macrovascular complications of the disease. Larger platelets with higher mean platelet volume increase the propensity to thrombosis. Therefore, increased MPV is emerging as a risk factor for vascular complications.

**Objectives:** To determine mean platelet volume (MPV) and platelet count (PC) in diabetics (type2) and non-diabetics and to determine correlation of MPV and platelet count with fasting blood sugar.

**Methods:** This prospective study was conducted on 100 subjects with type II DM and 50 non-diabetic controls over a period of 3 months.

**Results:** Significant increase in value of MPV was seen in diabetics.

**Conclusion:** MPV being a simple, economical test, can serve as an effective tool in monitoring the patients for thrombogenicity especially in patients with altered blood glucose metabolism.

***Keywords:*** *Diabetes Mellitus, Fasting Blood Sugar, Mean Platelet Volume, Platelet Count*

## Introduction

Diabetes mellitus (DM) is a global health problem. Most DM related deaths are due to the increased risk of developing atherosclerosis and micro- and macrovascular complications related to diabetes mellitus. Larger platelets with higher mean platelet volume (MPV) are hemostatically more reactive and produce higher amounts of the prothrombotic factor -Thromboxane A2, increasing the propensity to thrombosis. Therefore, increased MPV is emerging as an independent risk factor for thromboembolism, stroke and myocardial infarction. Activity of platelets is usually determined by very simple platelet indices like platelet count(PC) and MPV. Amongst that MPV is a proven marker of the platelet function and activation. In patients with diabetes, MPV was higher compared with the normal glycemic control.[1] It has been shown that diabetic patients have increased thrombotic adhesion, aggregation, thromboxane synthesis and platelet factor 4 plasma levels.[2] Aim of the present study **is** to determine mean platelet volume and platelet count in diabetics (type2) and non-diabetics and**, t**o determine correlation of mean platelet volume and platelet count with fasting blood sugar.

## Materials and Methods:

The present study is a prospective study which included type II diabetic patients who were screened from outpatient clinic of a medical college hospital in South Karnataka, over a period of three months. Institutional Ethical Committee gave approval for the study A total of 100 patients with type II DM and 50 non-diabetic controls belonging to the age-group of 35 years and older constituted the study population. Subjects on anti-platelet medications, subjects with leucocytic or platelet disorders and subjects with Hb<13g/dl in males and Hb<11.5g/dl in females were excluded from the study. Blood samples were collected from these patients after overnight fasting(8 hours) in EDTA and Fluoride vacutainers for measurement of complete blood count and blood glucose levels. All samples were run for blood glucose and complete blood counts within half an hour to avoid variations relating to old samples. Blood glucose levels were tested using automated biochemistry analyzer. The platelet count and MPV estimated using automated blood cell counter.

## Results

Initially the MPV and PC of diabetics and non diabetics were compared(Table 1). Independent sample t test was used for the same. In diabetics, MPV had a mean value of 9.64 with standard deviation of 0.81.In non diabetics the mean value was 8.66 with standard deviation of 0.58 . In diabetics, PC had a mean value of 284.21 with standard deviation of 79.41.In non diabetics the mean value was 298.18 with

standard deviation of 78.11. It was concluded that the mean platelet volume showed a statistically significant difference between the groups (p value <0.001) whereas there was no statistically significant difference with respect to platelet count between the groups (p value=0.309)

To examine the correlation of the two groups with respect to MPV and PC, scatter plot was used. When MPV and FBS among diabetics was correlated(Figure 1), it was found that there was significant correlation between the MPV and FBS with Pearson's correlation coefficient of 0.2 and p value = 0.03. Correlation between PC and FBS among diabetics was done (Figure 2). It showed significant correlation between the PC and FBS with Pearson's correlation coefficient of 0.19 and p value = 0.04.

On correlating MPV and FBS among non diabetics(Figure 3), there was no significant correlation between the MPV and FBS with Pearson's correlation coefficient of 0.263 and p value = 0.06. On correlating PC and FBS among non diabetics (Figure 4),there was no significant correlation between the PC and FBS with Pearson's correlation coefficient of 0.06 and p value = 0.65.

## Discussion

DM is a complex syndrome characterized by chronic hyperglycaemia responsible for complications affecting the peripheral nerves, kidneys, eyes, and micro- and macrovascular systems. The prevalence of all types of diagnosed diabetes in most western societies is 3–7%. Countries with highest number of diabetics are India(19 million),China(16 million) and United States(14 million) [3,4].The increased morbidity and mortality in DM is due to its vascular complications. Diabetic patients are at risk of increased thrombosis and atherogenesis. Changes in hemostatic balance constitute a pathogenetic factor with a role in vascular complication in DM.

Platelets play a major role in hemostatic balance. Changes in platelets in diabetic patients have been studied extensively

**Table 1: Comparison of mean platelet volume and platelet count in diabetics and non diabetics.**

| | Diabetics | | Non diabetics | | P value |
|---|---|---|---|---|---|
| | Mean | Standard deviation | Mean | Standard deviation | |
| Mean Platelet volume(fL) | 9.64 | 0.81 | 8.66 | 0.58 | <0.001 |
| Platelet count (Lakhs/cu.mm) | 284.21 | 79.41 | 298.18 | 78.11 | 0.309 |

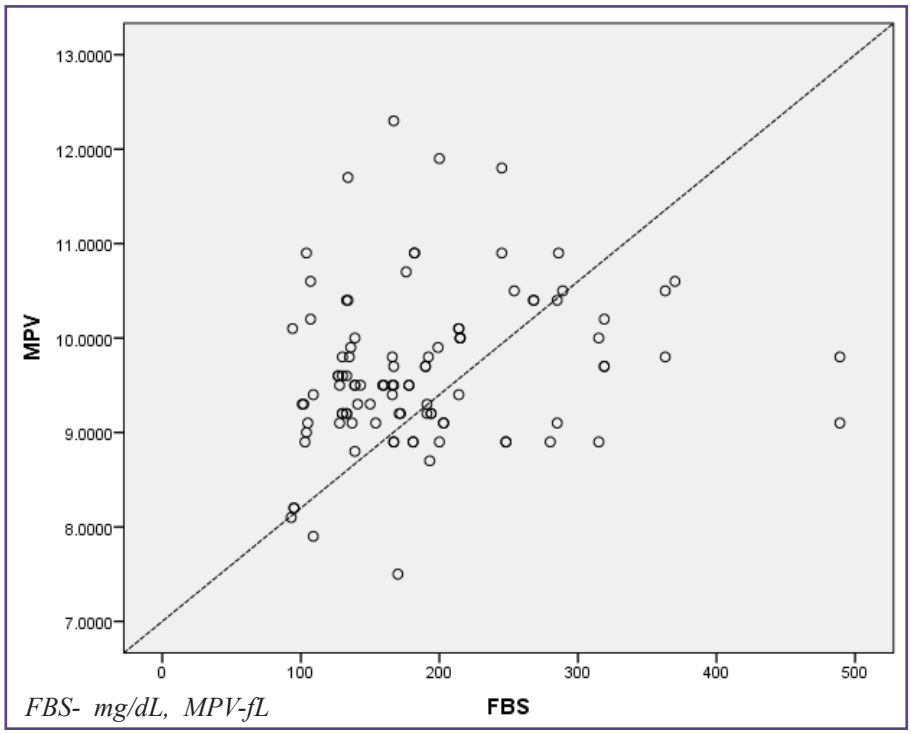


**Fig. 1: Scatter plot showing the Correlation between MPV and FBS among diabetics**

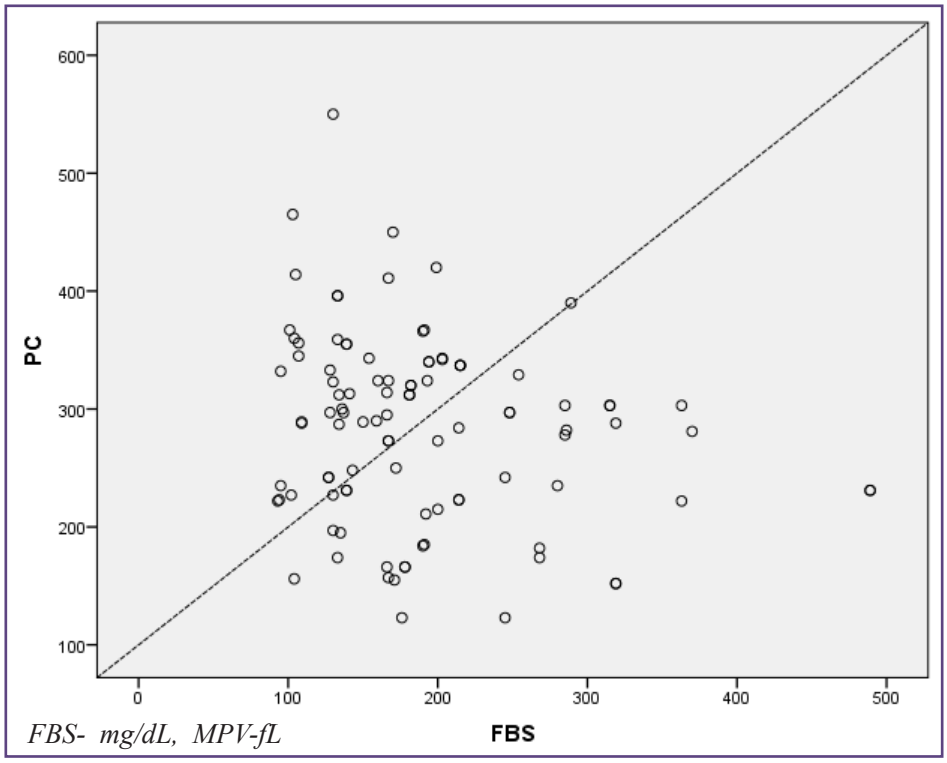


**Fig. 2: Scatter plot showing the Correlation between PC and FBS among diabetics.**

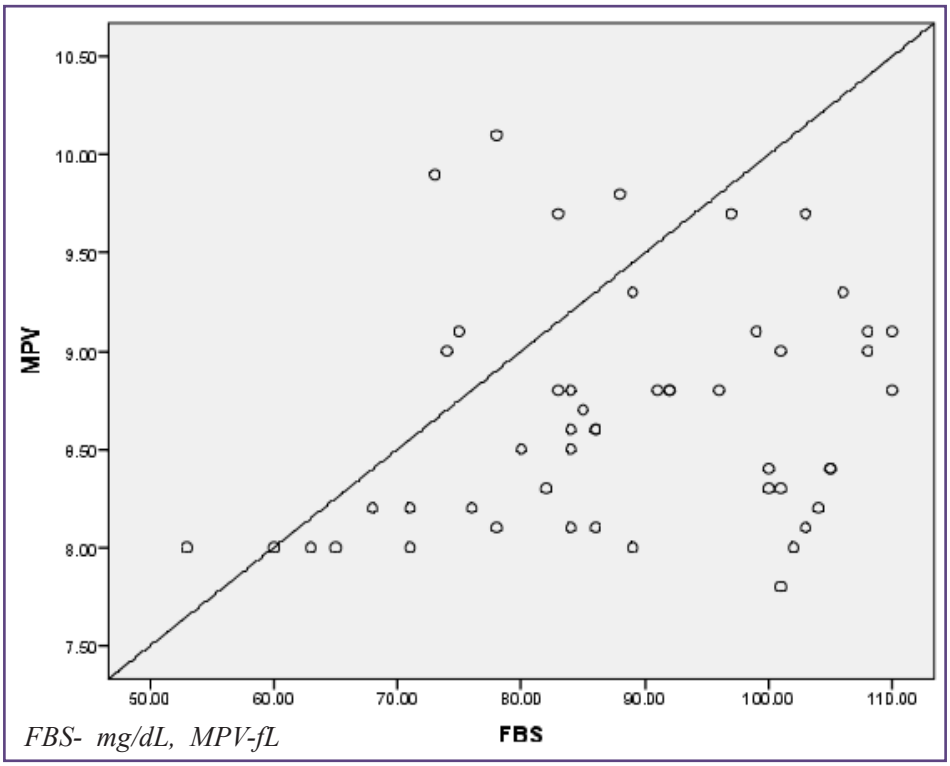


**Fig. 3: Scatter plot showing the Correlation between MPV and FBS among non diabetics.**

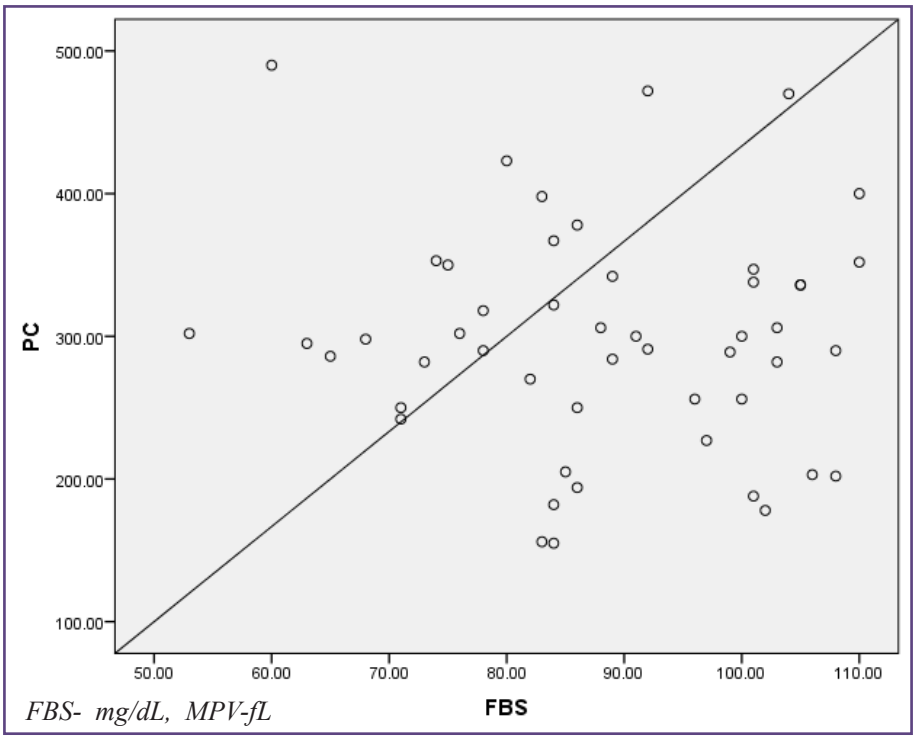


**Fig. 4: Scatter plot showing the correlation between PC and FBS among non diabetics**

and an increase in thrombotic adhesion, aggregation and secretion has been shown in many of these.

Mean platelet volume is an indicator of platelet function and activation. Large platelets have metabolically and enzymatically denser granules than smaller ones, and display high thrombotic potential [5,6]. This suggests a relationship between platelet functions, mainly MPV and vascular complications of DM. Mean platelet volume, a determinant of platelet activation, is an emerging risk factor for atherothrombosis. Hyperglycemia increases platelet reactivity directly and by promoting glycation of platelet proteins.

Various pathogenic mechanisms were proposed, of which significant ones are:

1. Persistent hyperglycaemia and its metabolic products causing osmotic swelling of platelets
2. Shorter life span of platelets in diabetics leading to higher platelet turn over with younger platelets being larger, more active and thrombogenic.
3. Platelets from patients with altered fasting glucose also have dysregulated signalling pathways as well as have significantly higher von-Willebrand factor levels in serum, resulting in an increased tendency to aggregate and activate. [7,8]

In a study conducted by Kapoor et al 3471 subjects subjects were taken for evaluation of fasting blood glucose (FBG) levels, PC and MPV, they found progressive increase in value of MPV with the increasing FBG levels. The platelet count however, did not show much statistical significance with rising glucose levels.[1] On the contrary ,in a study conducted by Yenigün et al, there was no association found between MPV, and HbA1c and fasting blood glucose, but they found an association between higher MPV and macrovascular complications.[2]

In a study conducted by Akinsegun et al on diabetics, a positive statistical Pearson's correlation was seen between MPV and fasting blood sugar and duration of diabetes. While a negative correlation was seen between platelet count and fasting blood sugar, and duration of diabetes.[7]

Kodiatte et al conducted a study which showed that, in diabetes mellitus platelets become more reactive and aggregable and their mean volume(MPV) is increased. The increased platelet size may be one of the factors in the increased risk of atherosclerosis associated with diabetes mellitus and associated vascular complications. And they concluded that MPV would be a useful prognostic marker of cardiovascular complications in diabetes.[8]

A study by Ulutas et al showed a relationship between MPV and HbA1c. They suggested that platelets of diabetic patients become more aggregable and reactive due to increased MPV. Increased risk of atherosclerosis in type 2

DM may be a result of high MPV. Therefore, MPV might be a useful prognostic marker of cardio-vascular complications in patients with type 2 DM.[9]

In a study conducted by Ozder et al it was shown that in diabetes mellitus, MPV is increased and it is indicative of worsening glycemic control. The increased platelet size may be one of the factors in the increased risk of atherosclerosis associated with diabetes mellitus and associated micro- and macro-vascular complications. Hence, MPV would be a useful prognostic marker of cardio-vascular complications in diabetes. They also proposed that increase in HbA1c was directly proportional to increase in MPV.[10]

In a study by Coban et al, results showed that subjects with impaired glucose tolerance(IGT) have higher MPV, which suggests increased platelet activation. Increased platelet activity could contribute to increasing the risk of atherothrombotic complications in IGT. Thus, due to the positive correlation between MPV and 2 h plasma glucose levels during oral glucose tolerance test, MPV may have clinical implications.[11] According to a study conducted by Dayal etal mean MPV was significantly higher in the diabetic group compared to the controls[12] .

Shah et al. reported a significant correlation between MPV and the degree of glycemic control in diabetic patients. They suggested that the positive relationship between an increased glucose level and increased MPV is a unique phenomenon of diabetes.[13] Although Kim et al mentioned negative correlation between MPV and FBG with normal glucose tolerance and intermittent hyperglycemia in Korean subjects, there was positive relationship between an increased glucose level and increased MPV in diabetes .[14]

In our study ,MPV showed significant correlation with FBS among diabetics similar to the results obtained in study by Kapoor et al,Kodiatte et al,Ulutas et al, and Ozder et al.[1,8,9,10]

In our study, the mean platelet count in the diabetic group was lower than that of the nondiabetic group that was similar to the studies done by Hekimsoy et al[15]. It is however in contrast with the findings of a study conducted by Thomas et al[8]. This suggests that the platelet count is the net result of the interplay of platelet survival and platelet production rate.Hence the platelet count could be dependent on several variables,that is, mean platelet survival, platelet production rate, and turnover rate in DM.

Keeping in view the uncertainties regarding results of various studies conducted in past further large prospective studies should be conducted to confirm the clinical utility of this marker and also to elucidate the association between MPV and platelet hyper-reactivity in relation with fasting plasma glucose levels. Therefore, it may be concluded that glycemic control decreases the hyperactivity of the platelet function and thus may prevent or delay possible diabetic vascular complications.However all these data has to be confirmed with larger studies.

## Conclusion

Our study supports the possibility of increase in MPV with rise in fasting plasma glucose levels. It is emphasized that MPV can be quick ,cost effective and very simple tool especially in developing country like India with limited resources to predict early vascular complications in patient with altered glucose metabolism.

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