

# Association of Mean Platelet Volume With The Degree of Retinopathy in Patients with Diabetes Mellitus

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## ABSTRACT

**Aim:** We investigated the association of mean platelet volume (MPV) with the degree of retinopathy in patients with diabetes mellitus (DM).

**Methods:** Ninety patients with diabetic retinopathy (DRP) and 30 healthy individuals were included in the study. Diabetic patients included 30 background, 30 non-proliferative and 30 proliferative diabetic retinopathy cases. Complete blood count, intra- and intergroup comparisons of MPV values were performed.

**Results:** Mean values for MPV in patients with background, non-proliferative and proliferative DRP were  $7.76 \pm 0.72$  fL,  $7.94 \pm 0.61$  fL and  $8.18 \pm 0.89$  fL, respectively. MPV values of patients with background DRP was not significantly different from that of the control group and patients with non-proliferative and proliferative DRP as well. However, MPV values of patients with proliferative DRP were significantly higher than the values of control group ( $p < 0.05$ ). A significant correlation was found between the degree of retinopathy and mean values of MPV in diabetic patients ( $r = 0.214$ ,  $p < 0.05$ ).

**Conclusions:** We found an association between the degree of retinopathy and mean values of MPV. This finding suggests a role for platelets in the pathogenesis of vascular complications and that mean platelet volume would be useful in monitoring the disease progression.

**Keywords:** Diabetes mellitus, retinopathy, mean platelet volume.

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## INTRODUCTION

Mean platelet volume (MPV) is an indicator of the average size and activity of platelets. MPV is measured as the part of the complete blood count. Under normal circumstances larger platelets are younger and exhibit more activity. Higher levels of MPV are encountered in conditions with increased production in response to increased destruction of platelets such as immune thrombocytopenic purpura. Large platelets contain more dense granules and produce large amounts of thromboxane A<sub>2</sub>. Thus, platelets exhibit hyper-responsiveness to ADP- or collagen-induced aggregation (1). Various studies reported that increased levels of MPV is an independent risk factor for arterial thrombotic events such as myocardial infarction and cerebral thromboembolism (2-5). The patients with diabetes mellitus are at increased risk of macrovascular and microvascular complications. Particularly the incidence of arterial complications (coronary artery disease, cerebrovascular events) is higher compared to normal population. Studies are available which suggest an association between impaired platelet function and vascular complications in patients with diabetes mellitus (6,7). The purpose of our study was to compare MPV values of diabetic and control groups and to associate it with the degree of diabetic retinopathy.

## MATERIALS AND METHODS

Ninety patients with DM, admitted to the outpatient clinic of Endocrinology and Metabolism Department of Internal Medicine in Ataturk University, were included in this present study. The patients with hypertension, a history of coronary or cerebrovascular events, receiving cardiac and antiaggregant medications, those with thrombocytopenia and with accompanying medical condition were excluded. The diagnosis of DM was verified by clinical and laboratory examinations and the patients were consulted with the Department of Ophthalmology for fundoscopic examination and the degree of retinopathy was determined, if there is. Control group consisted of healthy 30 volunteers. Blood samples were drawn in 2 mL EDTA tubes from forearm vein in the morning during fasting and complete blood counts were obtained within 30 minutes by Beckmann Coulter Lh 1500 Analyzer. Samples of the control groups were also analyzed in 30 minutes. MPV values were obtained of both patients and the control group. Intra- and intergroup comparisons were made for MPV values of the study population.

## Statistical Analyses

The data was expressed by means of mean±standard deviation. Mean values of patient and control groups were compared by student t test. For subgroup analysis, firstly, one way ANOVA test was used to determine whether a significant difference between groups is exist or not. By reason of significant difference, an appropriate post hoc test (Tukey's HSD test) was applied to comparison of subgroups. The correlation coefficients among the variables were calculated by using Spearman's rho ordinal correlation test.

## RESULTS

The mean ages of the diabetic patients and the control group were 52.56±8.79 and 51.76±7.90 years, respectively. There was no statistically significant difference between the groups with respect to the age ( $p>0.05$ ). Mean values for MPV in diabetic and control groups were 7.96±0.76 fL and 7.52±1.01 fL, respectively (Figure 1). The difference between the groups was statistically significant ( $p<0.05$ ). Diabetic group was divided into three subgroups. Mean age was not found to be significantly different between the subgroups ( $p>0.05$ ). Mean values for MPV in patients with background, nonproliferative and proliferative DRP were 7.76±0.72 fL, 7.94±0.61 fL and 8.18±0.89 fL, respectively (Figure 2).

One way ANOVA test revealed a significant difference between groups ( $p<0.05$ ). Subsequently applied post hoc (Tukey HSD) test showed that mean MPV values of the patients with proliferative DRP were significantly higher than the healthy controls ( $p<0.05$ ). On the other hand, no significant difference was found between proliferative, non proliferative and background DRP subgroups ( $p>0.05$ ). Despite the lack of significant difference between mean values of MPV

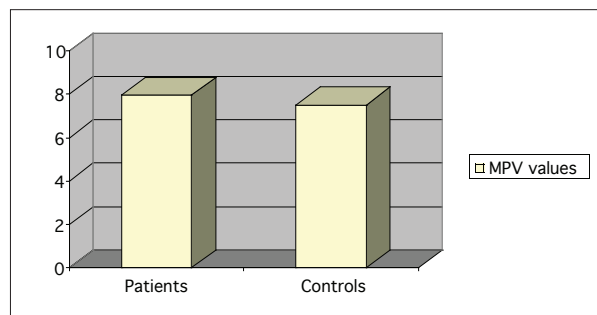
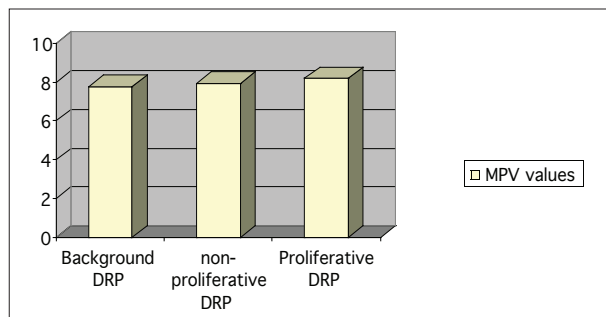


Figure 1. Mean MPV values in patients with diabetic retinopathy and controls.



**Figure 2.** Association between the degree of DRP and MPV values.

in patients with proliferative, non-proliferative and background DRP, mean values of MPV for the patients with proliferative DRP were found to be higher. Significant correlation was found between the degree of retinopathy and mean values of MPV ( $r= 0.214$ ,  $p<0.05$ ).

## DISCUSSION

Diabetes mellitus is a multisystemic disease affecting kidneys, eyes, peripheral nerves, micro and macro vascular systems. Functional and morphologic abnormalities of the platelets have been reported in diabetic patients. Increased activation of platelets has been implicated in the pathogenesis of vascular complications (6).

MPV is the indicator of the average size and activity of platelets. Generally, larger platelets store and release larger amounts of serotonin and  $\beta$ -thromboglobulin and produce more thromboxane A<sub>2</sub>, thus they are more reactive and prone to aggregation. Increased synthesis of thromboxane and/or decreased synthesis of prostacyclin and related platelet hyper-responsiveness have been demonstrated in diabetic patients. Higher values of MPV have been shown in diabetic patients in parallel to the microvascular complications such as retinopathy and microalbuminuria (6,7).

We studied whether the values of MPV are different in diabetic patients compared to normal population. We found higher values in diabetic population. Our secondary objective was to investigate the association between the mean values of MPV and retinopathy, a common microvascular complication in diabetic population. We found marked increase in MPV values, particularly in those with proliferative retinopathy, which suggests a role for increased platelet activity in the pathogenesis of proliferative retinopathy.

The most common cause of new blindness in adult population is diabetic retinopathy which develops two decades after onset in all cases with type 1 and more than 60% of cases with type 2 diabetes mellitus. Diabetic retinopathy begins with mild non-proliferative changes characterized by increased vascular permeability and advances to moderate to severe non-proliferative retinopathy characterized by vascular occlusions, microaneurysms, punctual hemorrhages, cotton wool spots and to a more severe form, the proliferative retinopathy, which is characterized by neovascularization (8).

Our study group was covering all three forms of retinopathy. The increase in MPV values was more apparent with advancing disease stage. A positive correlation was present between the degree of retinopathy and values of MPV. Although MPV values were higher in all stages of retinopathy compared to the control group, only the difference in patients with proliferative retinopathy reached to statistical significance. This might be due to the small number of cases.

Occlusions and micro aneurysms result in hypoxia in diabetic retinopathy which is a strong stimulus for new vessel formation. Vascular endothelial growth factor, which is released in response to hypoxia, strongly induces neovascularization. Platelet-derived growth factor, transforming growth factor-beta, epidermal growth factor, insulin-like growth factor-1, growth hormone and basic fibroblast growth factor induce collagen synthesis and cause proliferative retinopathy via neovascularization (9). We have not taken into account the growth factors in our study. However, significantly increased levels of MPV in proliferative retinopathy suggest that growth factors released from activated platelets indirectly contribute to the disease progression.

Several studies have demonstrated that, platelets accumulate in retinal vasculature and induce the release of local growth factors by causing inflammation (10). In another study, an increased level of platelet-derived growth factor in vitreous fluid of patients with proliferative DRP has been shown (11).

In conclusion we found increased levels of MPV particularly in patients with proliferative diabetic retinopathy. This finding suggests a role for platelets in the pathogenesis of retinopathy. Further studies are needed to demonstrate the mechanisms by which the platelets induce the development and progression of retinopathy in diabetic patients.

**REFERENCES**

1. Felgar RE, Ryan DH. Automated Analysis of Blood Cells. In: Hoffman R, Benz Jr EJ, Shattil SJ, et al, editors. *Hematology Basic Principles and Practice*. Philadelphia: Elsevier Churchill Livingstone, 2005:2673-86.
2. Smith NM, Pathansali R, Bath PM. Platelets and stroke. *Vasc Med* 1999;4:165-72.
3. Endler G, Klimesch A, Sunder-Plassmann H, et al. Mean platelet volume is an independent risk factor for myocardial infarction but not for coronary artery disease. *Br J Haematol* 2002;117:399-404.
4. Kiliçli Çamur N, Demirtunç R, Konuralp C, et al. Could mean platelet volume be a predictive marker for acute myocardial infarction. *Med Sci Monit* 2005;11:387-92.
5. Greisenegger S, Endler G, Hsieh K, et al. Is elevated mean platelet volume associated with a worse outcome in patients with acute ischemic cerebrovascular events? *Stroke* 2004;35:1688-91.
6. Papanas N, Symeonidis G, Maltezos E, et al. Mean platelet volume in patients with type 2 diabetes mellitus. *Platelets* 2004;15:475-8.
7. Hekimsoy Z, Payzin B, Ornek T, Kandogan G. Mean platelet volume in Type 2 diabetic patients. *J Diabetes Complications* 2004;18:173-6.
8. Fong DS, Aiello L, Gardner TW, et al. Retinopathy in diabetes. *Diabetes Care* 2004;27:84-7.
9. Powers AC. Diabetes Mellitus. In: Kasper DL, Braunwald E, Fauci AS, et al, editors. *Harrison's Principles of Internal Medicine*. New York: McGRAW-HILL Co, 2005: 2152-80.
10. Yamashiro K, Tsujikawa A, Ishida S, et al. Platelets accumulate in the diabetic retinal vasculature following endothelial death and suppress blood-retinal barrier breakdown. *Am J Pathol* 2003;163:253-9.
11. Freyberger H, Brocker M, Yakut H, et al. Increased levels of platelet-derived growth factor in vitreous fluid of patients with proliferative diabetic retinopathy. *Exp Clin Endocrinol Diabetes* 2000;108:106-9.