# MPV and PCT as biomarkers and prognostic factors for Type 2 Diabetic Patients with Retinopathy in Sudan

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## Abstract

*Background: Platelet parameters are markers of thrombotic potentials, and risk factors for micro-vascular complication in diabetic's retinopathy. In this study we aimed to determine platelet parameters among diabetic patient with retinopathy.*

*Materials and methods: this was cross-sectional study involved 100 participants consisting of 50 diabetics with retinopathy and 50 diabetic without retinopathy as controls. Two and half milliliters of blood were collected from participants into EDTA anticoagulant tubes. Complete blood count was performed using the Sysmex SEIMENS ADVIA 2120.*

*Results: The mean platelet volume and platelet crit were statistically significantly higher (P = <0.001) in diabetic retinopathy patients, while platelet count was insignificant decreased (P = 0.131), and platelet distribution width was insignificant increased (P = 0.056) among diabetic retinopathy.*

*Conclusion: This finding suggests a role for platelets in the pathogenesis of vascular complications (retinopathy) and that mean*

*platelet volume and platelet crit would be useful in monitoring the disease progression.*

**Keywords: DM**: Diabetes Mellitus, **DR**: diabetic retinopathy, **MPV:** mean platelet volume and **PCT**: platelet crit.

## 1. INTRODUCTION

Diabetic retinopathy is one of the most common micro vascular complications of diabetes, which can cause rapid blindness, Mean Platelet Volume (MPV) can be early marker for thrombosis and so early indicator for complication of diabetes such as retinopathy. In Sudan, published data was lacking regarding this study.

Diabetes mellitus (DM) is a long term metabolic disorder which characterized by hyperglycemia [1] Symptoms of hyperglycemia include frequent urination, increased thirst, and increased hunger. If left untreated diabetes can cause many complications such as heart diseases, strokes, diabetic retinopathy, kidney failure and poor blood flow in limbs which lead to amputation. [2]

Diabetic retinopathy make changes to retinal blood vessels that can cause them bleed, leak fluid and vision deformation. Affect up to 80% of diabetes who have had 20 years or more.[3] Most previous studies found that, higher platelet reactivity was noted even with a 1-h long increase in glucose concentrations in healthy subjects and in patients with DM [4] Elevated MPV was also found to be associated with impaired fasting glucose [5] And gestational DM. [6] In addition previous study revealed that occurrence of DR increases with increasing MPV levels (P > 0.05) [7] Thomas et al in 2012 found that, a higher mean platelet in diabetic retinopathy (P value = 0.001). [8] Muhammed Şahin show that Mean platelet volume in patients with retinal artery occlusion is significantly higher than non (P value =0.005). [9] Aslı Araz, et al; their study found that the mean platelet volume levels were higher in all diabetic patients, and they were highest in diabetics with retinopathy (P =<0.05). [10] Orhan Ateş found that, MPV in patients with background, non-proliferative and proliferative DR were 7.76±0.72 fL, 7.94±0.61fL and 8.18±0.89 fL, respectively. MPV values of patients with background DR were not

significantly different from that of the control group and patients with non-proliferative and proliferative DR as well. However, MPV values of patients with proliferative DR 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). [11]

Archana Buch showed that platelet count was significantly decreased in diabetics (P= 0.005). MPV was significantly increased in diabetic patients with complications as compared to diabetics without complications and non diabetic group (P < 0.0001). PDW showed statistically significant difference between diabetics with and without complications and non diabetics (P < 0.0001). However, no statistically significant difference was observed in platelet-large cell ratio (P-LCR) among all the three study groups. [12]

Study by Chawla R, *etal* observed platelet parameters, such as MPV, PCT and PDW were significantly higher in diabetic patients than controls. The Higher indices were observed in diabetic patients with microvascular complications compared with those without microvascular complications [patients with neuropathy with NDS > 6 had higher values of (MPV,PCT and PDW) than those with NDS < 6. Also There was significant difference regarding MPV when compared between diabetics with complication and the other two group (diabetic without complications and non-diabetics) ($p < 0.05$). Their result reported positive correlation between platelets parameters (PDW and MPV) with duration of diabetes.    [13]

Jindal S, et al, measure platelet indices (MPV, PCT, and PDW) and found that there are significance higher values (P= .006) in all indices among diabetic patient with complication compared with control group that without complication [14]

## 2. MATERIALS AND METHODS

This cross-sectional study was conducted in Diabetic center for endocrine glands specialist Khartoum state. The study population included 50 diabetic Patients with retinopathy (25 male and 25 female), compared with 50 diabetic Patients without retinopathy as control, the two groups were matched according to age and gender. The Study approved by the committee of faculty of medical laboratory sciences at

Al-zaiem Al-Azhari University, Samples was taken after verbal consent from participants, when aim of study was clarified and discussed with them. A total of 2.5 ml of venous blood sample was collected from patients in EDTA container after sterilization with 70% alcohol at the site of venous puncture. Samples were analyzed in fully automated hematology analyzer SEIMENS ADVIA 2120. The impedance method is principle of instrument in which cell size (MPV) detects by increase in highest of pulses (impedance) while the number of pulses is proportional to the number of cells (platelets count). The other platelet indices (PDW, PCT, P-LCR) is derived and calculated from platelet distribution curve. The PDW: means platelet size heterogeneity.

## 3. STATISTICAL ANALYSIS

Statistical evaluation was performed by SPSS. The data was expressed as median in both control and test groups by [a]Mann-Whitney test. The parameters were compared with Z test; difference between two medians. Pearson's coefficient of correlation (r value) was calculated to test the association between two variables. T test was done to test the significance of r value obtained and p value calculated (p value < 0.05 is considered significant, r of 0 - 1 reflect positive correlation (0.5 and more mean strong correlation), while r < 0 indicates negative correlation.

## 4. RESULT

This cross-sectional study was done among 50 DM patients with retinopathy and 50 DM without retinopathy as control were selected according to inclusion criteria for this study; the mean age for tested group was 55.76 years old, while the mean of age of control group was 50.4 years old.

There was a highly significant difference of median of MPV and PCT between test and control groups p value <0.001. However, there was insignificant difference of median of PLT count and PDW between test and control groups, the p value was (0.131 and 0.056) respectively. Table (1)

With increase duration of the disease of DM patient with retinopathy the MPV was significantly increased on patients (n = 50), (p value <0.001) ($r^2$ = 4.00).

Also the duration of the disease of DM patient with retinopathy has significant effect on PCT and PDW (p value <0.001) (r2 = 0.125), (p value =0.014) (r2 = 0.120) (n = 50) respectively.

This study showed insignificance variation on the effect of duration of the disease on PLT count, (p value =0.116) (r2 = 0.051)

No variation between male and female regarding platelets parameters Table (2).

**Table 1 Comparison of median (IQR) of MPV, PLT, PDW and PCT between test and control (n=50)**

| Variable | Median (IQR) | | Z statistic | *p*-value |
|---|---|---|---|---|
| | Test | Control | | |
| MPV (fl) | 9.40 (1.33) | 6.45 (0.8) | -8.621 | **<0.001** |
| Platelet count (x10³/µl) | 292.50 (143.00) | 331.50 (231.50) | -1.510 | 0.131 |
| PDW | 15.50 (1.35) | 15.05 (4.90) | -1.911 | 0.056 |
| PCT (%) | 0.27 (0.10) | 0.20 (0.11 | -3.575 | **<0.001** |

aMann-Whitney test was applied. P value less than 0.05 considered significant

**Table (2): Comparison of PLT parameters average and gender of case group.**

| PLT parameter | Sex Average | |
|---|---|---|
| | FEMALE | MALE |
| MPV( fl) | 9.59 | 9.63 |
| PLT(x10³/µl) | 302.8 | 316.76 |
| PDW | 15.78 | 16.73 |
| PCT (%) | 0.290 | 0.316 |

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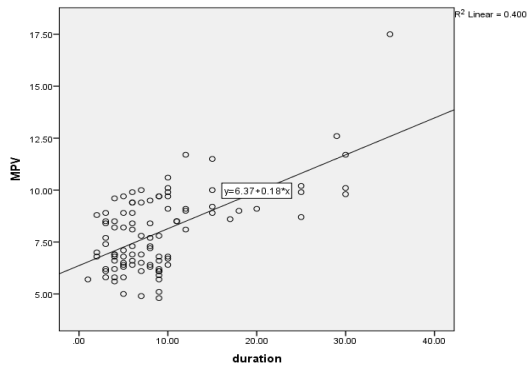


**Figure 1: relationship between MPV and duration of DM among patient with retinopathy (n = 50), (p value <0.001) (r² = 4.00).**



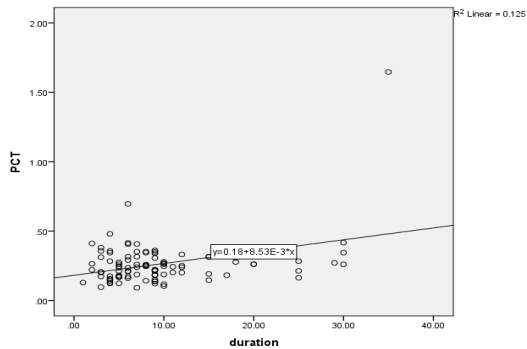**Figure 2: relationship between PCT and duration of DM among patient with retinopathy (n = 50), (p value <0.001) (r² = 0.125)**
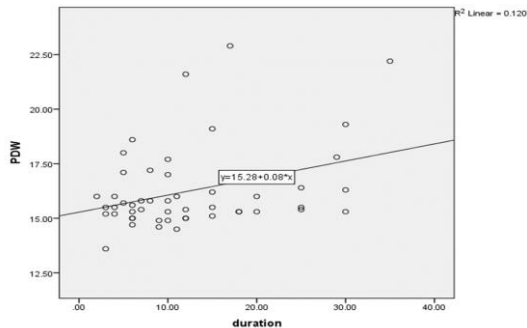


**Figure 3: relationship between PDW and duration of DM among patient with retinopathy (n = 50), (p value =0.014) (r2 = 0.120)**
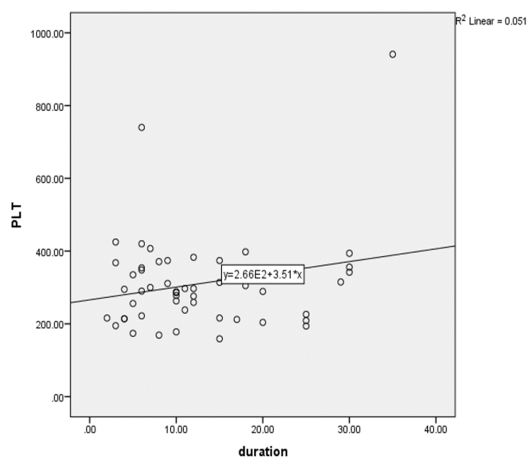
**Figure 4: relationship between PLT and duration of DM among patient with retinopathy (n = 50), (p value =0.116) (r2 = 0.051)**

## 5. DISCUSSION

MPV is the average size of platelets and reflect platelet activity. Generally, recent produced platelets are large in size and contain and release larger amounts of (thromboxane A2, ß-thromboglobulin and serotonin), 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 retinopathy in this study; this is in accordance with most of the previous studies, like Esra Ayhan Tuzcu (P=0.005),, Thomas (P= 0.005), Muhammad (P=0.006) and others studies. [7, 8,9 and10]

Increased in MPV among DM patients has not been properly detected yet especially in Sudan. But most developed countries worldwide applied researches on clarification of changes in platelets and their activation among DM patients who undergo vascular complication; Albino Carrizzo, etal reported that; Endothelial Dysfunction and Platelet Hyperaggregation, are the main determinant of vascular complication in DM patients [15], also patients with type2 DM have increased reactivity and activation of platelets and so atherosclerotic thrombus formation as dysregulation of the signaling

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pathway with activation of platelets occurs lead to occlusion of
microcapillary and consequence complication of DM. [16, 17]

In contrast some study suggested that platelet size was not
related to age and platelet age was determined at the time of production
from the megakaryocyte [18]

The current Sudanese study found an increased in MPV with
increase in diabetic duration. The result was similar to previous study
report; the severity of diabetic retinopathy is increased with duration
of diabetes. [10]

Also this study revealed that PCT and PDW have significant
association with diabetic retinopathy and diabetic duration; no
previous studies were found regarding this result.

Finally platelets count was found to be statistically
insignificant with diabetic retinopathy and had no effect on diabetic
duration; which was disagreed with study done by Archana Buchand
(Archana Buch, 2017) [12] , and other (Jindal S, 2011) [14] , differences
in results may related to the low sample size used in this study.

## 6. CONCLUSION

This study concluded that; MPV and PCT can be considered as
biomarkers and prognostic factors for early detection of diabetic
complication.

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