

RESEARCH ARTICLE

Evaluation of platelet function in subjects with type-2 diabetes mellitus: A case-control study

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Received: March 04, 2020; Accepted: May 14, 2020

ABSTRACT

Background: Diabetes mellitus (DM) has been growing as a worldwide health problem. Platelet morphology and functions have changed in diabetes because of its hyperactive behavior in DM 2 patient. **Aim and Objective:** This study aims to observe the change in the platelet parameters between the non-diabetics and diabetics patients. **Materials and Methods:** This case-control study was carried out on Type 2 DM cases ($n = 100$) and non-diabetic controls ($n = 100$). The study subjects were divided into two groups based on their glycosylated hemoglobin (HbA1c) report: With HbA1c levels $\leq 7\%$ ($n = 56$) and with HbA1c levels $> 7\%$ ($n = 44$). **Results:** There is statistically significant raise in mean platelet volume (MPV) in diabetics (control group: 10.45 ± 0.45 vs. diabetic group: 10.71 ± 0.39 , $P \leq 0.001$). It was observed that platelet distribution width (PDW) and MPV were increased in diabetics with HbA1c > 7 as compared to patients with ≤ 7 HbA1c (HbA1c ≤ 7 group vs. HbA1c > 7 group – PDW: 11.116 ± 1.28 vs. 11.593 ± 0.69 , $P = 0.03$, MPV: 10.67 ± 0.65 vs. 11.09 ± 1.03 , $P = 0.01$). **Conclusions:** The observation indicates the increase MPV value in diabetic patients which shows an increment in the size of platelet because of value-added prothrombotic factors. These larger sized platelets cause an increase in PDW and MPV value. Higher adherence and adhesion caused by hyperactive platelets in diabetes patients lead to vascular complications which are suggested by the present study through the significant high value of HbA1c in diabetics. Hence, MPV is considered as a distinguished prognostic marker in early identification of cardiovascular complications tandem reduction of fatality in diabetics.

KEY WORDS: Diabetes Mellitus; Glycosylated Hemoglobin; Mean Platelet Volume and Platelet Distribution Width

INTRODUCTION

Diabetes mellitus (DM) has been growing as a worldwide health problem. At present, in 2019, 463 million adults are suffering from diabetes and it will swell up to 700 million by the end of 2045. Majority of affected people are from the age

group of 40 to 59 years; however, its threat ranges from 20 to 79 years. The alarming concern is increasing the risk of type 2 diabetes which is 374 million people. It is estimated that India would leave its second highest burden impression on a global platform with 77 million adults from 2019 to 2045 by 134.2 million adults, leaving China on the top position.^[1]

Diabetes is a chronic metabolic disorder which is identified by its significant sign hyperglycemia. Hyperglycemia is a result of inadequate production of insulin or insulin resistance behavior of the human body.^[1] Insulin acts as a moderator of glucose level in the bloodstream and works as an antagonist of platelet hyperreactivity.^[2] Platelet morphology and functions have changed, because of its hyperactive behavior

Access this article online	
Website: www.njppp.com	Quick Response code 
DOI: 10.5455/njppp.2020.10.03057202014052020	

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in DM 2 patient.^[3] Moreover, this prolonged insulin resistance state causes a damaging effect on pericytes and vascular endothelium^[4] which make DM 2 patient more susceptible to diseases due to metabolic changes such as atherogenic dyslipidemia, hypertension, glucose intolerance, and prothrombotic state that enhance thrombosis and suppress thrombolysis.^[5,6] Ultimately, these changes anticipated to end up causing multiorgan damage and development of life-threatening organic microvascular deficiencies such as cardiovascular disease, neuropathy, nephropathy, and eye diseases such as retinopathy and blindness.^[1]

Role of platelet is vital in normal homeostasis, and thus, platelet indices, for instance, platelet count (PC), plateletcrit (PCT) (total mean of PC), platelet distribution width (PDW), mean platelet volume (MPV), and platelet-large cell ratio (P-LCR), are considered the prime indicators for any changes in platelet morphology.^[3,7-9] These indicators provide help in early identification of the prothrombotic event. MPV is an emergency risk marker for platelet activation since it shows the average size and activity of platelets. Many studies have depicted that these platelet indices show increasing trend results in diabetic patients which are not the case in non-diabetic patients.^[3,9] Therefore, this study is conducted to observe the change in the platelets parameters between diabetics and non-diabetics and also examine changes occurred on various platelet parameters by glycemic control and the duration of the disorder.

MATERIALS AND METHODS

This case-control study was carried out at the pathology department of NAMO Medical Education And Research Institute, Silvassa, Dadra and Nagar. A total of 100 individuals were included for the study who were diagnosed as a Type 2 DM, and age- and sex-matched 100 non-diabetic individuals were taken as controls. All participants were informed about the basic purpose of the study. Confidentiality was assured to them along with informed written consent. The Institutional Ethical Committee gave an ethical approval of the study. All the patients underwent a complete clinical examination. Demographic details were recorded. Few major diagnostic tests were performed along with overnight fasting status. The performed tests are the blood pressure examination, serum lipid profile, fasting and postprandial blood glucose levels, glycosylated hemoglobin (HbA1c), and platelet parameters such as PCT, MPV, PC (PLT), PDW, and P-LCR. Platelet parameters were estimated using an auto-analyzer. MPV was obtained using the formula, $MPV (fL) = ([PCT \% / PC \times 10^9 / l]) \times 10^5$. PCT estimates the total platelet mass in the blood. Histogram was used to check the normality of the data. The crest of the distribution curve was considered as 100% and the distribution was defined as 20% for PDW level. P-LCR was defined as the percentage above the normal platelet volume, i.e., 12 fL, in total PC.^[10] To examine the correlation between

the platelet parameter with glycemic control, the reference point of HbA1c has decided, i.e., seven. Various studies have taken up HbA1c level 7 as the reference points to distinguish between the appropriate and inappropriate control clinically.^[11] Hence, the diabetic patients were separated in two groups on the bases of HbA1c – one group was presenting 56 patients having HbA1c level $\leq 7\%$ while the second group was having 44 patients with HbA1c levels $> 7\%$ HbA1c.

Statistical Analysis

The collected data were entered into Microsoft Excel spreadsheet 2010 and analyzed by help EPI INFO software Ver.7. Moreover, Z test was applied to find out the outcome. The results have presented in mean $\pm$ standard deviation and checked at 95% of confidence level.

RESULTS

This case-control study was intended to observe the difference by comparing platelet parameters between the case – diabetic patients ($n = 100$) and the control – non-diabetic ($n = 100$) patients. Physical characteristics such as age, weight, height, and body mass index (BMI) of both groups are shown in Table 1. The results of Z test did not show a statistically significant difference between the groups.

Platelet indices have been compared between control and diabetic group. The results depicted significant higher MPV value in diabetic patients (control group: 9.81 ± 0.4 vs. diabetic group: 10.20 ± 0.77 , $P = 0.02$, Table 2).

Table 1: Comparison of physical characteristics between controls and (case) diabetics

Variables	Group I control ($n=100$)	Group II diabetics ($n=100$)	P value
Age (years)	48.1 $\pm$ 6.116	49 $\pm$ 7.34	0.34
Height (m)	1.65 $\pm$ 0.11	1.66 $\pm$ 0.13	0.07
Weight (kg)	63.4 $\pm$ 8.8	64.4 $\pm$ 11.5	0.07
Body mass index	23.51 $\pm$ 3.2	23.7 $\pm$ 3.37	0.92

Table 2: Comparison of platelet parameters between controls and (case) diabetics

Platelets	Mean $\pm$ SD		P value
	Group I control ($n=100$)	Group II diabetics ($n=100$)	
PLT	2.74 $\pm$ 0.47	3.010 $\pm$ 0.81	0.08
PDW	11.70 $\pm$ 0.86	11.98 $\pm$ 1.78	0.49
MPV	9.81 $\pm$ 0.4	10.20 $\pm$ 0.77	0.02*
P-LCR	25.50 $\pm$ 2.98	26.36 $\pm$ 5.43	0.46
PCT	0.27 $\pm$ 0.04	0.29 $\pm$ 0.07	0.11

*Statistically significant. PDW: Platelet distribution width, MPV: Mean platelet volume, P-LCR: Platelet-large cell ratio, PCT: Plateletcrit

Moreover, we compare the platelet parameters between diabetic patients having HbA1c value, less than or equal to 7 and greater than 7. With this the result indicates that MPV and PDW indices were significantly increased in diabetics with HbA1c >7.

Table 3 clearly shows a statistically significant increase in PDW and MPV values (HbA1c ≤ 7 group vs. HbA1c >7 group – PDW: 11.37 ± 1.01 vs. 12.42 ± 1.48 , $P = 0.01$, MPV: 10.01 ± 0.70 vs. 10.54 ± 0.85 , $P = 0.01$).

DISCUSSION

In this study, all the platelet indices were increased in diabetic patients as compared to non-diabetic patients but only MPV showed a statistically significant result. The similar statistically significant rise in MPV value in diabetics has been observed in Kodiatte *et al.*,^[3] Papanas *et al.*,^[12] Shilpi *et al.*,^[13] Jindal *et al.*,^[14] Demirtunc *et al.*,^[15] Ozae and Eker,^[16] and Ulutas *et al.*^[17] In contrast to this, the study result of Akinsegun *et al.*^[18] shows a lesser value of MPV in diabetics and also it is not significant.

However, in this study, other than MPV parameter, PDW and P-LCR value, also raised in diabetics, but these increments were not statistically significant enough to draw any decisive conclusion. On the other hand, the statistically significant rise in the value of both the parameters has observed in the study of Shilpi *et al.*^[13] Moreover, the higher and significant value of PDW has observed in the study results of Demirtas *et al.*,^[15] Jabeen *et al.*,^[19] and Dalamaga *et al.*^[20] In addition to this, Jindal *et al.*^[14] and Ashraf *et al.*^[21] showed the significantly higher result for P-LCR parameter.

Moreover, in diabetic patients, the mean PC has raised but not statistically significant which produces an analogy with a study result of Demirtunc *et al.*^[15] However, Kodiatte *et al.*^[3] showed a statistically significant rise in the mean PC in the respective group of the patients.

In the present study, MPV and PDW were carrying significantly higher value in the diabetics with HbA1c >7%

while comparing them to diabetics with HbA1c $\leq 7\%$. Kodiatte *et al.*^[3] and Zuberi *et al.*^[9] also showed similar increment in value for MPV and PDW in the diabetics with HbA1c >7%.

Platelet hyperreactivity is directly linked with the size and consistency of the platelet surface. The higher glucose level in hyperglycemic patients is generating a higher amount of glycoprotein.^[18] These glycoproteins undergo non-enzymatic glycation and decrease the platelet membrane tenderness. Bancroft *et al.*,^[22] eventually, these hyperactive platelets are transformed into multi-pseudopodia structure and become potentially liable for adhesion and adherence. Hence, the present study result of increase MPV and PDW is depicting platelet hyperreactivity. Thus, MPV can be a distinguished prognostic marker and a simple, economical tool to monitor the progression and control of DM and helps in preventing complications in primary health care.

This is a hospital-based study with small sample size. Therefore, the result of the present study could not be generalized to the population.

CONCLUSIONS

The present study indicates the increase MPV value in diabetic patients which shows the increment in the size of platelet because of value-added prothrombotic factors. These larger sized platelets cause an increased value of PDW and MPV indices. Moreover, higher adherence and adhesion caused by hyperactive platelets in diabetes patients lead to vascular complications which are suggested by the present study through the significant high value of HbA1c in diabetics.

ACKNOWLEDGMENT

I express my sincere gratitude to Dr. Jayant Makwana, Professor, to sharing his wisdom during the study. I am thankful to Dr. Bhadrash Vaghela, Associate Professor, for his suggestions. I want to thank wholeheartedly to the study participants without whom this study would not have been completed.

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Table 3: Comparison of parameters between diabetics with HbA1c ≤ 7 and HbA1c >7

Platelet parameters	Mean $\pm$ SD		P value
	Diabetics with HbA1c ≤ 7 (n=56)	Diabetics with HbA1c >7 (n=44)	
PLT	2.92 $\pm$ 0.79	3.09 $\pm$ 0.84	0.41
PDW	11.37 $\pm$ 1.01	12.42 $\pm$ 1.48	0.01*
MPV	10.01 $\pm$ 0.70	10.54 $\pm$ 0.85	0.01*
P-LCR	26.04 $\pm$ 5.14	26.73 $\pm$ 5.74	0.62
PCT	0.29 $\pm$ 0.06	0.3 $\pm$ 0.09	0.56

*Statistically significant. PDW: Platelet distribution width, MPV: Mean platelet volume, P-LCR: Platelet-large cell ratio, PCT: Plateletcrit

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How to cite this article: Goyal P, Mahajan S, Parmar C. Evaluation of platelet function in subjects with type-2 diabetes mellitus: A case-control study. *Natl J Physiol Pharm Pharmacol* 2020;10(08):667-670.

Source of Support: Nil, **Conflicts of Interest:** None declared.