Original Article

Platelets Indices as Biomarkers of Glycemic Control and Progression of Complications in Patients of Diabetes Mellitus Type II

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Abstract

Objectives: The main objective of this study was to analyze various platelet parameters among diabetes mellitus type patients (without and with complications) and controls.

Methodology: It was a prospective, cross sectional study, carried out at Dept. of Pathology and Dept. of Medicine, Indus Medical College Hospital, Tando Muhammad Khan. Complete blood count (CBC), serum glucose levels, and HbA1c were evaluated. All participants were divided into three groups: Group 1: Normal Controls (n=35); Group 2: DM type II patients without complications (n=35); and Group 3: DM type 2 with complications (n=35). Patients were also categorized as good and poor glycemic control (HbA1c <7% and HbA1c >7% respectively). All data variables were analyzed with SPSS 21.0. ANOVA test was applied to see the significant correlation. P value of <0.05 was considered statistically significant.

Results: All platelet parameters including mean platelet volume (MPV), platelet – large cell ratio, platelet distribution width (PDW), and plateletcrit and were significantly altered among patients of DM type 2 with complications as compared to other groups.

Conclusion: This study demonstrated higher platelet indices among diabetes mellitus type 2 patients. Our results postulated simple and cost – effective tool for monitoring of progression of complications in diabetic mellitus type 2 patients.

Keywords: Diabetes mellitus, Glycemic control, Mean platelet volume, Platelet indices, Platelet distribution width

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Introduction

Platelet function is an essential pathophysiological factor in the production of atherothrombosis among patients of DM type 2. The increased activity of platelets plays role in the advancement of vascular problems in this metabolic disorder. Platelet count and mean platelet volume (MPV) are effective, simple and cheap tests that may predict angiopathic or vascular complications in DM type 2.

Diabetes mellitus is considered as a common metabolic disorder and is increasing globally causing morbidity. Approximately 387 million people around the world are suffering from diabetes mellitus. By 2025, the prevalence of DM is estimated to be increased by 2025, with middle – income and low – income countries being most affected.[1] Chronic increase in glucose level in patients with diabetes is responsible for many macrovascular and microvascular complications.[2] Platelets play important role in many chronic vascular and non – vascular disorders. Diabetes mellitus is also one of the prothrombotic states, as it is causing a persistent increase in glucose level, dyslipidemias and resistance to insulin, leading to pericyte and endothelial damage. Large – sized platelets with dense granules are more active enzymatically as well as metabolically.[3,4] In diabetes mellitus mean platelet volume (MPV) is usually altered mainly due to stimulation of platelets or production rate of platelets. PDW is the measurement of heterogeneity of the platelets and is because of platelet aging or heterogeneous differentiation of the megakaryocytes. The platelet – P-LCR is the estimation of platelets with large-size. Increased MPV is seen to be altered in diabetes mellitus, metabolic disorders and stroke. Recently higher MPV is related to ocular complications of DM.[5,6] MPV to MPR is considered as an

important and independent risk factor in vascular disorders and septic patients. [7]

Parameters associated with platelets are routinely available in the laboratory using automated blood cell counters. These parameters include MPV, PCT, P-LCR, and PDW. Patients with diabetes mellitus with early prothrombotic stage can be investigated using these parameters. [8]

The central aim of this study is to determine various platelet parameters among diabetes mellitus type II patients, with or without complications.

Methodology

This was a cross-sectional, prospective study Patients were at Dept. of Pathology and Dept. of Medicine, Indus Medical College Hospital, Tando Muhammad Khan. The study was carried out for a period of 6 months (September 2019 - February 2020). Patients with divided into three groups: Normal controls (Group 1), diagnosed diabetic patients with no complications (Group 2) and diagnosed diabetic patients with complications (Group 3). Consent along with a brief history from the patients was taken.

Results

A total of 104 patients were included in the study. They were categorized into three groups: Group 1 included normal control (n=35), group 2 included diabetic patients with no complications (n=35) and group 3 consisted of diabetic patients with complications (n=35) (Figure 1).

Distribution of Study Population

- Controls
- Diabetes without Complications
- Diabetes with complications
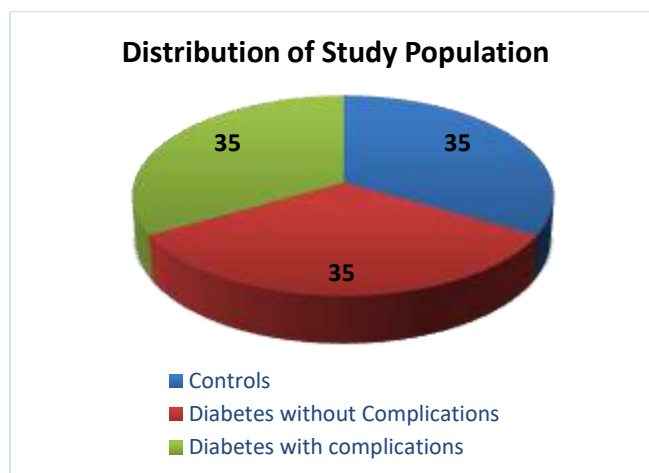
Figure 1: Distribution of Study Population (n=105)

Hemoglobin level was decreased in diabetic patients with complications (p – value 0.04). Platelet

Table I: Comparison of parameters among 3 groups (n=105)			
Variable	Group 1: Control (n=35)	Group 2: DM without complications (n=35)	Group 3: DM with complications (n=35)	P-value
Hb (g/dL)	13.43 ± 1.83	12.84 ± 1.01	11.9 ± 0.98	0.04
Platelet Count x10^9/L)	284 ± 94	278 ± 71	372 ± 43	0.02
MPV (fL)	12.09 ± 1.19	11.94 ±1.04	9.01 ± 1.41	0.04
PLCR (%)	43.12 ± 10.84	31.59 ± 8.45	22.43 ± 6.53	<0.001
Plateletcrit (%)	0.39 ± 0.1	0.34 ± 0.08	0.15 ± 0.03	<0.001
PDW (fL)	15.92 ± 2.98	16.04 ± 1.95	21.42 ± 1.51	<0.001

Table II: Comparison of variable in patients with different glycemic status		
Variable (mean)	HbA1c <7% (Good Glycemic Control) (n=40)	HbA1c >7% (Poor Glycemic Control) (n=38)	P-value
Age (years)	34.24	36.54	0.58
Weight (kg)	53.12	59.42	0.74
Fasting blood sugar (mg/dL)	92.42	131.74	<0.001
Postprandial blood sugar (mg/dL)	109.53	158.85	<0.001
Hemoglobin (g/dL)	13.42	13.01	0.76
Platelett Count (x10^9/L)	269	347	0.02
MPV (fL)	12.75	9.04	0.003
PLCR (%)	42.58	32.18	<0.001
Plateletcrit (%)	0.36	0.17	<0.001
PDW (fL)	16.13	20.01	<0.001

counts were also reduced in diabetic patients with complications with a statistically significant difference (p = 0.02). All platelet indices including MPV, PLCR, and plateletcrit were notably decreased in diabetic patients having complications, though PDW was higher as compared to diabetic patients with no complications and normal control group (Table I).

On evaluation based on glycemic control, patients having poor glycemic control had elevated fasting blood sugar, post-prandial blood sugar, platelet counts and PDW, while mean plateletcrit and P-LCR were higher in patients with good glycemic control (Table II).

Discussion

Diabetes mellitus is among the morbid and commonest metabolic diseases, associated with macroangiopathic and microangiopathic complications.[9] Diabetes mellitus is considered as prothrombotic state, with platelet playing an important part in the production of atherosclerosis and many complications. Platelets with large size are vigorously dynamic and have more dense granules, thereby manufacture extra β – thromboglobulin, serotonin, and thromboxane A_2, which ultimately cause aggregation of platelets. [10,11]

In our study, we compared patients with diabetes mellitus type II with and without complications with normal controls. There was no statistically significant difference between demographic parameters e.g. age, weight etc. Our study showed a significant difference of platelet parameters in patients with diabetes mellitus type II; although parameters were more altered in patients with complications as compared to patients without complications. Various studies have been performed to see the association of platelet parameters with glycemic control.

The study conducted by Swaminathan et al mentioned that MPV was raised in patients of diabetes mellitus in contrast to non – diabetic population. Parameters were more deranged in patients having poor glycemic control and patients having long history of DM.[12] Bhattacharjee et al proved in his study that platelet parameters were significantly higher among patients having poor glycemic control in contrast to patients having good glycemic control.[13] MPV was raised among patients in diabetic mellitus having poor glycemic control and patients presented with complications in a study by Dubey et al.[14] Jabeen et al in her study demonstrated that fasting blood glucose, glycated hemoglobin, MPV and PDW were raised among patients of diabetes mellitus as compared to normal control. Poor glycemic control had a positive correlation with elevated glycated hemoglobin.[15]

Dwivedi et al showed in one study that patients suffering from diabetic complications (e.g. diabetic nephropathy) were having higher platelet indices values. Patients having good glycemic control were having decreased values of platelet indices in contrast to poor glycemic control. He showed a positive correlation between the duration of diabetes mellitus and platelet indices. There was a negative correlation between HDL and platelet indices with a statistically significant difference. [16,17]

It is estimated that the size of the platelet plays important role in pathogenesis, with platelet with large volume are more aggregatable and more reactive. An increase in serum glucose level (hyperglycemia) is also an important factor that is responsible for increased reactivity of the platelets, therefore exert a direct effect on platelets and promotes the processes of glycosylation of platelets proteins. In this context, large platelets are imitated by an increase in MPV and its evaluation seems to be very essential as it is considered as an important and independent risk factor in the context of acute myocardial infarction, stroke and thromboembolism.[18]

Conclusion

In our study, platelet indices were significantly altered in patients having diabetes mellitus, especially in patients suffering from diabetic complications. Platelets and their indices are shown to be a good indicator for the detection of thrombotic states and make possibilities of early interventions in patients having diabetes mellitus type 2.

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