

Platelet Indices: As Biomarkers Of Vascular Complications In T2Diabetes Mellitus

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I. Introduction

In the modern world, diabetes mellitus (DM) has become a global health problem.¹ World Health Organization (WHO) defines diabetes mellitus (DM) as a chronic, metabolic disease characterized by elevated levels of blood glucose (or blood sugar), which leads to damage to the heart, blood vessels, eyes, kidneys, and nerves. Four hundred twenty-two million people suffering from it, and its incidence is rapidly rising in the middle- and low-income countries.² There is a globally aimed to halt the rise in diabetes by 2025.² The hyperglycemia, dyslipidemia, and insulin resistance in diabetes causes endothelial and pericyte injury, making it a prothrombotic state.

Platelets are known to play a vital role in thrombosis. Platelets with altered morphology are found in diabetics.³ Mean platelet volume (MPV) is a blood parameter used for measuring platelet size.⁴ Hence increased mean platelet volume (MPV) and platelet distribution width (PDW) might be associated with increased thrombotic potential.⁵ Diabetic patients have shown significantly higher MPV than the nondiabetic subjects.⁶ The newer hematological analyzers can give us various platelet parameters which help in early detection of the prothrombotic state of the platelets.

Platelet indices, namely PC (Platelet Count), mean platelet indices that are MPV, platelet distribution width (PDW) plays a prominent role in atherosclerosis and thrombosis. In myocardial infarction,⁷ coronary artery disease,⁸ as well as DM⁹⁻¹² MPV has been found to increase.

Platelet indices may serve as useful tools, being simple, quick, effective and routinely available at a relatively low cost; thus they can act as an alarm for diagnosis, initiation, or progression of diabetic complications. Hence, because of this, we aimed to study platelet parameters in type 2 diabetes and its relation to complications.

II. Material and methods

The present study was conducted in Department of General Medicine in Sri Venkateswara Ramnarayan RUIA Government General Hospital, Tirupathi. Written informed consent was taken from all the patients.

This was a cross-sectional study comprising 80 DM (type 2) patients admitted in medical wards and AMC, and 80 nondiabetic controls. Based on complications study group is divided into diabetes with complications and without complications and based on HbA_{1c} level study group is divided into two groups those with HbA_{1c}<7 and HbA_{1c}>7. The study was conducted over 6 months from February 2019 to July 2019. All the patients who met the inclusion criteria and those who gave consent were included in the study. The demographic information and clinical details of the patients were recorded, including duration of diabetes, family history of diabetics, hypertension, drug history, particular reference to any complications, or comorbidities. other biochemical parameters like fasting blood glucose, postprandial blood glucose, HbA_{1c} were obtained.

Inclusion criteria:

1. Age > 18 years.
2. All noninsulin-dependent DM (type 2 DM) patients on admitted in medical wards and AMC.

Exclusion criteria:

1. Male patients with hemoglobin (Hb) <13 g% and female patients with Hb <12 g%.

2. Control group – Nondiabetics with coronary artery disease were not taken as controls.
3. People with diabetes on anti-platelet drugs such as Aspirin and Clopidogrel.
4. Patients with any diagnosed malignancy/ thrombocytopenia/thrombocytosis, chronic renal failure, cyanotic heart disease.

Sample collection:

Venous blood samples for estimation of glucose, serum creatinine, and lipid profile were collected in the sodium fluoride tube, and for platelet indices were collected in tri-potassium ethylene diamine tetra acetic acid vacutainers. Samples were tested within 1 h of collection to minimize variations. Complete blood count was performed on 5-part hematology analyzer. Blood glucose and HbA1c were estimated using fully automated biochemistry analyzer. 2 ml venous blood was collected in each tube under strict aseptic precautions.

Statistical analysis:

The statistical analysis was done using Microsoft Excel in 2013. Analysis of variance (ANOVA) is used to compare the variables. Data are expressed as mean. The p-value <0.05 is considered statistically significant. ANOVA test was used for making the comparison between two variables namely HbA1c <7 v/s HbA1c ≥7 and diabetics with vascular complications v/s without vascular complications. Bar diagram and Pie charts were used for graphical representation of this data.

III. Observation and Results

The study group is divided into three groups. Group 1. Normal controls (non-diabetics) (n=80), Group 2. Diabetics without complications (n=30), Group 3. Diabetics with complications (n=50). In Group 3 (DM with complications), 29 patients had retinopathy, 18 had neuropathy, and 8 had nephropathy with many patients suffering from more than one complication. Based on HbA1c levels, there were two groups: DM with HbA1c <7% (n =22) and DM with HbA1c >7% (n = 58). The distribution of the study groups is shown in **Figures 1 and 2**.

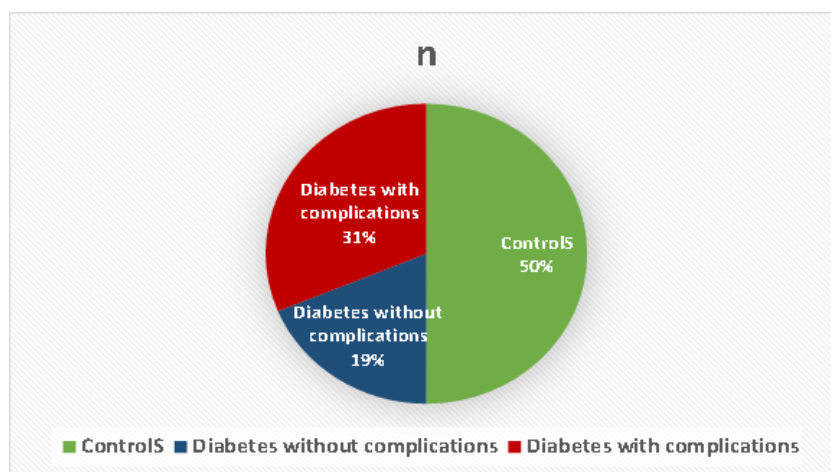


Figure 1: Distribution of the study population into three groups.

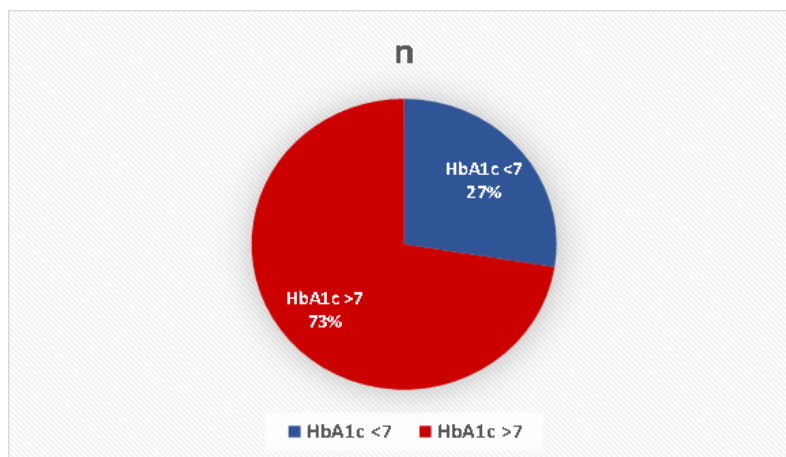


Figure 2: Distribution of Diabetic patients into two groups based on HbA1c values.

HbA1c-Glycated hemoglobin

On comparison of demographic, clinical and biochemical parameters between DM without complications and DM with complications (Table 1 and Figure 3), Patients having diabetes with complication had a higher mean age as compared to patients having diabetes without complication (51.27 vs 56.21), and this was found to be statistically significant ($P < 0.05$). The mean duration of diabetes (in years) in patients without complications was lower compared to those with complications the difference being statistically significant. BMI, Creatinine, and HbA1c were found to be higher among patients with complication as compared to patients without complication, and this was found to be statistically significant.

Table 1: Comparison of clinical and biochemical parameters between Diabetes Mellitus without complications and Diabetes Mellitus with complications expressed as mean

Variable	Diabetes without complications (n=30)	Diabetes with complications (n=50)
Age(years)	51.27	56.21
BMI(kg/m ²)	21.22	22.12
Duration of diabetes(years)	2.681	8.281
HbA1c (%)	7.264	8.916
fasting blood sugar(mg/dl)	158.421	174.281
postprandial blood sugar(mg/dl)	226.745	283.723
Total cholesterol(mg/dl)	179.29	190.672
HDL (mg/dl)	45.234	40.641
Creatinine (mg/dl)	0.81	1.175

BMI- Body Mass Index, HbA1c-Glycated hemoglobin, HDL- High-Density Lipoprotein

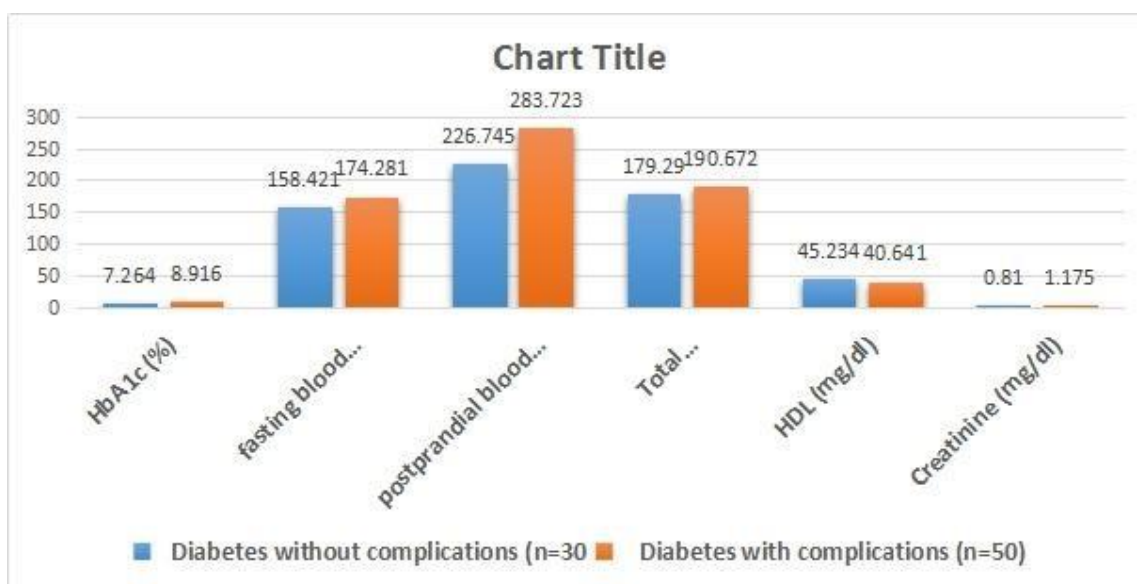


Figure 3: Bar diagram showing the comparison of biochemical parameters between diabetes mellitus with and without complications. HbA1c-Glycated hemoglobin, HDL- High-Density Lipoprotein

On comparison of haematological parameters between controls, Diabetes with complications and Diabetes without complications (Table 2 and Figure 4) Hb was found to be higher among patients without complication and controls as compared to patients with complications ($P < 0.05$). All the platelet parameters including PC, MPV, PDW were found to be higher among DM with complication as compared to DM without complication, and this was found to be statistically significant.

Table 2: Comparison of haematological parameters among controls, DM with complications and DM without complications

variable	control (n=80)	DM without complications (n=30)	Diabetes with complications (n=50)	P
Hb (g/dl)	13.824	12.68	11.023	<0.05
TLC (cumm)	8368.12	8004.66	7264.78	>0.05
Plt count (×10 ⁶ /cumm)	2.85	2.56	3.245	<0.05
MPV (fl)	12.123	13.133	14.14	<0.05
PDW (fl)	17.02	18.34	19.94	<0.05

Hb-Haemoglobin, TLC- Total Leucocyte Count, Plt count- Platelet count, MPV-Mean Platelet Volume, PDW-

Platelet Distribution Width

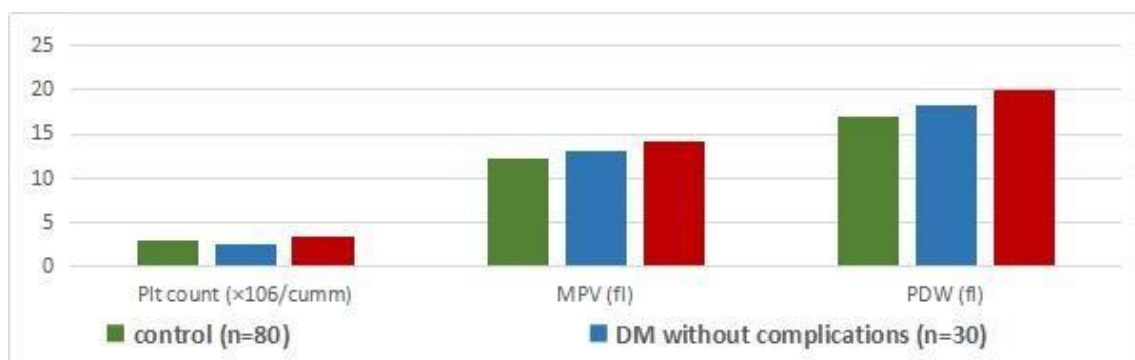


Figure 4: Bar diagram showing the comparison of platelet parameters among controls, DM without complications and DM with complications. Plt count- Platelet count, MPV-Mean Platelet Volume, PDW- Platelet Distribution Width

On comparison of biochemical and haematological parameters among DM with HbA1c <7% (n=22) and DM with HbA1c >7% (n=58) fasting blood sugar, postprandial blood sugar, total cholesterol, and serum creatinine were found to be higher among DM with HbA1c >7% (**Table 3, figure 5**). Among the platelet parameters platelet count, MPV, PDW was found to be higher among DM with HbA1c >7% (**table 4, figure 6**).

Table 3 : comparison of biochemical parameters among among DM with HbA1c <7% (n=22) and DM with HbA1c >7% (n=58)

Variable	HbA1c <7% (n=22) Mean	HbA1c >7% (n=58) Mean
fasting blood sugar(mg/dl)	141.21	186.121
postprandial blood sugar(mg/dl)	198.245	261.123
Total cholesterol(mg/dl)	161.242	180.715
HDL (mg/dl)	46.285	39.611
Creatinine (mg/dl)	0.78	1.163

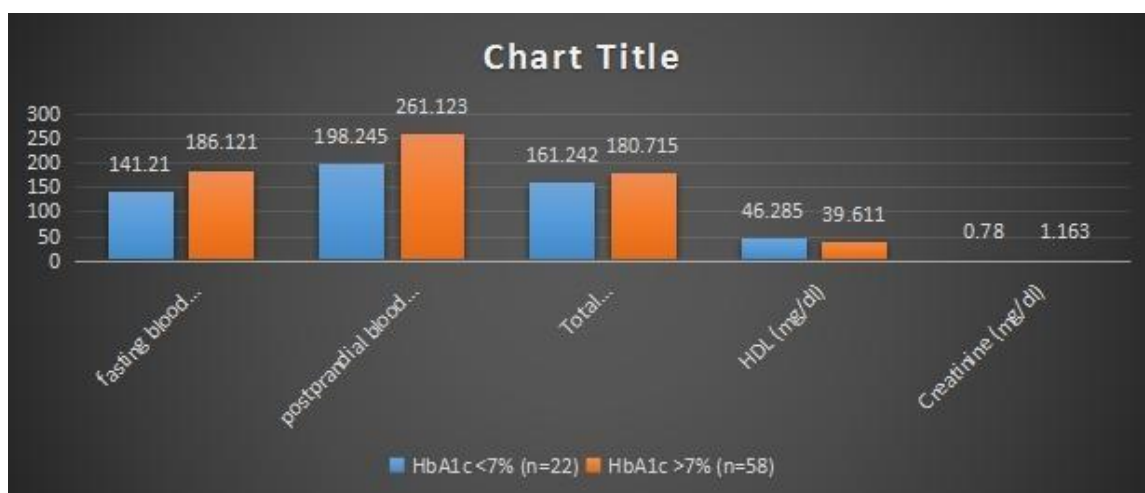


Figure 5: Bar chart depicting comparison of biochemical parameters among among DM with HbA1c <7% (n=22) and DM with HbA1c >7% (n=58)

Table 4: Comparison of haematological parameters among among DM with HbA1c <7% (n=22) and DM with HbA1c >7% (n=58)

variable	HbA1c <7% (n=22) Mean	HbA1c >7% (n=58) Mean	p value
Plt count (x10 ⁶ /cumm)	2.47	3.65	<0.05
MPV (fl)	10.163	12.36	<0.05
PDW (fl)	14.644	15.964	<0.05

Plt count- Platelet count, MPV-Mean Platelet Volume, PDW-Platelet Distribution Width



Figure 6: Bar chart depicting Comparison of haematological parameters among DM with HbA1c <7% (n=22) and DM with HbA1c >7% (n=58). Plt count- Platelet count, MPV-Mean Platelet Volume, PDW-Platelet Distribution Width

IV. Discussion

DM is characterized by a prothrombotic state comprising increased platelet activation, elevated circulating levels of C-reactive protein (CRP), PAI-1 and fibrinogen. An increased platelet activity has been reported in people with diabetes as demonstrated by an increase in GPIIb/IIIa, Ib-IX and Ia/IIIa.16 CD62 and CD 63 with increase in platelet count, platelet distribution width / and mean platelet volume, the most commonly used measure of platelet size is a potential marker of platelet reactivity.¹³⁻¹⁵ Platelet size seems to be related to their function as MPV is higher in people with diabetes with complications.¹⁶⁻²¹ This is followed by an increase in the development of cardiovascular and atherosclerotic complications associated with DM. In people with diabetes with poor glycemic control, longer duration of the disease, associated hypertension, and obesity the prevalence of microvascular complications is higher.²² The present study was conducted to study the role of platelet parameters in DM in terms of glycemic control and development of complications.

All the platelet parameters like platelet count, MPV, PDW were found to be higher in DM with complications group and in HbA1C ≥7 group and is found to be statistically significant. **Buch *et al.***²³ found a positive association of MPV, PDW with DM but not with PLCR and PC. **Ishan Dubey *et al.***,²⁴ observed that MPV is significantly higher in patients with type -2 diabetes mellitus with HbA1C ≥7 and those with vascular complications. **Rajas S. Walinjkar *et al.***²⁵ observed that MPV, PDW, and P/LCR was higher and more significant in diabetic subjects with microvascular complications. Platelet dysfunction also showed a positive association with HbA1C

V. Conclusion

Platelet parameters like PC, MPV, PDW were higher among people with diabetes compared to controls and DM with complications group and HbA1c >7 group. Thus Platelet indices may serve as useful, simple, and cost-effective markers for the development of complications in diabetic patients and thereby may play a crucial role in the monitoring of DM thereby decreasing morbidity and mortality.

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