Section: Pathology

Original Research Article

ERYTHROCYTE AND PLATELET INDICES IN TYPE 2 DIABETES MELLITUS PATIENTS VERSUS NON DIABETIC PEOPLE - A COMPARATIVE CROSS SECTIONAL STUDY IN A TERTIARY CARE HOSPITAL, MANDYA

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ABSTRACT

Background: Diabetes is a global public health problem and associated with metabolic, cellular, and blood disturbances. Erythrocytes and Platelet indices using Complete blood count can be an effective follow-up tool to predict the vascular complications in type2 diabetes mellitus(T2DM). Thus, the aim of this study was to compare the changes in hematological parameters between diabetics and non-diabetics in relation to glycemic control.

Materials and Methods: This cross-sectional study was conducted in the Central diagnostic laboratory, Department of Pathology, Mandya Institute of Medical Sciences, Mandya from October 2024 to December 2024 enrolling a total of 232patients, 116 T2DM patients and 116 control patients. The parameters in this study includes Erythrocyte indices such as mean corpuscular volume (MCV), red cell distribution width (RDW) and Platelet indices such as mean platelet volume (MPV), platelet distribution width (PDW). Data analysis was performed using SPSS statistical software. P-value <0.05 was considered as statistically significant.

Results: This study found statistically significant differences in MCV (p=0.001), MPV (p=0.001), and PDW (p= 0.027) between diabetics and non-diabetics. However, RDW showed a negative association, with no statistical significance (p=0.5) in diabetics. Additionally, a significant positive correlation was observed between MPV(r=0.627) and PDW (r=0.306) with HbA1c(p=0.001).

Conclusion: Our study showed MCV, MPV and PDW are significantly altered in diabetics compared to non-diabetics, highlighting their potential role in diabetes related hematological changes. Although RDW showed no significant association, the positive correlation between MPV and PDW with HbA1c suggests these parameters may serve as inexpensive tools for glycemic control and routine screening in proper management of type 2 diabetic patients.

Keywords: Diabetes mellitus, complete blood count, mean corpuscular volume, red cell distribution width, mean platelet volume, platelet distribution width.

INTRODUCTION

Diabetes mellitus describes a group of metabolic disorders characterized by hyperglycaemia and defects in insulin secretion and/or insulin action. WHO reports that the global diabetes prevalence in adults rose from 7% to 14% between 1990 and 2022. The risk factors of diabetes includes heredity, obesity, lack of physical activity, poor diet, stress, urbanization, impaired glucose tolerance, and hypertension. Chronic hyperglycaemia is associated with long-term damage and dysfunction of different organs, particularly the eyes, kidneys, nerves, heart, and blood vessels.[1]

Red blood cells (RBCs), are the most glucose-consuming cells. In the presence of long-lasting hyperglycaemia, the morphology, metabolism, and function of RBCs are inevitably subject to a series of changes that further affect hemorheology and microcirculation.[2]

The platelets play significant roles in the integrity of normal homeostasis and atherosclerosis process. The thromboxane generation is increased in patients with poor glycaemic control . Thus, Diabetes mellitus has been considered as a 'prothrombotic state' with enhanced platelet reactivity,[3] and many researchers have established the morphological changes of platelets and the increased platelet activity occurred in diabetic patients.

HbA1c measures the amount of hemoglobin with attached glucose and reflects the average blood glucose levels over the past 3 months providing reliable measure of chronic hyperglycemia.[4]

Complete blood count (CBC) is a simple, routinely requested test in all healthcare facilities. CBC report includes hematological parameters such as RBC count, RBC indices, WBC count, WBC differential count, platelet count and platelet indices. The effect of diabetes on RBC indices such as mean corpuscular volume (MCV), red blood cell distribution width(RDW) and platelet indices such as mean platelet volume(MPV) and platelet distribution width(PDW)can be altered due to dysregulated glycaemic control.[5]

So this study has been taken up to know the significance of haematological parameters in type 2 diabetic patients in relation to their glycaemic control.

MATERIALS AND METHODS

This cross-sectional study was conducted in the Central diagnostic laboratory, Department of Pathology, Mandya Institute of Medical Sciences, Mandya from October 2024 to December 2024 enrolling a total of 232patients, 116 T2DM patients and 116 control patients.

Diabetes mellitus was defined according to the American Diabetes Association criteria: HbA1c 6.5% Females with Hb <10g% and males with Hb <12g%, pregnant women, other causes of anemia like nutritional deficiencies, chronic systemic diseases and hemoglobinopathies are excluded from this study.

The study protocol was approved by the Ethics Committee of Mandya institute of medical sciences and the study is proceeded.

A venous blood sample of two mL was collected by a well trained and experienced nurse under all aseptic precautions from the antecubital vein by a clean puncture avoiding bubbles and froth from diabetic patients and healthy controls using vacutainer tubes containing ethylenediaminetetraacetic acid (EDTA) for CBC analysis and HbA1C measurement.

The CBC was performed using Sysmex XN–1000 Hematology Analyzer (Kobe, Japan). Glycated hemoglobin was measured using Abott ARCHITECT (Chicago, USA).

The study parameters in this study includes erythrocyte indices such as mean corpuscular volume (MCV), red cell distribution width (RDW) and platelet indices such as mean platelet volume (MPV), platelet distribution width (PDW) and the results are compared between diabetic patients with history more than 5 years and non diabetic random healthy individuals.

The collected data will be entered in Microsoft excel sheet and analysed using SPSS 2022 statistical software. The descriptive statistics like mean, standard deviation will be used. Comparison of the means of the hematological parameters between diabetic patients and controls was performed by the independent t-test. Correlation between the different variables was performed using the Pearson's momentary correlation equation for normally distributed data. A p-value of$\leq$ 0.05 was considered statistically significant.

RESULTS

Of the 232 patients included in the study,169 were men and 63 were women.

The mean age of diabetic patients in our study was 56.03±6 years and that of the control group was 53.56±6 years. [Table 1]

Table 1: Descriptive Statistics studied in this study.

Parameter	N	Minimum	Maximum
D_Age	116	45	71
D_HbA1c	116	6.60	8.90
D_MCV	116	56.00	89.00
D_RDW	116	8.10	121.10
D_MPV	116	8.50	19.50
D_PDW	116	6.20	16.10
ND_AGE	116	45	70
ND_MCV	116	71.80	91.00
ND_RDW	116	8.90	17.50
ND_MPV	116	5.50	13.20
ND_PDW	116	8.70	15.70

D- diabetic, ND- non diabetic, MCV- mean corpuscular volume, RDW- red cell distribution width, MPV- mean platelet volume, PDW- platelet distribution width

The mean MCV in diabetic patients73.6±5.8 was significantly lower than in control 81.4±3.4 (p=0.000).
The mean RDW level in diabetic patients was 14.05±10.2 while that of control 13.4±1.5 was (p=0.5), which is not statistically significant. The MPV in diabetic patients 13.2±2.6 was significantly higher than in control 9.09±1.3 (p=0.001). The RDW in diabetic patients 11.3±1.9 was significantly higher than in control 11.8± 1.6 (p=0.027). [Table 2]

Table 2: Comparison of parameters between the study groups (mean±SD)

Parameters	Diabetic group	Non-Diabetic group	p- value
MCV	73.6±5.8	81.4±3.4	0.001*
RDW	14.05±10.2	13.4±1.5	0.5
MPV	13.2±2.6	9.09±1.3	0.001*
PDW	11.8± 1.6	11.3±1.9	0.027*

MCV- mean corpuscular volume Normal range-80-95fl, RDW- red cell distribution width Normal range-11-14, MPV- mean platelet volume Normal range (8-12 fl), PDW- platelet distribution width Normal range (9-14 fl),* statistically significant.

Moreover, we studied correlations between HbA1 c with MCV, RDW, MPV, PDW in diabetic patients. [Table 3]. [Figure 1] show negative correlation between MCV and RDW. Figure 2 show statistically significant positive correlation between MPV and PDW with HbA1c.

Table 3: Correlation between HbA1 c with MCV, RDW, MPV, PDW in diabetic patients

Parameters		r- value	p- value
MCV	HbA1c	-0.219	0.018
RDW	HbA1c	-0.067	0.473
MPV	HbA1c	0.627*	0.001
PDW	HbA1c	0.306*	0.001

MCV- mean corpuscular volume, RDW- red cell distribution width, MPV- mean platelet volume, PDW- platelet distribution width, *Correlation is significant at the 0.01 level (2-tailed).

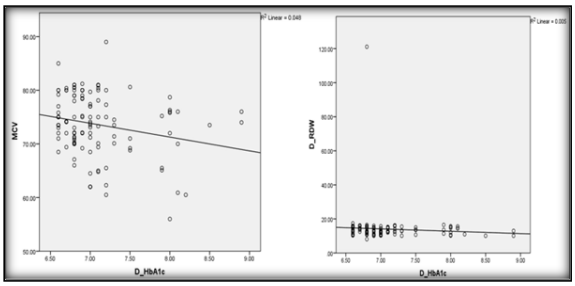

Figure 1: Pearson's correlation showing a linear relation between mean corpuscular volume (MCV) and red blood cell distribution width (RDW) with hemoglobin A1c (HbA1c) in diabetic patients.

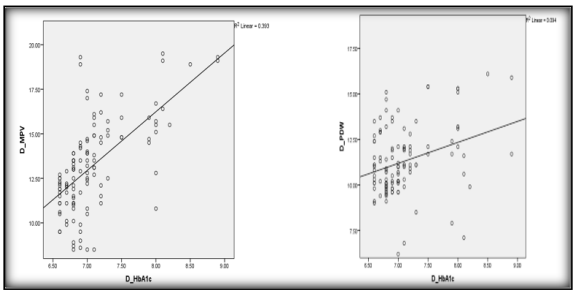

Figure 2: Pearson's correlation showing a linear relation between mean platelet volume (MPV) and platelet distribution width (PDW) with hemoglobin A1c (HbA1c) in diabetic patients.

DISCUSSION

Diabetes is a growing health problem associated with increased risk of micro and macro vascular complications. With the easy availability of various blood tests efforts are made to identify and prove their utility to act as biomarkers for early detection of diabetic complications.[6] Hematological changes is a common complication and represents significant and under-recognized burden. Slow glycosylation with constant elevation of HbA1c may be associated with structural and functional changes in hemoglobin molecule, and in the cytoplasmic viscosity of individual red cells, leading to the changes in red cell parameters.[7] Persistent hyperglycemia increases the production of ROS and nonenzymatic glycosylation of Hemoglobin and RBC membrane proteins leading to reduced deformability, increased aggregation, and acceleration in the aging of RBCs leading to increase in blood viscosity affecting the microcirculation in diabetes.[8-10]
The MCV is a blood parameter reporting the size of red blood cells, and allows classification of anemia into: microcytic, macrocytic, and normocytic. During hyperglycemia, red cells take in more glucose than usual creating osmotic imbalance, which draws water into the cell causing it to swell and increase in volume leading to higher MCV. This study shows significant correlation with MCV which is similar to the studies by Arkew M et al,[4] and Adane et al. (p<0.001).[11]
RDW indicates the presence of heterogeneity among the circulating RBCs, due to the impairment of erythropoiesis and degradation of RBCs. Chronic inflammation and increased level of oxidative stress are common in diabetes and they are known to reduce RBCs' survival resulting in variation in RBCs size and decreased RBCs count. This study does not show statistically significant correlation with RDW which

is contradictory to the studies done by Mhirig et al. ($p<0.001$) and Tsilingiris et al. ($p=0.001$).[3,12]

MPV is used to assess platelet size, and it is a potential biomarker of platelet reactivity reflects the rate of platelet production, average size, and activity. It has been shown that larger platelets are more reactive than smaller ones, contains more granules, produce greater quantities of vasoactive and thrombotic factors, to aggregate in response to a stimulus, and express a greater number of adhesion molecules resulting in prothrombotic state. This study shows statistically significant correlation supporting the studies by Mhirig I et al. and Buch A et al.[5]

PDW can directly measure the variability in platelet size, and its high values suggest increased production of larger reticulated platelets causing aggregation and thrombus formation mostly in case of poor glycemic control leading to complications such as retinopathy, nephropathy, CAD, and diabetic foot. This study shows positive correlation consistent with the studies done by Buch A et al. and Khanna et al.[13]

The correlation tests performed between MCV, RDW, MPV, PDW and glycemic parameter in our study observed that there is a significant and positive correlation between MPV and PDW with HbA1c in diabetic population ($p=0.001$), similar to studies by Harsha and Tripati ($p<0.001$) and Lippi et al.($p<0.001$).[14,15]

Lack of individual details, lifestyle and a hospital based study with small sample size, further prospective studies with larger sample size are required for identifying the utility of these markers to predict the diabetic disease burden, keeping all the compounding risk factors in mind, especially to predict the impact of microvascular complications on diabetic patients.

CONCLUSION

Complete blood count is a routine, simple test and inexpensive tools for follow up of patients with type 2 diabetic patients. Regular screening of hematological parameters is considered effective for proper management. Proper glycemic control improves erythropoiesis, decreases MPV, and recovers platelet functions and activity which may prevent the possible role of platelets in vascular complications. However, further studies are also needed for RDW in the complication risk in the diabetic population.

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