

## Original Research Article

**Role of Hematological Parameters: RDW, MPV, PDW as Predictive Markers in Prevention of Complications in Uncontrolled Type 2 DM (Diabetes Mellitus)**Ramesh S T<sup>1</sup>, Chaithra H<sup>2</sup>, Niranjana Murthy B<sup>3</sup><sup>1</sup>Professor, <sup>2</sup>Assistant Professor, <sup>3</sup>Professor and HOD, Department of Pathology, Sri Siddhartha Medical College, Agalakote, Tumkur, Karnataka 572017, India.**Corresponding Author:****Chaithra H**, Assistant Professor, Department of Pathology, Sri Siddhartha Medical College, Agalakote, Tumkur, Karnataka 572107, India.**E-mail:** Chaithra.3616@gmail.com**How to cite this article:**

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**Abstract**

**Aims and Objectives:** To study the hematological parameters and types of anemia in type 2 uncontrolled diabetes mellitus patients. To establish the role of this parameters (RDW, MPV, PDW) as predictive markers in type 2 uncontrolled DM.

**Methods and Materials:** This case control study includes 70 cases of type 2 diabetic patients with HbA1c levels >9.0% and 30 cases of controls with HbA1c levels <6.5% was carried out for 6 months duration. Hematological parameters like Hb, RBC count, TC, MCV, RDW, Platelet count, PDW, MPV were done in the automated cell counter (Sysmex XN330) and peripheral smear findings were studied.

**Statistical Analysis:** Data cleaning and data validation was done and analysed using Statistical Package for Social Sciences (SPSS-Version 20).

**Results:** In the study, mean age of type 2 uncontrolled diabetics was 51.79±11.14 years and controls were 56.43±11.13 years. RDW-CV in uncontrolled diabetics was 15.2 (13.3–17.2) and control were 12.2 (12.3–13.90). Leucocytosis was observed in uncontrolled diabetics as 9100 (7480–11900) and it indicates infections are more common in uncontrolled diabetics. MPV was (12.00±1.09) in uncontrolled diabetics and (10.05±0.97) in controls. PDW was 11.4 (10.3–12.9) in diabetics and control was 10.8 (9.8–12.5). MPV and PDW were significantly higher in uncontrolled diabetics.

**Conclusion:** Hematological parameters such as RDW, PDW, MPV, and Platelet count were high in patients with type 2 uncontrolled diabetes mellitus and they represent appropriate predictive markers for vascular complication due to diabetes mellitus. Present study recommends routine and regular screening for hematological parameters in diabetic patients to initiate early prevention strategies and to reduce the morbidity related to it.

**Keywords:** RDW; PDW; MPV.**Introduction**

Diabetes mellitus (DM) is a non-communicable disease with increasing prevalence worldwide.<sup>1</sup> India is known to be the diabetic capital of the

world. By 2030, about 80 to 87 million people of India will be diabetic and 438 million people (7.8%) of the adult population are expected to have diabetes worldwide.<sup>2</sup>



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Diabetes mellitus is a global metabolic disorder characterized by persistent hyperglycemia and increased risk of microvascular and macrovascular complications. Consistent elevation of HbA1c can be associated with functional and structural changes in hemoglobin molecule, cytoplasmic viscosity and osmotic disturbances within red cell. These changes are reflected in the red cell analytical parameters.<sup>3</sup>

Altered level of many hematological parameters such as red blood cells (RBCs), white blood cells (WBC), and the platelet function has been observed in patients with the diabetes.<sup>4</sup>

The Red Blood cell distribution width (RDW) is a measurement of the size variation among the circulating red cells and is calculated as a part of routine complete blood count. RDW along with MCV (Mean corpuscular volume) is useful in the differential diagnosis of the causes of anemia. RDW is now being considered as an inflammatory marker and an elevated RDW value is shown to be significantly associated with diabetic nephropathy in type 2 diabetes patients independent of traditional risk factors including diabetes duration and glycemic control.<sup>5</sup>

Recently, there has been reestablished enthusiasm for hematological parameters, for example, white blood cells (WBC), mean platelet volume (MPV), platelet distribution width (PDW) were assigned as indicators of endothelial dysfunction and chronic inflammation. Increased white blood cell count (WBC) is an established marker of cardiovascular diseases in diabetes. Moreover, the relationship of raised MPV, PDW, PCT and platelet counts associated with endothelial dysfunctions, metabolic disorder, diabetes, coronary artery disease and malignancy have been indicated.<sup>6,7</sup>

The present study is undertaken to study the various hematological parameters, with types of anemia and their role as predictive markers in uncontrolled type 2 diabetes mellitus.

#### Objectives

1. To study the hematological parameters and types of anemia in type 2 uncontrolled diabetes mellitus patients.
2. To establish the role of this parameters (RDW, MPV, PDW) as predictive markers in type 2 uncontrolled DM.

#### Material and Methods

The case control study was carried out for 6 months from November 2019 to April 2020 in Sri Siddhartha medical college, Tumkur. 70 cases of type 2 diabetic patients with HbA1c levels >9.0% and 30 cases of controls with HbA1c levels <6.5% were included in the study.

Collection of data is from both OP and IP diabetic patients visiting for routine biochemical and hematological investigations in central laboratory.

Hematological parameters like Hb (hemoglobin), RBC count, TC (total WBC count), MCV (mean red cell corpuscular volume), RDW (Red cell distribution width, Platelet count, PDW (Platelet distribution width), MPV (Mean platelet volume) were done in the automated cell counter (Sysmex XN330) and peripheral smear findings were studied.

Analysis of data done by comparing controls (group 1, N=30) data with uncontrolled diabetic individuals (group 2, N=70).

Ethical clearance was obtained from the institutional ethics committee and written informed consent was obtained from the study participants.

Data cleaning and data validation was done and analysed using Statistical Package for Social Sciences (SPSS-Version 20). All variables were tested for normality with the help of Kolmogorov-Smirnov test. Data was presented as Mean and Standard deviation for continuous variables.

*Inclusion criteria:* All type-2 uncontrolled DM patients visited to OPD or in patient was included in study.

*Exclusion criteria:* Type 1 Diabetes mellitus patients were not included in the study.

#### Results

The study was carried out at Sri Siddhartha medical college, Tumkur for 6 months duration.

In the study, 70 cases of type 2 diabetic patients with HbA1c levels >9.0% and 30 cases of controls with HbA1c levels <6.5% were included. Mean age of type 2 uncontrolled diabetics was 51.79±11.14 years and controls were 56.43±11.13years (Table 1).

**Table 1:** Socio-demographic characteristics of study participants.

Characteristics	Control (30) HbA1c levels <6.5%	Cases (70) HbA1c levels >9.0%	P- Value
Mean Age Mean±SD	56.43±11.13	51.79±11.14	0.058
Male/Female n (%)	13(43.33%)/17 (56.67%)	37 (52.11%)/34 (47.89%)	0.515

In uncontrolled diabetics mean hemoglobin was  $13.00 \pm 2.72$  (g/dl) and in controls was  $12.88 \pm 2.14$  (g/dl). RDW-CV in uncontrolled diabetics was 15.2 (13.3–17.2) and control was 12.2 (12.3–13.90). Increases in RDW-CV in uncontrolled diabetics were observed. Similarly, other hematological parameters are shown in Table 2.

**Table 2:** RBC parameters comparison between two groups.

Variables	Control (30) Mean $\pm$ SD	Cases (70) Mean $\pm$ SD	P-Value
RBC (millions/ cumm)	4.5 (4.3–4.8)	4.7 (4.2–5.2)	0.158
Hb% (g/dl)	12.88 $\pm$ 2.14	13.00 $\pm$ 2.72	0.820
MCV (fl)	82.8 (78.4–86.5)	82.5 (78.2–86.3)	0.637
RDW-CV%	12.2 (12.3–13.9)	15.2 (13.3–17.2)	0.163

Leucocytosis was observed in uncontrolled diabetics as shown in table 3 and it indicates infections are more common in uncontrolled diabetics.

**Table 3:** WBC parameters comparison between two groups.

Variables	Control (30) Mean $\pm$ SD	Cases (70) Mean $\pm$ SD	P-Value
WBC (cells /cu mm)	8180 (6250–9763)	9100 (7480–11900)	0.079

Thrombocytopenia and thrombocytosis were seen in uncontrolled diabetics and normal platelet count in controls. MPV and PDW were significantly higher in uncontrolled diabetics compared to controls as shown in Table 4. This shows that uncontrolled diabetics are prone for thrombocytosis, thrombocytopenia and large platelets.

**Table 4:** Platelet parameters comparison between two groups.

Variables	Control (30) Mean $\pm$ SD	Cases (70) Mean $\pm$ SD	P-Value
Platelet Count (cells/ cumm)	277400 $\pm$ 80148	261239 $\pm$ 108695	0.465
MPV (fl)	10.05 $\pm$ 0.97	12.00 $\pm$ 1.09	0.307
PDW (fl)	10.8 (9.8–12.5)	11.4 (10.3–12.9)	0.205

Uncontrolled diabetics are more prone for anemia compared to controls. In our study, 13 cases shows microcytic hypochromic anemia with one individual is of hemolytic anemia. 09 cases are of normocytic normochromic anemia and one case is of macrocytic anemia.

**Table 5:** Morphologic typing of anemia.

Morphological Type of Anemia	Type 2 uncontrolled Diabetics	Control
1 Normocytic normochromic anemia	09	05
2 Microcytic hypochromic anemia	13	04
3 Macrocytic anemia	01	00

## Discussion

Type 2 diabetes mellitus is a complex multifactorial endocrinal disease with progressive deterioration of beta cell function and insulin resistance. The important causes are changes in the dietary pattern and decreased physical activity.<sup>8</sup> In present study, 70 cases of type 2 uncontrolled diabetics with HbA1c levels  $>9.0\%$  and 30 cases of controls HbA1c levels  $<6.5\%$  were included.

Mean age of type 2 uncontrolled diabetics was  $51.79 \pm 11.14$  years and control was  $56.43 \pm 11.13$  years in our study. Similar profile observed in the study by Harish kumar S. et al. Mean age of uncontrolled diabetics was  $55.7 \pm 3.6$  years and control was  $56.2 \pm 3.5$  years.<sup>9</sup>

Present study showed that uncontrolled diabetics had mean hemoglobin of  $13.00 \pm 2.72$  (g/dl) and in controls  $12.88 \pm 2.14$  (g/dl). Among the RBC indices, only RDW values achieved statistically significant difference between type 2 uncontrolled diabetes mellitus and control groups. This finding is in accordance with the findings of Chen and Malandrino et al.<sup>10,11</sup>

This is due to the fact that high RDW indicates impairment of erythropoiesis, reflecting chronic inflammation and increased levels of oxidative stress, both of which are significant signs of uncontrolled diabetes mellitus that result in the RBC size variation.<sup>12</sup>

In the present study, WBC count increased significantly in the type 2 uncontrolled diabetes mellitus group compared with the control group. The reason for this variation might be due to the fact that the high WBC count in the type 2 diabetes mellitus group is in keeping with the increased oxidative stress triggered by the high levels of hyperglycemia. One study has also indicated that WBC count is elevated in the uncontrolled diabetes mellitus patients and may contribute to the vascular complications.<sup>13</sup>

In our study, 13 cases of type 2 uncontrolled diabetes shows microcytic hypochromic anemia, 9 cases shows normocytic normochromic anemia and 1 case of macrocytic anemia.

Anemia is common in patients with diabetes due to the high burden of chronic kidney disease, glycosylation of red blood cells membrane protein, and several other defects found in the diabetic population.<sup>14,15</sup> Macrocytic anemia is highly prevalent in type 2 diabetes mellitus and the probable mechanism is the use of metformin. It causes pancytopenia, megaloblastic anemia, peripheral neuropathy and subacute combined degeneration of the spinal cord.<sup>16</sup>

In this study, analysis of the platelet indices demonstrated that mean platelet volume, platelet distribution width and platelet counts were significantly higher among cases with type 2 uncontrolled diabetes mellitus. This is in accordance with the studies conducted by, Kodiatte et al, Demirtas et al, Alhadas et al.<sup>17,18,19</sup> Few of the diabetic cases shows thrombocytopenia and its correlates with Hekimsoy et al study.<sup>20</sup> The MPV and platelet counts are indicators of thrombotic potential and risk factors for microvascular complications in diabetics.<sup>21</sup>

According to Chen et al increased insulin resistance and glycemic status increases platelet count in hyperglycemia.<sup>22</sup>

Elevated levels of MPV in people with type 2 uncontrolled diabetics of the present study may also be explained in terms of oxidative stress. Increased oxidative stress in diabetes induces non enzymatic glycation of proteins on the surface of the platelet. Such glycation leads to over-accumulation of advanced glycation end products. Some of these advanced glycation cause externalization of platelet membrane phosphatidylserine that may cause changes in protein structure and alterations of membrane lipid dynamics.<sup>23,24,25</sup>

Present study shows elevated levels of platelet distribution width in type 2 uncontrolled diabetes which is in concordance with Vagdatli et al. Activated platelets undergo a structural change from discoid to a spherical shape and produces pseudopodia leading to a change in the PDW. Due to this reason, activated platelets may be different in size from non-activated platelets.<sup>26</sup>

Patients with uncontrolled diabetes mellitus have an increased risk of coagulation abnormalities and thromboembolic events. Platelets have a key role in increased adhesion, activation, and aggregation of platelets due to dysregulation of several signaling pathways and metabolic disturbances including insulin resistance, hyperglycemia, and dyslipidemia have been noted in diabetic patients.<sup>27</sup>

## Conclusion

Hematological parameters such as RDW, PDW, MPV, and Platelet count were high in patients with type 2 uncontrolled diabetes mellitus.

RDW, MPV and PDW represent appropriate predictive markers for vascular complication due to diabetes mellitus.

Treating anemia's in type 2 diabetic definitely improve the quality of life and decrease the speed of progression of renal disease.

Present study recommends routine and regular screening for hematological parameters in diabetic patients to initiate early prevention strategies and to reduce the morbidity related to it.

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