



Research Article

Study of red cell distribution width and its correlation to glycemic control and vascular complications in type 2 diabetes mellitus

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Abstract

Background: Diabetes is a global public health problem and associated with metabolic, cellular, and blood disturbances. The red cell distribution width (RDW) is an index of heterogeneity & has been recently recognised as an inflammatory marker for various diseases. In this study, we assessed the relation between RDW with HbA1C and vascular complications and to find the correlation between RDW and glycemic control (HbA1c) as well as vascular complications in patients with Type 2 DM

Material and Methods: Present study was single-center, prospective, observational study, conducted in patients of either gender, age >20yrs with diagnosed case of Type 2DM, levels of Glycated Hemoglobin (HbA1c) and RDW (Red Cell Distribution Width) were measured.

Results: Among 100 patients, majority were from > 60 years age group (35 %), followed by 51-60 years (28 %) & mean age of study group was 55.3 ± 7.51 years. Male patients (54 %) were marginally more than female patients (46 %). Majority of patients had duration of DM of 0-5 years (47 %) & 22 % had duration of DM of >10 years. In majority of patients HbA1C was ≥ 8.5 % (82 %). Mean RDW values in patients with HbA1C ≥ 8.5 % was 14.31 ± 2.45 as compared to patients with HbA1C ≥ 8.5 % as 13.56 ± 2.11 , difference was significant statistically (p value- 0.039). We compared RDW values in patients with & without vascular complications (retinopathy, neuropathy, nephropathy, ischemic heart disease, cerebro-vascular accident & peripheral arterial disease) & difference was not significant statistically (p value- >0.05).

Conclusion: RDW was significantly higher in patients with uncontrolled sugars, As RDW is an inexpensive, noninvasive, and convenient indicator, RDW can be used as a surrogate marker for HbA1C in assessing glycemic control.

Keywords: red cell distribution width (RDW), HbA1C, glycemic control, diabetes mellitus.

Introduction

Diabetes is a global public health problem and associated with metabolic, cellular, and blood disturbances. The primary cause of mortality in

diabetic patients is cardiovascular diseases, whereas the major cause of morbidity is microvascular complications.¹ Hematological changes have been reported in diabetes and play a

major role in diabetes-associated complications. Hyperglycemia has multiple effects on the red blood cell (RBC) including glycation of haemoglobin, reduced deformability & reduced lifespan.²

One widely accepted method for diabetes diagnosis in the general population is the measurement of glycated hemoglobin (HbA1c).³ This has several important advantages over fasting plasma glucose because it is less vulnerable to pre-analytical factors, it exhibits a much lower biological variability, it is less influenced by acute stress and conventional drugs that may impair glucose metabolism, and it provides dichotomized information with just one measurement.⁴

The red cell distribution width (RDW) is a quantitative measure of the heterogeneity of the volume of red blood cells (RBCs) with higher values reflecting greater heterogeneity in cell sizes (anisocytosis). RDW is an index of heterogeneity & has been recently recognised as an inflammatory marker for various diseases.⁵ Red cell distribution width (RDW) is calculated by dividing the standard deviation of erythrocyte volume by the mean corpuscular volume (MCV) and multiplied by 100 to convert to a percentage.⁶ In this study, we assessed the relation between RDW with HbA1C and vascular complications and to find the correlation between RDW and glycemic control (HbA1c) as well as vascular complications in patients with Type 2 DM

Material and Methods

Present study was single-center, prospective, observational study, conducted in department of general medicine at chettinad medical college & hospital,. Study duration was of 1 year (July 2016 to June 2017). The approval for conducting this study was obtained from the Institutional Ethics Committee prior to the study.

Inclusion Criteria:

- Patients of either gender, age >20yrs with diagnosed case of Type 2DM, willing to participate in the study

Exclusion criteria

- Patients with anemia, hemoglobinopathies, other red cell or hemoglobin disorders, hemolytic disorders including infections like malaria,
- Patients on iron and B12 supplements
- Patients with Type 1 DM, hypo or hyperthyroidism, congestive cardiac failure, kidney disease,
- Patients with acute complications (ACS, Acute stroke, Acute Kidney Injury)
- Patients not willing to participate in the study

100 Patients with Type 2 diabetes mellitus, selected at random from those attending the Diabetic outpatient clinic. Study was explained & a written informed consent was taken. Baseline characteristics such as age, gender, duration of DM were noted. The levels of Glycated Hemoglobin (HbA1c) and RDW (Red Cell Distribution Width) were done. Vascular complications such as retinopathy, neuropathy, nephropathy, ischemic heart disease, cerebrovascular accident & peripheral arterial disease were assessed by appropriate clinical & radiological investigations.

Data was collected and compiled using Microsoft Excel, analysed using SPSS 23.0 version. Frequency, percentage, means and standard deviations (SD) was calculated for the continuous variables, while ratios and proportions were calculated for the categorical variables. Difference of proportions between qualitative variables were tested using chi-square test or Fisher exact test as applicable. P value less than 0.5 was considered as statistically significant.

Results

Among 100 patients, majority were from > 60 years age group (35 %), followed by 51-60 years (28 %) & mean age of study group was 55.3 ± 7.51 years. Male patients (54 %) were marginally more than female patients (46 %).

Table 1- Age & Gender Distribution

Characteristic	No of patients (n=100)	Percentage
Age (years)		
21-30	3	3.00%
31-40	7	7.00%
41-50	27	27.00%
51-60	28	28.00%
>60	35	35.00%
Mean Age	55.3 ± 7.51 years	
Gender		
Male	54	54.00%
Female	46	46.00%

In present study, majority of patients had duration of DM of 0-5 years (47 %) & 22 % had duration of DM of >10 years.

Table 2- Duration of type 2 diabetes mellitus

Duration (years)	No of patients (n=100)	Percentage
0-5	47	47.00%
6-10	31	31.00%
>10	22	22.00%

In majority of patients HbA1C was ≥ 8.5 % (82 %).

Table 3- HbA1C Distribution

HbA1C (Percentage)	No of patients (n=100)	Percentage
< 8.5	18	18.00%
≥ 8.5	82	82.00%

Mean RDW values in patients with HbA1C ≥ 8.5 % was 14.31 ± 2.45 as compared to .patients with HbA1C ≥ 8.5 % as 13.56 ± 2.11, difference was significant statistically (p value- 0.039).

Table 4- HbA1C & mean RDW

HbA1C (Percentage)	Mean RDW	P value
< 8.5	13.56 ± 2.11	0.039
≥ 8.5	14.31 ± 2.45	

We compared RDW values in patients with & without vascular complications (retinopathy, neuropathy, nephropathy, ischemic heart disease, cerebro-vascular accident & peripheral arterial disease) &, difference was not significant statistically (p value- >0.05).

Table 5 - Vascular complications vs RDW

Vascular complications	RDW		P value
	Complication Present	Complication Absent	
Retinopathy	13.54	13.71	0.75
Neuropathy	13.6	13.71	0.86
Nephropathy	13.25	13.71	0.81
Ischemic Heart Disease	13.73	13.71	0.92
Cerebro-Vascular Accident	12.4	13.72	0.52
Peripheral Arterial Disease	14.0	13.69	0.71

Discussion

The global prevalence of diabetes in adults is estimated to be 8.8% in 2015 and 10.4% in 2040, as reported by the International Diabetes Federation (IDF).⁷ Persistent hyperglycemia resulting from insulin deficiency leads to the devastating and life threatening complications of diabetes.

The decreased erythrocyte deformability in T2D has been attributed to increased blood glucose, glycation, oxidative stress and increased content of saturated fatty acids in its membrane.⁸ Less deformable erythrocytes would contribute to the development of T2D-associated vascular complications.⁹

Red blood cell distribution width is a widely available and inexpensive test routinely performed as part of the complete blood cell count. Although higher RDW levels have been related to cardiovascular morbidity and mortality in several study populations.^{10,11,12,13}

In study by Chitra S.,¹⁴ among 610 patients with type 2 Diabetes Mellitus, a significant correlation between the values of HbA1c with age - with the number of patients increasing with age and showing elevated HbA1c levels. There was no significant correlation between the values of RDW and age. There was a significant positive correlation between HbA1c and RDW- (p= 0.003). For patients with HbA1c values between 6.2- 6-8 %, there was a particularly strong positive correlation with RDW values. Similar findings were noted in present study.

Barla K¹⁵ noted that HbA1c% was positively correlated with MCHC, RDW, MPV, WBC, TC, TG, and VLDL. Hyperlipidemia was also found to be persistent among patients with poor glycemic status, which is associated with a higher risk of cardiovascular-related mortality and morbidity. As a complete blood picture is simple and cost-effective, screening of hematological parameters and lipid parameters also should be done along with glycated hemoglobin to presume the risk of long-term vascular complications and to increase

the quality of life in T2DM patients. Similar findings were noted in present study.

In study by Nada AM¹⁶, red cell distribution width (RDW) was significantly higher in diabetic patients than in control subjects (P=0.008). It was also higher in patients with uncontrolled glycemia (HbA1c .7%) than those with good control (HbA1c #7%; P=0.035). RDW did not significantly correlate with fasting plasma glucose, HbA1c, or duration of diabetes, insulin and oral hypoglycemic agents. In present study, we noted a statistically significant association between HbA1C & RDW.

In study by Peersab M P,¹⁷ among 100 patients the relationship between RDW and HBA1C, RDW and mean glucose were found to be proportional with a significant p value. RDW value was more in females compared to males. But the relationship between RDW and creatinine, RDW and WBC counts, RDW and duration of diabetes were not statistically insignificant.

Multiple studies demonstrate an interesting interaction between diabetic status and RDW and consider the latter as “an inflammatory marker with a significant predictive.^{16,18} A significant association of gender (female), age, high-density lipoprotein level, duration of diabetes and type of medication, with poor glycemic control in T2DM patients that had secondary medical complications.¹⁹

Further studies should be conducted to investigate linear correlation between HbA1C and RDW & factors affecting affect the relationship between RDW and glycemic measurements.

Conclusion

RDW was significantly higher in patients with uncontrolled sugars, As RDW is an inexpensive, noninvasive, and convenient indicator, RDW can be used as a surrogate marker for HbA1C in assessing glycemic control. RDW might be considered for inclusion in the risk assessment of high-risk groups of diabetes. No significant correlation between RDW and vascular complications were found.

Conflict of Interest: None to declare

Source of funding: Nil

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