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Original Research Article

Relation between Red Cell Distribution Width and HbA1c Levels in Patients with Type 2 Diabetes Mellitus

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Conflict of interest: Nil

Abstract:

This study entitled as "Relation between Red cell distribution width and HbA1c levels in patients with Type 2 diabetes mellitus" was conducted among patients with Type 2 DM for more than one year duration in the age group of 20-50 years coming to Diabetology department in SGMC &RF. It was done to find out the relation between RDW & HbA1C levels in patients with type 2 Diabetes Mellitus. The total sample size was 148. Details were collected using questionnaire and Biochemical Analysis. For Biochemical Analysis, 2ml of blood was collected from patients attending the OPD after getting the informed consent and was given to pathology lab for estimating RDW. Blood level of RDW was done by Flow cytometry method and HbA1c by HPLC method was done in the laboratory. As against various literatures available, this study failed to prove any significant association between RDW and HbA1c. Here the p value is 0.234 and the r value is -0.098 which says that there is no relation between RDW and HbA1c. This study seems quite inadequate enough to draw any correlation between RDW and HbA1c and demands further changes in the pattern of approach.

Keywords: HbA1c, RDW, BMI, Age, Sex, Type II Diabetes Mellitus.

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Introduction

Diabetes mellitus (DM), commonly known as diabetes is a clinical syndrome of hyperglycaemia occurring with constellation of abnormalities. It is a group of metabolic disorders where there is high blood sugar levels over a prolonged period. It is due to either the pancreas not producing enough insulin, or the cells not responding properly to the insulin produced [1]. Normal range of Fasting Blood Sugar level are 70 -100 mg/dL and Post-Prandial Blood Sugar level is 100 – 140 mg/dL. If the values exceeds the normal range, the person should be evaluated to rule out diabetes mellitus. [1] There are 3 types of diabetes mainly. Type 1 DM results from the failure of pancreas to produce enough insulin due to loss of beta cells. This form was previously referred to as "insulin-dependent diabetes mellitus" (IDDM) or "juvenile diabetes". The cause is unknown.[2] Type 2 DM begins with insulin resistance, a condition in which cells fail to respond to insulin properly. As the disease progresses a lack of insulin may also develop. This form was previously referred to as "non-insulin-dependent diabetes mellitus" (NIDDM) or "adult-onset diabetes". The most common cause is excessive body weight and insufficient exercise.[2] Gestational diabetes is the third main form, and occurs when pregnant women without a previous history of diabetes develop high blood sugar levels.[3] When blood glucose becomes high, abnormal protein glycosylation are seen. Example, glycosylation of HbA to produce HbA1c which is a useful marker for long term glucose regulation. [12] HbA1c is a measure of the beta-N-1-deoxy fructosyl component of haemoglobin. It is a form of glycated haemoglobin that is measured primarily to identify the three-month average plasma glucose concentration. Red blood cell distribution width (RDW) is the measure of the range of variation of red blood cell (RBC) volume or RBC size. Normal value ranges between 11.5 to 14.5% [17]. It is reported that high RDW is associated with increased incidence of heart failure, atrial fibrillation and diabetes mellitus in middle aged individuals from gen-

eral population. If anemia is observed, RDW test results are often used together with mean corpuscular volume results to know the possible causes of the anemia. It is mainly used to differentiate an anemia of mixed causes from an anemia of a single cause.[18] While searching the literature seeking evidence for the exact relationship of RDW and HbA1c levels two reports are noteworthy.[20]

Hyperglycaemia has multiple effects on the red blood cell (RBC), including glycation of haemoglobin and reduced lifespan. A study by Engström G et al reported that low RDW was associated with increased incidence of DM independently of other risk factors. RDW is a biomarker that could improve the assessment for individuals at risk of developing DM. A study by Gang L et al also reported that elevated RDW is associated with an increased incidence of DM. Hence in this study it seems worthwhile to find out the relation between Red cell distribution width (RDW) and HbA1c levels; how far this can be utilized as an assessment factor for individuals at high risk of getting diabetes mellitus [20]

Objectives: To find out the relation between RDW & HbA1C.

Materials and Methods

Number of Subjects: 148.

Study Design: Observational study.

Study Setting: Sree Gokulam Medical College and Research Foundation, Department of Physiology, Department of Biochemistry, Department of Diabetology.

Study Population: Patients with Type2 diabetes mellitus.

Inclusion Criteria: Patients with Type 2 DM for more than one year duration in the age group of 20-50 years coming to Diabetology department in SGMC & RF.

Exclusion Criteria:

1. Patients with established coronary artery disease, renal diseases, liver diseases.

2. Patients on any medication other than hypoglycemic agents.

3. Presence of any infectious diseases.

Study Variables: HbA1c, RDW, BMI, Age, Sex

Study Period: May 2018 to October 2018

Study Instrument: Data collection procedure.

Patients attending the Diabetology clinic of SGMC & RF was included in the study.

Written informed consent was obtained from each patient prior to the study. IEC approval obtained. The study was conducted using questionnaire. The participants of the study filled out self-administered questionnaires, which included questions regarding personal data such as name, age, gender, food habits, physical activity and history of any medication and illness.

Height was measured to the nearest millimetre using a wall mounted measuring scale and weight was measured using a weighing machine. BMI was calculated as body weight in kilograms divided by square of height in metres. According to BMI subjects were categorized as underweight (BMI < 18.5), normal (BMI ≥ 18.5 AND < 25), overweight (BMI 25 – 29.9) and obese (BMI ≥ 30).

2ml of blood was collected from patients attending the OPD after getting the informed consent and was given to pathology lab for estimating RDW .Cost of the investigation was met by the investigator. Blood level of RDW was estimated by Flow cytometry method and HbA1c by High Performance Liquid Chromatography method were done in the laboratory.

Statical Methods

Sample Size: Sample size was calculated using the study.

Serum 25-Hydroxyvitamin D3 Concentrations and Prevalence of Cardiovascular Disease.

Among Type 2 Diabetic Patients

α=5%, Z1-α/2=1.96

β=20%, Z1-β=0.842

X1 = Mean

X2 = Mean

X1 = SD of Case = 9.1

X2 = SD of Control=.82

Sample size (n) = $(S1^2+S2^2)$ $\{(Z1-\alpha)/2 + (Z1-\beta)\}^2$ / $(X1-X2)^2$

So n is obtained as 74(from each group)

Sample size is 148

Ethical aspects: Study was commenced after clearance from institutional ethical committee. Permission was taken from the college authorities prior to commencement of study and data was collected after obtaining informed written consent from participants

Results

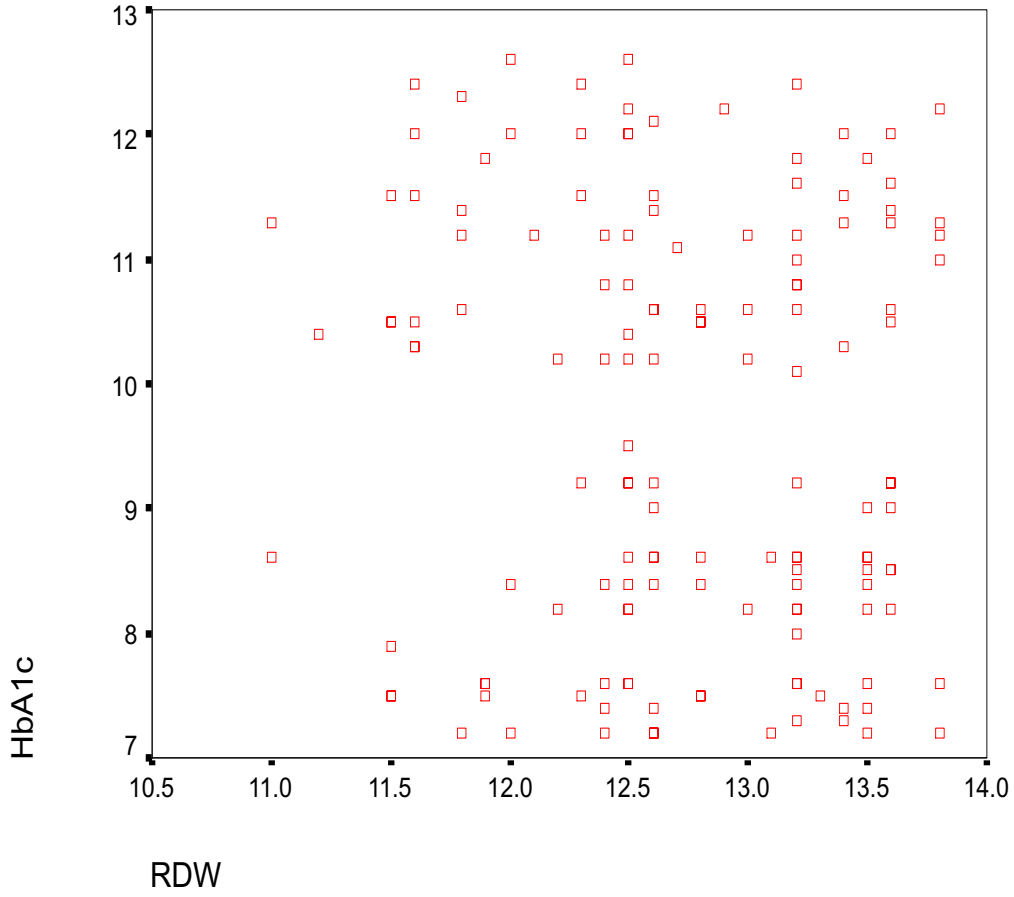

Figure 1: Scatter Diagram B for RDW & HBA1C (r = -0.098, p = 0.234)

This scatter diagram shows that there is no significant association between RDW and HbA1c.Here the p value is 0.234 and the r value is -0.098 which says that there is no relation between RDW and HbA1c.

Discussion

This was an observational study which was carried out in 148 patients with type 2 diabetes mellitus in a age group of 20 – 60 years. Patient with a history of any established coronary artery diseases, renal diseases, liver diseases, infectious diseases and also patient with a history of any medication other than oral antidiabetic agents were excluded from the study. The patients were recruited from the Diabetology Out-Patient department of Sree Gokulam Medical College and Research Foundation.

The study tools used were Questionnaires, HbA1c test and test for Red cell Distribution Width. The study variables included were HbA1c, RDW, BMI, Age and Sex. Data was entered in Microsoft Excel spread sheet 10 and analysed using SPSS version 16.0. The relation between RDW & HbA1C levels in patients with type 2 diabetes was studied using karl-pearson co-relation co efficient test. The total number of patients included in the study was 148. Out of 148 patients, 59 patients (39.9%) were in the age group of 41 – 50 years followed by 58 patients (39.2%) were 51 - 60 years and 31 patients (20.9%) were ≤ 40 years. Among the study population, 46.6% were males, and 53.4% were females. Out of these patients 52 patients (35.1%) were having diabetes for 6 – 10 years, 46 patients (31.1%) for 1 – 5 years, 30 patients (20.3%) for 11 – 15 years, and 20 patients (13.5%) for > 15 years.

In the study population, 22.3% had a history of alcohol intake and 23% of the study population had history of smoking. 45.3% of the study population had the history of either alcohol intake or smoking. Around 55% of the study population had no history of alcohol intake or smoking. A study by Engström G et al reported that low RDW was associated with increased incidence of DM independently of other risk factors. Low RDW could be a surrogate marker of reduced RBC survival, with lower HbA1c due to shorter duration of glucose exposure. A study by Gang L et al also reported that elevated RDW is associated with an increased incidence of DM. Though earlier literature shows an association, the present study could not draw a statistically significant association between RDW and HbA1c. [p value = 0.234 and the r value = -0.098]

Regarding RDW, even though no correlation can be drawn in this study, changes in the pattern of study is suggested to know the relation because of the strong factor that hyperglycemia produces glycosylated haemoglobin which decreases the life span of RBCs as glycated haemoglobin will remain thus till the cell is destroyed causing early destruction and hence anaemia .The time limit of this study is a factor. Hence it is suggested that a detailed study with slight changes in the parameters may be done in continuation for further relevant observations.

Conclusion

Regarding the occurance of anaemia due to glycation of haemoglobin which can change the RDW values, the aim of this study was to assess whether RDW has any significant correlation with glycemic status so as to use it as a tool during treatment. As against various literatures available, this study failed to prove any significant association between RDW and HbA1c. [Here the p value is 0.234 and the r value is -0.098 which says that there is no relation between RDW and HbA1c]. This study seems quite inadequate enough to draw any correlation and demands further changes in the pattern of approach. This study in our population can be considered as an initial step that necessitates further studies to define the relation between RDW and HbA1c, different diabetic complications and its prognostic value.

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