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Hematocrit and its Correlation with Fasting Blood Sugar of Type II Diabetes Mellitus Patients: A Cross-Sectional Study

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Abstract

Introduction: Diabetes mellitus (DM) is a non-communicable disease with increasing prevalence worldwide. In DM, hematological indices such as WBC count, Hematocrit, platelet count, erythro-cyte aggregation, and erythrocyte deformability, are disturbed, which can lead to the development of inflammation and a tendency for coagulation and microvascular complications. So the current study was aimed at correlating RBC count, PCV and RDW with Fasting blood sugar of Type 2 Di-abetes patients. *Methodology:* A total of 96 participants (47 cases and 47 healthy controls) were selected using a systematic random sampling technique. Data is retrieved from the Medical Records Department. Parameters are lab investigation values that are already done on patients who came to DM WIMS. FBS was estimated using (Cobas Integra 400 plus) automated clinical chemistry analyzer and hema-tological parameters using a fully automated (Sysmex XT-1800i) analyzer. *Statistical analysis:* The statistical analysis was done using SPSS 15.0 version. After checking for normality Pearson's or Spearman correlation analysis is carried out to study the correlation. *Results:* PCV and RBC count was significantly higher in diabetics when compared to controls. Even though there was a negative correlation between PCV, RBC count and RDW with FBS (fasting blood sugar) in diabetics it was not statistically significant. *Conclusion:* The routine hematological profile checking of patients with T2DM may help to prevent complications associated with aberrations in hematological values.

Keywords: Fasting blood glucose; Red cell distribution width; PCV; type 2 diabetes mellitus.

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Introduction

Diabetes mellitus (DM) is a non-communicable disease with increasing prevalence worldwide.[1] Poorly controlled diabetes leads to various complications such as nephropathy, retinopathy, neuropathy and oxidative stress causing oxidative damage to tissues and cells.[2] 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.[3,4]

Many studies have advocated the importance of raised levels of WBC and RBC count in the diagnosis of metabolic syndrome.[5,6] Many epidemiological studies have also suggested a close relationship between hematological parameters and different components of metabolic syndrome.[7,8]

In DM, hematological indices such as WBC count, Hematocrit, platelet count, erythrocyte aggregation, and erythrocyte deformability, are disturbed, which can lead to the development of inflammation and a tendency for coagulation and micro vascular complications.[9] Researchers have been demonstrated that higher or even normal reference range of RDW (red cell distribution width) was strongly associated with increased risk of cardiovascular disease (CVD) events in middle-aged and older adults.[10,11]

Patients with T2DM have an increased risk of atherogenic dyslipidemia and cardiovascular disease (CVD) and the enhanced blood viscosity adversely affect the microcirculation in diabetes patients, leading to microangiopathy.[12] Also, increased levels of hematocrit and blood viscosity contribute to the development of insulin resistance and are independent predictors of type 2 diabetes.[13]

So the current study was aimed at correlating RBC count, PCV and RDW with Fasting blood sugar of Type 2 Diabetes patients.

Aims and Objectives

To determine the Hematocrit, RBC count and Red cell distribution width. To correlate Hematocrit, RBC count and Red cell distribution width with FBS of type II diabetic patient.

Materials and Methods

The study done was a comparative cross-sectional study at DM Wayanad Institute of Medical Sciences, Kerala, India. Data including Fasting blood sugar and hematological parameters like Platelet count and platelet distribution width of patients aged between 25 and 70 years were collected from hospital records of the above-mentioned institute. The duration of the study was from the Ist of January 2018 to the 31st of June. Parameters are lab investigation values those are already done on patients who came to DM WIMS central lab and procedure was done by collecting 2 ml Fasting blood sample and FBS was estimated using (Cobas Integra 400 plus) automated clinical chemistry analyzer. 2 ml of venous blood was collected for hematological parameters using fully automated (Sysmex XT-1800i) analyzer.

Sample size

Hematological parameters of 47 patients with FBS below 126 mg/dl are collected and considered as a control group.

Hematological parameters of 47 patients with FBS above or equal to 126 mg/dl are collected and considered as the study group. Age and sex were matched.

Inclusion criteria

a) Control group includes the data of patients whose FBS < 126 mg/dl and is apparently healthy individuals who had no previous history of chronic diseases.

b) The study group includes the data of patients whose FBS ≥ 126 mg/dl.

Exclusion criteria

Severely ill patients, infected patients, pregnant women, on antihypertensive treatment, on antiplatelet drugs, on statins, and who had other chronic diseases were excluded from the study.

Statistical Analysis

The sample size required to study the correlation is 90 at 5% level of significance and 80% power assuming the population correlation to be .3 (moderate correlation).

The statistical analysis was done using SPSS 15.0 version. After checking for normality Pearson's correlation analysis was carried out to study the correlation.

Ethical consideration

Ethical clearance was obtained from the Research and Ethical Committee of DM Wayanad Institute of Medical Sciences, Kerala, India. A permission letter was also taken from the Hospital Superintendent head for collecting data from the hospital record. For maintaining the confidentiality of the study participant's information, the data was stored in a password-protected computer of a principal investigator.

Results

Out of 47 diabetic patients 28 (59.57%) were females & 19 (40.42%) were males. PCV and RBC count was significantly higher in diabetics when compared to controls. RDW was marginally higher but statistically not significant shown in Table 1. Even though there was a negative correlation between PCV, RBC count and RDW with FBS (fasting blood sugar) in diabetics it was not statistically significant as shown in Table 2.

Table 1: Ematological parameters in study and control group

Variables	Diabetics (study group)	Nondiabetics (control group)	*t* value	*p* value
PCV (%)	38.61 ± 7.67	36.32 ± 5.22	1.68	0.04
RBC (millions/ cumm)	4.74 ± 0.85	4.42 ± 0.76	1.88	0.03
RDW	14.70 ± 6.26	14.11 ± 2.61	0.59	0.27

$p < 0.05$ considered as significant

Table 2: Pearson's correlations(r) of Hematological parameters with FBS among T2DM patients and healthy controls

Variables	*r* value	*p* value
PCV (%)	-0.13	0.38
RBC(millions/cumm)	-0.11	0.46
RDW	-0.03	0.84

$p < 0.05$ considered as significant

Discussion

An increase in blood glucose levels is one of the factors that change the erythrocyte morphology. The extent of change in the shape of erythrocyte depends on the level of blood glucose level. All this affects the flow property of blood due to alteration and deformation.[14] The present study compares the hematological parameters between type II diabetics and nondiabetics. Our results showed that there is a significant increase in RBC count and PCV in diabetics when compared to nondiabetics this finding was similar to various previous studies.[15–17] Increased PCV, RBC count may be due to a variety of morphological changes exhibited by RBCs and compositional changes in plasma of diabetics.[18]

In contrast to this study, a study conducted on Chinese patients with T2DM reported that a decreased RBC count is associated with micro vascular complications.[19] Likewise, a study performed in Tobago (Caribbean) reported that RBC count, Haemoglobin concentration, and Hematocrit levels in T2DM patients are lower than in the control group.[20] The possible hypothesis for this difference might be that chronic hyperglycemia causes non-enzymatic glycosylation of RBC membrane proteins leading to accelerated aging of RBCs. A similar study on the middle-aged and elderly Chinese population in Taiwan also contradicts our findings as it is reported a reduced RBC count in patients with insulin resistance. Another study observed that diabetics are prone to anemia due to reduced kidney functions and decreased the production of erythropoietin hormone, which ultimately leads to decreased RBC count in the body.[21]

In our study even though there was a slight increase in RDW in diabetics than nondiabetics it was not statistically significant which us contradictory to other studies which showed a significant difference in RDW in diabetics and nondiabetics.[22–24] But few studies have shown results similar to our study.[25–27] Differences in study design and ethnic and cultural differences across the study populations may account for the variability of RDW across studies. High RDW indicates a high degree of anisocytosis which is associated with distortion and degradation of erythropoiesis reflecting chronic inflammation and an increased level of oxidative stress.[28]

The life span of red blood cells could be decreased in diabetes patients. So, RBC's are affected by various disturbances in the hematopoietic milieu. These disturbances lead to elevated internal viscosity and increased membrane rigidity in these blood cells. So, the RBC count is calculated as an increase.[29]

Conclusion

Hematological parameters like RBC count, RDW and PCV can be a predictor of good glycemic control diabetics. Unfortunately, our study didn't show any significant correlation between these parameters and FBS, this may be due to small sample size. The routine hematological profile checking of patients with T2DM may help to prevent complications associated with aberrations in hematological values.

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