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Hematological Parameters in Sudanese Type-2 Diabetes Mellitus

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Abstract: *Background:* Diabetes mellitus is a complex concept for a spectrum of disorders characterized by hyperglycemia and a variety of complications, comprising metabolic and cellular disturbances that lead to vascular complications. The objective of this project was to correlate type 2 diabetes patients to healthy controls in aspects of hematological indices and their association with demographic data. *Materials and Methods:* From May to September 2016, a case-control analysis has been performed in Khartoum, Sudan. 154 participants were enrolled in this study. 104 participants were diabetic type 2 and 50 were apparently healthy as control group to find out any variations in hematological parametersHbA_{1C} and CBC: (Hb, WBCs & differential, RBCs& indices and PLTs, hematocrit (HCT) among type 2 diabetic patients. Blood was gathered in EDTA containers. HbA_{1C} measured using i-CHROMA™ and complete blood count using the Sysmex® Kx21-N hematological analyzer. Before samples collection, each participant gave their informed consent, which had been approved by the Ministry of Health's ethical committee. The Statistical Package for Social Sciences (SPSS) SPSS version 20 was used. The meaning of the discrepancies was assessed using the Crosstab test. p- Value is significant at P< 0.05. *Results:* T2DM patients had a statically significant in white blood cells, neutrophils, and lymphocytes as comparison to the control group P<0.05. There was no considerable difference in red blood cell count, Hb, Hct, MCV, MCH, MCHC, RDW, Platelets count, MPV, and PDW between the two classes P> 0.05. *Conclusion:* T2DM patients had relatively increased levels of white blood cells, neutrophils, and lymphocytes than the control group (P<0.05).

Keywords: Hematological indices; type 2 diabetes mellitus; Sudan.

INTRODUCTION

Diabetes mellitus DM is a heterogeneous group of metabolic disorders characterized by hyperglycemia and a variety of implications, including metabolic and cellular complications that lead to micro and macro cardiovascular complications [1]. Type 2 diabetes mellitus is a long-term metabolic condition marked by elevated blood sugar, insulin resistance and/or deficiency [2]. Insulin resistance inhibits glucose release into liver and insulin dependent tissues, so, the liver releases glucose into the bloodstream in an inappropriate manner resulting in increased elevated plasma glucose or hyperglycemia which detected [3] by measuring of fasting plasma glucose level of 7.0 mmol/L (126 mg/dL) or more. Also two hours after a75g oral glucose load plasma glucose at or above 11.1 mmol/L (200 mg/dL) is suggested as a glucose tolerance measure. Diabetes Association recommended criterion in 2010, defined hyperglycemia symptoms and blood glucose level of 11.1 mmol/L (200 mg/dL) or higher and HbA_{1C} of 48 mmol/mol or higher (≥ 6.5

DCCT %) [4]. The American Type 2diabetes is regulated by lifestyle modifications and regular exercise[5].

T2DMprevalence rates have raised dramatically since 1960, synchronized with rising in BMI and obesity rates [6].In 2013, approximately 368 million people were diagnosed with the disease, growing from about 30 million in 1985 [7].Type 2 diabetes is becoming more common in young adults, but it usually strikes in middle or later life[8].

HbA_{1C} has glucose attached to terminal valine in each β chain by non-enzymatically reaction and occurs when plasma glucose is episodically elevated over time. The concentration of HbA_{1C} depends on the concentration of glucose in the plasma and the duration of hyperglycemia and is an index of diabetic control for a period over past 12 weeks. High levels of glycated hemoglobin lead to hypertension and vascular diseases in diabetic patients because of impair endothelium mediated vasoactive responses [9]. Watala *et al*. attributed an increase in erythrocyte internal viscosity to glycation derived structural alterations in hemoglobin molecules [10].

MATERIALS AND METHODS

Study design, period& population

From May to September 2016, a case-control evaluation was carried in the Khartoum state. The review investigated 154 participants; 104 of whom were diabetic patients in Jabir Abu Eliz Hospital patients and the other 50 were apparently healthy volunteers without a medical history of diseases enrolled as controls group to see if there was any variation in hematological parameters between groups.

Each subjects' blood samples were drawn in EDTA containers for full blood count evaluation using Sysmex® Kx21-N hematological analyzer or the direct current detection system with co-incidence correction was used to count WBCs, RBCs, and PLTs. Based on complex algorithms, automatic discriminators classify cell populations. The amplitude of each analyzed cell's electronic circuit is proportional to the cell volume. The hematocrit (HCT) is calculated directly from the red cell count and volume of each human RBC. The Sysmex® cell counters measure WBCs, RBCs, and PLTs with unrivaled precision and accuracy, even with samples at exceptionally low or extraordinarily high concentrations. Calculating of HbA_{1C} using i-CHROMA™ instrument is based on the fluorescence immunoassay technology, specifically the competition immune-detection system.

Ethical approval, sampling &data interpretation

This report was authorized by the Ministry of Health's ethics committee and each participant provided informed consent prior to sampling frame. Sample size determined depending in similar studies of Sudanese ethnicity. The Statistical Package for Social Sciences (SPSS) version 20 was used for statistical analysis. The meaning of the discrepancies was assessed using the Crosstab test. $P< 0.05$ was used to determine statistical significance.

RESULTS

Demographic, clinical and characteristics of study participants

In this study 104participants were diabetic type 2 and 50 were enrolled as control group. In diabetic type 2 group 64(61.6%) were females and 40 (38.4%) were males. For control group 29(58%) were females and 21 (42%) were males. The mean age was 50.59 years for diabetic type 2 group and 52.29 years for controls group (Table1). The duration of disease among diabetic type 2 was<10 years, 10-20 years and >20 years were 50(48.1%), 46(44.2%) and 8(7.9%) respectively. The results showed that the mean level of BMI, systolic and diastolic blood pressure and $HemoglobinA_{1C}$ levels were significantly higher ($P<0.05$) (Table2). The waist circumference was92.1cm for type 2 diabetic and78.7 cm for controls with significant increase in type2 diabetic by ($P<0.05$).

Comparison of hematological profile of study participants and control

The TWBCs mean were 8.4 Cell/mm^3in T2DM and 5.2 Cell/mm^3in control group. White cells mean were significantly higher in T2DM by ($P=<0.000$). Lymphocytes mean were 42.6% in T2DM and 35.8% in control group, Lymphocytes mean was significantly higher in T2DM by ($P=<0.000$). Neutrophils mean count was 65.1% in T2D Mand 53.3% incontrolgroup with significantly higher increase in T2DMby ($P=<0.000$).

Red blood cells count, Hb, Hct, MCV, MCH, MCHC, RDW, Platelets count, MPV and PDW showed insignificant change between two groups ($P> 0.05$).

Table-1: Demographic, clinical and characteristics of study participants

Variable		T2DM	Control	P. value
Age		50.59+/-7.89	52.29+/-7.58	0.908
Gender	Male	40 (38.4%)	21 (42%)	
	Female	64(61.6%)	29(58%)	0.320
Residence	Khartoum	89(8.6%)	45 (90%)	
	Aljazeera	14(56%)	5(10%)	0.431
	Rabak	4(3.8%)	0(0%)	
	Kosti	3(2.9%)	0(0%)	
Occupation	worker	36(34.6%)	19(38%)	
	Employee	18(17.3%)	11(22%)	0.900
	House-wife	46(44.2%)	15(30%)	
	students	4(3.9%)	5(10%)	
Duration of diabetes mellitus	<10	50(48.1%)	0(0%)	
	10-20	46(44.2%)	0(0%)	<0.0001
	>20	8(7.9%)	0(0%)	
Glycated Hemoglobin HbA_{1C}	Yes	68 (65.8%)	0(0%)	<0.0001
	No	36(34.6%)	0(0%)	
Complication	No	66(31.1%)	50(100%)	
	Cataract	32(15.1%)	0(0%)	<0.0001
	Hypertension	6(2.8%)	0(0%)	
Treatment	Tabs	64 (61.5%)	0(0%)	<0.0001
	Insulin	40(38.5%)	0(0%)	

Mean +/-; P- value adjusted to <0.05

Table 2: Comparisons of hematological of the study participants

Parameter	Percent %	T2DM	Control	P value
HbA_{1C}%		10.3 +/- 3.45	5.3 +/- 2.23	<0.0001
WBCs (cell/cumm)	TWBCs	8.4 +/- 1.54	5.2 +/- 1.30	<0.0001
	Lymphocytes %	42.6 +/- 0.80	35.8 +/- 0.68	<0.0001
	Neutrophils%	65.1 +/- 2.3	53.3 +/- 1.95	<0.0001
	MID(Monocytes,eosinophils,baophils)%	10.1 +/- 1.53	9.8 +/- 1.40	0.362
RBCs (cell/cumm)	RBCs count	5.0 +/- 0.89	5.2 +/- 0.76	0.733
	Hb(g/dl)	12.5 +/- 1.2	12.7 +/- 1.54	0.202
	HCT%	39.0 +/- 4.79	40.8 +/- 3.90	0.324
	MCV	84.0 +/- 3.32	85.6 +/- 4.10	0.349
	MCH(pictogram pg)	27.0 +/- 3.2	27.7 +/- 2.65	0.890
	MCHC(g/dl)	34.9 +/- 2.25	35.7 +/- 3.84	0.900
	RDW	40.1 +/- 2.5	40.8 +/- 2.00	0.822
Platelets(cell/cumm)	PLTs count	250.3 +/- 60.23	240.9 +/- 52.98	0.450
	MPV	11.2 +/- 2.9	10.3 +/- 1.10	0.062
	PDW%	14.8 +/- 1.12	13.2 +/- 1.1	0.401

DISCUSSION

There was association between some components of metabolic syndromes and leukocytes indicating association between total white blood cell count (WBC) and diabetes mellitus [11]. In this study the disparity in mean WBC count between diabetic patients and controls was statistically significant. This was consistent with findings of an Iraqi study2016 by [12]. Who noticed a substantial improvement in WBC count in diabetic patients as compared to the control group. Since the interaction between inflammatory, insulin, and human blood components formed a vital signal for disturbances caused by invading foreign agents or inflammation caused by these invaders, activation of the immune system and stimulation resulted in an increase in inflammatory symbols such as WBC and cytokines, As a result of the protection mechanism, blood parameters such as WBC, PCV, and phagocyte percentage can change[13].

Performed another study in Ethiopia in 2015 and realized the WBC indexes, statistically meaningful improvement in overall WBC (P=0.000), absolute neutrophil (*P*=0.012), and absolutely mphocyte (*P*=0.0001) counts were observed in the T2DM patients as compared to the control group-21. Among RBC's indices. Their study is similar to our report in that there is a significant difference in white cells as compared to that of control. The platelet indices of diabetic and non-diabetic patients were also compared in this study.

There was no statistically meaningful variation in platelet count between diabetic and control groups. The lack of a substantial difference ($p<0.05$) or ($p<0.01$) in the hematological diagnostic indices assessed in met-administered diabetic patients and normal human subjects suggests that these diagnostic indices act as effective indicators for monitoring recovery (rehabilitation) from type 2 diabetes mellitus[14].

The recent study showed diabetic patients with poor control of HbA1C and non-significant change in CBC. This finding was contradiction with that [15] which showed significant change in CBC indicating that the study participants were more susceptible to develop anemia.

CONCLUSION

T2DM patients had slightly higher levels of white blood cells, neutrophils, and lymphocytes than the control group ($p<0.05$).

CONFLICT OF INTEREST

The author declares that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

LIST OF ABBREVIATIONS

TWBCs: Total White Blood Cells Count; RBCs: Red Blood Cells Count; Hb: Hemoglobin; Hct: Hematocrit; MCV: Mean Corpuscular Volume; MCH: Mean Corpuscular Hemoglobin; MCHC: Mean Corpuscular Hemoglobin Concentration; RDW: RedCell Distribution Width; MPV: Mean Platelets Volume; PDW: Platelets Distribution Width.

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