



Haematological Parameters in Type 2 Diabetic Patients Attending Igbinedion University Teaching Hospital Okada, Edo State, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. Author OM conceptualized and designed the study. Author ZS drafted the literature review and general supervision. Author AKE reviewed the manuscript. Author OOC was in-charge of logistics. Author MUO reviewed the manuscript. Authors ADO and ICU operates the auto analyzer. All authors read and approved the final manuscript.

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ABSTRACT

Diabetes is a group of metabolic diseases in which there are high blood sugar levels over a prolonged period, and if untreated could lead to complications. This study, carried out at the Igbinedion university teaching hospital Okada to ascertain some hematological parameters, using 69 known diabetes patients who enrolled as an Out-patient in the General Out- Patient Department and 69 non- diabetes apparently healthy individuals as control. Thirty- nine of these diabetic individuals were female, while thirty were male individuals. For the non- diabetic individuals, thirty-seven were female, and thirty-two were male representing 53.6% and 46.4% respectively. Ethical approval from the institution was sought prior to commencement of study and quality control of reagents was strictly maintained. Five millilitres of whole blood was collected into an Ethylene Diamine Tetra-Acetic acid (EDTA) anticoagulated bottle, and haematological parameters including PCV, HB, WBC, RBC, MCV, MCH, MCHC and platelet count were conducted for all individuals. Result obtained for Diabetic individuals showed a mean value of 34.63, 11.24, 4.41, 7.20 and 204.27 for PCV, Hb, RBC, WBC and platelets counts respectively, while for non-diabetic individuals, a mean value of 35.04, 10.09, 3.99, 7.07 and 262.56 respectively. Hb concentration and RBC count were statistically significant ($p < 0.05$). The Red cell indices, MCV and MCHC, were statistically significant. This study showed a statistically significant variation in some hematological parameters of diabetic patients compared to control group. Low platelet count and alteration to red cell morphology as indicated in values of MCV and MCHC among diabetic patients are indicators of thrombotic potential. Hence, routine screening of hematological parameters should be considered for proper management of diabetic patients.

Keywords: Metabolic diseases; haematocrit; red blood cell indices.

1. INTRODUCTION

Diabetes mellitus (DM) is one of the most common non-communicable diseases affecting people around the world [1] and a metabolic disorder of chronic hyperglycemia characterized by disturbances to carbohydrate, protein, and fat metabolism resulting from absolute or relative insulin deficiency with dysfunction in organ systems [2]. It is a global issue, and the prevalence as reported by the International Diabetes Federation (IDF) was 425 million persons living DM of which about 50% of these undiagnosed [3]. The developing economies of Africa and Asia contribute a significant fraction of this figure. There is also a rising burden from the complications of DM alongside the ever-increasing prevalence of the disease [4]. We now see high rates of DM-related amputations, cerebrovascular disease, heart-related problems, and kidney disease in populations that were not previously known for these challenging health problems. In Nigeria however, with a population of over 158 million people, the most populous country in Africa and accounts for one sixth of Africa's population, "approximately" 50% of Nigerians are urban dwellers and the country has cultural diversity among the ethnic groups [5]. Health care delivery as seen in most facilities is at best sub-optimal with hematological parameters seldom measured in diabetic

patients. Some of these, such as white blood cell (WBCs) count and hematocrit (HCT) level, have been shown to be associated with insulin resistance and incident Type 2 Diabetes mellitus T2DM [6]. Hematocrit is positively correlated with hyperinsulinemia and other risk factors associated with insulin resistance such as high blood pressure, elevated serum triglycerides, low HDL cholesterol, and central obesity. Evidence from epidemiological studies suggests an association between total WBCs or leukocyte count, a non-specific marker of inflammation, and diabetes risk [7,8]. The aim of this study is to evaluate some haematological parameters of diabetic patients in Igbinedion University Teaching Hospital, Okada, Nigeria

2. MATERIALS AND METHODS

2.1 Study Population

The study population included a convenience sample of males and females with T2DM, aged 40-60 years and seeking medical care at the Igbinedion University Teaching Hospital Okada, Edo State. A total of 69 known patients with T2DM and 69 healthy subjects mostly Medical students and workers of the Institution with no history of diabetes and their fasting blood glucose (BG) levels were lower than 120 mg/dl. They were matched for age, gender and socio-

economic conditions and they had no concurrent acute illnesses.

2.2 Data Collection

A structured interview was conducted to collect data using a specially prepared questionnaire. All interviews were conducted face to face by the primary investigator who would explain the questions that participants may find difficult. Questions were simple consisting of a "yes/no" answers. All participants gave an informed consent prior to participation. All subjects were anonymized and a numerical system was used to identify both the patients and the corresponding samples obtained. Subjects fasted overnight for 8 hours during which no treatment (insulin or hypoglycemic drugs) was given. Lifestyle habits and medical history were documented.

2.3 Study Duration

This study had a two month duration commencing from July 2022 to August 2022. Samples were analysed in the hematology laboratory immediately after collection.

2.4 Laboratory Analysis

Full blood count was performed using the Mythic 18, a three- part auto analyzer able to run 19 parameters per samples including Hemoglobin concentration HCT, White Blood Cell count (WBCs), Red Blood Cell count (RBCs), Mean Cell Hemoglobin Concentration (MCHC), Mean Cell Volume (MCV), lymphocytes, neutrophils and platelet count. Standardization, calibration of instrument and sample processing were done according to manufacturer's instructions.

2.5 Procedure

Well mixed blood sample was aspirated by means of the probe after pressing the start button. Approximately 20 μ l of blood was aspirated and result of analysis displayed on the screen.

2.6 Data Analyses

Data were analysed using Statistical Package for Social Sciences, Inc., Chicago, Ill (SPSS for windows version 20), average value were calculated and expressed in mean and standard deviation (Mean \pm SD). Comparison of mean difference was done using independent sample t-test and p-value less than 0.05 ($p < 0.05$) was considered statistically significant. The actual p-values were reported in the tables but the p-

value as low as 0.0001 were expressed as p-value less than 0.001 ($p < 0.001$).

3. RESULTS

A total of 138 individuals comprising of sixty-nine known diabetes individuals patients and sixty-nine non diabetic individuals were enrolled for the study. Thirty-nine of these diabetic individuals were female, while 30 are male. For the non – diabetic individuals 37 (52.9%) were female and male individuals were 32 (Table 1).

The mean age for the diabetic was 44.7 ± 11.7 years with a minimum of 32 years and a maximum of 62 yeaes. The mean of the controls was 37.7 ± 17.3 years with a minimum of 19 years and a maximum of 45 years is as shown in Table 2 and is statistically significant ($p < 0.05$) Table 3. The mean comparison of haematological parameters of Diabetes individuals and control. Platelets count and PCV values were higher in the control subject though not statistically significant ($p > 0.05$), likewise there was slight elevation in the mean value for WBC count and also not statistically significant. Haemoglobin (Hb) concentration and RBC count for control versus diabetic subjects were statistically significant. Table 4 shows the Leukocyte differentials, Monocytes and granulocyte were elevated but not statistically significant when compared with the mean value for control against diabetic subjects. The red blood cell indices is as shown in Table 5. A statistically significant value ($p < 0.05$) was observed for the mean cell haemoglobin concentration (MCHC) for the control and the diabetic subjects. In the total number of patient with diabetic, a logistical regression ($n=69$) was performed. Table 6 it is shown that the odd of being diabetic is about 2.51 time likely for a unit in MCHC value with other variables are held constant.

4. DISCUSSION

Haematological changes are common phenomena in a diabetic and its complication constitutes a recognizable burden on patients care. In this study there was a statistically significant difference in the mean for RBC and haemoglobin concentration for diabetic subjects as compared to the control. Also there was an elevated WBC count with slight Monocytosis as well as granulocytes but were not statistically significant. This finding is in line with studies conducted by Khaled and Ameerah [9] in Libya.

Table 1. Gender distribution of the study population

Variable	Category	Frequency (%)	
		Non-diabetic	Diabetic
Gender	Female	37 (53.6)	39 (56.5)
	Male	32 (46.4)	30 (43.5)
Total		69 (100)	69 (100)

Table 2. Mean age comparison between non-diabetics and diabetics patients

Variable	No	Age (Mean±SD)	t-test	p-value
Non-diabetic	69	37.7±17.3	2.8	0.006
Diabetic	69	44.7±11.7		

Table 3. Mean comparison of the haematological profile of the patients and the control

Variables	Control(n=69)	Diabetics (n=69)	t-test	p-value
PCV	35.04±6.68	34.63±4.72	0.42	0.67
HB	10.09±2.33	11.24±1.63	3.41	0.001
RBC	3.99±0.77	4.41±0.67	3.51	0.001
WBC	7.07±3.63	7.20±2.30	0.22	0.83
PLATELET	262.56±102.75	204.27±90.23	1.47	0.14

Units: PCV (%), Hb= g/dl; WBC ($\times 10^9/L$); Platelet count $\times 10^9/L$

Table 4. Leukocytes differentials

Variables	Control	Diabetics	t-test	p-value
Lymphocytes	38.56±14.04	36.49±13.77	0.88	0.38
Monocytes	6.39±1.85	6.46±2.79	0.18	0.86
Granulocytes	54.97±14.92	57.14±14.80	0.86	0.39

Lymphocytes (%); Monocytes (%); Granulocytes (%)

Table 5. Red blood cell indices

Variables	Control	Diabetics	t-test	p-value
MCV	86.00±13.41	80.87±9.80	2.58	0.01
MCH	25.76±3.71	25.91±2.40	0.3	0.77
MCHC	29.41±1.60	32.27±2.41	8.55	<0.001

Reference range: MCV 80-100 μm^3 , MCH 25.4-34.6pg/cell; MCHC 31%-36%Hb/cell

Table 6. Multivariate analysis of the associated predictor of the diabetics status

Variable	B	p-value	OR (95%CI)
AGE	0.035	0.02	1.04 (1.00-1.07)
SEX(Male)	-0.74	0.11	0.48 (0.19-1.20)
HB	-0.11	0.49	0.89 (0.65-1.23)
RBC	0.37	0.39	1.45 (0.62-3.36)
MCV	0.001	0.95	1.001 (0.97-1.04)
MCHC	0.92	<0.001	2.51 (1.75-3.61)
Constant	-29.86	<0.001	-

The rise in RBC observed in diabetic subjects are as a result of persistent hyperglycemia creating an influx of glucose thereby resulting in RBC adhering together [10]. These changes in RBC can also influence blood viscosity that affects microcirculation in diabetes. This

tendency is associated with insulin resistance and results in stimulation of erythroid progenitors leading increased RBC count [11]. Low hemoglobin concentration is associated with a more rapid decline in glomerular filtration rate than that of other kidney diseases [12].

Hemoglobin concentration is closely associated with diabetic profiles, anemia in patients with diabetes increases susceptibility of the kidney to nephropathy, although the precise mechanism remains unknown. It is widely reported that patients with diabetes are more vulnerable to the effects of anemia [13]. In this study, there was elevated total WBC count which is a classical marker of inflammation and suggests an association between WBC count and diabetes risk [14]. An elevated WBC count with lowered platelets count as compared to control subjects is not in line with studies carried out in Western Nigeria [15]. The reason for this could be associated with the age of the subject, control subjects, have a low mean age of 37.7 in relation to diabetic patients of 44.7 and also being on treatment to control diabetes.

Thrombocytopenia was not observed in this study, although there was reduced platelet count in relation to the control subjects and the value was not statistically significant and is in line with previous studies in which there was no significant difference in mean platelet count between individuals with diabetes and control [16]. Diabetes is associated with metabolic cellular disorder and many increase the risk of thrombotic and vascular complication if not managed properly [17]. Likewise the total leucocytes differential such as lymphocytes, monocytes and granulocytes showed no statistical significance with $p > 0.05$ compared to control subjects. This finding is in line with report of Dorathy et al. [18] carried out in Calabar.

5. CONCLUSION

The findings in this study have implications for diabetes management and necessitate the need for routine full blood counts for all diabetic. Early detection and management of anemia, WBC count which is an inflammatory marker if elevated are cost effective especially in primary health care setting and will reduce diabetic complication.

CONSENT

As per international standard or university standard, Participants' written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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