Relationship between Fasting Blood Sugar and Some Haematological Parameters in Diabetic Patients Attending Nigerian Navy Reference Hospital Calabar, Cross River State, Nigeria

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Original Research Article

ABSTRACT

Background of Study: Diabetes mellitus is a clinical syndrome characterized by hyperglycemia due to absolute or relative deficiency of insulin. Lack of insulin, whether absolute or relative, affects the metabolism of carbohydrate, protein, fat, water and electrolytes (Sacks, 2013). Gestational Diabetes develops usually in the second or third trimester, as a result of hormones secreted by the placenta, which inhibit the action of insulin. A survey in Cross River State (CRS) gave a prevalence of Diabetes Mellitus (DM) at 6.5% in the age group 20 and above. This translates to an estimated 97,500 Diabetics within the population of 3 million.
Aim of Study: This study evaluated fasting blood sugar and some haematological parameters in patients with diabetes mellitus visiting Nigeria Navy Reference Hospital Calabar, Cross River State, Nigeria.
Materials and Methods: This cross sectional study evaluated a total of one hundred (100) subjects (males and females) comprising of diabetic and non-diabetic (controls) subjects using glucose oxidase peroxidase method, and sysmex KX-21N haematology CBC auto analyzer. Patients were aged between 20-55 years of age.

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Results: It showed that diabetes patients exhibited significant (p<0.05) decrease in the following parameters compared with the control group:Lymphocyte, Eosinophil and Platelets count. The Total White Blood Cells, Neutrophil, Monocyte, Basophil and FBS did not vary between the diabetes patients and the control group and only platelet established significant relationship in terms of age compared with other parameters. Based on the findings of the study, it can be concluded that there is a statistically significant increases (P<0.05) in platelet in the males compared with the females. Also, diabetic patients showed no significant in PCV and Hb value than the control subject.

Conclusion: It is important that haematological profile should be included as a routine screening investigation to diagnose diabetic patient and treat accordingly. Full blood count as one of the routine laboratory tests is required in the management of diabetic patients.

1. INTRODUCTION

Diabetes mellitus is a clinical syndrome characterized by hyperglycemia due to absolute or relative deficiency of insulin. Lack of insulin, whether absolute or relative, affects the metabolism of carbohydrate, protein, fat, water and electrolytes [1]. There are 3 types of diabetes namely, Type 1, Type 2 and Gestational diabetes [2]. Type 1 diabetes (T1D) is a heterogeneous disorder associated with the destruction of pancreatic beta cells, with the resultant effect of absolute insulin deficiency, while Type 2 diabetes is characterized by resistance to insulin action and sub-optimal insulin secretory response, and lastly, gestational diabetes develops when a woman without diabetes, develops high blood sugar levels during pregnancy, Risk factors to GM include, advanced maternal age, ethnicity, and family history of type 2 diabetes mellitus [3,4]. There is a relationship between some components of metabolic syndrome and leuckocytes. Peripheral blood leukocytes produce polymorphonuclear cells, including monocytes as well as lymphocytes [5], and also a decrease in haemoglobin concentration in diabetic patients [6]. Abnormal hematological parameters are observed in patients with chronic renal failure and among them anemia is the most common abnormality seen in patients with diabetes mellitus [7]. The understanding of pathogenesis of diabetes is the key to prevention and treatment of diabetes mellitus.

2. MATERIALS AND METHODS

2.1 Study Design

The study is a cross sectional study among diabetic patient and non-diabetic individuals who were apparently healthy as controls. The subjects were selected using simple random technique and convenient sample size.

2.2 Study Area

This study was carried out at Nigerian Navy Reference Hospital Calabar, Cross River State, Nigeria.

2.3 Study Population

A total of hundred (100) subjects (males and females) comprising of 50 diabetic and 50 apparently healthy non-diabetic (controls) subjects were enrolled in this study. A stratified random sampling method was used in the selection of both diabetic and apparently healthy (controls) who were between the ages of 20-55 years attending the Nigerian Navy hospital Calabar. All resident within Calabar Metropolis.

2.4 Eligibility of Subjects

2.4.1 Inclusion criteria for subjects

All diabetic subjects who gave written informed consent, with clinical symptom of increased thirst, increased urination, and unexplained weight loss, a blood sugar level equal to or greater than 7mmol/dL at two different fasting blood sugar test in the morning, Age 20-55, and Diabetes duration since diagnosis more than 12 months.

2.4.2 Exclusion criteria for subjects

Subjects who were diabetic, but pregnant, breast feeding, on weight loss medication, aged less than 20 years and above 55 years, had other underlining health conditions and refusal to give informed consent were excluded from this study.

2.4.3 Inclusion criteria for control

Individuals recruited for control were included according to these criteria:age ≥20 and ≤55 years, must be apparently healthy, non- diabetic with no underlining diseases, not pregnant and breastfeeding, and gave informed consent were included.

2.5 Sample Collection

5mls of venous blood was aseptically collected from each participant, 2.5ml dispensed into an Ethylene Diamine Tetraacetic Acid (EDTA) bottle for determination of haematological parameters and the remaining 2.5ml in flouride oxalate bottle, separated by centrifugation at 1000rpm for 5minutes and was then used for the determination of fating blood sugar.

2.6 Method of the Test

Full Blood Count (FBC): Measurement of haemoglobin, red blood, cells, white blood cells and platelets count were done by automation using Haematology CBC auto analyzer SYSMEX KX-21N (Sysmex Corporation Japan, S/No B4 577), made by Beckman Coulter, while Glucose Oxidase Method (Randox reagent) purchased from Hysec Services at 186, new site NAF market was used for determination of fasting blood sugar.

2.7 Data Analysis

The data were presented in tables and graphs as mean ± standard deviation (SD). The statistical package for social science (SPSS) 23 was used in the analysis of the results. Comparison was made between two and three groups using Student t-test and ANOVA respectively. Pearson correlation was also used to determine relationships. $P \leq 0.05$ were considered statistically significant.

3. RESULTS

The heamatological parameters of control subjects and Diabetic subjects based on gender shows that diabetes patients exhibited significant ($p<0.05$) decrease in the following parameters compared with the control group:Lymphocyte, Eosinophil and Platelets count. Diabetes patients showed no significant in PCV and Hb value than the control subject as shown in Table 1. While the TWBC, Neutrophil, Monocyte, Basophil and FBS did not vary between the diabetes patients and the control group. There is statistically significant increases ($P<0.05$) in platelet in males compared with the females (250±8.29vs221±16.24) as shown in Table 1.

Table 2 shows significant relationship ($p<0.05$) between the diabetic patients and the control group in age range 23-32 and compared to the age range 33-42 and 43-52. Table 2 revealed that only platelet established significant relationship in terms of age compared with other parameters.

3.1 Correlation between FBS and PCV

Correlation graph between FBS and PCV of control subject showed significant when $p<0.05$ and strong correlation when r=0.159. There also was a correlation between FBS and Hb estimation of control when r=0136 and significant at $p<0.05$. It was shown that there was no significant correlation between FBS and TWBC of control subject with $p>0.05$ and 0.072. Correlation between FBS and Platelet count of control subject and diabetes subject showed significant while correlation between FBS and PCV of diabetes subject was not significant when r=0.046 and $p>0.05$. Correlation between FBS and Hb estimation of diabetes subject was not significant. It was as well shown there was significant correlation between FBS and TWBC of diabetes subject.

4. DISCUSSION

This research work is a cross sectional study carried out among diabetic patients in Nigerian Navy Hospital Calabar, Cross Rivers State. It was carried out to investigate the relationship between fasting blood sugar and some haematological parameters in diabetic patients attending Nigerian Navy Reference Hospital Calabar, Cross River State, Nigeria.

Determining the demographic distribution of the study population, it was shown that the age groups of the population for the diabetic patients and the control group in age range from 23-32 and compared to the age range 33-42 and 43-52.

Table 1. Shows some haematological parameters of control subject and Diabetes subject based on gender

Parameters	Female			Male		
	Control (n = 19)	Diabetes (n = 24)	P Value	Control (n = 31)	Diabetes (n = 26)	P value
PCV (%)	39.1±1.03	38.9±0.69	P>0.05	39.9±0.49	39.7±0.54	P>0.05
Hb (g/L)	12.9±0.39	12.7±0.26	P>0.05	13.3±0.18	13.0±0.18	P>0.05
TWBC (X10^9)	4.6±0.22	6.8±0.92	P<0.05	4.3±0.19	5.8±0.47	P<0.05
Neutrophil (%)	58.7±2.19	55.8±2.67	P>0.05	58.5±1.52	55.0±1.96	P>0.05
Lymphocyte (%)	36.7±2.29	39.0±2.67	P>0.05	38.3±1.83	40.1±1.88	P>0.05
Eosinophil (%)	2.4±0.33	2.5±0.34	P>0.05	2.4±0.21	2.2±0.18	P>0.05
Monocyte (%)	2.2±0.16	2.9±0.22	P>0.05	2.0±0.15	2.7±0.22	P>0.05
Basophil (%)	0.05±0.05	0.00±0.00	P<0.05	0.10±0.05	0.00±0.00	P<0.05
Platelet (X10^9)	280±11.2	221±16.2	P<0.05	260±5.89	250±8.29	P>0.05
FBS (mmol/L)	4.6±0.10	11.7±0.42	P<0.05	4.5±0.84	12.7±0.48	P<0.05

$y = 1.2201x + 34.064$
$R^2 = 0.0253$
$r = 0.159$
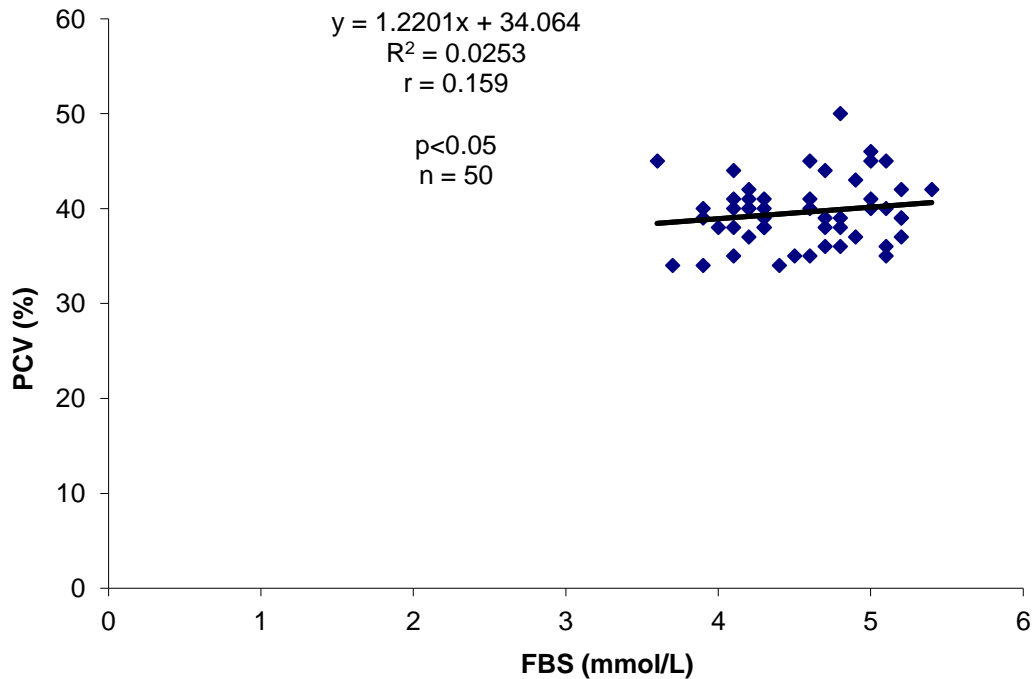
$p<0.05$
$n = 50$

Fig. 1. Correlation graph between FBS and PCV of control subject

The results of some haematological parameters of control subjects and Diabetic subjects based on gender implied that diabetes patients exhibited significant (p<0.05) increase in the following parameters compared with the control group: Lymphocyte, Eosinophil and Platelets count. Diabetes patients showed no significant in PCV and Hb value than the control subject. While the TWBC, Neutrophil, Monocyte, Basophil and FBS did not vary between the diabates patients and the control group. This result shows a statistically significant increases (P<0.05) in platelet in the males compared with the females (250±8.29 vs 221±16.24) as shown in Table 1. Statistical analysis showed that the mean of total white blood cells and basophil were significant (P< 0.05 and p<0.05) respectively in the control group and diabetes patients whereas the mean cell hemoglobin (p> 0.05) and mean cell hemoglobin concentration (p>0.05) were not significant in the both group, but there was no significant variation between patient and control

Table 2. Shows some haematological parameters of control subject and Diabetes subject based on age

Parameters/Age Range	23 – 32 (n = 17)	33 – 42 (n = 19)	43 – 52 (n = 14)	P Value
PCV (%)	38.4±0.92	39.5±0.59	39.9±0.74	p>0.05
Hb (g/L)	12.5±0.33	12.9±0.19	13.1±0.27	p>0.05
TWBC (X10^9)	7.2±1.29	5.2±0.32	6.5±0.74	p>0.05
Neutrophil (%)	54.4±3.62	56.2±1.59	55.6±3.29	p>0.05
Lymphocyte (%)	40.4±3.61	38.7±1.45	39.9±3.28	p>0.05
Eosinophil (%)	2.4±0.42	2.4±0.27	2.1±0.23	p>0.05
Monocyte (%)	3.2±0.27	2.7±0.29	2.4±0.17	p>0.05
Basophil (%)	0.1±0.01	0.0±0.00	0.0±0.00	p>0.05
Platelet (X10^9)	197±18.73	262±10.53*	249±12.05*	P<0.05
FBS (mmol/L)	11.7±0.56	12.1±0.54	13.0±0.58	p>0.05

group in platelets and lymphocytes count respectively and this result corroborates that of [8].

Table 2 shows significant relationship (p<0.05) between the diabetes patients and the control group in age range 23-32 and compared to the age range 33-42 and 43-52. This finding is in with a study of Bangladeshi with adult population there was significant association between control group and diabetes patients after adjustment of data for age and sex [9]. Table 2 revealed that only platelet established significant relationship in terms of age compared with other parameters. It has been established that raised platelet counts are frequently observed in diabetics with a long duration of disease while it was also shown that the presence of higher hemoglobin level in non-diabetic subjects compare to that of diabetic subjects can be attributed as a constitutional feature.

Comparing the haematological parameters of control subject and diabetes subject, it was observed that there was significant mean age difference between diabetic patients compared to non-diabetic controls [P < 0.05], as shown in Table 2. This study is in agreement with a comparative study on same subjects carried out by Biadgo, [9] on 296 participants, which reported significant difference in red blood cell distribution width between patients with diabetes and non-diabetes. Biadgo, also reported that platelet indices such as mean platelet volume and platelet distribution width were significantly higher in diabetes patients, but in present study we found the contrary results [9]. Hence there was no significant difference on diabetic haematological parameters on packed cell

volume (PCV) and haemoglobin (Hb) examined, while other haematological parameters such as platelet and fast blood sugar were significant. This finding disagreed with Mbata, Adegoke and Nwagu, [10] who on one study examined the effect of chronic diabetes on haematological parameters. The tests that were carried out include the determination of Total Red Cell Count, Haemoglobin estimation (Hb), Packed Cell Volume (PCV), Total White Cell Count, Differential leucocytes count and Platelet Count. It was observed in their study that there was a significant difference (P < 0.005) on the values of packed cell volume (PCV) of diabetic subjects both male and female (31.36 ± 2.96 and 30.25 ± 3.56) . Other haematological parameters that were slightly significantly affected include Red blood cell (RBC) count of diabetic female subject.

Correlation graph between FBS and PCV of control subject showed significance when p<0.05 and strong correlation when r=0.159. There also was a correlation between FBS and Hb estimation of control when r=0136 and significant at p<0.05. It was shown that there was no significant correlation between FBS and TWBC of control subject with p>0.05 and 0.072. Correlation between FBS and Platelet count of control subject and diabetes subject showed significance while correlation between FBS and PCV of diabetes subject was not significant when r=0.046 and p>0.05. Correlation between FBS and Hb estimation of diabetes subject was not significant. It was as well shown there was significant correlation between FBS and TWBC of diabetes subject. This study is not in line with Karthikeyan, [11] who after a study reported that there was significant difference in red blood cell distribution width (47.3±2.6 fL vs 45.2±3 fL)

between diabetic patients and controls. Total white blood cells in $10^3/\mu L$ (6.59±1.42 vs 5.56±1.38), absolute lymphocyte count in $10^3/\mu L$ (2.60±0.70 vs 2.04±0.63), and absolute neutrophil count in $10^3/\mu L$ (3.57±1.46 vs 3.11±1.04) increased significantly in diabetic patients compared with controls, respectively. Among platelet indices, mean platelet volume (10.4±1.1 fL vs 9.9±1.1 fL) and platelet distribution width (14.5±2.1 fL vs 13.4±2.1 fL) were found to be significantly increased in the diabetic patients ($P<0.05$). Anthropometric measurements significantly correlated with white blood cell and platelet indices [11].

5. CONCLUSION

Based on the findings of the study, it can be concluded that males are more affected with diabetes than females. Also, findings of this study uphold that diabetic patients showed no significance in PCV and Hb value than the control subject. There was a statistically significant increases (P<0.05) in platelet in the males compared with the females (250±8.29 vs 221±16.24). The result of this study revealed that there was no significant correlation between FBS and TWBC of control subject with p>0.05 and 0.072 while there was significant correlation between FBS and TWBC of diabetes subject. It is therefore important that some complete blood count profile be included as a routine screening investigation alongside fasting blood count as baseline and during doctor's visit to diagnose diabetic patient and treat accordingly/and in the management of diabetic patients.

ETHICAL APPROVAL

Ethical approval was gotten from the Cross River State Health Research Ethics Committee (CRSHREC) with reference number CRS/MOH/RP/REC/17/500

CONSENT

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

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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