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Research Article

Levels of Fibrinogen, White Blood Cell Count and Cholesterol in Type 11 Diabetes Mellitus Patients Attending Specialist Hospital Umuguma, Owerri

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Abstract:

Diabetes mellitus is a heterogeneous group of metabolic disorder characterized by high blood glucose level (hyperglycemia) with alteration in carbohydrate, lipid, and protein metabolism resulting from defects in insulin secretion and /or action. This study was aimed at determining the levels of white blood cell, fibrinogen, white blood cell count and cholesterol in type 11 diabetes mellitus patients attending federal Teaching Hospital Owerri. A cross – sectional study was carried out from month of January to March 2024 and all eligible subjects who filled the questionnaire and give a written informed consent for the study period were sampled. The study population consisted of 30 diabetes mellitus patients who were recruited for the study. An equivalent number of healthy study's (30) age matched non-diabetes mellitus subject served as the controls. The procedure was carried out using Turks solution for white blood cell count, fibrinogen kits for fibrinogen and Total cholesterol assay kits at the federal Teaching Hospital Owerri. The result of the test were analyzed using SPSS version 21.The mean value of WBC (9.57 ±3.17) X109/L, fibrinogen (410.3 ±108.2) mg/dl and cholesterol (234.80± 66.69) was significantly increased in type 11 diabetes when compared to controls (6.95±2.17)x109/l, 225.87±60.05)mg/dl and 14.50±37.29 (p=0.000, p=0.000 and p=0.000. There was no significant difference in the mean value of WBC (8.85±3.29)X109/L, 374.75±111.36)mg/dl and 209.67±41.51)m/dl male when compared to female type 11 diabetes patient (10.05±3.09)x109/l, 434.22±102.29)m/dl and 251.56±75.69mg/dl (p=0.322, p=0.143 and p= 0.092). There was a significant difference in the mean value WBC (9.78±3.11)X109/l, fibrinogen (384.17±120.09) mg/dl and cholesterol (247.82±65.83)mg/dl in type 11 diabetes patient within the age of (40 – 60) years when compared to type 11 diabetics of age>60 years of WBC (9.31±3.35)x109/l, fibrinogen (444.85±82.58) mg/dl and cholesterol (217.77±66.44) mg/dl. (p=0.695, p=0.130 and p=0.227). There was no significant negative correlation of cholesterol with fibrinogen and white blood cell in diabetics mellitus (r=0.49,p=0.006; r=0.06, p=0.748 type 11 diabetes mellitus is associated with a significant increase in white blood cell, fibrinogen and cholesterol, therefore, routine screening of these indices is recommended to minimize diabetes mellitus-related complication.

Key words: fibrinogen; white bloodd cell count; cholesterol type 11 diabetes mellitus

Introduction

Defects in insulin secretion, action, or both can lead to diabetes mellitus, a set of metabolic illnesses characterised by elevated blood glucose levels [1]. Diabetes can cause nerve damage, renal failure, and blindness over time. Microvascular disease, the term for damage to small vessels, is the cause of these kinds of harm. Diabetes also plays a significant role in the rapid atherosclerosis, or hardening and constriction of the arteries, which can result in coronary heart disease, strokes, and other diseases of the big blood vessels [3]. In Nigeria, roughly 17 million people, or 8% of the total population, suffer from diabetes.

Diabetic Nephropathy (DN), characterised by a progressive decline in renal function and structure over the course of a lifetime, develops in at least one-third of patients with diabetes mellitus [3]. The primary cause of end-stage renal disease (ESRD) globally is diabetic nephropathy. The onset of low but aberrant albumin levels in the urine (30 to 300 mg/day), known as microalbuminuria, is the first clinical sign of DN [4].

Furthermore, it is predicted that 12 million more Nigerians are unaware that they have diabetes. After cancer and heart disease, diabetes ranks as Nigeria's third most common cause of death [5].

Red blood cells, white blood cells, platelets, and other components are examples of haematological parameters. A high white blood cell count (WBC), a traditional indicator of inflammation, is linked to diabetes and a number of risk factors for cardiovascular disease. Increased MPV, PDW, PCT, and platelet count have been linked to endothelial dysfunction and inflammatory illnesses, including metabolic syndrome, diabetes, coronary artery disease, and cancer [6].

Patients with diabetes have been found to have altered levels of numerous haematological markers, including red blood cells (RBCs), white blood cells (WBC), and platelet function. [7]

The significance of elevated WBC and RBC counts in the diagnosis of metabolic syndrome has been supported by numerous investigations. Numerous epidemiologic research have also indicated a strong correlation between various metabolic syndrome components and haematological markers. The link between haematologic markers and insulin resistance has already been validated by several research [8].

individuals with diabetes mellitus who have chronic renal failure, a consequence of the disease, have abnormal haematological parameters; anaemia is the most prevalent anomaly among these individuals.

Patients with common risk factors, such as a longer history of diabetes, high blood pressure, poor metabolic control, smoking, obesity, and hyperlipidaemia, may be at a higher risk of developing complications from their diabetes [9].

Short doses of insulin reduce its ability to operate properly, and people who produce insufficient amounts of insulin are at risk for developing diabetes mellitus. The elevated blood glucose levels are caused by the lack of insulin. Patients in this condition experience thirst and urination. It is true that non-fasting triglycerides (TGs) are a better indicator of vascular risk than fasting measures. An excess of tiny, dense LDL particles, decreased HDL, and elevated triglycerides make up the trio of conditions known as diabetic dyslipidaemia. The majority of dyslipidaemia cases have a genetic basis, however in certain instances, environmental factors including nutrition, exercise, and smoking habits can play a significant part in the disease's onset and progression. The atherogenic nature of LDL cholesterol is linked to the risk of atherosclerosis and its consequences. [10] Small, thick LDL cholesterol particles are linked to atherogenicity. the high risk of cardiovascular disease in contrast to its straightforward quantitative assessment. The level of LDL cholesterol is rising due to a diet high in saturated fats, smoking, lifestyle choices, and an increase in visceral fat. The risk of coronary heart disease is decreased when LDL cholesterol levels are lowered [11].

From 108 million cases in 1980 to 463 million cases and 4.2 million deaths in 2019, the number of adults worldwide suffering from diabetes has increased significantly. Over three-quarters of the world's diabetes cases occur in low- and middle-income nations, and 700 million people are predicted to have the disease globally by 2045. The prevalence of diabetes is significantly rising in Sub-Saharan Africa. [12]

Therefore, preventing diabetes and its complications is of utmost importance. Furthermore, the pathophysiology of type 2 diabetes is also influenced by chronic inflammation. Epidemiological research indicates that blood fbrinogen, a non-specific indicator of inflammation, and total white blood cells are related to the risk of diabetes. Only a small number of earlier investigations, meanwhile, looked into the potential relationship between pre-diabetic states and specific haematological parameters [13].

In both the general population and individuals with Type 2 diabetes, cholesterol is linked to higher rates of cardiovascular morbidity and overall death. Numerous studies have documented the incidence of kidney disease and other metabolic abnormalities among individuals with type 2 diabetes in West African nations. In Nigeria, just one investigation was carried out in a randomly chosen population sample, and it described renal damage in diabetic individuals regardless of albuminuria [14].

Diabetes is linked to blood, cellular, and metabolic abnormalities and is a worldwide public health concern. Due to factors including urbanisation, ageing, and the rising rates of obesity and physical inactivity, type 2 diabetes mellitus has swiftly emerged as a major global health concern.

Haematological alterations have been documented in diabetes and are a significant contributor to problems related to the disease. Nevertheless, there are conflicting reports and little information available on the haematological characteristics of type 2 diabetes individuals in the research region. According to research by [15], a number of variables, such as elevated reactive oxygen species (ROS) production and the development of advanced glycation end products (AGEs) as a result of chronic hyperglycemia, can contribute to haematological alterations in diabetes. Oxidative stress, which is linked to tissue damage and haematological alterations like RBC malfunction, PLT hyperactivity, and endothelium dysfunction, is caused by increased ROS production [16]. Regular follow-up monitoring of haematological markers is not advised by current diabetes care guidelines. However, research on the haematological characteristics of diabetic patients conducted in various locations produced a variety of conflicting findings. Regarding RBC indices [17], WBC count, and platelet count, some research revealed no statistically significant difference between diabetic patients and healthy controls; however, another study found that diabetic patients had significantly higher RBC, WBC, and PLT indices than controls. Others noted that the diabetic group's WBC and PLT indices are much greater than those of the control group, but all RBC indices, with the exception of RDW, are significantly lower (Biadgo et al., 2015). Furthermore, there is a dearth of knowledge about haematological markers in type 2 diabetes in Nigeria, especially in the research area.

Although the veracity of the material has not been established, recent studies have suggested that changes in the serum lipid profile may also be linked to diabetes mellitus. Recently, the disease's rising incidence has shifted from high-income to middle- and low-income nations, particularly

Nigeria, which has the highest disease burden in Africa, with over 1.2 million individuals affected. However, there is little information on the levels of cholesterol, white blood cell count, and fibrinogen in Nigerian diabetes patients. Therefore, the purpose of this study was to evaluate cholesterol, white blood cell count, and fibrinogen in diabetes individuals [18].

Thus, information regarding fibrinogen, WBC, and cholesterol levels will be crucial for the diagnosis and follow-up of diabetic patients.

The current study is intended to assess the level of the individual meters and ascertain whether there is any variation in its level with regard to age and gender because there is a dearth of data on the levels of fibrinogen, WBC, and cholesterol in diabetes patients.

Materials And Methods

Study Area

The study was carried out at Imo State Specialist Hospital, Umuguma, Imo State.

Study Design

A cross-sectional study was carried out from month of September to July 2024 and all eligible subjects who filled the questionnaire and give a written informed consent for the study period were sampled. The study population consisted of 50 diabetes mellitus patients who were recruited for the study. An equivalent number of healthy subjects (50) age matched non-diabetes mellitus subjects served as the controls. The procedure was carried out at the Federal University Teaching Hospital, Owerri. The results of the tests were analyzed using SPSS version 27.

Method of Recruitment

A total of one hundred subjects (50 patients and 50 controls) were recruited for the study. The study participants were given an informed consent form. Subjects who agree to sign was recruited for the study and given a structured questionnaire to fill.

Selection Criteria

Inclusion criteria

1. Diabetes patients from18years and above.
2. Those without any other infection such as HIV, HBsAg, HCV, Syphilis etc.
3. Diabetes mellitus patients who gave informed consent.
4. Age-matched non diabetes mellitus subjects.

Exclusion criteria

1. Diabetes mellitus patients below 18years of age.
2. Diabetes mellitus patients whose informed consent could not be obtained because they were skeptical about the research.
3. Those with other infections such as HIV, HCV, HBsAg and syphilis.

Sample Collection

Ten millitres of venous blood sample was collected at the ante-cubital vein aseptically, 5ml was dispensed into Ethylene Di-amine Tetra Acetic Acid container, while 5ml was dispensed into plain container. The EDTA and plain container was properly labeled with the subject's name, sample number and date of collection. The blood dispensed into the EDTA container was stored in a refrigerator at 40C while the serum was stored in a freezer at -200C prior to use.

Laboratory Analysis

The Determination of Fibrinogen, white blood cells (WBCS) and

Total Cholesterol (TC), were done using standard method

Statistical Analysis

Statistical analysis was performed using SPSS version 27. Mean, standard deviation, ttest and Pearson correlation were determined. The level of significance was set at $p < 0.05$.

Results

Mean Values of Fibrinogen, WBC and Cholesterol in Type II Diabetes Mellitus Versus Controls

The mean values of fibrinogen (410.43±108.24)mg/dl, WBC (9.57±3.17) x109/L and cholesterol (234.80±66.69)mg/dl were significantly increased in type II diabetes patient when compared to controls (225.87±60.05)mg/dl, (6.95±2.17) x109/L and (146.50±37.29)mg/dl.(t=8.17 ,0.000 ;t=3.37,p=0.000; and t=6.33,p=0.000)

Parameter	Test	Control	t-value	p-value
Fibrinogen (mg/dl)	410.43±108.24	225.87±60.05	8.17	0.000*
WBC ($x10^9$/L)	9.57±3.17	6.95±2.17	3.73	0.000*
Cholesterol (mg/dl)	234.80±66.69	146.50±37.29	6.33	0.000*

4.1: Mean Values of Fibrinogen, WBC and Cholesterol in Type II Diabetes Mellitus Versus Control (Mean±SD)

*: Significant

Mean Values Fibrinogen, WBC and Cholesterol in Male Type II Diabetes Mellitus Versus Female Type II Diabetes Mellitus

There was no significant difference (p=0.143, p=0.322 and p=0.092) in the mean value of fibrinogen (374.75±111.36)mg/dl, WBC (8.85±3.29) x109/L and cholesterol (209.67±41.51)mg/dl in male type II diabetes patient when compared to female type II diabetes patient (434.22±102.29)mg/dl, (10.05±3.09) x109/L and (251.56±75.69)mg/

Parameter	Male n=12	Female n=18	t-value	p-value
Fibrinogen (mg/dl)	374.75±111.36	434.22±102.29	1.51	0.143
WBC (x10^9/L)	8.85±3.29	10.05±3.09	1.01	0.322
Cholesterol (mg/dl)	209.67±41.51	251.56±75.69	1.74	0.092

4.2: Mean Values of Fibrinogen, WBC and Cholesterol in Male Type II

Diabetes Mellitus Vs Female Type II Diabetes Mellitus

Comparison the Mean Values of Fibrinogen, WBC and Cholesterol in Type II Diabetes Mellitus Patient Based on Age

There was no significant difference in the mean value of fibrinogen (384.12±120.09)mg/dl, WBC (9.78±3.11) x109/L and cholesterol (247.82±65.83)mg/dl in type II diabetes patient within the age of (40-60) yrs when compared to type II diabetes patient of age >60 yrs (444.85±82.58)mg/dl, (9.31±3.35) x109/L and (217.77±66.44)mg/dl.

(t=1.56,p=0.130; t=0.39,p=0.695 and t=0.227, p=0.227)

Parameter	(40-60)yrs n=12	(>60)yrs n=18	t-value	p-value
Fibrinogen (mg/dl)	384.12±120.09	444.85±82.58	1.56	0.130
WBC (x10^9/L)	9.78±3.11	9.31±3.35	0.39	0.695
Cholesterol (mg/dl)	247.82±65.83	217.77±66.44	1.23	0.227

4.3: Comparison of the Mean Values of Fibrinogen, WBC and Cholesterol in Type II Diabetes Mellitus Patient Based on Age

Key WBC –White Blood Cell

*: Significant

Correlation Cholesterol with Fibrinogen and WBC in Type II Diabetes Mellitus Patient

There was a significant negative correlation (r=-0.49, p=0.006) between cholesterol with fibrinogen in type II Diabetes Mellitus Patient.

There was a no significant negative correlation (r=--0.06, p=0.748) between cholesterol with WBC in type II Diabetes Mellitus Patient.

Variable	N	R	p-value
Fibrinogen	30	-0.49	0.006
WBC	30	-0.06	0.748

4.4: Correlation of Cholesterol with Fibrinogen and WBC in Type II

Key WBC – White Blood Ce

Discussion

A diverse collection of metabolic disorders known as diabetes mellitus is typified by changes in carbohydrates and elevated blood glucose levels, or hyperglycemia. protein and lipid metabolism brought on by deficiencies in the secretion and/or action of insulin. Diabetes mellitus is the third most prevalent cause of end-stage renal disease, behind hypertensive nephrosclerosis and chronic glomerulonephritis, according to hospital-based research conducted throughout Nigeria [19].

According to the current study, diabetics' mean WBC values were noticeably higher than those of controls. In type 2 diabetes, a higher WBC count has been identified as a sign of chronic inflammation, which is linked to microvascular complications. Additionally, micro and macrovascular problems have been linked to elevated WBC counts, even when they fall within the normal range [20]. Epidemiological research indicates a correlation between the risk of diabetes and the WBC count, a non-specific inflammatory mediator. This study's findings are consistent with those of a study conducted by [21], which discovered that white blood cells are an independent predictor of diabetes mellitus. They added that increased WBC is a traditional indicator of inflammation and that it shows a correlation between inflammation and diabetes mellitus, insulin resistance, and poor glucose metabolism.

The study's current results demonstrated that, in comparison to controls, diabetics had significantly higher mean fibrinogen readings. One of the many potential explanations for hyperfibronogenemia in diabetics is that procoagulant states are frequently seen in diabetics. Numerous coagulation factors, including plasminogena activator inhibitor I, von-willebrand factor, fibrinogen, factor VII, and thrombin antithrombin complexes, are elevated, especially in relation to glycaemic management and macrovascular and microvascular illness [22, 23]. Individuals with diabetes, especially those with inadequate glycaemic control, have higher plasma levels of lipoprotein (Lp). At least two main proteins come together to produce the Lp (a) molecule. One disulphide bond covalently joins the apoB100 molecule to the apoliprotein (a) {APO(a) } molecule [24,25]. In terms of protein and lipid composition, it is structurally similar to low density lipoprotein (LDL); the primary distinction between the two is APO(a). The glycoprotein APO (a) shares structural similarities with plasminogen. Plasma's precursor can attach itself to fibrin as well as the membrane proteins of monocytes and endothelial cells. This prevents plasminogen binding and plasmin production, which delays thrombolysis,

reduces fibrinolysis, and increases the buildup of fibrin and Lp (a) at the sites of vascular damage. By lowering fibrinols and raising plasma fibrinogen levels, Lp(a) plays a significant part in diabetes and related vascular consequences [26]. This study's findings are consistent with the report by [27].

Conclusion

Type 11 Diabetes mellitus is associated with a significant increase in white blood cell, fibrinogen and cholesterol, therefore, routine screening of these indices is recommended to minimize diabetes mellitus – related complications

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