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Assessment of Plasma Levels of Total Cholesterol, Triglycerides, HbA_{1C} and Body Mass Index in Sudanese Patients with Type 2 Diabetes Mellitus

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ABSTRACT:
This is a case-control study conducted in Omdurman Military Hospital and Zenam Diabetic Center in Khartoum state, Sudan, during the period from March to June 2012. The study aimed to assess plasma levels of triglycerides, total cholesterol, HbA_{1C} and body mass index (BMI) of 100 Sudanese patients with type 2 Diabetes mellitus. (49 males and 51 females) as a test group and 50 Sudanese healthy (non-diabetic) subjects (24 males and 26 females) as a control group. The test and the control groups were matched in term of age and gender. Plasma levels of triglycerides and total cholesterol were measured using Biosystem BTS- 305 spectrophotometer and commercial kits from Biosystem Company, Glycosylated Haemoglobin (HbA1c) for each sample was measured using Nycocard reader II and commercial kits from Nycocard Company. Statistical package for social science (SPSS version 11.5) computer software was used for data analysis. The results showed that the means of plasma levels of total cholesterol, triglycerides, HbA_{1C} and body mass index (BMI) were significantly higher in test group compared to the control ($P < 0.050$).The study showed a significant weak positive correlation between HbA_{1C} % and the plasma levels of both total Cholesterol ($r = 0.283$, $p = 0.028$) and Triglycerides ($r = 0.288$, $p = 0.026$) of diabetic group. The study also showed a significant moderate positive correlation between the body mass index (BMI) and the plasma levels of total Cholesterol ($r = 0.447$, $p = 0.000$), and insignificant week positive correlation between the body mass index and the plasma levels of Triglycerides ($r = 0.124$, $p = 0.346$) of the diabetic group. From the results of this study it is concluded that: Total Cholesterol, Triglycerides, HbA_{1C} and body mass index in diabetic patients significantly increased when compared with non diabetic control subjects. Also there was a significant weak positive correlation between HbA_{1C} % and plasma levels of total Cholesterol and triglycerides in diabetic group, Furthermore, there was a significant moderate positive correlations between body mass index and plasma levels of total Cholesterol in diabetic group. Moreover, there was an insignificant weak positive correlation between body mass index and Triglycerides.

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KEYWORDS: Hyperglycemia, Glycated hemoglobin, Body mass index, Insulin Insistence.

المستخلص

أجريت هذة الدراسة في المستشفي العسكري بامدرمان ومركز زينام للسكري بولايه الخرطوم – السودان في الفتره من مارس الي يوليو 2012م. و هدفت الي قياس مستويات الدهون في بلازما الدم (الكلوستيرول و ثلاثي الغلسريد) و الهيموقلوبين المجلكز (هيموقلوبينA_{1c}) ودليل كتلة الجسم . تم إختيار 100 من المرضي السودانيين المصابين بداء السكري من النوع الثاني (49 من الرجال و 51 من النساء) و 50 من الاصحاء ظاهريا كمجموعه ضابطه (غير مصابين بداء السكري) (24 من الرجال 26 من النساء) للمقارنه , وكان هنالك تطابق في العمر والنوع بين المرضي والمجموعه الضابطه. تم قياس مستويات الدهون في بلازما الدم (الكلوستيرول و ثلاثي الغلسريد) باستخدام جهاز قياس الطيف الضوئي (بي تي اس 305) والمحاليل المستعمله في هذه الدراسه كانت من شركة الانظمه الحيويه الالمانيه وتم اجراء تحليل الهيموقلوبين المجلكز باستخدام جهاز نايكوكارد ريدر 11 ومحاليل تجاريه من شركه نايكوكارد.اظهرت نتائج هذه الدراسه إرتفاع ذو دلاله معنويه في كل المستويات الوسطيه للكوليستيرول و الدهون ثلاثية الغلسريد و الهيموقلوبين المجلكز (هيموقلوبين A_{1C}) ودليل كتلة الجسم في مرضي السكري من النوع الثاني عند مقارنتهم بالمجموعه الضابطه اقل من 0.050 , ايضا اظهرت الدراسة ارتباط ايجابي ضعيف وذو دلاله معنويه بين الهيموقلوبين المجلكز (هيموقلوبينA_{1C}) والكوليستيرول الكلي و الدهون ثلاثية الغلسريد وارتباط ايجابي متوسط وذو دلاله معنويه بين دليل كتلة الجسم والكوليستيرول الكلي بينما اظهرت إرتباط إيجابي ضعيف وغير ذو دلاله معنويه بين دليل كتلة الجسم و الدهون ثلاثية الغلسريد . خلصت هذه الدراسة الى أن مستويات الدم للدهون (الكلوستيرول و ثلاثي الغلسريد) و الهيموقلوبين المجلكز (هيموقلوبينA_{1c}) ودليل كتلة الجسم كانت مرتفعه وذات دلاله معنويه عند السودانيين المصابين بداء السكري من النوع الثاني.

INTRODUCTION:

Diabetes mellitus (DM) is a group of metabolic diseases characterized by hyperglycaemia resulting from defects in insulin secretion, insulin action, or both, and associated with disturbances of protein, carbohydrate and lipid metabolism. The decreased uptake of glucose into muscle and adipose tissue leads to chronic extra cellular hyperglycemia which results in tissue damage and chronic vascular complications in both type I and II Diabetes Mellitus. In 2011 there were approximately 285 million people with the disease compared to around 30 million in 1985. Diabetes mellitus causes about 5% of all deaths globally each year, type2 diabetes mellitus makes up about 90% of cases of diabetes with the other 10% due primarily to diabetes mellitus type 1 and gestational diabetes [1,2]. Chronic hyperglycemia of diabetes is associated with long-term damage, dysfunction, and failure of various organs, especially the eyes, kidneys, nerves, heart, and blood vessels. 50% of people with diabetes die of cardiovascular disease (primarily heart disease and stroke) [3, 4]. Diabetic patients with accompanied (but often unnoticed) dyslipidemia are soft targets of cardiovascular deaths (CVD). Patients with type 2 diabetes often exhibit an atherogenic lipid profile, which greatly increases their risk of CVD compared with individuals without diabetes. An early intervention to normalize circulating lipids has been shown to reduce cardiovascular complications and mortality. Rates of

diabetes have increased markedly over the last 50 years in parallel with obesity [5, 6]. Glycated hemoglobin (HbA_{1C}) is a routinely marker used for long-term glycemic control. In accordance with its function as an indicator for the mean blood glucose level, HbA_{1C} predicts the risk for the development of diabetic complications in diabetic patients[4]. Apart from classical risk factors like dyslipidemia, elevated HbA_{1c} has now been regarded as an independent risk factor for CVD in subjects with or without diabetes. Estimated risk of CVD has shown to be increased by 18% for each 1% increase in absolute HbA_{1c} value in diabetic population [7]. Positive relationship between HbA_{1C} and CVD has been demonstrated even in non-diabetic cases [8, 9].

MATERIALS and METHODS

This was a quantitative, analytic, case-control and hospital-based study conducted in Omdurman Military Hospital and Zenam Diabetes Centre, located in Khartoum State, Sudan, during the period from March 2012 to May 2012. A total of 100 Sudanese patients with type 2 diabetes who regularly visit the Military Hospital and Zenam Diabetic Centre for routine follow up, were selected in this study as a test group and 50 apparently healthy (non-diabetic) as acontrol group. Both groups were matched for age and gender. Patients with type 1 diabetes mellitus, thyroid disorders and familial hyperlipidemia or using lipid lowering drugs were excluded from this study. The study was approved by the research board of the College of Medical Laboratory Science, Sudan University of Science and Technology, and full permission was obtained from the medical authorities of Military Hospital and Zenam Diabetes Centre. An informed consent was obtained from each participant. For each participant an interview with a questionnaire was used to obtain clinical data.Venous blood samples (4mLs) were collected from each participant by standard procedures and divided into two containers, 2mLs in EDTA container for HbA_{1C} (whole blood) and 2mLs in heparin container which was centrifuged at 3000 rpm for 3minutes for plasma Triglycerides and T.Cholesterol tests.

Plasma was separated in a plain container and kept at -20°C until used. Spectrophotometeric methods were used for measuring plasma Triglycerides and total Cholesterol. HbA_{1C} was measured immediately using chromatographic-spectrophotometric ion-exchange method [10]. The precision and accuracy of all methods used in this study were checked each time a batch was analyzed including commercially prepared control sera. Statistical Package for Social Science (SPSS version 11.5) computer software was used for data analysis. (significance level was set at $P \leq 0.05$). Body mass index was calculated by this equation : weight/height^2 (individual mass divided by the square of their height, with the value universally being given in units of kg/m^2) .

RESULTS

In this study the test group was composed of 49 males (49%) and 51 females (51%), whereas the control group was composed of 24 males (48%) and 26 females (52%). The mean age of the test group was 55±9.7 years and that of the control group was 53.9±10.0 years. (p= 0.060). Table (1) showed a significant increase in the mean of HbA_{1C} % of test group when compared with control group: (8.51 ± 1.74) % and (5.07 ± 0.35) %, respectively, p= (0.000).

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Table 1: The plasma levels of triglycerides, total cholesterol, HbA_{1C} and body mass index of the study groups and the control groups.

Variable	Test group (n=100)	Control group (n=50)	P-value
Plasma T.Cholesterol (mg/dl)	188.00 ± 50.78	168.00 ± 45.57	0.040
Plasma Triglycerides (mg/dl)	109.00 ± 50.67	90 .00 ± 35.91	0.000
HbA_{1C} (%)	8.51 ± 1.74	5.07 ± 0.35	0.000
BMI (Kg/m2)	28.32 ± 4.07	24.45 ± 3.61	0.037

The table shows the mean ± Std. deviation and probability value (P-value). Independent t-test was used for comparison. P-value ≤ 0.05 was considered significant. A significant increase of plasma levels total Cholesterol of the test group when compared to the control group: (188 ± 50.78) mg/dl and (168 ± 45.57) mg/dl respectively, p= (0.040). A significant increase in the mean of plasma levels of Triglycerides of test group when compared with control group: (109.00 ± 50.67) mg/dl and (90.00 ± 35.91) mg/dl respectively, p= (0.000). The present results showed a significant difference between the mean of the body mass index (BMI) of the test group and the control group: (28.32 ± 4.07) Kg/m^2 and (24.45 ± 3.61) Kg/m^2 respectively, p= 0.037. The mean of the test group is significantly raised.

Figures 1 and 2 showed a significant positive correlation between the plasma levels of total Cholesterol and Triglycerides with HbA1C %.

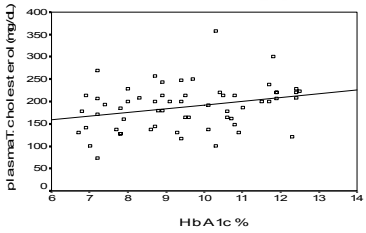

Figure 1: Relationship between HbA_{1C} % and plasma levels of total Cholesterol in the diabetic patients (r = 0. 283, P = 0.028).

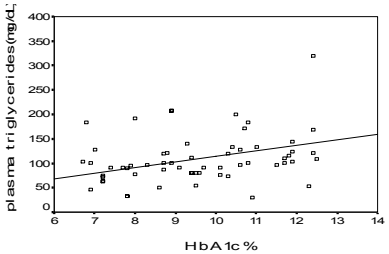

Figure 2: Relationship between HbA_{1C} % and plasma levels of Triglycerides in the diabetic patients (r =0.288, P = 0.026).

Figures 3 and 4 showed a significant positive correlation between the plasma levels of total Cholesterol and body mass index (BMI), whereas there was insignificant week positive correlation between the plasma levels of Triglycerides with body mass index.

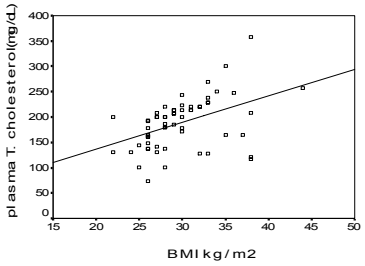

Figure 3: Relationship between body mass index (Kg/m2) and plasma levels of total cholesterol in the diabetic patients (r = 0.447, P = 0.000).

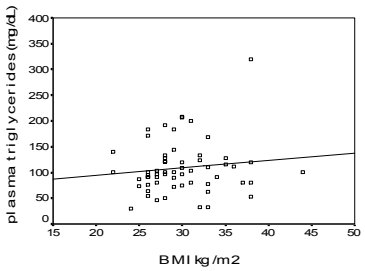

Figure 4: Relationship between body mass index (Kg/m2) and plasma levels of Triglycerides in the diabetic patients (r = 0.124, P = 0.346).

DISCUSSION:

In the present study the results showed that the mean of the plasma levels of triglycerides, total cholesterol, HbA_{1c} and BMI in the diabetic group were significantly raised when compared with the control group. These results agreed with many authors who reported increased triglycerides, T.cholesterol levels among diabetic patients [11-15], and also these results agree with a study done by Riffat, [16] who studied 14 patients with history of diabetes for 6-8 years, and reported that 8 has dyslipidaemia. There are many causes for high triglycerides and T.cholesterol plasma levels among diabetic patients, especially in those with uncontrolled diabetes who has high plasma levels of both glucose and insulin. Insulin helps the conversion of glucose into glycogen and to store glycogen in the liver. When the liver becomes too saturated with glycogen, glucose instead used to creates fatty acids that are released into the bloodstream. These fatty acids are used to make triglycerides, which build up in fat cells and contribute to body fat. Hyperglycemia leads to an increase in total cholesterol by reducing the ability of the body to remove cholesterol when blood sugars are too high. Total cholesterol and LDL-C receptors in the liver are coated with sugar (glycosylated), impairs the liver's ability to remove cholesterol from blood stream, this could be due to the effect of diabetes on lipoprotein lipase in the liver which lead to dyslipideamia. Insulin affects the liver apolipoprotein production; it regulates the enzymatic activity of lipoprotein lipase (LpL) and cholesterol ester transport protein. All these factors are likely cause dyslipideamia in diabetes

mellitus. [17] In the current study, correlation was studied between the plasma levels of triglycerides and T.Cholesterol with HbA_{1C} % and BMI in the diabetic group. The results showed a significant positive correlation between triglycerides and T.cholesterol with HbA_{1C} % in the diabetic group, these results agreed with several investigators whom reported significant positive correlations between triglycerides and cholesterol with HbA_{1C} in diabetic patients[18-21]. Similar results have been reported by Singh in Punjab[22] who found a significant weak positive correlation between HbA_{1C} %, and the plasma levels of triglycerides (r= 0.26) and Cholesterol (r= 0.29), and the same results are similar to that reported in the Eurobian Journal of Pediatrics by Ohta et al[21]. In this study the results showed an insignificant weak positive correlation between the plasma level of triglycerides and the body mass index of diabetic patients. These results disagreed with a study done by Garg et al [23]. who reported that there is a significant positive correlation between plasma level of triglycerides and body mass index in diabetic patients. The results also demonstrated a significant moderate positive correlation between the plasma levels of total cholesterol and body mass index in the diabetic group. These results agreed with a study done by Garg et al [23]. who reported positive correlation between plasma level of total cholesterol and body mass index in diabetic patients.

CONCLUSION:

Total Cholesterol, Triglycerides, HbA_{1C} and body mass index in diabetic patients significant increase when compared with non diabetic control subjects. Also there was a significant weak positive correlation between HbA_{1C} % and plasma levels of total Cholesterol and triglycerides in diabetic group, Furthermore, there was a significant positive correlations between body mass index and plasma levels of total Cholesterol in diabetic group. Moreover, there was an insignificant positive correlation between body mass index and Triglycerides.

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