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Lipid Profile and glycemic control of diabetic cardiovascular complication at White Nile State

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Abstract
Diabetes mellitus (DM) is a major public health problem worldwide. Type 2DM was associated with increased cardiovascular diseases and some major pathophysiologic mechanism linking T2DM to CV risk. This work was aimed to detect the prevalence of diabetic patients with cardiovascular complication admitted to different hospitals in White Nile state. 200 samples were collected within study area, 100 of diabetes mellitus type 2 and cardiovascular disease and 100 samples as control. Age, Duration, BMI, fasting blood glucose level FPG and lipid profile (cholesterol, triglyceride, LDL, HDL) were analyzed using standard methods of Type 2 diabetic subjects and control. SPSS program was used for statistical analysis. Results showed significantly high levels of TC as (231.5mg/dl), TG as (127.89mg/dl) and LDL (142.28mg/dl) in case group, whereas, control group showed (173.08mg/dl, 75.66 mg/dl and 84.41mg/dl) respectively. HDL mean was lower in case (44.9 mg/dl) than control (84.4 mg/dl) with p value (0.039). Low level of HDL in case samples may indicate the increasing of TG level. VLD was (28.55 mg/dl) in case and (43.8 mg/dl) in control with (p =0.000). Lipid profile values may be in the normal ranges for case and control. For type of drug used Group of patient that used Metformin alone showed decreasing of TC, whereas, metformin plus glibenclamide showed significant decreasing in LDL value. Insulin and metformin groups showed significantly similar effect on lipid profile in case samples. All p values considered were significant at 0.05 levels.

Keywords: Cholesterol, LDL, Lipid profile, Cardiovascular diseases, Diabetes mellitus

Introduction

Diabetes mellitus is a chronic, metabolic disease characterized by elevated levels of blood glucose, which may complicate and damage other organs as heart, vasculature, eyes, kidneys and nerves. The number of people with DM has quadrupled in the past three decades (Tajudeen O. Yahaya., 2020). It occurs primarily due to a 'high blood sugar level,' resulting in hyperglycemia, glycosuria, dyslipidemia (elevated triglycerides), i.e., high levels of low density lipoproteins (LDL), low levels of high density lipoproteins (HDL), cholesterol, and insulin resistance in the presence or absence of glucose intolerance (Sunaina Gautam *et al*., 2010) [13]. DM is now the ninth primary cause of death, accounting for about 1 in 11 adults with DM. In 2019, about 463 million people were diagnosed with DM and this number was projected to reach 578 million by 2030, and 700 million by 2045 **(**Tajudeen O. Yahaya., 2020). Diabetes mellitus characterized by presence of insulin but there is no or low cell response therefore, glucagon is attenuated, fatty acid oxidation is inhibited, leading to fatty acids incorporated into triglycerides for release as very low-density lipoproteins. (Sunaina Gautam *et al*., 2010, Unai Galicia, *et al*., 2020, Vicki S., 2018) [13, 17]. T2DM represent 90% of diabetes mellitus cases, a condition marked by defective insulin secretion by pancreatic cells or insulin resistance the inability of insulin sensitive tissues to respond appropriately to insulin (insulin resistance (IR)). T2DM is affected by genetics and the environmental factors, genetic factors exert their effect following exposure to an environment characterized by sedentary behavior and high-calorie intake (VICKI S, 2018, Unai Galicia, *et al*., 2020) [17].

Body mass index and DM

Excess weight and physical inactivity are also associated with an increased risk of developing various diseases, particularly type2 diabetes (Rudra C. B. *et al*., 2007, Guh D. P. *et al*., 2009) [5, 12]. Among adults over age 65, the incidence of DM complications has been rising, except for eye-related complications (Sloan F. A. *et al*., 2008) [14]. Natallia Gray *et al*., (2015) studied the association between the excess weight and the time to first diagnosis of type 2 DM and they concluded that, the excess weight and obesity may be a major contributing factor to type 2 DM. Norris S. L. *et al*., (2005) [10] and Tate D. F. *et al*., (2003) reported that, the reduction of body mass weight may lead to a significant decrease in diabetes incidence.

DM and cardiovascular disease

Type 2 diabetes mellitus (T2DM) is associated with increased cardiovascular (CV) morbidity and mortality (Sarwar N *et al*., 2010) [15]. The major pathophysiologic mechanism linking T2DM to CV risk is diabetic dyslipidaemia, characterized by high triglycerides (TG) and low high density lipoprotein cholesterol (HDL) plasma levels (Parhofer K G., 2015) [11]. Hobeika M J (2007) [6], Diamant M (2005) [2] and Goncalves I. (2015) studies reported that, there is a relation of TG and HDL with vascular and cardiac alterations.

Fatty acids and diabetes

Trans Fatty acids (TFAs) have long been used in food manufacturing. (Md. A. Islam *et al.*, 2019). Consumption of trans fat was not significantly associated with the risk of

diabetes in two of these studies - among male health professionals (Van Dam R M, *et al.*, 2002) and among women in Iowa (Meyer KA, *et al.*, 2001). However, the ingestion of trans-fatty acids significantly related to the risk of diabetes among 84,941 female nurses who were observed for 16 years and in whom self-reported diabetes was affirmed and report on dietary intake was periodically updated (Hu F. B, *et al.*, 2001). There is positive association between TFA intake and elevated plasma LDL as well as triglycerides (Matthan N. R. *et al.*, 2004, Adams T. H. *et al*., 2010). A 2% absolute increase in energy intake from trans-fat has been associated with a 23% increase in cardiovascular risk. They increase the levels of low-density lipoprotein which is bad for health. Moreover, several Epidemiological studies have been demonstrated that a high intake of TFAs increases the incidence of cancer and diabetes (Oh K, *et al.*, 2005, Md. A. Islam *et al.*, 2019). In the Iowa cohort, a validation study supposed that the self-reported diagnosis of diabetes was incorrect in 36% of subjects, and diet was assessed only at baseline and may have changed over time (Meyer KA, *et al.*, 2001). Molecular mechanisms that might account for an effect of trans-fatty acids on the incidence of diabetes are not well established (Saravanan N, *et al*., 2005). Dyslipidaemia: is defined by elevated levels of total cholesterol, LDL-C or triglycerides or low levels of HDL-C (Diana M and John A. S., 2019) [3].

Table 1: Normal ranges of glucose, lipid profile, age and BMI

Parameters	Glucose (mg/dl)	TC (mg/dl)	TG (mg/dl)	LDL (mg/dl)	HDL (mg/dl)	VLDL (mg/dl)	Age	BMI kg/m^2
Normal ranges	70-140	150 - 250	10- 90	60-130	>60	<30	27-60 years	18.5-25
Border line	140-199	200-239	150-199	130-159	35 - 45			26-39
High risk	>200	240	200-499	160-189	<35			>40

Materials and methods

The study was conducted within White Nile State. 200 participants Samples were collected from different Hospitals located in the State. Control group contain (100) samples of diabetic with cardiovascular disease patients, and 100 samples healthy as a control. Consent and management permissions were obtained. All subjects were interviewed using a questionnaire, underwent physical examinations and laboratory tests. The sample size was calculated. Biosystem A15 was used for Biochemical estimation of fasting blood glucose and lipid profile. *The HbA1c estimated by Nycocard*, is a fluorescence Immunoassay (FIA) for the quantitative determination *of HbA1c* (*Hemoglobin A1c*) in human whole blood. It is useful as an aid in management and monitoring of the long- term glycemic status in patients with diabetes mellitus. Data collected by using a standard data questionnaire consisting of basic demographic data.

Results and discussion

The age means of case populations was 50.73 year and the control population was 55.78 year (Table. 2). T2DM patients were significantly higher body mass value than control samples. Kozakova *et al.* (2019) reported age mean as (65 ± 7 year) in type2 diabetes mellitus patients.

Table 2: Ages mean of case and control/year

Type	(Mean± std)	N
Case	50.7300±7.6	100
Control	55.7800±9.8	100
Total	53.2550±9.1	200

As shown by table (3) the body mass index means value for case samples was (27.85 kg/m^2) and for control as (27.32 kg/m^2). Kozakova *et al.* (2019) reported BMI mean value in DM type 2 as (29.0 ± 4.5 kg/m^2) which, was higher than reported by this study.

Table 3: BMI means of case and control

Type	(Mean± std)	N
Case	27.8546±6.0	100
Control	24.3160±4.8	100
Total	26.0853±5.7	200

As shown by Fig. (1) Total cholesterol (TC) mean value was significantly high in case (231.5mg/dl) than control (173.08mg/dl). Triglyceride (TG) also was higher in case (127.89mg/dl) than control (75.66 mg/dl). The increase of TG level in case was statistically significant (p=0.000). LDL was higher in case (142.28mg/dl) than control (84.41mg/dl), Levels of LDL in case was statistically significant (142.28mg/l), which, may be due to the effect of DMT2 on lipid profile. HDL mean of case was lower in case (44.9 mg/dl) than control (84.4 mg/dl) with p value (0.039). HDL decreased in case as indicator of increasing in TG level. VLD was (28.55 mg/dl) in case and (43.8 mg/dl) in control with (p value 0.000). That means the lipid profile values were in the normal ranges for case and control, whereas all lipids profiles were within the normal range.

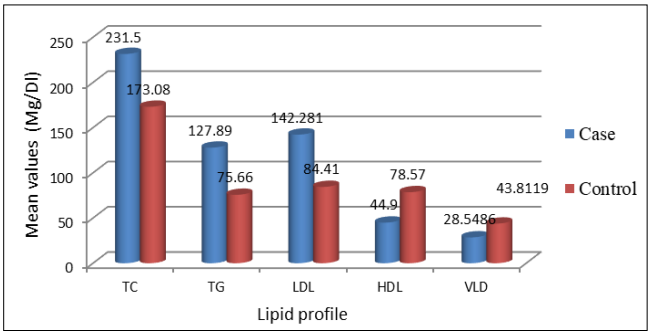

Fig 1: Relation between of lipid profile means in case and control groups

Figure No. 2 showed the relation between type of drug used by patients and lipid profile concentrations. Group of Insulin contain (20) samples, Metformine (27) samples, Glime (31) and MetGlime (22) samples. Total cholesterol content showed high value for all drug types but the highest value was shown by Glimedine. Mean of TC was 234mg/dl in insulin group, 228mg/dl in mitformin group, 240mg/dl in Glimepiride group and 220 mg/dl in mitformine+ Glimepiride group. TG showed lower mean values in mitformine plus Glimepiride group (88.5mg/dl), followed by glimepiride group (149mg/dl), insulin group (136.9mg/dl) and (128.2mg/dl) in mitformine group. That mean the highest TG mean value between drugs was in

Glimedine group. LDL mean values were (163.7mg/dl) in insulin, (157.6mg/dl) in mitformine, (163mg/dl) in glimepiride and (74.7mg/dl) in Mitformine+Glimepiride group. HDL cholesterol showed mean values as (43.8 mg/dl) in insulin group, (44.7mg/dl) in mitformine group, (46mg/dl) in Glimepirid and (44.4mg/l) in Mitformine+Glimepiride group, Mean levels of VLDL in Insulin, metformin, Glimepiride and metformin+Glimepiride groups were (27mg/dl, 25mg/dl, 30mg/dl and 31mg/dl) respectively. Insulin and metformin groups were showed significantly similar effect on lipid profile in case samples.

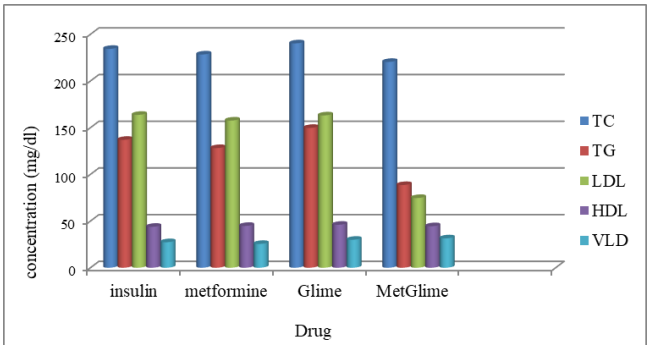

Fig 2: Relation between DMT2 drugs and lipid profiles

As shown by (table. 4) FBS showed significance difference of FBS mean values in case group as (177.35mg/dl) and in control group as (112.89mg/dl). HbA1c was insignificantly increased in diabetic cardiovascular group value as (8.89mg/dl) than control as (5.73mg/dl) this may agree with the study of Kafle D. *et al*., (2022) who reported, FBS and HbA1c levels significantly increased in diabetic with CHD Group as compared with control normal Group.

Table 4: Means value of FBS and A1C in case and control

Type	FBS	A1C
Case (N=100)	177.3500±86.70854	8.8970±1.51394
Control (N=100)	112.6900±38.23867	5.7280±4.40395
Total (N=200)	145.0200±74.28459	7.3125±3.64858

For DMT2 patient there is a relation between FBS and HbA1C concentration and type of drug used. Depending on drug type case samples were divided to four groups Insulin, metformin, Glimepiride and group that use combination of metformin plus Glimepiride. Results showed FBG values for Insulin group as (196mg/dl), metformin as (181mg/dl), Glimepiride as (189.7742 mg/dl), and metformin plus Glimepiride as (137.77mg/dl). Mean of glycated hemoglobin (HbA1c) concentration were (8.1%) in insulin group, (9.2%) in metformin group, 9.8% in Glimepiride and 9.1% in metformin plus Glimepiride group. That suggests difference in mean of FBG and HbA1c in the four groups.

Table 5: Relation of drug types with FBS and A1C concentration

Drug		FBS	A1C
Insulin	Mean	196.3000	8.1450
	N	20	20
	Std. Deviation	80.01783	1.59785
Metformine	Mean	181.2963	9.2148
	N	27	27
	Std. Deviation	102.53585	1.55011
Glime	Mean	189.7742	8.9484
	N	31	31
	Std. Deviation	77.60271	1.54313
MetGlime	Mean	137.7727	9.1182
	N	22	22
	Std. Deviation	76.15706	1.18106
No	Mean	112.6900	5.7280
	N	100	100
	Std. Deviation	38.23867	40395
Total	Mean	145.0200	7.3125
	N	200	200
	Std. Deviation	74.28459	3.64858

Conclusion

Total cholesterol, Triglyceride, and LDL was significantly higher mean value in case than control group. HDL and VLDL mean value were lower in case than control. Insulin and metformin groups were showed significantly similar effect on lipid profile in case samples. Group of metformin plus glibenclamide showed significant decreasing in TC and LDL mean values.

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