

Relationship Between Total Cholesterol, Bmi and Hba1c In Type 2 Diabetes Patients

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Abstract: Lipid profile and diabetes type 2 are common disorder in the world. Raised blood glucose results from the underlie creation of insulin or a hardened to the impact of insulin. Diabetes type 2 leads to complication in human body organs, therefore diagnosis of disease in an early stage is very important. The current study was conducted for the purpose of knowing the relationship between blood lipid profile and its correlation with body mass index and calculated among diabetes patients. This study included 70 subject aged 40-50 years, forty patients with diabetes type 2 and thirty as healthy subjects were selected randomly. Blood samples were taken for estimating biochemical parameters such as Body mass index (BMI), Glycated hemoglobin (HbA1c), High Density Lipoprotein Cholesterol (HDL-C), Low Density Lipoprotein Cholesterol (LDL-C), Fasting blood glucose (FBS), Triglycerides (TG), Total cholesterol (TC) and Total oxidant status (TOS) levels in both groups. The results revealed higher level of body mass, total oxidant status level and parameters of lipid profile in patients with diabetes type 2 in comparison with healthy group, with significant variation except in High Density Lipoprotein Cholesterol, in which there is no significant difference. Diabetes type 2 causes an increased in body mass index, HbA1c and lipid profile (Triglycerides, Total cholesterol, LDL expect HDL there is no differences).

1 INTRODUCTION

Diabetes type 2 is a complex disease represented the major internecine of the health and it is defined as a group of chronic diseases by high level of blood glucose [1]-[3]. Normal glucose results from a balance between insulin secretion and action; any defect in the balance is responsible for the initiation of diabetes [4]. Type 2 diabetes is associated with disorders such as obesity, hypertension and dyslipidemia properties by the level of small dense low-density lipoprotein (LDL) cholesterol and low level of high-density lipoprotein (HDL) cholesterol [5]-[7], in addition to elevated oxidative stress, which has been implicated in diabetic progression and its vascular complications [8], [9]. There was relevancy between body mass index (BMI) and average of plasma glucose, it was higher in patients with diabetes when compared with the control [10]. The chemically effective products of the

oxygen metabolism within the living system in all aerobic organisms named reactive oxygen species (ROS) which are produced in mitochondria and other processes in the cell examples of these ROS, nitric oxide, hydroxyl radical and others, when there is the lack of equilibrium between the process of oxidants and antioxidants that occurs in the human body called oxidative stress(OS) condition, which leads to gathering of the oxidants in the body, that is closely interested in many pathological conditions like cardiovascular and heart diseases, and cancer also in many metabolic and neurological diseases [11], [12]. Furthermore, the current study deals with the correlation between BMI, lipid profile (LDL, HDL) cholesterol, triglyceride, glycated hemoglobin (HbA1c) and TOS level in diabetes type 2.

2 EXPERIMENTAL

Five ml of venous blood were taken from control (healthy patients) and diabetes type2 patients from Iraqi population with age range (40-50) years, the blood was collected in fasting status included a total 70 subjects with 30 normal subjects (control) and 40 patients with diabetes type 2. The baseline of two groups used laboratory results, glycated hemoglobin (HbA1c), lipid profile includes total cholesterol (TC), low density lipoprotein cholesterol (LDL-c), high density lipoprotein cholesterol (HDL-c), and triglyceride, as well the information about two groups which includes (age, sex, smoking and marital status) also was recorded. The BMI was calculated according to the ratio depending on weight and height obtained by applying a mathematical equation, weight kg/height m² [13]. Regarding the examination of cumulative sugar (HbA1c) and cholesterol, the standard methods followed by researchers using ELISA kit for total oxidant status (TOS) from Elabscine, Chinese company, were used [14]-[16]. The procedure of this study was approved by our college committee for human protection as per guidelines of the ethical approval registered under the number 992 on 26-12-2024. The statistical data analysis is collected using SPSS software version 22, the variables' mean and standard deviation were reported.

3 RESULTS AND DISCUSSIONS

The sample of the current study includes 30 healthy people (20 smokers and 10 non-smokers), and 40 diabetes patients (24 smokers and 16 non-smokers), and age ranges (40-50), with male and female, smoking and marital status as in Table 1, while Table 2 shows the body mass index in patients with diabetes type 2 is higher than in healthy patient, and the same result for the fasting blood glucose, triglycerides, total cholesterol, HDL-c and LDL-c with significant variation between all groups except the test of HDL-c, in which there is no significant variation. The mean levels of HbA1c and TOS were higher in diabetes patients when compared with control (Table 3).

Table 1 General characteristics of diabetic and control groups.

| Characteristics | Healthy No. (%) | Diabetes type 2 No. (%) |
|-------------------------|-----------------|-------------------------|
| Sex | | |
| Male | 15 (50%) | 20 (50%) |
| Female | 15 (50%) | 20 (50%) |
| Smoking | | |
| Smoker persons | 20 (66.67%) | 24 (60%) |
| Non-smoker persons | 10 (33.33%) | 16 (40%) |
| Marital status | | |
| Single/Divorced/Widowed | 14 (46.67%) | 12 (30%) |
| Married | 16 (53.33%) | 28 (70%) |
| Total | 30 | 40 |

Table 2: Meanlevels of biochemical parameters among the diabetic and control groups.

| Biochemical Parameters | Mean | P value |
|-------------------------------------------------------|---------------------------|------------------------|
| BMI (Kg / m ²) | | |
| Healthy T2DM patients | 28.70±3.11 30.66 ±2.4 | <0.002 * |
| Fasting Blood Glucose (mg/dL) | | |
| Healthy T2D patients | 115 ±8.11 202 ±12.19 | <0.001 * |
| Triglycerides mg/dL | | |
| Healthy T2D patients (normal = Less than 150 mg/dL) | 131±9.22 192 ±11.12 | <0.001 * |
| Total Cholesterol (mg/dL) | | |
| Healthy T2D patients (normal = less than 200 mg/dL) | 168.7±8.3 212.6 ±7.2 | <0.001* |
| HDL-c (mg/dL) | | |
| Healthy T2D patients (normal = greater than 40 mg/dL) | 37.16 ±1.2 36.31±2.6 | <0.001 Non-significant |
| LDL-c (mg/dL) | | |
| Healthy T2D patients normal = less than 100 mg/dL) | 88.91 ±8.6 148.91 ±9.7 | <0.001* |

Table 3: Mean HbA1c and Total Oxidant Status (TOS) levels in diabetic and control groups.

| Group | HbA1 (mg/dL) | TOS (µmol) |
|--------------|---------------|--------------|
| Healthy | 5.4 ±0.6 | 15.04 ± 0.91 |
| T2D patients | 8.9 ±1.1 | 24.19 ± 1.31 |
| | 0.00* | 0.000* |

Lipid levels and HbA1c are a very common problem in more than one disease especially in diabetes mellitus, that pose a threat to security and the cause of high prevalence in wide public health that are considered strong risk factors which are linked significantly with the prevalence of heart disease. The present diabetic patients were older than those healthy in control group but did not differ significantly according to the age in comparison to the control group. Accordingly, many earlier previews and studies conducted in the world rumored a high prevalence of diabetes and they found that the high incidence relates to the age which considered it as a risk factor [17], [18]. In the current study, the mean of BMI in the group of diabetic patients is higher and there were significant differences when compared to the BMI of healthy normal individuals. Similarly, Patel and his team consider BMI higher in diabetic patients when compared and assessment of the relationship between BMI with the blood and salivary glucose by dividing the patient in the diabetic group into three groups according to the BMI named normal and to the pre-obese and obese, and they showed the individuals with higher BMI are more likely to develop diabetes and also have higher blood and salivary glucose, and reported that needs more research in different areas in the world with larger populations [19]. The diabetes type 2 group in this study consisted of 60% smoker persons and 40% were non-smoker persons, while the healthy control group consisted of 66% smoker and 33% were non-smoker persons. Regarding to the salivary HbA1c, this study showed higher levels of HbA1c in the group with diabetes than that of normal healthy group. In agreement with other studies that appeared increases in the levels of HbA1c in patients with diabetics type 2 and have other diseases like cardiac diseases in addition to the diabetes [20], [21]. Many previous researches suggesting that the higher values of HbA1c may indicated by signs of the dysmetabolism which found strong relationship between metabolic syndrome components and the HbA1c, also stated that there is a study of correlation between the HbA1c and the parameters of lipid profile to eliminate their interplay or their role in the heart diseases and reasons for metabolic disorders [22], [23]. Recently, according to the results of more than study the HbA1c emerged and is considered like a biomarker of the metabolic syndromes and cardiovascular diseases [24]. Considering to the level of the triglycerides, it was found that the type 2 diabetes patients have highest mean when compared to the participants of the healthy control group and the normal values which were less than 150 mg/dl. The

results of this study found that, there were relationship between the elevated mean of TC and lipid profile with the values of HbA1c in diabetic patients. Current results are concurred with the results of numerous earlier studies in different parts in the world about the HbA1c levels which rise with increasing of the levels of lipid profile parameters like TC and LDL but the HDL levels are decreased [25], [26]. In contrast, some other studies found that the higher levels of HbA1c have positive relationship with the level of HDL [27]. In addition, the study of Mohammed [28] found that the LDL and TC levels with HbA1c are expected to become risk factors or have significant relation with the high incidence of cardiac diseases especially peripheral artery disease. So that the recent evidence in the last years suggests that the lipid ratio gives greater sensitivity to the severity of the coronary heart disease. The results of this study appeared to increase the mean values of total oxidative stress in the diabetic group than that of healthy control group. In accordance, Abdullah [29] observed that the Insulin Resistance and Type2 diabetic patients have altered of the mean TOS. In fact, Pendyala [30] observed increasing evidence that the oxidative stress may be important strong factor that contributes to the pathogenesis and causes of diabetes, also Porovic et al. [31] showed the DMT1 effect on the Total antioxidant capacity when examined 60 children in Croatia. The diabetic subjects have highest values for all the variables used in this study; the cause may be related to the pathways of many biochemicals like the glucose auto-oxidation and the protein glycation that are associated with or involved in hyperglycemia and its role in the rise of free radicals in the diabetic subject [32].

4 CONCLUSIONS

The findings of the present study demonstrate significant alterations in biochemical and oxidative parameters among patients with type 2 diabetes mellitus (T2DM) compared with healthy individuals. Elevated levels of fasting blood glucose, HbA1c, triglycerides, total cholesterol, and LDL-c, along with increased total oxidant status (TOS), were observed in diabetic patients, indicating a strong association between poor glycemic control, dyslipidemia, and oxidative stress. In contrast, HDL-c levels showed no significant variation between groups, suggesting a complex lipid regulation mechanism in diabetes. The higher BMI values in diabetic individuals reflect the contribution of obesity to insulin resistance and metabolic imbalance. Increased oxidative stress, as

indicated by higher TOS levels, may play a critical role in the pathogenesis of vascular and metabolic complications of diabetes through the overproduction of reactive oxygen species (ROS) and the reduction of antioxidant defences. These findings support the concept that monitoring HbA1c, lipid profile, and oxidative stress markers could serve as valuable indicators for assessing metabolic control and predicting cardiovascular risk in patients with type 2 diabetes.

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