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Dyslipidemia in Type 2 Diabetes Mellitus Patients in Benghazi, Libya

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Abstract

Objectives: Dyslipidemia is one of the common complications that seen in most diabetic patients, which leads to atherosclerosis and cardiovascular disease. This study investigated the lipid disorders among 350 type 2 adult diabetic patients and 150 age and sex matched healthy non diabetic controls in Benghazi – Libya.
Material and Method: The serum samples were analyzed for fasting blood sugar (FBS), total cholesterol (TC), triglycerides (TG), high density lipoprotein cholesterol (HDL-C) and = low density lipoprotein cholesterol (LDL – C) by using standard enzymatic methods.
Results: Compared to controls we find a statistically significant higher levels ($P < 0.05$) of serum total cholesterol, triglycerides, LDL - cholesterol and no significant difference was detected regarding HDL – cholesterol. The serum total cholesterol, triglycerides and LDL - cholesterol levels were above the normal value in 41%, 56% and 57% in the diabetic group, as compared to 8%, 21% and 34% in the controls, respectively ($P < 0.05$) whereas the serum HDL – cholesterol was less than normal in similar manner 60% and 45% in the diabetics and controls.
Conclusions: Dyslipidemia is highly prevalent among type 2 adult diabetic patients in Benghazi city which aggravate the atherogenic process.
Keywords: Dyslipidemia, type 2 diabetes, lipid profile, Benghazi, Libya.

1. Introduction

Diabetes mellitus and its complications are the major and growing public health problem around the world, involvement in a developing country like Libya. Dyslipidemia and atherosclerosis are the main risk factors that accelerate onset of chronic complications such as cardiovascular disease in diabetes mellitus. In diabetes the associated hyperglycemia, obesity and insulin changes highly accelerate the progression to atherosclerosis [1, 2]. Atherosclerosis accounts for up to 80% of deaths in diabetic patients due to coronary heart disease (CHD) and cerbrovascular or peripheral vascular disease [3, 4], diabetic dyslipidemia using World Health Organization (WHO) criteria [5-7] is characterized by serum triglyceride levels are 150-400 mg / dL (1.7 to 4.5 mmol / L), total cholesterol (TC) > 200 mg / dL (> 5.2 mmol / L), low density lipoprotein cholesterol (LDL-C) > 135 mg / dl (> 3.5 mmol / L), high density lipoprotein cholesterol (HDL-C) <35 mg / dL (< 0.9 mmol / L) in men or < 40 mg / dl (< 1.0 mmol / L) in women, and a ratio of total cholesterol: HDL-cholesterol > 5. The lipid abnormalities in diabetic dyslipidaemia are prevalent in diabetes mellitus because insulin resistance or deficiency affects key enzymes and pathways in lipid metabolism [3, 8]. In particular, the following processes are affected: apoprotein production, regulation of lipoprotein lipase, action of cholesteryl ester, transfer proteins and hepatic and peripheral actions of insulin [3]. Even more, it has been proposed that the composition of lipid particles in diabetic dyslipidaemia is more atherogenic than other types of dyslipidaemia. This means that even normal lipid concentrations might be more atherogenic in diabetic than in nondiabetic people [3, 9, 10].

Complications are Due to a relative lack of local and regional literature on the problem of diabetic dyslipidemia in Benghazi city. The objective of this

study was to investigate the influence of diabetes on the lipid profile of affected subjects from the Benghazi Diabetes Center and Benghazi Medical Center, Benghazi – Libya, in order to draw the attention of the medical community on the occurrence and magnitude of this problem in Libya.

2. Material and methods

2.1. Data Collection

The subjects for this hospital based case control study were selected from the Benghazi Diabetes Center and Benghazi Medical Center, Benghazi – Libya. This study was approved with ethical clearance obtained from the local authority. A total 500 type 2 diabetic patients attending the medical outpatient clinics were selected. After following the inclusion and exclusion criteria, 350 patients were found eligible for the study. The study targeted medically diagnosed type 2 diabetic patients. Those associated with concomitant disease or conditions affecting lipid levels such as thyroid disease, renal disease, chronic liver disease, familial hyperlipidemia, on lipid lowering agents or other drugs known to alert lipid profile etc., and pregnant women were excluded. Age and sex matched 150 non diabetic healthy subjects were selected randomly from blood donor at the blood bank and were assigned as controls.

Venous blood samples for fasting blood glucose and lipid profile were collected after an overnight fast of at least 14 h from both diabetic and control subjects. Their weights were measured in kilograms using hospital health scale. Their heights were measured in meters using the same scale. The body mass index (BMI) defined as weight in kilogram divided by the square of subject's height in meters was then calculated. Blood pressure was measured twice for each patient after 5 min interval, and the mean of the two taken as the final record.

In both the diabetic patients and controls 5 ml venous blood samples were obtained in the morning, after an overnight fast (at least 12 h). Samples were obtained from the antecubital forearm vein, after a 10 min rest in a sitting position, using evacuated tubes. The blood was collected into centrifuge tubes. It was allowed to clot and it was then centrifuged at 3000 rpm for 15 min at room temperature. The serum which was obtained was pipetted into a clean blood sample bottle and analyzed on the day of collection for serum sugar and lipid profile tests. Samples were assayed in the clinical chemistry laboratory of central lab of the Benghazi Diabetes Center and Benghazi Medical Center, Benghazi – Libya. The serum sugar and lipid profile assays were done using already and well established methodology. The serum concentrations of total cholesterol and triglycerides were determined by an enzymatic colorimetric method [11, 12], HDL-Cholesterol was estimated by a precipitant method [13] and LDL cholesterol was calculated using the Friedewald formula, which can be used with TG values not exceeding 350 mg/dl [14]:

LDL [mg/dl] = total cholesterol – HDL-cholesterol – (TG/5).

Serum glucose was determined by using the glucose oxidase enzymatic method [15]. All the parameters which were under investigation were determined in the serum of the subjects by using commercially available reagent kits.

2.2. Statistical analysis

Results are expressed as mean ± S.D Statistical analysis was performed using the SPSS statistical software version 13. The statistical significance of the difference between the control and the diabetic group was evaluated by the Student's t-test. The accepted level of significance was defined at $p < 0.05$.

3. Results

Five hundred (500) subjects composed of 350 diabetic subjects and 150 healthy controls were enrolled in the study. Of the diabetic patients 152 (43.43%) were females and 198 (56.57%) were males, even though 53 (35.33%) of healthy control subjects were females and 97 (64.67%) were males.

The mean age of the subjects was 50 ± 13 and 51 ± 10 years for diabetics and the healthy control groups respectively (Table 1)

Table 1 also shows that the diabetic patients had higher levels of BMI (30.2 ± 6.2 kg/m^2 vs. 23.8 ± 4.7 kg/m^2, $P < 0.05$), systolic blood pressure (140 ± 16 mm Hg vs.124 ± 10 mm Hg, $P = 0.05$) and diastolic blood pressure (84 ± 11 mm Hg vs. 73 ± 10 mm Hg, $P < 0.05$) than healthy controls.

Diabetic patients had significantly higher levels ($P < 0.05$) of serum total cholesterol, triglycerides, LDL - cholesterol and no significant difference was detected regarding HDL – cholesterol compared to age matched healthy controls (Table. 2). Diabetic males show a significant increase ($P < 0.05$) in serum cholesterol, triglycerides and LDL - cholesterol as compared to non diabetic males (Table 3). In the female group, diabetic female shows a significant increase in the level of these lipid parameters compared to control subjects. Both males and females had no significantly difference in serum HDL – cholesterol as compared age and sex matched healthy controls (Table. 3). Among diabetic subjects, diabetic females had no significantly difference in serum cholesterol, HDL – cholesterol and non

significantly higher level of LDL - cholesterol and triglycerides as compared to that of male diabetics (Table 3).

The serum total cholesterol, triglycerides and LDL - cholesterol levels were above the normal value in 41%, 56% and 57% of the subjects in the diabetic group, as compared to 8%, 21% and 34% in the control group, respectively ($P < 0.05$) whereas the serum HDL – cholesterol was less than normal in similar manner 60% and 45% in the diabetic and control groups under study (Table 4).

Table 1: Background characteristics of diabetic patients and healthy controls understudy

Variable	Patients (n = 350) Mean ± SD	Controls (n = 150) Mean ± SD
Age (years)	50 ± 13	51 ± 10
Duration of DM (years)	10 ± 7	-----
Male/female (Numbers)	198/152	97/53
Body mass index (kg/m^2)	30.2 ± 6.2	23.8 ± 4.7
Systolic blood pressure (mmHg)	140 ± 16	124 ± 10
Diastolic blood pressure (mmHg)	84 ± 11	73 ± 10

n = number of subjects; SD = standard deviation.

Table 2: Biochemical Parameters of diabetic patients and healthy controls understudy

Parameters	Patients (n = 350) Mean ± SD	Controls (n = 150) Mean ± SD
FBS (mg/dl)	174.41 ± 53.99 *	83.19 ± 11.86
TC (mg/dL)	193.17 ± 46.76 *	167.30 ± 25.39
TG (mg/dL)	168.89 ± 76.90 *	132.06 ± 48.92
HDL - C (mg/dL)	39.83 ± 10.75 *	42.97 ± 5.45
LDL – C (mg/dL)	119.65 ± 31.27 *	94.32 ± 24.92

n = number of subjects; SD = standard deviation; * = significantly different ($P < 0.05$); FBS = fasting blood sugar; TC = total cholesterol; TG = total triglycerides; HDL-C = high density lipoprotein cholesterol, LDL – C = low density lipoprotein cholesterol.

Table 3: Comparison of Biochemical Parameters studied between male and female in diabetic patients and healthy controls understudy.

Parameters	Male Patients (n = 198) Mean ± SD	Male Controls (n = 97) Mean ± SD	Female Patients (n = 152) Mean ± SD	Female Controls (n = 53) Mean ± SD
FBS (mg/dl)	172.86 ± 50.39 *	85.74 ± 7.92	175.97 ± 58.48 *	80.64 ± 15.80
TC(mg/dL)	193.31 ± 50.67 *	169.08 ± 30.32	193.00 ± 43.84 *	165.52 ± 20.46
TG (mg/dL)	164.50 ± 70.84 *	134.19 ± 75.98	172.14 ± 81.27 *	129.93 ± 31.86
HDL – C (mg/dL)	40.73 ± 11.58 *	43.29 ± 7.03	40.28 ± 10.04 *	42.65 ± 13.87
LDL – C (mg/dL)	119.68 ± 29.58 *	95.11 ± 37.89	118.29 ± 32.86 *	93.53 ± 31.95

n = number of subjects; SD = standard deviation; * = significantly different ($P < 0.05$); FBS = fasting blood sugar; TC = total cholesterol; TG = total triglycerides; HDL-C = high density lipoprotein cholesterol, LDL – C = low density lipoprotein cholesterol.

Table 4: Percentage of abnormal lipid analyte in diabetic patients and healthy controls understudy.

Parameter	Patients [Numbers (%)]	Controls [Numbers (%)]
TC(mg/dl)		
Desirable (<200)	208 (59%)	137 (92%)
Borderline high (200-239)	91 (26%)	11 (7%)
High (≥240)	51 (15%)	2 (1%)
TG (mg/dl)		
Normal (<150)	155 (44%)	118 (79%)
Borderline high (150-199)	103 (29%)	23 (15%)
High (≥200)	92 (27%)	9 (6%)
HDL – C (mg/dl)		
Low (<40)	210 (60%)	67 (45%)
Borderline high (40-59)	119 (34%)	42 (28%)
High (≥60)	21 (6%)	41 (27%)
LDL – C (mg/dl)		
Optimal (<100)	150 (43%)	101 (67%)
Near optimal (100-129)	112 (32%)	34 (23%)
Borderline high (130-159)	60 (17%)	9 (6%)
High (160-189)	14 (4%)	4 (3%)
Very high (≥190)	14 (4%)	2 (2%)

TC = total cholesterol; TG = total triglycerides; HDL-C = high density lipoprotein cholesterol, LDL – C = low density lipoprotein cholesterol.

4. Discussion

The study revealed that the lipid profiles of Libyan type 2 diabetic were higher and statistically different from those of non-diabetic healthy controls. These findings are in consonance with previous studies which suggest that lipid abnormalities are higher in diabetic than in non-diabetic subjects [16, 17]. Our study in Benghazi indicated that nearly 90% of our Libyan diabetic patients sample had some disorder in their lipid profile. These results appeared relatively high compared with reports from America and Finland, where they noted an overall prevalence of lipid abnormalities of 70% and 85% among diabetic patients [18, 19]. The above observations was not consistent with previous regional studies that somewhat similar to our study in Sudan and Kuwaiti studies which show an incidence of lipid disorders of around 50% among diabetic patients [3]. Lifestyle, environment, occupation and level of education may account for these differences [20].

The results showed no significant gender differences in lipid levels in the studied Libyan type 2 diabetic patients. The above observation was not consistent with previous studies of Naknjavani *et al*. and Gustafsson *et al*. [21, 22].

The commonest lipid abnormality noted in the study was low HDL – cholesterol (60%) also hypertriglyceridemia (56%). The importance of this parameter stems from the growing evidence that reduced HDL-C is a powerful predictor of premature CHD [3, 8]. HDL acts by enhancing the removal of cholesterol from the peripheral tissues and so reduces the body's cholesterol pool. Type 2 diabetes mellitus was usually associated with low plasma levels of HDL-C [23]. Low HDL-C concentrations are often accompanied by elevated TG levels as seen in this study and others [24, 25], and this combination has been strongly associated with an increase in risk of coronary heart disease (CHD) [26-29]. The relative insulin deficiency that occurs in type 2 diabetes impairs the action of lipoprotein lipase and results in lower HDL-C levels and higher TG levels, which may improve with improved glycemic control [30]. Thus, HDL hypocholesterolemia in type 2 diabetes patients is mainly due to insulin resistance-linked lipoprotein lipase deficiency [31].

Most diabetic patients as well as in our study do not have marked elevations in LDL-C (57%) but they do carry levels high enough to lead to atherosclerosis where high TG levels cause increased transfer of cholesteryl esters from HDL-C and LDL-C to very VLDL-C via cholesteryl ester transfer protein, thus forming cholesteryl ester depleted, small dense LDL-C particles [32]. These small dense lipoprotein particles are taken up by arterial wall macrophages, resulting in atherogenesis [33-35]. The results of this study give the lipid profile of type 2 diabetics in the Libyan population in Benghazi city, and can be used for advanced lipid profile research and intervention.

5. Conclusion

The high prevalence of lipid disorders in Libyan type 2 diabetics in Benghazi city in our study suggests that they might be playing a major role in the development of atherosclerosis in Libyan patients. Therefore, lipid profiling of all patients with type 2 diabetes mellitus should be a routine test. All patients with type 2 diabetes must be started on primary prevention by health education, aggressive lifestyle changes, such as weight reduction and physical exercise and use of lipid-lowering drugs should go hand-in-hand with antidiabetic drugs to reduce the risk of CHD and atherosclerosis.

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