

Study of fasting blood glucose, glycated hemoglobin and lipid profile in male and female type 2 diabetic patients

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ABSTRACT

Background: Lipid abnormalities are more common in type 2 diabetes mellitus and are aggravated with poor glycaemic control. Lipid abnormalities play an important role in atherosclerosis, a leading cause of mortality in patients with diabetes mellitus. Thus there is a need to evaluate lipid profile and glycaemic status in type 2 diabetes mellitus population and determine the major lipid risk factors for coronary artery disease. Present study focuses on the dyslipidemic pattern and glycaemic status of male and female with type 2 diabetes mellitus.

Methods: Total 270 patients with type 2 diabetes, age 30-60 years, both gender were included for this cross-sectional study which was carried out from January 2019 to December 2019 at Bogura Diabetic Hospital, Bogura. A Structured questionnaire was prepared for each study subject after taking informed written consent. Detail personal, medical, family and socioeconomic history of study subjects were collected through history taking and review of clinical and biochemical records from the participants. Diabetic patients were diagnosed depending on history, clinical features and American Diabetes Association (ADA) criteria (2018). Fasting blood glucose, glycaemic haemoglobin (HbA1c), fasting lipid profile were estimated in all study subjects by standard laboratory methods. Appropriate statistical tests were done.

Results: Type 2 male diabetes mellitus participants showed mean fasting blood glucose, HbA1c, total cholesterol, triglyceride and low density lipoprotein cholesterol and high density lipoprotein cholesterol were 8.64 ± 3.38 (mmol/L), 7.86 ± 2.36 (%), 233.09 ± 73.71 , 198.19 ± 61.38 , 152.98 ± 57.33 and 40.41 ± 5.44 (mg/dl) respectively. In case of female patients, fasting blood glucose, HbA1c, total cholesterol, triglyceride and low density lipoprotein cholesterol and high density lipoprotein cholesterol 8.59 ± 3.62 (mmol/L), 7.88 ± 2.496 (%), 215.899 ± 83.01 , 186.18 ± 67.595 , 139.10 ± 65.59 and 40.28 ± 5.66 mg/dl respectively. There were statistically significant difference ($p < 0.05$) of fasting blood glucose, fasting blood glucose, total cholesterol, triglyceride and low density lipoprotein cholesterol between male and female type 2 diabetic patients.

Conclusion: Our study had shown that total cholesterol, triglycerides, and low-density lipoprotein levels were significantly increased in male type 2 diabetes mellitus patients, compared with female type 2 diabetes mellitus patients, while high-density lipoprotein had shown a statistically non-significant difference. This study demonstrated the existence of dyslipidemia in male diabetic population than female which is major risk factor for atherosclerosis and coronary artery disease.

Key words: dyslipidemia, lipid profile, HbA1c.

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INTRODUCTION

Diabetes mellitus (DM) is one of the most common metabolic disease globally and hence one of the most challenging health concerns in modern era.¹ Type 2 DM owes its rapid growth to cultural and social changes and urbanized lifestyle, dietary changes, reduced physical activity and other unhealthy lifestyle and behavioral patterns.^{2,3} The effects of hyperglycemia are broadly classified into macro-vascular complications and micro-vascular complications. The risk of development of Cardiovascular Disease (CVD) is more in people with T2DM compared to non-diabetic subjects. Dyslipidemia affects approximately 70% to 97% of people with

diabetes.⁴World Health Organization(WHO) in 2002 reported that dyslipidemia accounted for 18% of ischemic heart disease, 56% of stroke and over 4million deaths per year globally.⁵

Dyslipidemia and altered lipid metabolism is commonly seen in diabetes. Diabetic dyslipidemia is characterized by increased Low Density Lipoprotein Cholesterol (LDL-C), Very Low Density Lipoprotein Cholesterol (VLDL-C), Triglycerides (TG) concentrations and decreased High Density Lipoprotein Cholesterol (HDL-C) concentration in diabetes patients.⁶ Dyslipidemia associated with diabetes has more atherogenic effect than other types of dyslipidemia.⁷

The lipid abnormalities are prevalent in DM because insulin resistance or deficiency affects key enzymes and pathways in lipid metabolism.⁸ In particular, the following processes are affected: apolipoprotein production, regulation of lipoprotein lipase, action of cholesteryl ester, transfer proteins and hepatic and peripheral actions of insulin.^{9,10} This means that even normal lipid concentrations might be more atherogenic in diabetic than in nondiabetic people.^{11,12} This study has demonstrated the existence of dyslipidemia in male and female T2DM patients.

METHODS

This cross-sectional study was carried out from January 2019 to December 2019 at Bogura Diabetic Hospital, Bogura. Total 270 type 2 DM patients aged 30-60 years, were selected by purposive sampling technique from the outpatient department. The diagnosis of type 2 diabetes mellitus was based on World Health Organization (WHO) criteria. Current American Diabetes Association definitions and (Adult Treatment Panel III) ATP III guide lines were used to label patients as type 2 DM and to classify lipoprotein concentrations into different cardiovascular disease risk categories respectively.^{13,14} The values used to define low-, borderline-, and high-risk Low density lipoprotein cholesterol (LDL-C) were <100 mg/dl, 100-129 mg/dl, >130 mg/dl, respectively. For triglycerides (TAG), the cut-off points were <150 mg/dl and so on, 200-399 mg/dl and >400 mg/dl. For total cholesterol (TC) low, borderline, high were <150 mg/dl, 150-200 mg/dl, >200 mg/dl respectively. High-, borderline-, and low-risk categories for high density lipoprotein cholesterol (HDL-C) concentrations were defined

according to sex. For men, the cutoff points were <35 mg/dl, 35-45 mg/dl, and >45 mg/dl, respectively. For women, the cutoff points were <45 mg/dl, 45-55 mg/dl, and >55 mg/dl, respectively. American Diabetes Association (ADA) guidelines recommend TAG levels <150 mg/dl, LDL-C <100 mg/dl and an HDL-C level >45 mg/dl in men and >55 mg/dl in women.¹³

The patients with stress factor like trauma, infection, surgery, myocardial infarction, pregnancy, diabetic ketoacidosis, history of amputation were excluded from this study. A prescribed questionnaire sheet was used to record the information. The methods were explained to the patients and verbal as well as written consent was taken in a consent form. All necessary physical examination (Height, Weight, BMI, Blood pressure) of the patient were performed. Body weight was measured by weight machine & body height was measured by measuring tape. Blood pressure was measured by sphygmomanometer. At first 8ml blood sample was collected from each study subjects after an overnight fasting of 10-12 hours. From this blood sample, 2ml was delivered in a fluoride test tube for estimation of fasting plasma glucose and 3ml was delivered in a plain tube for serum lipid profile. Remaining 3ml blood sample was collected for HbA_{1c} in ethylene diamine tetra acetic acid (EDTA) tube. Data were analyzed by SPSS computer software version 20.0.

RESULTS

A total 270 T2DM patients were involved in the study, out of which 109 (40.4%) were female participants and 161 (59.6%) were male participants. Mean age of the participants included in the study was male 49.37 ± 6.1 and female 50.65 ± 7.28 years (Table I). Mean \pm SD of FBG and HbA_{1c} were 8.61 ± 3.47 mmol/L and 7.86 ± 2.41 % respectively. In overall participants the Mean \pm SD of TC, TG, LDL-C and HDL-C were 193.34 ± 64.11 , 147.37 ± 61.07 , 226.15 ± 77.91 and 40.36 ± 5.52 mg/dl respectively (Table II).

Comparison of lipid profile between male and female participants showed mean TC, TG and LDL-C concentrations higher in male type 2DM (233.09 ± 73.71 , 198.19 ± 61.38 and 152.98 ± 57.33 mg/dl respectively) than female type 2DM (215.899 ± 83.01 , 186.18 ± 67.595 and 139.10 ± 65.59 mg/dl respectively) and the difference were statistically significant in case of TC, TG and LDL-C ($p < 0.013$, 0.030 , and 0.038

respectively). HDL-C concentration was also higher in the males (40.41 ± 5.44 mg/dl) than females (40.28 ± 5.66 mg/dl) with T2DM but the difference was not statistically significant ($p < 0.144$) (Table II). Table III showed the Mean \pm SD of FBG, HbA1c, TC, TG, LDL-C and HDL-C according to age groups. In case of aged < 50 years patients ($n=126$) the FBG, HbA1c, TC, TG, LDL-C and HDL-C were 8.44 ± 3.68 , 7.795 ± 2.64 , 223.20 ± 81.88 , 191.895 ± 65.66 , 145.14 ± 63.76 and 40.49 ± 5.55 respectively, on the other hand those aged ≥ 50 years ($n=146$) the FBG, HbA1c, TC, TG, LDL-C and HDL-C were 8.83 ± 3.22 , 7.94 ± 2.13 , 229.52 ± 73.27 , 195.0 ± 62.52 , 149.93 ± 57.99 and 40.21 ± 5.50 respectively and the difference were statistically highly

significant ($p < 0.001$). Table IV showed the gender distribution according to their glycemic control and there was no significant difference.

Table I Gender distribution and age all study subjects

Gender	No of Patients (%)	Age ¹ (Mean \pm SD)
Male	161 (59.6%)	49.37 ± 6.1
Female	109 (40.4%)	50.65 ± 7.28
Total	270 (100%)	49.89 ± 6.63

Data were expressed as numbers (n) and percentage (%) in parentheses (percent).

¹Units expressed as years. SD=Standard Deviation

Table II Status of FBG, HbA1c and serum lipid profile in all subjects

Variables	Total (n=270)	Male (n=161)	Female (n=109)	p-value
Mean (\pm SD) FBG (mmol/L)	8.61 ± 3.47	8.64 ± 3.38	8.59 ± 3.62	0.008
Mean (\pm SD) HbA1c (%)	7.86 ± 2.41	7.86 ± 2.36	7.88 ± 2.496	0.192
Mean (\pm SD) TC (mg/dl)	226.15 ± 77.91	233.09 ± 73.71	215.899 ± 83.01	0.013
Mean (\pm SD) TG (mg/dl)	193.34 ± 64.11	198.19 ± 61.38	186.18 ± 67.595	0.030
Mean (\pm SD) LDL-C (mg/dl)	147.37 ± 61.07	152.98 ± 57.33	139.10 ± 65.59	0.038
Mean (\pm SD) HDL-C (mg/dl)	40.36 ± 5.52	40.41 ± 5.44	40.28 ± 5.66	0.144

FBG- Fasting blood glucose; TC- Total cholesterol; TG-Triglyceride; HDL-C: High density lipoprotein cholesterol; LDL-C: Low density lipoprotein cholesterol

Table III FBG, HbA1c and lipid profile in all subjects according to age group

Parameter	Age < 50 years (n=126)	Age ≥ 50 years (n=144)	P-value
FBG	8.44 ± 3.68	8.83 ± 3.22	0.001
HbA1c	7.795 ± 2.64	7.94 ± 2.13	0.001
Total Cholesterol	223.20 ± 81.88	229.52 ± 73.27	0.001
Triglyceride	191.895 ± 65.66	195.0 ± 62.52	0.001
LDL-C	145.14 ± 63.76	149.93 ± 57.99	0.001
HDL-C	40.49 ± 5.55	40.21 ± 5.50	0.008

Table IV Distribution of the study subjects on glycemic status

Gender	Adequate Glycemic Control		Poor glycemic control		Total		P-value
	(HbA1c $< 7\%$)		(HbA1c $\geq 7\%$)				
	n	%	n	%	n	%	
Male	63	54.8	98	63.2	161	59.9	0.162
Female	52	45.2	57	36.8	109	40.4	
Total	115	100.0	155	100.0	270	100.0	

DISCUSSION

One of the important target for diabetes management is to keep lipid profile within normal limit. Because abnormal lipid profile is common in diabetic patients and is an important predictor for metabolic disturbance.¹⁵ The lipid abnormalities are prevalent in DM because insulin resistance or deficiency affects key enzymes and pathways in lipid metabolism.¹⁶ The term diabetic dyslipidemia comprises a triad of raised triglycerides, reduced HDL-c and excess of small, dense LDL-C particles.

In the present study, we evaluated the pattern of lipid profile parameters in 270 diabetic patients and this study revealed that the respondents had increased TG, TC and LDL-C. The biochemical parameters showed significant ($p < 0.05$) relation compared between males and females except for the HbA1c and HDL-C, which were statistically not significant ($p > 0.05$) between the two groups. This was in agreement with Bello- Sani et al., and Rashastudies.^{17,18} This is attributed to insulin deficiency which results in faulty glucose utilization, causing hyperglycemia and mobilization of fatty acids from adipose tissue. The fatty acids from adipose tissue are mobilized for energy purpose and excess fatty acids are accumulated in liver, which are converted to triglyceride.¹⁹ LDL- C in diabetes was found to be significantly increased which is consistent with the findings of Bello- Sani et al.¹⁷ Hypercholesterolemia, hypertriglyceridemia, elevated LDL-C, and low HDL-C are generally accepted as strong risk factors for cardiovascular disease (CVD) and mortality.²⁰⁻²² A study done in India by Smith and Lall revealed that diabetic males had significantly higher level of cholesterol.²³ But in another study by Elham N and Flora MS had found, the influence of sex on lipid profile was not statistically significant.²⁴ Another study showed that South Asian men and women had lower total cholesterol and a higher proportion of them also had lower HDL.²⁵ LDL-C is a major risk factor for CVD, significant higher LDL-C value in male T2DM group indicates the higher risk of CVD in male compare to female with T2DM.²⁶

In patients with diabetes, many studies have clearly established that complications are mainly due to chronic hyperglycemia through several mechanisms: dyslipidemia, platelet activation, and altered endothelial metabolism.²⁷ Both lipid profile and diabetes have been

shown to be the important predictors for metabolic disturbances including dyslipidaemia, hypertension, cardiovascular diseases. Lipids play a vital role in the pathogenesis of DM.²⁸ Dyslipidemia as a metabolic abnormality is frequently associated with DM. Abnormalities in lipid metabolism have been reported in patients with DM accompanied by the risk of cardiovascular arteriosclerosis.²⁹ Therefore, improving glycaemic control might substantially reduce the risk of cardiovascular events in diabetic patients.

Lipid levels affected by glucose levels because metabolism of carbohydrates and lipid is interrelated to each other; because any disorder in metabolism of carbohydrate leads to a disorder in metabolism of lipid, so high concentration of TC, TG, LDL-C and a reduction in HDL-C levels lead to insulin resistance with or without hyperglycemia which is related to qualitative changes in the lipid profile.

Conclusion

Most of our patients had a combination of high TC, TG, LDL-C and a low HDL-C level which is the most common pattern of dyslipidemia found in this study found in male DM. Overall, a greater proportion of men are found dyslipidemic as compared to women. But there was no significant difference of HbA1c level between male and female type 2DM. Type 2 DM patients are usually dyslipidemic even if under good glycemic control. Laboratory evaluation of lipid profile along with HbA1c in DM patients aids in early medical intervention, to prevent or delay microvascular complications.

Authors' contribution: MSI designed the study, collected data, did literature search and drafted the manuscript. FAM performed analysis and edited manuscript. MK helped in data collection and reviewed manuscript. MAI was the overall supervisor of the study.

Conflicts of interest: Nothing to declare.

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