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Research Article

Pattern of Dyslipidemia in Type 2 Diabetic Patients attending Tertiary Care Centre of Nepal

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Received: September 14, 2019; **Published:** October 21, 2019

Abstract

Background: Dyslipidemia is a very common finding in patients with type 2 Diabetes Mellitus (DM) which strongly increases risk for the development of cardiovascular diseases. The aim of this study was to determine the pattern of dyslipidemia and establish correlation between lipid profile and glycemic parameters in type 2 diabetic patients attending tertiary care center of Chitwan, Nepal.

Methods: This is a hospital based cross-sectional study including 320 type 2 diabetic patients (Male = 160 and Female = 160) aged between 30-70 years visiting Chitwan Medical College Teaching Hospital (CMCTH) for their routine medical check-up. Informed consents were taken from all the patients enrolled in this study. Data were collected using pre-validated set of questionnaires and biochemical data were obtained from the laboratory analysis of the patient's blood samples. Statistical analysis was done with SPSS version 20.0.

Results: Glycemic parameters like Fasting blood sugar (FBS), postprandial blood sugar (PPBS) and glycated hemoglobin A1c (HbA1c) were significantly elevated. Dyslipidemia was evident with elevated total cholesterol (TC), triglyceride (TG), low density lipoprotein cholesterol (LDL-C), very low density lipoprotein cholesterol (VLDL-C) and lowered high density lipoprotein cholesterol (HDL-C) levels. The prevalence of dyslipidemia was 72.4% and the most common pattern of dyslipidemia was decreased HDL and hypertriglyceridemia. There was a direct and significant correlation of FBS, PPBS and HbA1c with TC, TG, LDL-C and VLDL-C while the correlation was just reverse with HDL-C.

Conclusion: Prevalence of dyslipidemia is very high among Nepalese type 2 diabetic patients which is a strong risk factor for the development of cardiovascular events. So, optimal glycemic control should be achieved in these patients to minimize morbidities and mortalities associated with diabetic dyslipidemia.

Keywords: *Type 2 Diabetes Mellitus; Dyslipidemia; Glycemic Control; HbA1c*

Abbreviations

DM: Diabetes Mellitus; FBS: Fasting Blood Sugar; PPBS: Postprandial Blood Sugar; HbA1c: Glycated Hemoglobin A1c; CMCTH: Chitwan Medical College Teaching Hospital; TC: Total Cholesterol; TG: Triglyceride; LDL-C: Low Density Lipoprotein Cholesterol; VLDL-C: Very Low Density Lipoprotein Cholesterol

Introduction

Diabetes mellitus (DM) is a chronic metabolic disorder resulting due to reduced insulin secretion, decreased glucose utilization, and increased glucose production [1]. Type 2 DM alone accounts for more than 90% of all diagnosed cases of adult diabetes worldwide. Type 2 DM frequently goes undiagnosed for many years because the hyperglycemia develops gradually and at earlier stages is often not severe enough for the patient to notice any of the classic symptoms of diabetes [1,2].

Individuals with type 2 DM do not need insulin treatment for survival either initially, or often throughout their lifetime. Nevertheless, such patients are at increased risk of developing macrovascular and microvascular complications [3,4]. Type 2 DM increases two to four fold risk for the development of cardiovascular disease (CVD) or stroke compared to the general population [5]. The glycated haemoglobin (HbA1c) is still considered as the gold standard in the assessment and monitoring of glycemic control in patients with type 2 DM [6]. Poor glycemic control characterized by elevated HbA1c levels further aggravates the risk of CVD in these patients. Diabetes has also been considered as one of the seven major controllable risk factors for CVD by American Heart Association [7].

The lipid abnormalities or dyslipidemia in type 2 diabetes has been attributed to insulin resistance and increased free fatty acid flux which is further aggravated by increased inflammatory adipokines [8]. It is characterized by the atherogenic triad of, low high density lipoprotein cholesterol (HDL-C) concentration, high plasma triglyceride (TG) concentration and increased concentration of small dense low density lipoprotein cholesterol (LDL-C) particles [9]. Dyslipidemia, an established and modifiable risk factor for CVD, is strikingly common in patients with type 2 DM, affecting almost 50% of this population [10]. The economic burden of dyslipidemia associated with type 2 DM in developing countries like Nepal is rapidly increasing. So, an early detection of dyslipidemia and optimal glycemic control is therefore warranted in type 2 DM to prevent coronary and peripheral vascular atherosclerosis. This study was an attempt to determine the various patterns of dyslipidemia in type 2 Nepalese diabetic patients and establish correlation between glycemic parameters and lipid profile.

Methods

This was a hospital based cross-sectional study conducted in the Department of Biochemistry, Chitwan Medical College Teaching Hospital (CMCTH), Bharatpur during December 2017 to November 2018 for a period of 1 year.

Study population

Altogether 320 patients (male = 160 and female = 160) with type 2 DM attending CMCTH for their routine medical check-up were enrolled in this study. World Health Organization (WHO) criteria were used for the diagnosis of DM [11]. Presence of type 2 DM was confirmed by patient's own medical records and their past or current laboratory test reports. Patients who are known to have type 2 DM and are under medication with either hypoglycemic agents or insulin are included in this study and those with chronic complications of type 2 DM, addictive habits, systemic illnesses and malignancies were excluded from this study. All data were collected from personal interviews using a pre-validated set of questionnaires.

Sample collection

Five ml of the venous blood in fasting state was collected with the help of a sterile 5 ml syringe from the antecubital vein of each of the consenting subjects and kept in (EDTA) vacutainer.

Biochemical analysis

Fasting blood sugar (FBS) was measured by glucose oxidase-peroxidase (GOD-POD) method [12]. Glycated hemoglobin (HbA1c) was estimated by Nycocard Reader [13]. Blood collected in plain test tube was allowed to clot at room temperature and the serum was carefully

separated. Serum lipids (TG, total cholesterol-TC, and HDL-C) were directly measured and the value of LDL-C was calculated using the Friedewald's formula [14]. All these parameters were analyzed using a fully automated chemistry analyzer (Siemens Advia Centuar 1800) and ready-to-use reagent kits according to the manufacturer's instructions (Siemens Diagnostics, Germany).

Ethical issues

The study was approved by the institutional ethical committee and informed consent was taken from all the patients.

Data analysis

The obtained data were analyzed using Statistical Package for Social Sciences (SPSS) for windows version 20.0. Quantitative data were expressed as mean and standard deviation (SD). Pearson's bivariate correlation analysis was used to show the correlation between blood sugar parameters and lipid profile. p value less than 0.05 was considered to be statistically significant.

Results

Table 1 shows the baseline and biochemical characteristics of the study subjects. The result showed no significant difference between age, BMI, WHR, SBP and DBP between male and female subjects included in this study. Biochemical parameters like FBS, PPBS, HbA1c and lipid profiles (TC, TG, HDL-C, LDL-C and VLDL-C) were also compared between male and female diabetic subjects. With the exception of TC, no statistically significant difference between male and female biochemical parameters were seen in this study.

Parameters	Male	Female	Mean values
Age	51.8 ± 9.0	52.55 ± 9.6	52.17 ± 9.2
Duration of DM (years)	7.89 ± 5.32	6.74 ± 5.08	7.31 ± 5.2
BMI (kg/m^2)	25.9 ± 3.0	25.8 ± 3.7	25.9 ± 3.3
WHR	0.91 ± 0.07	0.90 ± 0.06	0.90 ± 0.07
SBP (mmHg)	131.0 ± 8.5	130.1 ± 6.4	130.5 ± 7.6
DBP (mmHg)	85.0 ± 6.6	86.79 ± 4.8	85.9 ± 6.0
FBS (mg/dl)	139.7 ± 43.2	134.8 ± 36.4	137.25 ± 39.9
PPBS (mg/dl)	215.4 ± 57.2	212.2 ± 63.0	213.8 ± 59.6
HbA1c (%)	7.27 ± 1.2	7.21 ± 1.0	7.24 ± 1.1
TC* (mg/dl)	214.1 ± 28.5	197.0 ± 19.7	206.0 ± 26.0
TG (mg/dl)	188.9 ± 53.6	174.1 ± 31.9	181.9 ± 45.0
HDL-C (mg/dl)	45.63 ± 4.8	46.57 ± 6.6	46.1 ± 5.8
LDL-C* (mg/dl)	129.4 ± 27.7	116.6 ± 19.1	123.3 ± 24.7
VLDL-C (mg/dl)	38.0 ± 10.7	34.73 ± 6.3	36.5 ± 9.0

Table 1: *Demographic and biochemical characteristics of the study subjects.*

**significant difference between male and female, at the level of $p < 0.05$.*

Abbreviations: BMI: Body Mass Index; WHR: Waist Hip Ratio; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; FBS: Fasting Blood Sugar; PPBS: Postprandial Blood Sugar; TC: Total Cholesterol; TG: Triglyceride; HDL-C: High Density Lipoprotein Cholesterol; LDL-C: Low Density Lipoprotein Cholesterol; VLDL-C: Very Low Density Lipoprotein-Cholesterol.

The relationship between blood glucose parameters and lipid profile is shown in table 2. The result showed statistically significant positive correlation between FBS, PPBS and HbA1c with TC, TG, LDL-C and VLDL-C. In addition, there was an inverse relationship between HDL-C and all glucose parameters (FBS, PPBS and HbA1c). This showed that hyperglycemia is strongly associated with derangement of lipid metabolism.

Correlation between	TC	TG	HDL-C	LDL-C	VLDL-C
FBS	0.238**	0.326**	-0.146*	0.209**	0.309**
PPBS	0.228**	0.329**	-0.177*	0.271**	0.329**
HbA1c	0.269**	0.379**	-0.178*	0.295**	0.376**

Table 2: *Correlation between glycemic parameters and lipid profile.*

**Correlation is significant at the 0.05 level.*

***Correlation is significant at the 0.01 level.*

Majority of the diabetic patients have dyslipidemia with a prevalence of 72.40% (Figure 1). As recommended by American Diabetes Association (ADA) 2010, patients with one or more parameters, that is, TG, HDL-C, LDL-C, or TC outside the clinical targets were considered to have dyslipidemia [15]. The ADA guidelines recommend HDL-C level of 45 mg/dl in men and 55 mg/dl in women, an LDL -C level of < 100 mg/dl, and a TG level of < 150 mg/dl as clinical targets for lipids in type 2 DM. Figure 2 shows the pattern of dyslipidemia among the subjects. Reduced HDL-C constituted the highest single abnormality (33.1%) followed by hypertriglyceridemia in 31.8%, elevated LDL-C in 24.3% and hypercholesterolemia in 21.8%.

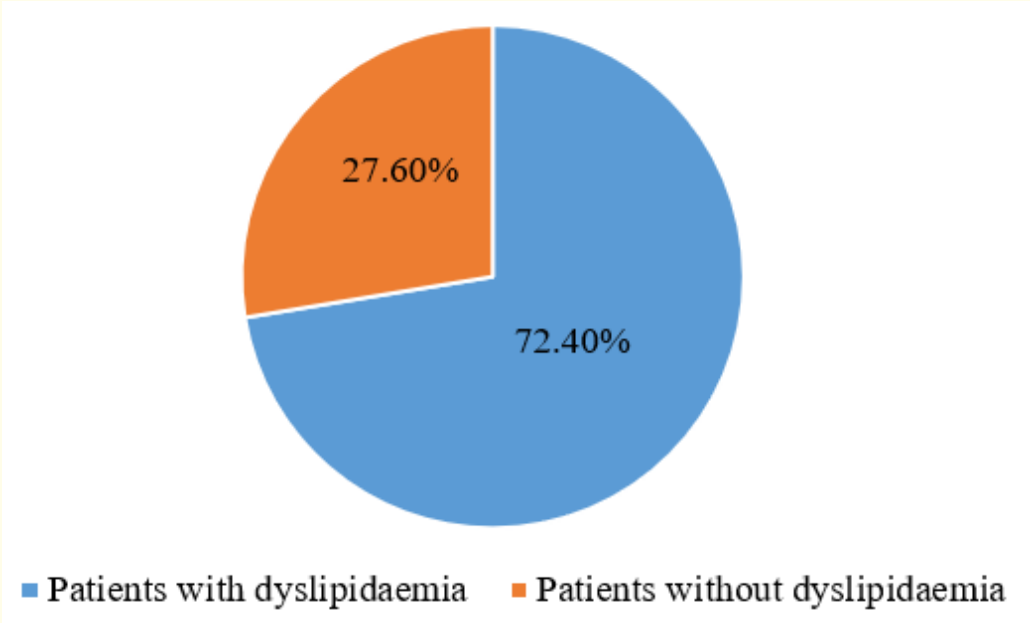

Figure 1: *Prevalence of dyslipidaemia in study subjects.*

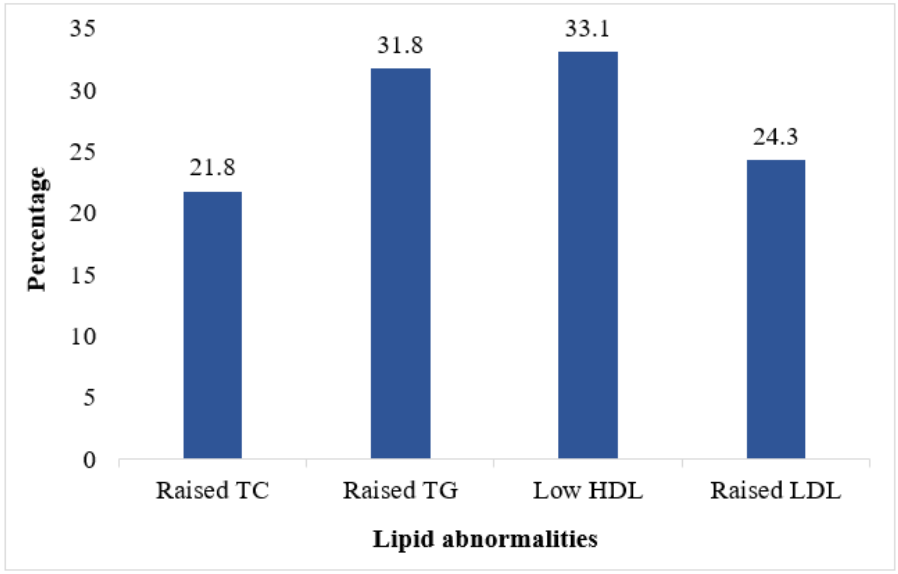

Figure 2: *Distribution of lipid profile outside clinical target among the subjects.*

Discussion

The present study aimed to determine the pattern of dyslipidemia and establish the correlation between glycemic parameters and lipid profile in Nepalese patients with type 2 DM. Baseline data did not differ significantly in type 2 diabetic male and female subjects (Table 1). All the glycemic parameters were markedly raised and dyslipidemia was prevalent in the subjects. There was even significant difference in the TC and LDL-C between male and female patients in this study (Table 1). This findings suggest that the pattern of dyslipidaemia could vary in male and female diabetic subjects.

Diabetes mellitus is characterized by chronic hyperglycemia. Constantly elevated blood glucose level results in glycation of common proteins including Hemoglobin forming glycated haemoglobin (HbA1c). Measurement of HbA1c provides the mean blood glucose of the past 8 - 12 weeks and is still considered as the gold standard test for the assessment of glycemic control in diabetic patients.

Dyslipidemia is simply defined as an abnormality in any one of the serum lipids or lipoproteins concentration. In the present study, we found 72.4% prevalence of dyslipidemia in type 2 diabetics (Figure 1). The most common pattern of dyslipidemia in this current study is decreased HDL-C and hypertriglyceridemia accounting 33.1% and 31.8% respectively. This pattern of lipid abnormality is also one of the most common pattern of dyslipidemia observed among type 2 diabetics worldwide. The glycemic parameters also showed significant positive correlation with TC, TG, LDL-C and VLDL-C while the correlation with HDL-C was just reverse.

Majority of people with type 2 DM have insulin resistance as primary defect. Many studies have shown that insulin affects the liver apolipoprotein production and regulates the enzymatic activity of lipoprotein lipase and cholesterol ester transport protein, which causes dyslipidemia in diabetes mellitus [16-18]. Hence insulin resistance is a key factor for the pathogenesis of type 2 DM and contributes to dyslipidemia [19]. Dyslipidemia as a metabolic abnormality is strongly linked with type 2 DM. Its prevalence is variable, depending on the type and severity of diabetes, glycaemic control, nutritional status, age and other factors.

Our findings in this study are concomitant with Khan., *et al.* who also reported a direct correlation between FBS and HbA1c with TC, TG and LDL-C and inverse correlation with HDL-C [20]. Mahato., *et al*. also observed significant correlation between HbA1c with TC, LDL-C and LDL-C/HDL-C ratio [21]. Ramona., *et al*. reported direct and significant correlation between HbA1c with TC, TG and LDL-C, and reverse correlation with HDL-C [22]. In our study, correlation of HbA1c with the lipid profile was even more compared to FBS and PPBS. This finding supports HbA1c is even better predictor of dyslipidemia and can be used as a potential biomarker for predicting dyslipidemia in type 2 diabetic patients.

Chronic hyperglycemia in type 2 DM associated with dyslipidemia, further increases two-four fold excess risk for the development of coronary heart disease. The highest priority for diabetic individuals who have poor glycaemic control should be to achieve near normal blood glucose levels, in the expectation that this approach will also improve dyslipidemia [17,23,24]. Our study clearly depicts that lipid fractions are abnormal in type 2 DM. Realizing that most of the diabetics have a high probability of developing cardiovascular and cerebrovascular disease, it is essential that an individual who is diabetic should take care of dyslipidemia. This is a hospital based study with small sample size and limited representation of Nepalese type 2 diabetics. Large extensive prospective study is therefore required to determine the prevalence of dyslipidemia and its pattern among Nepalese type 2 diabetic population.

Conclusion

Our study confirms, type 2 DM is strongly linked with dyslipidemia. For the optimal care of type 2 diabetic patients, frequent monitoring of lipid profile along with blood sugar is equally important to lessen the risk for development of CVD. HbA1c, being gold standard in the assessment of glycemic control together with its strong correlation with the lipid profile, makes it an ideal marker for predicting dyslipidemia in type 2 DM.

Acknowledgement

Authors express their sincere gratitude to the Department of Biochemistry, CMC, Bharatpur. We sincerely acknowledge the work of all the laboratory staffs of Biochemistry department, CMC.

Authors Contribution

LBS - Concept and design of the study, statistical analysis, helped manuscript preparation and critical revision of the manuscript. ST - Helped in standardization and statistical analysis and helped in preparing first draft of manuscript.

Source of Support

Nil.

Conflict of Interest

We declare that we have no conflict of interest.

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Volume 4 Issue 9 November 2019