



Original Article

Dyslipidemia in type 2 diabetes mellitus

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ABSTRACT

Background: In type 2 diabetes mellitus lipid abnormalities are very common and is associated with increased risk of cardiovascular diseases. This study was conducted to find association of type 2 diabetes and dyslipidemia.

Materials and Methods: This cross-sectional study was conducted at KIST medical college teaching hospital. All the necessary data of patient with type 2 diabetes in the period between December 2016 and May 2017 were studied.

Results: Out of 199 patients with diabetes mellitus 30.7% had total cholesterol >200 mg/dl, 64.4% had elevated low density lipoprotein, 53.77% patient had elevated triglyceride and 64% patients had low high density lipoprotein level. Cholesterol showed significant correlation with triglyceride ($P < 0.001$), low density lipoprotein ($P < 0.001$). Triglyceride showed a significant negative correlation with high density lipoprotein ($P < 0.01$), while a highly significant positive correlation was observed with cholesterol and high density lipoprotein ($P < 0.001$).

Conclusion: Diabetes is associated with high incidence of dyslipidemia with elevated level of low density lipoprotein, cholesterol and triglyceride.

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INTRODUCTION

Type 2 Diabetes Mellitus (T2DM) is associated with a marked increased risk of cardiovascular diseases (CVD). Individuals with T2DM have an absolute risk of major coronary events similar to that of non diabetic individual with established coronary heart disease (CHD).¹ Furthermore, after an acute coronary event, diabetic subject develop congestive heart failure more frequently and have a higher mortality rate than non diabetic individual.^{2,3} A greater burden of risk factor is at least partly responsible for the increased risk of CHD in diabetes. Dyslipidemia is a well recognized and modifiable risk factor that should be identified early to institute aggressive cardiovascular preventive management.

In T2DM, lipid abnormalities are common. Typical findings

Table 1: Gender distribution and age of selected type-2 diabetes patient

Age group (yrs)	Male (n)	Female (n)	Total (%)
25-35	13	13	26 (13.06)
36-45	30	25	55 (27.63)
46-55	30	28	58 (29.14)
56-65	17	15	32 (16.08)
66-≥70	19	09	28 (14.07)
Total	109 (54.77%)	90(45.23%)	199 (100)

are elevation of total and VLDL cholesterol, triglyceride concentration, exaggerated postprandial lipidemia, lowering of HDL cholesterol and a predominance of small, dense LDL-C particles.⁴ Insulin resistance is often involved in this process.⁵

Hypertriglyceridemia has been associated with increased risk of coronary heart disease both in non diabetic and diabetic subjects.^{6,7} Remnants of triglyceride rich lipoproteins seem to be extremely atherogenic.⁸ Such dyslipidemia is related to life style factors such as diet and exercise.⁹ It also has association with metabolic syndrome.¹⁰ The Pro-atherogenic properties of small LDL particles may relate to their ability to penetrate the arterial wall and thereby making them more susceptible to oxidation, indirectly linked with coronary artery disease.^{11,12}

Coronary artery disease represents a wide spectrum of atherosclerosis and includes angina pectoris, unstable angina, non ST elevation myocardial infarction, heart failure, ST elevation myocardial infarction and sudden death to silent myocardial ischemia.¹³ Silent myocardial ischemia has a reported prevalence of 10-20% in diabetic population as compared to 1-4% in non diabetic population.¹⁴

This study was conducted to evaluate the fasting lipid profile pattern in T2DM patients attending KISTMCTH, Lalitpur, Nepal.

MATERIALS AND METHODS

This study was conducted in department of Medicine and department of Pathology of KIST Medical College and Teaching Hospital, Lalitpur. All the medical files of patients with type 2 diabetes in the period between December 2016 and May 2017 were studied. Patients with known diabetics taking oral hypoglycaemic agents or managed with diet or using insulin for the glycaemic control were included in the study. Permission from the institutional review committee was obtained.

Data like height, weight, blood glucose level, serum lipid profile which included total cholesterol, low density lipoprotein cholesterol (LDL-C), high density lipoprotein cholesterol (HDL-C) and Triglyceride (TG) were recorded whenever possible in the proforma. BMI was calculated as weight in kg divided by square of height in meter. BMI of <24.9kg/m² was considered normal, 25-29.9kg/m² as overweight and ≥30kg/m² as obese.¹⁵ Classification of different components of serum lipid (total cholesterol, LDL cholesterol, triglyceride and HDL cholesterol) was followed according to the recommendation of NCEP ATP III.¹⁶

RESULTS

During the study period, a total of 199 cases were found in the medical record department. Among these patients mean age was 50.35 years with youngest being 26 years and oldest being 76 years of age. Most of the patients with type 2 diabetes were in the age group 46-55yrs (29.14%) followed by 36-45yrs age group (27.63%). Most of the diabetic patients were male than female with male to female ratio of 1.21:1.

Weight and height were available in 100 patients of study population. Fifty per cent patients had normal BMI (<24.9) whereas 28 patients (28.0%) were overweight and 22 patients (22.0%) were obese. Blood glucose levels were recorded and mean blood glucose level was 222.01 mg/

Table 2: Blood glucose level at various age group

Age Group		Blood glucose (mg/dL)			Total	Mean blood glucose (mg/dL)
		<125	126-200	≥200		
25-35 years	F	4 (2.01%)	5 (2.51%)	4 (2.01%)	13 (6.53%)	142.5
	M	5 (2.51%)	7 (3.51%)	1(0.5%)	13 (6.53)	
36-45 years	F	3 (1.5%)	9 (4.52%)	13 (6.53%)	25 (12.56%)	268.2
	M	7 (3.51%)	11 (5.52%)	12 (6.03%)	30 (15.07%)	
46-55 years	F	6 (3.01%)	4 (2.01%)	18 (9.04%)	28 (14.07%)	233.3
	M	4 (2.01%)	9 (4.52%)	17 (8.54%)	30 (15.07%)	
56-65 years	F	3 (1.5%)	8 (4.02%)	4 (2.01%)	15 (7.53%)	193.1
	M	2 (1.0%)	8 (4.02%)	7 (3.51%)	17 (8.54%)	
≥66 years	F	3 (1.5%)	4 (2.01%)	2 (1.0%)	9 (4.52%)	217.8
	M	2 (1.0%)	7 (3.51%)	10 (5.02%)	19 (9.54%)	
Total		39 (19.59%)	72 (36.18%)	88 (44.22%)	199 (100%)	

Table 3: Total cholesterol level at various age groups in both sexes

Age Group		Total Cholesterol (mg/dL)			Total	Total Cholesterol (mg/dL)
		<125	126-200	≥200		
25-35 years	F	8 (4.02%)	0	5 (2.51%)	13 (6.53%)	192.65
	M	10 (5.02%)	2 (1.0%)	1(0.5%)	13 (6.53%)	
36-45 years	F	16 (8.04%)	6 (3.01%)	3 (1.5%)	25 (12.56%)	201.48
	M	22(11.04%)	6 (3.01%)	2 (1.0%)	30 (15.07%)	
46-55 years	F	13 (6.53%)	10 (5.02%)	5 (2.51%)	28 (14.07%)	178.42
	M	19 (9.54%)	9 (4.52%)	2 (1.0%)	30 (15.07%)	
56-65 years	F	12 (6.03%)	3 (1.5%)	0	15 (7.53%)	170.81
	M	14 (7.03%)	3 (1.5%)	0	17 (8.54%)	
≥66 years	F	9 (4.52%)	0	0	9 (4.52%)	173.87
	M	15 (7.53%)	4 (2.01%)	0	19 (9.54%)	
Total		138(69.3%)	43(21.6%)	18 (9.1%)	199 (100%)	

Table 4: Total LDL-C level of patients at various age group

Age Group		Low density lipoprotein (mg/dL)					Total	Mean LDL-C
		<100	100-129	130-159	160-189	≥190		
25-35 years	F	5 (2.51%)	3 (1.5%)	1(0.5%)	2 (1.0%)	2 (1.0%)	13 (6.53%)	129.21
	M	3 (1.5%)	4 (2.01%)	5 (2.51%)	0	1(0.5%)	13 (6.53%)	
36-45 years	F	7 (3.51%)	13 (6.53%)	3 (1.5%)	2 (1.0%)	1(0.5%)	25 (12.56%)	127.96
	M	9 (4.52%)	10 (5.02%)	6 (3.01%)	3 (1.5%)	3 (1.5%)	30 (15.07%)	
46-55 years	F	9 (4.52%)	9 (4.52%)	6 (3.01%)	4 (2.01%)	0	28 (14.07%)	120.00
	M	11 (5.52%)	8 (4.02%)	9 (4.52%)	2 (1.0%)	0	30 (15.07%)	
56-65 years	F	8 (4.02%)	4 (2.01%)	1(0.5%)	2 (1.0%)	0	15 (7.53%)	104.07
	M	9 (4.52%)	9 (4.52%)	2 (1.0%)	0	0	17 (8.54%)	
≥66 years	F	4 (2.01%)	4 (2.01%)	1(0.5%)	0	0	9 (4.52%)	112.47
	M	10 (5.02%)	3 (1.5%)	6 (3.01%)	0	0	19 (9.54%)	
Total		71 (35.6%)	64(32.1%)	40 (20.1%)	15 (7.53%)	7 (3.51%)	199 (100%)	

dL with minimum detected level was 102.0 mg/dL and maximum 588.0 mg/dL. Mean value of blood glucose level at different age group is tabulated in table 2. Uncontrolled blood glucose level (>200mg/dL) was detected in male (n=109, 54.7%) than in female (n=90, 45.3%). Similarly uncontrolled blood glucose level was observed in the 46-55 age group (n=35, 17.58%) followed by 36-45 age group (n=25, 12.56%).

Lipid profile was analysed among these patients with type 2 diabetes mellitus. Mean value of total cholesterol level at different age group is shown in table 3. Majority of the patients (n=138, 69.3%) had desirable cholesterol level. High level of total cholesterol (≥ 200 mg/dL) was seen male than in females. As the age increases total cholesterol was below 200 mg/dL in larger percentage than in younger age group. Only 5.01 % of age 55 years had total cholesterol level >200 mg/dL. Similarly highest mean cholesterol level was observed in the age group of 36-45 years (201.48 mg/dL). Approximately 36 percent of the patients were found to have optimal level of serum LDL cholesterol; 32.1 % had near optimal/ above optimal level of serum LDL cholesterol; 20.1% had borderline high; 7.53% had high

LDL cholesterol level where as 3.51 % had very high level of serum LDL cholesterol. (Table 4) Mean LDL-C was highest in 25-35 years age group (129.21mg/dL) and lowest in 55-65 years age group (104.07 mg/dL).

Most of the patients had normal serum TG level (n=92, 46.23%); 56 (28.14%) had borderline high serum TG level; 45 (22.61%) had a high serum TG levels where as 6 (3.01%) had very high level of serum Triglyceride. (Table 5) Extremely high level of triglyceride level was observed in male younger than 45 years of age. Mean triglyceride level was highest at the age group of 36-45 years (267.28 mg/dL) and normal level was observed in the patient older than 55 year of age. HDL-C was lower than normal in 119 (64%) of the studied population. Ten patients had more than 60 mg/dl of HDL-C whereas 65 (33%) patients had normal level of HDL-C.

In correlation studies, cholesterol showed significant correlation with TG (P<0.001), LDL-C (P<0.001). Triglyceride showed a significant negative correlation with HDL-C (P<0.01), while a highly significant positive

Table 5: Triglyceride level of patients at various age group

Age Group		Triglyceride (mg/dl)				Total	Mean Triglyceride (mg/dL)
		<150	150-199	200-499	≥500		
25-35 years	F	6 (3.01%)	3 (1.5%)	4 (2.01%)	0	13 (6.53%)	275.07
	M	4 (2.01%)	1(0.5%)	5 (2.51%)	3 (1.5%)	13 (6.53%)	
36-45 years	F	17 (8.54%)	6 (3.01%)	2 (1.0%)	0	25 (12.56%)	267.28
	M	7 (3.51%)	7 (3.51%)	13 (6.53%)	3 (1.5%)	30 (15.07%)	
46-55 years	F	13 (6.53%)	12 (6.03%)	3 (1.5%)	0	28 (14.07%)	237.84
	M	9 (4.52%)	8 (4.02%)	13 (6.53%)	0	30 (15.07%)	
56-65 years	F	9 (4.52%)	3 (1.5%)	3 (1.5%)	0	15 (7.53%)	125.21
	M	11 (5.52%)	4 (2.01%)	2 (1.0%)	0	17 (8.54%)	
≥66 years	F	8 (4.02%)	1(0.5%)	0	0	9 (4.52%)	118.11
	M	8 (4.02%)	11 (5.52%)	0	0	19 (9.54%)	
Total		92 (46.23%)	56 (28.14%)	45 (22.61%)	6 (3.01%)	199 (100%)	

Table 5: Correlation studies between serum lipid profile variables of diabetic patients

	Cholesterol	HDL-C	LDL-C	Triglyceride
Cholesterol		.844	.001	<0.01
HDL-C	.844		.297	<0.01
LDL-C	<0.01	.297		<0.001
Triglyceride	<0.01	<0.01	<0.01	

***Correlation is significant at the 0.01 level (2-tailed).*

correlation was observed with Cholesterol and HDL-C ($P < 0.001$). However, HDL-C showed a negative correlation with LDL-C and Cholesterol and triglyceride ($P < 0.01$). (Table 6)

DISCUSSION

Lipid profile varies and is highly associated with diabetes mellitus and both are important parameters for dyslipidemia, hypertension, hyperinsulinemia and coronary artery disease. Accelerated coronary and peripheral vascular atherosclerosis is very common and serious chronic complications of long term diabetes mellitus. Along with other risk factors such as hypertension, smoking, obesity etc. increasing importance has been given to dyslipidemia in the causation of accelerated atherosclerosis.¹⁷ Dyslipidemia as a metabolic abnormality is frequently associated with diabetes mellitus. Its prevalence is variable depending on the type and severity of diabetes, glycaemic control, nutritional status, age and other factors. The most characteristic lipid abnormality in diabetics is hypertriglyceridemia and low HDL cholesterol with or without associated increased in serum total and LDL cholesterol.^{18,19}

In our study, the most common abnormality detected in T2DM elevated low density lipoprotein (64.4%) followed by low serum HDL cholesterol level (62%). The next common abnormalities being increase in serum TG level (53.7%) and hypercholesterolemia (30.7%). Fifty percent patients had normal BMI; 28% were overweight and 22%

of patients being overtly obese.

A study by Packard et al., reported that reduced HDL-C as a powerful predictor for premature coronary heart diseases.²⁰ According to Goldberg HDL-C is converted to VLDL-C particles, and denser LDL particles acquire a large proportion of these HDL esters. This process decreases the HDL-C level.²¹ Beside, HDL-C is a ready substrate for hepatic lipase which converts it into smaller particles, which are readily cleared from the plasma.^{15,22} As with the triglycerides, improvement in glycaemic control leads to an increase in the levels of HDL-C, and suggest the evidence for a role for poor glycaemia in decreasing the level of this lipoproteins.

In our study hypertriglyceridaemia was quite common, seen in 53.7% among study population. Body Mass Index was increased in almost half of the patients. Other researchers also associated the high triglyceride level to the poor glycaemic control of diabetes and obesity.^{15,23} Decrease of TG level has been observed with improvement in glycemic control. Abbate and Brunzell reported that the increase in triglycerides in poorly controlled patients was related to the decrease of activities of adipose tissue and muscle lipoprotein lipase activity.²⁴

Epidemiological study has shown evidence for relationship of serum lipid profile with the CAD risk. In Multiple Risk Factor Intervention Trial (MRFIT), CAD risk declined with progressive lower serum cholesterol level.²⁵ Further supportive relationship between CAD risk and dyslipidemia comes from various recent primary and secondary prevention trials with lipid lowering therapy, for example, the HEART PROTECTION STUDY (HPS)²⁶ has shown that lipid lowering with statin therapy is efficacious in patients with diabetes to reduce the risk of CAD. Similarly, the Pravastatin or Atorvastatin Evaluation and Infection-Thrombolysis in Myocardial Infarction²² (PROVE IT) trial has demonstrated that intensive LDL cholesterol lowering will reduce the major coronary events.²⁷ The NCEP ATP III guidelines recommend a LDL cholesterol goal of $< 100\text{mg/}$

dl in Type 2 Diabetic patients.²⁸ However, on the basis of recent landmark studies, the recommendation for the optimal goal is <70mg/dl, whereas <100mg/dl is considered as minimal goal for therapy.^{29,30} Recent other trials, nonetheless, indicate that for every 1.0% reduction in LDL cholesterol levels, the relative risk for major coronary events is reduced by 1.0% approx.^{31,32} Framingham study^{33,34} has demonstrated the correlation between low HDL cholesterol and CAD as an independent risk factor. Also the elevated TG level has recently become an independent predictor of CAD risk.³⁵⁻³⁷

CONCLUSION

The present study supports that diabetes is associated with higher incidence of dyslipidemia. This association may be the mechanism by which T2DM is associated with increased CAD risk. The presence of T2DM with any other risk factors is sufficient to consider an indication for lipid lowering therapy as a primary prophylaxis for CAD that includes both lifestyle modifications and statin therapy. The presence of both dyslipidemia and T2DM warrants a more intensive drug therapy in addition to lifestyle modification to achieve successfully the NCEPATP III recommendations.

Conflict of interest: None

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