



A Study of Diabetic Dyslipidemia at an Outpatient Clinic in Chennai City

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ABSTRACT

Background : Prevalence of diabetes has reached epidemic proportions. Dyslipidemia associated with this is one of the major risk factors for cardiovascular disease.

Objective : To assess dyslipidemia associated with diabetes at a private clinic in urban areas of Chennai city.

Methods : Patients attending a private clinic in Chennai were enrolled. Prevalence of diabetes was assessed by using fasting and postprandial blood sugar levels. Pattern of dyslipidemia was assessed in the diabetics using fasting lipid profile. Data was analyzed using appropriate statistical tests.

Results : Around 345 patients were enrolled in the study. Blood glucose data was available for 313 patients. 71 patients out of the enrolled patients suffered from diabetes. Total cholesterol was elevated in about 35% of patients, Low density lipoprotein-cholesterol (LDL-c) was higher than optimal in nearly half of the patients and serum High density lipoprotein-cholesterol (HDL-c) was optimal in only 15% of the patients, while very low density lipoprotein (VLDL) was elevated in 50% of the enrolled patients. Serum triglycerides were also elevated in 50% of the patients. Difference between males and females was not found to be statistically significant in any of the observed lipid parameters. Correlation between blood sugar and serum LDL-c was also found to be statistically insignificant.

Conclusion : Our results reveal high prevalence of hypercholesterolemia, hypertriglyceridemia, high LDL-c levels, high VLDL-c and low HDL-c, which are known risk factors for cardiovascular diseases.

KEYWORDS : Diabetes mellitus, Dyslipidemia, Cardiovascular risk.

Introduction

Diabetes is a growing epidemic in all parts of the world. About 62 million people diagnosed with diabetes currently live in India. Pattern of diabetes is related to geographic distribution in India. Prevalence of diabetes in rural India is about one-fourth as compared to urban India.^{1,2} The dramatic rise in prevalence of diabetes could be attributed to rapid lifestyle changes brought about by rapid urbanization in last 50 years.^{1,2} Potential burden imposed by diabetes makes the future of the country uncertain. For facilitation of life style changes, it is necessary to identify the factors affecting prevalence of the disease. There has been tremendous advance in the field of cardiovascular diseases. However, the prevalence of type 2 diabetes continues to increase and also there is parallel increase in associated dyslipidemia. About 70-80% of diabetics die because of cardiovascular diseases.³ Dyslipidemia is associated with increased cardiovascular mortality and it is one of the major risk factors of cardiovascular disease.⁴ Most patients of type 2 diabetics have dyslipidemia which is related to insulin resistance. Profile consistent with diabetic dyslipidemia is decreased high density lipoprotein (HDL), increased triglycerides, and increased low density lipoprotein (LDL). The LDL particles are more dense and small. Also increased are amounts of intermediate lipid particles like very low density lipoprotein (VLDL) and intermediate density lipoprotein (IDL).⁵ Result is an increase in non-HDL cholesterol which is associated with an even higher risk of cardiovascular diseases than increased LDL levels alone. Production of small dense LDL is increased by IDL and VLDL which is very atherogenic.¹⁰ Diabetic patients also exhibit increased levels of C-reactive protein and other inflammatory markers which promote thrombosis.⁶ Diabetes has also been considered as a coronary heart disease equivalent.⁷ It has been suggested that high LDL/HDL ratio along with high triglyceride levels are highly atherogenic and are associated with high risk dyslipidemia.^{8,9} A simpler calculation of total cholesterol/HDL ratio has also been suggested. The national cholesterol education panel (NCEP) gave guidelines for treatment of dyslipidemia in adults in 2001⁷. The recommendations of the panel were as mentioned in table 1.

Table 1. National cholesterol education panel third adult treatment panel guidelines (NCEP ATP III) of recommended dyslipidemia goals for diabetics.⁷

Risk Category	LDL goal (mg/dl)	Level of LDL recommended for life style changes (mg/dl)	Level of LDL for considering drug therapy (mg/dl)
CHD or CHD equivalents (10 years risk >20%)	>100	<100	<130
1-2 risk factors (10 years risk <20%)	<130	>130	10 year risk 10-20% >130 10 year risk <10% >160
0-1 risk factors	<160	>160	>190

Hence, it is clear that management of dyslipidemia in diabetes is important and it should not be neglected. Studies on diabetes prevalence have been few throughout the India. Also, the studies are marred by heterogeneity of the study population in the country considering differences in cultures, socioeconomic status and ethnicity. Study on diabetic dyslipidemia will help in risk stratification and proper management of the patients. This may have an impact on morbidity and mortality in diabetic patients. The following study was conducted to know about pattern of dyslipidemia in diabetics at a private clinic in Chennai. This study also gave us an opportunity to compare the pattern of dyslipidemia with other studies.

Methods

The following study was conducted in out-patient set up in a private clinic in urban area of Chennai city. Patients of both genders were enrolled in the study. Patients attended the outpatient department of the private clinic. Thorough history about present illness, medications and concomitant illness was taken. After giving consent for the study, blood sample was analyzed at a laboratory for various parameters. Blood glucose i.e. fasting and postprandial levels were estimated, while in some patients random blood sugar (RBS) was estimated. As per WHO 2006 recommendations, patients having fasting blood glucose levels more than 126 mg/dl or postprandial levels higher than 200 mg/dl were diagnosed to be suffering diabetes, while those

having fasting blood glucose less than 126 mg/dl and postprandial blood glucose between 110 mg/dl and 200 mg/dl were said to be having impaired glucose tolerance (table 1). A patient having apparent symptoms of diabetes and RBS value more than 200 mg/dl was also diagnosed to be suffering from diabetes. Fasting blood sample was taken to study lipid profile in the enrolled patients. Parameters recorded were total cholesterol, low density lipoprotein cholesterol (LDL-c), high density lipoprotein cholesterol (HDL-c), and very low density lipoprotein cholesterol (VLDL-c) and serum triglycerides. Level of non-HDL-c was also assessed from the obtained data. All the parameters were recorded in Microsoft excel worksheet version 2007. Unpaired *t* test was used for intergroup comparisons while qualitative was compared using Fisher's exact test. Graph pad demo version 3.0 was used for detailed analysis of the obtained data.

Results

Demographic details

A total of 345 patients were enrolled in the study. Out of the enrolled patients, about 161 were males and 184 were females. Mean age of the study population was 50.4 ± 19.8 years. Mean age of females was 47.9 ± 46.4 years while mean age of the males was 51.9 ± 44.2 years.

Laboratory parameters

Blood glucose

Blood glucose values were available for 313 patients. Out of 313 patients, data was available for 159 females and 154 males. Remaining 32 patients were excluded from further analysis. Mean fasting glucose level was found to be 107 ± 48 mg/dl while mean postprandial glucose levels was 159 ± 74 mg/dl. In males, mean fasting blood sugar levels were found to be 113 ± 65 mg/dl, while mean postprandial blood sugar level was found to be 174 ± 44 mg/dl. In females, mean fasting blood sugar value was 105 ± 48 mg/dl while, mean postprandial level was 154 ± 49 mg/dl. No statistical difference was found between the two genders, neither for fasting blood glucose nor for postprandial blood glucose levels.

Out of 313 patients analyzed further (table 2), blood sugar level was found to be elevated in 71 patients i.e. about 22 percent of the enrolled patients were found to be suffering from diabetes. Out of the 71 diabetic patients, 39 were males and 32 were females. Higher numbers of males were found to be suffering from diabetes as compared to females. Out of the enrolled males percentage of diabetic males was 25 percent while percentage of diabetic females was 20. Percentage prevalence was also high among males in our study as compared to females. However, the difference in diabetes prevalence was not statistically significant on comparing the two genders. Mean age of patients diagnosed with diabetes was 50.56 years, which was comparable in males and females (51.6 vs. 50.2 years). Majority of diabetics belonged to age group of 31-60 years.

Table 2. Demographic details and blood glucose characteristics of the enrolled patients

Parameter	Males	Females	Total
Number of enrolled patients	154	159	313
Mean fasting blood glucose levels (Mean \pm SD)	113 ± 65 mg/dl	105 ± 48 mg/dl	107 ± 48 mg/dl
Mean postprandial blood glucose levels (Mean \pm SD)	174 ± 44 mg/dl	154 ± 49 mg/dl	159 ± 74 mg/dl
Number of diabetic patients	39	32	71
Percentage of diabetic patients (Approx)	25	20	22
Mean age of diabetic patients	50.56	51.6	50.2

Lipid Profile

Fasting blood was collected for lipid profiling in all the patients diagnosed to be suffering from diabetes. Parameters recorded were total cholesterol, low density lipoprotein cholesterol (LDL-c), high density lipoprotein cholesterol (HDL-c), very low density lipoprotein cholesterol (VLDL-c) and serum triglycerides (table 3). Mean total cholesterol level was 179.09 ± 38.8 mg/dl, mean HDL-c level was found to be 38.29 ± 7.5 mg/dl, mean LDL-c was 106.39 ± 32.1 mg/dl, mean VLDL-c was 35.19 ± 17.9 mg/dl and mean triglyceride level was

169.46 ± 84.06 mg/dl.

Table 3. Lipid profile of the enrolled patients

Parameter	Value (mg/dl) (Mean \pm SD)
Mean total cholesterol	179.09 ± 38.8
Mean LDL-c	106.39 ± 32.1
Mean HDL-c	38.29 ± 7.5
Mean VLDL-c	35.19 ± 17.9
Mean total cholesterol	169.46 ± 84.06

Optimal value of total cholesterol is less than 200 mg/dl. This was found to be elevated in 25 out of 71 diabetics. Since serum LDL levels are used for risk stratification, further analysis of serum LDL was done. It has been recommended that near optimal concentration of serum LDL is less than 100 mg/dl in diabetics. As mentioned above mean LDL value was 106 mg/dl. It was found that 32 patients had LDL level lower than 100 mg/dl, 19 patients had LDL level between 100 mg/dl and 130 mg/dl, while 20 patients had LDL level more than 130 mg/dl. LDL levels were found to be more than 160 mg/dl in 2 patients. Hence, about 39 patients had serum LDL levels higher than optimal. Also, as serum HDL levels confer negative risk, their levels were also assessed. Recommended levels of serum HDL levels is >40 mg/dl in males and >50 mg/dl females. In only 8 males the level of HDL was found to be more than 40 mg/dl and in only 4 females this level was more than 50 mg/dl. On comparing mean LDL and HDL values between the two genders, the difference was not statistically significant. Acceptable value of serum VLDL value is 15-30 mg/dl. Analysis of our data showed that serum VLDL was higher than optimal in 37 patients. Diabetes is also associated with elevated levels of serum triglycerides. Optimal value of serum triglycerides is between 50-150 mg/dl. In 37 individuals serum triglycerides were elevated i.e. the value was more than 150 mg/dl. On comparing mean triglyceride values between males and females, result was not statistically significant ($p > 0.05$).

Correlation between blood sugar levels and serum LDL levels

Correlation between blood sugar levels and serum LDL levels was assessed using Pearson's correlation coefficient. Both fasting as well as postprandial blood sugar levels were compared with LDL levels. On comparing fasting blood sugar levels with serum LDL levels, the correlation coefficient was found to be -0.03 which was not significant ($r^2 = 0.0013$). Similarly, on correlating postprandial blood sugar levels with LDL the correlation coefficient was found to be -0.18, which was not significant ($r^2 = 0.036$).

Assessment of total cholesterol/HDL ratio

Since, high total cholesterol/HDL ratio is associated with high risk of cardiovascular events, this ratio was also assessed. Total cholesterol/HDL ratio of more than 5 is associated with high risk of cardiovascular events. Assessment of Total cholesterol/HDL ratio showed that this value was more than 5 in 40 out of the enrolled 71 patients.

Discussion

Diabetes is a non-communicable disease caused by absolute or relative deficiency of insulin. It is a non-communicable disease which has assumed epidemic proportions. Prevalence of the disease is increasing day by day. Associated with diabetes is dyslipidemia which is characterized by hypercholesterolemia, hypertriglyceridemia, elevated non-HDL cholesterol (LDL and VLDL) and high total cholesterol/HDL ratio. There has been a lot of discussion over relationship between dyslipidemia and diabetes over the decades.^{8,10-12} Diabetes and lipid profile are important predictors of metabolic disturbances like dyslipidemia, hypertension, and hyperinsulinemia⁹. Prevalence of dyslipidemia in diabetes depend on the type and severity of diabetes, glycemic control, nutritional status, age and other factors. Previous studies have shown that about 70% of patients with type 2 diabetes mellitus may have one or more types of dyslipidemia^{13,14}. Our study was conducted at a private clinic in Chennai city to know about diabetes prevalence. Our study enrolled 345 patients; blood sugar values were available for 313 patients. Blood sugar was found to be elevated in 71 patients i.e. they were in the diabetic range. Out of 71 diabetics 39 were males and 32 were females. Prevalence of diabetes in males was about 25%, while prevalence in females was around 20%. Overall prevalence of diabetes in our study was 22%. Lipid profile analysis of the enrolled patients revealed that total cholesterol was elevated in

about 35% of patients, LDL-c was higher than optimal in nearly half of the patients, and serum HDL-c was optimal in only 15% of the patients, while VLDL was elevated in 50% of the enrolled patients. Serum triglycerides were also elevated in 50% of the patients. Difference between males and females was not found to be statistically significant in any of the observed lipid parameters. Correlation between blood sugar and serum LDL-c was also found to be statistically insignificant. Total cholesterol/HDL ratio was at risk levels in about 55% of the enrolled patients. Our results reveal high prevalence of hypercholesterolemia, hypertriglyceridemia, high LDL-c levels, high VLDL-c and low HDL-c, which are known risk factors for cardiovascular diseases. These patients already have significant dyslipidemia, which increases the risk of cardiovascular events, requiring a certain therapeutic intervention.

Due to interlinked metabolic pathways of carbohydrate and lipid metabolism, the disorder in any one of the pathways may affect the other. In diabetes, as there is disorder in carbohydrate pathway, lipid pathway is bound to be affected.¹⁵ Several studies have shown that dyslipidemia in diabetes may be caused by lack of insulin, as insulin affects apolipoprotein production in liver and also regulates the enzymatic activity of lipoprotein lipase and cholesterol ester transport protein. Moreover, activity of hepatic lipase is reduced due to insulin deficiency and several steps in the production of biologically active lipoprotein lipase may also be affected.^{8, 10, 16}

The results in our study are in agreement with Pandya et al, where a similar prevalence of hypertriglyceridemia and low levels of LDL were reported. However, low HDL was seen in considerably low number of people as compared to ours (35% vs 85%). This may be due to ethnic differences in the study population.¹⁷ However, our results are in accordance with Indian Council of Medical Research-India Diabetes (ICMR-INDIAB) study, where prevalence of low HDL was similar to our study.¹⁸ Similar rates as of our study were observed in a study conducted in Jordan, with a prevalence of 48.8% of hypercholesterolemia, 43.6% of hypertriglyceridemia, 40.1% of low HDL-C and 40.7% of high LDL-c.¹⁹ Our study shows that most of the lipid fractions are abnormal in diabetes mellitus. As most diabetics have a high probability of developing cardiovascular and cerebrovascular disease, it is essential that in a diabetic, dyslipidemia should be managed properly.

Conclusion

Diabetes, a non-communicable disease, has assumed epidemic proportions. Prevalence of the disease is increasing at an alarming rate and it is one of the most important health problems of today. Our study was conducted at a private clinic in Chennai city to study diabetes prevalence. Steps need to be taken to stop or decrease this steep rise in disease prevalence. Our results reveal high prevalence of hypercholesterolemia, hypertriglyceridemia, high LDL-c levels, high VLDL-c and low HDL-c, which are known risk factors for cardiovascular diseases. These patients already have significant dyslipidemia, which increases the risk of cardiovascular events, requiring a certain therapeutic intervention. Various health programs need to be started by the government to increase awareness in the general population about the disease. Lifestyle interventions need to be implemented early to inculcate healthy lifestyle measure starting from small children. Sample size of our study was small and keeping this limitation in mind we need to confirm the results in large scale population based study. Due to common occurrence of dyslipidemia in diabetes, management of dyslipidemia should go hand in hand with management of blood glucose. Steps like aggressive lifestyle changes, such as weight reduction and physical exercise should be initiated first followed by medications with lipid lowering drugs.

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