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Original Research Article

Comparison of lipid levels in the diabetic and non diabetic patients: a study in a tertiary care hospital

Vydehi Veeramalla[1], Swetha Madas[2]*

[1]Department of Biochemistry, Anupama Hospital, KPHB Colony, Kukutpalli, Hyderabad, Telangana, India
[2]Department of TB and Chest, RVM Institute of Medical Sciences and Research Centre, Hyderabad, Telangana, India

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***Correspondence:**
Dr. Swetha Madas,
E-mail: swetha.madas@gmail.com

ABSTRACT

Background: The incidence of coronary artery diseases is 3 to 5 times higher in both male and female diabetic patients compared to general population. Individuals with diabetes may have several forms of dyslipidemia leading to additive cardiovascular risk of hyperglycemia. This study was therefore conducted to identify the levels of lipidemia in the diabetic patients in our area.
Methods: This study was conducted on 100 diabetic and 100 healthy patients, with 50 patients were males and 50 were females in both groups. Blood was collected in sodium fluoride tubes for all the patients for the estimation of glucose (both fasting and post prandial) and in serum tubes for lipids such as Triglycerides, Total cholesterol, High density cholesterol, Low density cholesterol and Very low density cholesterol.
Results: The total cholesterol among the males who were diabetic was in the normal range in 46% and high in 20% of the patients. Among the control, i.e. non diabetic patients, 76% of them had total cholesterol in the normal range and high cholesterol levels were observed in only 8% of them. The levels of triglycerides, total cholesterol and LDL were significantly higher in the patients with diabetes, compared to the non diabetic patients. HDL in these patients was significantly low.
Conclusions: The incidence of raised lipid levels in the diabetic patients is very high and since the elevated levels of lipids especially in these patients can lead to CHD and its complications, it is important for the monitoring of these levels throughout the course of the disease.

Keywords: Coronary heart disease, Diabetes, Elevated lipid levels

INTRODUCTION

Diabetes mellitus is a common metabolic disorder characterized by absolute or relative deficiencies in insulin secretion and/or insulin action associated with chronic hyperglycemia and disturbances of carbohydrate, lipid and protein metabolism. Though it was first described by Aretacus of Alexandria in the second century A.D., only in the last few decades new discoveries have provided great hopes to minimize morbidity and mortality. The diabetic ketoacidosis was major fatal complication of diabetes has virtually come down with advent of insulin.

The most important vascular complication among diabetics is coronary artery disease. Diabetes is associated with a marked increase by a factor of two to four times increased risk of coronary artery disease.

The relationship between alteration of serum lipids and vascular complications is more significant in diabetics than in the general population.[1]

Type 2 diabetes is said to be associated with a cluster of interrelated plasma lipid and lipoprotein abnormalities, including reduced HDL cholesterol and elevated triglycerides.[2] These abnormalities are seen in many patients in spite of normal LDL cholesterol levels. These changes are also seen in the insulin resistance syndrome which underlies in many cases of type 2 diabetes. The pre-diabetic individuals often exhibit an atherogenic pattern of risk factors that includes higher levels of total cholesterol, LDL cholesterol, and triglycerides and lower levels of HDL cholesterol than individuals who do not develop diabetes.[3,4] Insulin resistance has striking effects on lipoprotein particle concentrations for VLDL, LDL, and HDL.[5,6] The high risk status of these groups of patients and their need for more aggressive lipid lowering therapy have been recognized by both the National Cholesterol Education Program and American Diabetes Associations.[7,8]

In 2000, diabetes mellitus was the third leading cause of mortality in some parts of the world, accounting for approximately 10% of all deaths, especially in those aged between 45–64 years. The number of diabetic patients in the world has been estimated more than 175 million. Diabetes mellitus is ranked 7th among leading causes of death & has been rated 3rd when all its fatal complications are taken in to account.[9] Indians have genetic phenotype characterized by low body mass index, but with high upper body adiposity, high body fat percentage and high level of insulin resistance. With a high genetic predisposition and the high susceptibility to the environmental insults, the Indian population faces a high risk of diabetes and its associated complications.[10]

Serum triglycerides, Very Low Density Lipoproteins (VLDL), cholesterol are raised in uncontrolled diabetes, both at fasting as well as post meal. In case of post meal Chylomicrons remnants and Low Density Lipoproteins (LDL) remain high for longer period than normal. Total cholesterol and Low Density Lipoproteins (LDL) are usually mild to moderately high in about one-third of the patients while HDL remain significantly low especially in patients with type-2 diabetes. Among the changes seen in the composition of Lipoproteins, high proportion of small, dense triglyceride rich LDL and glycoxidation products of LDL are considered to be most atherogenic. The incidence of coronary artery diseases is 3 to 5 times higher in both male and female diabetic patients compared to general population. Individuals with diabetes may have several forms of dyslipidemia leading to additive cardiovascular risk of hyperglycemia. So, lipid abnormalities should be aggressively detected and treated as a part of comprehensive diabetic care.[11.12] This study was therefore conducted to identify the levels of lipidemia in the diabetic patients in our area.

METHODS

This study was conducted by the department of biochemistry at Anupama hospital from March-2016 to July-2017 on 100 diabetic and 100 healthy patients, who attended the outpatient as well as inpatient wards of our hospital. In both the groups, 50 patients were males and 50 were females.

All the patients were selected randomly. The nature of the study was thoroughly explained to the patients as well as the relatives and the informed consent was obtained. The patient details including the height, weight and body mass index were carefully noted.

Every patient was advised for at least 12-14 hours overnight fasting and the 5ml venous fasting blood sample were collected the next morning before breakfast for the serum lipid profile and fasting blood sugar. Venous sample was collected once again 2 hours after breakfast for post parandial glucose result.

3ml of blood was collected in serum tubes (red cap) and 2ml into sodium fluoride tubes (grey cap) for all the patients for the estimation of lipids and glucose respectively. Blood glucose estimation was done by GOD/POD method. Glucose is oxidized by the enzyme glucose oxidase (GOD) to give D- gluconic acid and hydrogen peroxide. Hydrogen peroxide in presence of the enzyme peroxidase (POD) oxidizes phenol which combines with 40aminoantipyrine to produce a red colored quinoneinine dye. The intensity of the color developed is proportional to glucose concentration in the sample. The normal range was taken as 70 – 110 mg% for fasting plasma glucose. This method is linear up to 500mg%. Samples exceeding 500mg% should be diluted and retested. The result has to be multiplied by the dilution factor.

Cholesterol is a fatty substance found in blood, bile and brain tissue, and it is mainly found in esterified form. It serves as a precursor of bile acids, steroids and vitamin D. the determination of serum cholesterol is a major aid in the diagnosis and classification of lipemias. Other conditions such as hepatic and thyroid diseases influence cholesterol levels. Total cholesterol was measured by the cholesterol oxides and peroxidase method. The values were considered to be desirable if they were up to 200 mg/dl (5.2mmol/L), Borderline high in case of 200 – 239 mg/dl (5.2 – 6.2 mmol/L), and they were considered high of the values were > 240 mg/dl (6.2 mmol/L).

Triglycerides were measured by the GPO-Trinder method where the intensity of redcoloured complex formed during the reaction is directly proportional to the triglycerides concentration in the sample and is measured at 505nm. Normal range was if the values were < 150 mg/dl, 150 – 200 mg/dl was borderline high, 200 – 500 mg/dl was high and ≥ 500 mg/dl was very high.

HDL was estimated using phosphotungstate/ magnesium precipitation method. Phosphotungstate precipitates VLDL and LDL in the Presence of magnesium ions. The sample is then centrifuged, and cholesterol is measured in

the supernatant containing HDL. The determination of total and HDL serum cholesterol is a major aid in the diagnosis and classification of lipemias. Up to 35 mg/dl was considered as high and > 60 mg/dl was low.

LDL-cholesterol was calculated from FRIEDWALD formula i.e.

$$TCH - (HDL + TG/5)$$

VLDL cholesterol is equivalent to $1/5^{th}$ of plasma TG in a fasting state. The statistical analysis was done using SPSS software, version 13 with student t test for comparison.

RESULTS

The total cholesterol among the males who were diabetic was in the normal range in 46% and high in 20% of the patients.

Among the control, i.e. non diabetic patients, 76% of them had total cholesterol in the normal range and high cholesterol levels were observed in only 8% of them.

Among the women population, only32% of the diabetics and 74% of the non diabetics had total cholesterol in the normal range while 22% and 12% respectively had high levels.

There was a significant difference in the levels of triglycerides among the diabetic and the non diabetic patients. 58% of the males and 56% of the females had high triglyceride levels, while less than 20% of them in either case had in the normal range.

Low HDL levels were seen in 52% males and 58% females patients who were diabetics, while among the non diabetics, 26% males and 12% females had low HDL levels (Table 1).

Table 1: Lipid ranges among the diabetic and the non diabetic patients.

Parameter	Men		Women	
	Diabetics (n=50)	**Controls (n=50)**	**Diabetics (n=50)**	**Controls (n=50)**
Total Cholesterol (mg/dl)				
Normal range (<200)	23(46%)	38 (76%)	16 (32%)	37 (74%)
Borderline (200 -239)	17 (34%)	8(16%)	23 (46%)	7 (14%)
High (≥ 240)	10 (20%)	4 (8%)	11 (22%)	6 (12%)
Triglycerides (mg/dl)				
Normal range (<150)	9 (18%)	36 (72%)	10 (20%)	35 (70%)
Borderline (150 -199)	12 (30%)	9(18%)	12 (24%)	11(22%)
High (≥ 200)	29 (58%)	5 (10%)	28 (56%)	4 (8%)
HDL-C (mg/dl)				
Low (<40)	26 (52%)	13 (26%)	29 (58%)	6 (12%)
Borderline (40 - 59)	17 (34%)	16 (32%)	10 (20%)	13 (26%)
High (≥ 60)	7 (14%)	21 (42%)	11 (22%)	31 (62%)
LDL-C (mg/dl)				
Optimal (<100)	16 (32%)	26 (52%)	17 (34%)	42 (84%)
Borderline (100 - 159)	28 (54%)	17 (34%)	15 (30%)	4 (8%)
High (≥ 160)	6 (12%)	7 (14%)	18 (36%)	4 (8%)
VLDL-C (mg/dl)				
Optimal (2-30)	19 (38%)	42 (84%)	15(30%)	33(66%)
High (≥ 31)	31 (62%)	8 (16%)	35 (70%)	17(34%)

Patients in the age group of 30-40 years had a total cholesterol level of 182 ± 13.4, while those between 61-70 years had 245 ± 17.9 mg/dl.

High triglyceride levels were found in almost all the age groups, with 30-40 years being 179 ± 11.7 mg/dl, 41-50 years being 171 ± 11.3 mg/dl, 51-60 years being 197 ± 11.9 mg/dl and those between 61-70 years had 288 ± 21.2 mg/dl.

HDL levels were the highest in the 51-60 age groups, while in the 30-40 age group it was lowest. The male patients who were diabetic had a total cholesterol value of 231 ± 13.1 mg/dl, in comparison with 248 ± 16.3 mg/dl in females. The triglycerides levels were also higher in women (159 ± 14.5 mg/dl) when compared to the males (157 ± 11.4 mg/dl), so was the LDL levels, with 177 ± 12.4 mg/dl and 153 ± 10.9 mg/dl respectively (Table 3).

Table 2: Age related lipid profile changes among the patients.

Age (Yrs)	TCh(mg/dl) Mean±SD)		TGL(mg/dl) (Mean±SD)		HDL (mg/dl) (Mean±SD)		LDL (mg/dl) (Mean±SD)		VLDL(mg/dl) (Mean±SD)	
	Cases	Control	Cases	Control	Cases	Control	Cases	Control	Cases	Control
30 – 40	182 ± 13.4	181 ± 12.1	179 ± 11.7	132 ± 12.7	37 ± 5.4	39.2 ± 5.3	117 ± 9.3	94 ± 7.4	34 ± 3.1	14 ± 1.6
41 – 50	234 ± 11.7	144 ± 14.2	171 ± 11.3	123 ± 13.8	39 ± 4.3	45 ± 6.9	177 ± 14.4	109 ± 11.1	34 ± 4.2	23 ± 2.8
51 – 60	232 ± 12.7	186 ± 14.9	197 ± 11.9	109 ± 10.2	48 ± 5.9	47 ± 5.2	164 ± 13.2	122 ± 11.9	43 ± 6.1	29 ± 3.7
61 – 70	245 ± 17.9	159 ± 10.1	288 ± 21.2	110 ± 10.9	39 ± 5.5	35 ± 5.8	168 ± 12.9	109 ± 9.9	51 ± 5.5	31 ± 5.0
P value	<0.05	<0.05	<0.05	<0.05	<0.01	<0.01	<0.05	<0.05	<0.05	<0.05

Table 3: Lipid parameters among the diabetic males and females.

	TCh (mg/dl) (Mean+SD)	TGL (mg/dl) (Mean+SD)	HDL (mg/dl) (Mean+SD)	LDL (mg/dl) (Mean+SD)	VLDL(mg/dl) (Mean+SD)
Diabetic male	231 ± 13.1	157 ± 11.4	44 ± 6.7	153 ± 10.9	35.1 ± 3.9
Diabetic female	248 ± 16.3	159 ± 14.5	42 ± 6.2	177 ± 12.4	37.0 ±5.6
	P<0.05	P<0.05	P<0.05	P<0.05	P<0.05

DISCUSSION

Diabetic patients have 2 to 3 times increased risk of coronary artery disease as compared to the non diabetic. The causes for it are multiple, which include dyslipidemia, hypertension, obesity and smoking. Dyslipidemia which is usually present in diabetics in the form of increased triglycerides and decreased HDL cholesterol level. It confers much of accelerated and increased early risk of coronary artery disease (CAD), cerebrovascular disease, peripheral vascular disease and sudden cardiac death.

Patients with type 1 diabetes mellitus with very good glycemic control can have normal postprandial lipid levels. However, as glycemic control worsens because of inadequate insulin, lipoprotein lipase activity decreases, and postprandial hyperlipidemia can result. In patients with type 2 diabetes, the underlying insulin resistance can be associated with mild reductions in lipoprotein lipase, but overproduction of VLDL is a major problem. Increased VLDL competes with chylomicrons for lipoprotein lipase, resulting in postprandial hyperlipidemia in most patients with type 2 diabetes. The fasting triglyceride level is, therefore, a predictor of the severity of postprandial hyperlipidemia. Disordered metabolism of VLDL and/or chylomicrons may be proatherogenic. Chylomicron remnants and VLDL or its remnants enter the sub-endothelial space of the vessel wall where the atherogenic process is initiated. The cholesterol content of the triglyceride-rich lipoproteins is important, because persons with more cholesterol-enriched particles will be at greater risk for atherosclerotic cardiovascular disease. The plasma concentration of very-low-density lipoprotein, intermediate-density lipoprotein, and low-density lipoprotein cholesterol is linearly related to the flux of these particles into the arterial wall.[13]

The Framingham study has demonstrated a linear increase in coronary heart disease risk with increment of total cholesterol level from 180mg upward the normal level of serum total cholesterol in adults varies from 150-250mg/dl.[14]

In the present study, the prevalence of dyslipidemia was 82% in males and 80% in female diabetic patients. Abnormal total cholesterol levels were seen in 54% of the males and 68% of the diabetic females. Triglycerides were high in 82% of the diabetic males and only 18% of them had normal levels. 80% of the women had high triglyceride levels. HDL was high only in 14% of the cases among the males while the same was seen in 22% of the females. Optimum LDL levels were seen in 32% of the males and 34% of the females. In non diabetic patients, most of them had low LDL levels.

In a similar study by Bhambani et al, a 72% of lipidemia was found in patients with type 2 Diabetes mellitus, with a raised triglyceride levels in 48% of the cases.[9] According to the survey conducted by CDC, 97% of adults with diabetes have one or more lipid abnormalities while the prevalence of diabetic dyslipidemia varies from 25% to 60% in other studies.[15] This variation in prevalence was attributed to differences in BMI and possibly genetic variation among the different patients. Ahmed et al reported a prevalence of 21% patients with type 2 diabetes to have raised serum cholesterol and 34. 2% patients have raised triglycerides in serum.[16]

In the present study, the triglyceride levels were more in the males (46%) than in the females (32%). Similar results were observed in another study by Jain et al.[17] This high incidence of lipids in diabetes was found in comparison to the non diabetics. Hyperlipidemia was more prevalent among the patients in the age group above 41 years. In a study by Singh et al., the mean age of the patients to have high lipid levels was 50 years. The reasons for increasing TC, LDL-C are increasing in the incidence of the obesity, sedentary life, lack of physical activity, diet, and risk factors like hypertension.[18]

The lipid fraction in the present studies was higher among the females with diabetes than the males. The HDL levels were also lower in these patients compared to their male counterparts. Similar picture was seen in a study by Bhambani et al.[9]

CONCLUSION

Hyperlipidemia is one of the most common complications of diabetes mellitus. It is known to predispose to premature atherosclerosis and macrovascular complications. Common lipid abnormalities in diabetes are raised triglycerides, raised serum LDL, raised serum cholesterol and low serum HDL. Since these elevated levels can lead to CHD and its complications, it is important for the monitoring of these lipid levels throughout the course of the disease.

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REFERENCES

1. Abou-Seif MA, Youssef A. Evaluation of some biochemical changes in diabetic patients. Clin Chim Acta. 2004;346(2):161-70.
2. American Diabetes Association: Management of dyslipidemia in adults with diabetes (Position Statement). Diabetes Care. 2003;26(Suppl 1):S83-6.
3. Haffner SM, Mykkanen L, Festa A, Burke JP, Stern MP. Insulin-resistant prediabetic subjects have more atherogenic risk factors than insulin-sensitive prediabetic subjects: implications for preventing coronary heart disease during the prediabetic state. Circulation. 2000;101:975-80.
4. Haffner SM, Stern MP, Hazuda HP, Mitchell BD, Patterson JK. Cardiovascular risk factors in confirmed prediabetic individuals: does the clock for coronary heart disease start ticking before the onset of clinical diabetes. JAMA. 1990;263:2893-8.
5. Garvey WT, Kwon S, Zheng D, Shaughnessy S, Wallace P, Hutto A, et al. Effects of insulin resistance and type 2 diabetes on lipoprotein subclass particle size and concentration determined by nuclear magnetic resonance. Diabetes. 2003;52:453-62.
6. Reaven GM, Chen YD, Jeppesen J, Maheux P, Krauss RM. Insulin resistance and hyperinsulinemia in individuals with small, dense low density lipoprotein particles. J Clin Invest. 1993;92:141-6.
7. Summary of the second report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel II). JAMA. 1993;269(23):3015-23.
8. American Diabetes Association. Management of Dyslipidemia in Adults with Diabetes. Diabetes Care. 2002;25(suppl 1):s74-7.
9. Bhambhani GD, Bhambhani RG, Thakor NC. Lipid profile of patients with diabetes mellitus: a cross sectional study. Int J Res Med Sci. 2015;3:3292-5.
10. Ramachandran A. "Rising prevalence of diabetes in India and the implications of ADA – EASD consensus on the management" Chp 30. Singhal R K. Medicine update 2007;17:180-4.
11. Khan SR, Ayub N, Nawab S, Shamsi TS. Triglyceride profile in dyslipidemia of type 2 diabetes mellitus. J Coll Physicians Surg Pak. 2008;18(5):270-3.
12. Gadi R, Samaha FF. Dyslipidemia in type 2 diabetes mellitus. Curr Diabetes Rep. 2007;7(3):228-34.
13. Golay A. HDL metabolism in NIDDM measurement of HDL turn over using titrated HDL J. Clin Endocrinol Metab. 1987;65:512-8.
14. Kannel WB, McGee DL. Diabetes and glucose tolerance as risk factors for cardiovascular disease: The Framingham Study. Diabetes Care. 1979;2(2):120-6.
15. Hidron AI, Edwards JR, Patel J, Horan TC, Sievert DM, Pollock DA. NHSN annual update: antimicrobial-resistant pathogens associated with healthcare-associated infections: annual summary of data reported to the National Healthcare Safety Network at the Centers for Disease Control and Prevention, 2006-2007. Infect Control Hosp Epidemiol. 2008;29(11):996-1011.
16. Ahmad A, Khan AR, Raja ZA, Mustafa G. Measurement of serum cholesterol and triglyceride: evaluation in patients with diabetes, hypertension and cerebrovascular accidents in South Punjab. Professional. 2003;10(2):92-8.
17. Jain HR, Shetty V, Singh GS, Shetty S. A Study of Lipid Profile in Diabetes Mellitus. Int J Sci Stud 2016;4(9):56-61.
18. Singh G, Kumar AK. A Study of Lipid Profile in Type 2 Diabetic Punjabi Population. J Exercise Sci Physiotherapy. 2012;8(1):7-10.

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