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Study of dyslipidemia in patients of type 2 diabetes mellitus

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ABSTRACT

Dyslipidemia is one of the major risk factors for cardiovascular disease in diabetes mellitus. The characteristic features of diabetic dyslipidemia are a high plasma triglyceride concentration, low HDL cholesterol concentration and increased concentration of small dense LDL-cholesterol particles. The lipid changes associated with diabetes mellitus are attributed to increased free fatty acid flux secondary to insulin resistance. This was a case control study. The sub-jects who were included in the study were divided into two groups. Group A included 50 normal healthy individuals who were in the age group of 40-65 years, who were of either sex and with no family history of Diabetes mellitus. Group B includ-ed 50 newly diagnosed patients of Type 2 Diabetes Mellitus, who were in the age group of 40-65 years, who were of either sex, from the same population. Fasting blood samples were drawn and they were investigated for the serum insulin, serum uric acid, fasting blood sugar, HbA1C levels and lipid profile. The values were compared with those of normal healthy subjects. All the parameters, FBS, HbA1C and serum lipid profile were found to be increased in the patients of Type 2 Diabetes Mellitus as compared to their levels in the con-trols ($p<0.001$). In the present study, it was concluded that Serum total cholesterol, serum triglyceride, LDL and VLDL were significantly raised in diabetics while serum HDL-C levels were significantly decreased when compared to healthy individual.

KEYWORDS

FBS (Fasting blood sugar);
HbA1C (Glycated Hemoglobin);
Tg (triglycerides);
HDL (High Density Lipoproteins);
LDL (Low Density Lipoproteins);
VLDL (Very Low Density Lipoproteins).

INTRODUCTION

Diabetes is a chronic metabolic disorder that continues to be a major worldwide epidemic[1]. Type 2 diabetes mellitus is on track to become one of the major global public health challenges of 21st century. It accounts for approximately 90-95% of all diagnosed cases of diabetes. According to WHO report the prevalence of diabetes in adults worldwide has risen. In 2000 an estimated 171 million people had diabetes and it is projected that by 2030, the number of people with diabetes will be 366 million. Epidemiological data in India shows the same upward trend from 33 million diabetics in 2000 to 57 million in 2025[2].

Dyslipidemia affects people with type 2 diabetes more often than those with type 1diabetes. The most common dyslipidemia in diabetes is the combination of high triglycerides and low HDL levels. People with diabetes may also have elevated LDL cholesterol. Dyslipidemia means lipid levels in the bloodstream are

too high or low. Dyslipidemia has no symptoms, so the diagnosis is made by a blood test called a lipid profile. This test measures the amount of cholesterol, triglycerides, and other fats in your bloodstream[3].

Insulin resistance and type 2 diabetes are associated with a clustering of interrelated plasma lipid and lipoprotein abnormalities, which include reduced HDL cholesterol, a predominance of small dense LDL particles, and elevated triglyceride levels. Each of these dyslipidemic features is associated with an increased risk of cardiovascular disease. Increased hepatic secretion of large triglyceride-rich VLDL and impaired clearance of VLDL appears to be of central importance in the pathophysiology of this dyslipidemia. Small dense LDL particles arise from the intravascular processing of specific larger VLDL precursors[4].

MATERIAL AND METHOD

The present study was undertaken in the Department of Biochemistry in collaboration with Department of Medicine, Sri Guru Ram Das Institute of Medical Sciences and Research, Amritsar into two group

Group A

This group consisted of clinically newly diagnosed 50 patients of Type 2 Non Insulin Dependent Diabetes Mellitus (NIDDM) between 40-65 yrs of age, of either sex.

Group B

This group consisted of 50 healthy, age and sex matched subjects from the same population but without any disease and without family history of DM.

Informed consent was taken from all subjects included in the study. The permission of the ethical committee of the institution was taken.

Exclusion criteria

Patients suffering from type-1 DM, patients with acute complications of DM and with history of acute infections, other ailments like gross congestive heart failure, tuberculosis, gout, rheumatoid arthritis and skeletal muscle injury, serum creatinine > 1.5mg/dl, renal failure and those on hypoglycemic drugs and on insulin therapy were excluded from the study.

A detailed history and thorough clinical examination was carried out on each patient. The patients and controls were screened for fasting blood sugar (by GOD-POD Method (Trinder 1969))[5] and lipid profile (Total Serum Cholesterol was estimated by CHOD-PAP Method (Allain C.C.et al 1974)[6], Serum Triglyceride was estimated by GPO-Trinder Method. (McGowan MW et al 1983)[7], Serum High Density Cholesterol (HDL-C) was estimated by Phosphotungstic Acid Method (Gordon T. Et al 1977)[8], Low Density Lipoprotein-D Cholesterol (LDL-D) by direct enzymatic method[9],Very Low Density Lipoprotein-Cholesterol (VLDL-C) by Freidwald equation (Freidwald equation W.T.1974) and the values were compared with that of normal healthy subjects.

STATISTICS

The comparison was done by students 't' test on the number of variables for each parameter. Correlation was done by Pearson's correlation analysis. Logistic regression analysis was also done on the variables of each parameter.

RESULTS

Statistically it was observed that the difference between the fasting blood sugar of normal individuals and patients of type 2 diabetes was statistically highly significant ($p < 0.001$), with the patient group having significantly higher levels than the normal group

TABLE 1 : Comparison of fasting blood sugar levels in normal individuals (controls) and patients of type 2 diabetes (cases)

S. no.	Subjects	Number	Fasting Blood Sugar (mg/dl)		
			Range	Mean± SD	± SE
1.	Group B	50	60-90	75.14 ± 8.43	1.19
2.	Group A	50	80-240	140.98 ± 42.0	5.95

t = 10.849 (p= < 0.001), highly-significant; Reference levels of FBS= 70-110 mg/dl

It was also observed that the difference between total serum cholesterol levels of normal individuals and patients of type 2 diabetes was statistically highly significant. ($p < 0.001$), with the patient group having sig-

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TABLE 2 : Comparison of HbA1c levels in normal individuals (controls) and patients of type 2 diabetes (cases)

S. no.	Subjects	Number	Glycated Haemoglobin/ HbA1c (%)		
			Range	Mean± SD	± SE
1.	Group B	50	3.2- 6.0	4.77± 0.56	0.080
2.	Group A	50	4.5- 11	7.78± 1.87	0.264

t = 10.905 (p<0.001), highly-significant; Reference levels of 4.5-6.3 %

TABLE 3 : Comparison of total serum cholesterol levels in normal individual (controls) and patients of type 2 diabetes (cases)

S. no.	Subjects	Number	Total serum cholesterol (mg/dl)		
			Range	Mean± SD	± SE
1.	Group B	50	96- 240	148± 32	4.63
2.	Group A	50	118- 660	208± 78	11.1

t = 4.991(p< 0.001), highly-significant; Reference levels < 200 mg/dl

TABLE 4 : Comparison of serum triglycerides levels in normal individuals (controls) and patients of type 2 diabetes (cases)

S. no.	Subjects	Number	Serum Triglycerides (mg/dl)		
			Range	Mean± SD	± SE
1.	Group B	50	60- 226	128± 37.1	5.24
2.	Group A	50	105- 532	202± 88.2	12.47

t =5.459 (p<0.001), highly-significant; Normal Fasting Level= 25-160 mg/dl

TABLE 5 : Comparison of serum HDL levels in normal individuals (controls) and patients of type 2 diabetes (cases)

S. no.	Subjects	Number	Serum HDL (mg/dl)		
			Range	Mean± SD	± SE
1.	Group B	50	30-60	48.1± 6.1	0.87
2.	Group A	50	26-70	39.8± 13.5	1.92

t =3.923 (p<0.001), highly-significant; Reference levels 30-65 mg/dl (males), 35-80 mg/dl (females)

TABLE 6 : Comparison of serum LDL levels in normal individuals (controls) and patients of type 2 diabetes (cases)

S. no.	Subjects	Number	Serum LDL (mg/dl)		
			Range	Mean± SD	± SE
1.	Group B	50	29- 173	74.8± 32.9	4.66
2.	Group A	50	19- 489	129.9± 67.4	9.53

t = 5.188(p< 0.001), highly-significant; Reference levels < 100 mg/dl

nificantly higher levels than the normal group.

The serum triglycerides levels was statistically highly

TABLE 7 : Comparison of serum VLDL levels in normal individuals (controls) and patients of type 2 diabetes (cases)

S. no.	Subjects	Number	Serum VLDL (mg/dl)		
			Range	Mean± SD	± SE
1.	Group B	50	12- 45	25.6± 7.42	1.05
2.	Group A	50	18- 106	38.4± 18.1	2.57

t =4.610 (p< 0.001), highly-significant; Reference levels = upto 34 mg/dl

TABLE 8 : Comparison of lipid profile in normal individuals and diabetics in various studies

Studies	p value				
	TC	TG	HDL	LDL	VLDL
Our study	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
M M Yassin et al (2010)	< 0.01	< 0.01	< 0.01	< 0.01	-
Dayanand C D et al (2010)	< 0.001	< 0.001	0.02	< 0.001	-

significant. ($p < 0.001$) in type 2 diabetics as compare to normal group. It was observed that the difference between serum HDL levels of normal individuals and patients of type 2 were statistically highly-significant. ($p < 0.01$), with the patient group having significantly lower levels than the normal group. Serum LDL and serum VLDL levels were statistically highly significant. ($p < 0.001$) in type 2 diabetics as compare to normal group.

DISCUSSION

Diabetes is projected to increase significantly in the coming period and it is estimated that 80 million people in India would be having diabetes by the year 2030[10]. Type 2 diabetes mellitus is on track to become one of the major global public health challenges of 21st century. Type 2 diabetes mellitus is a heterogeneous disease characterized by variable degrees of insulin resistance, impaired insulin secretion and increased glucose production[11].

In our study we found fasting blood sugar and HbA1c significantly high ($p< 0.001$) in T2DM patients as compare to healthy individuals. These findings are consistent to those of D A Muttur et al (2010) [12] and Safiullah et al (2010)[13] who stated that the patients of type 2 diabetes have higher levels of fasting blood sugar than the normal healthy individuals and this difference was highly significant ($p < 0.001$). The reason may be that when influx of glucose in insulin dependent glucose utilizing cells and adipose tissue starts diminishing. For

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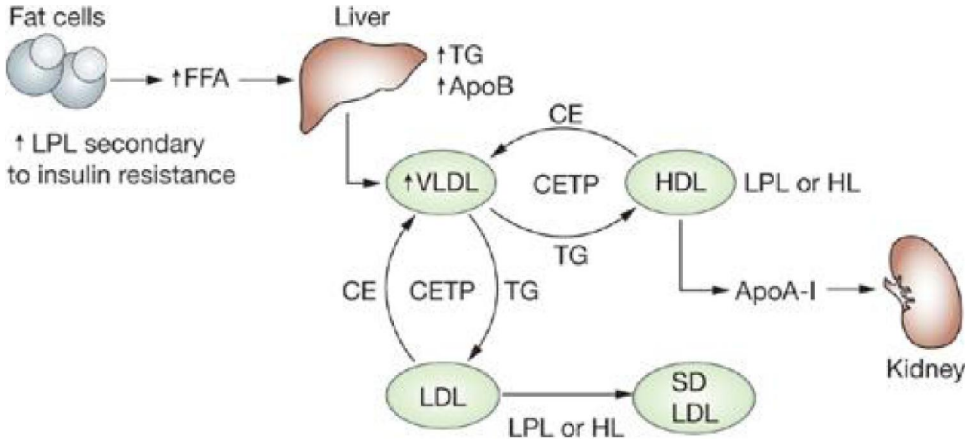

Figure 1

a considerable period of time beta- cell may compensate this defect by synthesizing more insulin and sending it to circulation to maintain normal level of glucose in blood and tissue, i.e. in the first instance hyperinsulinemia develops to compensate hyperglycemia. Progressively, beta-cells start getting tired and exhausted and level of insulin secretion starts declining with the result hypoinsulinemia develops along with type 2 DM[14,15]. The levels of $HbA1_c$ are increased in diabetic patients and reflect their metabolic control over the past 8-10 weeks. The measurement of $HbA1_c$ has proved to be useful in assessing relationship between diabetic control and long term complications[16].

In our study Plasma Lipid Profile showed significant increase ($p<0.001$) in Total cholesterol (TC), Triglycerides(TG), Low Density Lipoproteins (LDL), Very Low Density Lipoproteins (VLDL) and in diabetics when compared to controls. In contrast there was significant decrease ($p<0.001$) in HDL-C in diabetes. It is known that cholesterol, triglycerides, LDL and VLDL are elevated in diabetic patients. The abnormal high concentrations of serum lipids in diabetics is mainly due to increase in the mobilization of free fatty acids from fat droplets, since insulin inhibits the hormone sensitive lipase. Excess fatty acids in serum of diabetics are converted into phospholipids and cholesterol in liver. These two substances along with excess triglycerides formed at the same time in liver may be discharged into blood in the form of lipoproteins. Hyperinsulinemia is also associated with low HDL cholesterol levels[17,18]. The increased number of VLDL cholesterol particles and increased plasma triglyceride levels decrease the level of HDL cholesterol and increase the concentration of small dense LDL-cholesterol particles via several processes: VLDL-transported triglyceride is exchanged for HDL-transported cholesteryl ester through the action of the cholesteryl ester transfer protein (CETP), which results in increased amounts of both atherogenic cholesterol-rich VLDL remnant particles and triglyceride-rich, cholesterol-depleted HDL particles. The triglyceride-enriched HDL is subsequently hydrolyzed by hepatic lipase or lipoprotein lipase; ApoA-I dissociates from the reduced-size HDL, which is filtered by the renal glomeruli and degraded in renal tubular cells (Figure 1)[18,19]. The increased concentration of small dense LDL-cholesterol particles is explained by a similar lipid exchange. Increased levels of VLDL-transported triglyceride enable CETP to promote the transfer of triglyceride into LDL in exchange for LDL-transported cholesteryl ester. The triglyceride-rich LDL undergoes hydrolysis by hepatic lipase or lipoprotein lipase, which results in lipid-depleted small dense LDL particles (Figure 1).

M M Yassin et al (2010)[17] also found similar results as our study. Plasma lipids are elevated among the diabetic patients as compared to controls ($p< 0.01$).

Dayanand C D et al (2010)[18] also observed highly significant rise in TC, TG and LDL in diabetic patients as compared to controls while HDL showed a significant fall in the diabetic patients ($p< 0.001$).

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