Comparative study of lipid profile in obese type 2 diabetes mellitus and obese non diabetes

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Abstract: *Diabetes mellitus is the most common metabolic disorder affecting the people all over the world. Obesity is a physiological variant which leads to various pathological complications including Type 2 diabetes mellitus. Type 2 diabetes mellitus, obesity and dyslipidemia are considered as independent risk factors for coronary heart disease and cerebrovascular disease. Present study is to compare lipid profile in Type 2 diabetics with obesity and non diabetic obese people, the control group.*

This study enrolled 50 obese Type 2 diabetes mellitus patients and 50 obese non diabetic controls of age 35-65 yrs with good glyceamic control. Patients with BMI (Body Mass Index) > 30 were selected. Fasting blood samples were collected and different lipid fractions along with fasting blood glucose were estimated by enzymatic method.

Statistical analysis was carried out using standard deviation and chi-square from which 'p' value is derived, 'p' value <0.05 is significant. Among 50 obese diabetic patients total cholesterol levels were increased in 28 patients, triglyceride levels were raised in 32 patients; LDL-C levels were increased in 25 patients and HDL-C levels were decreased in 19 patients. This showed significantly high triglycerides, high VLDL-C, high LDL-C and low HDL-C in type 2 diabetes mellitus with obesity when compared to control group; there was no significant change in total cholesterol levels between the two groups. This study showed strong evidence of Type -2 diabetes mellitus associated with obesity leading to high levels of lipids which aggravate the atherogenic process, leading to increased morbidity and significant mortality compared to non diabetes obese population. As diabetes is a chronic disease intensive and prolonged medical management is required along with hypolipidaemic drugs.

Keywords: *Type2 Diabetes Mellitus, Obesity, Lipid Profile, BMI (Body Mass Index), Coronary heart disease.*

I. Introduction

Diabetes mellitus is a heterogeneous chronic metabolic disorder characterized by hyperglycemia and its lethal complications. Among the various types of diabetes, Type2 diabetes mellitus (T2DM) is the most prevalent variant and it is due to combination of insulin resistance and relative insulin deficiency due to pancreatic β cell failure. T2Dm often have both quantitative and qualitative abnormalities of lipoproteins that are responsible for increased incidence of microvascular and macrovascular complications.[1]Incidence of coronary heart disease is three to four folds higher in patients with T2DM compared to non diabetics.

The worldwide prevalence of diabetes mellitus had risen dramatically. Basing on current trends, the International Diabetes Federation projects that 438 million individuals will have diabetes by the year 2030. [2] Although the prevalence of both type 1 and type 2 DM is increasing worldwide, the prevalence of type 2 DM is rising much more rapidly, presumably because of increasing obesity, reduced activity levels as countries become more industrialized and the aging of the population. India is considered the diabetes capital of the world by 2020AD. It is estimated that 35 million in our country already have diabetes and it is expected to reach 70 to 80 millions by 2030AD. In India the prevalence is 2-4% in rural and 4.0-11.6% in urban areas. [3] Worldwide estimates project that in 2030 the greatest number of individuals with diabetes will be aged 45–64 years.

Dyslipidemia (raised triglycerides, raised cholesterol and low HDL) were common in patients with T2DM with other features of insulin resistance like hyperinsulinemia, hypertension with central obesity together known as metabolic syndrome or Reaven's syndrome; and is strongly associated with atherosclerosis. Low HDL-C was a major risk factor had emerged from the Framingham Heart Study. Total cholesterol (TC): HDL-C ratio (>4.5) is considered the most powerful predictor of coronary heart disease. The obese T2DM subjects have a very high level of serum triglycerides, a triglyceride level >130mg/dl and /or a triglycerides-to-HDL-C ratio above three is highly predictive of small, dense LDL particles. LDL is the most important proatherogenic lipoprotein. Smaller, denser LDL's were more atherogenic than larger buoyant LDL's; Lp(a) was a genetic variant of LDL-C it had an abnormal protein called apo(a) attached to it and is the most dangerous lipoprotein.

[4] Hyperglycemia and dyslipidemia affects the progression of coronary heart disease and increases the mortality rate in diabetic patients. Endothelial dysfunction occurs due to increased LDL-C and decreased HDL-

C levels. So, aggressive management of lipid levels along with anti-diabetic treatment, which not only reduces the complications of type 2 diabetes mellitus but also mortality.

Obesity is a disorder of body regulatory system characterized by accumulation of excess body fat. [5] It is an abnormal growth of fat cell size (hypertrophic obesity) or an increase in fat cell number (hyperplastic obesity) or combination of both. Obesity is the most common and most expensive nutritional problem in U.S.A.

Obese people are more likely to have high cholesterol levels, this increases the risk of atherosclerosis. Android obesity – high risk abdominal fat distribution (Apple shaped= upper body obesity), [5] this abdominal obesity is important in development of insulin resistance in metabolic syndrome that link with coronary heart disease. Obesity is a major risk factor for diabetes especially central obesity and as many as 80% of patients with T2DM (due to insulin resistance) were obese.[2] So, patients with T2DM with dyslipidemia and obesity have markedly increased risk of coronary heart disease than dyslipidemic non diabetic obese patients. There are major ethnic and gender differences in the rate of accumulation and the amount of visceral fat. For example, Asian Indians have relatively higher truncal and abdominal fat mass as compared to Caucasians and black population despite similar or less average value of waist circumference. [6]

In view of the present scenario, this work was taken up to study the lipid profile status in patients who were obese type 2 diabetics and compared with a control group who were obese but non diabetic.

II.   Materials And Methods

This study was conducted on 100 subjects out of them 50 were obese T2DM patients and 50 were obese non diabetic control. The study was approved by the Institutional ethics committee. Written informed consent was taken from the patients in local language. This is an observational and cross sectional study.
The criteria for selection of cases were:

1. Inclusion criteria:
1.1. Age of the patients /controls was 35-65 years.
1.2. T2DM patients on diet/ or on oral hypoglycemic agents with good glycaemic control
1.3. Patients with Body Mass Index (BMI) >30 were selected.

2. Exclusion criteria:
2.1. Diabetic patients with overt complications like neuropathy, nephropathy, retinopathy, and ischemic heart disease.
2.2. Patients with acute complications like diabetic keto-acidosis, non ketosis hyperosmolar coma and hypoglycemia.
2.3. Patients with any concurrent illness like chronic liver disease, hypothyroidism.
2.4. Patients on drugs like diuretics, steroids, oral contraceptives and beta blockers etc.

3. Anthropometric parameters:
3.1. Weight and Height:
Weight was recorded in kilograms with the subject standing on the weighing machine without shoes and minimum clothing. Weight of the patients and controls were recorded in the same weighing machine. Height was recorded with the subject barefooted, feet together, back and heels against the upright bar of the height scale; head upright in Frankfort horizontal plane – look straight ahead. The height measuring equipment consisted of a vertical bar with a horizontal bar of wood which was brought down snugly on examinee's head. [7]
3.2. Body Mass Index (BMI) also known as Quetelet Index is used far more commonly to define Obesity.
$BMI = Weight\ in\ Kilogram's / Height\ in\ meters^2$
Patients were considered obese if their BMI was more than 30 in males and females.

3.3. Collection of blood samples:
After an overnight fasting of 10-12 hours, about 5 ml of whole blood was collected via vena puncture with the help of a disposable syringe in between 7.00am and 8.00am. Different Lipid fractions were estimated along with fasting plasma glucose. Glucose- detected by enzymatic reaction (glucose oxidase and peroxidase=GOD-POD). [8] Serum total cholesterol was determined by an enzymatic (CHOD-PAP) colorimetric method. [9] Triglycerides were determined by an enzymatic (GPO-PAP) method. [10] HDL-Cholesterol was estimated by a precipitant method. [11] LDL-Cholesterol was estimated by using Friedewald formula. [12]
LDL-Cholesterol = Total Cholesterol – (HDL cholesterol + Triglycerides/5).
Statistical analysis was carried out using standard deviation and chi-square test from which 'P' value is derived. The 'P' value less than 0.05 was considered significant.

III. Results And Discussion

The study was initiated in September 2012 and completed in February 2013 at Department of General Medicine, Government General Hospital, Siddhartha medical college, Vijayawada, Andhra Pradesh, India. This study was conducted on 50 obese type 2 diabetes patients and 50 obese age matched controls. Age, sex and employment status of the study group was shown in table no.1.

Table no. 1: Age, Sex and Employment status of study group

	Age		Sex		Employment Status	
	Range	mean±SD	Males	Females	Employed	Unemployed
ObeseT2DM	35-65	49.6±9.1	24(48%)	26(52%)	24(48%)	26(52%)
Obese control	35-65	42.94±6.7	27(54%)	23(46%)	35(70%)	15(30%)

*SD = Standard deviation, T2DM= type 2 diabetes mellitus.

The detailed anthropometric parameters: height in meters, weight in kilograms, body mass index and waist circumference in centimeters were shown in table no.2.

Table no.2: Anthropometric Parameters of the Subjects

			Obese T2DM	Obese Control
1	Height in meters	Range	1.43-1.76	1.42-1.76
		Mean ±(SD)	1.57(0.0856)	1.58(0.083)
2	Weight in Kilograms	Range	60-98	60-96
		Mean ±(SD)	79.44(8.94)	79.66(9.31)
3	BMI	Range	30-39	30-42
		Mean ±(SD)	32.06(2)	31.68(2.62)
4	Waist circumference in centimeters	Range	80-116	80-120
		Mean ±(SD)	101.96(9.1428)	98.86(8.66)

SD-Standard deviation, BMI – Body mass Index, T2DM – Type2 Diabetes Mellitus
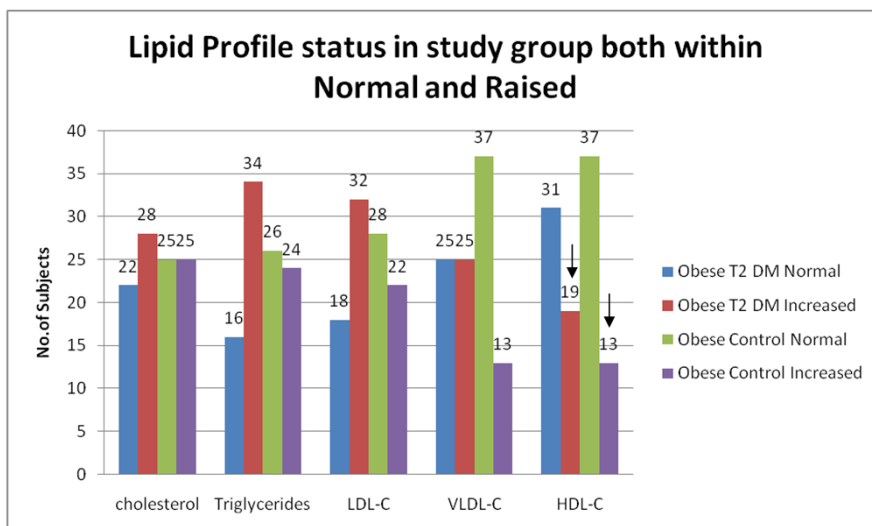
The estimated levels of lipid profile in obese type 2diabetes and obese non diabetic cases along with fasting blood sugars of obese T2DM were shown in table no.3. It is seen from the table that there was no significant difference in cholesterol levels between T2DM with Obesity and Obese non diabetic cases; in both groups cholesterol levels were raised**.** The levels of triglycerides were very high in T2DM with obesity when compared to obese controls, the 'p' value was <0.05 and it was significantly high in obese diabetes patients. Serum HDL cholesterol levels were significantly low in obese type2 diabetes with ´p´value <0.05. In both groups the LDL-C levels were increased, the 'p' value was <0.05 and it was significantly high in obese T2DM. The VLDL cholesterol levels were high in T2DM with obesity when compared with control group, the 'p' value was <0.05 they were significantly high in T2DM with obesity. The fasting blood sugars in both the groups were within normal limits.

Table no.3: Lipid Profile in the Study Group

S. No.	Lipid Protein	Ob T2DM/C	Mean	+/- SD	P value	Sig
1	Cholesterol	ObT2DM	189.42	33.82	>0.05	NS
		Ob C	181.9	32.36		
2	Triglycerides	ObT2DM	225.76	139.9	<0.05	S
		Ob C	167.76	65.61		
3	HDL-C	ObT2DM	40.86	8.45	<0.05	S
		Ob C	46.46	9.19		
4	LDL-C	ObT2DM	104.02	35.04	<0.05	S
		Ob C	102.28	35.26		
5	VLDL-C	ObT2DM	46.14	28.56	<0.05	S
		Ob C	33.62	13.24		
6	FBS	ObT2DM	99.64	12.68		

Ob T2DM= obese type 2 diabetes mellitus, Ob c= obese non diabetes, SD= standard deviation, HDL-C=high density lipoprotein, LDL-C=low density lipoprotein, VLDL-C=very low density lipoprotein, FBS=fasting blood sugar, NS=Non Significant, S = significant.

The cholesterol levels in 48% of obese T2DM patients and 50% of obese non diabetics showed increased values. The triglycerides were increased in 68% of obese T2DM patients and only 48% of the obese non diabetics showed increased values. The LDL-C levels were increased in 64% of obese T2DM, where only 44% of the obese non diabetics had increased values. The VLDL-C levels were increased in 50% of obese T2DM, where only 26% of the obese non diabetic's had increased values. The HDL-C levels were decreased in 38% of obese T2DM; whereas only 26% of the obese non diabetics had decreased values and were shown in figure no.1

LDL-C=low density lipoprotien, VLDL-C=very low density lipoprotien, HDL-C=high density lipoprotien.

Obesity, Dyslipidemia and Diabetes were considered as independent risk factors for coronary vascular disease and is associated with high amount of morbidity and mortality. Even though they were independent risk factors, the three entities were closely related i.e. obesity leads to insulin resistance which in turn causes type 2 diabetes and both together leads to dyslipidemia.

ADA (American diabetic association) and AHA(American heart association) have declared that diabetes is considered a coronary artery disease (CAD) equivalent and patients should be started on treatment for secondary prevention of CAD.[13] According to guidelines of the ADA and the AHA, the target lipid values in diabetic individuals (age >40 years) without cardiovascular disease should be as follows: LDL < 2.6 mmol/L (100 mg/dL); HDL >1 mmol/L (40 mg/dL) in men and >1.3 mmol/L (50 mg/dL) in women; and triglycerides <1.7 mmol/L (150 mg/dL). In patients >40 years, the ADA recommends addition of a statin, regardless of the LDL level in patients with CHD(coronary heart disease) and those without CHD, but who had CHD risk factors. The recommended lipid goals for Indians with heart disease was <60mg/dl for LDL-C and <90mg/dl for non HDL-C. A reasonable HDL-C goal was 45mg/dl for men and 55mg/dl for women, whereas 60mg/dl for Indian men and women. [4] Diabcare Asia-India study conducted nationwide survey of patients attending tertiary diabetes care centers and reported a mean age of onset of diabetes as 43.6years with a mean duration of diabetes of 10.0years and 90.6% having T2DM (Raheja B S, Kapur A-2001).

This study showed that there was not much sex variation in the prevalence of T2DM with obesity; with only a slight increase in female group, a study made by Nalchjavani and others found that all types of dyslipidemia were significantly more prevalent in females. [14] Women had higher HDL-C compared to men, high prevalence of hypertriglyceridemia in females due to their higher BMI. It showed that disease status was high in unemployed or employed with sedentary jobs.

The findings in this study showed that the obese T2DM patients had significantly higher serum triglycerides, LDL-C levels and serum VLDL-C levels; with significant lower HDL-C levels when compared to obese non diabetic cases. Total cholesterol levels were increased without significant 'p' value. Similar results had been observed by some. [15-18] similar results were also seen in others but their HDL-C levels did not differ significantly. [19,20] The studies of Santen et al (1972) and Peret et al (1974) observed mean serum triglyceride levels higher in obese diabetics in comparison to obese control subject. [21, 22] Hypercholesterolemia and hypertriglyceridemia were seen in this study. [23] Hypertriglyceridemia predisposes the patients to life threatening complications like diabetic ketoacidosis, coronary artery disease and lipaemia retinalis. [24] Sharma (1970) and Jain (1980) observed increase in the levels of serum total cholesterol, serum triglycerides, and serum phospholipids in diabetic subjects when compared to normal controls. [25, 26]

Bijlani et al (1984) found HDL-C to be significantly lower in obese diabetics when compared to normal weight diabetics. [3] Gambhir et al found that low HDL-C were independent risk factor for premature coronary artery disease. [27] In a study at Joslin clinic also showed an inverse correlation of HDL-C with adiposity and triglyceride levels.

IV. Conclusion

As diabetes is a disease of self management, appropriate nutrition (low calories, low carbohydrates, and low fat with high fiber diet) regular physical activity and proper medication to achieve good glycaemic control have to be followed. Patients of diabetes with obesity- weight management are a key factor. Reduction of at least 600 kcal from total daily calorie intake is required. The goal is to lose 0.5 kg/wk. [4] as it is well established that reducing total cholesterol and LDL cholesterol levels can significantly reduce the risk of CHD morbidity and mortality; aggressive therapy of hyperlipidaemia/dyslipidaemia can help to reduce the epidemic of premature coronary artery disease seen in Indians and people from other countries. [13] HMG CoA Reductase inhibitors (statins) should be used to achieve LDL goals. [28] Life style modifications like regular exercise, quitting smoking and alcohol along with yoga will help the diabetic patients to live a better life.

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