

A comparison of BMI and Lipid Profile in patients with metabolic syndrome and Type 2 Diabetes Mellitus

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Abstract

Introduction: Diabetes mellitus is a metabolic disease known by chronic hyperglycemia which results from defective insulin action and secretion. Metabolic syndrome consists of a constellation of metabolic abnormalities that confer increased risk of diabetes mellitus. The aim of the present study was to study BMI and lipid profile in patients with metabolic syndrome and type 2 diabetes mellitus. **Materials and methods:** 50 controls, 50 individuals with metabolic syndrome and 50 individuals with type 2 diabetes mellitus were selected by purposive sampling technique. BMI was calculated and serum levels of cholesterol, triglycerides, LDL, VLDL and HDL were estimated in controls and cases. **Results:** BMI, serum triglycerides, VLDL, cholesterol/HDL ratio were significantly increased ($p < 0.05$) and serum HDL levels were significantly decreased ($p < 0.05$) in metabolic syndrome and type 2 diabetes compared to controls. **Conclusion:** Our study concluded that there is significant dyslipidemia in patients with metabolic syndrome and type 2 diabetes mellitus.

Keywords: BMI, Diabetes mellitus, Lipid profile, Metabolic syndrome

Introduction

Diabetes mellitus is a metabolic disease known by chronic hyperglycemia which results from defective insulin action and secretion. World Health Organization projects that number of diabetics will exceed 350 million by 2030. Various studies have documented liver disease as a major cause of mortality in patients with type 2 diabetes (T2DM). It is well known that liver plays an important role in maintenance of normal glucose levels during fasting as well as in the postprandial period. Metabolic syndrome (MetS) consists of a constellation of metabolic abnormalities that confer increased risk of diabetes mellitus.

The major features of the metabolic syndrome include central obesity, hypertriglyceridemia, low HDL cholesterol, hyperglycemia and hypertension [1].

Central feature of metabolic syndrome is insulin resistance. It results in hyperglycemia and hyperinsulinemia later leading to diabetes mellitus. It contributes to pathogenesis of various diseases like hypertension, atherosclerosis, coronary artery disease and organ dysfunctions [2].

Obesity is associated with a variety of cardiometabolic diseases, such as type 2 diabetes mellitus (T2DM), hypertension, hyperlipidemia, metabolic syndrome, and cardiovascular disease (CVD), all of which contribute

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to increased mortality. In addition, in a number of epidemiologic surveys, even in people deemed otherwise healthy and lacking any identifiable diseases or health risks, there is a higher risk for cardiometabolic dysfunction and mortality if they are overweight or obese [3].

Metabolic syndrome (MetS) and body mass index (BMI) are established independent risk factors in the development of diabetes. Obesity consists of heterogeneous phenotypes resulting from interplay between genetic and environmental factors. Increased BMI has been associated with metabolic and cardiovascular risk factors including diabetes, hypertension, dyslipidemia, but there is increasing evidence that sub-phenotypes of obesity exist that appear to deviate from the standard dose-response relationship between increased BMI and its adverse clinical outcomes [4].

Several studies have reported a strong association between excess weight and increased risk of death, placing the overweight group at a 40% higher and the obese group at up to 300% higher risk of death than individuals whose BMI is normal ($18.5 \leq \text{BMI} < 25$).

Excess weight and physical inactivity are also associated with an increased risk of developing various diseases, particularly type 2 diabetes. Since excess weight is an important predictor of type 2 DM, the term “*diabesity*” was proposed by Astrup and Finer in 2000. Specifically, In comparison to women with normal BMI, overweight, obese class I and II ($30 \leq \text{BMI} < 39.99$), and class III ($\text{BMI} \geq 40$) individuals face increased risks of developing type 2 DM with 7.6%, 20.1% and 38.8% greater risk respectively [5].

Dyslipidemia contributes to the progression of atherosclerosis, the underlying pathology of CVD. Individuals with MetS or T2DM exhibit a characteristic pattern of abnormalities in serum lipid levels consisting of low levels of HDL-C and elevated levels of triglycerides (TG).

This dyslipidemia is also characterized by increased concentration of small, dense low-density lipoprotein cholesterol (LDL-C) particles [3]. Such lipid pattern is termed atherogenic dyslipidemia. Evidence from epidemiologic studies suggests that the co-occurrence of low levels of HDL-C and elevated levels of TG is a strong risk factor for CVD [6].

The aim of this study is to study BMI and lipid profile in patients with metabolic syndrome and type 2 diabetes.

Materials and Methods

Study design- The present study was conducted in the department of Biochemistry, Father muller’s medical college after obtaining clearance from institutional ethics committee.

The study group consisted of 150 individuals selected by purposive sampling technique who had come to hospital for health check-up during a time period of two years. Informed written consent was obtained from all individual participants included in the study. This was a case-control study with a sample size of 150 patients.

Selection of subjects- 50 individuals with metabolic syndrome (all patients who fulfil criteria for metabolic syndrome, according to National cholesterol education program (NCEP): ATP III 2001 for metabolic syndrome [7]), 50 individuals with type 2 diabetes mellitus and 50 controls were selected.

Exclusion criteria- Smokers, alcoholics, patients with history of liver and renal impairment were excluded from the study.

Sample and data collection- For the selected patient’s history was taken, physical examination was done and BMI was calculated as weight (kg) divided by square of the height (m^2).

Serum cholesterol, LDL, HDL, Triglyceride levels were estimated. Serum levels of cholesterol, LDL were estimated using enzymatic colour test CHOD-PAP method and Triglycerides were estimated by enzymatic colour test GPO-PAP method. HDL was estimated by immune-inhibition enzymatic colour test. VLDL levels were calculated using Friedewald’s equation.

All estimations were done on Olympus AU 400 autoanalyzer.

Statistical analysis- The data was analysed by ANOVA for multiple group comparisons and Pearson’s correlation coefficient for relationship between variables. Statistical analyses were performed with the help of SPSS software. For all statistical analyses the *p* value was considered to be significant when $p < 0.05$.

Results

In our study, the BMI in metabolic syndrome, diabetes mellitus was more than controls. The BMI is 24.78 ± 3.83 in controls, 26.94 ± 4.01 in metabolic syndrome and 27.07 ± 4.17 in diabetes. Statistical analysis ($F = 5.177$) shows that there is a significant increase in BMI in ($p < 0.001$). metabolic syndrome and diabetes mellitus when compared to controls. We found that in patients with metabolic syndrome there is significant positive correlation of BMI with FBS. In the present study it was found that FBS, PPBS, serum triglycerides, serum VLDL and HDL ratio levels were significantly increased and serum HDL levels were significantly decreased in patients with metabolic syndrome and diabetes mellitus when compared to controls. In patients with metabolic syndrome there is significant positive correlation of BMI with FBS.

There is significant positive correlation of serum triglycerides with serum cholesterol, serum VLDL and HDL ratio in patients with metabolic syndrome. There is significant positive correlation of serum triglycerides with serum cholesterol, serum VLDL and HDL ratio in patients with diabetes mellitus.

Table-1: Distribution of cases and controls with respect to BMI [22]

BMI	Controls	Metabolic syndrome	Diabetes mellitus
Normal (18.5-22.9)	17 (33.3%)	6 (12.2%)	5 (10.2%)
At risk (23-24.9)	10 (19.6%)	10 (18.4%)	13 (26.5%)
Obese I (25-29.9)	20 (39.2%)	28 (57.1%)	19 (38.8%)
Obese II (≥ 30)	3 (7.8%)	6 (12.2%)	13 (24.5%)
Total	50	50	50

Table-2: Comparison of FBS, PPBS, lipid profile between the 3 groups.

	Control	Metabolic syndrome	Diabetes mellitus	p value
FBS	99.2± 9.23	111 ±8.49	153.29 ±22.58	<0.001
PPBS	105.82± 39.41	111.77± 41.72	176.4±52.28	<0.001
Cholesterol	222.72 ± 48.17	223.16 ± 48.47	225.33 ± 40.71	0.955
HDL	45.29 ± 7.82	38.22 ±5.82	40.63± 9.51	.001
LDL	105 ±29.08	107 ±28.47	111.55 ± 25.29	.519
VLDL	27.54 ±19.59	44.33± 31.55	46.91± 30.65	.001
Triglycerides	139.31± 103.67	217.98± 143.25	225 ±140.89	.002
Cholesterol/HDL Ratio	5.18 ± 0.9	5.89 ±1.46	5.39 ±1.71	.043

Table-3: Correlation of triglycerides with FBS, PPBS and lipid profile in metabolic syndrome.

		Pearson correlation r value	p value
Triglycerides	FBS	-0.718	0.598
	PPBS	-.105	0.580
	Cholesterol	.607	0.000
	HDL	-.257	0.075
	LDL	.145	0.325
	VLDL	.998	0.000
	Cholesterol/ HDL_ratio	.710	0.000

Table-4: Correlation of triglycerides with FBS, PPBS and lipid profile in diabetes mellitus.

		Pearson correlation r value	p value
Triglycerides	FBS	.154	.294
	PPBS	.210	.325
	Cholesterol	.387	.007
	HDL	-.119	.422
	LDL	.047	.764
	VLDL	.971	.000
	Cholesterol/ HDL_ratio	.258	.091

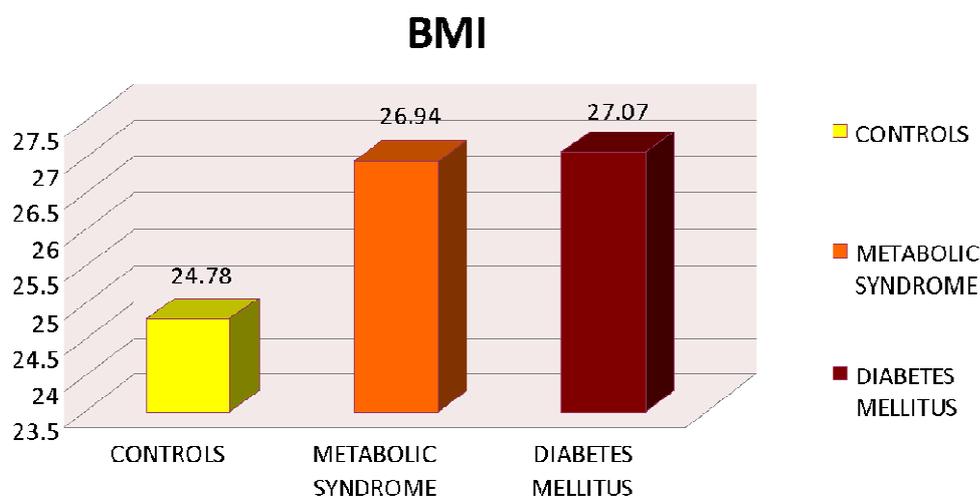


Fig-1: Comparison of BMI between controls, metabolic syndrome and diabetes mellitus (p<0.001)

Discussion

Diabetes mellitus is a metabolic disorder due to defect in the secretion of insulin and/or defect in the action of insulin characterized by hyperglycemia. Diabetes mellitus type 2 and metabolic syndrome are conditions associated with insulin resistance. Metabolic syndrome may be associated with dyslipidemia, hypertension, glucose intolerance, proinflammatory state, and a prothrombotic state [8].

BMI is significantly increased in patients with metabolic syndrome and type 2 diabetes compared to controls [4, 9-13]. Further it was noted that in patients with metabolic syndrome there is significant positive correlation of BMI with FBS. This is in accordance with study done by Vittal BG et al[14].

Individuals with MetS or T2DM exhibit a characteristic pattern of abnormalities in serum lipid levels consisting of low levels of HDL-C and elevated levels of TG.

Evidence from epidemiologic studies suggests that the co-occurrence of low levels of HDL-C and elevated levels of TG is a strong risk factor for CVD [6].

We found that the serum triglyceride levels were significantly increased (p<.001) in metabolic syndrome when compared to controls. The serum triglyceride levels in diabetics were further increased when compared to metabolic syndrome. Lipoprotein lipase (LPL) is the main enzyme responsible for clearing TG-containing lipoproteins from the circulation. Impairment of LPL activity is associated with insulin resistance [6]. That is the reason for increase for in triglycerides levels in metabolic syndrome and type 2 diabetes mellitus. It was also found that there is significant positive correlation of serum triglycerides with serum cholesterol, serum VLDL and cholesterol/HDL ratio in patients with metabolic syndrome and diabetes mellitus.

In our study serum VLDL levels were significantly higher in metabolic syndrome and diabetes mellitus when compared to controls. This is in agreement with the work done by Songa RM and co-workers [15]. Serum VLDL is positively correlated with HDL ratio which is significant in patients with metabolic syndrome and diabetes mellitus. The HDL levels were significantly decreased in metabolic syndrome and diabetics when compared to controls. Hepatic lipase is the enzyme which clears HDL particles from the circulation. It shows increased activity in the presence of insulin resistance and as a result HDL-C levels decline. Low levels of HDL-C is an important risk factor for the development of CVD. The cardioprotective effects of HDL-C is due to its role in reverse cholesterol transport, its effects on endothelial cells, and its antioxidant activity [6].

Our studies are in accordance with previous studies which also found that there is hypertriglyceridemia and low HDL levels in metabolic syndrome and type 2 diabetes mellitus when compared to controls [6,15-20].

HDL ratio is significantly increased in patients with metabolic syndrome and diabetes mellitus when compared to controls. The TC/HDL ratio with raised values especially above 6 is a specific and sensitive index of cardiovascular risk and predictor of coronary heart disease [21-22].

Even Though total cholesterol and LDL cholesterol levels were increased in metabolic syndrome and diabetes mellitus, it was not found to be significant.

Conclusion

In the present study BMI and lipid profile were assessed in patients with metabolic syndrome and diabetes mellitus. It was found that serum triglycerides, VLDL levels were significantly increased in patients with metabolic syndrome and type 2 diabetes mellitus when compared with controls. Serum HDL levels were significantly decreased in patients with metabolic syndrome and diabetes mellitus when compared to controls. Our study concluded that there is significant dyslipidemia in patients with metabolic syndrome and type 2 diabetes mellitus which is a strong risk factor for CVD, so all type 2 diabetic patients should undergo lipid profile as a routine test.

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