ORIGINAL RESEARCH

Evaluation of Pattern of Dyslipidemia and its Association with Obesity in Type 2 Diabetes Mellitus

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ABSTRACT

Introduction: Dyslipidemia is common and prominent in diabetes and an important risk factor for high frequency of atheromatous complication in the disease. The objective of this study was to evaluate the pattern of dyslipidemia and its association with obesity in type 2 diabetes mellitus.

Material and Methods: All type 2 diabetic patients seen as outpatients as well as inpatients were included in the study. The patients were interviewed for the age and mode of onset diabetes mellitus, dietary pattern and mode of treatment. Body Mass Index (BMI), Waist Hip Ratio (WHR), and Waist height ratio (WHtR) were calculated in all patients. Fasting glucose, fasting lipid profile, postprandial glucose were done in these patients.

Results: A total of 150 type 2 diabetic patients were studied. 65 patients out of 150 were found to be obese (BMI>25). Waist hip ratio was abnormal in 84.7% cases. Mean lipoprotein levels showed higher levels in females than males, but the difference was statistically not significant. Comparison of mean lipoprotein level in patients with normal and high BMI did not show statistical significance. Out of 150 patients 94.7% patients had dyslipidemia. There was no significant difference in the number of patients with dyslipidemia among normal and high BMI category. Mean levels of serum total cholesterol, triglycerides, LDL, Non-HDL cholesterol were higher and serum HDL lower in patients with abnormal waist hip ratio than patients with normal waist hip ratio. The association was statistically significant with regard to serum triglycerides and HDL cholesterol.

Conclusion: Waist hip ratio and waist height ratio are better predictors of central obesity and risk assessment of dyslipidemia than body mass index. Mean levels of lipids are higher in women than men in type 2 diabetes.

Keywords: Dyslipidemia, Body Mass Index, Waist-Hip Ratio,Waist Height Ratio, Diabetes Mellitus

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INTRODUCTION

Many pathological conditions cause secondary hyperlipidemia, and of the common diseases, diabetes mellitus exerts some of the most profound effects on plasma lipid metabolism. Dyslipidemia is common and prominent in diabetes and an important risk factor for high frequency of atheromatous complication in the disease. This is particularly relevant to type 2 diabetes mellitus which currently accounts for at least 95% of all cases worldwide. 65-80% of deaths in patients with type 2 diabetes mellitus are due to coronary heart disease. The excess risk of CHD in diabetes is not fully explained, but dyslipidemia is likely to be a major contributor. The risk attributable to cholesterol increases with increasing levels in diabetics as compared with non-diabetic subjects.[1] An association between hypertriglyceridemia, obesity, hyperinsulinemia, insulin resistance, impaired glucose tolerance, hypertension, and coronary artery disease (CAD) has been appreciated since the early 1960s.[2] Intra-abdominal fat has been demonstrated to be the main fat store responsible for insulin resistance. Central obesity was associated with increased risk of diabetes and CAD in both men and women.[3] Studies have shown that[4] body weight, through its entire range, regulates cholesterol metabolism in type 2 diabetes such that with increasing insulin resistance, cholesterol absorption is lowered and cholesterol synthesis increased. The cholesterol absorption efficiency is lower and cholesterol synthesis is higher in obese subjects with diabetes than in those without diabetes, suggesting that diabetes modulates cholesterol metabolism more than obesity alone.[5] The objective of this study was to evaluate the pattern of dyslipidemia and its association with obesity in type 2 diabetes mellitus.

MATERIAL AND METHODS

This prospective observational study was conducted at a tertiary care hospital. All type 2 diabetic patients seen as outpatients as well as inpatients, on any mode of treatment for diabetes were included in the study. Patients with hypothyroidism, hepatic impairment, renal diseases of nondiabetic origin, diabetic ketoacidosis and secondary dyslipidaemias were excluded from the study. The study was approved by institutional ethics committee and written informed consent

was taken from all patients. After inclusion in the study, patients were interviewed for the age and mode of onset diabetes mellitus, dietary pattern and mode of treatment. Body Mass Index (BMI), Waist Hip Ratio (WHR), and Waist height ratio (WHtR) were calculated in all patients. Body mass index was graded as follows: BMI<25- Ideal; 25-30- Overweight; >30 – Obesity; >35 - Morbid obesity. WHR ≤ 0.90 in males and ≤ 0.85 in females is considered normal. WHtR ≤ 0.54 is considered normal.

Venous blood samples were obtained after overnight fasting for fasting blood glucose concentration (FBS) and serum lipid estimation. Venous blood samples were also obtained for postprandial (PPBS) blood glucose concentration, renal function tests (RFT), and wherever clinical suspicion of hypothyroidism was made thyroid function test (TFT) was done.

Dyslipidemia is defined as Low Density Lipoprotein (LDL)> 100 mg/dl; Triglycerides (TG)> 150 mg/dl; High Density Lipoprotein (HDL) < 40 mg/dl in males,< 50 mg/dl in females; Total Cholesterol (TC)> 200 mg/dl;Total cholesterol / HDL cholesterol ratio (TC:HC): < 5.0 - Ideal, 5.0-6.0-moderate risk, >6.0-high risk; Non HDL cholesterol>130 mg/dl.

STATISTICAL ANALYSIS

Microsoft office 2007 was used for the statistical analysis. Chi square test was used for comparative analysis.

RESULTS

A total of 150 type 2 diabetic patients were studied. Among them 100 were males and 50 were females. Duration of diabetes was less than 10 years in 72.7% of patients, between 11-20 years in 26% of patients, 1.3% of patients only were of >20 years duration. In 4 patients diabetes was newly detected.

Table 1 shows the distribution of patients according to BMI and WHR. 65 patients out of 150 were found to be obese (BMI>25) i.e. 43.3% cases were obese. In males 40 out of 100 i.e. 40% were obese and in female 25 out of 50 i.e. 50% were obese. Mean BMI in males was 24.04± 2.98 and in females was 25.29±3.27. In comparison to BMI, waist hip ratio was abnormal in 84.7% cases. 85 out of 100 males and 42 out of 50 female had abnormal waist hip ratio. Out of 127 cases with abnormal WHR, 71 had normal BMI. 91 out of 150 cases had abnormal waist height ratio i.e. >0.54.

Mean lipoprotein levels showed higher levels in females than males, but the difference was statistically not significant.Comparison of mean lipoprotein level in patients with normal and high BMI did not show statistical significance.

Out of 150 patients 94.7% (47 females, 95 males) patients had dyslipidemia. Among these 94 patients (62.7%) had hypercholesterolemia, 87 (58%) had hypertriglyceridemia, 93 (62%) low HDL levels, 119 (79.3%) had high LDL levels, 87 (58%) had high TC HC ratio, 125 (83.3%) had Non HDL cholesterol There was no significant difference in the number of patients with dyslipidemia among normal and high BMI category (table 2).

Mean levels of serum total cholesterol, triglycerides, LDL, Non-HDL cholesterol were higher and serum HDL lower in patients with abnormal waist hip ratio than patients with normal waist hip ratio. The association was statistically significant with regard to serum triglycerides and HDL cholesterol (table 3). Table 4 shows the distribution of patients with dylipidemia according to waist-hip ratio**.** There was no sig-

	Sex		Total
	Male	Female	
BMI ≤25Kg/m^2	60 (60%)	25 (50%)	85 (56.7%)
BMI 25-30Kg/m^2	37 (37%)	20 (40%)	57 (38%)
BMI ≥30Kg/m^2	3 (3%)	5 (10%)	8 (5.3%)
Normal WHR	15 (15%)	8 (16%)	23 (15.3%)
Abnormal WHR	85 (85%)	42(84%)	127 (84.7%)
BMI= body mass index; WHR = waist hip ratio			

Table-1: Distribution of patient according to BMI and WHR

Lipoprotein abnormality	BMI		X^2 value
	Normal (n=85)	High (n=65)	
High T. cholesterol	53	41	0.008
High Triglycerides	49	38	0.010
Low HDL	52	41	0.005
High L DL	65	54	0.619
High TC:HC ratio	48	39	0.071
High Non HDL cholesterol	70	55	0.022
Chi-square test			

Table-2: Distribution of patients with dyslipidemia according to BMI

Lipids	Waist Hip Ratio	
	Normal	High
T. Cholesterol (mg/dl)	206.9	217.81
Triglycerides (mg/dl)	140.47	197.35*
HDL cholesterol (mg/dl)	45.2	40.5*
LDL cholesterol (mg/dl)	137.3	144.1
TC:HC ratio	4.8	5.7
Non HDL cholesterol (mg/dl)	161.7	177.3
Student 't' test *p<0.05		

Table-3: Comparison of mean lipoprotein levels in patients with normal and abnormal WHR

Lipoprotein abnormality	Waist-Hip ratio		X^2 value
	Normal	High	
High T. cholesterol	15	79	0.002
High Triglycerides	7	80	7.19*
Low HDL	11	82	1.66
High L DL	19	100	0.02
High TC:HC ratio	12	75	0.15
High Non HDL cholesterol	18	107	0.16
Chi-square test *p<0.05			

Table-4: Distribution of patients with dyslipidemia according to WHR

nificant difference except for high triglyceride level which is more frequent in patients with abnormal waist hip ratio**.**

DISCUSSION

The close relationship between the metabolism of fatty acids and glucose, the two major fuels of the body makes it inevitable that disorders involving one are associated with altered metabolism of other. It is well recognized that the most frequent complication of diabetes is atherosclerotic cardiovascular disease. The classic cardiovascular risk factors account for only 25-50% of the increased atherosclerotic risk in diabetes, other obvious risk factors are hyperglycemia and dyslipidemia.[6] However, hyperglycemia is a very late stage in the sequence of events from insulin resistance to frank diabetes, whereas lipoprotein abnormalities are manifested during the largely asymptomatic prodrome and contribute substantially to the increased risk of macrovascular disease.

In comparison with Diabcare Asia – India Study[7], our study has shown slightly higher incidence of dyslipidemia. In this study, 62.7% patients had hypercholesterolemia whereas the earlier study had shown that 46% of diabetic patients had hypercholesterolemia. Deepa, Arvind, et al[8] in a Chennai urban population based study has shown mean serum cholesterol level of 191mg/dl and 213mg/dl in patients with or without coronary artery disease. However in our study mean total cholesterol levels were higher than the previous study.

Our study has shown that mean cholesterol levels were higher in females than males. It is similar to the study done by Deborah, Richard, et al[9] and UKPDS study[10] They also showed that females are less likely than men to have HBA1c less than 7%. It is in concordance with our study. The most common abnormality in diabetes is elevation of serum triglyceride levels. In this study 58% of the patients had hypertriglyceridemia, out of that 58% were females and 58% were males. The mean triglyceride levels were 188.63mg/dl. It was only marginally different in males (187.9 mg/dl) and females (189.96mg/dl). This observation is in concurrence with the UK prospective diabetes study,[10] which showed similar findings. Waldon, Knopp, et al [11] also showed that triglyceride levels are higher in females than males in diabetes. There were 2 patients with triglyceride levels above 500mg/dl. Whenever serum triglyceride levels exceed > 500mg/dl, it is highly probable that a genetic disorder of lipoprotein metabolism is contributing to the elevation of serum triglycerides.

In this study, 62% cases had low serum HDL cholesterol. 76% of the female and 55% of males had low serum HDL cholesterol. UK prospective diabetic study [10] has shown a sex differential of 7% in patients with type 2 diabetes. However in our study has higher difference of 21%. Mean serum HDL cholesterol levels were 41.28 mg /dl. It was 40.5mg/dl in males and 42.7 mg/dl in females. In UK prospective diabetic study[10] mean HDL levels in males was 39.0 mg/dl and 42.1 mg/dl in females. Thus females had higher mean HDL cholesterol than males which is in concurrence with this study. Aleyassine, Gardiner, et al [12] and Walden C., Knoop, et al[11] has also shown that HDL – cholesterol levels are lower in males than in female diabetics.

In this study, 79.3% patients had high serum LDL cholesterol levels. 82% of the females and 78% of males had high serum LDL cholesterol levels. The mean serum LDL cholesterol was 143.1mg/dl. The mean LDL cholesterol levels were higher in females than in males, 149.2 mg/dl and 140.0 mg/dl respectively. U.K. prospective diabetic study [10] has also demonstrated higher levels in females than males, 150.8mg/dl and 139.2mg/dl respectively. National health and nutrition examination survey III (NHANES III) has reported that 44% of diabetic patients have serum LDL Cholesterol levels > 160mg/dl. However in this study 32% had serum LDL cholesterol > 160mg/dl and 53.3% had serum LDL cholesterol >130mg/dl.

The greater adverse effect of diabetes on lipoprotein concentrations in women may be related to greater rate of entry of VLDL into circulation in women which is suggested from studies of animal models, estrogen treatment and pregnancy. A greater generation of HDL and LDL is likely to result from such an increase in VLDL entry. Because of these differences, an equivalent reduction in insulin action on LPL mediated removal of VLDL triglyceride from the circulation, among other possible effect may result in greater lipoprotein abnormalities may result in women than in men.[11]

The association between obesity and dyslipidemia has long been appreciated. Central obesity has been considered more important and different parameters have been considered. In this study mean serum levels of all lipoproteins were marginally high in patients with high body mass index. However the number of patients with high lipoprotein levels was higher in patients with normal body mass index than with high body mass index. In comparison to this, mean levels of serum total cholesterol, triglycerides, LDL, Non-HDL cholesterol were higher and serum HDL lower in patients with abnormal waist hip ratio than patients with normal waist hip ratio. The association was statistically significant with regard to serum triglycerides and HDL cholesterol.

One interesting finding of this study was out of 127 cases with abnormal waist hip ratio, 71 had normal BMI. 91 cases had abnormal waist height ratio. Waist-height ratio and means levels of lipoproteins had shown similar trends as of waist-hip ratio. Many studies have compared body mass index, waist hip ratio and waist-height ratio. Hadaeqh, Zebetian, et al [13] in a study in Tehran have shown that waist height ratio is superior to body mass index as a variable of abdominal obesity. Lopatynski, et al[14] has shown similar value of body mass index, waist hip ratio, waist circumference, waist height ratio in assessing risk factor for diabetes mellitus. Sayeed, Mehtab, et al[15] has shown that waist height ratio is a better predictor of diabetes, hypertension and lipidemia than waist hip ratio and body mass index. Yoshinaga, et al[16] has compared body mass index and waist height ratio and has

shown that waist height ratio is a better predictor of central fat distribution and assessing metabolic risk than body mass index. Qiao Q et al[17] in a meta analysis did not show any significant difference between various methods of measuring obesity and its correlation with diabetes. Browning LM et al[18] indicate that WHtR may be a more useful global clinical screening tool than WC, with a weighted mean boundary value of 0·5, supporting the simple public health message 'keep your waist circumference to less than half your height'. Lee CM et al[19] supports the superiority of measures of centralized obesity, especially WHtR, over BMI, for detecting cardiovascular risk factors in both men and women. Measures of abdominal obesity are better than BMI as predictors of CVD risk, although combining BMI with these measures may improve their discriminatory capability; for any given level of BMI, waist circumference or waist–hip ratio, the absolute risk of diabetes or hypertension (risk factors for CVD incidence) is higher in some population groups than in Caucasian adults.[20]

CONCLUSION

To conclude, waist hip ratio and waist height ratio are better predictors of central obesity and risk assessment of dyslipidemia than body mass index. Mean levels of lipids are higher in women than men in type 2 diabetes. Although the control of diabetes does play a major role, a more comprehensive and multidimensional approach is required to reduce the risk of dyslipidemia in diabetes.

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