Original Article

High Incidence of Dyslipidemia In Obese Type 2 Diabetics

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ABSTRACT

Objective: To ascertain the effect of Body Mass Index (BMI) on plasma lipid profile in type 2 diabetes mellitus (T2DM).

Study design: Comparative, observational study

Place and duration of study: Army Medical College, Rawalpindi from Jan 2007- June 2010.

Patients and Methods: Sample size was 60, subdivided in to two groups. Group 1 comprising on 30 type 2 diabetics with BMI $\leq$ 25, whereas Group 2 consisted of 30 type 2 diabetics with BMI $\geq$ 28. Blood glucose, HbA_{1c}, plasma cholesterol and triglyceride levels were determined.

Results: Group 1 consisted of 56% males and 44 % females, whereas Group 2 had 54 % males and 46 % females. Mean age to develop T2DM for group 1 was 44.60 $\pm$ 1.22 years and for group 2 was 42.13 $\pm$ 0.86 years. BMI of group 1 was 20.29 $\pm$ 0.56 and Group 2 was 28.95 $\pm$ 0.26. Mean plasma cholesterol and plasma triglyceride levels of group 2 diabetics were significantly higher ($p< 0.001$) as compared with group 1 non obese diabetics. Whereas, mean plasma glucose ($p< 0.01$) and Glycosylated hemoglobin ($p< 0.05$) of group 2 diabetics were significantly higher as compared with group 1 non obese diabetics

Conclusion: Dyslipidemia was more marked in obese type 2 diabetics. Whereas diabetics with low BMI had plasma lipid profile within normal range.

Key Words: Body Mass Index (BMI), Type 2 Diabetes Mellitus (T2DM), Dyslipidemia, Coronary Artery Disease (CAD), Atherosclerosis

INTRODUCTION

Diabetes is emerging as a serious challenge for physicians everywhere in the world, particularly in developing countries. According to several epidemiological studies, T2DM is an independent risk factor for cardiovascular disease due to accompanying dyslipidemia (1). Framingham (2) recognized and several subsequent studies confirmed that T2DM is responsible for 50 – 200% increase in the mortality rate due to ischemic heart diseases associated with disturbed lipid profile. Dyslipidemia is mainly defined as the raised plasma levels of total cholesterol, triglycerides, or both (3). It is a characteristic feature of T2DM and an electrifying rise in the incidence of T2DM accompanied with dyslipidaemia is expected to occur in the near future (4). Dyslipidemia is readily associated with insulin resistance – another hallmark of T2DM, which leads to hyperinsulinemia, as a compensatory mechanism. It also leads to hepatic overproduction of VLDL, decrease clearance of triglycerides from lipoproteins and suppressed activity of lipoprotein lipase. Other factors contributing in disturbed lipid profile include increase availability of glucose and free fatty acids substrates in the blood, obesity, sedentary life styles, fatty food consumption, Hypothyroidism, tobacco smoking and alcohol consumption, thus enhancing the risk to develop ischemic heart disease in the diabetics than non-diabetics (5). Therefore, the effective management of dyslipidemia is essential to reduce the risk of cardiovascular diseases in diabetic population. Several studies have revealed that obesity is strongly linked with dyslipidemia in diabetics (6). Recently, in 2009, a study in Pakistan revealed high incidence of dyslipidemia in obese diabetics (7). Moreover, other two Pakistani studies found dyslipidemia as the only significant feature in obese diabetics (8, 9). Abbasi MA et al (2007) reported raised levels of total cholesterol as the only main finding in type 2 diabetics (10). Few Canadian reports also confirmed these findings (11).

Hence, it can be concluded safely that obesity, T2DM and dyslipidemia form an established triad characterized by insulin resistance and atherosclerotic disorders increasing the morbidity and mortality in diabetics (12).

Obesity is usually labeled with reference to body weight (Kg) and height (m) i.e. BMI. In T2DM, the association between dyslipidemia and BMI has been extensively discussed during the past few decades (13). Undoubtedly, thorough assessment of all risk factors in the diabetics is essential to implement specific preventive measures to modify these factors and enabling the diabetics to live a life with minimum

complications. Fortunately, some of these risk factors are modifiable if given proper attention before the complications start to develop. One of these modifiable risk factors is obesity – a big problem which can trigger dyslipidemia, CAD, hypertension and many others disasters. Ghoddusi et al, 2008 (14) described BMI as a noteworthy predictor of CAD and T2DM. As raised BMI is related with dyslipidemia in T2DM, an important fact gets attention that if diabetics manage to reduce BMI, the lipid profile can be changed in to more favorable pattern. Thus, low BMI should reduce the chance to develop atherosclerotic disorders. The best way to achieve this target is by educating the diabetics about diabetes, its complications and the significance of preventive measures.

Aims & Objectives

This study was planned to evaluate the association of low and high BMI with lipid profiles in patients with T2DM in perspective of Rawalpindi and Multan Districts.

Statistical Analysis

All statistical calculations were done with computer software programme "Statistical Package for Social Sciences (SPSS)" for windows, version 15.00. Data was subsequently examined by Independent – Sample T-test. The results are phrased as mean ± s.e.m.

PATIENTS AND METHODS

This study was carried out in the Armed Forces Institute of Cardiology (AFIC) and Army Medical College, Rawalpindi. The study period was Jan 2008 to Jan 2010. Patients were randomly selected from government hospitals of Rawalpindi and Multan district. The study was conducted according to the declaration of Helsinki and approved by the Ethics committee of National University of Sciences and Technology (NUST).

Total sample size was 60. It was subdivided into two groups. Group 1, comprised of 30 confirmed cases of T2DM with BMI $\leq$ 25. Diabetics with other metabolic disorders were excluded. Group 2 comprised of 30 confirmed cases of T2DM with BMI $\geq$ 28. Every possible effort was made to exclude the probability of using lipid lowering drugs. Peripheral venous blood samples were analyzed for estimation of plasma glucose, plasma cholesterol and triglyceride levels by enzymatic colorimetric method and Glycosylated hemoglobin by ion exchange chromatograph (15). Plasma cholesterol level was interpreted according to the criterion established by National Cholesterol Education Program (NCEP) i.e. plasma cholesterol level < 5.17 mmol/L (normal), 5.17 – 6.20 mmol/L (borderline) and > 6.20 mmol/L as hypercholesterolemia. Plasma triglyceride level > 1.82 mmol/L was taken as hypertriglyceridemia (16). BMI was calculated by measuring the weight (Kg) and height (m^2).

Weight of all the subjects was recorded by the same weighing machine, without shoes and minimum clothing. Height was measured by a vertical bar with a steel tape attached. BMI of 19 – 25 kg/m^2 was considered as normal, 25 – 28 acceptable but not desirable, 28 – 30 as overweight and $\geq$ $30kg/m^2$ as obese (17).

RESULTS

Group 1 comprised of 56% males and 44 % females. Group 2 consisted of 46 % females and 54% males (Table 1). Mean age at which Group 1 developed T2DM was found to be 44.60 $\pm$ 1.22 years and of group 2 was 42.13 $\pm$ 0.86. BMI of group 1 was 20.29 $\pm$ 0.56 and found to be significantly lower as compared with Group 2 (28.95 $\pm$ 0.26). Mean plasma cholesterol and plasma triglyceride levels of group 2 diabetics were very significantly higher ($p< 0.001$) as compared with group 1. There was no significant statistical difference between males and females with regard to the plasma lipid levels. Mean plasma glucose ($p< 0.01$) and Glycosylated hemoglobin ($p< 0.05$) of group 2 diabetics were significantly higher as compared with group 1. This comparison is shown in Table 2.

Table-1: Age and sex distribution of Type 2 diabetics with high and low BMI. The number of subjects is given in parenthesis.

	Group 1 (30)	**Group 2 (30)**
Age in years (mean $\pm$ SD)	52.47 $\pm$ 1.77	54.20 $\pm$ 1.32
Sex distribution (%)		
Male	56 %	54 %
Females	44 %	46 %

DISCUSSION

In this study, comparison of two BMI groups (normal and overweight) with regard to serum total cholesterol and triglycerides in T2DM was evaluated. Study showed positive and remarkable association between BMI and serum lipid profiles in type 2 diabetics. Moreover, plasma triglyceride and total cholesterol levels were linearly associated with BMI both in males and females.

Table-2: Comparison of age of onset of diabetes, plasma glucose, HbA_{1c}, plasma cholesterol, plasma triglyceride and BMI of two groups of type 2 diabetics. The number of subjects is given in parenthesis. The values are mean ± s.e.m.

	Group 1 (30)	Group 2 (30)
Age of onset of T2DM(years)	44.60 ± 1.22	42.13 ± 0.86
Plasma glucose (mmol/L)	9.69 ± 0.80	12.47 ± 0.78**
Glycosylated hemoglobin (%)	7.49 ± 0.50	8.91 ± 0.34*
Plasma Cholesterol (mmol/L)	3.91± 0.23	6.19 ± 0.30***
Plasma Triglyceride (mmol/L)	1.36 ± 0.77	2.07 ± 0.23***
BMI (Kg/m^2)	20.00 ± 0.44	28.95 ± 0.26***

*p <0.05 as compared with group 1 (significant).
**p <0.01 as compared with group 1 (highly significant).
***p < 0.001 as compared with group 1 (very highly significant).

Present study revealed that plasma cholesterol and triglycerides levels were significantly higher in overweight diabetics as compared to diabetics with low BMI. Hence the significant impact of low BMI on lipid profile cannot be overlooked. Moreover, it gives a satisfactory feeling to the patient and the doctor as well because one important and common risk factor responsible for CAD and other ischemic heart diseases i.e. lipid profile can be controlled if BMI is managed within normal range (17, 18). The significance of this finding can be better understood with an example of a case study (19) which showed that in spite of bringing blood glucose to the normal limit in obese diabetic, improvement in dyslipidemia was observed only after weight reduction.

American Diabetes Association (ADA) has also acknowledged that high BMI (> 27) can lead to type II diabetes and dyslipidemia. Hence, the condition can be labeled as a vicious cycle i.e. high BMI increases the chance to develop T2DM, which, along with raised BMI, sequentially increase the probability to develop dyslipidemia – a potent threat for CAD (20).

Much has been printed in recent years about the diabetes and its association to both obesity and dyslipidemia. The findings of our study were consistent with the earlier studies. Present study also showed that BMI could be used as an indicator of dyslipidemia in selected study group and provided the evidence for the low incidence of dyslipidemia in type 2 diabetic patients with low BMI. This is consistent with the findings of Arora et al (2007) (21) and a study on Spanish population (22).

Moreover, poor glycaemic control in group 2 diabetics cannot be overlooked as their blood glucose and Hb_{A1c} was higher as compared with group 1. Persistent hyperglycemia can also disturb lipid profile due to insulin resistance and hyperinsulinemia which in turn is associated with hypertriglyceridemia (6). This finding is statistically significant and needs to be evaluated on a bigger scale as there are studies which show that better glycaemic control can positively modify dyslipidemia in T2DM (23). Therefore, both factors i.e. high BMI and uncontrolled hyperglycemia may be taken as responsible for dyslipidemia in the selected study group.

Evaluation and assessment of plasma lipid profile in diabetics, by simple and non-invasive methods, can be resourcefully used in clinical practice to further see the relationship between BMI and dyslipidemia.

Hence, we can conclude that strict monitoring of BMI and glycaemic control in diabetic patients can keep lipid profile within normal limits which may alleviate the symptoms and improve the quality of life of type 2 diabetics. Otherwise, if hypercholesterolemia and hypertriglyceridemia co–exist with high BMI among diabetics, a high prevalence of atherosclerosis and CAD would be inevitable in future (24).

Unfortunately, low literacy rate and poverty is a great barrier for better understanding of the diabetes and its effective management in developing countries (3). To improve or eliminate obesity related diabetic complications, weight reducing measures must be given special attention. In addition, diabetic community must be educated about the hazards of high BMI. Moreover, reduced dietary intake of saturated fats (< 7% of total calories) and cholesterol and regular exercise should be promoted (25).

CONCLUSION

Type 2 diabetics having high BMI accompanied with uncontrolled hyperglycemia are more prone to develop dyslipidemia. Hence, in order to manage dyslipidemia, it is essential to identify its secondary contributing causes, like raised BMI and poor glycaemic control and then patients can be benefited by restricting caloric intake and achieving near-normal blood-glucose levels, hoping that this approach will also improve plasma lipid profile.

RECOMMENDATIONS

The immediate clinical goal in the management of T2DM should be to control hyperglycemia and the long

term objective must be to adopt preventive measures, like BMI control, in order to avoid future microvascular and macrovascular complications.

In spite of laborious studies done to explain the multifaceted pathogenesis of the dyslipidemia of high BMI, prospective statistics for such an effect is still lacking. Hence further research work on diabetics with different BMI values is still required to expedite dietary patterns and other measures which can be adopted to decrease BMI and control dyslipidemia in type 2 diabetics.

REFERENCES

1. Graces C, Guisado JG, Benavente M et al. Brief epidemiologic report: Obesity in Spanish schoolchildren: relationship with lipid profile and insulin resistance. Obesity Research: 2005; 13(6): 959.
2. Grundy SM et al. primary prevention of coronary heart disease: guidance from Framingham. A statement for healthcare professionals from the AHA Task Force on risk reduction. American Heart Association. Circulation: 1998; 97(18): 1876 – 87.
3. Wierzbicki AS. Diabetic dyslipidemia: the triad. European Heart Journal Supplements: 2006; 8: 30 – 33.
4. Mangesha AY. Lipid profile among diabetes patients in Gaborone, Botswana. JEMD SA: 2006; 11(1): 32 – 34.
5. Betteridge D.J. Treating dyslipidemia in the patient with type 2 diabetes. European Heart Journal Supplements: 2004; 6: 28 – 33.
6. Ahmed N, Khan J, Siddiqui TS. Frequency of dyslipidemia in type 2 diabetes mellitus in patients of Hazara Division. J Ayub Med Coll Abbotabad: 2008; 20(2): 51 – 54.
7. Habib SS, Aslam M. Risk factors, knowledge and health status in diabetic patients. Saudi Medical Journal: 2003; Vol. 24 (11): 1219 – 1224.
8. Bhatti SM, Dhakam S, Khan MA. Trends of lipid abnormalities in Pakistani Type-2 Diabetes Mellitus patients: A tertiary Care Centre Data. Pak J Med Sci: 2009; 25(6): 883 – 889.
9. Khan SR, Ayub N, Nawab S, Shamsi TS. 2008 May. Triglyceride profile in dyslipidaemia of type 2 diabetes mellitus. J Coll Physicians Surg Pak: 2008; 18(5):270 – 3.
10. Abbasi MA, Hafeezullah, Shah NA, Abro AD, Sammo JA. Non high density lipoprotein cholesterol in type 2 diabetes mellitus. Pak J Physiol: 2007. 3(2), 40 – 43.
11. Canadian Diabetes Association. Dyslipidemia in adults with Diabetes. Canadian Journal of Diabetes: 2006; 30(3): 230 – 240.
12. Rosenson RS. HDL-C and the diabetic patients: target for therapeutic intervention. Diabetes Res. Clin. Pract: 2005; 68: 36 – 42.
13. Joeng SK, Seo MW, Kim YH et al. Does waist indicate better than BMI in Korean adult population .J Korean Med Sci: 2005; 20: 7 – 12.
14. Ghoddusi K, Ameli J, Kachuee V et al. Association of diabetes mellitus and dyslipidemias in the Tehran population. Eastern Mediterranean Health Journal: 2008; 14(3): 647 – 53.
15. First MR. Kaplan LA, Pesco AJ, Kazmierczak SC. Clinical chemistry. JB lippincott company, Philadelphia: 1994; 2: 269 – 80.
16. Executive Summary of the Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). JAMA: 2001; 285: 2486 – 2497.
17. Abbas S, Abbas S. Lipid-lowering effect of Atorvastatin in patients with type-2 Diabetes Mellitus. PAFMJ: 2004; 54(2):170 – 5.
18. Howard BV, Ruotolo G, Robbins DC. Obesity and dyslipidemia. Endocrinol Metab Clin N Am: 2003; 32: 855 – 67.
19. Anderson JE. Case Study: Dyslipidemia in a patient with Type 2 Diabetes. Clinical Diabetes: 2006; 24(4); 189-90.
20. McPherson R, Frolich J, Fodor G, et al. Canadian cardiovascular society position statement. Recommendations for the diagnosis and treatment of dyslipidemia and prevention of cardiovascular disease. Can J Cardiol: 2006; in press.
21. Arora, M. Koley, S. Gupta , S et al. A study on lipid profile and body fat in patients with diabetes mellitus. Anthropologist: 2007; 9(4): 295 – 298.
22. Garce's C, Guisado JG, Benavente B et al. Obesity in Spanish schoolchildren: Relationship with lipid profile and insulin resistance. Obesity Research: 2005; 13(6): 959 – 63.
23. Marcus AO. Lipid disorders in patients with type 2 diabetes; Meeting the challenges of early, aggressive treatment. Postgrad Med: 2001; 110(1):111 – 23.
24. Bruce DG, Davis WA, Cull CA, Davis TM. Diabetes education and knowledge in patients with type 2 diabetes from the community: The Fremantle Diabetes Study. J Diabetes Complications: 2003; 17: 82 – 89.
25. Nakhjavani M, Esteghamati A.R., sfahanian F, Heshmat AR. Dyslipidemia in type2 diabetes mellitus: more atherogenic lipid profile in women. Acta Medica Iranica: 2006; 44(2): 111 – 118.