Original Article

Effect of Abdominal Obesity On Fasting Blood Glucose Levels In Type-2 Diabetes Mellitus Patients Treated With Oral Hypoglycemic Agents

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Objective: To observe the effect of abdominal obesity on fasting blood glucose levels in T2DM patients who are on treatment with oral hypoglycemic agents.

Material & Methods: The study included 55 T2DM patients, who were taking oral hypoglycemic drugs for the last 3 to 5 years. Abdominal obesity was assessed by measuring waist circumference. Fasting blood glucose levels were measured in all patients.

Results: According to our observation there were 41.81% non-obese, 23.63% overweight and 34.54% obese T2DM patients. The obese T2DM patients had significantly higher mean fasting blood glucose level as compared to non-obese and overweight T2DM patients ($p<0.001$). Overweight T2DM patients though had higher mean fasting plasma glucose levels as compared to non-obese T2DM patients but it was not significant.

Conclusion: Abdominal obesity is associated with significantly higher fasting blood glucose levels in T2DM patients who are on treatment with oral hypoglycemic agents.

Keywords: Type-2 diabetes mellitus (T2DM), Obesity, Fasting Plasma Glucose (FPG)

Introduction

Obesity is considered to be one of the major risk factors in developing insulin resistance and aggravating the metabolic disturbances in patients of type 2 diabetes mellitus.[1] Obesity is also related to adverse levels of several cardiovascular risk factors, including high blood pressure, dyslipidemia and hyperglycemia.[2] Obesity is defined as weight greater than 20% of desirable weight of a person or BMI greater than 27 kg/m^2 or the person is considered obese if the waist circumference is >88 cm and >102 cm in female and male respectively.[3,4] Increased waist hip ratio i.e central obesity in T2DM patients increases the risk of hyperglycemia, cardiovascular disease and atherosclerosis.[5,6] Obesity not only causes the development of peripheral insulin resistance but also diminishes the suppression of hepatic glucose production resulting in hepatic insulin resistance.[7] The insulin resistance is further aggravated with diminished physical work capacity and development of obesity.[8] Treatment of obese T2DM patients requires modification to keep the blood glucose levels in normal limits.[9] When diabetes, hypertension or family history of these diseases is present, treatment will have benefits only when a lesser degree of obesity is present.[10] Insulin sensitivity and other metabolic disorders like glucose level seem to improve with weight loss in obese patients.[1,7,11]

Material & Methods

The study included 55 male & female T2DM patients, with age between 30-60 years already taking oral hypoglycemic agents for the last 3-5 years. Waist circumference was measured in all T2DM patients, and was used to categorize them as follows:

Male:

1) Non-obese < 90 cm
2) Over weight >90 cm but <102 cm
3) Obese > 102 cm

Female:

1) Non Obese < 80 cm
2) Over weight > 80 cm but < 88 cm
3) Obese > 88 cm

The waist circumference was measured with a soft tape at the level of the smallest girth above the umbilicus in standing position.[12,13] Blood analysis for fasting plasma glucose (FPG) was done on 2 ml venous blood and estimated by glucose oxidase method.[14] Statistical analysis was done for, mean value, standard deviation, and student's t test was used for comparison of means.

Results

The study included 55 T2DM patients with 34 males and 21 females who were evaluated for FPG, and for status of obesity. It was observed that 34.54% T2DM patients were obese, 23.63% were overweight and 41.81% had normal weight **(Table1)**. 11 males & 8 females were obese having mean waist circumference of 109.20 $\pm$ 5.63 cm and 97.63 $\pm$ 8.40

cm respectively. The mean waist circumference of 9 male and 4 female over weight T2DM patients, were 95.58±2.86 & 83.69±1.55 cm respectively. The mean waist circumference of 14 male & 9 female non-obese T2DM patients were 74.28±5.73 and 71.75±5.12 cm respectively **(Table-2).** The waist circumference was significantly ($p<0.001$) higher in obese as compared to non-obese & over weight male & female T2DM patients. The mean FPG in non-obese male and female patients were 98.64±10.43 & 96.66±7.93 mg/dL respectively. The mean FPG in over weight male and female T2DM patients were 102.20±8.63 & 95.50±10.34 mg/dL respectively. The mean FPG in obese male & female patients were 134.00±12.89 and 132.50±12.46 mg/dL respectively. The mean FPG level was significantly ($p<0.001$) higher in obese as compared to non obese and over weight T2DM patients **(Table-2).** There was no significant difference in mean FPG levels in obese male & female T2DM patients.

Table-1: T2DM patients categorized on the basis of waist circumference

No. Of T2DM Patients	Obese T2DM Patients	Over-weight T2DM Patients	Non-Obese T2DM Patients
Male (n=34)	11	09	14
Female (n=21)	08	04	09
Total (n-55)	19 (34.54%)	13 (23.63%)	23 (41.81%)

Table-2: Fasting plasma glucose & waist circumference in different groups of T2DM Patients. Values of (Mean ± SD) are shown

T2DM Patients.	M/F	FPG (mg/dL)	Waist Circumference (cm)
Obese (n=19)	Male	134.00±12.89*	109.20±5.63*
	Female	132.50±12.46*	97.63±7.85*
Over-weight (n=13)	Male	102.20±8.63	95.58±2.86
	Female	95.50±10.34	83.69±1.55
Non-Obese (n=23)	Male	98.64±10.43	74.28±=7.93
	Female	96.66±7.93	71.75±5.12

*$p< 0.001$

Discussion

The number of studies carried out earlier have reported that the pattern of fat distribution in body influences the degree of insulin resistance that develops with obesity.[13,15,16,17] The measurement of waist circumference in obese T2DM patients has been carried out which shows that a high waist hip (W/H) ratio causes more metabolic disturbances, increased risk for cardiovascular diseases and an increased mortality and morbidity in both lean and obese individuals.[13,16,17] The development of obesity or change in body fat pattern in T2DM patients taking hypoglycemic drugs can affect the metabolic status of the patients particularly the blood glucose levels.[17,18,] The presence of obesity causes an increased risk for insulin resistance, cardiovascular disease including elevated blood pressure, lipids and glucose levels.[4,18,19] In present study the incidence of obesity was observed in 34.54% of T2DM patients, whereas 23.63% T2DM patients were overweight and 41.81% had normal weight. The risk of diabetic complications in obese T2DM patients is highly increased specially when there is central obesity.[4,16,18,19] The affect of obesity on suppression of hepatic glucose output has also been assessed in previous studies and it seems to be diminished in obese T2DM patients as compared to normal healthy controls, indicating that obesity is accompanied by not only peripheral insulin resistance but also hepatic insulin resistance.[20,21,22] The fasting plasma glucose levels were significantly ($p<0.001$) increased in obese male & female T2DM patients in present study as compared to non-obese & over weight T2DM patients. Similar finding have also been observed in number of earlier studies.[4,15,22,23] Life style modification through weight reduction and exercise can play a significant role in better glycemic control in T2DM patients.[7,8,11]

Conclusion:

Abdominal obesity disturbs the blood glucose levels in T2DM patients who are on treatment with oral hypoglycemic drugs.

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References

1. Maeguwa H, Kashiwagi A, Shigeta Y. Obesity as a risk factor for developing non-insulin dependent diabetes mellitus. Obesity and insulin resistance. Nippon Naibunpi Gakkai Zasshi 1995; 71 (2): 97-104.
2. Kissebah AH, Vydelingum N, Murray H. Health risk of obesity. Med Clin N Am 1989; 73:111-38.
3. Ali N, Afzal N, Ahmad MZ, Shahjahan S, Shaikh AS. Obesity indices and lipid levels in healthy relatives of T2DM patients. Pak Postgrad Med J 2003; 14 (4): 189-93.
4. Tan CE, Ma S, Wai D, Chen SK, Tai ES. Can we apply the National Cholesterol Education Program Adult Treatment Panel definition of the metabolic syndrome to Asians? Diabetes Care 2004; 27(5): 1182-86.
5. Landin K, Stigenal L, Erikson E, Krotkiewski M, Risberg B, Tenborn L, et al. Abdominal obesity is associated with an impaired fibrinolytic activity and elevated plasminogen activator inhibitor-I. Metabolism 1990; 39(10): 1044-48.
6. Kissebah AH. Insulin resistance in obesity. Int J Obesity 1991; 15(Suppl 2): 109-15.
7. Walker M. Obesity, insulin resistance and its link to non-insulin dependent diabetes mellitus. Metabolism 1995; 44(9) Suppl 3: 18- 20.
8. Nyholm B, Mengel A, Nielsen S, Skjaerback CB, Moller N, Alberti KG, et al. Insulin resistance among relatives of patients with NIDDM. Significance of physical fitness and muscle metabolism. Ugeskr-Laeger 1998; 160(4): 410-15.
9. Masud F, Hasan M, Abaidullah S, Alam I. Assessment of metabolic profile and body mass index (MBI) in type II diabetics treated with metformin and insulin. Pak J Med Sci 1992; 9 (1): 29-34.
10. Caro JF. Insulin resistance in obese and non-obese men. J Clin Endocrinol Metabol 1991; 73 (4): 691-95.
11. Golay A, Felder JP, Dusmet M. Effect of weight loss on glucose disposal in obese and non obese diabetic patients. Int J Obesity 1985; 9: 181-90.
12. Mckeigue PM, Shah B, Marmot MG. Relation of central obesity and insulin resistance with high diabetes prevalence and cardio-vascular risk in South Asians. Lancet 1991; 337: 382-86.
13. Hartz AJ, Rupley DC, Rimm AA. The association of girth measure-ment with disease in 32,856 women. Am J Epidemiol 1984; 119: 71-80.
14. Barham D and Trinder P. An improved colour reagent for the determination of blood glucose by the oxidase system. Analyst 1972; 97: 142-5.
15. Landin K, Krotkiewski M, Smith U. Importance of obesity for the metabolic abnormalities associated with an abdominal fat distribution. Metabolism 1989; 38(6): 572-76.
16. Lapidus L, Bengtsson C, Larsson B. Distribution of adipose tissue and risk of cardiovascular disease and death. A 12-year follow up of participants in the population study of women in Gothenberg, Sweden. Br Med J 1984; 289: 1257-61.
17. Krotkiewski M, Bjorntorp P, Sjostrom L. Impact of obesity on metabolism in men and women. Importance of regional adipose tissue distribution. J Clin Invest 1983; 72: 150-62.
18. Scheen AJ. From obesity to diabetes. Why, when and who? Acta Clin Belg 2000; 55(1): 9-15.
19. Ali N, Afzal N, Shahjahan S, Ahmad MZ, Baseer A. A study of insulin resistance in obese and non-obese healthy first degree relatives (FDRs) of type-2 diabetes mellitus patients. Pak Postgrad Med J 2004; 15(2): 81-92.
20. Funahashi T, Matsuzawa Y. Metabolic syndrome: clinical concepts and molecular basis. Ann Med 2007; 39(7):482-94.
21. Bonadona RC, Group L, Kraemer N. Obesity and insulin resistance in humans: A dose-response study. Metabolism 1990; 39: 452-59.
22. Sparrow D, Borkan G, Gerzof S. Relationship of fat distribution to glucose tolerance: results of computed tomography in male participants of the Normative Aging Study. Diabetes 1986; 35: 411-15.
23. Ohlsson LO, Larsson B, Suardsudd K. The influence of body fat distribution on the incidence of diabetes mellitus. 13.5 years of follow up of the participants in the study of men born in 1913. Diabetes 1985; 34: 1055-58.