Section: General Medicine

Original Research Article

A STUDY ON ASSOCIATION BETWEEN ULTRASONOGRAPHIC VISCERAL FAT THICKNESS AND CARDIOVASCULAR RISK IN TYPE 2 DIABETES MELLITUS

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Abstract

Background: Diabetes mellitus (DM) is a metabolic disorder, with 150 million cases worldwide, with India leading the way. Obesity causes metabolic and cardiovascular disease. Estimation of visceral fat accumulation is crucial in high-risk patients. **Aim:** This study aimed to assess the independent relationship between visceral fat thickness and cardiovascular risk in patients with type 2 diabetes and identify a high-risk group for cardiovascular diseases. **Material and Methods**: This observational study included 50 patients with known cases of type 2 diabetes mellitus who were selected from the Department of Diabetology, Government Rajaji Hospital, Madurai Medical College, Madurai, from April 2014 to September 2014. A thorough clinical evaluation was performed, and a detailed history, blood pressure, height, weight, waist circumference, and hip circumference were obtained. **Results**: Most patients were between 41 and 50 years of age, and approximately 27 had a BMI between 26-28. All patients with increased visceral fat thickness had increased triglyceride and LDL levels. Therefore, there was a strong positive correlation between increased visceral fat thickness and the LDL and TGL levels. Thirteen patients had microalbuminuria, of which > 90% had visceral fat thickness > 7.5. They also had increased triglyceride and LDL levels. There was no significant correlation between visceral fat thickness and total cholesterol levels. Similarly, HDL levels did not show any strong correlation with visceral fat thickness. **Conclusion**: Visceral fat thickness, microalbuminuria, and elevated LDL and TGL levels are reliable indicators of cardiovascular risk. Ultrasonographic measurements are used because of radiation exposure and cost.

INTRODUCTION

Diabetes mellitus (DM) is a metabolic disorder characterised by hyperglycaemia and insufficient secretion or action of endogenous insulin. Currently, the number of diabetes cases worldwide is estimated at approximately 150 million. India leads the world with the largest number of diabetic subjects earning the dubious distinction of being the "diabetic capital of the world". The International Diabetes Federation estimates the total number of diabetic subjects to be around 40.9 million in India, and this is further to be set to 69.9 million by the year 2025.

Obesity has caused many public health problems related to metabolic diseases, including glucose intolerance, hypertension, hyperinsulinaemia, dyslipidaemia, and atherosclerosis. Moreover, these complexes are known to increase the risk of cardiovascular disease. In particular, the accumulation of adipose tissue predominantly in the visceral cavity plays a major role in the development of metabolic syndrome and cardiovascular diseases. Therefore, estimating visceral fat accumulation is important for evaluating patients at high risk of cardiovascular disease.

Generally, computed tomography (CT) is recognised as the standard method for estimating visceral fat. However, radiation exposure, the high cost of CT, and its low availability prevent the widespread use of CT in clinical and epidemiological studies. Therefore, alternative

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simple and noninvasive methods have been used to assess visceral fat thickness. Some alternative methods are Body Mass Index (BMI), waist-hip ratio, dual-energy X-ray absorptiometry, and ultrasonography. Ultrasonography is a reliable and convenient method for quantifying visceral fat, and diverse USG values have been reported to be useful.

Aim

This study aimed to assess the independent relationship between visceral fat thickness and cardiovascular risk in patients with type 2 diabetes and to identify a high-risk group for cardiovascular diseases.

MATERIALS AND METHODS

This observational study was conducted on 50 patients who had known cases of type 2 diabetes mellitus and were selected from the Department of Diabetology, Government Rajaji Hospital, Madurai Medical College, Madurai, from April 2014 to September 2014. The study was approved by the institutional ethics committee before initiation, and informed consent was obtained from all patients.

Inclusion Criteria

Patients with type 2 diabetes, aged > 35 years, both sexes and BMI > 25 were included.

Exclusion Criteria

Patients with self-reported diabetes mellitus, dyslipidaemia, pregnancy, hypothyroidism, hypertension, renal failure, smokers, alcoholics, and patients on thiazolidinediones were excluded.

A thorough clinical evaluation was performed, and a detailed history, blood pressure, height, weight, waist circumference, and hip circumference were obtained. A fasting lipid profile was obtained using enzymatic methods, such as the Zaks method, and a spot urine sample for microalbuminuria was obtained. Waist circumference was measured at the midpoint between the lower costal margin and the anterior superior iliac spine in the mid-axillary line, and hip circumference was measured at the level of the greater trochanter of the femur. Waist-hip ratio (WHR) ≥ 0.90 in males and ≥ 0.80 in females were considered significant, anthropometric measurements were performed to calculate BMI and WHR, and BMI > 25 for males and females was considered significant to indicate obesity.

Visceral fat thickness (VFT) was measured by ultrasound of the patient's fasting, bowel preparation performed by an enema, the patient in a supine posture with full expiration, USG probe was kept 5 cm above the umbilicus in the midline joining the xiphisternum and umbilicus; the distance between the internal surface of the rectus abdominis muscle and posterior wall of the aorta was measured, frozen images were taken, and at least three measurements were taken and the mean was calculated to avoid measurement errors.

Statistical Analysis.

RESULTS

Most patients were between 41 and 50 years of age. The second highest age group was 51 – 60 years. 25 males and 25 females were equally enrolled in the study. As BMI > shows the BMI distribution of the study among the 50 patients selected, approximately 27 patients had a BMI between 26-28 (Table 1).

The mean visceral fat thickness was 6.08 in the 50 subjects. The mean total cholesterol was 220.72, the mean triglyceride level was 178.3 which was very high, the mean HDL was 39, and the mean LDL was 145.32. Therefore, there was a positive correlation between visceral fat thickness and triglycerides and LDL, and the mean BMI was 27.61 for 27 patients with a BMI between 26-28. The mean visceral fat thickness was 6.08 (Table 2).

Among the 50 patients, 13 had microalbuminuria, of which > 90% had a visceral fat thickness of > 7. This clearly shows a strong positive correlation between increased visceral fat and microalbuminuria. In the comparison between BMI and microalbuminuria, 13 patients among 50 were found to have microalbuminuria, out of which most of the patients belong to the group of BMI > 28. The mean BMI microalbuminuria was 29.59.

Microalbuminuria and triglyceride levels in 50 subjects with type 2 diabetes mellitus; more than 90% of these patients had a visceral fat thickness of > 7.5, and when their triglyceride levels were compared, the mean TGL level was approximately 212. Therefore, there was a strong positive correlation between increased visceral fat thickness, microalbuminuria, and triglyceride levels.

The presence of microalbuminuria and LDL levels in the 13 patients with microalbuminuria and the mean LDL level was approximately 178.8. Therefore, there was a positive correlation among increased visceral fat thickness, microalbuminuria, and LDL levels (Table 3).

Approximately 34% of the patients had visceral fat < 5.5. 32% of the patients had a visceral fat thickness between 5.6-6.5. 26% of the patients had visceral fat thickness of 6.6-7.5. 8% of the subjects had a visceral fat thickness of > 7.5 and had high levels of TG microalbuminuria.

The mean triglyceride levels in different measurements of the visceral fat thickness of the 50 subjects, 17 patients had a VFT of < 5.5 and had a TGL level of approximately 147.8. However, patients who had a high visceral fat thickness of > 6.5 significantly had high levels of triglycerides, and their mean level was around 176.6. Therefore, there was a strong positive correlation between increased visceral fat thickness and triglyceride levels (Table 4).

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Table 1: Demographic data of the study

		Number of patients
Age in years	< 40	3
	41 – 50	20
	51 – 60	18
	> 60	9
Sex	Male	25
	Female	25
BMI	< 26	7
	26.1 to 28.0	27
	28.1 to 30.0	8
	> 30	8
Visceral Fat	< 5.5	17
	5.6-6.5	16
	6.6-7.5	13
	> 7.5	4

Table 2: Comparison between mean visceral fat thickness and lipid profile

Visceral fat and lipid profile	Mean ± SD	P value
Visceral Fat	6.08±0.97	-
Cholesterol	220.72±34.43	< 0.001
TGL	178.3±41.87	< 0.001
HDL	39±2.67	< 0.001
VLDL	35.67±8.47	< 0.001
LDL	145.32±31.41	< 0.001
BMI	27.61±1.81	< 0.001

Table 3: Comparison of visceral fat thickness, BMI, TGL, and LDL with microalbuminuria in subjects with type 2 diabetes

		Mean ± SD	P value
Visceral Fat	Present	7.22±0.59	< 0.001
	Nil	5.68±0.74	
BMI	Present	29.59±1.82	< 0.001
	Nil	26.92±1.19	
TGL	Present	212.15±42.4	< 0.001
	Nil	166.41±35.02	
LDL	Present	178.8±22.74	< 0.001
	Nil	133.56±24.96	

Table 4: Comparison of occurrence of increased TGL in different levels of visceral fat thickness in type 2 diabetic subjects

	Mean ± SD	P value
< 5.5	147.8±34.9	< 0.001
5.6 - 6.5	176.6±18.2	
> 6.5	210.4±41.8	

DISCUSSION

Diabetes mellitus refers to a group of metabolic disorders, and India is referred to as the world's diabetic capital. At the same time, obesity is an emerging problem in most of the developing countries and developed countries. Previously, many parameters have been used to assess the cardiovascular risk in any individual. BMI and waist-hip ratio have been used previously. However, measurement of visceral adiposity is now considered the method of choice for assessing the risk of cardiovascular diseases. Visceral adiposity or visceral fat thickness can be measured by computerised tomography, dual-energy X-ray absorptiometry, etc.

Among the 50 diabetic subjects (25 males and 25 females) attending the department of Diabetology in Government Rajaji Hospital, Madurai, with BMI of > 25, increased visceral fat thickness was found in 12 males and 15 females.

Although measuring the VFT by CT is considered the gold standard method, various studies have been conducted with the measurement of visceral adiposity by ultrasonography, and it has been proven that ultrasound measurement of visceral adiposity is equally efficacious when compared with CT. Therefore, in our study, ultrasound was used to measure visceral adiposity. Moreover, CT is not preferred owing to its high cost and radiation exposure. Because ultrasound is noninvasive, easily measurable, and less costly, USG is preferred over CT. Another emerging method for measuring visceral adiposity is to measure sagittal abdominal diameter (SAG).

Among the 50 patients, all the patients who had increased visceral fat thickness had an increased triglyceride level and increased LDL level. Therefore there is a strong positive correlation between increased visceral fat thickness and LDL, TGL levels. Similarly, 13 patients had microalbuminuria, out of which more than 90% of

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patients had a Visceral fat thickness of more than 7.5. They also had a increased triglyceride level and LDL levels.

Many studies have been conducted on sagittal abdominal diameter, which will also show the cardiovascular risk of patients. SAG is measured using a separate calliper known as a agittometer. However, in our study, USG-guided visceral adiposity measurement in type 2 diabetic subjects with a BMI > 25 showed a strong positive correlation with TGL, LDL, and microalbuminuria. The cut-off for visceral fat thickness was maintained in a range of less than 5.5, 5.6, 6.5, 6.6, 7.5, and more than 7.5. Patients were classified according to these categories, and their lipid profiles were compared. There was a clear positive correlation between increased visceral fat thickness, elevated LDL and TGL levels and microalbuminuria.

CONCLUSION

Even though there are many parameters to assess the cardiovascular risk like BMI, WHR, etc., measuring the visceral fat thickness is a reliable indicator to assess the cardiovascular risk. Because of the presence of microalbuminuria, there is evidence of subclinical endothelial injury in this patient, who is more prone to cardiovascular risk in the later part of their life. These patients also had elevated LDL and TGL levels, which supports the point of cardiovascular risk.

Although CT is the gold standard for measuring visceral fat thickness, many studies have shown that ultrasonographic measurement of visceral fat is equally efficient for assessing cardiovascular risk. Moreover, owing to radiation exposure and the cost of CT, ultrasonographic measurements alone were used in this study.

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