Mahtabuddin et al / International Journal of Biomedical Research 2017; 8(02): 103-107.

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Original Research Article

Study of Association of Sagittal Abdominal Diameter with Glycosylated Hemoglobin [HbA1c] in assessment of Risk of Type-II Diabetes Mellitus

Mahtabuddin[1], R. C. Sharma[*2], Rashmi Tiwari[1] and Qazi Rais Ahmed[2]

[1]Assistant Professor, [2]Professor, Department of Physiology, G.C.R.G. Institute of Medical Sciences, Lucknow, UP, India

QR Code

*Correspondence Info:
Prof. Rajesh Chandra Sharma,
Professor,
Department of Physiology,
G.C.R.G. Institute of Medical Sciences, Lucknow, UP, India

Abstract

Waist circumference (WC) has been reported as an index of measurement of abdominal obesity, and cardiovascular diseases. Recent studies suggest the measurement of sagittal abdominal diameter (SAD) as an index to predict the amount of visceral fat. Present study has analyzed anthropometric indicators mainly BMI [body mass index, WC [waist circumference], HC [hip circumference], WC/HC[waist-to-hip ratio] and SAD [sagittal abdominal diameter], laboratory measurements i.e. HbA1c, and lipid indices [TC, TG, LDL, and VLDL and HDLin 110 patients with type II diabetes to evaluate association of SAD as an index of approximation of visceral fat and its relevance with HbA1c level. The study revealed a positive correlation between HbA1c and WC in the patients, while other anthropometric indices i.e. BMI, HC and WC/HC and HbA1c <7.5 and ≥7.5 did not show significant difference, but level of SAD was similar in the patients of HbA1c <7.5 and ≥7.5 and there was no correlation between HbA1c and SAD. We conclude that evaluation of association of changes in SAD with cardiovascular manifestations in type II diabetes need further research with large sample size with longitudinal follow up.

Keywords: Sagittal Abdomen diameter-type II diabetes-lipid profile-HbA1c- anthropometric indicators- atherogenic visceral fat.

1. Introduction

Association between visceral obesity and risk of type II diabetes differs by sex, age, race, and various anthropometric indicators remains poorly understood [1-2]. BMI is a commonly used index to measure and define over-weight and obesity across populations. However, BMI does not accurately reflect regional fat distribution [3]. Waist circumference (WC) is currently the most commonly used measurement for abdominal obesity, and highly related with the risk of developing cardiovascular diseases [4-5]. Several studies suggest that sagittal abdominal diameter [SAD] is a simple anthropometric index of visceral obesity to correlate obesity-related metabolic disturbances, particularly of insulin resistance, than body mass index (BMI), waist circumference, or waist-to-hip ratio [6-8]. It has been reported that SAD is strongly related to cardiovascular risk and mortality [9-10]. Cardiovascular disease (CVD) is the major cause of morbidity and mortality in patients with type II diabetes. Traditional risk factors such as high LDL cholesterol and low HDL cholesterol, hypertension and smoking do not fully explain the increased cardiovascular risk in patients with type II diabetes [11-13]. Therefore, it is of great importance to identify simple and non-invasive risk factor assessment tools to predict and ultimately to prevent CVD in this group. The present study aimed to prospectively explore significance of laboratory and anthropometric indicators as an index of subclinical organ damage in patients with type-II diabetes.

2. Material and Method

The study was carried out in the department of physiology in association with the department of medicine after approval of ethics review committee. The material for the present study was drawn amongst the clinically diagnosed cases of diabetes mellitus type II of outpatient clinic of department of medicine. Patients were selected on the basis of standard medical history taken with reference to data on diabetes duration, previous illness other than diabetes, and ongoing medication. The inclusion criteria for selection of patients type II diabetic patients of attending diabetic clinic OPD irrespective of age,sex, and duration of diabetes. Diabetic patients having complications such as Anemia, Polycythemia, Hemoglobinopathy, Abnormal lipid profile, Thyroid disease, Chronic alcoholism and use of drugs like Beta blocker, steroid, lipid lowering agents were excluded from the study.

2.1 Anthropometric measurements:

Measurement of height (to the nearest cm) and weight (to the nearest 0.1 kg) with the patients wearing light indoor clothing were taken in all the selected patients in the department of physiology. Waist circumference (WC) was measured according to WHO's recommendations with the patient standing, after a regular expiration, to the nearest cm, midway between the lowest rib and the iliac crest. SAD was recorded with the patient in the supine position and with bent knees, with a standardized sliding beam calliper at the highest point of the abdomen [14].

2.2 Laboratory tests

10-hours fasting blood specimens were drawn in the morning for measurements of HbA1c, plasma glucose and serum lipids, cholesterol, HDL, and triglycerides. LDL was calculated by Friedewalds formula. The samples were analyzed in the central pathology laboratory following standard methods [15-16].Data were statistically analyzed using SPSS [version 16] for calculation of Pearson correlation coefficients between the different measurements, using bivariate correlation analysis. Statistical significance was assumed when $p < 0.05$.

3. Results

Data analysis of the anthropometric indicators revealed that average height of the patients was 164.72 ($\pm$9.88) cms with mean weight of 70.41 ($\pm$9.24) kg. The BMI was 26.71 ($\pm$7.13) kg/m^{2}with minimum of 17.35 and maximum of 41.08. The WC, HC, and WC/HC were found to be 95.27 ($\pm$11.73), 98.72 ($\pm$12.84) and 1.98 ($\pm$10.72) respectively. Mean SAD was found to be 22.74 ($\pm$3.66) with median of 23.00. Laboratory results revealed mean value of HbA1c to be 9.34 ($\pm$1.80) with median of 9.40. The standard cutoff of HbA1c showed that 84.1% of the patients had HbA1c level $\geq$7.5. Lipid profile of all the subjects depicted increased level of TC, TG, LDL, and VLDL and decreased level of HDL. We analyzed the association of SAD with gender, age, and different anthropometric indicators and observed that level of SAD was higher among younger patient [age group below 30 years] as compared to older age group, but difference between different age group was not statistically significant. The correlation coefficient (r) between SAD and WC or HC is depicted in figure 1.a and 1.b, revealed mild positive correlation between SAD and WC (r=0.42, p=0.001) & HC (r=0.40, p=0.001). However, the WC/HC ratio was negatively correlated with SAD (r=-0.56, p=0.001).

Figure 1: Correlation coefficient (r) between SAD and anthropometric indices.
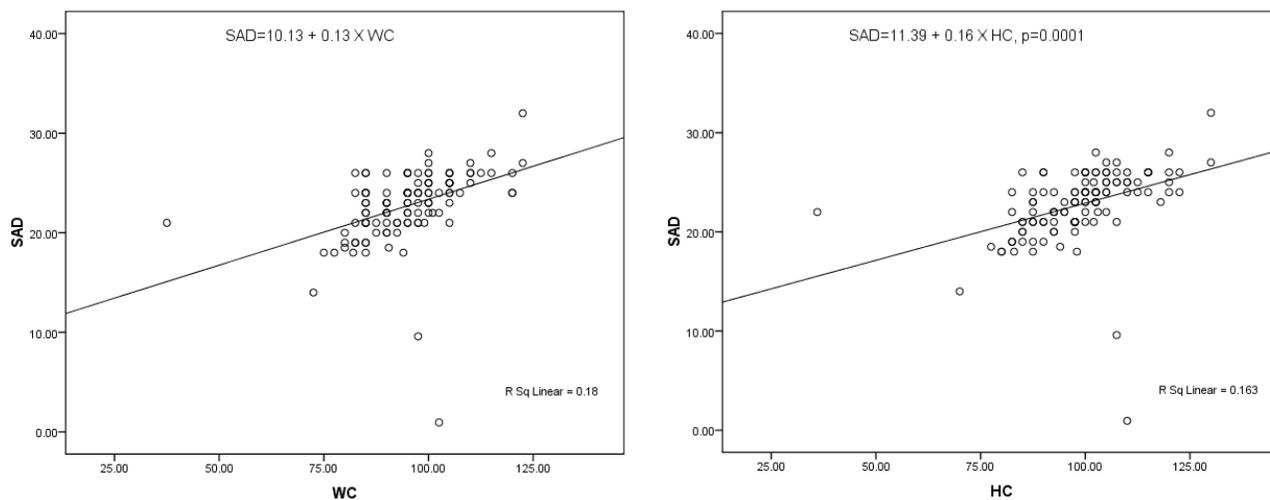
We also statistically analyzed the association of lipid profile with HbA1c level and observed that TC, HDL, and LDL/HDL were significantly (p<0.05) higher among the patients of HbA1c <7.5 compared with ≥7.5. However, LDL was significantly lower (p=0.004) in patients of HbA1c <7.5 than ≥7.5. Level of SAD was similar in the patients of HbA1c <7.5 and ≥7.5 and there was no correlation between HbA1c and SAD. We did not observed significant (p>0.05) difference in the BMI, HC, and WC/HC between HbA1c <7.5 and ≥7.5. However, WC was significantly (p=0.03) higher in the patients of HbA1c <7.5 (100.69±9.88) than ≥7.5 (94.25±11.81).

4. Discussion

Analysis of anthropometric indicators mainly BMI, WC, HC, WC/HC and SAD with laboratory measurements i.e. HbA1c, and lipid indices [TC, TG, LDL, and VLDL and HDL was carried out in 113 patients in the present study. We observed average height of the patients was 164.72 (±9.88) cms with mean weight of 70.41 (±9.24) kg. The BMI was 26.71 (±7.13) kg/m^2 with minimum of 17.35 and maximum of 41.08. The WC, HC, and WC/HC were found to be 95.27 (±11.73), 98.72 (±12.84) and 1.98 (±10.72) respectively. Mean SAD was found to be 22.74 (±3.66) with median of 23.00. Our results are in conformity to the reports published previously. Rosediani M *et al [18]* reported higher HbA1c level among the patients of age >60 (10.02±1.61) and lowest among <30 (7.63±1.39) years and found that difference in the level of HbA1c among all the age groups was statistically insignificant (p>0.05). In our study, we found mean value of HbA1c to be 9.34 (±1.80) with median of 9.40, without significant difference in HbA1c level in different age group. Many studies reported substantial variations between individuals, age, gender, and even those with similar blood glucose levels. About one third or less of the variance in HbA1c levels in nondiabetic subjects may be explained by differences in blood glucose levels. The cause of these variability in levels of HbA1c is unclear, but a smaller difference in intraindividual than interindividual values suggests familial effects [19]. Doruk *et al* was also stated absence of a significant correlation between HbA1c and age [20]. Level of HbA1c was similar (p>0.05) in male (9.39±1.76) and female (9.26±1.88) patients. However, there was no significant (p>0.05) difference between HbA1c with gender. The results of previous study clearly showed that the levels of HbA1c are not affected by patients' gender as neither of these parameters differed significantly between male and female diabetic patients. it was noticed that type 2 diabetic patients without CHD had the same HbA1c levels irrespective of gender whereas female patients with CHD had higher HbA1c than respective male controls [21]. We observed a positive correlation between HbA1c and WC in the patients, while other anthropometric indices i.e. BMI, HC and WC/HC and HbA1c <7.5 and ≥7.5 did not show significant difference. Previous studies have reported that anthropometric indices provide effective screening for type II diabetes mellitus but there is no unanimity for best index (BMI, WC, WHR or WSR) for indicating the relationship between obesity and type II diabetes mellitus. Most studies in China and Asian countries, such as Iran, Korea, and Japan confirmed that WSR was better than BMI, WC, and WHR [22-24]. Runa Zazai *et al* reported that WC as well as related anthropometric indices are associated with many metabolic vaiables independently of body weight and BMI [25]. Santosh *et al* concluded that SAD with anthropometric measurements had better correlation all the parameters other than Waist Circumference, which had negative correlation and suggested that SAD can be used in evaluation of obese or overweight children for evaluation[29].

The reliability of measurements is an important factor to consider in clinical practice. SAD has a high reliability in both lean and obese subjects [26]. WC can be measured in various ways and there is no consensus about which is the best measurement protocol [27]. In this study we have chosen the method of measuring WC recommended by WHO, where WC is measured mid-way between the last rib and the iliac crest and not at maximum WC, compared to SAD which is measured at maximum abdominal height. This might partly explain our finding that SAD was more robustly associated to the change in arterial stiffness. We propose that SAD is a clinically feasible measurement with high reproducibility, gives a good approximation of the atherogenic visceral fat [17] provided measured using standard protocol.

5. Conclusion

Our study found significant positive correlation between HbA1c and TC, TG, LDL and the ratio LDL/HDL but there is a positive correlation between HbA1c and WC in the patients, and other anthropometric indices i.e. BMI, HC and WC/HC and HbA1c <7.5 and ≥7.5 did not show significant difference. We also conclude that there may not be significant correlation in between lipid profile and anthropometric parameters, but WC and SAD could be used as an index of good approximation of the atherogenic visceral fat and consequent cardiovascular complications in type II diabetes. Our study also proposed further research with large sample size with longitudinal follow up of patients with type II diabetes for more than 5 years to evaluate association of changes in SAD with cardiovascular manifestations.

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