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Original Article

Measurement of body fat percentage and visceral fat rating using bioelectrical impedance analysis in coronary artery disease patients and its associations with aggressive lipid lowering treatment

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ABSTRACT

Background: Obesity is often linked with an abnormal lipid profile and heightened risk for and cardiovascular diseases. A new technique of bioelectrical impedance analysis (BIA) which directly estimates obesity by measuring body fat and its distribution has recently become available. We aimed to assess association of body fat percentage (BF%) and visceral fat rating (VFR) with coronary artery disease (CAD) along with conventional risk factors and study the effect of aggressive lipid lowering treatment on these parameters.

Methods: We enrolled patients with documented CAD, subjects at high risk of CAD and healthy controls. Documented CAD patients included were those who had received prior treatment for with high dose lipid-lowering drugs for minimum 6 weeks. High risk for CAD group were those with Metabolic Syndrome (NCEP-ATPIII criteria) or with Framingham 10 yr risk >10%. Established anthropometric indices of waist circumference (WC) and body mass index (BMI) and lipid profile were measured. We used bioelectrical impedance analysis to measure BF% and VFR using a device called *InnerScanV (TANITA, Tokyo)*.

Results: 477 subjects were enrolled, [150 (32%) documented CAD patients, 174 (36%) at high risk for CAD and 153 (32%) healthy controls]. On comparing the CAD patients and healthy controls the WC, VFR and HDL were significantly different ($p < 0.001$). Among the risk factors of CAD, BF% and ratio of total cholesterol and HDL were found to be strongest predictors. On comparing the CAD patients and the high risk for CAD group, the BMI, WC, BF% and entire lipid profile was higher in the high risk for CAD group. The VFR of CAD patients was higher as compared to high risk for CAD group.

Conclusion: BF% emerged as significant risk factor for CAD. VFR levels remained high even after treatment. Aggressive lipid lowering treatment has significant beneficial effect on all risk parameters except on those measuring abdominal obesity, i.e., WC, VFR and HDL.

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1. Introduction

Coronary artery diseases (CADs) remain the major cause of death and premature disability in the world. Current knowledge of CAD and associated risk factors is mostly derived from the studies done in European populations and its relevance amongst Asian Indians is uncertain. Studies in past have shown that high rates of CAD in Asian Indians are accompanied by paradoxically low prevalence of conventional risk factors. Therefore, the role of newer risk factors keeps coming in question and more parameters need to be studied and identified.

Obesity predisposes an individual to most of the risk factors CAD like hypercholesterolemia, hypertension and diabetes mellitus. Obesity itself is identified as an independent risk factor for cardiovascular diseases among both sexes.[1] Currently, body mass index (BMI) is the most widely accepted method of estimating obesity. Other anthropometric indices such as waist-hip ratio and skin fold thickness are shown to have limited accuracy.[2] Newer equipments have recently become available to assess body fat percentage (BF%) and visceral fat rating (VFR) and its distribution by using bioelectrical impedance analysis (BIA). At present, there is no consensus on how BF% and VFR are associated with CAD in an Indian population. The aim of our study was to analyze BF% and VFR, measured by BIA, and correlate with the conventional risk factors and serum lipid levels in patients of CAD. Further, we intended to study the effect of aggressive lipid lowering treatment on these parameters.

2. Material and method

We enrolled consecutive patients attending the cardiology out-patients department. Subjects were categorized into 3 groups; documented CAD patients, individuals at high risk for CAD and normal healthy individuals as controls. Group 1 included documented CAD patients having a history of acute ST elevation or non-ST elevation myocardial infarction or chronic stable angina with treadmill test positivity or coronary angiography proven CAD, and having received prior treatment with high dose lipid lowering therapy (typically atorvastatin 40 or 80 mg per day) for at least 6 weeks prior to enrollment. Group 2 included individuals without documented CAD but being at high risk of developing CAD, i.e., those qualifying as Metabolic Syndrome (based on the NCEP-ATPIII criteria[3]) or having Framingham 10 yr risk score[4] of more than 10% or both and not on any lipid lowering therapy. Group 3 included apparently healthy individuals without documented CAD or being at high risk for the same. Exclusion criteria included all subjects younger than 35 years or older than 75 years, those having cardiac pacemaker or other metallic implants in body, patients of neuromuscular or skeletal disorders and limb anomalies. After an informed written consent, a detailed history, smoking, previously diagnosed diabetes or hypertension, drug intake, alcohol intake and family history for CAD was taken. Anthropometric indices of weight, height and waist circumference (WC) were measured and BMI was calculated. A fasting blood sample for complete lipid profile comprising of triglycerides (TG), total cholesterol (TC), low density lipoprotein (LDL) and high density lipoprotein (HDL) was done at the Department of Biochemistry. We used *InnerScanV (TANITA Inc, Tokyo)* which works on the principal of BIA, to measure BF% and VFR. The BIA device applies an alternating current to electrodes placed on subjects' hand and feet and yields a measure of body resistance and reactance. Body composition is estimated based on the specific resistivity offered by different body tissues.[5]

3. Statistical analysis

We used MINITAB (Windows version 16.0) software to assess each independent predictor variable as a risk factor of CAD by binary logistic regression analysis. The significant predictor variables were further analyzed by multivariate logistic regression analysis adjusted with sex, age, weight, WC, BMI, diabetes and hypertension. Thereafter, the significant predictors were again analyzed by multivariate logistic regression among themselves. Data were summarized as Mean ± SE. STATISTICA (Windows version 8.0) was used to compare the means of CAD patient group and control group by *t*-test. A $p < 0.05$ was considered statistically significant for all tests.

4. Results

We enrolled 477 subjects in 3 groups viz Group 1 – 150 (32%) patients of documented CAD, Group 2 – 174 (36%) high risk for CAD group and Group 3 – 153 (32%) apparently healthy controls. Among the documented CAD patients, 95 (63%) were of acute myocardial Infarction, 21 (14%) of acute coronary syndrome, 34 (23%) of chronic stable angina with either treadmill positive or angiographic proven CAD. All socio-demographic and clinical characteristics of the three studied groups are summarized in Table 1.

The anthropometric measurements showed the mean WC of documented CAD patients and high risk for CAD group were 94.7 cm and 96.1 cm respectively while the healthy control had WC of 86.1 cm. However, the BMI values among the three groups showed a different trend. Documented CAD patients had a BMI of 23.9 kg/m^2, high risk for CAD group 27.9 kg/m^2 and the healthy control group 24.3 kg/m^2.

40.7% of documented CAD patients were smokers. This proportion was 2.4 times more in comparison to high risk for CAD group and 3.3 times more than the healthy controls. Similarly, diabetics were also highest among documented CAD patients (52.1%), 1.3 times more than high risk for CAD group and 5.7 times more than healthy control. Surprisingly, the proportion of hypertensive among documented CAD patients (45.3%) was 1.1 times lesser than high risk for CAD group (51.1%) and 2.5 times more than healthy control (20.9%). Family history of known CAD was positive among 12% in the documented CAD patients group, 2.6 times more than high risk for CAD group and 1.4 times more than in healthy controls.

Complete lipid profile was done for all subjects included measurement of TG, TC, LDL, HDL and ratios of LDL:HDL and