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Waist circumference, but not body mass index, is a predictor of ventricular remodeling after anterior myocardial infarction

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ABSTRACT

Objective: The impact of obesity on ventricular remodeling after myocardial infarction (MI) is still poorly understood. Therefore, the aim of this study was to evaluate the role of waist circumference (WC) and body mass index as predictors of cardiac remodeling in patients after an anterior MI.
Methods: Eighty-three consecutive patients with anterior MI were prospectively evaluated. Clinical characteristics and echocardiographic data were analyzed at admission and at a 6-mo follow-up. Ventricular remodeling was defined as a 10% increase in left ventricular end-systolic or end-diastolic diameter at the 6-mo follow-up.
Results: In our study, 83 consecutive patients were evaluated (72% men). Ventricular remodeling was present in 31% of the patients (77% men). Patients with remodeling had higher creatine phosphokinase and creatine phosphokinase-MB peak values, a higher resting heart rate, a larger left atrial diameter, and a larger interventricular septum diastolic thickness. In addition, patients with remodeling had lower peak velocity of early ventricular filling deceleration time and ejection fraction. Patients with remodeling presented higher WC values (with remodeling, 99.2 ± 10.4 cm; without remodeling, 93.9 ± 10.8 cm, $P = 0.04$), but there were no differences in the body mass index values. In the logistic regression analysis, WC, adjusted by age, gender, ejection fraction, and creatine phosphokinase levels, was an independent predictor of left ventricular remodeling (odds ratio 1.067, 95% confidence interval 1.001–1.129, $P = 0.02$).
Conclusion: Waist circumference, but not body mass index, is a predictor of ventricular remodeling after an anterior MI. Therefore, the WC of these patients should be measured in clinical practice.

Introduction

Myocardial infarction (MI) has been associated with an increased number of hospitalizations and deaths around the world [1,2]. The prognosis after an MI has been related to several factors, including age, gender, heart rate, cardiogenic shock, infarct size, previous infarct, type 2 diabetes, hypertension, decreased ejection fraction, and signs of heart failure [3–6]. In recent years, another variable studied as a predictor of poor outcome after an MI has been ventricular remodeling [7].

Considering the relation between remodeling and outcomes, in the acute phase after MI, ventricular remodeling has been associated with ventricular rupture, aneurysmal formation, and complex ventricular arrhythmias. Similarly, chronic ventricular remodeling has been shown to play a key role in the pathophysiology of ventricular dysfunction [8,9]. Taking into consideration that the course of remodeling can be modified through several therapeutic interventions, several strategies have been used to predict the remodeling process.

Obesity has been well established as a risk factor for cardiovascular diseases [10]. However, the impact of obesity on ventricular remodeling and on outcomes after an MI is still poorly understood. Obesity has been independently associated with poor outcomes after an MI in some studies [11] but not in others [12–14]. In contrast, different reports have demonstrated a possible protective effect of obesity on outcomes (the “obesity paradox”) [15–17].

In addition, taking into account the relation between excess adiposity and the adverse health consequences, several recent studies have demonstrated that anthropometric measurements

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related to central obesity are more sensitive predictors of type 2 diabetes [18], cardiovascular diseases [19,20] and left ventricular (LV) diastolic dysfunction [21] than an index of general adiposity, such as the body mass index (BMI).

Importantly, the role of obesity in ventricular remodeling after an MI is unknown. Therefore, the objective of this study was to evaluate the role of waist circumference (WC) and BMI as predictors of cardiac remodeling in patients after an anterior MI.

Material and methods

All procedures were approved by the ethics committee of our institution, and all participants provided their written consent.

Study design

We used the formula by Fisher and Belle [22] for the sample size estimation, with the following variables: a ventricular remodeling prevalence of 30% to 60%, a 95% confidence interval, and a sample error of 10%. The result was 81 patients. Therefore, from December 2008 to July 2010, 94 consecutive patients with an anterior MI were studied. The exclusion criteria were active malignancy; infection; end-stage cardiac, pulmonary, or hepatic disease; pregnancy; an age younger than 18 y; atrial fibrillation; a previous MI; and valve disease. Three patients did not agree to participate, three patients were excluded because of an atrial fibrillation, and five patients died. Therefore, 83 patients were prospectively evaluated.

On admission, patient characteristics, including WC, BMI, age, gender, heart rate, cardiovascular risk factors, concomitant diseases, medical treatment, admission symptoms, and prehospital delay, were recorded. The BMI was calculated as body weight in kilograms divided by height in meters square. WC was measured at the umbilicus level, while the patient was standing, at end expiration [23]. Body height was measured using a stadiometer; body weight was measured using calibrated scales (Filizola, São Paulo, Brazil).

An echocardiographic assessment was completed during the index hospitalization (approximately 3–5 d after admission) and at the 6-mo follow-up. After the echocardiographic analysis, the patients were divided into two groups: those with and those without ventricular remodeling.

Definitions

Acute MI was diagnosed in the presence of the two following criteria: persistent angina pectoris for at least 20 min and an ST-segment elevation of at least 2 mm in at least two contiguous precordial leads or the presence of a left bundle branch block. An acute MI was later confirmed by the increase of cardiac enzymes to more than twice the upper limit of the normal range [24]. The infarct size was determined using the creatine phosphokinase and creatine phosphokinase-MB values.

The definition of diabetes mellitus was based on clinical features and a fasting glucose level of at least 126 mg/dL on two separate occasions or ongoing treatment of the disease. According to the Seventh Report of the Joint National Committee on the Prevention, Detection, Evaluation, and Treatment of High Blood Pressure, systemic hypertension was defined as a systolic blood pressure higher than 140 mmHg and/or a diastolic blood pressure higher than 90 mmHg [25]. Dyslipidemia was identified according to the National Cholesterol Education Program Adult Treatment Panel III guidelines as total cholesterol levels of at least 200 mg/dL, a high-density lipoprotein level lower than 40 mg/dL for men and lower than 50 mg/dL for women, or a triacylglycerol level of at least 150 mg/dL [26].

Ventricular remodeling was defined as a 10% increase in LV end-systolic or end-diastolic diameter at the 6-mo follow-up [27].

Echocardiographic analysis

The echocardiograph was an HDI 5000 Sono model (Philips Medical Systems, Bothell, WA, USA) equipped with a 2.0- to 4.0-MHz probe capable of acquiring second harmonic, tissue, pulsed, continuous, and color Doppler and one- and two-dimensional mode images. With subjects positioned in the left lateral decubitus position and monitored with an electrocardiographic lead, the following echocardiographic views were obtained: the parasternal short-axis view to measure the ventricles, the aorta, and left atrium and the apical two-, four-, and five-chamber views to evaluate the cavities and the systolic and diastolic functions of the ventricles. All measurements were performed in accordance with the American Society of Echocardiography/European Association of Echocardiography [28] recommendations. The average of three measurements was calculated for each variable. Three operators assessed the echocardiograms. However, for each patient, the same operator assessed the echocardiogram at baseline and after 6 mo. Intraobserver and interobserver variabilities were lower than 3% and lower than 5%, respectively.

Left ventricular systolic function was evaluated by measuring the ejection fraction according to the Simpson method. LV diastolic function was evaluated by measuring the early and late diastolic mitral inflow velocities, the ratio between the two diastolic mitral inflow velocities, the early diastolic mitral inflow velocity deceleration time, and the isovolumic relaxation time.

Statistical analysis

The data are expressed as mean ± standard deviation or median (lower and upper quartiles). Statistical comparisons for continuous variables between the groups were performed with Student's t test for parameters with a normal distribution, which was assessed by the Kolmogorov–Smirnov test. Otherwise, comparisons between the groups were completed with the Mann–Whitney U test. Comparisons between baseline and 6 mo were performed by the paired t test. For categorical data, chi-square tests were performed. To adjust BMI and WC by gender and age, we used analysis of covariance. The logistic regression was used for the remodeling prediction. The calibration of the model was assessed by the Hosmer–Lemeshow statistic. Data analysis was completed with SigmaStat 2.03 for Windows v2.03 (SPSS, Inc., Chicago, IL, USA). $P < 0.05$ was considered statistically significant.

Results

Demographic, clinical, and laboratory data are presented in Table 1. Eighty-three consecutive patients were evaluated; 72% were men. Ventricular remodeling was present in 31% of the patients. A large proportion of patients had systemic hypertension and dyslipidemia (approximately 60% and 77%, respectively) Type 2 diabetes was present in 27% of the patients. There were no differences in these comorbidities between the two groups. Patients with remodeling presented larger WC values than patients without remodeling ($P = 0.04$). In contrast, there was no difference in the BMI between the groups ($P = 0.21$; Table 1). A comparison of the BMI and WC values when separated by male and female subjects showed no differences (Table 2).

The infarct size was larger in the remodeling group (Table 1). Reperfusion therapy was performed in 88% of the patients, and approximately 69% of patients underwent primary angioplasty (a Thrombolysis In Myocardial Infarction flow grade ≥2 was present in 96% of these patients; Table 3). In addition, all patients received acetylsalicylic acid (ASA) and clopidogrel. Patients in the left ventricular remodeling group used more spironolactone ($P = 0.007$) than the group without remodeling (Table 3).

The initial echocardiographic analysis demonstrated a greater interventricular septal diastolic thickness and a larger left atrial diameter in the remodeling group (Table 4). In addition, patients

Table 1
Demographic, clinical, and laboratory data

Variables	Left ventricular remodeling		P
	No ($n = 57$)	Yes ($n = 26$)	
Age (y)	59.7 ± 13.0	54.9 ± 9.8	0.10
Men	70 (40)	77 (20)	0.71
SR	56 (32)	69 (18)	0.37
DM	28 (16)	27 (7)	0.88
Dyslipidemia	77 (44)	76 (20)	0.80
Smoking	40 (23)	46 (12)	0.80
BMI (kg/m^2)	26.7 ± 4.52	28.0 ± 3.68	0.21
WC (cm)	93.9 ± 10.8	99.2 ± 10.4	0.04
CK (U/L)	1566 (1017–4623)	6168 (3593–8805)	<0.001
CK-MB (U/L)	199.0 (135.5–495.3)	514.5 (300.0–721.0)	0.002

BMI, body mass index; CK, creatine phosphokinase; CK-MB, creatine phosphokinase-MB; DM, diabetes mellitus; SR, systemic hypertension; WC, waist circumference
Data are expressed as mean ± SD, percentage (number), or median (lower and upper quartiles).