Original Article

Abdominal Circumference as a Predictor of 30-day Outcome in Acute Coronary Syndrome

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Abstract

Background: **Abdominal circumference (AC) is the measure that correlates most closely with the risk factors and death from cardiovascular disease. However, the impact of obesity on the prognosis of patients with cardiovascular disease remains controversial and requires further clarification.**

Objective: **To evaluate AC as a predictor of 30-day outcome in patients who were hospitalized with acute coronary syndrome (ACS), in a referral hospital for the treatment of cardiovascular diseases.**

Methods: **Contemporary cohort 267 patients who were hospitalized for ACS and who were followed for 30 days after discharge, taking into account the major cardiovascular events - MACE - (death, reinfarction, rehospitalization for coronary artery bypass grafting procedures). In the first 24 hours of admission, patients answered a questionnaire and were subsequently measured for AC. The statistical analysis was performed with SPSS 17.0, using the chi-square test for categorical variables and Student t test for numerical variables, with significance level of $p \leq 0.05$. The variables that had $p < 0.10$ in the bivariate analysis were included in a logistic regression model to evaluate the AC role as an independent predictor of MACE.**

Results: **After multivariate analysis, only the female gender (OR = 8.86; 95% CI: 4.55-17. 10, $p < 0.00$), hypertension (OR = 2.06; 95% CI: 1.10-3.87; $p = 0.02$) and family history of ischemic heart disease (OR = 2.10; 95% CI: 1.17-3.74; $p = 0.01$) remained associated with the MACE.**

Conclusion: **In our study, the modified AC was not associated with increased incidence of MACE over the 30 days of follow-up. (Arq Bras Cardiol 2011;96(5):399-404)**

Keywords: **Acute coronary syndrome; abdominal circumference; obesity, risk factors.**

Introduction

Cardiovascular diseases (CVD) are responsible for 17 million deaths, about one third of annual deaths in the world[1]. In Rio Grande do Sul (RS), this trend is also observed[2], especially in relation to coronary artery disease (CAD).

Acute coronary syndrome (ACS) is characterized by a spectrum of clinical and laboratory manifestations of acute myocardial ischemia, and is classified in three ways: unstable angina (UA) and acute myocardial infarction (AMI) with and without ST-segment elevation[3].

Several studies demonstrate the relationship between obesity, especially abdominal obesity, and the development of cardiovascular diseases[4-7]. Patients who are overweight are at higher risk for developing CHD, mainly as a consequence of obesity-related conditions such as diabetes, hypertension and dislipidemia[4].

The risks associated with abdominal obesity are best identified by anthropometric variables that may reflect the distribution of body fat such as abdominal circumference (WC) and waist-hip ratio (WHR)[8]. These have shown a greater correlation with cardiovascular risk than overall obesity indicators such as body mass index (BMI)[9,10]. However, AC is the measure that correlates most closely with the risk factors and death from cardiovascular disease[9,11,12].

With regard to the prognosis of patients after cardiovascular events, the data are still controversial: most studies show an inverse association between overall obesity (the obesity paradox), mortality after AMI and percutaneous coronary intervention[13,14]. On the other hand, some studies show the direct relationship between obesity and major cardiovascular events - MACE - (death, reinfarction, rehospitalization for coronary artery bypass grafting procedures)[15,16] suggesting that abdominal obesity acts as a prognostic factor in short-and long-term in CVD. Patients with low BMI and increased AC would be part of the higher-risk group[17].

Although the association between excess body fat and cardiovascular risk in the general population is well established, the impact of obesity on the prognosis of patients with CVD remains controversial and requires further clarification. Therefore, this study aims to evaluate the abdominal

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Manuscript received March 15, 2010; revised manuscript received October 22, 2010; accepted December 02/12/10.

circumference as a predictor of 30-day outcome in patients who were hospitalized with acute coronary syndrome in a referral hospital for the treatment of cardiovascular diseases, in Porto Alegre/RS.

Methods

Patients

Contemporary cohort study with patients who were hospitalized for ACS from November 2006 to January 2008. The study was conducted from a pre-existing database containing 412 individuals. Out of these, all those older than 65 were excluded. The final sample consisted of 267 patients. This study was approved by the Ethics Committee of the Institution (UP 4173/08).

The study included patients with diagnosis of ACS: acute myocardial infarction (AMI) with and without ST-segment elevation, unstable angina (UA) with electrocardiographic changes (ST segment depression greater than 1 mm in at least two leads, or T-wave inversion).

As this is a cohort that also assesses the inflammatory response, the exclusion criteria were: presence of systemic inflammatory disease, malignant neoplasm diagnosed with or without treatment, HIV infection, recent or current use (less than one month) of anti-inflammatory drugs or corticosteroids, duration of ACS greater than 12 hours, absence of 12-hour fasting, age older than 65, and patient unable to or with any pathology preventing him/her to have anthropometric measures performed.

Data collection procedure

After having signed an informed consent form, approved by the Research Ethics Committee, the patients fasted for the performance of biochemical tests (total cholesterol, HDL-c, LDL-c, triglycerides and fasting glucose). They also answered a questionnaire where they reported age, sex, cardiovascular risk factors - physical inactivity, smoking, family history of ischemic heart disease, hypertension, obesity, diabetes, dyslipidemia, and alcohol use - and previous diseases. The anthropometric measurements (weight, height, and AC) were taken within the first 72 hours.

Physical inactive patients were considered to be those who did not practice any regular physical activity (< 3 times/week for at least 30 minutes)[18]. Those patients who were regular smokers were defined as smokers, and ex-smokers were those who had stopped smoking for at least one year. Family history of ischemic heart disease included those with first-degree male relative younger than 55 years, and younger than 65 years for females diagnosed with coronary artery disease or other atherosclerotic disease[18].

Hypertension was considered in those who had this diagnosis prior to admission and/or used anti-hypertensive drugs[19]. Dyslipidemia included those who had total cholesterol, triglycerides, LDL and HDL cholesterol values changed according to the IV Brazilian Guidelines on Dyslipidemia and Prevention of Atherosclerosis[18]. Individuals with a previous diagnosis of diabetes and/or those using anti-diabetes drugs were classified as patients with diabetes[20]. Regarding the use of alcohol, we used the recommendations of the V Brazilian Guidelines on Hypertension[19]. Regular use of alcohol was considered for those individuals who consumed up to 30 g of ethanol/day for men and 15 g of ethanol/day for women.

Measurements of weight and height were made in Filizola anthropometric scale (maximum capacity of 150 kg and variation of 100 g) with attached stadiometer with the patient barefoot and wearing light clothing. The BMI was calculated by the weight (kg)/height^2 (m) ratio. Obese patients were considered those with BMI equal or higher than 30 kg/m^2.

AC was measured using a flexible anthropometric tape with precision of 0.1 cm at the midpoint between the iliac crest and the lower costal arch[21]. We used the cutoffs according to the NCEP-ATP III (men > 102 cm and women > 88 cm)[22].

All laboratory tests were collected in a single sample, with 12-hour fast within the first 24 hours from the onset of ischemic coronary event. The analysis was conducted in the clinical laboratory of the hospital.

After discharge, telephone contacts were made and medical records were reviewed to search for MACE (death, reinfarction, rehospitalization for coronary artery bypass grafting procedures), and other complications such as heart failure (HF), arrhythmia and angina occurring within 30 days.

Statistical analysis

The data were analyzed in the program Statistical Package for Social Sciences version 17.0 (SPSS Inc., Chicago, IL, USA, 2008) for Windows. The variables collected were presented descriptively, with mean and standard deviation for numerical variables and frequency (absolute and relative) for categorical variables. We used the chi-square test for categorical variables and Student t test for numerical variables.

The variables that had $p < 0.10$ in the bivariate analysis were included in a logistic regression model to evaluate the AC role as an independent predictor of clinical outcomes. We considered p values ≤ 0.05 statistically significant.

Bivariate and multivariate logistic regression models were used to calculate the odds ratio (OR) and adjustments were made for the following variables: gender, hypertension (HBP), smoking, family history of ischemic heart disease, angina and heart failure.

The ROC curve considered AC as a continuous variable.

Results

Out of 267 patients evaluated, 75.3% (201) were male, of which 24.3% (49) had increased AC, while the percentage observed in females was 74.2% (49). The mean AC found in males was 96.6 cm ± 12.96 cm and in females, 94.8 ± 15.11 cm.

The average age of men with AC changed was 55.0 ± 8.2 years and women 54.1 ± 6.91 years. No statistically significant differences were found among individuals with normal and increased AC in different genders.

The general characteristics, according to the categories of abdominal circumference in different genders are shown in Table 1. The percentages are according to the risk factor (AC).

Table 1 - General characteristics according to categories of abdominal circumference

General characteristics	Men AC (cm) Normal ≤ 102 cm n = 152 n (%)	Men AC (cm) Increased > 102 cm n = 49 n (%)	p	Women AC (cm) Normal ≤ 88 cm n = 17 n (%)	Women AC (cm) Increased > 88 cm n = 49 n (%)	p
Age (years) mean ± SD	53.57 ± 7.18	55.00 ± 8.22	0.244	51.29 ± 8.84	54.10 ± 6.91	0.185
Diagnosis						
UA or AMI without ST-segment elevation	48 (31.6)	19 (38.8)	0.450	6 (35.3)	22 (44.9)	0.685
AMI ST-segment elevation	104 (68.4)	30 (61.2)		11 (64.7)	27 (55.1)	
Previous diseases						
Carotid	1 (0.7)	1 (2.0)	0.984	0 (0.0)	1 (2.0)	1.000
AMI	34 (22.4)	15 (30.6)	0.328	3 (17.6)	14 (28.6)	0.572
PVD	6 (3.9)	1 (2.0)	0.853	2 (11.8)	5 (10.2)	1.000
CVA	4 (2.6)	4 (8.2)	0.193	2 (11.8)	3 (6.1)	0.821
DM	39 (25.7)	9 (18.4)	0.396	5 (29.4)	15 (30.6)	1.000
HF	3 (2.0)	1 (2.0)	1.000	0 (0.0)	2 (4.1)	0.980
Risk Factors						
HBP	87 (57.2)	37 (75.5)	0.034	13 (76.5)	40 (81.6)	0.915
Alcohol	43 (28.3)	15 (30.6)	0.896	4 (23.5)	10 (20.4)	1.000
Dyslipidemia	48 (31.6)	22 (44.9)	0.126	5 (29.4)	18 (36.7)	0.802
Obesity	23 (15.1)	36 (73.5)	0.000	0 (0.0)	19 (38.8)	0.006
FH	55 (36.2)	28 (57.1)	0.015	6 (35.3)	21 (42.9)	0.795
Smoking	79 (52.0)	21 (42.9)	0.344	9 (52.9)	19 (38.8)	0.463
Physical inactivity	137 (90.1)	44 (89.8)	1.000	16 (94.1)	46 (93.3)	1.000

Pearson's chi-square test for all variables except for age where we used t-Student Test. SD- standard deviation, UA - unstable angina; AMI without ST - segment elevation-acute myocardial infarction without ST-segment elevation; AMI ST - segment elevation - acute myocardial infarction with ST-segment elevation; AMI - acute myocardial infarction; PVD - peripheral vascular disease; CVA - cerebrovascular accident; DM - diabetes mellitus; HF - heart failure; HBP - hypertension; FH - family history.

Regarding the type of ACS, 38.8% (19) of male patients and 44.9% (22) of females with increased AC were hospitalized for AMI with no ST-segment elevation or UA and 61.2% (30) of men and 55.1% (27) of women for AMI with ST-segment elevation (p = 0.45; p = 0.68, respectively).

There was no statistically significant difference between the previous diseases presented by the patients and the categories of AC in both sexes.

As for the risk factors, there was a statistically significant difference for men with increased AC in relation to hypertension (p = 0.03), obesity (p = 0.00) and family history of ischemic heart disease (p = 0.01), while in women this difference was observed only for obesity (p = 0.00).

Over the 30-day follow-up, 7.9% (21) of individuals had one MACE, and 16.4% (8) of men and 2% (1) of women had increased AC. The only outcome which correlated with categories of AC was HF (p = 0.01), where 11.1% (5) of men with increased AC had this complication over the first 30 days, including hospitalization. For females, the same was not observed. The incidences of cardiovascular outcomes in relation to the categories of AC are presented in Table 2.

After adjusting for those variables that showed p < 0.10 in the bivariate analysis (gender, hypertension, smoking, family history of ischemic heart disease, angina, and HF), only the female gender (OR = 8.86; 95% CI: 4.55-17. 10, p < 0.00), hypertension (OR = 2.06, 95% CI: 1.10-3.87, p = 0.02) and family history (OR = 2, 10, 95% CI: 1.17-3.74, p = 0.01) remained associated with the MACE. These data are shown in Table 3.

When the AC was evaluated as a continuous variable, for both sexes, using the ROC curve, we observed a small area under the curve (0.60), which demonstrates the low sensitivity and specificity.

Discussion

In this study, the vast majority of patients who were hospitalized for ACS was male (75.3%), similar percentages (73.4[23]; 60.8[24]) are also observed in other studies on this group of patients.

The average AC found in our study, in males (96.62 ± 12.96 cm) is similar to other studies that correlate AC with

Table 2 - **Incidence of cardiovascular outcomes in relation to the categories of abdominal circumference**

Outcomes	Men AC (cm) Normal ≤ 102 cm n = 152	Men AC (cm) Increased > 102 cm n = 49	p	Women AC (cm) Normal ≤ 88 cm n = 17	Women AC (cm) Increased > 88 cm n = 49	p
	n (%)	n (%)		n (%)	n (%)	
MACE	12 (7.9)	8 (16.4)	0.150	0 (0.0)	1 (2.0)	1.000
Death	2 (1.3)	1 (2.0)	1.000	0 (0.0)	0 (0.0)	-
Re-AMI	4 (2.6)	2 (4.1)	0.971	0 (0.0)	0 (0.0)	-
Coronary artery bypass grafting	6 (4.3)	5 (11.1)	0.186	0 (0.0)	1 (2.3)	1.000
HF	2 (1.4)	5 (11.1)	0.012	1 (5.9)	1 (2.3)	1.000
Arrhythmia	13 (8.6)	8 (16.3)	0.201	3 (17.6)	3 (6.1)	0.350
Angina	25 (16.4)	8 (16.3)	1.000	4 (23.5)	19 (38.8)	0.400

Pearson's chi-square test. MACE- major cardiovascular events (death, re-AMI and coronary artery bypass grafting); Re-AMI - reinfarction; HF - heart failure.

Table 3 - **Predictors of MACE in 30 days (multivariate analysis)**

Variables	OR	Confidence Interval (95%)	p
Females	8.86	4.55 - 17.10	< 0.001
Hypertension	2.06	1.10 - 3.87	0.024
Family history	2.10	1.17 - 3.74	0.012

cardiovascular risk (92.7 ± 12.96[25] cm; 93.3 cm ± 11.3[26]; 95.9 cm ± 9.8[27]), however the average female AC (94.88 ± 15.11 cm) was significantly higher than that observed in the literature (84,1 cm ± 12,50[25]; 85,9 cm ± 12,00[26]; 82,4 ± 10,80[27]). This difference is probably due to the fact that most studies are conducted with the general population for predicting cardiovascular risk and not by patients after a cardiovascular event Thus, the values of changed CA were higher in females (74.2%) compared to males (24.4%). This predominance was also observed by Hauner et al[12] (41.5%; 36.4%) and Ingelsson et al[5] (67.0%; 49.5%). Koutsovasilis et al[28] compared a control group of patients who had the first event of ACS, and found an association between increased AC and ACS in both sexes.

When the gender variable was included in the bivariate analysis, it was found that women with increased AC have increased risk of MACE in 30 days (RC = 8,86; 95% HF: 4,55-17,10; p < 0,00). In the literature, there are no studies that correlate AC with outcomes in 30 days in patients with ACS. Bonarjee et al[29] evaluating short and long term survival of patients with AMI, found that women have a higher risk of death from any cause and from cardiovascular disease, re-AMI and rehospitalization for coronary artery bypass grafting (p < 0.00). However, Tarastchuk et al[30] found an association between increased AC (male 90 cm and female 80 cm) and cardiac outcomes after percutaneous coronary intervention, only in males.

As for the risk factors, there is evidence in the literature that men with increased AC have higher rates of hypertension than women[27,12,31]. After the bivariate analysis (OR=2.06; 95% HF: 1.10 to 3.87; p = 0.02), we observed the role of hypertension as a predictor of MACE in 30 days. Research has shown that excess fat tissue is a major risk factors associated with hypertension[4,32]. In Brazil, a study shows that for men, the impact of abdominal obesity on hypertension was greater than the impact of overall obesity, and that AC is the only anthropometric measure that relates to this pathology[32]. There is evidence that hypertensive patients have higher chances of having ACS[28] and MACE[33].

Another risk factor that was significantly associated with increased AC in men was family history of early ischemic heart disease (OR = 2.10; 95% CI: 1.17-3.74, p = 0.01). Canoy et al[27] conducted a study evaluating the relationship between body fat distribution and risk of CHD in men and women, and found no association between increased CA and family history. In this case, the only significant anthropometric measure was WHR. Tarastchuk et al[30] found that 43.8% of patients WHO had outcomes after percutaneous coronary intervention had a family history of ischemic heart disease.

The percentage of patients with increased AC who had one MACE over the 30-day follow-up (16.4% males and 2.0% females), is similar to that observed in a cohort study conducted with 6,364 individuals and randomized study with 456 patients after percutaneous coronary intervention, where 5.7% presented some MACE in the first 30 days of follow-up[34,35].

HF was the only cardiovascular outcome associated with increased AC in men (11.1%) over the first 30 days. There are no published studies describing this relationship. However, Pinheiro et al[36] found that 70% of Brazilian women with HF had increased AC, while in men this incidence was much lower (24.2%). O'Meara et al[37] compared the characteristics of men and women with HF, and found that most are overweight and men are more likely to have AMI and death from cardiovascular disease.

Limitations

This is an observational study with reduced follow-up time, which could reduce the chance of identification of adverse cardiovascular events and statistical power of the associations. Another aspect to consider is that those patients who did not attend the medical appointment for review within 30 days were followed-up by telephone, which increased the chances of misinterpreting information and inability to confirm the data. Although the full cohort was composed of 412 patients, only 267 were included in this analysis. This was because we had the concern to exclude those individuals older than 65, since studies report changes in body distribution according to age, with higher accumulation in the abdominal region of the elderly.

Conclusion

In conclusion, in the sample studied, increased AC was not associated with MACE in 30 days follow-up in patients with ACS. The MACE were associated with female gender, hypertension, and family history of ischemic heart disease.

Additional research is needed to evaluate the role of anthropometric indices, especially abdominal circumference, as a prognostic factor in ACS.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

Sources of Funding

There were no external funding sources for this study.

Study Association

This article is part of Priscila Souza's final paper for the specialization course completed at *Fundação Universitária de Cardiologia do Rio Grande do Sul*.

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