Impact of Different Obesity Assessment Methods after Acute Coronary Syndromes

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Abstract

Background: Abdominal obesity is an important cardiovascular risk factor. Therefore, identifying the best method for measuring waist circumference (WC) is a priority.

Objective: To evaluate the eight methods of measuring WC in patients with acute coronary syndrome (ACS) as a predictor of cardiovascular complications during hospitalization.

Methods: Prospective study of patients with ACS. The measurement of WC was performed by eight known methods: midpoint between the last rib and the iliac crest (1), point of minimum circumference (2); immediately above the iliac crest (3), umbilicus (4), one inch above the umbilicus (5), one centimeter above the umbilicus (6), smallest rib and (7) the point of greatest circumference around the waist (8). Complications included: angina, arrhythmia, heart failure, cardiogenic shock, hypotension, pericarditis and death. Logistic regression tests were used for predictive factors.

Results: A total of 55 patients were evaluated. During the hospitalization period, which corresponded on average to seven days, 37 (67%) patients had complications, with the exception of death, which was not observed in any of the cases. Of these complications, the only one that was associated with WC was angina, and with every cm of WC increase, the risk for angina increased from 7.5 to 9.9%, depending on the measurement site. It is noteworthy the fact that there was no difference between the different methods of measuring WC as a predictor of angina.

Conclusion: The eight methods of measuring WC are also predictors of recurrent angina after acute coronary syndromes. (Arq Bras Cardiol. 2014; 103(1):19-24)

Keywords: Evaluation; Acute Coronary Syndrome; Abdominal Circumference.

Introduction

Obesity is currently considered an epidemic in many countries and is one of the main health problems of contemporary society, being associated with high prevalence and incidence of cardiovascular disease[1]. Cardiovascular disease, in turn, is the leading cause of death and disability worldwide. Despite the decrease in the proportion of deaths from cardiovascular disease in developed countries in recent decades, rates have grown enormously in low- and middle-income ones[2].

Complications associated with overweight and obesity are related mainly to adipose tissue deposition, which leads to excess adiposity or body fat. However, the way in which fat is distributed throughout the body can be more important than total body fat in determining cardiovascular risk. Thus, recent evidence suggests that, although excess fat is associated with cardiovascular risk, the accumulation of intra-abdominal adipose tissue, specifically, is characterized by more severe cardiovascular risk[3-7].

There are several indirect methods to precisely estimate the total amount of body fat, as well as its distribution, to establish the diagnosis of obesity. Comparison of anthropometric measures with diagnostic imaging tests, such as magnetic resonance imaging and computed tomography, shows that waist circumference (WC) was the anthropometric variable that showed the best correlation with visceral adipose tissue[8].

However, in a recent literature review[9], experts detected eight different documented methods of measuring the WC: the midpoint between the last rib and the iliac crest (1), at the point of minimum circumference (2); immediately above the iliac crest (3), at the umbilicus (4), one inch above the umbilicus (5), one centimeter inch above the umbilicus (6), at the smallest rib (7) and the point of greatest circumference around the waist (8). This variability in WC measurement may hinder the use of this measurement as a marker of cardiovascular risk.

Thus, the aim of this study was to evaluate the eight measurement sites of WC in hospitalized patients with acute coronary syndrome and determine which methods are predictors of cardiovascular complications during hospitalization.

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Methods

This is a prospective, observational study carried out in the Coronary Care Unit of our institution. Patients with acute coronary syndrome, characterized by acute myocardial infarction with ST-segment elevation (STEMI), acute myocardial infarction without ST-segment elevation (NSTEMI) or unstable angina (UA)[10, 11] between August 2012 and April 2013, were included in the study.

The diagnosis of STEMI was made by the presence of ST-segment elevation in at least two leads that represent the same region, larger than 2 mm in men and 1.5 mm in women in leads V1-V3; or greater than 1 mm in other leads[10]. The diagnosis of NSTEMI was based on elevated marker of myocardial injury (troponin). Unstable angina was diagnosed by the presence of: recent angina with intensity of at least II of CCS; angina at rest and prolonged; angina after acute myocardial infarction (AMI); or accelerated angina, according to previous definitions[11]. The study protocol was approved by the Ethics Committee of our institution and patients were enrolled after signing a free and informed consent form.

Regarding the clinical profile, data were obtained from the clinical history and physical examination on admission. The variables analyzed were: age, gender, ethnicity, heart rate, blood pressure and duration of chest pain, the symptom onset to the time of initial evaluation in the emergency room. Regarding laboratory data, it included peak total creatine phosphokinase (CPK) isoenzyme MB (CK-MB) and troponin. The investigated risk factors were patient's personal and family history, smoking status and presence of hypertension, diabetes mellitus, dyslipidemia, family history of premature atherosclerosis and obesity.

The assessed treatments were platelet antiaggregants, anticoagulants, angiotensin-converting enzyme (ACE) inhibitors, beta-blockers, calcium-channel blockers, nitrates, positive inotropic agents, diuretics and reperfusion therapy.

The presence of complications was evaluated during hospital stay and the following variables were considered: angina, characterized by chest pain with angina characteristics and/or acute and dynamic ischemic changes at ECG (T-wave inversion or ST segment elevation/depression); arrhythmias (ventricular fibrillation, ventricular tachycardia, sinus bradycardia, AV block of at least second degree, atrial tachyarrhythmias); cardiogenic shock defined by systemic hypotension (systolic blood pressure ≤ 80 mmHg), signs of hypoperfusion, such as cold extremities, oliguria and dyspnea caused by pulmonary congestion; heart failure, characterized by clinical or radiological pulmonary congestion requiring intravenous diuretics; arterial hypotension, when the systolic blood pressure is ≤ 80 mmHg; pericarditis (confirmed by echocardiography) and death. These and other definitions were similar to those of previous studies[11-15].

WC measurements were performed by the eight methods described previously. Regarding the statistical analysis, continuous variables were tested for normality; when the variables were tested, the mean values and standard deviations were calculated for the studied groups. In the case of normal distribution, Student's *t* test was used to compare variables. For nonparametric variables, median values and interquartile ranges were calculated and Mann-Whitney test was used to compare the groups.

Existing associations between the independent variables and complications were analyzed by means of uni- and multivariate logistic regression analyses. Data analysis was performed with the statistical package SigmaPlot v. 12.0. The level of significance was set at 5% for all tests.

Results

A total of 55 patients, mean age of 62 ± 12 years, 42 (76%) males, were assessed. During the hospitalization period, which corresponded on average to seven days, 37 (67%) patients had at least one complication observed, except death, which was not observed in none of the cases, as shown in Table 1.

Of the variables analyzed, including clinical profiles, risk factors and medications used by patients, only diastolic blood pressure showed a positive association with the occurrence of angina (Tables 2 and 3).

Considering the complications, angina was the only variable that, after being adjusted for gender, age and infarct size, showed a positive association ($p < 0.05$) with abdominal obesity, regardless of the method used for WC measurement, as shown in Table 4. Additionally, we observe that for every centimeter of waist circumference increase, the risk for angina increased from 7.5 to 9.9%, depending on the measurement site, as shown in Table 5.

Discussion

The aim of this study was to investigate the impact of eight sites for the measurement of waist circumference in predicting complications after acute coronary syndromes during patient hospitalization. The results suggest that all sites used for WC measurement are associated with the incidence of angina after acute cardiac events, with no significant differences among them.

The first aspect to be considered refers to the fact that some studies suggest that body fat distribution, as assessed by WC and waist-hip ratio (WHR), may be more relevant than BMI as a cardiovascular risk factor[16]. This topic is controversial, as the study that evaluated WC as a predictor of 30-day evolution in patients with acute coronary

Table 1 – Presence of complications

Variables	n (%)
Angina	8 (16.3)
Arrhythmia	5 (10.2)
Congestive heart failure	18 (36.7)
Cardiogenic shock	3 (6.10)
Hypotension	14 (28.6)
Pericarditis	1 (2.00)
Death	0 (0.00)

Table 2 – Demographic, clinical and laboratory data

Variables		Angina		p value
		No (n = 47)	Yes (n = 8)	
Demographic data		-	-	-
Age (years)		64.4 ± 11.1	60.5 ± 14.1	0.385
Time of hospitalization (days)		6.00 (4.00 – 8.00)	7.00 (6.30 – 8.00)	0.355
Time of precordial pain (minutes)		240.0(30.00 – 1440)	135.0 (75.00 – 1155)	0.924
Male gender, n (%)		35.0 (74.5)	7.00 (87.0)	0.664
Diagnosis		-	-	-
NSTEMI, n (%)		13 (27.7)	2 (25.0)	0.918
Inferior AMI, n (%)		13 (27.7)	3 (37.5)	0.918
Anterior AMI, n (%)		8 (17.0)	1 (12.5)	0.918
HRUA, n (%)		10 (21.3)	1 (12.5)	0.918
MRUA, n (%)		3 (6.40)	1 (12.5)	0.918
Raça		-	-	-
Caucasian, n (%)		34 (72.3)	6 (75.0)	0.949
African descendant, n (%)		12 (25.5)	2 (25.0)	0.949
Asian, n (%)		1 (2.2)	0 (0)	0.949
Family history		-	-	-
Smoking, n (%)	**Yes**	40 (85.1)	5 (62.5)	0.149
SAH, n (%)	**Yes**	23 (48.9)	4 (50.0)	1.000
DM, n (%)	**Yes**	18 (38.3)	4 (50.0)	0.700
DLP, n (%)	**Yes**	13 (27.7)	3 (37.5)	0.678
Obesity, n (%)	**Yes**	23 (48.9)	7 (87.5)	0.059
Personal history		-	-	-
Smoking, n (%)	**Yes**	14 (29.8)	1 (12.5)	0,423
SAH, n (%)	**Yes**	34 (72.3)	8 (100.0)	0,176
DM, n (%)	**Yes**	17 (36.2)	5 (62.5)	0,244
DLP, n (%)	**Yes**	43 (91.5)	7 (87.5)	0,559
Obesity, n (%)	**Yes**	20 (42.5)	5 (62.5)	0,446
Clinical data		-	-	-
HR (bpm)		71,0 (63,0 – 83,0)	75.5 (65.2 – 92.0)	0.310
SBP (mmHg)		120 (102 – 136)	115 (105 – 133)	0.943
DBP (mmHg)		66,0 (60,0 – 80,0)	78.5 (70.0 – 88.5)	0.012
Laboratory data		-	-	-
CPK (U/L)		333,0 (109,0 – 2678)	320.0 (88.2 – 2764)	0.711
CK-MB (U/L)		60,0 (160-235)	38.5 (15.0 – 282)	0.711
Troponin (U/L)		0,90 (0,20 – 4,00)	1.80 (0.0 0– 8.30)	0.886

NSTEMI: non-ST segment elevation acute myocardial infarction; HRUA: high-risk unstable angina; MRUA: moderate-risk unstable angina; SAH: systemic arterial hypertension; DM: diabetes mellitus; DLP dyslipidemia; HR: heart rate; SBP: systolic blood pressure; DBP: diastolic blood pressure; CPK: Total creatine phosphokinase; CK-MB: MB isoform.

syndrome (ACS) in reference hospital for the treatment of cardiovascular disease, found no association between WC and major cardiovascular events[17].

On the other hand, in other studies, WC was the measure most associated with risk factors and death from cardiovascular disease[18-20]. Additionally, in an analysis of 6,560 patients with

Table 3 – Drug therapy

Variables	Angina		p value
	No (n = 47)	Yes (n = 8)	
Reperfusion therapy (angioplasty), n (%)	10 (21.3)	1 (12.5)	1.000
ASA and clopidogrel therapy, n (%)	46 (97.9)	8 (100)	1.000
Enoxaparin therapy, n (%)	1 (100)	49 (90.7)	1.000
ACEI, n (%)	3 (60.0)	32 (64.0)	1.000
Beta-blockers, n (%)	38 (80.8)	8 (100)	0.327
Calcium-channel blockers, n (%)	7 (14.9)	2 (25.0)	0.604
Nitrates, n (%)	10 (21.7)	3 (33.3)	0.428
Positive inotropics, n (%)	9 (19.1)	1 (12.5)	1.000
Diuretics, n (%)	30 (63.8)	3 (37.5)	0.244

ACEI: angiotensin-converting enzyme inhibitors.

Table 4 – Association of different sites for waist circumference measurement and the incidence of angina

WC measurement method (cm)	Angina (Yes) n = 8	Angina (No) n = 47	p
Greatest circumference	114.5 ± 16.70	99.80 ± 14.47	0.012
Smallest rib	106.5 (100.5 - 117.0)	93.00 (85.00 - 104.0)	0.011
One centimeter above the umbilicus	113.1 ± 16.10	97.80 ± 14.50	0.009
One inch above the umbilicus	113.3 ± 17. 90	96.80 ± 14.30	0.006
Umbilicus	114.4 ± 18.70	98.60 ± 14.10	0.007
Above iliac crest	110.2 ± 17.80	98.10 ± 13.40	0.029
Minimum circumference	107.6 ± 12.70	94.30 ± 13.00	0.010
Midpoint	113.1 ± 16.40	97.70 ± 13.70	0.006

WC: waist circumference.

Table 5 – Logistic regression for predicting angina adjusted for gender, age and peak CPK

Variables	OR (%)	95%CI	p value
Greatest circumference	1.081	1.016 - 1.151	0.015
Smallest rib	1.095	1.017 - 1.179	0.016
One centimeter above the umbilicus	1.088	1.018 - 1.164	0.013
One inch above the umbilicus	1.090	1.020 - 1.166	0.011
Umbilicus	1.086	1.018 - 1.158	0.012
Above iliac crest	1.075	1.010 - 1.144	0.023
Minimum circumference	1.096	1.016 - 1.182	0.017
Midpoint	1.099	1.022 - 1.182	0.011

ACS, the disproportion between body mass index and WC (indicative of central obesity) increased the probability of cardiovascular death, myocardial infarction and recurrent ischemia[21]. Similarly, the WC, but not BMI, was a predictor of the remodeling process after anterior-wall acute myocardial infarction[7]. Therefore, identifying the best method of WC measurement may have important clinical implications.

The main finding of our study was that there was no difference between the WC measurement procedure and complications during hospital stay in patients hospitalized with ACS. In this sense, the WC, regardless of the method used, could predict recurrent angina during hospitalization. For each centimeter of WC increase, the patients in our study had, on average, a nine-fold higher chance to have angina. Similarly,

none of the methods of WC measurement was associated with the other evaluated complications. Therefore, one can deduce that any of the eight available methods for WC assessment could be incorporated into clinical practice.

Another relevant aspect is related to the mechanisms involved in the cardiovascular risk associated with abdominal obesity. Although the mechanisms are complex and not completely understood, several hypotheses have been formulated. For instance, the visceral adipose tissue has greater capacity to secrete components of the renin-angiotensin-aldosterone system. Similarly, abdominal obesity would more adversely modulate the release / inhibition of substances secreted by adipose tissue (adipokines), which can regulate blood pressure, insulin sensitivity, energy homeostasis, immune response, oxidative stress and inflammatory response[5-7]. Therefore, these mechanisms alone or concomitant, could explain the association found in our study between waist circumference and recurrent ischemia.

Some issues should be considered when interpreting our results. Firstly, the clinical, demographic and laboratory data, as well as drug therapy used for the treatment of patients at the hospital discharge showed no association with the presence of angina in the studied population. Thus, in the absence of better markers, our result further highlights the importance of using different sites for WC measurement when predicting the risk of angina in individuals at risk of cardiovascular complications.

A second characteristic that expands the importance of abdominal obesity assessment is that the measure of the WC is considered a reliable, easy to use and low-cost anthropometric indicator. Additionally, the WC may have other important applications, considering it is used to predict the risk of early onset of certain diseases such as diabetes mellitus and other cardiovascular diseases, as well as to provide useful information to identify populations at risk even before obesity is identified through body mass index[22,23].

Finally, some limitations should be taken into account when interpreting the results. Our study assessed a low number of patients and included patients from a single center. Despite these limitations, we believe our study raises two important hypotheses to be confirmed in large clinical trials: first, this study suggests no significant differences between the different methods of WC assessment; and, second, our data suggest that WC measurement may be a clinically relevant marker for predicting the risk of angina after acute coronary syndromes and may, in this scenario, be incorporated as a marker of cardiovascular risk by health professionals.

Conclusion

For these reasons, we conclude that the eight methods used for waist circumference measurement are associated with the presence of angina after acute coronary events, with no significant differences between them.

Author contributions

Conception and design of the research: Azevedo PS, Paiva SAR, Zornoff LAM; Acquisition of data: Nunes CNM, Minicucci MF, Farah E, Fusco D; Analysis and interpretation of the data: Nunes CNM, Minicucci MF, Farah E, Fusco D, Zornoff LAM; Statistical analysis: Minicucci MF, Paiva SAR; Writing of the manuscript: Nunes CNM, Minicucci MF, Azevedo PS, Paiva SAR, Zornoff LAM; Critical revision of the manuscript for intellectual content: Azevedo PS, Zornoff LAM.

Potential Conflict of Interest

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

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Study Association

This study is not associated with any thesis or dissertation work.

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