Original Article

# Immediate Results of Myocardial Revascularization. Comparison Between Men and Women

Vivian Lerner Amato, Ari Timerman, Ângela T. Paes, Valéria T. Baltar, Pedro S. Farsky,
Jorge A. Farran, Carlos Gun, Paulo Paredes Paulista, Leopoldo S. Piegas,
J. Eduardo M. R. Sousa

São Paulo, SP - Brazil

## Objective

*To assess morbidity and mortality in men and women undergoing isolated myocardial revascularization and to analyze the factors related to differences occasionally found.*

## Methods

*Comparative analysis of 2032 patients, 1402 (69%) men and 630 (31%) women, who consecutively underwent surgery from January 1999 to December 2002.*

## Results

*Women had a greater mean age, more risk factors, and a greater incidence of unstable angina. Internal thoracic artery grafts were more frequently used in men, 85.6% vs 78.3%, P < 0.001. No differences in the postoperative complication rates were observed, except for infections, more frequent in women. In-hospital mortality rates were 4.1% and 6.3% for men and women, respectively (P = 0.026). On multivariate analysis, neither the female sex was identified as an independent prognostic factor for death nor was the use of thoracic artery grafts identified as an isolated protective factor. However, sex-internal thoracic artery graft interaction was significant. The following variables were also selected: age (OR = 1.03; 95% CI = 1.01 to 1.06; P = 0.004), preoperative renal failure (OR = 1.82; 95% CI = 1.07 to 3.11; P = 0.028) and urgent/emergency surgery (OR = 2.85; 95% CI = 1.32 to 6.14; P = 0.008).*

## Conclusion

*The female sex had a greater surgical mortality; this, however, was not an independent prognostic factor for death. The use of thoracic artery grafts proved to be protective. Older patients with renal failure in an emergency situation had greater indices of in-hospital death.*

## Keywords

*myocardial revascularization surgery, men, women*

Several studies [1-11] have shown that women who undergo myocardial revascularization surgery (MR) have a greater in-hospital mortality rate and a greater rate of complications, as compared with those of men, the first of those studies being attributed to Bolooki et al [12].

Several studies [1,10,13] have reported a similar survival after surgery for men and women, while others [7,14,15] have reported a shorter survival for women, whose rates of angina recurrence are greater [16] and whose graft patency is lower [1,17].

On average, the surgical mortality rate for women has been reported as twice that of men. The reasons for that have not been completely clarified, and several hypotheses have been discussed.

Studies [11] have shown that, on the occasion of surgery, women compared with men are usually older and have a greater number of risk factors and also of symptoms. Some of those factors, as well as the more unstable symptomatology, are known to relate to greater surgical morbidity and mortality rates [18].

The greater technical difficulty during surgery, with greater rates of complications and in-hospital mortality, has been attributed to the smaller body surface area, and, consequently, lower coronary diameter in the female sex, the anatomical aspects being the major thing responsible for the worse results in women [1,6,19,20]. Studies on autopsy [21], angiography [22], and in vivo with intracoronary ultrasound [23] have confirmed that women have coronary arteries of lower caliber than men do.

Women have also been shown to receive fewer arterial grafts, mainly internal thoracic artery grafts [11], which have been related in the literature to a lower mortality rate and fewer complications, even in the in-hospital phase [24], in addition to their already known benefit in long-term evolution [25]. The reasons why the female sex has been less favored by these grafts have not been completely clarified.

In some studies, after correction for age and risk factors, female sex has no longer been a prognosis for greater in-hospital mortality, indicating that those factors, and not sex per se, account for the greater surgical risk [5].

The same occurs with the analyses with the same correction, which consider, in addition to clinical factors, body surface and coronary diameter, showing that, in reality, "smaller" people, both men and women, have greater mortality and complication rates [1,6,10,19,20].

Those conclusions, however, have not been uniform, and, in some reports, even after correcting for these clinical and anatomical factors, the female sex has remained related to greater mortality

and complication rates, as if something intrinsically linked to sex, and not yet clarified, exists, leading to worse results in the in-hospital phase [8,9,11].

It is worth noting that in some series, mainly in recent years, these differences in in-hospital morbidity and mortality between men and women have no longer been observed. The authors have attributed that to the refinement in the surgical technique and peri-operative care, which have overcome the old difficulties regarding the female sex [13,26-28]. Therefore, several questions about that theme remain to be discussed.

This study aimed at the following: 1) to compare, in the material at our institution, in-hospital morbidity and mortality in men and women who undergo isolated myocardial revascularization; and 2) to identify preoperative, intraoperative, and postoperative factors related to occasional differences found between sexes.

## Methods

A theoretical statistical calculation [29] was carried out leading to a sample with 580 patients of each sex. We calculated that 4 years would be required for this number of women to be achieved; therefore, the study was planed to encompass the years from 1999 to 2002.

The study comprised a prospective analysis of patients consecutively undergoing isolated myocardial revascularization at the Instituto Dante Pazzanese de Cardiologia from January 1999 to December 2002. Reoperations and surgeries with associated procedures, such as left ventricular aneurysmectomy, the valvular approach, and carotid endarterectomy were excluded. During that period, 2443 patients underwent myocardial revascularization, 411 of whom met the exclusion criteria, resulting in a study sample of 2032 patients, 1402 (69%) men and 630 (31%) women.

The personal antecedents were as follows: 1) systemic arterial hypertension: patients who reported this antecedent and were using antihypertensive medication, or who, on hospital admission, had systolic blood pressure ≥ 140 mmHg or diastolic blood pressure ≥ 90 mmHg, or both [30]; 2) diabetes mellitus: patients who reported that antecedent and were receiving a specific diet, oral hypoglycemic agents or insulin, or both, or whose preoperative fasting glycemia was ≥ 126 mg/dL [31]; 3) familial antecedents of coronary artery disease: information about parents or siblings or other first-degree relatives with coronary artery disease that appeared at an age ≤ 55 years in male relatives, or at an age ≤ 65 years in female relatives [32]; 4) smoking: considered current if the patient had that habit on hospital admission or if he/she had quit smoking within a period shorter than 1 year; 5) chronic obstructive pulmonary disease: history of asthma or chronic bronchitis; 6) renal failure: preoperative serum levels of creatinine ≥ 1.5 mg/dL (normal range in the laboratory of our institution: 0.7 to 1.2 mg/dL); 7) previous neurologic findings: previous history of a transient ischemic episode or stroke; 8) carotid lesion: patients with lesions ≥ 50% in the carotid system; 9) peripheral arterial vasculopathy (other than cerebral): preoperative physical examination with a decrease in or absence of peripheral pulses, or both, with or without intermittent claudication, or a history of previous vascular surgery, or even thoracic or abdominal aortic aneurysm, which had or had not been previously surgically treated; 10) dyslipidemia: patients reporting that antecedent and who were receiving a specific diet or lipid-lowering medication or whose preoperative fasting blood test showed total cholesterol levels ≥ 200 mg/dL or triglyceride levels ≥ 200 mg/dL [32].

The degree of arterial impairment was assessed on conventional angiography, and the patients were divided as follows: 1) patients with lesions in the left main coronary artery ≥ 50%; 2) patients with 1-, 2-, 3-vessel lesions ≥ 70% in 1, 2, or 3 of the following territories: anterior descending artery or diagonal branches, or both; circumflex artery or marginal branches, or both; right coronary artery. The ejection fraction was obtained through quantitative angiography [33].

The patients were classified as having stable angina, unstable angina, and silent ischemia or asymptomatic after acute myocardial infarction. The functional degree of angina and heart failure were recorded according to the Canadian Cardiovascular Society (CCS) and New York Heart Association (NYHA) classifications, respectively.

The surgical procedure was considered as follows: 1) emergency procedure – when the surgery was performed immediately after the hemodynamic procedure or angioplasty, or within the first 24 hours after the patient arrived at the hospital; in this case, the emergency was determined by conditions of instability of the patient; 2) urgent procedure – when the surgery was performed on the day following the hemodynamic study due to clinical need; 3) elective procedure – in the remaining situations. The surgeries were usually performed by using anoxic arrest through intermittent aortic clamping, with body temperature of 33ºC.

The postoperative complications were as follows: 1) low-output syndrome: hypotension, with systolic blood pressure levels < 90 mmHg and peripheral signs compatible with low output; 2) significant arrhythmias: sinus bradycardia or junctional rhythm that require provisory pacemaker, complete atrioventricular block, paroxysmal supraventricular tachycardia, atrial fibrillation or flutter, ventricular tachycardia, and ventricular fibrillation; 3) perioperative myocardial infarction: defined as the appearance of new pathological Q waves or amputation of R waves; the enzymatic markers were not considered; 4) prolonged respiratory support: defined as length of mechanical ventilation longer than 48 hours; 5) stroke: defined as the appearance of compatible neurologic signs, and, when necessary, confirmation with brain computed tomography or magnetic resonance imaging; 6) renal failure: defined as serum creatinine level > 1.9 mg/dL during the postoperative in-hospital phase.

The associations between the qualitative variables were assessed by using the chi-square test or Fisher exact test, when necessary. For comparisons of the quantitative variables, the Student $t$ test or the nonparametric Mann-Whitney test was used, if the supposition of normality was rejected. For assessing the influence of the risk factors and sex, the multivariate approach was used with the logistic regression technique and the stepwise method for selection of variables, considering in-hospital death as the dependent variable. The results referring to that analysis were expressed as odds ratios and their respective 95% confidence intervals [34]. The significance level considered was lower than or equal to 0.05. SPSS for Windows, version 8.0, was the software used for all statistical analyses.

## Results

The ages ranged from 29 to 91 years for men and from 32 to 87 years for women. The latter had a greater mean age than men did (mean ± standard error): 64 ± 0.39 years versus 61.6 ± 0.27 years, respectively (P < 0.001). Table I shows the preoperative clinical characteristics for both groups; women had a greater number of risk factors, except for smoking, which was more frequent among men, who also had the greatest rates of previous infarction and renal failure. In regard to preoperative clinical findings, no significant differences were found between men and women in regard to the rates of stable angina, 50.4% vs 50.5%, and silent ischemia, 6.7% vs 4.9%, respectively; unstable angina was more frequent in the female sex, 33.2% vs 25.7%, P = 0.001; in the asymptomatic group, after acute myocardial infarction, men predominated, 17.1% vs 11.4%, P = 0.002. No difference was found between both sexes in regard to the degree of congestive heart failure.

Cine coronary angiographies were assessed in 2028 patients (in 4 patients, the data were not correctly recorded and could not be computed), and, as can be seen in table II, no significant difference was found between both groups in regard to the number of 1-, 2-, 3-vessel patients or those with lesions in the left main coronary artery.

Differences between men and women were observed neither in regard to the rates of elective (close to 96.5% for both sexes), urgent or emergency surgeries, nor in the mean number of grafts performed (2.8 in both sexes), nor in the rates of coronary endarterectomy (approximately 9% for both sexes). The durations of extracorporeal circulation and anoxia were slightly more elevated in the male sex. Grafts of the right or left internal thoracic arteries, or both, were clearly less used in the female sex (85.6% vs 78.3%, P < 0.001).

No statistically significant difference was found between men and women in regard to the occurrence of postoperative complications, except for infections, which were more frequent in the female sex, both in the chest (2.9% vs 0.9%, P = 0.001) and limbs (3.7% vs 1.0%, P < 0.001). The other postoperative complications were as follows, respectively in men and women: low-output syndrome, 16.0% and 16.7%; arrhythmias, 13.8% and 14%; prolonged respiratory support, 4.6% and 5.6%; acute myocardial infarction, 5.3% and 6.3%; stroke, 2.6% and 4.1%; reoperation, 1.9% and 3.2%; renal failure, 2.3% and 2.1%; and use of intra-aortic balloon, 2.1% for both sexes. In our study, 444 (31.7%) men and 215 (34.1%) women had one or more complications (P = 0.274).

The length of stay in the intensive care unit was greater for women, but without statistical significance (mean ± standard error): 71 ± 3.8 h vs 65 ± 2.1 h, P = 0.170. The mean drainage was greater in men (mean ± standard error): 871.6 ± 11.5 mL vs 683.6 mL ± 18.2 mL, P < 0.001. The in-hospital length of stay after surgery was slightly greater in the female sex (mean ± standard error): 10 ± 0.43 days vs 9 ± 0.37 days for the male sex (P = 0.04).

The mortality rates, total and of several subgroups, are found in table III. Total in-hospital mortality was 4.1% for men and 6.3% for women (P = 0.026). Dividing into age groups, a significant difference was observed only in patients aged < 50 years, in whose group only 2 (3.2%) women and no man died (P = 0.018). It is worth noting that women have a greater mortality in the younger groups and that the death rates are almost equal after 70 years or are even higher among men older than 80 years, 11.1% vs 8.7%, but with no statistical significance (P = 0.777). In all other subgroups analyzed, the female sex had greater death rates, but this difference only reached statistical significance in patients with hypertriglyceridemia (P = 0.005).

To analyze the influence of sex or other factors on the occurrence of death, the logistic regression technique was used. The results are shown in table IV as follows: a mean 3.6% increase in the chance of death is observed for each year increase in age; a 1.8-fold increase in the chance of death is observed in a patient with preoperative renal failure compared with that of a patient with no renal failure; a 2.8-fold increase in the chance of death of patients undergoing urgent or emergency surgery is observed compared with that of patients undergoing elective surgery. In isolation, sex was not identified as an independent factor for mortality and, in isolation, the use of internal thoracic artery grafts was not identified as protective. However, in this model, an inte-

| Table I – Comparison of the preoperative characteristics of men and women (number of patients/percentage) | | | |
|---|---|---|---|
| | Men (1402 / 69%) | Women (630 / 31%) | p |
| White race | 1219 / 86.9% | 522 / 82.9% | 0.015 |
| Systemic arterial hypertension | 1022 / 72.9% | 560 / 88.9% | < 0.001 |
| Diabetes mellitus | 456 / 32.5% | 277 / 44% | < 0.001 |
| Hypercholesterolemia | 772 / 55.1% | 452 / 71.7% | < 0.001 |
| Hypertriglyceridemia | 292 / 20.8% | 177 / 28.1% | < 0.001 |
| Smoking | | | |
|     Current | 301 / 21.5% | 97 / 15.4% | < 0.001 |
|     Suspension | 615 / 43.9% | 121 / 19.2% | |
| Familial antecedents | 281 / 20% | 138 / 21.9% | 0.337 |
| Previous infarction | 667 / 47.6% | 253 / 40.2% | 0.002 |
| Renal failure | 179 / 12.8% | 46 / 7.3% | < 0.001 |
| COPD• | 76 / 5.4% | 20 / 3.2% | 0.027 |
| Peripheral vasculopathy | 87 / 6.2% | 42 / 6.7% | 0.693 |
| Previous neurologic findings | 65 / 4.6% | 30 / 4.8% | 0.901 |
| Carotid disease > 50% | 59 / 4.2% | 39 / 6.2% | 0.054 |
| • COPD- chronic obstructive pulmonary disease. | | | |

raction between sex and use of the internal thoracic artery appeared, showing a chance of death 2.1 times greater for the feminin sex, comparing women and men who received internal thoracic artery grafts and chances of death of men who received the graft 66% lower than those of men who did not receive them.

| Table II – Comparison of arterial impairment in men and women (number of patients/percentage) | | | |
|---|---|---|---|
| | Men (1399) | Women (629) | p |
| Lesion in the left main coronary artery | 275 / 19.7% | 112 / 17.8% | |
| 1-vessel * | 182 / 13.0% | 85 / 13.5% | 0.267 |
| 2-vessel | 431 / 30.8% | 217 / 34.5% | |
| 3-vessel | 511 / 36.5% | 215 / 34.2% | |
| * Isolated lesion of the anterior descending coronary artery | 79 / 5.6% | 39 / 6.2% | 0.620 |

The ejection fraction could be quantified in 1374 patients (67.6% of the total population, 68.7% of the women and 67.1% of the men) and was slightly more elevated in the female sex (mean ± standard error): 61.5 ± 0.48 vs 58.1 ± 0.64% (P < 0.001).

## Discussion

In our study, women were older and had more risk factors, while men had a greater incidence of smoking and previous infarction; the degree of arterial impairment was similar in both sexes and the ejection fraction was slightly more elevated in the female sex.

Except for some studies that reported a greater number of 3-vessel disease among men [1,4,13], that profile reproduces exactly the results of the great majority of the studies that compare both sexes [11], and several characteristics are related to greater in-hospital morbidity and mortality [18].

In our case series, women had a significantly greater incidence of diabetes mellitus than men did (44% vs 32.5%). It is worth remembering that, contrary to systemic arterial hypertension, hypercholesterolemia and smoking, which have, as risk factors, the same influence on the male and female sexes, diabetes has a particular impact on women, eliminating the protective effect provided by sex and leading to a greater chance of developing coronary artery disease and a worse evolution after its appearance [35,36]. Worse early and late results have been reported in diabetic patients undergoing

| Table III – In-hospital mortality of men and women undergoing myocardial revascularization surgery - univariate analysis (Number of patients operated on/ Number of deaths/ Percentage of deaths) | | | |
|---|---|---|---|
| | Men | Women | p |
| Total | 1402 / 57 / 4.1% | 630 / 40 / 6.3% | 0.026 |
| Age (years): | | | |
| ≤ 50 | 174 / 0 / 0 | 63 / 2 / 3.2% | 0.018 |
| 50 – 59 | 404 / 12 / 3.0% | 122 / 7 / 5.7% | 0.151 |
| 60 – 69 | 493 / 17 / 3.4% | 246 / 15 / 6.1% | 0.095 |
| 70 – 79 | 304 / 25 / 8.2% | 176 / 14 / 8.0% | 0.917 |
| > 80 | 27 / 3 / 11.1% | 23 / 2 / 8.7% | 0.777 |
| Ejection fraction (%): | | | |
| ≤ 35 | 85 / 5 / 5.9% | 24 / 1 / 4.2% | > 0.999 |
| 35 – 50 | 170 / 8 / 4.7% | 59 / 6 / 10.2% | 0.202 |
| > 50 | 686 / 24 / 3.5% | 350 / 17 / 4.9% | 0.289 |
| Systemic arterial hypertension | 1022 / 43 / 4.2% | 560 / 34 / 6.1% | 0.099 |
| Diabetes mellitus | 456 / 20 / 4.4% | 277 / 18 / 6.5% | 0.211 |
| Hypercholesterolemia | 772 / 33 / 4.3% | 452 / 29 / 6.4% | 0.099 |
| Hypertriglyceridemia | 292 / 8 / 2.7% | 177 / 15 / 8.5% | 0.005 |
| Renal failure | 179 / 15 / 8.4% | 46 / 6 / 13.0% | 0.392 |
| Peripheral vasculopathy | 87 / 6 / 6.9% | 42 / 6 / 14.3% | 0.203 |
| Previous neurologic findings | 65 / 5 / 7.7% | 30 / 4 / 13.3% | 0.457 |
| Previous AMI * < 30 days | 156 / 12 / 7.7% | 75 / 9 / 12.0% | 0.286 |
| Previous AMI > 30 days | 511 / 20 / 3.9% | 178 / 8 / 4.5% | 0.701 |
| Unstable angina | 361 / 22 / 6.1% | 209 / 17 / 8.1% | 0.353 |
| COPD* | 76 / 0 / 0 | 20 / 1 / 5.0% | 0.208 |
| Lesion in the left main coronary artery | 275/ 13 / 4.7% | 112 / 9 / 8.0% | 0.202 |
| 1-vessel | 182 / 5 / 2.7% | 85 / 6 / 7.1% | 0.110 |
| 2-vessel | 431 / 13 / 3.0% | 217 / 11 / 5.1% | 0.186 |
| 3-vessel | 511 / 26 / 5.1% | 215 / 14 / 6.5% | 0.467 |

* AMI- Acute myocardial infarction; COPD- chronic obstructive pulmonary disease.

| Table IV – Factors related to mortality in men and women undergoing myocardial revascularization surgery – Multivariate analysis | | | |
|---|---|---|---|
| Variable | Mean odds ratio | P value | 95% confidence interval |
| Age | 1.036 | 0.004 | 1.011 - 1.061 |
| Renal failure | 1.823 | 0.028 | 1.068 - 3.112 |
| Urgent/ emergency surgery | 2.851 | 0.008 | 1.323 - 6.141 |
| Sex-use of internal thoracic artery interaction: | | | |
| Female sex with thoracic artery graft/ male sex with thoracic artery graft | 2.170 | 0.003 | 1.300 - 3.636 |
| Female sex without thoracic artery graft/ male sex without thoracic artery graft | 0.660 | 0.288 | 0.301 - 1.430 |
| Female sex with thoracic artery graft / female sex without thoracic artery graft | 1.121 | 0.771 | 0.520 - 2.419 |
| Male sex with thoracic artery graft / male sex without thoracic artery graft | 0.338 | <0.001 | 0.187 - 0.610 |

Note: Variables analyzed - sex, age, systemic arterial hypertension, diabetes mellitus, hypercholesterolemia, hypertriglyceridemia, previous neurologic findings, renal failure, previous vasculopathy, previous myocardial infarction, unstable angina, ejection fraction, use of internal thoracic artery graft, urgent/ emergency surgery.

myocardial revascularization surgery [37], although not all studies identify diabetes as an independent prognostic factor of in-hospital mortality. The increase in triglyceride levels and HDL-cholesterol levels seem also to have a particular meaning for women [35].

In our study, women also had a greater incidence of systemic arterial hypertension (88.9% vs 72.9%). Neither the presence of left ventricular hypertrophy could be detected in those patients, nor any degree of hypertensive heart disease; however, in several series, the female sex has greater degrees of heart failure than the male sex does, despite their better preserved systolic function. This may lead to the belief that a diastolic impairment in ventricular function exists, which could eventually also influence surgical results. A hypertrophic ventricle is believed to adapt less to variations in volume or transient periods of ischemia, a hypothesis formulated by Jacobs in a recent publication [38].

In regard to the greater proportion of women with unstable angina, it is worth emphasizing that for the same degree of arterial impairment and due to unknown reasons, women are always more symptomatic than men are [14].

Some authors [5] have claimed the existence of a lower proportion of women referred for diagnostic and therapeutic procedures, the result being that women who reach surgery do that at a more advanced age and with greater comorbidities, more symptomatic and, more frequently, on an emergency basis. Those authors have claimed that these may be the reasons for the less satisfactory surgical results in women compared with those in men.

In some studies comparing sexes, lower rates of referral for coronary angiography have been reported for women after acute myocardial infarction, altered simple exercise tests or perfusion tests in nuclear medicine; and yet, lower rates of referral for revascularization procedures after coronary angiography have also been found among women [39,40]; these same results were not found in others [41].

In our study, no difference between men and women was observed in regard to the number of grafts or performance of coronary endarterectomy; the right or left internal thoracic artery, or both, was used less frequent in the female sex; longer times of anoxia and extracorporeal circulation were more often found in the male sex.

Except for the rates of coronary endarterectomy, which, in some studies, were greater in men [13], and the number of grafts, which, in most studies, is also greater in men [26], the other findings are compatible with the information usually found in the literature.

In a study by Leavitt et al [42], women received fewer internal thoracic artery grafts in all age and clinical groups; however, in individuals with body surface area lower than 1.8 m$^2$, the graft was used at the same frequency in men and women. In multivariate analysis, the following variables were identified as factors related to the nonuse of the internal thoracic artery: female sex (P = 0.03); elderly patients (P < 0.001); small body surface area (P < 0.001); and urgent or emergency surgery (P < 0.001). In 1994, Edwards et al [24], comparing 18,614 patients who received at least one internal thoracic artery and 19,964 patients who received only venous grafts, reported after multivariate analysis that the use of that graft was an independent factor for lower surgical mortality (P < 0.0025).

In our material, no significant difference between men and women was observed in the rates of postoperative complications, except for infections, which were more frequent in women, probably influenced by obesity and diabetes mellitus, which are more prevalent in the female sex.

In-hospital mortality was significantly greater in women in the different subgroups analyzed; however, statistical significance was only achieved in patients < 50 years of age and in those with hypertriglyceridemia.

In multivariate analysis, sex did not appear as an independent factor of mortality, which was related to age, preoperative renal failure, urgent/emergency surgery, and the sex-use of internal thoracic artery interaction.

Similarly to our findings, some authors have observed that the difference in mortality between the 2 sexes is greater for younger patients, disappearing or decreasing for the elderly. Vaccarino et al [43], in a recent study comprising 51,187 patients (30% women), reported that, after correction for multivariate analysis, the differences in mortality decreased as age increased, and significance was lost after the age of 80 years.

In regard to the greater mortality of women with hypertriglyceridemia, no study in the literature was found relating the elevation in triglycerides to worse results in the in-hospital phase of myocardial revascularization surgery; only references to its later influence were found [44]. The greater mortality in the female sex in the remaining subgroups analyzed did not reach statistical significance, which prevents us from stating that no difference really exists or whether the sample did not reach a sufficient size for demonstrating the difference.

In regard to the factors that have been usually identified as related to in-hospital death in myocardial revascularization surgery, a great variability exists in the different studies, depending on the type of analysis and the variables included. In an attempt at uniformity, Jones et al [18] assessed 7 important databases of myocardial revascularization surgery in the United States and identified the following prognostic factors as the most significant for in-hospital mortality: urgent/emergency surgery, age (these 2 were also found in our study), previous heart surgery, ejection fraction, sex, number of impaired vessels, and presence of a lesion in the left main coronary artery. The authors named these 7 factors "core" and attributed the major prognostic role to them in regard to the occurrence of in-hospital death. Then, 13 additional prognostic factors, called "level 1" variables, were identified as follows: weight, height, angioplasty in the current hospitalization, more recent myocardial infarction, history of angina, severe ventricular arrhythmias, congestive heart failure, mitral regurgitation, diabetes mellitus, cerebrovascular disease, peripheral vascular disease, chronic obstructive pulmonary disease, and creatinine levels.

We identified the relation of the sex-internal thoracic artery interaction and death as difficult to understand, perhaps aided by the knowledge of mortality in both sexes with and without the use of that graft (being for men and women with the graft, 2.9% and 5.9%, respectively, and for men and women without the graft, 10.9% and 8.0%, respectively). Four situations were pointed out as follows: 1) female sex with thoracic artery/male sex with thoracic artery (OR = 2.17, P = 0.003): inferior results for the female sex, even when the thoracic artery is used in both sexes. Mortality provided by the female sex seemed to exceed even the use of grafts. Considering this, we can hypothesize that the female

sex did not appear in the multivariate analysis model as an independent factor for death, because the male sex without the thoracic artery graft has an extremely high mortality; 2) female sex without thoracic artery/male sex without thoracic artery (OR = 0.660, P = 0.288), showing that men who received no grafting had a high mortality, which was equal to that of women; 3) female sex with thoracic artery graft/female sex without thoracic artery (OR = 1.121, P = 0.771), showing that maybe the use of a graft did not sufficiently decrease mortality for women; 4) male sex with thoracic artery/male sex without thoracic artery (OR = 0.338, P < 0.001), showing the strong beneficial and protective influence of the internal thoracic artery graft in the male sex. It is worth noting that this analysis does not include the body surface area and the coronary diameters, factors extremely important for analyzing the difference in mortality between both sexes.

Similarly to our findings, other authors did not identify sex as an independent factor of mortality [1,5,6,10].

Khan et al [5], in a study with 2.6% mortality for men and 4.6% for women (P = 0.036), also concluded that, after adjusting for age and functional degree of heart failure, sex lost significance. Loop et al [1], analyzing 2,445 women and 18,079 men, found a greater mortality for the female sex, 2.9% vs 1.3% (P < 0.001); in multivariate analysis, when clinical variables were added to sex, the latter persisted as a prognosis of death; when body surface area was added to the model, it lost significance. The authors concluded that "small people" had a greater risk of death.

Some authors, analyzing patients who undergo myocardial revascularization surgery identified, contrary to the previous studies and our analysis, the female sex as an independent factor of mortality [3,8,9,11]. The greatest study of all was that by Edwards et al [11], who used the database of the American Society of Thoracic Surgery with 344,913 patients, who were divided into several groups of risk so that the 2 sexes were level; those authors observed that in all of them the women had a significantly greater mortality than men did, except for the highest-risk group, when the operative risk was close to 30% and the surgical results in both sexes were similar; in that study, the authors emphasized the importance of body surface area, showing a significant decrease in mortality as body surfaces increased.

In conclusion, although women have greater surgical mortality, sex was not identified as an independent prognostic factor for death, appearing only in the interaction with the internal thoracic artery graft, which proved to be protective, mainly in the male sex. Age was a fundamental factor for the greater mortality in the female sex. Older patients with preoperative renal failure or who were in an emergency situation had a greater chance of in-hospital death.

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