Acute Myocardial Infarction. Clinical and Epidemiological Profile and Factors Associated with In-Hospital Death in the Municipality of Rio de Janeiro

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Objective – To study the factors associated with the risk of in-hospital death in acute myocardial infarction in the Brazilian public health system in Rio de Janeiro, Brazil.

Methods – Sectional study of a sample with 391 randomly drawn medical records of the hospitalizations due to acute myocardial infarction recorded in the hospital information system in 1997.

Results – The diagnosis was confirmed in 91.7% of the cases; 61.5% males; age = 60.2 ± 2.4 years; delta time until hospitalization of 11 hours; 25.3% were diabetic; 58.1% were hypertensive; 82.6% were in Killip I class. In-hospital mortality was 20.6%. Thrombolysis was used in 19.5%; acetylsalicylic acid (ASA) 86.5%; beta-blockers 49%; angiotensin-converting enzyme (ACE) inhibitors 63.3%; calcium channel blockers 30.5%. Factors associated with increased death: age (61-80 years: OR=2.5; > 80 years: OR=9.6); Killip class (II: OR=1.9; III: OR=6; IV: OR=26.5); diabetes (OR=2.4); ventricular tachycardia (OR=8.5); ventricular fibrillation (OR=34); recurrent ischemia (OR=2.7). The use of ASA (OR=0.3), beta-blockers (OR=0.3), and ACE inhibitors (OR=0.4) was associated with a reduction in the chance of death.

Conclusion – General lethality was high and some interventions of confirmed efficacy were underutilized. The logistic model showed the beneficial effect of beta-blockers, and ACE inhibitors on the risk of in-hospital death.

Keywords: acute myocardial infarction; in-hospital mortality; multivariate analysis

Cardiovascular diseases play a relevant role as indicators of morbidity and mortality in Brazil and are the first cause of proportional mortality in the country since the 1960s. In 1998, 25% of male deaths and 31.3% of female deaths were caused by cardiovascular diseases [1]. Ischemic heart disease, including acute myocardial infarction, is the major cause of death in the cities in the southern and southeastern regions [1,2].

Acute myocardial infarction is an acute event that always requires hospitalization. Its clinical diagnosis is relatively simple and well established and is usually based on the triad, clinical history, electrocardiographic evolution, and enzymatic curve [3,4]. The management of acute myocardial infarction comprises several therapeutical options with scientifically confirmed efficacy, which have been discussed extensively throughout the practical guidelines of several international societies and those of the Brazilian Society of Cardiology [3,5].

However, some studies have shown that the existence of or even knowledge about these guidelines has not assured treatment practices based on scientific evidence. The variability in the use of therapeutic interventions in acute myocardial infarction reported in the literature is great, and many times shows the nonadherence to well-established protocols [6-16]. Recently, a study about the profiles of pharmacological treatment in acute myocardial infarction in the municipality of Rio de Janeiro showed the underutilization of interventions of confirmed efficacy in acute myocardial infarction, such as the use of intravenous thrombolytic agents, of acetylsalicylic acid, of I.V. beta-blockers, and of I.V. nitrates, and a relatively widespread use of calcium channel blockers not based on scientific evidence [17].

In-hospital mortality has been reported to vary greatly, and, among other reasons, it may be related to differences in the severity of the cases and to differences in the quality of medical treatment [7, 10-15, 17-22].

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Considering all that, this study aimed at analyzing the clinical and epidemiological profile of a representative sample of acute myocardial infarction treated at the Sistema Único de Saúde (SUS – Brazilian public health system) in the municipality of Rio de Janeiro. The major factors associated with the variation in the risk of in-hospital death, including those related to the severity of the cases and the process of medical assistance, were identified.

Methods

A sectional study of a random sample of 391 medical records was carried out. The sample was stratified according to the hospitals, drawn from a total of 1,936 hospitalizations recorded with the main diagnosis of acute myocardial infarction based on the AIH (Authorization for Hospitalization) of the system of hospital information (SIH/SUS) in the municipality of Rio de Janeiro in 1997. The calculation of the size of the sample considered the proportion of patients and deaths with a relative error of 10% and a significance level of 5% in a stratified sample model with proportional allocation and no reposition [23]. The patients were randomly drawn from 22 hospitals included in the sample, which were chosen from the initial universe of 38 hospitals. Hospitals treating less than 10 cases in the year studied were excluded from the study. The field work comprised data collection in the medical records to confirm the diagnosis of acute myocardial infarction, data about risk factors and the severity of the disease, and data about the use of diagnostic and therapeutic interventions, and was reported in detail in another publication [24]. The study protocol was approved by the committee on ethics in research of the Escola Nacional de Saúde Pública/FIOCRUZ.

The diagnosis of acute myocardial infarction was confirmed according to the criteria of definitive or probable cases adopted by the MONICA Project of the World Health Organization [25]. The clinical classification of the hemodynamic status of patients was performed according to Killip & Kimball [26].

Univariate and multivariate analyses were performed with the Epi Info 6.04d and SAS™ (6.0 version) programs. The χ^2 test was used to check the statistical significance of the differences observed in the proportions of the categories of the variables studied; a 2-tailed $p < 0.05$ was considered statistically significant. When necessary, the Fisher exact test was used. Confidence intervals of 95% (95% CI) of the estimated proportions and odds ratio (OR) were calculated. To study the factors associated with the variation in the risk of in-hospital death, multivariate analysis with logistic regression was used; in this case, the Wald test was used to check the significance of the independent variables included in the model. To analyze the overall adjustment of the model, the test of likelihood ratio (-2 LOG L) was used. The following parameters were analyzed: the concordance between the probabilities foretold by the model and the responses observed; the presence of interaction between the variables; the diagnosis of regression

through the analysis of the residues and extreme observations, and its possible impact on the model. Through hierarchic modeling, the random effect on the level of the hospitals was tested based on the hypothesis of the existence of an intraclass correlation relative to the hospital units.

Results

Three hundred and eighty-four of the 391 randomly drawn medical records were reviewed (loss of 1.8%). The diagnosis of acute myocardial infarction was confirmed in 91.7% (95% CI=88.3-94.2) of the patients according to the already cited criteria. Of the patients, 61.5% were males and 38.5% were females, and their mean age was $60.2 + 2.4$ years. The time interval (delta time) between symptom onset and hospitalization was up to 6 hours in 21.9% of the patients; the median delta time was 11 hours. The analysis of delta time was limited to a percentage, of missing data of 37.8%, most of the time due to lack of a report in the medical records. In-hospital mortality was 20.6% (95% CI=16.7-25.0).

The clinical findings at presentation were typical of acute myocardial infarction in 313 cases (81.5%); 16 (4.2%) patients had no presentation findings reported in their medical records. In 21 of the remaining 55 cases, chest pain noncharacteristic of acute myocardial infarction was reported; 14 patients presented with left ventricular failure; in 6 (14.3%) patients, cardiopulmonary arrest was reported; 3 occurred after a cardiac procedure; 2 occurred after a noncardiac surgery; the remaining varied.

The municipality of residence was Rio de Janeiro in 80.7% of the cases; 11.7% lived in the municipalities of the Baixada Fluminense (a region in the state of Rio de Janeiro). Of the cases, 29.7% came from public emergency departments [usually from the hospital issuing the AIH (Authorization for Hospitalization)] and 10.9% from health care units or public outpatient care units; however, the percentage of ignored place of origin was high (25.5%).

Table I shows the distribution of some characteristics of the sample. For risk factors, such as obesity and sedentary lifestyle, the lack of information in the medical records was so high (67.1% and 78%) that it made the analysis unfeasible. Of the risk factors, the information about arterial hypertension and diabetes mellitus had the greatest quality. These 2 factors prevailed in females (hypertension: 64.2% vs 54.2%; p=0.02; diabetes: 32.4% vs 20.8%; p=0.03). Except for sex, age group, and Killip class on admission, the distribution of the factors shown in table I varied widely among the hospitals in the sample, which were previously detailed[24].

The 28 patients, whose Killip classes on admission had not been reported, were as follows: 3 had associated respiratory findings, which prevented classification; 5 had left ventricular failure reported with no Killip classification; and in 20, the information was not available in the medical records. High lethality was observed in these 28 cases. During hospitalization, 65.4% of the patients remained in Killip I.

Table II shows the frequency of some complications with the respective lethalities. In addition, 1 case of pulmo-

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Table I - Distribution of some characteristics of the sample of acute myocardial infarction reported in the medical records							
Factor	f	%	95% CI	Lethality (%)	OR[1]	95% CI	p
Sex							
Male	236	61.5	56.4 -66.3	17.8	1	-	-
Female	148	38.5	33.7 -43.6	25	1.5	0.9 - 2.6	0.09
Age group [2]							
≤ 60 y	187	49	43.8 -54.1	12.8	1	-	-
61 – 80 y	180	47.1	42 -52.3	25.6	2.7	1.3 - 4.2	0.002
> 80 y	15	3.9	2.3 - 6.5	53.3	7.8	2.3 - 26.7	0.0005
Killip class on admission							
I	317	82.6	78.3 -86.1	12.3	1	-	-
II	19	5	3.1 - 7.8	42.1	5.2	1.8 - 15	0.002
III	9	2.3	1.1 - 5.2	55.6	8.9	2 - 41.7	0.003
IV	11	2.9	1.5 - 5.2	90.9	71.3	9 -1.524	<0.000001
Not reported	28	7.3	5 -10.5	60.7	11	4.5 - 27.4	<0.000001
Arterial hypertension	223	58.1	53 -63	17.9	2	0.9 - 4.8	0.06
Smoking	160	41.7	36.7 -46.6	13.1	1.2	0.5 - 2.8	NS
Diabetes mellitus	97	25.3	21.1 -30	27.8	4.2	2 - 9	0.00003
Dyslipidemia	71	18.5	14.8 -22.8	9.9	3	0.6 - 18.3	NS
Familial history	96	25	20.8 -29.7	13.5	1.9	0.6 - 7.1	NS
Previous infarction	61	15.9	12.5 -20	18	1.9	0.7 - 4.7	NS
Previous angina	154	40.1	35.2 -45.2	15.6	1.3	0.4 - 4.7	NS
Previous stroke	21	5.5	3.5 - 8.4	19.5	2	0.5 - 7.1	NS

1- OR of death in the presence of factor versus lack of it or versus the explicit category of reference; 2- 2 patients with ignored age excluded, 1 of which died.

Table II - Frequency of some in-hospital complications of acute myocardial infarction reported in the sample							
Complication	f	%	95% CI	Lethality (%)	OR[1]	95% CI	p
Post-AMI angina	69	18	14.3 -22.3	20.3	1	0.5 - 2	NS
Reinfarction	9	2.3	1.1 - 4.6	44.4	3.2	0.7 - 15.2	NS
Recurring ischemia [2]	72	18.8	15 -23.1	22.2	1.4	0.7 - 2.7	NS
Ventricular tachycardia	17	4.4	2.7 - 7.1	52.6	4.8	1.7 - 13.4	0.001
Ventricular fibrillation	17	4.4	2.7 - 7.1	76.5	14.8	4.3 - 63.7	<0.00001
Primary cardiac arrest	19	4.9	3.1 - 7.8	84.2	25.6	6.9 -139.2	<0.00001
Left or right bundle-branch block	31	8.1	5.6 -11.4	45.2	3.7	1.6 - 8.3	0.0004
Atrial fibrillation/flutter	21	5.5	3.5 - 8.4	23.8	1.2	0.3 - 3.6	NS
Pericarditis	16	4.2	2.5 - 6.8	12.5	06	0.1 - 2.5	NS
Total atrioventricular block	12	3.1	1.7 - 5.8	41.7	2.9	0.7 - 10.8	0.08
Stroke	6	1.6	0.9 - 3.5	50	4	0.5 - 30.1	NS
Interventricular septal rupture	3	0.8	0.2 - 2.5	66.7	7.9	0.4 -467.3	NS
Papillary muscle dysfunction/rupture	3	0.8	0.2 - 2.5	33.3	1.9	0.03 - 37.7	NS

1- OR of death in the presence of complication versus lack of information; 2- post-AMI angina or reinfarction or both; 3- includes a stroke after thrombolysis with streptokinase.

nary embolism with no death was reported. The most frequent noncardiological complications were as follows: 22 cases of pneumonia (5.7%) and 3 of digestive hemorrhage (0.8%). Other secondary noncardiological diagnoses reported were as follows: chronic obstructive pulmonary disease (22 patients), gastritis (9), chronic renal failure (8), peripheral vascular disease (4), and peptic ulcer (3).

Of the 17 cases of ventricular fibrillation, 7 were of the primary type (1.8%). Immediate lethality in primary ventricular fibrillation was observed in 3 of the 7 cases (42.9%); in-hospital mortality was observed in 4 cases, because 1 patient, in whom the arrhythmia was reversed, had an anoxic cerebral lesion and died due to obstruction of the tracheal cannula. Primary ventricular fibrillation was associated with a chance of in-hospital death expressed as OR=5.4 (95% CI=0.9-37.2; P=0.04) as compared with the absence of complications. The

10 cases of secondary ventricular fibrillation in the sample had a 90% lethality with OR=84.2 (95% CI=10.8-3,701.6; P<0.0001) as compared with the lack of complications.

Electrocardiography was performed in 360 patients (93.8%; 95% CI=90.7-95.9). The electrocardiographic pattern of localization of acute myocardial infarction was as follows: anterior wall in 151 cases (39.3%); inferior wall in 129 (33.6%); acute myocardial infarction with no Q wave in 60 cases (15.6%); and left bundle-branch block (LBBB) pattern in 12 cases (3.1%). In 24 patients (6.3%), electrocardiography was not performed (5 patients) or the result was not available in the medical records (19 patients); in the remaining 8 cases (2.1%), electrocardiography was not performed, but acute myocardial infarction was ruled out. Lethality according to the electrocardiographic pattern was as follows: anterior – 18.5%; inferior – 14.7%; no Q wave –

11.7%; and LBBB – 33.3%. Lethality in the cases with no electrocardiogram or with an ignored result was particularly high (75%) with OR=14.7 (95% CI=5.3-46.7; P<0.0000001) as compared with the simple performance of electrocardiography, regardless of the resulting pattern. Right ventricular acute myocardial infarction was reported in 13 patients (3.4%), 1 of whom died (lethality=7.7%).

Measurement of cardiac enzymes was reported in 289 patients (75.3%; 95% CI=70.6-79.4).

The use of chest radiography was reported in 190 patients (49.5%; 95% CI=44.4-54.6), with a frequency similar to that of the echocardiography (175 patients; 45.6%; 95% CI=40.5-50.7). Early exercise testing prior to hospital discharge was used in only 30 patients (7.8%; 95% CI=5.4-11.1).

In the sample, 51 patients (13.3%; 95% CI=10.1-17.2) underwent cardiac catheterization, 19 of whom (37.5%) underwent the procedure out of the hospital of origin, but still during the hospitalization that generated AIH. The university-affiliated hospitals showed the highest use of catheterization (48.4%). In-hospital lethality of the cases undergoing catheterization was 2%. Generally, a significant variation in the use of diagnostic interventions was observed among the hospitals studied.

Table III shows the frequency of some therapeutic interventions in the sample; the percentage of information ignored was lower. The use of the intensive care unit or the coronary care unit (ICU/CCU) represents hospitalization during any period of the hospitalization studied. Coronary angioplasty and myocardial revascularization during hospitalization for acute myocardial infarction was infrequent; the 8 angioplasties performed included the only patient undergoing primary mechanical reperfusion in the sample, who died. In this table, the term ACE inhibitor refers to the group of drugs inhibiting the angiotensin-converting enzyme. Of the 75 patients undergoing pharmacological thrombolysis, 68 underwent the intervention at the same hospital that issued the AIH, and 7 patients underwent the intervention at other places. A significant variation in regard to the use of therapeutic interventions was observed in the sample, except for acetylsalicylic acid and nitrates.

Table IV shows the results of the final logistic model of the study of risk variation in in-hospital death. Modeling controlled the variables expressing the severity of infarction (including Killip class on admission, age, sex, and electrocardiographic pattern of acute myocardial infarction), complications, comorbidities (including diabetes), admission to ICU/CCU, and use of interventions. The variables independently associated with an increased chance of death were as follows: increasing age group, increasing Killip class on admission, diabetes mellitus, recurring ischemia, ventricular tachycardia, ventricular fibrillation, and electrocardiography ignored or not performed. The use of acetylsalicylic acid, beta-blockers, and ACE inhibitors was associated with a lower chance of death. The option to maintain Killip II in the model, although with no statistical significance, was based on the biological plausibility of a higher risk of death as compared with that of the reference category Killip I, and also on the fact that its inclusion or exclusion did not change the estimates of the other parameters.

The variable electrocardiography ignored or not performed (comprising the cases in which the exam was not performed or no information existed about its results) was included as a possible indicator of problems with care or of the quality of information. Not performing electrocardiography when acute myocardial infarction was suspected should be considered an indicator of a deficient treatment system, although in some cases, its severity with rapid evolution to death may have been a factor of difficulty.

The concordance of the model shown was 90.1%, and no random effect at the level of hospitals was detected. The tests for interaction between variables did not suggest its presence (the tests were systematically nonsignificant). The analysis of residues was performed and the withdrawal of extreme cases did not substantially modify the estimates, showing the stability of the model.

Generally, the profile of the results reported from the exploratory analysis to modeling was similar in the sample as a whole and in the subgroup of cases of confirmed/possible acute myocardial infarction, emphasizing that most cases met the criteria for confirmation of acute myocardial infarction, which neither interfered with modeling nor reached

Table III – Frequency and lethality associated with some therapeutic interventions reported in the sample of acute myocardial infarction							
Intervention	f	%	IC 95%	Lethality (%)	OR[1]	95% CI	p
Use of ICU or CCU	312	81.3	76.9 -85	19.2	0.8	0.4 - 1.7	NS
Coronary angioplasty	8	2.1	0.97 - 4.2	12.5	0.6	0.01 - 1.7	NS
Myocardial revascularization	4	1	0.3 - 2.8	25	1.4	0.03 -17.8	NS
Acetylsalicylic acid	332	86.5	82.5 -89.6	14.2	0.1	0.03 - 0.2	<0.000001
Oral or I.V. nitrate, or both	315	82	77.7 -85.7	14.8	0.2	0.1 - 0.4	0.000001
SC or I.V. heparin, or both	312	81.3	76.9 -85	16.4	0.3	0.2 - 0.7	0.0007
ACE inhibitor	243	63.3	58.2 -68.1	14.8	0.5	0.3 - 0.8	0.004
Beta-blocker	188	49	43.9 -54.1	8	0.2	0.1 - 0.4	<0.000001
Calcium channel blocker	117	30.5	26 -35.4	14.5	0.7	0.4 - 1.3	NS
I.V. thrombolysis	75	19.5	15.8 -23.9	13.3	0.6	0.3 - 1.3	NS
Lidocaine	35	9.1	6.5 -12.6	34.3	2.7	1.2 - 6	0.009

1- OR of death due to use of intervention versus lack thereof.

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Table IV - Final logistic model to study the risk of in-hospital death in the sample of acuite myocardial infarction

Variable	OR	95% CI	p
Age group			
61 to 80 years	2.5	1.2 - 5.3	0.02
> 80 years	9.6	1.95 - 47.5	0.005
Killip class on admission			
Killip II	1.9	0.5 - 7.2	NS
Killip III	6	1.4 - 25.9	0.02
Killip IV	26.5	2.9 -242.1	0.004
Diabetes	2.4	1.1 - 5.1	0.03
Not performed/ignored ECG	11.8	3.5 - 39.9	0.0001
Ventricular tachycardia	8.5	2.5 - 29.6	0.0007
Ventricular fibrillation	34	7.9 -146.9	0.0001
Recurring ischemia	2.7	1.2 - 6.2	0.02
Use of acetylsalicylic acid	0.3	0.1 - 0.8	0.01
Use of beta-blocker	0.3	0.1 - 0.7	0.005
Use of ACE inhibitor	0.4	0.2 - 0.95	0.04

- 2 LOG L intercept and covariables =225.5. χ^2 for covariables =164.9 with 13 GL (p=0,0001). Concordance =90.1%.

statistical significance. The option to analyze the sample as a whole was chosen because it does not interfere with its representativity and provides more precise estimates.

Discussion

The great contribution of this study was the fact that it represents a random sample of all hospitalizations recorded in the SUS with the diagnosis of acute myocardial infarction, establishing a picture with the least possible bias about what occurred in the municipality of Rio de Janeiro in regard to acute myocardial infarction in the period studied.

In general, the 20.6% lethality found in the sample is very far from the reduced figures reached in randomized clinical trials [15], or in selected centers [7,13], or estimated based on a projection of efficacy of the technologies available for treating the cases [27]. However, other international studies of nonselected cases have reported high in-hospital lethality associated with acute myocardial infarction. In the USA, the second National Registry of Myocardial Infarction from 1994 to 1998 reported 19.7% of deaths when no cases were excluded [27]. European multicenter studies reported 18% to 21.7% of deaths in the 1990s [10-12].

Of the national studies of nonselected cases, 2 using AIH stand out with 17.1% lethality in the state of São Paulo in 1997 [18] and 18.4% in the state of Rio de Janeiro in 1995 [22]. A recent study reported a 30-day mortality of 22% in a university-affiliated hospital in the city of Botucatu, in the state of São Paulo [28]. On the other hand, Passos et al [13] reported a 12.9% lethality in the city of Salvador from 1993 to 1994. Those authors, however, selected the participating hospitals according to criteria quality of information and treatment.

The structure of sex and age group of the sample was similar to that reported in the literature for national studies [13,22,27] and did not vary in the sample. The median delta time observed was similar to that of another Brazilian study [27].

The prevalence of arterial hypertension was similar to that of another North American study [28] and lower than that reported by Passos et al (67%) [13] and by Zornoff et al (63%) [28]. The prevalences of diabetes and dyslipidemia were similar to those in other studies [13,28,29]. The percentage of ignored risk factors was high and, most of the time, represented the lack of information in medical records.

The severity of our cases of acute myocardial infarction was detailed in another publication [24] and does not seem higher than that reported by other groups. The percentage of Killip class I on admission observed was much greater than the 56% reported in the English Nottingham Heart Attack Register [12], and much closer to the 77.8% of the study by Passos et al [13]. This study from the Brazilian state of Bahia reported a 6.3% lethality in the cases presenting in Killip class I on admission, which is approximately half of that observed in the present sample (tab. I).

The 1.8% incidence of primary ventricular fibrillation was lower than the 4.7% reported in the Worcester Heart Attack multicenter study, which found an associated in-hospital lethality of 44% [30].

Variability in the use of catheterization depended on the availability of a hemodynamic laboratory at the hospital of AIH. However, some hospitals with no hemodynamics had patient management protocols that allowed the performance of the examination at another hospital, still during hospitalization. International studies have reported varied frequencies of use of cardiac catheterization during hospitalization in acute myocardial infarction, usually greater than the mean of 13.3% observed in our sample (tab. III). European studies report a use of cardiac catheterization ranging from 32% to 53% [11,16]. A variation in use among the North American entities participating in the GUSTO Study was reported ranging from 52 to 81% [15].

Although the use of acetylsalicylic acid has been widespread (86.5%) in this study, it was lower than that expected, because of its almost universal indication in acute myocardial infarction, simple administration, low cost, and confirmed efficacy [3,31]. Another publication referring to this sample [17] reported that only 72.3% of the patients treated with acetylsalicylic acid received the treatment from the first day of hospitalization; in addition, that study reported a loss of opportunity to perform thrombolysis in 32% of the cases with an explicit indication for treatment. This fact has also been reported in other countries: the National Registry of Myocardial Infarction-2 showed that 24% of the patients with a clear indication for thrombolysis received no therapy [32]. The general frequency of use of pharmacological thrombolysis in that registry was 35%, and, in a Norwegian study, it was 32% [10].

Two national studies reported 36.8% and 39% of thrombolysis, respectively [13,28]. Another study estimated that the percentage of indication of thrombolysis in acute myocardial infarction in Brazil was approximately 40% of the cases [27]. A recent national study reported 41% of use of pharmacological thrombolysis and 15% of primary angioplasty in acute myocardial infarction; and yet, in-hospital

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mortality was high: among the patients undergoing primary angioplasty it was 18.5% [33]. The CENIC Registry of the Brazilian Society of Hemodynamics and Interventional Cardiology [34] reported an in-hospital mortality of 5.9% in its cases of primary angioplasty.

In the literature, the use of beta-blockers has ranged from 35% to 78%, and, frequently, no route of administration has been reported [7,8,11-15,28]. In our sample, the administration of beta-blockers has been almost restricted to the oral route [17].

The use of ACE inhibitors was high (63.3% of the cases), similar to that of a North American registry of cases of acute myocardial infarction (59.3%) [8], greater than the 43% reported in Switzerland [15] and the 41% reported in another Brazilian study [28].

In general, the use of calcium channel blockers was high, despite the lack of scientific evidence of its efficacy in the acute phase of acute myocardial infarction, except for specific cases.

The great variability in the use of technologies with well-established scientific-based indications and efficacy has been the object of analysis in other countries [5,7,8]. Apparently, one of the major explanations for this variability does not lie in the variability of indication of the interventions, but in different levels of adherence to protocols based on scientific evidence of efficacy, or even on its knowledge.

Regarding multivariate modeling, the independent associations found among the more advanced age group, diabetes, and increasing Killip class on admission are in accordance with those found in the literature [3,4].

Despite the possible limitations regarding the diagnosis of ventricular tachycardia, it remained associated with a high chance of in-hospital death on multivariate analysis. Both the effects of primary and secondary ventricular fibrillation were analyzed; both persisted associated with a greater chance of death, but the reduced number of cases led to less accurate estimates. The recurring ischemia variable was not statistically significant on bivariate analysis (tab. IV), but was included in the modeling because of the biological plausibility of the association with a higher risk of death [4], which was shown in the logistic model.

The interventions associated with a smaller chance of death were the use of acetylsalicylic acid, beta-blockers, and ACE inhibitors. The use of thrombolysis was not statistically significant, which may be related to the size of the sample. The possible presence of a doubtful indication of an intervention (which may appear when analyzing the effect of the interventions out of the controlled clinical assays) was controlled with the inclusion in the model of variables related to the severity of the case and the indication of interventions.

In our study, the possibility of the existence of an internal correlation at the level of the hospitals was investigated with hierarchic modeling, which detected no significant random effect. This may be related to the size of the sample, both from the point of view of the number of observations of the upper level (the hospitals) and the number of observations of the first level (the case), because the calculus of the sample was based on the proportion of deaths in the municipality as a whole. Anyway, this fact confirms the choice of the logistic model.

In conclusion, despite the high overall lethality, the profile of severity, major risk factors, and the frequency of the complications studied were similar or more favorable than those found in other studies. Diabetes, advanced age group, Killip class, recurring ischemia, ventricular tachycardia, and ventricular fibrillation were associated independently with an increased chance of in-hospital death. The use of acetylsalicylic acid, beta-blockers, and ACE inhibitors was associated with a smaller chance of in-hospital death. The underutilization of effective interventions suggests the possibility of better outcomes in the hospital treatment of acute myocardial infarction in the municipality studied.

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