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In-hospital mortality and complications after coronary angioplasty, City of Rio de Janeiro, Southeastern Brazil

ABSTRACT

OBJECTIVE: To estimate in-hospital mortality and prevalence of complications of percutaneous transluminal coronary angioplasty (PTCA) in public hospitals.

METHODS: Data for 2,913 PTCA were obtained from the Brazilian National Health System (SUS) Hospital Authorization Database in the city of Rio de Janeiro, Southeastern Brazil, between 1999 and 2003. After simple random sampling and data weighting, 529 medical records of patients undergoing PTCA, including all deaths, in four public hospitals (federal and state university, and federal and state reference hospitals) were studied. Comparison tests of mortality according to patient characteristics, comorbidities, complications, types of PTCA procedures, and indications for PTCA were performed using Poisson's regression models.

RESULTS: The overall in-hospital mortality was 1.6% (range: 0.9–6.8%). The age distribution of mortality was as follows: 0.2% in patients younger than 50; 1.6% in those 50–69; and 2.7% in those older than 69. High mortality was seen in primary and rescue PTCAs: 17.4% and 13.1%, respectively; and mortality in elective PTCA was 0.8%. The main complications during PTCA were dissection (5%; mortality: 11.5%) and artery occlusion (2.6%; mortality: 21.8%). Bleeding was seen in 5.9% of the patients (mortality: 5.6%) and 3.0% required blood transfusion (mortality: 12.0%). The complication of acute myocardial infarction was seen in 1.1% of patients (mortality: 38%) and stroke was associated with a mortality of 17.5%.

CONCLUSIONS: The cardiac in-hospital mortality was high when PTCA was performed for a patient with ST elevation acute myocardial infaction. Elective PTCA had mortality and complications levels above the expected in four public hospitals in the main city of Rio de Janeiro

DESCRIPTORS: Angioplasty, adverse effects. Angioplasty, mortality. Lethality.

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INTRODUCTION

Cardiovascular diseases account for around 30% of all deaths in Brazil, of which 60% are due to cerebrovascular and ischemic cardiovascular diseases. High-complexity treatments consist of interventions requiring high technology and resources that are generally costly. Resources have been increasingly allocated to expand the delivery of these services. The most common high-complexity procedures for chronic cardiovascular diseases are coronary artery bypass surgery (CABG) and percutaneous transluminal coronary angioplasty (PTCA) as well as permanent pacemaker implants and hemodynamic studies. The rate of PTCAs varies widely between countries and different specialty centers. PTCA with stent ranged between 1 per 100,000 inhabitants in Mexico to 69 per 100,000 in Finland and 426 per 100,000 in the United States. These differences apparently reflect greater access to and availability of these procedures,[a] and health care organization rather than specific population needs. Finland has one of the highest mortality rates due to coronary disease worldwide but 80% reduction was seen in the last 30 years.

In 1999, high-complexity procedures within the Brazilian National Health System (SUS) were performed in 16% of ischemic heart disease hospital admissions in the state of Rio de Janeiro, representing a relative cost of 66% of all costs of ischemic heart disease admissions. (In 2003, these rates increased to 25% and 79%, respectively.) In-hospital mortality reported in 10 PTCA centers in the state of Rio de Janeiro was 1.7% (ranging from 0 to 3.2%), which is well above that expected (between 0.6 and 1.2%) and varies widely among care services.[18] Also, PTCA complications have been little reported in the literature.

The objective of the present study was to assess in-hospital mortality and prevalence of complications of PTCA in public hospitals.

METHODS

A total of 2,913 patients underwent PTCA covered by SUS in public services in the city of Rio de Janeiro, Southeastern Brazil, between 1999 and 2003.

Data on PTCAs were obtained from SUS Hospital Authorization Database (HAA) between 1999 and 2003 and medical records from four public hospitals with the largest number of PTCA procedures and CABG surgeries in the city of Rio de Janeiro were reviewed. Two university hospitals (A and B) and two reference centers, one federal (C) and one state hospital (D) were selected.

For each hospital cases were alphabetically arranged by patient name, date of birth, gender, and admission date and then grouped into contiguous blocks of cases. From each block, only the last procedure performed for each patient was included. A total of 2,913 patients were studied: 644 in Hosp A; 203 in Hosp B; 809 in Hosp C; and 1,257 in Hosp D. Based on HAA database, the total number of deaths in the hospitals studied was 13, 12, nine, and 12, respectively.

As the total number of cases (last procedures) during the study period exceeded our operational capacity of data collection from medical records, simple random sampling was applied including deaths and surviving patients in each hospital studied. We opted for a sampling design that quantitatively matched both groups. Data on the last PTCA were collected from 150 medical records of patients at each hospital. All deaths by procedure and hospital were included in the final samples. The sampling process provided the following information: Hosp A – 137 surviving patients, 13 deaths; Hosp B – 138 surviving patients, 12 deaths; Hosp C – 141 surviving patients, nine deaths; Hosp D – 138 surviving patients, 12 deaths. The final sample comprised 554 medical records of surviving patients and 46 of dead ones.

Information about identification, diagnosis at admission, socioeconomic condition, risk factors, comorbidities, ancillary tests, indication for PTCA, category of PTCA, PTCA description, prescription, complications and progress were collected from medical records using a standard form. No criteria were applied for completing data collection forms; they were completed according to the instructions. There were considered only risk factors and comorbidities recorded in the medical records (diagnosis at admission was not considered a comorbidity). Data was collected by cardiologists trained as field researchers. Unfavorable outcomes were PTCA mortality as well as associated complications such as acute myocardial infarction (MI), angina, heart failure or low cardiac output, cerebrovascular accident (stroke), acute renal failure, and blood transfusion.

In the statistical analyses for estimating prevalence and mortality, data weighting of each patient was inversely proportional to its probability of selection in the sample, complemented by data from related medical records. Therefore, weighting was equal to one for in-hospital deaths in Hosp A and C; 2.8 and 4 for deaths in Hosp B and D, respectively; 4.7, 1.8, 5.8, and 9.7 for surviving patients in Hosp A, B, C and D, respectively. Comparison tests of in-hospital mortality according to patient characteristics, comorbidities, complications,

[a] Organization for Economic Co-Operation and Development. Health at a glance - OECD indicators - 2005 [cited 2009 Nov 25]. Available from: http://website1.wider.unu.edu/lib/pdfs/OECD-Health-2005.pdf

indications for PTCA were performed using Poisson's regression models to estimate ratios and p-values at 5% significance level with weight adjustments. Stata software (version 8.2) was used in the analyses.

The study was approved by the Research Ethics Committee of Universidade Federal do Rio de Janeiro Medical School and Clementino Fraga Filho Teaching Hospital and was conducted following the guiding principles of the Declaration of Helsinki.

RESULTS

Of 535 medical records identified, six were excluded because patients did not undergo PTCA. There were found 98.7% of medical records in Hosp A; 73.3% in Hosp B; 97.3% in Hosp C, and 87.3% in Hosp D. Loss among deaths was significant in Hosp B (66.7%) and Hosp D (75%). All deaths were found in Hosp A and Hosp C. Inconsistent information was found in three cases of death: two patients who died during admission in Hosp B were recorded as living while a living patient in Hosp C was recorded as dead in HAA database.

Inconsistencies between HAA database and medical records regarding procedures, deaths, and loss of medical records in each hospital were corrected. The sample for analysis included the following: Hosp A – 146 patients and 12 deaths; Hosp B – 110 patients and six deaths; Hosp C – 142 patients and seven deaths; Hosp D – 131 patients and three deaths. The expansion of selected samples changed the total number of patients undergoing PTCA. Of 2,913 PTCAs originally recorded in HAA database, there remained 2,888 due to the exclusion of patients who did not undergo PTCA and inconsistencies.

Of 529 patients analyzed, 339 (64%) were males. Mean weighted age was 60.2 years old (SD = 10.3) (range: 29–92). Of 28 deaths identified, 27 were cardiovascular. Only one cardiovascular death occurred in a patient younger than 50; 16 occurred in those aged between 50 and 69 and 10 in patients older than 69. Weighted mortality in the sample of 2,888 patients for these age groups was 0.2%, 1.6%, and 2.7%, respectively.

Table 1 shows patient demographic characteristics, risk factors, diagnoses, and cardiovascular mortality with data weighting of 2,888 patients undergoing PTCA in the hospitals studied. Table 2 shows comorbidities and in-hospital cardiovascular mortality. In-hospital mortality in patients with prior history of heart failure was 6.9%.

There was no information on either tests or pre-PTCA electrocardiogram in 311 (59%) medical records. For the remaining patients, 190 (87%) had abnormal results; 18 (8%) had normal results; and 10 (5%) did not undergo testing. Of 27 cardiovascular deaths, 25 had abnormal pre-PTCA results and two did not have information on testing. No deaths were seen among those with normal results. MI with ST elevation in any wall had a strong impact with cardiovascular mortality of 10.8%.

Pre-PTCA echocardiography was performed in 170 patients. In the weighted analysis, 53.3% of deaths had moderate or severe dysfunction (compared to only 20% among surviving patients). Cardiovascular mortality was 5.8% in patients with moderate or severe dysfunction and 2.8% in those with normal function or mild dysfunction. Mortality was 1.0% among those with missing information (49%).

With respect to ischemia assessment, 112 pre-PTCA non-invasive tests were performed in 88 patients, of which 76 had ischemia in at least one test. Only 14% of patients undergoing PTCA had information on myocardial ischemia. This proportion was 16% when those patients undergoing primary or rescue PTCA were excluded, and it was 20% when only those undergoing elective PTCA were considered.

Combined information of PTCA report and the artery treated showed the following: 270 patients had more than 50% occlusion in one artery; 155 in two arteries; 75 in three arteries and 17 in four or more arteries. Weighted mortality according to affected arteries was: one artery, 1.0% (when the anterior descending coronary artery [ADCA] was affected, it was 1.1%; non-ADCA, 0.9%); two arteries, 0.92% (when ADCA, 1.3%; no major occlusions in ADCA, 0%). When three arteries were affected, the mortality was 5.6%. Patients with occlusion in at least one artery (28.1% of 78.7% patients with information reported) had a weighted cardiovascular mortality of 3.6% compared to 1.0% in those with no occlusions (p=0.016).

As for medication use, among those patients who were not taking digitalis, diuretics, dopamine/noradrenalin or dobutamine (80.6%) before PTCA, the weighted mortality was 0.43%; it was 8.5% in those taking at least one pre-PTCA drugs (4.1%). The mortality among those who started taking one of these drugs post-PTCA (9.3%) was 4.4%.

Of the remaining drugs used, the association of acetylsalicylic acid and ticlopidine proved to be more effective than single use of acetylsalicylic acid (mortality of 0.6% versus 2.8%; p=0.010); only 49% of patients used both drugs (46.5% of patients with missing information). Clopidogrel was rarely used both pre-PTCA (11.3%) and post-PTCA (12.9%) (46.4% of missing information). Tirofiban was used in 5% of patients pre-PTCA (47.9% of missing information) and pre-PTCA use of abciximab was not reported (48.7% of missing information).

Of 2,741 patients analyzed, 81.3% reported stent implant. In-hospital mortality with at least one stent

Table 1. Estimated cardiovascular mortality and prevalence (%) of patient demographic characteristics, risk factors, and diagnoses in patients undergoing percutaneous transluminal coronary angioplasty in public hospitals. Rio de Janeiro, Southeastern Brazil, 1999–2003. (N= 2,888)

Variable	Patients with information		Patients with missing information		
	% patients	% cardiovascular mortality	p-value[a]	%[b]	% cardiovascular mortality
Gender					
Male	62.2	1.88	0.262	0	
Female	37.8	1.01			
Age group (years)					
70 or more	19.3	2.72	0.017	0.8	0
50–69	63.7	1.58	0.052		
<50	17.0	0.2	-		
Skin color					
White	74.0	1.95	0.66	35.8	1.07
Non-white	26.0	1.45			
Family history: CID					
Yes	62.9	1.72	0.537	52.7	1.64
No	37.1	0.99			
Family history: sudden death					
Yes	3.9	7.96	0.002	77.5	1.87
No	96.1	0.16			
Diabetes mellitus					
Yes	33.3	2.26	0.573	40.3	1.12
No	66.7	1.64			
Arterial hypertension					
Yes	86.6	1.59	0.541	25	1.11
No	13.4	2.41			
Dyslipidemia					
Yes	68.0	2.06	0.263	48.6	1.5
No	32.0	0.63			
Obesity					
Yes	28.8	1.7	0.071	71.6	1.88
No	71.2	0.34			
Smoking					
Current	33.6	2.07	0.815	45.3	1.3
Former smoker	37.8	0.97	0.177		
Non-smoker	28.6	2.44			
Diagnosis					
MI	13.2	6.45	0	2.1	1.64
Unstable angina	36.5	0.97	0.296		
Other	5.3	3.34	0.029		
Stable angina - CID	45.1	0.38			

[a] Poisson's regression

[b] Missing information in medical records

CID: chronic ischemic disease

MI: acute myocardial infarction

Table 2. Cardiovascular mortality and prevalence (%) of comorbidities in patients undergoing percutaneous transluminal coronary angioplasty in public hospitals. Rio de Janeiro, Southeastern Brazil, 1999–2003. (N= 2,888)

Variable	Patients with information		Patients with missing information		
	% patients	% cardiovascular mortality	p-value[a]	%[b]	% cardiovascular mortality
Stroke					
Yes	10.8	1.01	0.507	68.2	1.36
No	89.2	2.08			
Renal failure					
Yes	13.0	2.25	0.619	52.5	0.32
No	87.0	3.02			
COPD					
Yes	9.6	1.15	0.493	68.4	1.2
No	90.4	2.42			
Peripheral vascular disease					
Yes	17.8	4.58	0.288	70.2	1.08
No	82.2	2.26			
Prior arrhythmia					
Yes	7.6	1.69	0.849	73.1	1.36
No	92.4	2.09			
Prior MI					
Yes	41.0	1.17	0.355	0	
No	59.0	1.82			
Prior unstable angina					
Yes	52.2	0.93	0.273	51.2	1.61
No	46.8	2.12			
Prior chronic coronary disease					
Yes	76.2	1.2	0.073	50.8	1.35
No	23.8	3.55			
Prior heart failure					
Yes	8.8	6.94	0.042	60.5	1.08
No	91.2	1.83			
Cancer					
Yes	6.3	5.55	0.315	70.2	1.32
No	93.7	1.86			
Prior PTCA					
Yes	17.1	0.58	0.441	29.8	2.88
No	82.9	1.07			
Prior CABG					
Yes	11.1	4.44	<0.0005	29.8	3.11
No	88.9	0.44			

[a] Poisson's regression
[b] Missing information in the medical record
COPD: chronic obstructive pulmonary disease
PTCA: percutaneous transluminal coronary angioplasty
CABG: coronary artery bypass graft surgery

Table 3. Cardiovascular mortality and prevalence (%) of complications during and post-percutaneous transluminal coronary angioplasty in patients treated in public hospitals. Rio de Janeiro, Southeastern Brazil, 1999–2003. (N= 2,888)

Variable	% patients	Cardiovascular mortality	p-value[a]	%[b]
PTCA dissection				
Yes	5.0	11.46	<0.0005	9.9
No	95.0	0.89		
Artery occlusion in PTCA				
Yes	2.6	21.79	<0.0005	9.3
No	97.4	0.94		
Repeat procedure post-PTCA				
Sim AC	1.2	12.3	0.006	4.36
Sim cirurgia	0.8	8.63		
Não	98.0	1.44		
Low cardiac output				
Yes	2.6	37.28	<0.0005	3.3
No	97.4	0.07		
Use of intra-aortic balloon				
Yes	0.3	25.52	<0.0005	3.5
No	99.7	0.69		
Bleeding				
Yes	5.9	5.61	<0.0005	5.7
No	94.1	0.51		
Blood transfusion				
Yes	3.0	12.01	<0.0005	3.1
No	97.0	1.1		
MI				
Yes	1.1	37.97	<0.0005	4.8
No	98.9	0.19		
Angina				
Yes	4.6	8.04	<0.0005	4.9
No	95.4	0.42		

To be continued

was 0.9% compared to 4.0% in those with no stent implant (p=0.002). The most common artery treated was ADCA (50.4% of cases).

The main post-PTCA complications and weighted mortality rates are displayed in Table 3. Table 4 shows estimated percents of cardiovascular mortality by hospital according to category and indication for PTCA. Table 5 shows estimated percents of cardiovascular mortality according to category and indication for PTCA. The overall cardiovascular mortality was 1.6%. After weighting based on sampling fractions, overall mortality rates were: Hosp A, 1.9%; Hosp B, 6.8%; Hosp C, 0.9%; and Hosp D, 1.0%. The main complications during PTCA were dissection (5% in patients with cardiovascular mortality of 11.5%) and artery occlusion (2.6% in patients with cardiovascular mortality of 21.8%).

Besides cardiovascular mortality, unfavorable outcomes included other serious complications such as acute myocardial infarction (MI), angina, low cardiac output, heart failure, and stroke. Among surviving patients, the rate of unfavorable outcomes was 8.2% (MI: 22.0%; unstable angina: 8.8%; stable angina/chronic coronary artery disease (CCAD): 4.3%; other: 3.3%). When blood transfusion and acute renal failure were considered, there were 11.5% of unfavorable outcomes in PTCA (MI: 24.2%; unstable angina: 14.1%; stable angina/CCAD: 6.0%; and other diagnoses: 9.8%).

DISCUSSION

The present study found an in-hospital mortality of 1.6%, ranging between 0.9% and 6.8%, in public hospitals in the city of Rio de Janeiro. In the state of Rio de Janeiro, PTCA mortality was 1.7% based on SUS HAA database between 1999 and 2003.[19]

Tabela 3 continuation

Variable	% patients	Cardiovascular mortality	p-value[a]	%[b]
Prosthesis >24 hours				
Yes	0.4	43.58	<0.0005	3.5
No	99.6	0.79		
Pneumonia				
Yes	0.4	43.58	<0.0005	3.1
No	99.6	0.79		
Renal failure				
Yes	2.2	12.42	<0.0005	8.3
No	97.8	0.69		
Stroke				
Yes	0.4	17.48	0.001	4.4
No	99.6	1.15		
Coma				
Yes	0.2	100	<0.0005	3
No	99.8	0.72		
Heart failure				
Yes	2.2	22.62	<0.0005	3.3
No	97.8	0.3		
Arrhythmia				
Yes	4.0	12.84	<0.0005	3.9
No	96.0	0.11		

[a] Poisson's regression

[b] Missing information in medical records

The predominance of male patients (62.2%) found in our study was also reported in several other studies,[7,24,25] but in contrast to other studies that reported greater mortality among women,[24,25] no significant difference of cardiovascular mortality was seen by gender. Mean age was slightly lower than that described in some studies (60.2 in the present study versus 64,[24] 65,[7] 65.6[14]) and there was a slightly smaller proportion of patients older than 70 (19.3%). In Hannah et al study,[3] 38.1% of patients were older than 70.

In contrast to NACI Registry,[16] no significant differences of clinical characteristics and mortality were seen between white and non-white patients. It should be noted that it is often difficult to apply skin color definition in Brazil due to great miscegenation of population. Although mortality due to chronic ischemic disease is known to have an inverse association with income,[20] this information was largely missing in most medical records studied. Due to missing information on income, Alter et al[1] reported estimating patient socioeconomic condition based on area of residence. This inference may be misleading in Brazil as the highest and the lowest income census tracts live together in the metropolitan area of Rio de Janeiro.[4]

In-hospital mortality increased with age, which is consistent to that described in other studies.[24,25] Holper et al[10] found greater in-hospital mortality (2.6%) in patients with heart failure undergoing PTCA. When left ventricle ejection fraction was lower than 50%, post-PTCA mortality increased to 4.5%. In our study, mortality among patients with prior history of heart failure was 6.9%, of which 5.8% was seen in patients with moderate to severe dysfunction evidenced in echocardiography. The finding of ventricular dysfunction as a major factor for in-hospital PTCA outcome is consistent to that reported in many studies both before[15] and after stent implants have been widely performed.[11] Lower mortality was seen among patients with stent implants in our study. Resnic et al[19] claimed that use of stent during PTCA was thought to be a protective factor in the simplified risk score.

In the United States, PTCA mortality rates between 1998 and 2000 ranged between 1.4% (hospitals with more than 1,000 cases per year) and 2.6%, (hospitals with five to 199 cases per year).[6] The mortality was on average 3.5% in primary PTCA. Canto et al[3] reported a mortality rate in primary PTCA between 5.7% in hospitals performing a large number of PTCAs and 7.7% in those performing a small number of PTCAs.

Table 4. Cardiovascular mortality (%) and percent of patients undergoing percutaneous transluminal coronary angioplasty, by category and indication, in public hospitals. Rio de Janeiro, Southeastern Brazil, 1999–2003.

Variable	Mortality (% patients)				
	Hosp A n=638	Hosp B n=203	Hosp C n=790	Hosp D n=1,257	Total N=2,888
Category of PTCA					
Primary	9.7 (9.7)	32.2 (9.2)	22.6 (1.1)	29.0 (1.1)	17.4 (3.6)
Rescue	13.8 (3.4)	35.6 (4.1)	0 (0.7)	0 (0.8)	13.1 (1.6)
Elective	0.5 (83.2)	3.1 (76.9)	0.5 (95.1)	0.8 (38.2)	0.8 (66.4)
Missing information	0 (3.7)	0 (9.8)	4.1 (3.1)	0.5 (59.9)	0.6 (28.4)
Total	1.9 (100.0)	6.8 (100.0)	0.9 (100.0)	1.0 (100.0)	1.6 (100.0)
Indication for PTCA					
Post-MI with ST-elevation	6.9 (2.8)	17.8 (24.8)	11.7 (4.3)	17.1 (1.9)	10.6 (8.8)
Acute coronary syndrome with no ST-elevation	1.0 (31.8)	0 (14.2)	1.5 (17.2)	0 (14.7)	0.7 (19.1)
Chronic CAD	0 (36.6)	5.1 (46.7)	0 (68.0)	0 (27.9)	0.4 (42.1)
Missing information	0 (8.8)	0 (14.2)	1.2 (10.5)	1.1 (55.6)	1.0 (30.0)
Total	1.9 (100)	6.8 (100)	0.9 (100)	1.0 (100)	1.6 (100)

CAD: Coronary artery disease

No difference regarding thrombolytic use was found and the mortality was 6.9% and 7.0%, respectively. The Greater Paris Registry[24] did not find a relationship between number of PTCAs and in-hospital mortality among low-risk patients. However, an inverse relationship between number of interventions and mortality was found in emergency high-risk interventions (primary PTCA, cardiogenic shock): 6.8% versus 8.5% (p=0.028).[24] In our study, a small proportion of primary PTCAs (17.4%) showed very high mortality. Three out of four hospitals studied did not have an emergency department; i.e., there was an obstacle to direct access of patients and none of them had 24-hour hemodynamic departments. In at least 40% of cases, primary PTCA was performed in patients referred from other units, which may suggest greater than recommended delay for intervention.

A cardiovascular mortality of 1.6% is above that reported by Mack et al[22] (1.2%) who studied 97,045 PTCAs between 1999 and 2002 in 200 hospitals in the US.[14] But it is similar to that reported in Brazil by the National Cardiovascular Intervention Center (CENIC) in 1997 (1.6%) and higher than that reported in 2000 (1.2%). A 0.8% mortality in elective PTCAs was higher than that reported (0.6%) by the Greater Paris Registry.[24] Information on non-invasive tests was notably missing in ischemia cases undergoing elective PTCA in the present study. A recent study found that the combination of an invasive strategy with drug therapy in patients with stable chronic ischemic heart disease (CID) does not reduce the risk of death or MI.[2]

Of 254 patients with indication for PTCA due to MI with ST elevation, 113 (44%) underwent elective PTCA with a mortality rate of 6.2%. The rationale for routinely performing post-MI PTCA is based on the "open artery hypothesis."[12] Prospective studies such as that of Hochman et al showed that restoration of anterograde flow did not either delay disease progression

Table 5. Cardiovascular mortality (%) by category and indication for percutaneous transluminal coronary angioplasty in public hospitals. Rio de Janeiro, Southeastern Brazil, 1999–2003.

Category of PTCA	Indication for PTCA				
	Post-MI with ST-elevation	Acute coronary syndrome with no ST-elevation	CCAD	Missing information	Total
Primary	15.6 (3.1)	0 (0.3)	-	100.0 (0.1)	17.4 (3.6)
Rescue	14.6 (1.4)	0 (0.2)	-	-	13.1 (1.6)
Elective	6.2 (3.9)	0.8 (17.1)	0.4 (41.1)	0 (4.3)	0.8 (66.4)
Missing information	0 (0.3)	0 (1.5)	0 (1.0)	0.7 (25.6)	0.6 (28.4)
Total	10.7 (8.8)	0.7 (19.1)	0.4 (42.1)	1.0 (30.0)	1.6 (100.0)

CCAD: chronic coronary artery disease

or prevent mortality.[9] Thus, there would be no indication for routine PTCA in most post-MI patients with preserved ventricular function and no spontaneous or induced ischemia.[8]

Higher mortality associated to pre-PTCA use of digitalis, diuretics, and amines suggests that these patients are more severely ill. O'Connor et al[17] described shock, heart failure, and hemodynamic instability markers as predictors of in-hospital death.

There was found a considerable rate of post-PTCA complications (Table 3). The rate of cardiovascular mortality associated to other complications (MI, angina, heart failure, stroke, and low cardiac output) was high and varied as expected according to disease severity, from 3.3% to 22.0%. It was even concerning in patients with stable disease (4.3%). Therefore, a minimum performance level has to be achieved for a procedure to be incorporated into routine clinical practice. The required minimum performance level of interventional procedures is lower in more severe cases than in stable patients with better prognosis and receiving clinical therapy.[23]

In the present study, teaching hospitals provided care to a larger number of severely ill patients and performed more primary PTCAs as well. This finding can be explained by the geographical localization of these centers, though it has been described that specialty hospitals usually provide care to less severe cases with less comorbidities.[5]

The rate of cardiovascular mortality and complications was high, especially in patients with more severe conditions: MI with ST elevation, prior history of heart failure, left ventricle dysfunction, hemodynamic instability and age over 70 years old. Also, in elective interventions, non-invasive procedures were underutilized for detecting myocardial ischemia.

The wide variation in PTCA rates between countries shows that the very existence of guidelines does not ensure its consistent indication. In Spain, in 1988, more CABG surgeries were performed than PTCAs (0.5:1 ratio) and, in 1989 and 1990, this ratio increased to 1.3 and 1.8.[13] In the US, while the number of CABG surgeries doubled between 1980 and 1990, PTCAs had a nine-fold increase.[21]

A limitation of the present study was the loss of a considerable number of medical records, especially among deaths in hospitals B and D, evidencing poor management of medical records. Another limitation was an expressive amount of missing information for risk factors and comorbidities in medical records, which compromised the comparative analysis between surviving and dead patients.

Also, the number of SUS-covered PTCAs does not represent total PTCAs performed. Within SUS, for instance, federal hospitals with allocated budgets are not reimbursed by procedure performed. HAAs are paid after system review and according to a financial ceiling and not all of them are paid when this ceiling is reached. Data from the Health Department of the City of Rio de Janeiro[a] showed that the difference between number of registered and covered HAAs was not relevant in hospitals A, B and D; however, it was significant in hospital C. There are no defined criteria in HAAs for reimbursement.

It is essential to have an instrument that can assess and follow up inadequate performance standards so that potential discrepancies can be corrected and better care provided to patients requiring high-complexity cardiovascular interventions.

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