



## Mortality Predictors of Coronary Revascularization Procedures in Brazilian Public Health System

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### 1. Introduction

Despite all technological advances in new medications and procedures, coronary artery disease still remains one of the main causes of death in the world. A higher life expectancy associated with a higher prevalence of systemic arterial hypertension and diabetes are important factors for this data [1,2]. In the treatment of coronary arterial disease, revascularization procedures have an important role in the prognosis of some types of patients, especially the diabetic and multiarterial [3-7]. Randomized studies haven't show any superiority of coronary bypass graft surgery(CABG) over percutaneous angioplasty (PTCA) in mortality rates, except in some specific population such as in patients with left ventricular dysfunction and multivascular coronary disease in diabetic patients [3-7]. The aim of this study was to perform an analysis of the revascularization procedures performed in public Brazilian health care system and evaluate mortality predictors, including regional data.

### 2. Methods

#### 2.1. Study-design

This is a retrospective cohort in all hospitalized patients who underwent coronary revascularization procedures in public Brazilian hospital between January 1<sup>st</sup>2001 and November 30 2007. Observation time lasted until December 31 2007 in order to have at least, a 30-day observation time. In Brazil, medical procedures in public hospitals are reimbursed by Ministry of Health and since 1979 all information is coded through International Disease Code and processed through Hospital Information System (HIS). HIS data don't include private health plans. Mortality Integrated System (MIS) was created in 1975 and its mortality data are considered as accurate as those used in other countries which employ the same methodology. HIS and MIS are independent data bases and there's no field that identifies or links patients between them. Statistical analysis

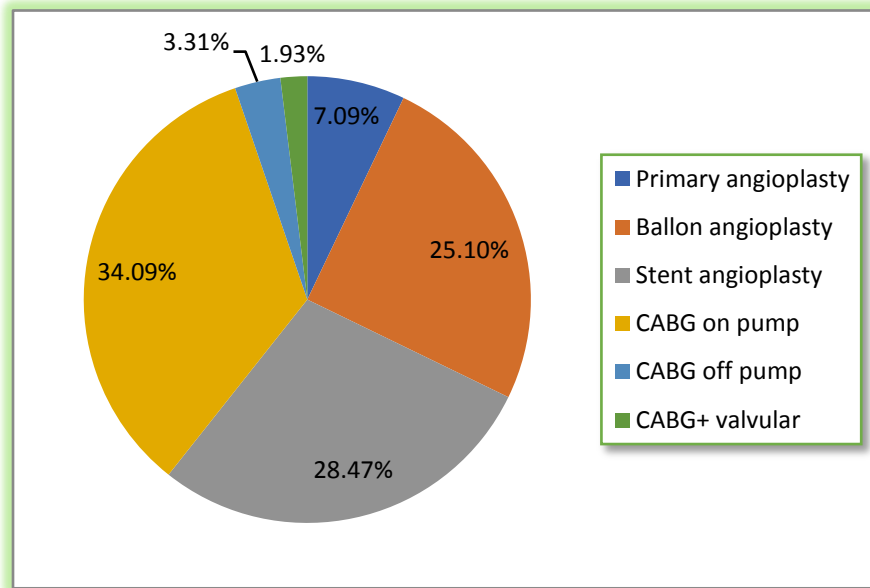
As there's no primary key linking HIS and MIS, probabilistic link technique was employed. A step-by-step strategy utilizing "Soundex" phonetical code of the first and the last patients' name associated to gender was chosen. Comparison between fields was made through the complete name and birthday. Pair revision was based in previously criteria of a pilot study that showed 90.6% sensibility and 100% specificity in Brazilian public health system. In order to make probabilistic link, RecLinksoftwareversion3 was used. In descriptive analysis, media and standard-deviation or medium and interquartile for continous variables, depending whether it's a normal distribution or not. Categorical data were described by absolute numbers and relative frequency. For dicotomical variables,

Student's t-test was used when normal distribution was present and Mann-Whitney test when not. Continuous variables with more than 2 groups were analyzed by ANOVA test when normal distribution was present and Kruskal-Wallis test when not. Qui-square was used for categorical data.

Univariate and multivariate logistic regression were employed to evaluate hospital mortality, odds-ratio and confidence interval of 95% were calculated. A forward stepwise fashion was done in multivariate analysis. For survival analysis, outcome was time until death, with additional information of day of death and its link to hospitalization. Patients who died from other causes were censored. Patients who died abroad were not considered, as the number was inexpressive. The first hospitalization day for coronary procedure was the initial one. Kaplan-Meier test estimated survival rate. Curves were estimated after stratification and covariables selectes for possible prognostic significancy. Log-rank test compared survival among possible categoric covariables. Cox model and hazard-ratio evaluated prognostic factors related to survival.

### 3. Results

Registries from 261.095 patients submitted to 303.945 revascularization procedures were analysed, 64.93% were male and the mean age was  $61.67 \pm 10.77$  years. Of all procedures, 39.33% of the patients underwent coronary bypass surgery, 34.09% on-pump surgery, 3.31% off-pump and 1.93% combined to valvular procedure (**Figure 1**).



**Figure 1:** Revascularization procedure distribution.

PTCA was performed in 60.67%, 28.47% employed stent devices, 25.11% only balloon angioplasty and 7.09% primary angioplasty (Figure 1). Global mortality rate was 14.9% and 30 days rate was 5.2%. Patients submitted to CABG had a higher mortality rate in 30 days compared to those that had percutaneous treatment (7.83% versus 3.49% -  $p < 0.00$ ). Women also had a higher mortality rate in 30 days compared to men (6.22% versus 4.64% -  $p < 0.0001$ ). Patients who survived were younger than those who died ( $61.38 \pm 10.7$  versus  $66.82 \pm 10.5$  -  $p < 0.0001$ ).

The majority of the procedures was performed in Southeast (52.04%), followed by South with 29.23% and then Northeast, Center-West and North, 12.46%, 4.16% and 2.11%, respectively. Mortality rates were different amongst the regions. Center-West had the highest 30-day mortality (7.6%, followed by South (5.84%), North (5.46%), Northeast (5.21%) and Southeast (4.63%) ( $p < 0.0001$ ). In the univariate survival analysis, we found an increased risk in female patients (RR=1.1222, IC95%=1.0994 a 1.1455 -  $p < 0.0001$ ), in one year increase on age (RR=1.0452, IC95%=1.0442 a 1.0462 -  $p < 0.0001$ ) and in the surgical procedure (RR=1.3820, IC95%=1.3548 a 1.4098 -  $p < 0.0001$ ) (**Table 1**).

	RR	IC95%	p
Female sex	1,1222	1,0994 a 1,1455	0,0001
Age( increased by year)	1,0452	1,0442 a 1,0462	p<0,0001
Surgery	1,3820	1,3548 a 1,4098	<0,0001

**Table 1:** Survival univariate analysis.

In the multivariable analysis, all three components remained with statistical significance, female patients (RR=1.0220, IC95%=1.0011 a 1.0433 – p=0.039), older age (RR=1.0459, IC95%=1.0449 a 1.0470 - p<0.0001) and surgical procedure (RR=1.4089, IC95%=1.3811 a 1, 4372 - p<0.0001) (**Table 2**).

	RR	IC 95%	P
Female sex	1,0220	1,0011 a 1,0433	0,039
Age( increased by year)	1,0459	1,0449 a 1,0470	<0,0001
Surgery	1,4089	1,3811 a 1,4372	<0,0001

**Table 2:** Survival multivariable analysis.

#### 4. Discussion

With the technological advance, percutaneous treatment of coronary disease overlapped surgical procedures. Randomized data suggest that in some patients, treatment with coronary stents is not inferior to the CABG [3,5,8,9]. Our study consists in a Brazilian national registry of consecutive patients submitted to a revascularization procedures and showed that in our country, surgical death rate is higher than the percutaneous approach in 30-day and global survival rates. In our results, age was an independent predictor of mortality on each year increase, data very consistent with the world literature. This can be explained by the fact that older patients have more comorbidities which implies a higher procedure risk no matter what kind of revascularization employed [10-12]. Female sex was also a predictor. This is a very controversial aspect in the literature, mainly because the mean age of women who present coronary disease is higher than men's, which can be a confounding factor. But there are also anatomic aspects such as a smaller coronary artery diameter in women that can explain this fact [13-18]. Surgery was a mortality predictor, mainly because surgical patients have a more complex coronary anatomy than PTCA patients. Since this is a consecutive series and it's well known that surgical patients are more often multivascular, have lower ejection fraction and have a worst prognosis. On the other hand, the patient that goes to percutaneous treatment usually have a less complex coronary artery disease and ventricular function is preserved [3,10,19,20].

Regarding region specific data, Southeast and the South performed the vast majority of procedures (almost 82%). This can be explained by the higher number of specialized hospitals in these regions, wealthier than the others. Looking at the mortality rates, we observed that the region that performs more surgeries is the one with the lowest mortality. That can be explained by two factors: the procedure-volume rate improved the surgeon ability and reduced the surgical complications and that the majority of Brazilian hospitals that have cardiac surgery center are reference institutes or university hospitals [21-24]. Another fact is that the population assisted by the Brazilian public health system is the poorer population and the access to consults, procedures and exams sometimes takes months. So many times diagnosis and treatment are made in an advanced status, which could explain the higher mortality rates in our data [23,24].

#### 5. Conclusion

In summary, our results suggest that female sex, older age and surgical interventions are long and short-term predictors of mortality in coronary artery disease treatment in Brazil and that our higher mortality rates may be explained by lower social and economical conditions in our country.

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