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ORIGINAL ARTICLE

# Clinical Course of Patients Undergoing Myocardial Revascularization Surgery in a Public Cardiology Referral Hospital in Pará, Brazil

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## Abstract

**Background:** Myocardial revascularization surgery (MRS) is the most frequently performed cardiac surgery in Brazil. However, data on mortality rates among patients undergoing MRS in hospitals other than the main referral centers in the northern Brazil are scarce.

**Objective:** To describe the clinical course of patients that submitted to MRS in the major public cardiology referral hospital in the Brazilian Amazon.

**Methods:** Retrospective cohort analysis, by review of medical records of patients who had undergone MRS at *Hospital das Clínicas Gaspar Vianna* (FHCGV) from January 2013 to June 2014.

**Results:** A total of 179 patients were evaluated. Mortality rate was 11.7% until 30 days after surgery. Waiting time for surgery ≥ 30 days (OR 2.59, 95%CI 1.02 – 6.56, p = 0.039), infection during hospitalization (OR 3.28, 95%CI 1.15 – 9.39, p = 0.021) and need for hemodialysis after surgery (OR 9.06 95%CI 2.07 – 39.54, p = 0.001) were predictors of mortality after CABG.

**Conclusion:** A high mortality rate in the study population was found, higher than that reported in the literature and in other regions of Brazil. (Int J Cardiovasc Sci. 2018; [online].ahead print, PP.0-0)

**Keywords:** Myocardial Revascularization / mortality; Hospitals, Public; Epidemiology; Postoperative Complications.

## Introduction

Ischemic heart disease is the main cause of death and work disability, causing high costs in public health and socio-economic impact in Western countries.[1] In Brazil, coronary artery disease (CAD) accounted for approximately 250 thousand hospitalizations and 16 thousand deaths in 2015. In the city of Belem, CAD caused nearly 800 hospitalizations and 151 deaths.[2]

Management of ischemic heart disease is complex and encompasses the control of risk factors and symptoms, aiming at reducing morbidity and mortality and optimizing patients' quality of life by means of optimized clinical therapy associated or not with revascularization procedures – percutaneous coronary intervention (PCI) or myocardial revascularization surgery (MRS).[3-6]

Despite historical advances in clinical therapy and percutaneous intervention in terms of technique and materials, results of multicenter studies have shown that MRS is superior to both PCI and clinical treatment alone in reduction of major cardiovascular events in specific groups of patients, such as diabetics, patients with multiple vessel disease or complex CAD involving left coronary trunk.[5,7-10]

MRS is the most performed cardiac surgery in Brazil, approximately 80% of them in public health centers. Mean mortality rate i is 6.2% in the country,[11] with wide variation by region (1.9% - 11.2%),[12] and higher in small surgical volume hospitals, public hospitals, and among female and older patients.[11]

In a recent national registry, a total of 1,722 patients who had undergone cardiac surgery were prospectively

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evaluated. The study involved 17 centers from four Brazilian regions (the North region was not included). Of all procedures, 83% were performed in public or private hospitals of the Brazilian Unified Health System (SUS). MRS accounted for 48.8% of the procedures, with a 7-day mortality of 2.6%.[13]

In the state of Pará, Brazil, 341 MRSs were performed in 2014, with a mortality rate of 7.0%. Of these surgeries, 46.0% were conducted at *Fundação Hospital de Clínicas Gaspar Vianna* (FHCGV) (city of Belem, Para), the main public center for treatment of cardiovascular diseases of Amazonia, with documented institutional death of 10.8%.[2] Today, nearly 50% of all MRSs carried out in the public system of Para state are conducted at FHCGV.[2]

Considering that current recommendations of guidelines of cardiology societies are based on clinical trials performed in American and European institutions, it is urgently necessary, for scientific knowledge and healthcare administration, to verify whether the global evidence can be reproduced to the Amazonian population, considering preoperative conditions, previous comorbidities, severity of underlying disease and postoperative course.

The aim of this study was to describe the clinical course of patients undergoing MRS at the largest, referral public cardiology center in the Brazilian Amazon.

## Methods

### Study design and selection of patients

This is an observational study, with analysis of a retrospective cohort from a historical series of patients who had undergone MRS at *Fundação Hospital de Clínicas Gaspar Vianna* from January 2013 to June 2014. The study was approved by the ethics committee of this institution.

The study population was composed of adult patients (> 18 years old) who had undergone MRS.

Patients who had undergone MRS combined with valvuloplasty or valve replacement, repair of congenital heart defects or aortic surgery were excluded from the study. We also excluded patients whose medical records were not located, had illegible handwriting, or whose data were unavailable for any reason.

### Data collection

Data were collected from medical records using a standard half-open questionnaire of clinical and demographic characteristics of the study population. We collected all data registered from hospital admission to outpatient follow-up, until one year of the procedure.

### Clinical outcomes

Main outcome was postoperative mortality from the admission day until one year after the procedure. Secondary outcomes were the following surgical complications – need for hemodialysis, major bleeding (as defined in the medical records), need for blood transfusion, cardiogenic shock and hospital infection.

### Statistical analysis

The Kolmogorov-Smirnov test was used to verify the normality of distribution of continuous variables, expressed as mean ± standard deviation.

Categorical variables were described as frequency and percentage, and respective 95% confidence interval. Differences in the occurrence of the variables were evaluated by the chi-square test.

For mortality-related variables, odds ratio analysis was performed, with confidence interval of 95%.

For all statistical tests, a $p < 0.05$ was set as statistically significant. Statistical processing of the data was performed using the IBM SPSS Statistics Client for Trial 21.0 Mac OS Multilingual®.

## Results

A total of 179 medical records of patients of both sexes who had undergone elective and urgent MRS were analyzed. All patients were submitted to extracorporeal circulation. Due to characteristics of our institution, as compared with the assistance provided by other public hospitals in which MRS is also performed, located in southern Para state, all patients underwent MRS after an episode of acute coronary syndrome (ST segment elevation myocardial infarction, non-ST-segment elevation myocardial infarction or unstable angina). Despite this, only 7.8% of patients underwent urgent surgery and 92.2% to elective procedure.

Mean age of patients was 62.1 ± 9.2 years; most patients were aged between 60 and 70 years (45.8%), followed by 50-60 years (24.6%) and older than 70 years (19.0%). Most patients were male (74.9%) and originated from the capital and metropolitan area (65.4%) (Table 1).

**Table 1 - Clinical and demographic characteristics of patients who underwent myocardial revascularization surgery between 2013 and 2014**

| Variable | N | % or mean ± SD | 95% CI | |
|---|---|---|---|---|
| | | | Lower limit | Upper limit |
| Sex | | | | |
| Male | 134 | 74.9 | 67.8 | 81.0 |
| Female | 45 | 25.1 | 19.0 | 32.2 |
| Age (years) | 179 | 62.1 ± 9.2 | - | - |
| Origin | | | | |
| Belem (capital) | 90 | 50.3 | 42.7 | 57.8 |
| Metropolitan area* of Belem | 29 | 16.2 | 11.1 | 22.4 |
| Countryside cities | 58 | 32.4 | 25.6 | 39.8 |
| Other state | 2 | 1.1 | 0.1 | 4.0 |
| Risk factors[1] | | | | |
| SAH | 149 | 83.2 | 76.9 | 88.4 |
| Dyslipidemia | 38 | 21.2 | 15.5 | 27.9 |
| Diabetes mellitus | 87 | 48.6 | 41.1 | 56.2 |
| Family history of CAD | 4 | 2.2 | 0.6 | 5.6 |
| Smoking | 103 | 57.5 | 49.9 | 64.9 |
| Previous comorbidities | | | | |
| Previous stroke/TIS | 3 | 1.7 | 0.4 | 4.8 |
| Left ventricular contractile dysfunction (LVEF < 45.0%) | 59 | 33.0 | 26.3 | 40.0 |
| Chronic obstructive pulmonary disease | 7 | 3.9 | 1.6 | 7.9 |
| Peripheral artery disease | 2 | 1.1 | 0.1 | 4.0 |
| Baseline chronic kidney disease | 7 | 3.9 | 1.6 | 7.9 |
| Previous cardiac surgery | 6 | 3.3 | 1.2 | 7.2 |
| Previous percutaneous coronary intervention | 28 | 15.6 | 10.6 | 21.2 |
| Previous medication | | | | |
| ACEi or ARB | 74 | 41.3 | 34.6 | 48.6 |
| Betablocker | 29 | 16.2 | 26.7 | 21.2 |
| Statin | 18 | 10.0 | 5.6 | 14.5 |
| AAS | 34 | 19.0 | 13.4 | 24.6 |
| Clopidogrel | 9 | 5.0 | 2.2 | 8.4 |
| Potassium-sparing diuretics | 6 | 3.3 | 1.1 | 6.1 |
| Thiazide and loop diuretics | 11 | 6.1 | 2.8 | 10.0 |
| Calcium channel blockers | 8 | 4.5 | 1.7 | 7.8 |
| Oral nitrate | 16 | 8.9 | 5.0 | 13.4 |
| Glucose lowering drug | 36 | 20.1 | 14.0 | 26.3 |
| Insulin | 7 | 3.9 | 1.7 | 7.3 |

*ASA: acetylsalicylic acid. TIA: transient ischemic attack; ARB: angiotensin receptor blockers. CAD: coronary artery disease. SD: standard deviation. LVEF: left ventricular ejection fraction. SAH: systemic arterial hypertension. 95%CI: 95% confidence interval. ACEi: angiotensin converting enzyme inhibitors; *cities of Ananindeua, Benevides, Castanhal, Marituba, Santa Bárbara and Santa Izabel.*

Systemic arterial hypertension was the most common cardiovascular risk factor (83.2%), followed by active smoking at admission (57.5%) and diabetes mellitus (48;6%). The most common comorbidities were left ventricular contractile dysfunction (33.0%), chronic obstructive pulmonary disease (3.9%) and baseline chronic kidney disease (3.4%). A small proportion of patients had undergone any myocardial revascularization procedure. Less than half of patients were on medical therapy for coronary artery disease (Table 1).

Most patients underwent elective surgeries. Mean extracorporeal circulation and anoxia time was 77.6 and 46.2 minutes, respectively. Mean time from admission to surgery was 23.4 days, and the length of stay at the intensive care unit and hospital stay was 10.5 days and 15.6 days, respectively (mean) (Table 2).

A high incidence of hospital infection was found (52.5%), 16.2% during the admission-to-surgery period and 47.5% after surgery (Table 3); hospital-acquired respiratory tract infection was the most frequent (p = 0.003) (Figure 1).

Other common postoperative complications during hospitalization were bleeding (37.4%), blood transfusion (37.4%), complex arrhythmias (21.8%) and acute renal injury requiring hemodialysis (4.5%) (Table 3). There was no case of perioperative myocardial infarction documented.

Mortality rate was 11.7%; 85.7% of deaths (n = 18) occurred during hospital stay and 1.3% (n = 3) during the first year of follow-up. The most frequent cause of death was septic shock (57.1%) and cardiogenic shock (33.3%) (Table 4).

Of patients discharged after MRS, 18.9% were lost to outpatient follow-up. Among the others, 24.5% had 1-2 outpatient visits, more than half of patients (56.6%) had 3 or more visits during the first year after surgery; 10.1% reported recurrence of stable angina, 1.5% stroke and 0.8% needed another revascularization procedure.

Mortality-related factors were previous MRS, age ≥ 80 years (Figure 2), infection before or after surgery, baseline chronic kidney disease, renal failure requiring hemodialysis, previous MRS, prolonged hospital stay and patients waiting for surgery (Table 5).

## Discussion

MRS is a therapeutic option for some CAD patients, aiming not only to increase patients' survival but also to alleviate symptoms, especially angina.[14]

**Table 2 - Characteristics of myocardial revascularization surgeries of the patients who underwent the procedure at Fundação Hospital de Clínicas Gaspar Vianna between 2013 and 2014**

| Variable | N | % or mean ± SD | 95%CI | |
|---|---|---|---|---|
| | | | Lower limit | Upper limit |
| Year of surgery | | | | |
| 2013 | 113 | 63.1 | 55.6 | 70.2 |
| 2014 | 66 | 36.9 | 29.8 | 44.4 |
| Emergency of MRS | | | | |
| Elective | 165 | 92.2 | 87.2 | 95.7 |
| Urgent | 14 | 7.8 | 4.3 | 12.8 |
| Time of ECC (minutes) | 179 | 77.6 ± 28. 2 | - | - |
| Time of anoxia (minutes) | 179 | 46.2 ± 18.8 | - | - |
| Time to surgery (days) | 179 | 23.4 ± 15.9 | - | - |
| Postoperative time (days) | 179 | 15.6 ± 14.2 | - | - |
| ICU stay (days) | 179 | 10.5 ± 9.8 | - | - |

*ECC: extracorporeal circulation; MRS: myocardial revascularization surgery; SD: standard deviation. ICU: intensive care unit.*

**Table 3 - Complications of myocardial revascularization surgery during hospitalization at Fundação Hospital de Clínicas Gaspar Vianna between 2013 and 2014**

| Complications | N | % | 95%CI | |
|---|---|---|---|---|
| | | | Lower limit | Upper limit |
| Infection | 94 | 52.5 | 45.2 | 59.8 |
| Hospitalized, waiting for surgery | 29 | 16.2 | 10.6 | 21.8 |
| Postoperative | 85 | 47.5 | 40.2 | 54.7 |
| Bleeding | 67 | 37.4 | 30.3 | 44.9 |
| Blood transfusion | 67 | 37.4 | 30.3 | 45.0 |
| Complex arrhythmias | 39 | 21.8 | 16.0 | 28.6 |
| ARI requiring hemodialysis | 8 | 4.5 | 1.9 | 8.6 |
| ARI without dialysis | 1 | 0.6 | 0.1 | 3.1 |
| Stroke/acute ischemic attack | 5 | 2.8 | 0.9 | 6.4 |
| Need for new surgery | 1 | 0.6 | 0.1 | 3.1 |
| Others | 1 | 0.7 | 0.1 | 3.7 |

*ARI: acute renal injury.*

Expected benefits may be significantly reduced by factors related to the surgical procedure itself, to the center where the surgery was performed, and to the patient.

In our study, surgical mortality was high (11.1%), higher than national mortality (6.2%) and much higher than that reported in European and American countries (2.13% and 4.4%, respectively).[15,16] In the northern region of Brazil, global mortality between 2005 and 2007 was 7.24%.[11] Studies conducted in other regions showed a wide variation in mortality rates, ranging from low rates as 1.7%, observed in a private hospital in Pernambuco to 14.2% in a hospital renowned for the cardiology service provided, located in the south of Brazil.[17,18] In another study carried out at this institution from January 2008 and December 2011, involving 233 patients, a mortality rate of 5.4%[19] was reported. Nevertheless, intraoperative and immediate (first 24 hours after surgery) postoperative deaths were excluded from the study, different from our study that considered all deaths for analyses.

Such wide variation in mortality may be explained by differences in healthcare services provided in each institution. FHCG is a referral center for emergencies in cardiology in the northern region of Brazil to which highly complex patients are referred, as exemplified in our study group. All patients undergoing surgery had been admitted for acute coronary syndrome (ST segment elevation myocardial infarction, non-ST-segment elevation myocardial infarction or unstable angina), which may have contributed to high preoperative mortality. The lack of scores for predicting preoperative mortality at FHCGV, such as EuroScore or STS, which are widely used in many countries and were validated in some centers in Brazil,[18,20] does not allow the comparison between our study group and patients from other centers. Another explanation for the different results may be the type of health care provided; lower mortality rates were observed in private than public centers. In general, people have lower access to primary health care and centers specialized in highly complex cases. Also, higher availability and more effective use of financial resources are seen in private centers than in public ones.

Although postoperative mortality rate seemed to be positively associated with age, particularly considering patients older than 80 years, the number of patients at this age range was considerably small, so that a definite conclusion cannot be made. Rocha et al.,[21] reported higher mortality and postoperative complications such as need for new surgery, respiratory complications, mediastinitis, stroke, acute kidney failure, sepsis, atrial fibrillation and

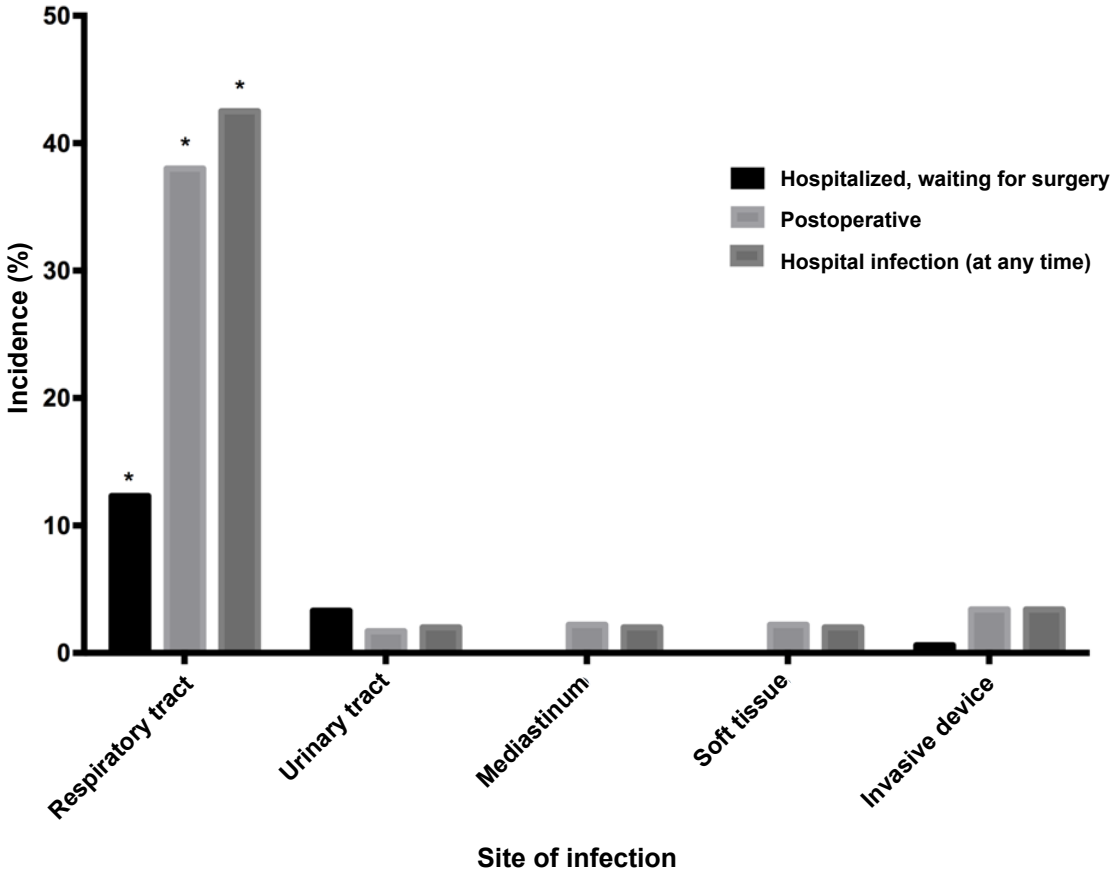


**Figure 1 - Frequency of hospital infection by infection site during hospital stay.**

complete atrioventricular block in patients older than 70 years undergoing MRS.

We did not observe a relationship of mortality with age. Some studies have reported higher mortality rates among women, as in a study conducted from 2002 to 2010 including 655 patients.[22]

Mean admission-to-surgery time was 23 ± 15.9 days, mean intensive care unit stay was 10.5 ± 9.8 days and the mean number of days from surgery to hospital discharge/death was 15.6 ± 14.2 days. The longer waiting time for surgery was associated with higher risk of infectious events during hospitalization, which was probably the main cause of mortality in our study.

In a study carried out in Rio de Janeiro, the authors found that the waiting time for MRS had no effect on operative mortality; however, approximately 11.0% of patients died in this period. Factors associated with mortality in these patients were left ventricular ejection fraction < 45% and a waiting time longer than 16 weeks.[23] In our population, left ventricular dysfunction was not a predictor of death. Another study conducted at *Santa Casa de Limeira*, including patients older than 70 years, showed that an intensive care unit stay longer than 48 years was associated with higher mortality, whereas hospital stay was not a predictor of mortality in these patients.[24]

With respect to comorbidities, only previous MRS and chronic kidney disease were associated with mortality. Anatomic localization of the arteries affected or postoperative complications (major bleeding, need for transfusion of blood derivatives, complex arrhythmias, stroke and angina) showed no association with mortality. On the other hand, both postoperative infection and kidney injury were associated with higher mortality. Results of a study conducted in a referral center for cardiology care differ from ours, as no difference in mortality was reported among patients who had infection. A study carried out at HCGV from

**Table 4 - Clinical outcomes and postoperative complications in the first year of follow-up of patients who underwent myocardial revascularization surgery at Fundação Hospital de Clínicas Gaspar Vianna between 2013 and 2014**

| Variable | N | % | 95%CI | |
|---|---|---|---|---|
| | | | Lower limit | Upper limit |
| Clinical outcome | | | | |
| Discharge | 158 | 88,3 | 82,6 | 92,6 |
| Postoperative mortality | 18 | 10,0 | 6,1 | 15,4 |
| Mortality after discharge | 3 | 1,7 | 0,4 | 4,8 |
| Cause of death | | | | |
| Septic shock | 12 | 57,1 | 34,0 | 78,2 |
| Cardiogenic shock | 7 | 33,3 | 14,6 | 57,0 |
| Acute myocardial infarction | 1 | 4,8 | 0,1 | 23,8 |
| Ventricular tachycardia | 1 | 4,8 | 0,1 | 23,8 |
| Outpatient follow-up | | | | |
| Lost to follow-up | 30 | 18,9 | 12,8 | 24,9 |
| 1-2 visits | 39 | 24,5 | 17,8 | 31,2 |
| 3 or more visits | 90 | 56,6 | 48,9 | 64,3 |
| Complications after discharge | | | | |
| Recurrent angina | 13 | 10,1 | 5,5 | 16,6 |
| Stroke/TIA | 2 | 1,5 | 0,2 | 5,5 |
| Need for new MRS | 1 | 0,8 | 0,1 | 4,2 |

*TIA: transient ischemic attack; MRS: myocardial revascularization surgery.*

2008 to 2011 showed that acute kidney failure, blood transfusion and sepsis in the postoperative period, as well as urgency/emergency procedures were associated with higher mortality. These findings were different from ours, since emergency surgery had no significant effect on mortality.[19,25]

An important finding was the lack of acute myocardial infarction in the perioperative period in our study group, which differs from studies in the literature that report an incidence ranging from 2 to 30%, depending on the criteria used by the authors.[26] In a study on 116 patients, 24.1% had perioperative acute myocardial infarction, which was related with worse ventricular function and death.[26] This can be explained by the fact that acute myocardial infarction may be difficult to be detected in the perioperative period due to its particular characteristics during this phase, different from usual manifestation. For example, patients are usually under sedation and anesthesia and thereby not able to identify pain, requiring a high degree of suspicion by the clinician and complementary tests such as markers of myocardial necrosis, ECG and echocardiography for the diagnosis. Besides, endarterectomy, an important risk factor for perioperative acute myocardial infarction, is rarely performed in our center.

The most frequent causes of mortality were septic shock, followed by cardiogenic shock, acute myocardial infarction (at clinical follow-up, after discharge) and arrhythmia. A study conducted at *Instituto Nacional de Cardiologia* (National Institute of Cardiology) between 2004 and 2009 showed that main causes of mortality after MRS were cardiac-related (38.7%), infection (14.1%), multiple organ failure (3.8%), neurological (1.9%) and others (41.5%).[27]

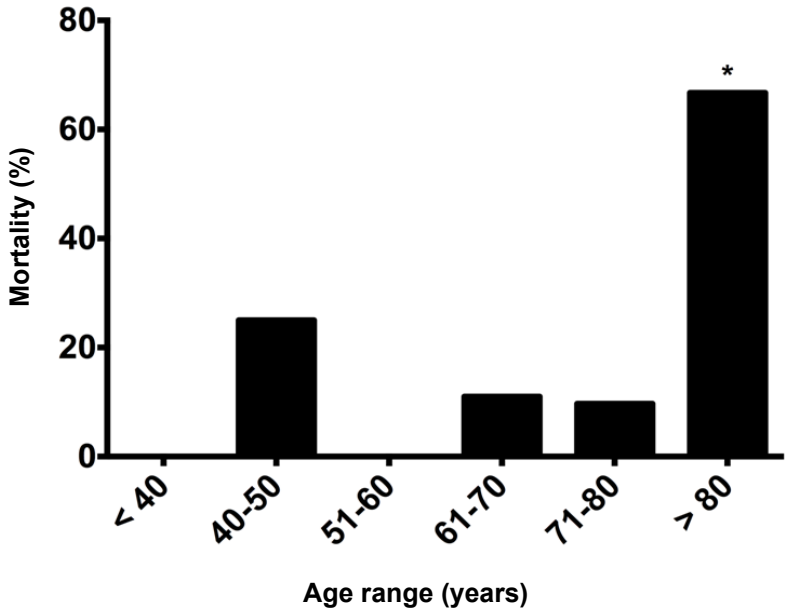


**Figure 2 - Mortality rate by age range. In patients older than 80 years, mortality rate was 66.7%, significantly higher than other ages (p = 0.03).**

**Table 5 - Variables associated with hospital mortality and mortality in the first year of follow-up in patients who underwent myocardial revascularization surgery at Fundação Hospital de Clínicas Gaspar Vianna between 2013 and 2014**

| Variable | *Odds Ratio* | 95%CI | | p value |
|---|---|---|---|---|
| | | Lower limit | Upper limit | |
| Previous MRS | 18.3 | 3.1 | 107.7 | < 0.001 |
| Age > 80 years | 16.5 | 1.4 | 191.0 | 0.003 |
| Need for hemodialysis after MRS | 9.1 | 2.1 | 39.5 | 0.001 |
| Baseline chronic kidney disease (GFR < 60 mL/min) | 6.4 | 1.3 | 31.0 | 0.009 |
| Infection in patients waiting for surgery | 3.1 | 1.1 | 8.5 | 0.023 |
| Postoperative infection | 3.1 | 1.2 | 8.5 | 0.019 |
| Hospital infection at any time | 3.3 | 1.2 | 9.4 | 0.021 |
| Prolonged preoperative hospitalization (> 30 days) | 2.6 | 1.0 | 6.6 | 0.039 |

*MRS: myocardial revascularization surgery; GFR: glomerular filtration rate. p < 0.05.*

Most patients were discharged, approximately 20% were lost to outpatient follow-up; three deaths occurred in the first year after discharge. A study conducted in four public hospitals in Rio de Janeiro showed a mortality rate of 14.9% one year after discharge.[12] Such divergency may be explained by the high loss to follow-up rate in our study, which may have underestimated mortality rate after discharge (since no information of these patients were obtained).

Based on the high mortality rate, the increased waiting time for surgery and the high incidence of infection related to waiting time, it would wise to

increase the number of patients referred to percutaneous coronary intervention instead of MRS. This would alleviate, at least in part, excessive waiting times for surgery. Further studies are needed to compare the use of both strategies in our institution to identify the group of patients that would benefit most from percutaneous coronary intervention.

In addition, limitations of the retrospective cohort design of the study include missing data in the registry database, which may have affected the analysis.

## Conclusion

We found a high mortality rate in patients undergoing MRS, higher than that reported in the literature and in other regions of Brazil. Further studies are needed to determine the causes of these findings and find effective solutions.

## Author contributions

Conception and design of the research: Lobato PHM, Vieira Junior FM, Nunes MBG, Galucio VAQL. Acquisition of data: Lobato PHM, Vieira Junior FM, Nunes MBG, Galucio VAQL, Barreto EL. Analysis and interpretation of the data: Lobato PHM, Vieira Junior FM, Nunes MBG, Galucio VAQL. Statistical analysis: Lobato PHM, Vieira Junior FM, Nunes MBG, Galucio VAQL. Obtaining financing: Lobato PHM, Vieira Junior FM, Nunes MBG, Galucio VAQL. Writing of the manuscript: Lobato PHM, Vieira Junior FM, Nunes MBG, Galucio VAQL. Critical revision of the manuscript for intellectual content: Lobato PHM, Vieira Junior FM, Nunes MBG, Galucio VAQL.

### Potential Conflict of Interest

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

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### Study Association

This article is part of the thesis of medical residency submitted by Patrick Hernani Matias Lobato, from Fundação Pública Hospital de Clínicas Gaspar Vianna.

### Ethics approval and consent to participate

This study was approved by the Ethics Committee of the Fundação Pública Hospital de Clínicas Gaspar Vianna under the protocol number CAAE: 66557717.0.0000.0016. All the procedures in this study were in accordance with the 1975 Helsinki Declaration, updated in 2013. Informed consent was obtained from all participants included in the study.

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