Original Article

Risk factors for surgical site infection in patients of myocardial revascularization surgery in Montes Claros, Brazil, between 2008 to 2012

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Abstract

Objective: To identify the risk factors for the development of surgical site infection in patients undergoing myocardial revascularization at a philanthropic and educational hospital in Brazil. Methods: Retrospective cohort study at a philanthropic hospital of Minas Gerais, Brazil, with patients submitted to myocardial revascularization in the period from 2008 to 2012. Data were collected from medical records and records of hospital infection notification. The patients were divided into two groups according to the presence or absence of surgical site infection. For data analysis, one used logistic regression model, with a significance level of 5%. Results: Among the 120 patients studied, 22.5% (27) presented surgical site infection. The presence of hypertension (OR=7.5; CI 95% 2.4-23.6); use of chest tube for a period greater than three days (OR=7.5; CI 95% 2.4-23.6); staying at the hospital after surgery for more than 18 days (OR=9.8; CI 95% 3.1-30.8) remain associated with the surgical site infection. Conclusion: One proposes greater effort in an attempt to reduce the length of stay in hospital after surgery for myocardial revascularization, encouraging the removal, in the shortest possible time, of invasive devices such as the chest tube, aimed at better outcome of patients undergoing that type of surgery.

Key words: Infection, Cardiovascular Surgical Procedures, Risk factors.

Introduction

Cardiovascular diseases are one of the major causes of morbidity and mortality in Brazil and worldwide. Despite the progress of the clinical treatment of heart diseases, with less invasive procedures, cardiac surgery remains the choice in some cases and myocardial revascularization (MR) is one of the options in that treatment modality [1-3].

In Brazil, in 2011, approximately 100 thousand cardiac surgeries were performed, and more than 50% related to myocardial revascularization, whose index is comparable to the one from the international literature [1-3].

The main complications of cardiac surgery are hospital infections, defined as those acquired after the patient's hospitalization and occurring during the hospitalization period, or even after discharge, when they may relate to the hospital permanence or procedures [4].

Among them, surgical site infection (SSI), which occurs in the surgical incision or in manipulated tissues during the operation, is classified according to its topography in superficial incisional; deep incisional; of organ/space [5].

In cardiac surgeries, infections represent significant postoperative complications related to several factors [1-3]. Postoperative infections of cardiac surgery collaborate to increase morbidity and mortality, increase length of hospital stay and costs6.

Studies indicate that the main preoperative risk factors for surgical site infection after cardiac surgery are: diabetes mellitus; obesity [7-9]; age [10]; time of preoperative hospitalization [7,10]; among others.

Regarding surgical procedures, SSIs characterize the most regular complication among patients, with the main Health Care Related Infections (HCRI) [11].

With regards to cardiac surgeries, SSIs are serious and have high financial repercussions due to the longer hospital stay, between 15 and 45 days; of the high cost, with expenses of up to 600% higher, considering the patient without infection, with values ranging from

$19,000.00 to $150,000.00; and, by raising the mortality rate even after treatment, by about 8% to 20% [12-14].

Identifying risk factors for MR-related infection may provide parameters to plan and adopt strategies to prevent, control and monitor that infection, in order to minimize its occurrence and to assure a better quality of care for patients submitted to that type of procedure [1,15].

Considering the relevance of the topic and the lack of epidemiological work on that reality, this study aimed to identify pre, intra and postoperative risk factors for the development of surgical site infection in patients submitted to myocardial revascularization at a philanthropic and educational hospital.

Methods

This is a retrospective cohort study, carried out at a philanthropic and educational hospital in the city of Montes Claros, northern Minas Gerais, Southeastern region of Brazil. The hospital has 323 beds. The cardiology department attends an expressive portion of patients through the Unified Health System (SUS), with a 10-bed Cardiology Intensive Care Center (ICU). The hospital has two cardiac surgery teams, who perform, on average, 36 cardiac surgeries per month, of which 20 are myocardial revascularization. The study population consisted of all patients undergoing MR surgery between 2008 and 2012.

Figure 1. Location of Montes Claros, Minas Gerais, city where the study was carried out, in the Brazilian territory.

Patient data were collected from medical records and records of hospital infection notification with diagnosis of surgical site infection provided by the Hospital Infection Control Commission. The collection took place between October 2013 and February 2014. One included a data collection instrument that included sociodemographic, clinical and epidemiological variables related to the risk factors for the occurrence of SSI infection. It is noteworthy that the medical records with illegibility of spelling and those that were not within the current period of the survey were excluded. In the period considered for this study, 140 MR surgeries occurred, and there was exclusion of 20 out of the 140 analyzed medical records. Thus, the universe consisted of 120 patients.

Regarding the diagnosis of SSI, the studied hospital uses the National Infection Surveillance System (NISS) methodology, currently modified for the National Health Care Safety Network (NHSN).

Patients were divided into two groups according to the presence or absence of surgical site infection after MR surgery. The dependent variable was SSI and the independent variables were socio-demographic and comorbidities (gender, age, diagnosis of hypertension, diagnosis of diabetes, diagnosis of renal failure, diagnosis of obesity, diagnosis of congestive heart failure, diagnosis of neurological trauma); risk factors related to pre and postoperative hospitalization (preoperative hospitalization, hospital stay); intraoperative factors (extracorporeal circulation, chest drainage, mediastinal drainage, mammary use and increased bleeding).

Initially, a descriptive analysis of all the variables investigated was carried out through position measurements (mean and standard deviation). The technique used for quantitative, discrete or continuous variables consisted of comparing the means of the groups with presence or absence of SSI, through the student *t* test, in order to verify significant differences between the means of such groups. In the univariate analysis, the logistic regression model was used, considering, in this step, the significance of 0.25 to incorporate, or not, the variable in the multivariate model.

In the multivariate analysis, the Logistic Regression model was used, and the level of significance adopted was 5%.

The statistics from the models constructed in the analysis were: odds ratio (OR), confidence interval (CI) of 95% and significance probability (p values) of less than 0.05. The collected data were processed and analyzed in the Statistical Package for Social Science (SPSS), version 20.0.

The Research Ethics Committee of the Federal University of São Paulo (UNIFESP) approved this study, process number 304.688 of June 14, 2013.

Results

Among the 120 patients studied, 86 (71.7%) were men. The infection incidence was 22.5%. Regarding the type of infection developed, 37% were due to mediastinal connective tissue infection; 25.9% due to infection in saphenectomy.

Table 1 shows the association of socio-demographic variables and comorbidities with surgical site infection.

Among the patients with SSI, 17 (63%) were men and 10 (37%), women. Regarding the use of extracorporeal circulation during surgery, 33.3% used that procedure, while chest and mediastinal drainage was performed in 37% and 51.9%, respectively (Table 2). Regarding the use of the mammary artery for revascularization, 81.5% used it, and 74.1% were of the unilateral type.

Table 1. Association of sociodemographic and comorbidities variables with surgical site infection in patients of a philanthropic hospital of Montes Claros, Minas Gerais, Brazil, 2008-2012.

Variable	With SSI* n=27 (%)	Without SSI* n=93 (%)	OR (95% CI)	p-value
Age (60 years or more)	20 (74.1)	59 (63.4)	1.65 (0.6-4.3)	0.308
Systemic arterial hypertension	24 (89.9)	66 (71.0)	3.30 (1.2-8.7)	0.018
Diabetes *Mellitus*	12 (44.4)	28 (30.1)	1.86 (0.9-3.9)	0.106
Chronic Renal Insufficiency	01 (3.7)	01 (1.1)	3.50 (0.2-58.5)	0.377
Obesity	0.0 (0.0)	01 (1.1)	0.00 (0.0-0.0)	1.000
Congestive heart failure	01 (3.7)	02 (2.2)	1.80 (0.2-20.1)	0.653
Neurological trauma	01 (3.7)	03 (3.2)	1.20 (0.1-11.6)	0.903

*SSI - Surgical site infection.

Among those with SSI, mean age was 67.3 years (standard deviation [SD] = 8.5). Regarding the preoperative hospitalization time, the mean permanence of those with SSI was 6.7 days (SD=4.2). The mean hospital stay was 33.8 days (SD=19.1), with a statistical difference between the means of those with SSI and those who did not have SSI (p<0.001). Regarding the extracorporeal circulation time, the mean was 24 minutes (SD=93.8). The mean number of chest drainages was 1.06 (SD = 0.25), while the mean number of days of chest drainage was 7.1 days (SD=11.8) and 3.4 days (SD=2.3) for mediastinal drainage. Regarding the days for the diagnosis of the infection, the mean was 12.4 days (SD = 5.8), and there was no statistical difference between the groups.

In the multivariate analysis by logistic regression, systemic arterial hypertension remained associated with surgical site infection (OR = 3.30; 95% CI 1.2-8.7).

Table 2 shows the results of the multivariate analysis between surgical site infection and pre, intra and postoperative risk factors.

Table 2. Association of pre, intra and postoperative risk factors with surgical site infection in patients of a philanthropic hospital of Montes Claros, Minas Gerais, Brazil, 2008-2012.

Variable	With SSI* n=27 (%)	Without SSI* n=93 (%)	OR (95% CI)	p-value
Preoperative hospitalization (> 7 days)	27 (100.0)	42 (45.2)	0.90 (0.4-2.3)	0.912
Hospital stay (> 18 days)	23 (85.2)	38 (40.9)	9.80 (3.1-30.8)	<0.001
Extracorporeal circulation (> 85 minutes)	09 (33.3)	41 (44.1)	2.40 (0.9-6.3)	0.067
Chest drainage (> 3 days)	10 (37.0)	08 (8.6)	7.50 (2.4-23.6)	0.001
Mediastinal drainage (> 2 days)	14 (51.9)	42 (45.2)	1.70 (0.6-3.3)	0.489
Use of mammary	22 (81.5)	80 (86.0)	0.60 (0.2-1.8)	0.318
Increased bleeding	05 (18.5)	09 (9.7)	2.10 (0.6-7.0)	0.215

*SSI - Surgical site infection.

Among intraoperative risk factors, the use of a chest drain for a period longer than three days (OR=7.5; 95% CI 2.4-23.6) remained associated. Among the postoperative factors, the hospital stay after MR surgery greater than 18 days remained associated (OR=9.8; 95% CI 3.1-30.8).

Discussion

The incidence of SSI found in this study (22.5%) was higher than the one reported in other Brazilian and international studies (values between 0.2% and 9.4%) [10,13-17], considering the follow-up period (an average of five years). The maximum value found was 9.4% in a historical cohort performed at a public and educational hospital with 290 beds in Uberaba, Minas Gerais, Brazil [15]. Although not significant in this study, the age variable could explain that incidence, since among the patients presenting with SSI, 74.1% were 60 years old or older, and the risk of SSI increases with the age [9,15]. Although it is a risk factor for SSI, it is emphasized that age is not susceptible to modification [6].

Other studies corroborated the greater occurrence of men among the cases of SSI after cardiac surgery in this study [9,16-19]. Although there is a greater predisposition of men to develop SSI, when compared to women, although not fully elucidated in the literature, there is a hypothesis suggesting that men, because of their greater amount of hair follicles in the thoracic area, where the sternotomy is performed, may be more susceptible to bacterial growth and infections [20].

There was an association between the presence of systemic arterial hypertension and the development of SSI. Regarding this finding, authors [21] demonstrated a predominance of systemic arterial hypertension in cases of SSI, finding, in their study, that such comorbidity was present in 80.9% of the patients. A study [6] that

attempted to describe the occurrence of surgical site infection in patients submitted to myocardial revascularization, found out hypertension as comorbidities more frequently in 24.2%. Thus, in terms of previous history, hypertension is considered one of the main risk factors to be investigated.

Risk factors related to comorbidity most commonly found in patients with SSI also associate with cardiovascular complications, requiring special care and surgical correction through myocardial revascularization surgery.

Those factors become serious aggravating aspects, since, in addition to predisposing to the need for surgical intervention, especially SAH, they influence systemically in the individual's metabolism, hindering the recovery [21].

Differently from other studies, in this study there was no association between the other comorbidities. A cohort of 18,532 patients undergoing MR and an average follow-up of 10.3 years in Oslo, Norway, found that 107 patients progressed with mediastinitis-type SSI.

The authors identified as independent risk factors for the development of mediastinitis: chronic obstructive pulmonary disease; age; male gender; stenosis of the trunk of the left coronary artery; diabetes mellitus; obesity [20].

Regarding intraoperative risk factors, in this study there was a higher incidence of SSI in patients submitted to MR surgery with the use of extracorporeal circulation. Several factors influence the incidence of SSI, including invasive procedures and insufficient primary defense caused by surgical trauma and extracorporeal circulation. That procedure causes changes in the immune system, especially by the use of hypothermia and hemodilution, predisposing to the appearance of infections, altering the normal physiology of the individual [21].

Regarding the postoperative risk factors, the length of stay after MR surgery was longer than 18 days, presenting a higher risk (OR=9.8) to develop SSI. Other studies have mentioned the association between high hospital stay and colonization by microorganisms with the occurrence of infections, confirming as effective predictive factors of SSI occurrence. Hospital stay exposes patients to other risk factors, either as a consequence of their severity or the need for monitoring using invasive procedures, increased exposure to the environment and the risk of cross-infection [22].

In a study carried out in a cardiovascular reference hospital in Santa Catarina, it has been associated hospitalization time to infected patients with the occurrence of death in patients submitted to MR [6], which is, the manifestation of an infectious condition may be directly related to a negative outcome. In addition, it is evident that the length of in-hospital stay in patients with SSI can be up to three times higher, resulting in the wear of the patient and his / her relatives and the increase in care costs [6,12,14].

Regarding intraoperative risk factors, there was association between the use of chest drainage for a period longer than three days and SSI. Regarding this finding, a study carried out in São Paulo, Brazil, pointed out its permanence for more than four days as one of the predisposing factors for the occurrence of SSI [23].

As limitations of the study, it is possible to take into account its retrospective nature, besides the impossibility to evaluate other aspects and potential risk factors for SSI, such as surgical environment, paramentation, surgical antisepsis, and not considering antibiotic prophylaxis. In addition, it focused on a single hospital, even if it is a regional reference. However, those limitations did not compromise the achievement of the proposed objectives, considering the rigor to the collection methodology and analysis techniques used.

It was possible to identify that the variables that remained associated with the occurrence of surgical site infection after myocardial revascularization were systemic arterial hypertension; length of hospital stay greater than 18 days; use of a chest drain for more than three days. Thus, as implications for the practice, one proposes a greater effort in the attempt to reduce the length of hospital stay after MR surgery, encouraging the removal, in the shortest possible time, of invasive devices such as the chest drain, among others. Moreover, one mentions the stimulus to early deambulation in the postoperative period, in order to prepare the patient for the hospital discharge as soon as possible. Those considerations can also be analyzed under the focus of the importance of reducing the SSI incidence rate, while an indicator of the quality of the provided service.

It is necessary to carry out such studies, in the various hospital spaces that perform myocardial revascularization surgeries, in order to subsidize the formulation and implementation of measures to prevent, control and monitor surgical site infections, promoting a better outcome in patients submitted to that type of surgery.

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