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RESEARCH

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## RISK FACTORS FOR MEDIASTITIS IN THE POST-OPERATIVE PERIOD OF HEART SURGERY

Fatores de riscos para mediastinite no pós-operatório de cirurgia cardíaca

Factores de riesgo para mediastinitis en el período postoperatorio de cirugía cardíaca

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### ABSTRACT

**Objectives:** To identify pre and postoperative risk factors related to the development of mediastinitis among patients submitted to cardiac surgery at a hospital in the city of *Rio de Janeiro*, to characterize the study population and to analyze the relationship between risk factors and the incidence of mediastinitis in patients undergoing cardiac surgery. **Method:** descriptive study, quantitative approach, in which the risk factors for mediastinitis were identified in patients who underwent cardiac surgery in a hospital in *Rio de Janeiro*. **Results:** a n of 192 patients, mostly males, aged 50 to 69 years and overweight were obtained. Diabetes *mellitus* and smoking were the most frequent comorbidities, and CRVMC the most performed surgery, 4 patients had mediastinitis. **Conclusion:** the identification of these factors contributes to the elaboration of prevention strategies for mediastinitis, and the implementation of nursing care in the pre and postoperative period of cardiac surgeries.

**Descriptors:** Operative wound infection; Mediastinitis and risk factor.

### RESUMO

**Objetivos:** Identificar os fatores de risco pré e pós-operatórios relacionados ao desenvolvimento de mediastinite entre pacientes submetidos à cirurgia cardíaca em um hospital da cidade do Rio de Janeiro, caracterizar a população estudada e analisar a relação entre os fatores de risco e a incidência de mediastinite nos pacientes submetidos à cirurgia cardíaca. **Método:** Estudo descritivo, abordagem quantitativa, em que foram identificados os fatores de risco para mediastinite em pacientes que realizaram cirurgia cardíaca em um hospital do Rio de Janeiro. **Resultados:** Obteve-se um n de 192 pacientes, de maioria homens, na faixa etária de 50 a 69 anos e em sobrepeso. Diabetes *mellitus* e tabagismo foram as comorbidades mais frequentes, e CRVMC a cirurgia mais realizada, 4 pacientes apresentaram mediastinite. **Conclusão:** A identificação destes fatores contribui para elaboração de estratégias de prevenção para mediastinite, e na implementação de cuidados de enfermagem no pré e pós-operatório de cirurgias cardíacas.

**Descritores:** Infecção da ferida operatória; Mediastinite e Fator de Risco.

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## RESUMEN

**Objetivos:** Identificar los factores de riesgo pre y postoperatorios relacionados al desarrollo de mediastinitis entre pacientes sometidos a la cirugía cardíaca en un hospital de la ciudad de Río de Janeiro, caracterizar a la población estudiada y analizar la relación entre los factores de riesgo y la incidencia de mediastinitis en los pacientes sometidos a la cirugía cardíaca. **Método:** Estudio descriptivo, abordaje cuantitativo, en que se identificaron los factores de riesgo para la mediastinitis en pacientes que realizaron una intervención cardíaca en un hospital de Río de Janeiro. **Resultados:** Se obtuvo un n de 192 pacientes, de mayoría hombres, en el grupo de edad de 50 a 69 años y en sobrepeso. La diabetes *mellitus* y el tabaquismo fueron las comorbilidades más frecuentes, y CRVMC la cirugía más realizada, 4 pacientes presentaron mediastinitis. **Conclusión:** La identificación de estos factores contribuye a la elaboración de estrategias de prevención para la mediastinitis, y en la implementación de cuidados de enfermería en el pre y postoperatorio de cirugías cardíacas. **Descriptor:** Infección de la herida operatoria; Mediastinitis y Factor de Riesgo.

## INTRODUCTION

Surgical site infection (SSI) is one of the main infections related to health care in Brazil, occupying the third position among all infections in health services. Such infections are considered serious complications and threaten the safety of hospitalized patients, since they increase morbidity and mortality rates, increase hospitalization costs due to the length of hospital stay and expenses with diagnostic and therapeutic procedures, also, increase the time of hospitalization. removal of the patient from his work and family.<sup>1,2</sup>

Considering the Healthcare-Associated Infections, the surgical site has been identified as one of the most important sites where infections occur, leading to an average increase of 60% in the hospitalization period, in addition to requiring great efforts for its prevention.<sup>1,2</sup>

In 2009, the *Agência Nacional de Vigilância Sanitária* (ANVISA)<sup>3</sup> [Brazilian Health Regulatory Agency] created the manual called “National Criteria for Healthcare-Associated Infections”, whose main objectives are to systematize the surveillance of SSIs and to define result, process and structure indicators for the prevention of postoperative infection in healthcare services.

Acute mediastinitis is an inflammatory process in the connective tissue of the mediastinum. It is a serious complication of surgeries that address the heart and the great vessels of the base. Inflammation of the mediastinum can occur for several causes, the main ones being as follows: median post-sternotomy, rupture of the esophagus, and suppurations of the head and neck such as peritonsillar abscesses, deep cervical abscesses, etc. Other less frequent causes also cited are pleural empyema, osteomyelitis of vertebrae and ribs, and retroperitoneal and subphrenic abscesses.<sup>4,5</sup>

It is an important SSI that occurs in the postoperative period of heart and major vessel surgeries, being responsible for high rates of morbidity and mortality, with a consequent increase in medical and hospital costs and prolonged hospitalizations.<sup>5,6</sup>

Factors related to the development of infection in the postoperative period of cardiac surgery are generally associated with the patient and/or surgical procedures.<sup>7</sup>

Among the risk factors for mediastinitis, the following stand out: age, above 70 years old; male; obesity, >20% of the ideal weight; diabetes mellitus; renal dysfunction; pulmonary dysfunction and infection; cardiac dysfunction and low cardiac output; smoking; chronic obstructive pulmonary disease (COPD); tracheostomy; sternal instability; surgical time; surgical re-approach; malnutrition; myocardial revascularization using the mammary artery; long hospital stay; mechanical ventilation for more than 72 hours; previous hospitalization for more than 72 hours in the intensive care unit (ICU).<sup>8-10</sup>

Mediastinitis is classified as mediastinal dehiscence, which consists of opening the surgical wound spontaneously in the absence of either clinical or microbiological evidence of infection and infection of the mediastinal wound which consists of clinically and microbiologically confirmed infection of the sternal tissues and sternal osteomyelitis.<sup>10</sup>

Among the most commonly found infectious agents in cultures harvested from inflamed mediastinal tissue, *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Pseudomonas sp.*, and *Escherichia coli* stand out, the latter being associated with a high mortality rate.<sup>4,5</sup>

The criteria that define mediastinitis are: isolation and cultivation of microorganisms in the mediastinal tissues or the secretions collected by fine-needle puncture; evidence of mediastinitis observed during surgery or through histopathological study; sternal instability, chest pain, fever (>38° C) associated with sternal secretion culture and/or positive blood culture.<sup>10</sup>

The prognosis of mediastinitis is severe, even with antibiotic treatment and surgical wound debridement, as the infection can spread to the mediastinum and involve cardiac structures, also leading to septic shock and hemorrhages.<sup>11</sup>

Characteristics of patients, such as age, gender, and comorbidities, who undergo cardiac surgery increase the predisposition to infectious, as well as cardiovascular diseases. For this reason, it is necessary to know the population affected with mediastinitis in health institutions that operate in cardiac surgery.<sup>11</sup>

The description of the population assisted allows the formulation and establishment of protocols or institutional measures aimed at the control and prevention of mediastinitis, because they make them reliable to the population that will be addressed.<sup>11</sup>

Bearing the aforesaid in mind, this research meant to identify both pre and postoperative risk factors related to the development of mediastinitis among patients who underwent cardiac surgery at a hospital from the *Rio de Janeiro* city. Moreover, to characterize the study population and to analyze the relationship between risk factors and the incidence of mediastinitis in patients who underwent cardiac surgery.

This study has the benefit of identifying the main risk factors for mediastinitis in patients assisted at the studied hospital and this provides subsidies for creating strategies to prevent such events.

## METHODS

It is a descriptive and retrospective study with a quantitative approach, where there were identified the risk factors related to the development of mediastinitis in patients who underwent cardiac surgery at a university hospital from the *Rio de Janeiro* State.

Data collection took place through Documentary Research in medical records of patients who underwent cardiac surgery over the period from January 2014 to December 2016. It was performed in two stages, performed at the cardiac ICU of the hospital, where they were collected the numbers of the medical records of patients who underwent cardiac surgery from January 2014 to December 2016. This collection was performed through the hospitalization record book of these sectors, and a number of 348 was obtained.

After applying the exclusion criteria, there was a total of 192, and the second stage of data collection began, which was carried out in the hospital's medical file, and the collection was carried out from the patients' medical records, through a data collection instrument developed by the researcher, and related to the risk factors for the development of mediastinitis in the postoperative period of cardiac surgery described in the literature.

The medical records of patients who underwent cardiac surgery from January 2014 to December 2016 were used as an inclusion criterion. The medical records of patients who underwent surgeries without median anterior sternotomy were used as exclusion criteria; deaths; medical records that were incomplete; and the medical records that were not found.

The study was carried out through a simple descriptive and inferential statistical analysis using the Microsoft Office Excel software.

The project was submitted to *Plataforma Brasil*, having received approval on 06/26/2017, with Legal Opinion No. 2.138.680. It was requested to waive the use of the informed consent form (ICF), due to the fact that secondary data were used in medical records, in addition to being a study with a retrospective approach, which would make it impossible to offer the form to the study participants.

## RESULTS

Bearing the aforementioned in mind, a total of 192 patients/medical records were obtained. The sample collected was mostly men, within the age group from 50 to 69 years old, and overweight, in other words, with BMI (body mass index) ranging from 25 to 30,<sup>12</sup> **Table 1**.

**Table 1** - Data addressing gender, age and body mass index (BMI).

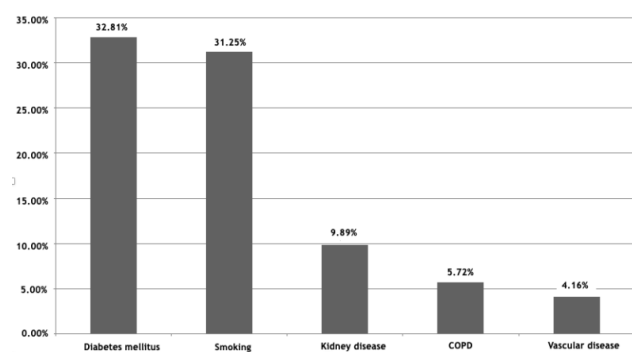
Characteristics	Number of Patients (n)	Percentage (%)
<b>Gender</b>		
Male	134	69.80%
Female	58	30.20%
<b>Age</b>		
Up to 39 years old	8	4.16%
40-49 years old	28	14.59%
50-59 years old	57	29.69%
60-69 years old	68	34.42%
70 years old or more	31	16.14%
<b>BMI</b>		
Low weight	7	3.65%
Adequate weight	49	25.52%
Overweight	70	36.46%
Obesity	37	19.27%
No BMI	29	15.10%

Source: Medical records.

Note: BMI data calculated and classified according to the Brazilian Ministry of Health.

Concerning the comorbidities, diabetes mellitus and smoking, were the ones that appeared most frequently among patients. Other comorbidities that appeared were COPD, kidney disease, and vascular disease, all in less than 10% of patients, **Figure 1**.

**Figure 1** - Comorbidities.

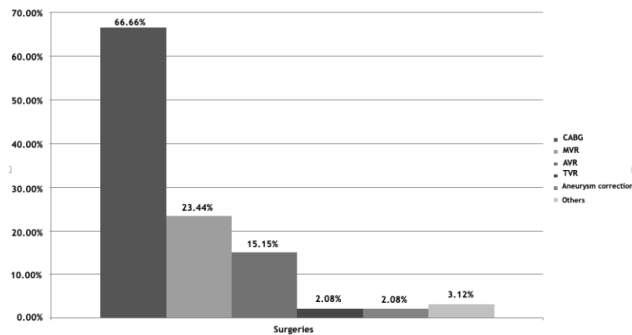


Source: Medical records.

Abbreviation: COPD - Chronic Obstructive Pulmonary Disease.

Coronary artery bypass graft surgery (CABG) was the most performed surgery in the studied period, followed by mitral valve replacement (MVR), aortic valve replacement (AVR), tricuspid valve replacement (TVR), thoracic aortic aneurysm correction and other surgeries performed with lower frequency, such as correction of the atrial septal defect, atrioseptoplasty, pericardiectomy, closure of atrial aortic fistula and correction of atrial myxoma. Considering the patients who underwent CABG, 91.41% used the mammary artery to perform a myocardial bypass.

**Figure 2 - Surgeries.**

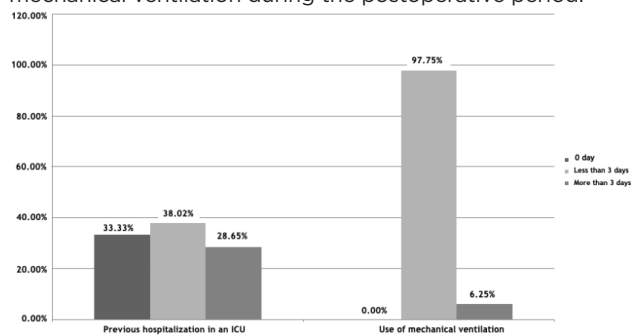


Source: Medical records.

Abbreviations: CABG – coronary artery bypass graft surgery; MVR – mitral valve replacement; AVR – aortic valve replacement; TVR – tricuspid valve replacement.

Concerning the preoperative hospitalization, most patients stayed 3 days or less in the ICU. Like most patients used mechanical ventilation in the postoperative period for 3 days or less, **Figure 3**.

**Figure 3 - Previous hospitalization in an ICU/ Use of mechanical ventilation during the postoperative period.**



Source: Medical records.

Considering the total sample of investigated patients, 7 underwent a surgical re-approach in the postoperative period, representing 3.64%. And 4 patients had postoperative mediastinitis (**Table 2**).

**Table 2 - Profile of patients who had mediastinitis during the postoperative period.**

Characteristics	P1	P2	P3	P4
<b>Gender</b>				
Male		X	X	X
Female	X			

Characteristics	P1	P2	P3	P4
<b>Age</b>				
50-59 years old		X	X	X
70 years old or more	X			
<b>BMI</b>				
Low weight	X			
Adequate weight		X		
Obesity			X	
No BMI				X
<b>Comorbidities</b>				
Diabetes mellitus	X		X	X
Smoking			X	
Kidney disease			X	
Vascular disease			X	
<b>Surgery</b>				
CABG	X		X	X
AVR		X		

Source: Medical records.

Abbreviations: P – Patient; BMI – body mass index; CABG – coronary artery bypass graft surgery; AVR – aortic valve replacement.

In regard to the preoperative hospitalization, all patients who had mediastinitis stayed less than 3 days in the ICU, as well as also used mechanical ventilation for less than 3 days in the postoperative period. And of the patients who underwent CABG, in all of them, the mammary artery was used for making a bypass.

## DISCUSSION

The male gender was more frequent among the studied patients, and at higher risk of mediastinitis, probably due to the higher tension of the sternal wound in men.<sup>10,13</sup> As in the present study, there was a higher incidence of mediastinitis in male patients.

The risk of mediastinitis increases with age. Patients over 70 years old have a higher incidence of mediastinitis when compared to others.<sup>10,20</sup> Contradictory to this, of the patients who presented mediastinitis in this study, only one, a female, was over 70 years old, the other 3 patients were in the age group from 50 to 59 years old.

Observing the obesity, although obese patients are not the majority in this research, they represent a high percentage taking into account the high risk of developing mediastinitis in obese patients, and one patient who presented mediastinitis was obese.

It is noteworthy that the increase in mechanical load in the postoperative period can facilitate local contamination by bacteria. Furthermore, obesity can make it difficult to adjust antibiotic doses to body mass, consequently leading to low tissue concentration of the antibiotic.<sup>8,14,15</sup> Weight reduction in obese patients in the preoperative period may be a strategy adopted to prevent this type of infection.<sup>16</sup>

The most frequent comorbidity found among patients during the study was diabetes mellitus, which corresponds to the literature, and was also the most recurrent comorbidity among patients who had postoperative mediastinitis. Diabetes mellitus, an important factor for the development of mediastinitis, is considered a modifiable factor, since with strict control of blood glucose in the perioperative period it minimizes the occurrence of mediastinitis.<sup>8,17</sup>

Hyperglycemia promotes the proliferation of pathogens, impairing the function of neutrophils. The optimization of preoperative levels of glycosylated hemoglobin and blood glucose results in good results and a reduction in sternal wound infections, mediastinitis, in patients who underwent cardiac surgery.<sup>21</sup>

Smoking also appears with a high percentage among the patients studied and is also considered a modifiable risk factor. Nicotine delays the healing of primary wounds, being an important risk factor for the occurrence of dehiscence of the median sternotomy. Nevertheless, there are studies that address that smoking termination during 4 weeks before surgery reduces the risk of infection of the surgical site.<sup>16</sup>

Coronary artery bypass graft surgery was the most performed surgery in the studied period, representing 66.66% of the patients (**Figure 2**) and, consequently, the surgery that most presented postoperative cases of mediastinitis. Also having a high percentage of use of the mammary artery for making the myocardial bypass.

Studies point to the mammary artery as the “gold standard” graft for coronary artery bypass graft surgery, mainly for making bypasses to the anterior descending coronary artery, as it improves patient survival, decreases the incidence of recurrent angina, acute late myocardial infarctions and the need for repeated revascularization, as they provide a better graft permeability compared to the bypass using the saphenous vein.<sup>13,14,16</sup> Which justifies this high percentage of patients who had bypasses made with mammary artery.

Nonetheless, the use of a mammary artery graft is an important risk factor for the development of mediastinitis, especially when both are used. And strategies to reduce the risk of infection after using mammary arteries can be adopted, such as avoiding a long intraoperative period (>7h), avoiding the need to use an intra-aortic balloon, preventing the patient from presenting low cardiac output in the postoperative period, among others.<sup>13</sup>

Preoperative hospitalization in an ICU and use of mechanical ventilation in the postoperative period, both longer than 3 days, also increase the risk for the development of mediastinitis.<sup>8-10</sup> In **Figure 3**, it can be seen that the greater most patients are within the time limit for these two variables, making them good indicators for preventing mediastinitis.

Surgical re-approach, another important factor for the development of mediastinitis, obtained a small rate among the patients in the study, only 3.64%, and also represents a good indicator. Surgical re-approach due to acute bleeding in the immediate postoperative period has also been associated with mediastinitis. Studies indicate that

the surgical re-approach in the immediate postoperative period increases the risk of mediastinitis and death.<sup>8,18</sup>

The lack of registration or precariousness of the records in medical records were limiting factors for carrying out the research, some data were missing due to the absence of recorded information, and the data regarding the time of surgery and functional class (New York Heart Association) had to be excluded from the research, since few medical records contained this information. Hence, it was possible to underline the importance of the medical record by the multidisciplinary team.

## FINAL CONSIDERATIONS

The most frequent risk factors for mediastinitis identified during this research were male gender, diabetes mellitus, smoking, and use of the mammary artery for making myocardial bypass. The profile of the patients studied was mostly male, within the age group from 50 to 69 years old, overweight and who had at least one comorbidity related to the development of mediastinitis, which coincides with the profile of patients who had postoperative mediastinitis, in which the majority were male and had diabetes mellitus, as preoperative risk factors.

The identification of these factors can contribute to the development of prevention strategies for mediastinitis, as well as in the implementation of nursing care in both pre and postoperative periods of cardiac surgery in order to avoid the incidence of this type of infection.

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