

# CUIDADO É FUNDAMENTAL

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RESEARCH

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## RISK OF MEDIASTINITIS IN THE POSTOPERATIVE PERIOD OF CORONARY ARTERY BYPASS GRAFT SURGERY

*Risco de mediastinite no pós-operatório de cirurgia de revascularização do miocárdio**Riesgo de mediastinitis en el postoperatorio de cirugía de revascularización miocárdica***Rafaela Dias Coloni Morelato<sup>1</sup>** **Silvia Rita Marin da Silva Canini<sup>1</sup>** **Helen Francine Rodrigues<sup>1</sup>** **Fabiana Bolela<sup>1</sup>** **Suellen Rodrigues de Oliveira Maier<sup>1</sup>** **Carina Aparecida Marosti Dessotte<sup>1</sup>** 

### ABSTRACT

**Objective:** to classify patients according to the risk of developing mediastinitis in the postoperative period of Coronary Artery Bypass Graft Surgery. **Method:** observational, cross-sectional study, carried out in the Post-Operative Intensive Care Unit of a university hospital in the interior of São Paulo. Consecutive and non-probabilistic sample consisted of adult patients who underwent myocardial revascularization. Data collection was performed at discharge from the Intensive Care, using the Multivariable Risk Score for Mediastinitis. To obtain the score, descriptive statistical analyzes were performed. **Results:** the 50 patients participated in the study, 68% were male, with a mean age of 62.7 years. No patient was reoperated or had chronic obstructive pulmonary disease; 26.0% were obese; 12.0% had unstable angina and 4.0% were transfused in the postoperative period. According to the score, 58.0% had a low and 42.0% medium risk of developing mediastinitis. **Conclusion:** most patients were at low risk of developing mediastinitis.

**DESCRIPTORS:** Mediastinitis; Cardiac surgical procedures; Chronic disease; Perioperative nursing.

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## RESUMO

**Objetivo:** classificar os pacientes segundo o risco de desenvolvimento de mediastinite no pós-operatório de cirurgia de revascularização do miocárdio. **Método:** estudo observacional, transversal, realizado na Unidade de Terapia Intensiva Pós-Operatória de um hospital universitário no interior paulista. Amostra consecutiva e não probabilística foi constituída por pacientes adultos, submetidos à revascularização do miocárdio. A coleta de dados foi realizada na alta da Terapia Intensiva, utilizando o Escore de Risco Multivariável para Mediastinite. Para a obtenção do escore foram realizadas análises estatística descritivas. **Resultados:** participaram do estudo 50 pacientes, 68% do sexo masculino, com média de idade de 62,7 anos. Nenhum paciente foi reoperado ou apresentava doença pulmonar obstrutiva crônica; 26,0% eram obesos; 12,0% apresentaram angina instável e 4,0% foram politransfundidos no pós-operatório. Segundo o escore, 58,0% apresentaram baixo e 42,0% médio risco de desenvolvimento de mediastinite. **Conclusão:** a maior parte dos pacientes apresentava baixo risco de desenvolvimento de mediastinite.

**DESCRITORES:** Mediastinite; Procedimentos cirúrgicos cardíacos; Doença crônica; Enfermagem perioperatória.

## RESUMEN

**Objetivo:** clasificar a los pacientes según el riesgo de desarrollar mediastinitis en el postoperatorio de cirugía de revascularización miocárdica. **Método:** estudio observacional, transversal, realizado en la Unidad de Cuidados Intensivos Posoperatorios de un hospital universitario del interior de São Paulo. La muestra consecutiva y no probabilística estuvo constituida por pacientes adultos sometidos a revascularización miocárdica. La recolección de datos se realizó al alta de la Unidad de Cuidados Intensivos, utilizando el Multivariable Risk Score para Mediastinitis. Para obtener la puntuación se realizaron análisis estadísticos descriptivos. **Resultados:** participaron en el estudio 50 pacientes, el 68% eran varones, con una edad media de 62,7 años. Ningún paciente fue reintervenido ni presentó enfermedad pulmonar obstructiva crónica; El 26,0% eran obesos; El 12,0% presentó angina inestable y el 4,0% recibió transfusión en el postoperatorio. Según el puntaje, el 58,0% tenía un riesgo bajo y el 42,0% medio de desarrollar mediastinitis. **Conclusión:** la mayoría de los pacientes tenían un riesgo bajo de desarrollar mediastinitis.

**DESCRIPTORES:** Mediastinitis; Procedimientos quirúrgicos cardíacos; Enfermedad crónica; Enfermería perioperatoria.

## INTRODUCTION

Numerous advances have occurred in healthcare-related infection control practices, but surgical site infection remains one of the most frequent complications in surgical patients. In relation to cardiac surgeries, the occurrence of surgical site infection increases healthcare-related costs, the length of hospital stay, and the mortality rate.<sup>1-2</sup>

Mediastinitis is a severe complication that can occur after cardiac surgery, including coronary artery bypass graft surgery. It is classified as an organ/space type surgical site infection and is diagnosed in the presence of fever (>38°C), evidence on anatomical or histopathological examination, positive culture of mediastinal tissue or fluid, sternal instability, chest pain, mediastinal enlargement on imaging examination, with purulent drainage from the mediastinal area.<sup>3</sup>

The incidence of postoperative mediastinitis ranges from 0.4 to 5% and is present in 1 to 2% of patients undergoing cardiac surgeries, with high mortality rates ranging from 14 to 47%. Most studies investigating the risk factors for the development of perioperative mediastinitis in cardiac surgeries were conducted with patients undergoing different cardiac surgeries simultaneously.<sup>4-7</sup>

Given the difference in profile between patients with coronary artery disease, candidates for coronary artery bypass grafting and those with valve disease who will undergo correction surgery, the evaluation of risk factors should be performed according to the underlying disease, in an individualized manner.

On this line, a risk score was created for the development of mediastinitis in patients undergoing exclusively coronary artery bypass graft surgery, called Multivariable Risk Score for Mediastinitis.<sup>4</sup>

In 2017, a study was conducted with the aim of testing the applicability of the aforementioned score in patients undergoing coronary artery bypass graft surgery in a cardiology referral hospital in Rio Grande do Sul. Through the evaluation of 1,322 medical records of patients undergoing CABG surgery, the authors concluded that the instrument proved to be useful to assist in preoperative assessment of the risk of mediastinitis in this population. However, considering the importance of prevention and early treatment of this postoperative infectious complication, it was considered important to apply the instrument in the postoperative setting.<sup>8</sup>

Considering the impact of mediastinitis on patient morbidity and mortality and the consequent increase in healthcare costs, the present study aimed to classify patients according to the risk of developing mediastinitis in the postoperative period of coronary artery bypass graft surgery, in order to obtain results that may support the proposition of protocols for the prevention of this complication.

## METHOD

This is a cross-sectional, descriptive observational study conducted in a Postoperative Intensive Care Unit of a university hospital in the interior of São Paulo.

A non-probabilistic and consecutive sample was composed of patients who met the inclusion criteria: older than 18 years of age, who underwent coronary artery bypass graft surgery, regardless of being the first surgery or reoperation. Patients who did not present cognitive conditions to participate in the interview were excluded.

In the period of data collection, from January 2017 to July 2019, 373 cardiac surgeries were performed, of which 207 (55.5%) were surgeries to correct valve diseases (repair/replacement), 111 (29.7%) coronary artery bypass graft surgeries, 34 (9.2%) surgeries to correct aortic diseases (dissection/aneurysm) and 21 (5.6%) surgeries to correct congenital heart disease.

The cognitive conditions of the patients were evaluated through six questions, four of which were adapted from an instrument available in the literature that comprised: What is your age?, What is today's date?, What is the name of the place where we are at this moment?, What day of the week are we?; and two were prepared by the researchers: What is the name of the city where you were born? and What is your full name?<sup>9</sup> The participants were excluded from the study when they made a mistake or were unable to inform three or more questions. After the verification of cognitive conditions only 50 patients were included in the final sample, because they agreed to participate in the study.

Data collection was performed postoperatively, when the patient was discharged from the Postoperative Intensive Care Unit, by means of individual interviews and later consultation of the participants' medical records.

An instrument was created containing the sociodemographic and clinical variables: dates of hospitalization, of the interview and of birth; gender; marital status; education and professional status; family monthly income; main diagnosis of coronary artery disease; comorbidities (dyslipidemia, hypothyroidism, diabetes mellitus, acute or chronic renal failure, arrhythmias, systemic arterial hypertension and chronic obstructive pulmonary disease (COPD), arrhythmias); weight and height (for the calculation of the body mass index); life habits (smoking) and number of surgeries. The patients' weight and height were collected from the patient's medical chart on the day before the cardiac surgery. This collection was possible because it is a routine of the institution to measure these variables daily, with the patient fasting.

To assess the risk of developing postoperative mediastinitis, the Multivariable Risk Score for Mediastinitis was used.<sup>4</sup> The instrument is composed of five variables, and each variable, when present, imputes a value in the score, namely: surgical reintervention (three points), Chronic Obstructive Pulmonary Disease (COPD) (two points), obesity (two points), Angina class IV/Unstable (one point) and Polytransfusion (postoperative) (one point), totaling nine points.

Data regarding surgical reintervention, presence of comorbidities, COPD, diagnosis of coronary artery disease (Angina class IV/unstable), and polytransfusion were collected from the patient's medical record. It is worth mentioning that the infusion of three or more red blood cell concentrate bags in the postoperative period was considered a multiple transfusion, according

to the index authors' orientation. For obesity it was considered the body mass index (BMI)<sup>4</sup> above 30 Kg/m<sup>2</sup>.

The instrument used was developed based on variables based on the literature as mediastinitis predictors and on the authors' clinical practice, patients may receive a score of "0" (zero) classified as low risk, score "1 (one) or 2 (two)" medium risk, "3 (three) or 4 (four)" high risk and "5 (five) or more" very high risk.<sup>4</sup>

Data were entered into the IBM-SPSS Program, version 22.0 for Windows (SPSS, Inc., Chicago, IL, USA), for descriptive analysis of the study variables. We performed simple frequency analysis for nominal or categorical variables, and central tendency (mean and median) and dispersion (standard deviation) analysis for continuous variables.

This study followed the precepts of National Health Council Resolution 466/12 and was approved by the Research Ethics Committee of the Ribeirão Preto School of Nursing of the University of São Paulo, under opinion no. 2,372,602/2017 and number Certification of Ethics Submission and Appreciation no. 75607317.8.0000.5393. The patients were invited to participate in the research and, after consent, received two copies of the Informed Consent Form, and after reading and signing, they kept one copy and the other was filed by the researcher.

## RESULTS

For the characterization of eligible patients, the sociodemographic variables were presented in Table 1.

Most participants were male, married and inactive at the time of hospitalization for CABG. Moreover, the mean age was 62.73 years (SD=10.8), with patients presenting a mean education of 6.22 years and a mean monthly income of a little over three minimum wages.

Table 2 shows the clinical characterization of the participants, which classifies the type of CAD, the existence of comorbidities and smoking.

Part of the patients presented previous acute myocardial infarction, followed by stable angina. Regarding comorbidities, most participants already had systemic arterial hypertension, dyslipidemia and Diabetes Mellitus.

The mean BMI of the patients was 28.2 (SD=3.9). All patients who participated in the study underwent their first coronary artery bypass graft surgery, electively. Only one patient (2%) did not use cardiopulmonary bypass during surgery.

Regarding the descriptive results of the risk score variables, no patient evaluated presented surgical reintervention and chronic obstructive pulmonary disease, while 13 (26.0%) presented obesity, six (12.0%) presented class IV/unstable angina and two (4.0%) presented polytransfusion in the postoperative period.

It is worth mentioning that of the 50 participants, the diagnosis of coronary artery disease was not present in 15 (30.0%) patients. Thus, to calculate the final score, we considered "0 points" for patients who did not have the classification of coronary artery disease described in the medical record, since it was not possible to assign the score for the item class IV/unstable angina.

The risk classification for the development of mediastinitis of the approached patients is shown in Table 3.

Most participants presented low risk of developing mediastinitis in the postoperative period of coronary artery bypass grafting. It is noteworthy that the variables that score highest for a worse risk classification of patients did not occur with the participants, namely surgical reintervention (three points) and COPD (two points). No patient received higher scores indicating high risk or very high risk.

## DISCUSSION

Returning to the main results presented herein, most participants presented low risk of developing mediastinitis in the postoperative period of coronary artery bypass graft surgery. An important fact to be considered was that there is no urgency and emergency cardiology service available in the institution where the present study was conducted. In this service, cardiac surgeries occur from Monday to Friday during business hours, and urgent and emergency cases are referred to other hospitals in the city and abroad.

On the other hand, researches developed with this population have reiterated the severity of these patients, even with the surgeries taking place in an elective manner, namely: elderly; a large portion with a diagnosis of recent acute myocardial infarction; hypertension, obesity, diabetes mellitus, dyslipidemia, and smoking.<sup>10</sup>

With regard to the profile of patients undergoing coronary artery bypass grafting, most patients were male, data corroborated by other authors.<sup>4,8,11</sup> Although gender is not part of the risk score used, male gender can be considered an independent risk factor in the onset of mediastinitis. A possible explanation is related to the anatomical aspects of the male thorax, which has hair follicles in the region of the sternotomy, i.e., a greater amount of hair that, if not removed in the immediate preoperative period or if removed inadequately, may favor the growth of microorganisms and, consequently, predispose to the occurrence of bacterial infection.<sup>6</sup>

The mean age found was above 60 years, can also be observed in other studies performed with patients undergoing coronary artery bypass grafting.<sup>8,12-13</sup>

Comparing the presence of comorbidities of patients in the present study, other studies developed with the same public also identified that hypertension was the most frequent comorbidity, ranging from 82.8% to 89.9%, data that corroborate with the study carried out in a capital city in the northeast of Brazil, in which all patients (100%) submitted to coronary artery bypass grafting presented systemic arterial hypertension.<sup>13-15</sup>

Regarding dyslipidemia, our results differed from data found in another research, in which 96% of patients undergoing coronary artery bypass grafting presented comorbidity preoperatively.<sup>15</sup> However, they corroborated with the percentages found in other research, in which the frequency ranged from 41.1% to 44.5%.<sup>13-14</sup>

**Table 1** – Sociodemographic characterization of the participants. Ribeirão Preto, SP, Brazil, 2017-2019

Variable	Mean (SD)*	n (%)
Gender		
Male		34 (68)
Female		16 (32)
Age	62,73 (10,8)	
Marital status		
Married/Consensual Union		30 (60)
Separated		13 (26)
Widower		4 (8)
Single		3 (6)
Education (complete years)	6,22 (4,6)	
Monthly Income (in Reais)	3.833,10 (5.784,6)	
Professional Status		
Inactive		35 (70)
Active		15 (30)

Mean (SD)\*: Mean (Standard deviation)

**Table 2** – Clinical characterization of the participants. Ribeirão Preto, SP, Brazil, 2017-2019

Variable	n (%)
Classification of Coronary Artery Disease	
Previous Acute Myocardial Infarction	11 (22)
Stable Angina	10 (20)
Recent Acute Myocardial Infarction	8 (16)
Unstable Angina	6 (12)
Not described in the medical record	15 (30)
Comorbidities	
Systemic Arterial Hypertension	39 (78)
Dyslipidemia	24 (48)
Diabetes Mellitus	22 (44)
Obesity	13 (26)
Hypothyroidism	6 (12)
Chronic Renal Insufficiency	5 (10)
Smoking	
Previous	33 (66)
Current	6 (12)
Never smoked	11 (22)

**Table 3** – Risk score classification for mediastinitis of the 50 participants. Ribeirão Preto, SP, Brazil, 2017-2019

Variables	n (%)
Low risk	29 (58)
Medium risk	21(42)

Results of studies with patients undergoing coronary artery bypass grafting showed similar data with a variation of comorbidities (hypertension and diabetes mellitus) between 25% and 45.2%.<sup>11,14</sup> It is noteworthy that currently, as a routine in the Postoperative Intensive Care Unit, a continuous intravenous infusion of regular insulin is used when capillary blood glucose levels remain above 180 mg/dL, aiming to maintain blood glucose levels around 100 mg/dL.

We also found a large number of smokers in the present study. This data is not similar to most other results available in the literature, in which the percentages found were lower, ranging from 8% to 32.2%.<sup>11,13-14</sup> Only one study presented similar results in which the authors identified that 64%, i.e., most patients were smokers. Smoking is considered a risk factor for the development of mediastinitis.

Regarding the use of predictor scores in the health area, it is observed that the use of risk classification scores of postoperative complications of cardiac surgeries has occurred since the late 1980s; however, until now, there is no consensus on the best method to assess the risk of complications and death.<sup>16</sup> However, it is believed that knowing the potential risk factors and preventing them, since the preoperative period, may favor the postoperative evolution of these patients, facing the preventive measures and early detection of mediastinitis.

For the development of the score, the variables included were gender, age, functional class of heart failure according to the criteria of the New York Heart Association, chronic renal failure, history of diabetes mellitus, COPD, hypertension, obesity (BMI  $\geq 30\text{kg/m}^2$ ), left ventricular ejection fraction, class IV stable and unstable angina, surgical priority (elective, urgent or emergency), previous cardiac surgery, CPB time greater than 120 minutes, postoperative blood polytransfusion (three or more bags of packed red blood cells), and need for a new surgical approach. After backward multiple logistic regression, the score was composed by the variables COPD, obesity, postoperative multiple blood transfusion, need for surgical reintervention, and class IV/unstable angina, and the patient could be classified as low, medium, high, or very high risk of developing mediastinitis.<sup>4</sup>

The "Multivariable Risk Score for Mediastinitis" was used in a study in which the researchers concluded that it was useful to assist in the preoperative evaluation by indicating the risk of mediastinitis in this population of critically ill patients.<sup>8</sup>

The results from the use of the "Multivariable Risk Score for Mediastinitis", identified low and medium risk for the development of mediastinitis, were divergent from the results of a study conducted in southern Brazil, which found that 29.1% presented low risk; 49.3% medium risk; 19.4% high risk, and 2.3% very high risk.<sup>8</sup>

The first consideration to be made refers to the number of patients evaluated, which may have influenced the difference. Another characteristic to be noted is that in the institution where the present study was developed, there is no urgency and emergency cardiology service, and this information is not present in the other article.<sup>8</sup> However, a concordance can be observed in

the results, since most patients in both studies were classified as low or medium risk for developing mediastinitis.<sup>8</sup>

In view of these contextualizations, it is considered necessary to perform the classification of patients in order to contribute to reducing the risk of developing mediastinitis in the postoperative period of coronary artery bypass graft surgery and, in the future, in the construction of a protocol that contributes to the prevention of this complication in this population.

One of the main limitations of the study refers to the number of participants in this research. Even though the period of data collection extended over two years and two months, a small number of coronary artery bypass grafting surgeries were performed in the period, differing from the prediction made based on previous years. This was due to the hospital going through constant changes, mainly because of the reduction of human resources (such as anesthesiologists and nursing staff), which has directly affected the number of surgeries performed.

In addition, data collection was carried out in a period after the structural reform of the Post-Operatory Unit, which was previously exclusive for patients submitted to heart and thoracic surgery. After the reform, it became a Post-Operative Intensive Care Unit, receiving patients from various specialties, causing lack of beds and, sometimes, culminating with the cancellation of cardiac surgeries, such as coronary artery bypass graft surgery.

Another limitation to be highlighted was the lack of description of the diagnosis of coronary artery disease in some medical records. The lack of this information for some patients may have contributed to an underestimation of the results found, since the presence of class IV/unstable angina adds one point to the final score, which may be related to the low and medium risk of mediastinitis.

It is believed that the results of this research may support the creation of a protocol for the prevention of mediastinitis in the Postoperative Intensive Care Unit and, after the implementation of this protocol, it will be possible to perform new longitudinal researches, comparing the prevalence and incidence of mediastinitis before and after the implementation of the protocol.

## CONCLUSION

It is concluded that most patients evaluated by the "Multivariable Risk Score for Mediastinitis" presented low risk of developing mediastinitis in the postoperative period of coronary artery bypass grafting. It is noteworthy that the variables that score highest for a worse risk classification of patients did not occur with the participants, namely surgical reintervention (three points) and chronic obstructive pulmonary disease (two points).

It is believed that the implementation of a mediastinitis prevention protocol may subsidize the better evaluation of the risk of mediastinitis development and help summarizing data that may subsidize new researches with more robust methods, comparing the prevalence and incidence of mediastinitis before and after the protocol implementation.

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