

RISK FACTORS FOR SURGICAL SITE INFECTIONS IN CARDIOVASCULAR SURGERY

FACTORES DE RIESGO PARA INFECCIONES QUIRÚRGICAS DEL SITIO EN CIRUGÍA CARDIOVASCULAR

FATORES DE RISCO PARA INFECÇÕES DE SÍTIO CIRÚRGICO EM CIRURGIAS CARDIOVASCULARES

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ABSTRACT

Introduction: Surgical Site Infection is classified as Healthcare-Associated Infections that can reach superficial or deep layers of the incision, organs or spaces that have been manipulated or traumatized. It is associated with increased morbidity and mortality and hospital costs. **Objective:** To identify risk factors for the onset of Surgical Site Infection in cardiovascular surgery. **Method:** This is a documentary, retrospective and quantitative study of hospital axis based on the database related to the Health Surveillance Unit of a University Hospital in which we sought to compare data from the first semester of the year 2023 and the first semester of 2024. **Results:** We included 211 clean cardiovascular surgeries, of which 97 occurred in the first half of 2023 and 114 in the first half of 2024. Of these, 24 surgical procedures (11.3%) presented Surgical Site Infection in 24 different patients, of which 13 were male (54.2%) and 11 were female (45.8%), with a mean age of 62 years and an age range from 18 to 92 years. **Conclusion:** Therefore, the variables hypertension and diabetes mellitus were not statistically significant enough to be considered risk factors for Surgical Site Infection in clean cardiovascular surgery.

Keywords: Surgical Wound Infection; Patient Safety; Cross Infection.

RESUMEN

Introducción: La Infección del Sitio Quirúrgico se clasifica como Infección Relacionada con la Asistencia Sanitaria, que puede alcanzar capas superficiales o profundas de la incisión, órganos o espacios que han sido manipulados o traumatizados. Está asociada al aumento de la morbilidad y la mortalidad y de los costos hospitalarios. **Objetivo:** Identificar factores de riesgo para el inicio de la infección quirúrgica en cirugía cardiovascular. **Método:** Se trata de un estudio documental, retrospectivo y cuantitativo del eje hospitalario basado en la base de datos relacionada con la Unidad de Vigilancia de la Salud de un Hospital Universitario en el que buscamos comparar datos del primer semestre del año 2023 y el primer semestre de 2024. **Resultados:** Incluimos 211 cirugías cardiovasculares limpias, 97 ocurrieron en la primera mitad de 2023 y 114 en la primera mitad de 2024. De esto, 24 procedimientos quirúrgicos (11,3%) presentaron Infección del Sitio Quirúrgico en 24 pacientes diferentes, de los cuales 13 eran hombres (54,2%) y 11 mujeres (45,8%), con una edad media de 62 años y una variación de edad de 18 a 92 años. **Conclusión:** Por lo tanto, las variables hipertensión y diabetes mellitus no fueron estadísticamente significativas para ser consideradas factores de riesgo para Infección del Sitio Quirúrgico en cirugía cardiovascular limpia.

Palabras clave: Infección de La Herida Quirúrgica; Seguridad del Paciente; Infección Hospitalaria.

RESUMO

Introdução: A Infecção de Sítio Cirúrgico é classificada como Infecção Relacionada à Assistência à Saúde que pode atingir camadas superficiais ou profundas da incisão, órgãos ou espaços que foram manipulados ou traumatizados. Ela é associada ao aumento da morbimortalidade e elevação de custos hospitalares. **Objetivo:** Identificar os fatores de risco para o surgimento de Infecção de Sítio Cirúrgico em cirurgia cardiovascular. **Método:** Trata-se de um estudo documental, retrospectivo e quantitativo de eixo hospitalar, que teve como base o banco de dados referentes à Unidade de Vigilância em Saúde de um Hospital Universitário, em que se buscou comparar dados do primeiro semestre do ano de 2023 e do primeiro semestre de 2024. **Resultados:** Incluíram-se 211 cirurgias cardiovasculares limpas, 97 ocorreram no primeiro semestre do ano de 2023 e 114 no primeiro semestre de 2024. Disso, 24 procedimentos cirúrgicos (11,3%) apresentaram infecção do sítio cirúrgico em 24 pacientes distintos, dos quais 13 eram do sexo masculino (54,2%) e 11 eram do sexo feminino (45,8%), com média das idades de 62 anos e com variação de idade de 18 a 92 anos. **Conclusão:** Portanto, as variáveis hipertensão e diabetes mellitus não apresentaram, estatisticamente, significância suficiente para serem consideradas fatores de risco para infecção do sítio cirúrgico em cirurgia cardiovascular limpa.

Palavras-chave: Infecção da Ferida Cirúrgica; Segurança do Paciente; Infecção Hospitalar.



INTRODUCTION

Surgical Site Infections (SSIs) are classified as Healthcare-Associated Infections (HAIs) that can reach superficial or deep layers of the incision, organs, or spaces that were manipulated or traumatized. They are associated with increased morbidity and mortality and increased hospital costs, in addition to the emotional and physical suffering of the affected patient due to prolonged hospitalization⁽¹⁾.

SSIs are complications that pose a major challenge to public health in Brazil. In the city of Três Pontas, in the state of Minas Gerais, from January 2020 to July 2023, there were 73 cases among 3544 orthopedic surgeries performed⁽²⁾, while in Brazil they represent one of the main current HAIs, with a prevalence of 14% to 16% among hospitalized patients⁽³⁾. A study revealed that patients with SSI had average hospital costs for antibiotics of \$2,680.88, in addition to a significantly longer hospital stay⁽⁴⁾.

Endogenous and exogenous factors can influence the establishment and severity of the infectious process. Diabetes mellitus (DM), obesity, malnutrition, extremes of age, and smoking are the main risk factors, classified as endogenous, associated with an increased incidence of SSI, which should preferably be identified in the immediate preoperative period⁽⁵⁾.

According to the Brazilian Health Regulatory Agency (ANVISA), SSIs can occur in surgeries with or without implants and in inpatients or outpatients. In accordance with ANVISA, the Centers for Disease Control and

Prevention (CDCs) define the types of SSIs: skin, tissue, organ and cavity, which cause, among other signs and symptoms, fever, perioperative pain, edema, redness in the surgical incision, and discharge from the surgical wound^(6,5).

Regarding surgeries, SSIs can be classified, according to Consultation Opinion No. 006/2015 of the Regional Medical Council of Espírito Santo, into 4 types: Clean; Potentially Contaminated; Contaminated; and Infected. Regarding clean surgery, in which cardiac surgery falls, it is characterized by surgical incisions in sterile or decontaminated tissues, in the absence of local infectious and inflammatory processes⁽⁸⁾.

SSIs commonly occur in low- and middle-income countries, but to a lesser extent, they also appear in richer countries in Europe and in the United States⁽¹⁾.

The most common type of adverse event, which is an incident that results in unintentional harm to a patient during healthcare, in hospitals in Spain, was SSI⁽⁹⁾. In Brazil, in turn, SSIs rank third among infections in health services⁽¹⁰⁾. SSIs remain one of the main causes of HAIs in the country, ranking third and leading the risks to patient safety⁽⁷⁾. In line with this study, SSIs related to implant insertion stand out, which are growing due to the aging of the Brazilian population and the improvement of health services.

More regionally, the state of Piauí, which has several large public and private hospitals, as well as several other smaller hospitals spread

across numerous municipalities, presents important data on the predominance of SSIs in services. For example, in 2023, ANVISA, through the Report on HAIs and Antimicrobial Resistance in Health Services, highlighted that the state of Piauí registered the following incidence densities of SSI: Caesarean section (0.7%), breast implants (4.4%), and hip replacement (5.8%)⁽¹⁰⁾.

Therefore, given the alarming presence of SSIs throughout Brazil and, especially, in Teresina, this study is relevant due to the need to understand what the possible risk factors for SSI are, at the University Hospital of the Federal University of Piauí (HU-UFPI), in cardiovascular surgery. Although the low incidence of SSI in patients undergoing cardiac surgery has been observed in the literature, evidence suggests that when the outcome is negative, it can be fatal, which contributes to increased morbidity and mortality⁽¹¹⁾.

Understanding these risk factors will allow the creation of assertive and targeted SSI prevention strategies for each group of patients with a given risk factor. Furthermore, this research seeks to contribute to the expansion of the analysis of data on surgical site infections in Piauí, with a view to providing a situational diagnosis of healthcare-associated infections in the State.

OBJECTIVE

To identify the risk factors for the emergence of SSI in patients undergoing cardiovascular surgery.

METHOD

This is a documentary and retrospective quantitative study based on the secondary database relating to the Health Surveillance Unit and sought to compare data from the first half of 2023 and the first half of 2024.

Data were collected from hospital records of the Healthcare-Associated Infection Control Service, of the Health Surveillance Unit (UVS), of a large University Hospital in northeastern Brazil. This research was guided by the tool *Strengthening the Reporting of Observational Studies in Epidemiology* (STROBE).

A total of 325 medical records corresponding to the first half of 2023 and the first half of 2024 were accessed. This universe is related to the total number of hospitalizations in this period listed; therefore, to establish the sample, a census survey of the aforementioned years was used.

The HU-UFPI Health Surveillance Unit is part of the hospital's Quality Management Sector. The research site is part of the health care network of the State of Piauí as a reference high-complexity facility; it provides outpatient and inpatient services in orthopedics, cardiology, cardiovascular surgery, neurosurgery, oncology, gastroenterology, and digestive system surgery, being a state reference in these specialties.

The Surgical Suite (SS) of the study hospital has 10 operating rooms, in which cardiovascular surgeries are performed, such as pacemaker implantation, myocardial revascularization, heart valve implantation,



exploratory thoracotomy, aortic root reconstruction with a valved conduit, valve prosthesis implantation, transvenous dual-chamber cardioverter-defibrillator implantation, and ascending aorta replacement⁽¹²⁾.

The inclusion criteria were: presenting a thoroughly fulfilled electronic medical record, being over 18 years old, having undergone cardiovascular surgery during the period mentioned, and presenting medical records available for analysis. The exclusion criteria were: incomplete medical records, being under 18 years of age, or having presented SSI in a location other than cardiovascular surgery.

To evaluate the surgery listed for each case, the checklist safe surgery performed by the Patient Safety Unit (NSP) of the hospital institution studied⁽¹³⁾ was used.

The collection period was from April 2024 to May 2024, the space of the Health Surveillance Unit of the aforementioned study hospital was used, based on the participation of extension workers from the extension project “Good Practices for Patient Safety and Quality of Care” of the Federal University of Piauí.

The data used from medical records were: presence of SSI from clean cardiovascular surgery performed at the SS; previous HAIs; sex; age; presence of comorbidities, such as DM, arterial hypertension and obesity, the latter being acquired through the Body Mass Index (BMI), which followed the classification of the Brazilian Association of Nutrology (ABRAN).

This collected information was entered in an Excel spreadsheet and the collected data were

imported into the R software, version 4.1.1, with the aim of analyzing the statistics based on descriptive and inferential principles. The significance level adopted was 5%. After checking and cleaning the database, analyses were performed using simple descriptive statistics, with distribution of absolute and relative frequencies and measures of central tendency. Furthermore, Fisher's exact test and Chi-square test were performed to assess the association between the presence of comorbidities/risk factors mentioned and the incidence of SSI, as well as the Mann-Whitney test for quantitative variables.

This study is part of a matrix research entitled “Evaluation of healthcare-associated infections by multidrug-resistant bacteria in a university hospital in the Northeast”. The Project followed all the ethical principles guiding research involving human beings, as set out in Resolution No. 466/2012⁽¹⁰⁾. This research was approved by the Ethics Committee of the University Hospital of the Federal University of Piauí, with opinion No. 4,852,2505 and CAEE 46437921.3.0000.8050.

RESULT

The sample studied included 211 (100%) clean surgeries, of which 97 (46%) occurred in the first half of 2023 and 114 (54%) in the first half of 2024, in the cardiovascular medical specialty. This temporal delimitation occurred due to the unavailability of the complete consolidation of the subsequent months until the time of data collection. Of the total procedures

analyzed, 24 (11.3%) surgical procedures presented SSI and occurred with 24 different patients, of which 13 (54.2%) were male and 11 (45.8%) were female, with an average age of approximately 62 years and an age range of 18 to 92 years.

Regarding the total value of SSIs recorded in the cardiovascular specialty, 03 (12.5%) occurred in the first half of 2023, while the remaining 21 (87.5%) occurred in the first half of 2024.

The infection rate by specialty, which is the ratio between the number of existing SSIs and the number of clean surgeries performed in the same period, was calculated during the months of January to June 2023 and 2024. In 2023, the infection rate in the cardiovascular specialty ranged from 0% to 9%, while in 2024 it ranged from 5.8% to 61.5%, as shown in Table 1.

Table 1 - Number of Surgical Site Infections, Clean Surgeries and Hospital Infection Rate by Surgical Specialty from January to June 2023 and 2024, Brazil, 2024.

Month	Total number of cardiac surgeries		SSI Cardiovascular	
	2023	2024	2023	2024
January	17	14	0 (0%)	5 (35,7%)
February	11	14	1 (9%)	1 (7.1%)
March	23	17	0 (0%)	1 (5.8%)
April	16	13	1 (6.25%)	8 (61.5%)
May	11	18	1 (9%)	2 (11.1%)
June	16	17	0 (0%)	4 (23.5%)

Source: UVS/ HU-UFPI

The statistical tests performed to evaluate the association between specific comorbidities - DM, Obesity and Systemic Arterial Hypertension (SAH) - and Smoking with SSI revealed the following results: no statistically significant association was observed between DM and SSI ($p = 0.5273$), Obesity and SSI (p -

$value = 0.7315$), Smoking and SSI (p -value = 0.1331), nor between SAH and SSI (p -value = 0.2656). These findings indicate that, based on the data analyzed, none of the variables investigated presented a statistically significant correlation with the occurrence of SSI.

Table 2 - Analysis of the association between comorbidities (obesity, DM and SAH) and incidence of Surgical Site Infection, Brazil, 2024.

Variables/SSI	Yes (%)	No (%)	Total	p value
OBESITY				
No	21	167	188	0.7315
DM				
Yes	9	54	63	0.5273
No	15	133	148	
SAH				
Yes	22	149	171	0.2656
No	2	38	40	
SMOKING				
Yes	4	14	18	0.1331
No	20	172	192	

Source: UVS/ HU-UFPI

According to Table 3, the median age of patients was 63 years, and presented a standard deviation (σ) of 14.49004060, while the average length of hospital stay of patients who underwent

clean cardiovascular surgery at the SS was 14 days, and presented a standard deviation (σ) of 11.65590840.

Table 3 - Assessment of patient age and length of hospital stay, Brazil, 2024.

Variables Quantitative	Mean	Median	Standard deviation
Age	62	63	14,49004060
Length of Hospital Stay	14	12	11,65590840

Source: UVS/ HU-UFPI

DISCUSSION

The complexity of SSI infections does not depend solely on individual factors, but is at the mercy of health care services and processes⁽¹⁴⁾. Regarding the risk factors related to SSIs, there are four predisposing factors: direct contact, air, vehicle, and vector. Among these, transmission by direct contact is the most prominent, and can be caused by actual physical contact when carrying out patient care activities, such as bathing, changing dressings, introducing invasive devices, and was present on the hands of the professionals themselves or on contaminated gloves⁽¹³⁾.

The distribution of cases between the sexes, with 13 (54.2%) of the cases in men and 11 (45.8%) in women, resembled what was presented in a study carried out in a philanthropic hospital, since, among those who developed SSI, 11 (55%) were women and 09 (45%) were men¹⁶. This similarity in percentages suggests that the incidence of SSI may be influenced by other factors, such as clinical characteristics of patients, types of surgeries performed, and care contexts.

The average age of patients who developed SSI in the present study was approximately 62 years, with a range between 18 and 92 years, a characteristic that is repeated in other studies, in which the average was 60.2 years¹⁷. This data reinforces the trend that population aging is a relevant factor in the occurrence of these infections. Furthermore, the age variation among the participants in this study (18 and 92 years) suggests that, although the

incidence of SSI, according to the research, presented an average closer to older age groups, the infection can affect a wide range of ages, especially in complex procedures such as those performed in the cardiovascular specialty.

In the present study, the p-value of 0.2656 did not show a statistically significant association between SAH and the incidence of SSI, which suggests that the presence of this comorbidity did not influence the occurrence of this outcome. However, a study carried out at a university hospital identified hypertension as the comorbidity of greatest magnitude related to the prevalence of SSI in cardiovascular surgeries⁽¹⁷⁾. This discrepancy reflects the possibility that, in other scenarios or with different samples, hypertension has a more evident impact on the risk factor for developing SSI.

With respect to the statistical tests performed, the comorbidities obesity, DM and SAH did not show a statistically significant relationship. However, as opposed to what was discovered in the analyzed data, the most prevalent comorbidities in patients with SSI, in a study carried out in an SS of a large private hospital located in the north of São Paulo, were hypertension, DM and obesity¹⁸. This underscores the importance of considering the particularities of each study when interpreting and comparing results related to risk factors for postoperative complications.

Furthermore, there was no statistical significance in any of the problematic associations, as all p-values were greater than 0.05. Despite the above, such risk factors were



considered relevant to be analyzed during nursing care for patients in the perioperative process of cardiac surgery¹⁹.

Moreover, as all p-values are greater than 0.05, there was no statistical significance in any of the problematic associations. This demonstrates that the presence of these comorbidities did not present significant relevance with the incidence of SSI in the sample studied. These results suggest that other factors may be more directly associated with the occurrence of SSI and that the presence of these comorbidities, in isolation, was not a determining factor in this context.

Another relevant aspect found in the study results was the average length of hospital stay (14 days) of patients who underwent clean cardiovascular surgery in the surgical block. This average was higher than other studies, in which the average postoperative hospital stay was 6.22 days⁽¹⁶⁾. In this regard, it is emphasized, again, that this difference may be due to differences in the patients' profile, such as the presence of more serious comorbidities or postoperative complications that may delay recovery.

In 2023, the infection rate in the cardiovascular specialty ranged from 0% to 9%, while in 2024 the infection rate ranged from 5.8% to 61.5%; however, no statistically significant association was observed between DM, Obesity, SAH, Smoking, and SSIs.

The limitations of this study include the fact that a sample was used only with patients undergoing clean cardiovascular surgery and restricted to a university hospital in the Northeast

region of Brazil, excluding other contexts and regions of the country. The scarcity of previous studies directly related to the topic hindered the comparison of the results obtained with those of other populations or health centers. Thus, this scenario shows that further studies in the area are required, especially in university hospitals and in contexts similar to that of HU-UFPI, which can contribute to a more precise understanding of the factors that may influence the incidence of surgical site infections.

CONCLUSION

From the data obtained, it can be seen that the variables analyzed in the present study, i.e., hypertension, DM, obesity and smoking, did not present, statistically, sufficient significance to be considered as risk factors for the incidence of SSI in clean cardiovascular surgeries.

In addition, the importance of constant evaluation of data from clean surgeries by health surveillance at university hospitals is highlighted as a way to assist managers in taking health actions to achieve the recommended goals, as well as to recognize in advance risk factors that may lead to the emergence of SSI in clean cardiovascular surgeries.

Conflict of interest

The authors declare no conflict of interest.

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