Surgical site infection in patients undergoing hip and knee arthroplasties

Infecção de sítio cirúrgico em pacientes submetidos a artroplastias de quadril e joelho

Infección del sitio quirúrgico en pacientes sometidos a artroplastias de cadera y rodilla

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ABSTRACT: Objective: To characterize cases of Surgical Site Infections (SSI) in patients undergoing hip and knee arthroplasties. **Method:** A cross-sectional, retrospective, and quantitative study conducted in a public, teaching, and high-complexity hospital in the southern region of Brazil. Data collection took place between 2020 and 2022 from records contained in 91 medical records and post-discharge forms within 90 days after surgery for prosthesis implantation. Data were analyzed by descriptive statistics and SSI incidence rate. **Results:** 49 (53.8%) knee arthroplasty records and 42 (46.2%) hip arthroplasty records were analyzed. Five cases developed infection, all detected at the post-arthroplasty knee outpatient visit, resulting in an SSI incidence rate in arthroplasties of 5.5% (n=5). Infections were characterized as deep incisional (40%; n=2), organ or cavity (40%; n=2), and superficial (20%; n=1), resulting in readmission in 80% of cases and a corresponding average hospitalization time of 11 days (SD=4.2). **Conclusion:** The significant rate of SSI in clean surgeries points to the need to intensify good surgical practices. Outpatient surveillance is emphasized as a strategy for building realistic indicators and providing support for prevention efforts.

Keywords: Epidemiological monitoring. Surgical wound infection. Patient safety. Orthopedics. Arthroplasty, replacement.

RESUMO: Objetivo: Caracterizar os casos de Infecções de Sítio Cirúrgico (ISC) em pacientes submetidos a artroplastias de quadril e joelho. **Método:** Pesquisa transversal, retrospectiva e quantitativa realizada em um hospital público, de ensino e de alta complexidade da região sul do Brasil. A coleta de dados ocorreu entre 2020 e 2022 em registros contidos em 91 prontuários e fichas pós alta hospitalar no período de até 90 dias após a cirurgia destinada ao implante da prótese. Os dados foram analisados por estatística descritiva e taxa de incidência de ISC. **Resultados:** Foram analisados 49 (53,8%) registros de artroplastia de joelho e 42 (46,2%) de quadril. Cinco casos evoluíram com infecção, todos detectados no retorno ambulatorial pós artroplastia de joelho, resultando em taxa de incidência de ISC em artroplastias de 5,5% (n=5). As infecções foram caracterizadas como incisional profunda (40%; n=2), de órgão ou cavidade (40%; n=2) e superficial (20%; n=1); decorrendo em reinternação em 80% dos casos e correspondente tempo médio de hospitalização de 11 dias (DP=4,2). **Conclusão:** O expressivo índice de ISC em cirurgias limpas direciona para a necessidade de intensificar boas práticas cirúrgicas. Reitera-se a vigilância ambulatorial como estratégia para a construção realística de indicadores e subsídio para a prevenção.

Palavras-chave: Monitoramento Epidemiológico. Infecção da ferida cirúrgica. Segurança do paciente. Ortopedia. Artroplastia de substituição.

RESUMEN: Objetivo: Caracterizar los casos de Infecciones del Sitio Quirúrgico (ISQ) en pacientes sometidos a artroplastia de cadera y rodilla. **Método:** Investigación transversal, retrospectiva y cuantitativa realizada en un hospital público, docente y de alta complejidad en la región sur de Brasil. La recolección de datos se realizó entre 2020 y 2022 en registros contenidos en 91 historias clínicas y formularios posteriores al alta hospitalaria en un período de hasta 90 días después de la cirugía destinada al implante de la prótesis. Los datos fueron analizaron mediante estadística descriptiva y tasa de incidencia de ISQ. **Resultados:** Se analizaron 49 (53,8%) registros de artroplastia de rodilla y 42 (46,2%) de cadera. Cinco casos evolucionaron con infección, todos detectados en el seguimiento ambulatorio después de la artroplastia de rodilla, lo que resultó en una tasa de incidencia de ISQ en artroplastias del 5,5% (n=5). Las infecciones se caracterizaron como incisionales profundas (40%; n=2), de órgano o cavidad (40%; n=2) y superficiales (20%; n=1); resultando en reingreso en el 80% de los casos y el correspondiente tiempo promedio de hospitalización de 11 días (SD=4,2). **Conclusión:** La tasa significativa de ISQ en cirugías limpias apunta a la necesidad de intensificar las buenas prácticas quirúrgicas. Se reitera la vigilancia ambulatoria como estrategia para la construcción realista de indicadores y apoyo a la prevención.

Palabras clave: Monitoreo epidemiológico. Infección de la herida quirúrgica. Seguridad del paciente. Ortopedia. Artroplastia de reemplazo.

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INTRODUCTION

Surgical patient safety must be incorporated as one of the pillars of quality in health institutions. This can be achieved, among other factors, through the dedication and commitment of the multidisciplinary team to promoting safe practices[1].

In surgical care, qualitative advances have been recognized, particularly since the World Health Organization (WHO) published the Safe Surgeries Save Lives program between 2007 and 2008. However, alarming rates of health-associated infections (HAIs), especially surgical infectious complications, continue to persist[2].

The WHO indicates that Surgical Site Infection (SSI) is the most common HAI in low- and middle-income countries, affecting approximately one-third of patients. Although their incidence is lower in high-income countries, SSIs rank second among HAIs in Europe and the United States[3]. In Brazil, it is estimated that 14 to 16% of patients are affected by this event, with 60% of these cases being potentially preventable[4].

It is recognized that patients undergoing orthopedic surgical procedures are more exposed to risk factors for the occurrence of SSI, particularly in subspecialties that require the use of tools and implants, such as knee and hip arthroplasties[5]. This increased risk arises from the specific characteristics of the specialty, the health professionals involved, the quality of the implant materials, and the duration of the surgery — all of which impact the incidence of SSI[6].

Additional risks include issues related to the processing of consigned health products[7], the degree of wound contamination, comorbidities, and failures related to surgical techniques. Other factors include the poor quality of inputs and weaknesses in monitoring the patient during the post-surgical anesthetic period[8,9]. Consequently, these combined factors significantly contribute to high and varying rates of infection in health services[6].

Scientific evidence indicates that orthopedic patients are more vulnerable to the occurrence of SSI and are more likely to require surgical reintervention compared to patients from other specialties[10,11]. Considering that SSIs have physical and psychological consequences for the patient and impact the length of hospital stay and readmissions, resulting in financial costs and potential death[12,13], it is crucial to conduct investigations related to this topic. Such research can help recognize the problem and encourage healthcare managers to develop and adopt measures aimed at improving structural and process indicators to prevent and/or minimize SSIs.

Therefore, understanding the epidemiology of these infections is essential for implementing systematic and effective actions to promote critical and safe surgical care in orthopedic units. Consequently, the research question was established: How are SSIs occurring in hip and knee arthroplasties characterized?

OBJECTIVE

To characterize cases of SSIs occurring in patients undergoing hip and knee arthroplasty.

METHOD

This is a cross-sectional, retrospective study with a quantitative approach conducted at a highly complex public teaching hospital located in the southern region of Brazil. The hospital is considered a reference center for performing surgical procedures and advanced diagnostic exams, and it is financed exclusively by the Brazilian Unified Health System (*Sistema Único de Saúde* – SUS).

The data source consists of the database provided by the hospital's IT service, comprising all primary hip or knee arthroplasties performed in 2016, totaling 160 cases and their corresponding medical records. A random sample of cases was selected, amounting to 91 medical records. This sample size was determined based on an SSI incidence rate of 16%[4], a sampling error of 5%, and a significance level of 5%. Records with unavailable and/or ineligible data were immediately replaced by the subsequent record from the general list of hip or knee arthroplasty surgeries.

Since 2014, the hospital under study has undergone administrative transition, resulting in an impact on patient safety actions and the quality of care. This transition included adaptations, from 2017 onward, of the surgical safety checklist implemented in 2011. Therefore, the time frame adopted in this research is justified as it allows for future comparisons of SSI rates following modifications to perioperative safety measures. This is particularly significant due to the pioneering use of this care tool in the orthopedic specialty[14].

Inclusion criteria for the research encompassed medical records of adult patients with a minimum length of stay of 24 hours and procedures classified as clean in the surgical record. Surgeries categorized in the surgical description as

potentially contaminated, contaminated, and infected were excluded, as it is recognized that the potential for wound contamination is a risk factor for infectious evolution[13].

Data collection occurred between November 2020 and March 2022, conducted by a single nurse and researcher. It involved a retrospective review of records found in physical files, focusing on the index hospitalization, outpatient care records for up to 90 days after implant insertion, and records of readmission due to SSI. Infections related to the surgical procedure, characterized by compromised incision, deep soft tissue, manipulated organ or cavity, were considered, with clinical and/or laboratory diagnosis within 90 days after implant placement. Diagnosis criteria included corresponding signs and symptoms (pain, increased sensitivity, local edema, hyperemia or heat, spontaneous dehiscence, purulent drainage, abscess, and fever >38°C), or positive culture[4,13].

For the identified cases of SSI, an instrument prepared for the research was completed with information regarding demographic factors (gender, age), clinical characteristics (comorbidities), surgical details (urgency classification, operative duration in hours), and anesthetic variables (type of anesthesia, duration of anesthesia in hours, surgical risk according to American Society of Anesthesiology criteria)[15], in addition to preoperative hospitalization time (less than 24 hours; equal to or greater than 24 hours) and hospital stay duration in days during the index hospitalization and readmission due to the infection were recorded.

The data were entered into a Microsoft Office Excel 2016® spreadsheet using double typing. Quantitative variables were analyzed using univariate descriptive statistics, while categorical variables were analyzed using absolute and relative frequencies.

SSIs were classified according to the anatomical structures affected, namely:

a) superficial incisional (skin and subcutaneous tissue only);
b) deep incisional (includes soft tissue deep to the incision); and
c) organ/cavity (includes any organ or cavity opened or manipulated during surgery)[4,13].

The SSI incidence rate was calculated using the following formula, as shown in Chart 1.

The research was approved by the institution's Research Ethics Committee under No. 3.651.686 and CAAE No. 20342519.2.0000.0096.

Chart 1. Formula intended for calculating surgical site infection rate.

$$\text{SSI Rate} = \frac{\text{Total number of SSIs occurred in hip/knee arthroplasties from anuary 1st to December 31st, 2016}}{\text{Study patient sample}} \times 100$$

RESULTS

In the sample analysis of 91 (100%) medical records, 49 (53.8%) were from patients undergoing knee arthroplasty, and 42 (46.2%) were from patients undergoing hip arthroplasty. Five cases developed infection, all during knee arthroplasty, resulting in an incidence rate of SSI in arthroplasties of 5.5%; and 10.2% when specifically considering knee arthroplasties.

Table 1 displays the profile of patients, with and without SSI, according to demographic characteristics and clinical-surgical hospitalization.

All SSIs were detected during outpatient follow-up. Among the five cases of infection, microbiological investigation was conducted in one case, with secretion collected from the surgical site, revealing the presence of *Staphylococcus aureus* sensitive to methicillin.

Table 2 presents the distribution of cases according to diagnostic criteria, classification of infection, management, and outcome.

The average length of stay for readmission due to SSI was 11 days (SD=4.2).

DISCUSSION

The SSI rate of 5.5% in arthroplasties was higher than that reported in European countries. For instance, an investigation conducted in an orthopedic surgery and traumatology unit in Serbia showed a rate of 4.8%[16]. Additionally, available data from the National Health Service of the United Kingdom indicated an average incidence of 0.6% in primary and elective knee arthroplasties[10].

Scientific literature indicates that periprosthetic joint infection occurs between 1 and 2%[17]. In Brazil, a study conducted in medium and high complexity public hospitals showed an SSI rate in orthopedic surgeries of 2.1%[5]. Additionally, the prevalence of periprosthetic joint infection after an elective primary total knee arthroplasty surgical procedure was reported to be 1.38%[18].

Table 1. Clinical, surgical, and anesthetic characterization of patients undergoing hip or knee arthroplasty, according to the occurrence, or not, of surgical site infection (n=91). Curitiba (PR), Brazil, 2022.

Characteristic	Cases without SSI n=86	Cases with SSI n=05
	n (%)	n (%)
Gender		
Female	55 (64)	4 (80)
Male	31 (36)	1 (20)
Age (in years)		
Mean (standard deviation)	59.5 (SD=15.4)	58 (SD=17.2)
Comorbidities/risk factors*		
Systemic arterial hypertension	50 (58.1)	3 (60)
Diabetes mellitus	15 (17.4)	2 (40)
Smoking	13 (15.1)	-
Thyroid disease	6 (7)	1 (20)
Heart diseases	6 (7)	-
Hemophilia	6 (7)	1 (20)
Pulmonary diseases	5 (5.8)	-
Alcoholism	5 (5.8)	
Hepatitis	4 (4.7)	-
Other†	9 (10.5)	
Preoperative diagnosis		
Knee osteoarthritis	40 (46.5)	3 (60)
Hip osteoarthritis	36 (41.9)	-
Secondary knee osteoarthritis	8 (9.3)	1 (20)
Secondary hip osteoarthritis	2 (2.3)	-
Hemophilic arthropathy	-	1 (20)
Preoperative length of hospital stay		
<24 hours	83 (96.5)	5 (100)
≥24 hours	3 (3.5)	-
ASA Surgical Risk		
I	12	-
II	63	3 (60)
III	11	2 (40)
Type of anesthesia‡		
Spinal	62 (72.1)	4 (80)
Sedation	43 (50)	3 (60)
General	40 (46.5)	1 (20)
Epidural	7 (8.1)	-
Duration of anesthesia (in hours)		
Mean (standard deviation)	2.7 (SD=0.7)	2.8 (SD=0.7)
Surgical classification		
Elective	86 (100)	5 (100)
Emergency	-	-
Duration of surgery (in hours)		
Mean (standard deviation)	1.8 (SD=0.6)	2.0 (SD=0.5)
Length of hospital stay (in days)		
Mean (standard deviation)	4.6 (SD=4.5)	5.4 (SD=3.0)

SSI: surgical site infection; SD: standard deviation; ASA: American Society of Anesthesiology. *A single patient could present more than one comorbidity and/or risk factor; †Includes dyslipidemia, neoplasms, and rheumatoid arthritis; ‡A single patient may undergo more than one anesthetic technique.

Table 2. Distribution of surgical site infections following knee arthroplasty, according to diagnostic criteria and surgical outcomes (n=5). Curitiba (PR), Brazil, 2022.

Characteristic	n=05 (100%)
Diagnostic criteria for SSI	
Clinical	4 (80)
Clinical and microbiological	1 (20)
Classification of SSI	
Superficial infection	1 (20)
Deep incisional infection	2 (40)
Organ or cavity infection	2 (40)
Hospital readmission	
Yes	4 (80)
No	1 (20)
Surgical reintervention	
Yes	4 (80)
No	1 (20)
Outcome	
Discharge	5 (100)
Death	-

SSI: surgical site infection.

In the present research, there was a predominance of cases classified as deep infection and organ/cavity, necessitating surgical reintervention. These cases are deemed severe and demand preventive and effective actions, which may target patients, surgical technique execution, and the surgical setting[19]. This is particularly crucial as these infections significantly impact readmission and surgical reintervention, resulting in intangible and financial consequences, along with the risk of sequelae. A longitudinal study conducted in a hospital in southern Brazil revealed that surgical readmissions were five times higher in orthopedics compared to the general surgical specialty[11].

Furthermore, due to the severity of the infection, readmitted patients were 10 times more likely to undergo reoperation[11]. In the present study, 80% of patients with SSI required surgical reintervention, underscoring the importance of prevention given the financial, social, and intangible costs associated with these infections. Therefore, investigating the associated surgical risks in the researched institution can contribute to reducing the problem. For instance, routinely conducting internal audits to identify weaknesses in the care process helps improve actions aimed at enhancing perioperative practices, especially among patients considered

at high risk, such as those with diabetes and hypertension, for developing SSI[16,20].

Additionally, the relevance of measuring indicators related to the time of operative processes and hospitalization is emphasized, such as surgical duration and hospital stay. Studies indicate that prolonged operative time (≥2 hours)[21] and hospital stays exceeding five days[22] are factors associated with the occurrence of SSI, corroborating the findings of the present research.

In a complementary manner, the pre-operative visit by the surgical, anesthesiology, and nursing team is highlighted, as it enables knowledge of comorbidities and risk factors. Coupled with the adoption of strongly recommended measures to prevent SSI[13], this contributes to protecting patients and, subsequently, reinforces good practices aimed at ensuring the safety and quality of surgical care.

The cases of SSI in this research were entirely detected during outpatient follow-up, underscoring the importance of post-discharge surveillance of the patient. This approach aims to identify problems early and intervene to prevent serious complications and death. The nursing team, with emphasis on nurses, plays an essential role in discharge management, as they must observe the patient's particularities, provide guidance, and accompany them in their post-surgical recovery[9].

In this manner, the necessity to enhance traditional post-discharge follow-up methods is underscored, such as telephone consultations and outpatient visits. Additionally, consideration should be given to the inclusion of platforms available in electronic applications that enable patients to provide real-time information regarding wound healing, providing benefits for both patients and the healthcare team and hospital institution[23].

The primary limitation of this research lies in the utilization of data derived from retrospective consultation of medical records, which is contingent upon the quality of documentation by healthcare professionals in the records accessed. Furthermore, the absence of employment of inferential statistics to explore the higher incidence of SSI in knee arthroplasties compared to hip arthroplasties further contributes to the limitations.

However, the study results depict a high incidence of SSI among a group of patients vulnerable to this condition, emphasizing the importance of not confining the detection of infection solely to the hospitalization period. To address this, it is imperative to ensure an adequate number of professionals, both quantitatively and qualitatively, in risk management sectors. These professionals can facilitate post-discharge follow-up and aid in accurately identifying the occurrence of SSI. This collaborative effort will help in implementing additional measures to promote good nursing practices and collaborative care, thereby fostering the development of organizational safety culture and improving indicators related to infectious diseases specific to surgical units.

CONCLUSION

The rate of SSI was notable among patients undergoing clean knee arthroplasty, predominantly characterized by involvement in deep structures and organ/cavity, necessitating readmission and surgical re-intervention. Interestingly, no occurrences of SSI were identified in hip arthroplasties within the sample. Recognizing the potential for preventability, meticulous risk management plays a crucial role in continuously identifying weaknesses in the perioperative process and promoting good surgical practices. Particularly, attention should be directed toward the organizational and technical aspects of the operating room environment, which are fundamental for prevention efforts.

The findings underscore the importance of outpatient surveillance in diagnosing and treating SSI, with thorough documentation of patient assessments being crucial for facilitating research using documentary sources. Moreover, implementing a system for early communication of signs and symptoms by patients prior to outpatient visits has the potential to mitigate the development and severity of infections.

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CONFLICT OF INTERESTS

The authors declare there is no conflict of interests.

AUTHORS' CONTRIBUTION

JB: Formal analysis, Conceptualization, Investigation, Metholodogy, Resources. JTJAFGS: Investigation, Writing – original draft, Writing – review & editing, Validation, Visualization. GCPP: Investigation, Writing – original draft, Writing – review & editing, Validation, Visualization. DPS: Investigation, Writing – original draft, Writing – review & editing, Validation, Visualization. EDAC: Project administration, Conceptualization, Metholodogy, Supervision, Validation, Visualization.

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