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Characterization of surgical site infections in a public teaching hospital in Cascavel, Paraná

Caracterização das infecções de sítio cirúrgico em um hospital público de ensino na cidade de Cascavel, Paraná

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ABSTRACT

Introduction: Surgical Site Infection (SSI) is one of the major Health Care-Related Infections (HAI) and a persistent problem in the hospital setting. **Objective:** To characterize SSI in a public teaching hospital located in the city of Cascavel-PR. **Method:** cross-sectional retrospective study of documentary source and quantitative approach. The SSIs notified from May 2017 to May 2018 were analyzed. The variables of interest were tabulated and submitted to descriptive statistical analysis. **Results:** there were 5,169 surgical procedures in the period, with 196 (100%) cases of SSI. Of these, there was a predominance in young adults aged between 21 and 40 years (39.3%). The specialty of Gynecology / Obstetrics (30.1%) and General Surgery (29.1%) presented the highest rates of SSI, most frequently in Potentially Contaminated surgeries (53.1%); with superficial incisional SSI (59.7%); and with clinical confirmation criteria (79.1%). Regarding the microorganisms isolated in the cultures, Pseudomonas aeruginosa (16.7%) and Enterococcus spp (16.7%) stood out. **Conclusions:** It is noted that there is a need to review SSI prevention measures, especially due to the proportion of clean surgeries that developed the adverse event. However, considering the values reported in the literature, the overall rate of SSI was discrete.

KEYWORDS: Infection; Surgical Wound Infection; Patient Safety; Epidemiological Monitoring

RESUMO

Introdução: A infecção de sítio cirúrgico (ISC) é uma das principais infecções relacionadas à assistência à saúde (IRAS) e um problema persistente no âmbito hospitalar. **Objetivo:** Caracterizar as ISC em um hospital público de ensino localizado na cidade de Cascavel, PR. **Método:** Estudo transversal, retrospectivo, de fonte documental e abordagem quantitativa. Foram analisadas as ISC notificadas entre maio de 2017 a maio de 2018. As variáveis de interesse foram tabuladas e submetidas à análise estatística descritiva. **Resultados:** Ocorreram 5.169 procedimentos cirúrgicos no período, com 196 (100,0%) casos de ISC. Destes, houve predominância em adultos jovens com idade entre 21 e 40 anos (39,3%). A especialidade de Ginecologia/Obstetrícia (30,1%) e Cirurgia Geral (29,1%) apresentaram as maiores taxas de ISC, com maior frequência nas cirurgias Potencialmente contaminadas (53,1%), com ISC do tipo incisional superficial (59,7%) e com critério de confirmação clínica (79,1%). Quanto aos microrganismos isolados nas culturas, houve destaque para *Pseudomonas aeruginosa* (16,7%) e *Enterococcus* spp (16,7%). **Conclusões:** Denota-se que há espaço de revisão das medidas de prevenção de ISC, especialmente devido à proporção de cirurgias limpas que desenvolveram o evento adverso. Contudo, considerando os valores referidos na literatura, a taxa geral de ISC foi discreta.

PALAVRAS-CHAVE: Infecção; Infecção da Ferida Operatória; Segurança do Paciente; Monitoramento Epidemiológico

INTRODUCTION

Healthcare-associated infections (HAI) are recurrent adverse events in healthcare settings and should therefore be considered important for patient safety[1]. This is because HAI are usually responsible for increased morbidity and mortality of patients, especially of those who are hospitalized[2,3].

Surgical site infection (SSI) is the most common complication resulting from surgical procedures and, in Brazil, it ranks third among all HAI. Overall, SSI manifest in the postoperative period in 3% to 20% of all surgical procedures[3,4].

SSI may result from an elective, urgent or emergency surgical procedure, with or without the insertion of implants. They can be classified according to the anatomical planes that were affected as: superficial incisional (SI), deep incisional (DI) and organ/cavity (OC)[4].

An SSI is an adverse event that can be triggered by several factors, taking into account the following triad: pathogen, patient and surgical procedure[5]. Regarding the pathogen, local microbial load, pathogenicity and especially virulence stand out. Regarding the patient, age extremes, pre-existing diseases, preoperative hospitalization period, nutritional status and pre-existing infectious conditions should be considered. Regarding the surgical procedure, factors involved in the intraoperative period, like hair removal, preparation of the surgery area, antisepsis of the surgical team's hands, antimicrobial prophylaxis, aseptic surgical technique, organ and tissue oxygenation, body temperature, among others, may lead to the onset of the infection[6].

The onset of SSI can cause several damages to both patients and health organizations, as it tends to cause physical, psychological and financial damage through: longer hospitalization of the patient (from 7 to 11 days), increased likelihood of hospital readmission, the need for additional surgeries and the burden of hospital costs due to the use of high-cost antimicrobial drugs[7].

One of the key strategies for reducing and/or controlling SSI was the second Global Patient Safety Challenge, the so-called Safe Surgery Saves Lives Program, established in 2007-2008 by the World Health Organization (WHO) and the World Alliance for Patient Safety[8].

The objective of this challenge was to promote improved surgical safety and reduce deaths and complications during surgeries. The suggested means to achieve this objective was the use of a convenient and easy-to-apply tool by healthcare professionals: the WHO Safe Surgery Checklist. This checklist addresses three different stages of the surgery and should be used before anesthetic induction, before the surgical incision and before the patient leaves the operating room[8].

The checklist evaluates 19 items, some of which are directly related to the prevention of SSI, like: review of materials for expiration date and result of the sterility indicator (before surgical incision), administration of microbial prophylaxis (before surgical incision) and proper counting of surgical instruments, compresses and needles (before the patient leaves the operating room)[8].

Another strategy indicated by the aforementioned program is the monitoring of SSI indicators individually, when each healthcare institution should establish ways to monitor surgical patients. Therefore, the systematic monitoring of these indicators enables the identification of groups at higher risk and the control of these events, in addition to the planning of preventive actions and the design of SSI control strategies[8].

Among other activities, the hospital infection control commission (CCIH) is responsible for tracking and monitoring SSI. This includes the systematic and periodic analysis of measures that streamline decision making to control this type of adverse event[9]. In this context, it is believed that it is socially and scientifically relevant to know the profile of SSI in healthcare institutions. Since this is a persistent problem, these results may enable the enhancement of SSI control strategies.

Given the above, the following question was asked: how are SSI characterized in a public teaching hospital? With that in mind, the present study aimed to characterize SSI in a public teaching hospital located in the city of Cascavel, state of Paraná, Brazil.

METHOD

This is a cross-sectional, retrospective study, of documentary source and quantitative approach. The research was conducted in a public teaching hospital located in the city of Cascavel. This hospital has 210 beds and the surgical suite has six operating rooms for the exclusive care of patients of the Unified Health System (SUS).

The research population consisted of all case reports of SSI from May 2017 to May 2018, according to data provided by the hospital's infection control service (SCIH). Therefore, there was no sampling procedure, because the intention was to get a sense of the timeframe investigated, which resulted in 196 cases of SSI.

The period determined for data collection matched the beginning of the practical activities of the first class of Resident Nurses of the Health Surveillance and Infection Control Residency Program of the researched institution, characterized by the redesign of the routine activities of the SCIH. This redesign included the adoption of the Diagnostic Criteria for Healthcare-associated Infections, proposed and updated by the Brazilian Health Surveillance Agency (Anvisa) in 2017[4], as the main reference for defining cases of HAI in the hospital under study.

Data were collected in July 2018 by a single researcher. Data were collected manually from the internal HAI control spreadsheet that is fed daily by SCIH members and Resident Nurses. The following variables were recruited for each case of SSI: 1) Patient's age (in years); 2) Surgical specialty; 3) Potential for contamination; 4) Classification of SSI by planes; 5) Confirmation criteria for SSI (clinical or microbiological); and 6) The microorganisms that were isolated from microbiological cultures. Additionally, together with the hospital inpatient department, we surveyed the total number of surgeries performed during the investigation period in order to enable the calculation of the SSI rate in the same period.

The collected data were entered into Microsoft® Office Excel version 16.12 spreadsheets. After tabulation, the data were submitted to descriptive statistical analysis and presented as absolute and relative frequency.

The research complied with all applicable ethical requirements and was submitted and approved by the Committee of Ethics and Research with Human Beings under Opinion n. 3.062.301/2018 and CAAE protocol: 50066815.8.0000.0107.

RESULTS

During the investigated period, 5,169 surgical procedures were performed, with a total of 196 (100.0%) notified SSI cases, which corresponds to a rate of 3.8% surgical patients with SSI. Table 1 shows the distribution of variables related to SSI.

Microbiological analyses identified 13 species of microorganisms confirmed by culture of the surgical wound exudates. Depending on the affected anatomical plane, the collection was done by swab or aspiration, according to the institutional protocol approved by the CCIH. The identification of the strains was done by biochemical tests obtained via automated Vitek system (bioMérieux).

In some cultures, more than one type of microorganism was identified. Table 2 presents the distribution of isolated microorganisms in surgical wound exudates of SSI patients hospitalized in the study hospital and Table 3 presents the distribution of isolated microorganisms by surgical specialty.

DISCUSSION

The interest in characterizing SSI in the hospital under study is warranted by the complexity and recurrence of this adverse event[10], which reinforces the need to subsidize the epidemiological surveillance process in the institution under study with actual and updated SSI data. Thus, it is believed that the research is consistent with evidence-based practice and encourages the (re) planning of SSI prevention and control actions.

Among the surgical procedures performed during the investigated period (n = 5,169), 3.8% of all surgical patients developed SSI. This result is consistent with the literature[7], since 3% to 20% of surgical patients tend to have some type of SSI. This reinforces the need for organizations to continually monitor their results,

Table 1. Distribution of variables related to surgical site infections in a public teaching hospital. Cascavel, PR, Brazil, 2018.

Variable of surgical site infections	N	%
Age of patients (years)		
0 to 20	50	25.5
21 to 40	77	39.3
41 to 60	37	18.8
Over 61	32	16.4
Surgical specialty		
Gynecology/Obstetrics	59	30.1
General Surgery	57	29.1
Orthopedics/Traumatology	28	14.3
Neurology	22	11.2
Pediatrics	22	11.2
Oral & Maxillofacial	2	1.0
Cardiology	2	1.0
Angiology/Vascular	2	1.0
Dermatology	1	0.5
Urology	1	0.5
Contamination potential		
Potentially contaminated	104	53.1
Clean	59	30.1
Contaminated	24	12.2
Infected	9	4.6
Classification by plans		
Superficial incisional	117	59.7
Organ/cavity	59	30.1
Deep incisional	20	10.2
Confirmation criteria		
Clinical confirmation	155	79.1
Microbiological confirmation	41	20.9
Total	196	100.0

Table 2. Distribution of isolated microorganisms in surgical wound exudates of patients with surgical site infections hospitalized in a public teaching hospital. Cascavel, PR, Brazil, 2018.

Microorganism	N	%
Pseudomonas aeruginosa	9	16.7
Enterococcus spp	9	16.7
Acinetobacter baumannii complex	7	13.0
Escherichia coli	7	13.0
Staphylococcus aureus	7	13.0
Enterobacter cloacae	5	9,3,0
Serratia marcescens	3	5.6
Staphylococcus negative coagulase	3	5.6
Klebsiela pneumoniae	2	3.7
Citrobacter feundii	2	3.7
Total	54	100.0

Table 3. Distribution of isolated microorganisms in surgical wound exudates of patients with surgical site infection by surgical specialty (n = 54). Cascavel, PR, Brazil, 2018.

Microorganism by Specialty	G/O1		CG2		O/T3		N4		P5		B6		C7	
	N	%	N	%	N	%	n	%	n	%	N	%	N	%
Pseudomonas aeruginosa	-	-	1	1.9	3	5.6	1	1.9	3	5.6	-	-	1	1.9
Enterococcus spp	-	-	3	5.6	4	7.4	1	1.9	-	-	-	-	1	1.9
Acinetobacter baumannii complex	-	-	2	3.7	5	9.2	-	-	-	-	-	-	-	-
Escherichia coli	-	-	2	3.7	3	5.6	1	1.9	1	1.9	-	-	-	-
Staphylococcus aureus	1	1.9	1	1.9	1	1.9	2	3.7	1	1.9	1	1.9	-	-
Enterobacter cloacae	-	-	1	1.9	4	7.4	-	-	-	-	-	-	-	-
Serratia marcescens	-	-	-	-	3	5.6	-	-	-	-	-	-	-	-
Staphylococcus negative coagulase	-	-	-	-	-	-	2	3.7	1	1.9	-	-	-	-
Klebsiela pneumoniae	-	-	-	-	-	-	1	1.9	1	1.9	-	-	-	-
Citrobacter feundii	-	-	-	-	1	1.9	-	-	1	1.9	-	-	-	-
Total	1	1.9	10	18.7	24	44.6	8	15.0	8	15.0	1	1.9	2	3.8

G/O1: Gynecology/Obstetrics; CG2: General surgery; O/T3: Orthopedics/Traumatology; N4: Neurology; P5: Pediatrics: B6: Oral & Maxillofacial; C7: Cardiology.

seek internal and external comparisons, and thus continually reset improvement goals.

Regarding age, it is known that newborn and elderly patients are more susceptible to infections because of the fragility of their immune system[11]. Notwithstanding, as seen in Table 1, this study found a higher predominance of SSI in young adults, aged between 21 and 40 years (n = 77; 39.3%), which is possibly related to the most frequent surgical specialties of the study hospital.

Also according to Table 1, Gynecology/Obstetrics (n = 59; 30.1%) and General Surgery (n = 57; 29.1%) were the surgical specialties with the highest SSI rates. This finding may be related to prolonged surgical time and increased potential for surgical site contamination[12].

Regarding the classification of SSI cases according to the potential for surgical contamination (Table 1), the study identified a higher frequency of SSI in potentially contaminated surgeries (n = 104; 53.1%). The human body has a symbiotic relationship with microorganisms of the resident microbiota when under adequate health conditions. Based on that, surgeries are classified according to the potential risk of contamination of the operated site[4]. Therefore, it can be stated that the greater the contamination of the surgical wound, the greater the probability of incidence of SSI[13]. However, even considering the prior definition of the potential for contamination of each surgery, the classification of the surgical procedure should always be done at the end of any surgery[14].

The study identified a large number of cases of SSI in surgeries classified as Clean (n = 59; 30.1%) which, by definition, are procedures performed in sterile or decontaminated tissues, without installed inflammatory or infectious processes, and without failures of gross surgical techniques[14]. This finding makes us wonder whether the surgical procedure classification process is being done correctly in the hospital in question, or even if the basic principles of SSI prevention have been complied with, when we see the ratio of clean surgeries that resulted in SSI.

Regarding the distribution of SSI cases by anatomical planes, it was possible to identify the predominance of SI in the study hospital (n = 117; 59.7%) (Table 1). This result was also reported by other studies done in Brasília, DF[15], and in Rio de Janeiro, RJ[10]. Furthermore, in a review study done in Salvador, BA, which aimed to analyze the costs of treating SSI, the authors analyzed two Japanese studies that investigated the relationship between the type of SSI (classification by planes) and the length of hospitalization and hospital costs, attesting to the average increase in cost and hospital stay related to the severity of the type of SSI[16].

The cost of treating SSI patients has a negative impact on the management of funds, which are normally scarce in the public sector, since these institutions receive a fixed value for each surgical procedure, with no extra funding in the case of procedure-related infections[16].

As criteria to confirm the presence of SSI, the SCIH of the researched institution uses the guidelines of Anvisa's Manual of Diagnostic Criteria for Healthcare-associated Infections[4]. The guidance contained in Anvisa's manual is that any SSI should be confirmed by findings about the patient's clinical condition (clinical confirmation) or microbiological confirmation. In terms of clinical confirmation, the following findings should be considered: purulent drainage, presence of abscess, spontaneous dehiscence of surgical incision points, hyperthermia (> 38°C), and report of pain at the surgical wound site. Microbiological confirmation is achieved by isolating microorganisms in cultures of surgical wound secretion or abscesses/collections resulting from the surgical procedure, accompanied by clinical signs. It is important to ensure that the isolated culture microorganism is not present in another topography of the body, which would turn the SSI found by the microbiological criterion into a false positive result[4].

According to data from the present study, the clinical confirmation of SSI (n = 155; 79.1%) stood out compared to microbiological confirmation (n = 41; 20.9%) (Table 1). Similar data were found in another study conducted at a teaching hospital in Brasília (DF), where most SSI were confirmed by the patients' clinical condition (n = 76; 88.4%)[17]. Although the clinical diagnostic definition is important for early treatment and is less costly to the organization, the lack of knowledge about the microorganism that causes the infection may lead to an empirically-determined drug treatment, with inappropriate antimicrobial classes, thus favoring microbial selective resistance[18].

SSI can be caused by a plethora of microorganisms. The aspects related to each microorganism's potential to cause infections are generally linked to bacterial growth, type of microorganism, synthesized toxins, spore generation, among others[18].

According to Table 2, the most frequent microorganisms isolated in the cultures were: *Pseudomonas aeruginosa* (16.7%) and *Enterococcus* spp (16.7%). In particular, infections caused by these species of microorganisms can have severe complications, like complete surgical dehiscence without evisceration, reduction in the wound healing process, presence of abscesses. These infections may cause death by septic shock and/or pneumonia[19].

Since they are usually found in patients' endogenous microbiota and also in the hands and equipment of healthcare professionals, the research findings raise questions as to the correct execution of the hand hygiene technique by the surgical team, the proper preparation of the patient's skin during the preoperative period, maintenance of the aseptic technique during the intraoperative period, and the correct use of surgical attire, among others[10,16,20].

It is important to highlight that about 60% of SSI could be prevented with the adoption of safe care measures[4]. Furthermore, the monitoring of these events enables the planning of preventive actions and the implementation of strategies to prevent SSI[20].

The study's limitation is the fact that the research was based on SSI cases reported by the SCIH of the hospital under study. In the field of epidemiological surveillance, although the process of investigation and notification of infection cases is well outlined and developed, we recognize the possible existence of underreported cases that may influence the rates and values presented in this research. Another limitation is the lack of inferential statistical analysis. However, since the study used a period of one year and took place in a public hospital, the description presented is solidly valid to promote SSI prevention and management actions, in addition to increasing the knowledge about the area in question.

CONCLUSIONS

The research found that 196 cases of SSI were reported during the study period, which corresponds to a rate of 3.8%. There was a predominance of SSI in young adults served by Gynecology/Obstetrics and General Surgery and who underwent potentially contaminated surgeries. There was a predominance of superficial incisional SSI, with the criterion of clinical confirmation. *Pseudomonas aeruginosa* and *Enterococcus* spp were the most frequently identified microorganisms in microbiological cultures.

We concluded that the aforementioned findings denote space for improvement/revision of surgical safety procedures, especially considering the proportions of clean surgeries that resulted in SSI. However, when compared to the literature, the overall adverse event rate can be considered low.

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Conflict of Interest

Authors have no potential conflict of interest to declare, related to this study’s political or financial peers and institutions.