Occurrence and risk factors for surgical site infection in orthopedic surgery

Ocorrência e fatores de risco para infecção de sítio cirúrgico em cirurgias ortopédicas

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Keywords
Perioperative nursing; Operating room nursing; Nursing research; Surgical wound infection; Risk factors; Orthopedic procedures

Descritores
Enfermagem perioperatória; Enfermagem de centro cirúrgico; Pesquisa em enfermagem; Infecção da ferida operatória; Fatores de risco; Procedimentos ortopédicos

Submitted
July 24, 2013
Accepted
August 26, 2013

Abstract

Objective: To analyze the occurrence and risk factors for surgical site infection in patients undergoing orthopedic surgery.

Methods: A prospective cross-sectional study with 93 patients undergoing elective and clean orthopedic surgery.

Results: The surgical site infection was diagnosed in 16 patients (17.2%). In data analysis, after adjusting the binary logistic regression model, only the variable total time of hospitalization was statistically significant with respect to the presence or absence of infection.

Conclusion: The occurrence of surgical site infection in orthopedic surgery was higher, with 75% of cases diagnosed after hospital discharge, this result reinforces the need for post-discharge surveillance.

Resumo

Objetivo: Analisar a ocorrência e os fatores de risco para infecção de sítio cirúrgico em pacientes submetidos a cirurgias ortopédicas.

Métodos: Estudo transversal prospectivo com 93 pacientes submetidos a cirurgias ortopédicas eletivas e limpas.

Resultados: A infecção de sítio cirúrgico foi diagnosticada em 16 pacientes (17,2%). Na análise dos dados, após ajuste do modelo de regressão logística binária, apenas a variável tempo total de internação mostrou-se com relação estatisticamente significativa com a presença ou não de infecção.

Conclusão: A ocorrência de infecção de sítio cirúrgico em cirurgia ortopédica foi mais elevada, sendo 75% dos casos diagnosticados após a alta hospitalar, resultado que reforça a necessidade da vigilância pós-alta.

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Conflict of interest: no conflict of interest to declare.

Introduction

Infection related to health care is a localized or systemic condition resulting from an adverse reaction caused by endogenous or exogenous infectious agents. It is present or incubated during the hospitalization of the patient until his discharge from any health service.[1]Among them, the surgical site infection stands out, which occurs in the surgical incision or in tissues handled during the surgery, the classification is according to their incisional superficial topography, deepth, organ/space incisional.[2]

In Brazil, the surgical site infection comprises between 14% to 16% of diagnosed infections in hospitalized patients, 93% of these are serious, invading organs or spaces site during surgery.[3]

In orthopedic patients, the surgical site infection prolongs hospital stay on average for two weeks, doubles re-hospitalization rates, and costs can increase by over 300%. In addition, patients may have physical limitations and significant reductions in quality of life.[4]

In a multicenter study involving 16,291 patients undergoing orthopedic surgery, with surgical site infection rate of 2.23%, the results indicated that advanced age, length of preoperative hospitalization, duration of surgery, ASA score (≥ III)as main risk factors for the occurrence of this type of infection.[5] In another research, the authors followed-up 1,073 patients in postoperative orthopedic surgery, and of those, 58.7% developed postoperative infectious complications, surgical site infection and dehiscence. Among the main factors associated with complications, some were more relevant, namely: age over 40 years, duration of surgery greater than 90 minutes, high ASA score (≥ III), use of mechanical suture and delay for ambulation.[6]

In a literature review, the authors indicated that the main risk factors for the occurrence of infection in orthopedic surgery are: advanced age, diabetes, smoking, nutritional changes (malnutrition and obesity), immune impairment, rheumatoid arthritis, infection in other parts of body, be Sthapylococcus aureus nasal carrier, anemia pre-and postoperative.[7]

The aim of this study is to analyze the occurrence and risk factors for surgical site infection in patients undergoing orthopedic surgery.

Methods

Prospective cross-sectional study. The site selected for the development of the research was a private-philanthropic hospital with 313 beds. This hospital is a regional reference for medium and high complexity procedures for population of over 700,000 people in the city of Franca, Sao Paulo state, southeastern region of Brazil.

The study included subjects aged over 18 years, of both genders, undergoing elective orthopedic surgery and classified as clean (potential contamination of the operative wound) with deployment, or not, of synthetic bone materials (plates and screws) and prostheses, up to 30 days after surgery. The exclusion criteria were: patients with active infection in another site, with ASA classification above III, who had died before the stipulated follow-up period and loss of follow-up in ambulatory or on telephone contact.

The sample size was defined according to the number of predictor variables initially delimited, following the method which preconizes that there must be between five and ten subjects for each of the predictive variables of the multiple regression model.[8] Thus, the sample was estimated to be 80 patients, since eight variables were investigated. The initial sample of the research was102 subjects, however, two patients died before presenting the expected outcome, seven were not found in telephone contacts, therefore, they were excluded from the study. The final sample consisted of 93 subjects.

For data collection, an instrument was developed in two parts, the first being the data related to the characterization of the patient and the identification of factors predisposing to the development of surgical site infection. In the second part, the data were related to the diagnostic criteria of infection, monitoring the patient during hospitalization and after hospital discharge. The development of the instrument

was based on different studies investigating this issue.[2,3,9,10]

The instrument developed was submitted to face and content validity by three judges (nurses). The agreement of responses between the judges on the items of the instrument was higher than 80%. The suggestions were related to the presentation of the instrument adding items to reach the objective of the research, which were accepted by researchers.

Data collection occurred during perioperative (pre, intra and post-operative), in the ambulatory follow-up of the patient and by telephone contact on the thirtieth day after surgery. This procedure was carried out from October 2011 to March 2012.

The procedure for data collection was carried out as follows:

The patient who agreed to participate in the study were followed-up from the admission of the Surgical Center, operating room until his transfer to the recovery room after anesthesia;

Patient were visited on a daily basis from the first day after surgery. The evaluations for each patient continued until reaching the endpoint event, i.e. SSI, or to hospital discharge;

The selected hospital has ambulatory discharged patients from orthopedics. Thus, patients were also followed-up on the day of return. At this point of follow-up, the surgical incision was evaluated in search of the outcome, diagnosed by the patient's physician;

Thirty days after surgery, a telephone contact was conducted to the patient to record their verbal report on the general condition of the surgical incision, seeking evidence for the occurrence of infection.

In data analysis, the sample was divided into two groups: surgical site infection and no infection, using the bivariate analysis for the two groups versus the variables age, body mass index, ASA classification, chronic diseases, use of antibiotic prophylaxis, duration of anesthesia, duration of surgery and total length of hospitalization.

For the bivariate analysis of categorical factors associated with infection (chronic diseases, ASA classification antibiotic prophylaxis), we calculated the odds ratio (OR unadjusted), the confidence intervals (95% CI) and the probabilities resulting from the Chi-square with Yates correction for continuity.

In the case of quantitative factors (age, BMI, duration of anesthesia, duration of surgery and total length of hospitalization), we performed the statistical tests: Student's t test and Mann-Whitney test, with mean values, standard deviations (SD), confidence intervals (CI) for the difference between means, median, minimum and maximum values.

Considering the variables in the bivariate analysis, presenting p-value less than 0.25, for association tests or comparison between means or medians with the variable response, adjusted to a multiple regression model.

After selecting the variables with p-values p <0.25 in the bivariate analyzes (ASA classification and total length of hospitalization). We proceeded to set the binary logistic regression model, with infection categorized as absent (0) or present (1) as dependent variable and as ASA covariates, coded as dummy healthy or mild variable (0) and compromised(1) and total length of hospitalization time as continuous quantitative variable. The stepwise method (backward) was used for selection of variables that remained in the final model.

Data were analyzed using the Statistical Package Social Sciences (SPSS) version 19.0 (license number 10101111255). The level of significance was α = 0.05. The study development followed national and international standards of ethics in research involving human.

Results

Of the 93 patients participating in the study, 77 (82.8%) had no surgical site infection and 16 (17.2%) presented an infection. The average group age with no infection was 42.29 years, with a minimum age of 18 years and maximum of 85 years. In the group with infection, the average age was 47.31 years, with a minimum age of 19 years and maximum of 92 years; however, 10 patients (62.5%) were between 18 and 48 years, the same age group accounted for 65.5% of the sample studied (n = 93). Regarding gender,

63 patients (67.7%) were male and 30 (32.3%) were female.

In the studied sample, the average Body Mass Index was 25.47 kg/m^2 (overweight) ranging from 15.43 to 41.51 kg/m^2. The SSI was more frequent in patients with normal weight (18.50 to 24.99 kg/m^2), with 50% of cases (n = 8), followed by patients with low weight (<18.49 kg/m^2), with 25% of cases (n = 4).

Regarding the classification of patients' clinical conditions, according to the surgical risk score of American Society of Anesthesiology, ASA classification, it was observed that 68 patients (73.1%) were classified as ASA I, 22 (23.6%) as ASA II and three (3.3%) as ASA III. Out of 16 subjects with SSI, 10 (62.5%) were classified as ASA I.

From the 93 patients studied, 75 (80.7%) had no chronic disease, however, of those, 11 (14.6%) developed SSI. Of the 18 subjects (19.3%) with chronic disease, 16 (88.8%) had diabetes and two were obese (11.1%). Of these patients, six (33.3%) developed SSI.

Regarding the use of antibiotic prophylaxis, the 93 patients studied, 88 (94.6%) received antibiotics, five (5.4%) did not. The antibiotic was administered in 87 patients (98.8%) before surgical incision and only one (1.2%) after completion of the surgical incision. It was not observed reapplication of antibiotic in the followed procedures. It was observed that in the group with infection (n = 16), all subjects received antibiotic prophylaxis.

As regards to the duration of anesthesia, the average was 103.82 minutes, with a minimum of ten and a maximum of 210 minutes; for the group with no infection, the average was 102.53 minutes (minimum - 10, maximum - 210 minutes); in the group with infection, the average was 110 minutes (minimum - 50, maximum - 205 minutes).

With regard to the duration of surgery, 64 procedures (68.8%) were of size I (procedure whose duration is two hours) and 29 procedures (31.2%) were of size II (procedure whose duration is in the range above two hours to four hours). The average duration of surgery was 1 hour and 35 minutes. The SSI was more frequent in procedures size I, with 13 (81.2%) of the 16 cases of infection.

All 93 patients underwent different types of orthopedic surgeries, osteosynthesis of the femur was the most frequent one (18 procedures, 19.4%), followed by removal of synthesis material (11 procedures, 11.8%), osteosynthesis of metacarpal (10 procedures, 10.8%) and tibia with nine procedures (9.7%). The occurrence of SSI was also more frequent in patients undergoing osteosynthesis of femur, with eight cases (50%).

The total length of hospitalization of the sample had an average of 3.27 days, with a minimum of one day and a maximum of 22 days. The occurrence of SSI was higher in patients who remained hospitalized from one to three days (six cases, 37.5%), followed by patients who were hospitalized for a period of four to six days and seven to nine days (four cases each period, 50%).

Regarding the time of diagnosis of SSI, from the 16 patients, four (25%) were diagnosed still in the hospital, or during their hospitalization; five (31.2%) were diagnosed at the time of his/her return in the specialty clinic after discharged, seven (43.7%) reported SSI diagnosis to the researchers through telephone contact on the thirtieth day after surgery. The account was through the called search, which reported that complications have occurred with the surgical site, a fact that made them seek discharged ambulatory specialist; infection was diagnosed by the doctor and he/she started antibiotic therapy.

Table 1 presents the results of the statistical tests used in the study, in bivariate analysis only the variables ASA classification and total length of hospitalization showed a statistically significant difference between the groups with infection and without infection, when tested association with SSI. After adjustment of the logistic model, the results showed only the variable total length of hospitalization, with statistically significant relationship with the presence or absence of infection (Wald = 11.072, p =0.01). The odds ratio value, adjusted for this variable was equal to 1.633, greater than 1, indicating that an increase in total length of hospitalization leads to greater chance of infection.

Table 1. Distribution of patients undergoing orthopedic surgery in a private-philanthropic

Variables	Infection				OR	IC[95%][a]	p-value
	Yes n(%)		No n(%)				
Chronic disease							
Yes	5(27.8)		13(72.2)		2.238	[0.665;7.532]	0.329
No	11(14.7)		64(85.3)		1	-	
ASA							
Compromised (ASA III)	2(66.7)		1(33.3)		10.857	[0.921;128.00]	
Healthy and mild (ASA I e II)	14(15.6)		76(84.4)		1	-	0.126
ATBP*							
Yes	16(18.2)		72(81.2)		- [(c)]	-	
No	0(0)		5(100)		-	-	0.661
	Mean	SD	Mean	SD	t	IC[95%][b]	p-value
Age	47.3	24.0	42.3	17.2	0.796	[-8.2;18.3]	0.436
BMI	25.8	6.2	25.4	3.3	0.280	[-2.9;3.8]	0.783
Surgery**	76.9	34.9	76.2	45.1	0.059	[-23.1;24.5]	0.953
Anesthesia**	110.0	42.7	102.5	48.7	0.569	[-17.4;32.3]	0.571
Hospitalization ***	Median 5	(Min; Max) (2;22)	Median 2	(Min; Max) (1;8)	U 271.5	-	<0.0001

Legend:*ATBP - antibiotic; **duration in minutes; ***total length in days, OR - Odds Ratio, CI[95%][a] - 95% confidence interval to the odds ratio value, CI [95%][b] - 95% confidence interval for the difference between means; SD - standard deviation, t- Student's t test, U – Mann Whitney U test, p - probability associated to the statistical test, (c) - unable to calculate the odds ratio

Discussion

Practical applications of the results of this study are subsidies for health professionals in the planning and implementation of measures for the prevention and control of surgical site infection.

In this study, the age group with the highest occurrence of SSI was 18 to 48 years, which is different from the reported numbers from the literature; in which the higher risk for orthopedic surgery are among older people (age over 50 years).[11-13] This result can be explained by the fact that many of the research subjects had a main diagnosis of fractures caused by motorcycle accidents, also falls, and these situations are most commonly seen in younger people.

Although BMI of eight patients with infection fit the normal weight category, four patients (25%) were underweight, two overweight (12.5%) and two were obese (12.5%). In the literature, different studies show nutritional changes (malnutrition and obesity) as factors associated with the occurrence of SSI.[14-18]

For statistical analysis, patients in the study were divided into two groups: ASA I and II (combined), ASA III. This variable showed a statistically significant difference between the group with infection and the group with no infection when tested association with SSI, and this result is corroborated by other researches.[17,19,20]

The presence of chronic diseases was also investigated, the types found were diabetes and obesity. Although the results of the research showed no association with SSI, in literature this variable is a risk factor for the occurrence of SSI.[2,11,14, 21]

The average duration of anesthesia was higher in patients with infection, and the SSI was more frequent in procedures size I. The variable duration of anesthesia and surgery, showed no statistically significant difference between the groups with and without infection, similar to a Danish study conducted with the same number of subject of this

research.[17] However, other studies showed that increased time of surgical anesthesia is directly associated with increased postoperative complications, in which it includes, in addition to the SSI, the wound dehiscence, presence of bruising, and increased length of hospitalization.[6,19,22]

To prevent and reduce the occurrence of SSI, studies indicate that the use of antimicrobial prophylaxis is well established, mainly in clean surgeries.[11,23] It is noteworthy that in this study, all subjects with SSI received antibiotic prophylaxis.

The variable length of hospitalization showed a statistically significant relationship with the presence or absence of infection, i.e. the occurrence of SSI was more frequent in patients who were hospitalized for a longer period. This result was also shown in other researches that have investigated this association.[15,24,25] The long period of hospitalization increase hospital costs, both to the hospital and patient care, as with the diagnosis and complications.[13,15,25, 26]

As already pointed out, the occurrence of SSI was 17.2% (n = 16), which shows high percentage, as the expected rate of SSI to the type of surgical procedure studied (clean surgery) is from 1% to 5% according to the parameters established by the CDC.[2] This result is also higher when compared to studies conducted in patients undergoing orthopedic surgery, with a larger number of subjects[5,19,27] and from research with similar number of subjects.[21, 22]

Importantly, the delimitation of the actual rates of SSI, is only possible when performing the follow-up of patients in both the hospitalization, as in post hospital discharge, as performed in this research. Thus, patients with SSI, in 25% of cases, they were diagnosed still in the hospital and 75% in the post hospital discharge in both ambulatory discharge specialty, as the telephone search on the thirtieth day after surgery. This result is consistent with the national study, which indicated that 15% to 77% of SSI occurs after hospital discharge.[28]

The telephone search is a cheap and effective method, since it is performed by a qualified people to identify the signs and symptoms reported by the patient. The post hospital discharge follow-up by telephone is valid and secure, showing to be an efficient method for the diagnosis of SSI.[29]

Conclusion

The occurrence of SSI in orthopedic surgery was higher than the occurrence found in the literature for the surgical procedure studied (clean surgery). The variable total length of hospitalization was statistically significant with respect to the presence or absence of infection. In the study, 75% of infections cases were diagnosed after hospital discharge, this result reinforces the need for post hospital discharge surveillance and the problem of SSI underreporting in health services.

Collaborations

Ribeiro JC collaborated with the project design, data collection, analysis and interpretation of data, drafting the article and approval of the final version to be published. Santos CB participated in the project design, implementation of statistical analysis, critical revision of intellectual content and approval of the final version to be published. Belluse GC and Rezende VF contributed to the analysis and interpretation of data, critical revision of intellectual content and approval of the final version of the manuscript. Galvão CM participated in the project design, analysis and interpretation of data, drafting the article and approval of the final version of the manuscript.

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