Original Article

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The Rate of Surgical Site Infection and Associated Factors in Patients Undergoing Orthopedic Surgeries in Babol, Northern

H. Azizi (MD)[1], N. Janmohammadi (MD)[2], M. Bahrami (MD)[2], M. Rouhi (MD)[3], M. Falsafi (MD)[3], A. Bijani (MD, PhD)[4], S.M. Esmaeilnejad-Ganji (MD) *[5]

1.Student Research Committee, School of Medicine, Babol University of Medical Sciences, Babol, I.R.Iran
2.Mobility Impairment Research Center, Health Research Institute, Babol University of Medical Sciences, Babol, I.R.Iran
3.Cancer Research Center, Health Research Institute, Babol University of Medical Sciences, Babol, I.R.Iran
4.Social Determinants of Health Research Center, Health Research Institute, Babol University of Medical Sciences, Babol, I.R.Iran
5.Clinical Research Development Center, Shahid Beheshti Hospital, Babol University of Medical Sciences, Babol, I.R.Iran

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ABSTRACT

BACKGROUND AND OBJECTIVE: The surgical site infection is one of the most common complications after orthopedic surgeries, which is associated with significant complications and mortality. The present study aimed to determine the prevalence rate of SSI and the associated factors in traumatic patients.

METHODS: This cross-sectional study was conducted on 516 patients with hip and knee trauma and femoral fracture who underwent orthopedic surgeries in Shahid Beheshti Hospital in Babol during a five-year period. The demographic and surgical information were collected and then analyzed.

FINDINGS: SSI was observed in 88 patients (17.1%). The mean age in the infected and non-infected patients was 43.11±19.08 and 39.22±9.54 years old, respectively (p=0.014). The duration of hospitalization was 17.59±6.23 days in the infected group and 13.08±5.77 days in the non-infected group (p<0.001). Duration of surgery in the infected and non-infected subjects was 2.42±1.62 and 2.11±1.23 hours (p=0.043). The patients underwent general anesthesia were infected more than those underwent spinal anesthesia (23% vs. 12.9%, p=0.003). Emergency surgery was negatively associated with the infection (CI-95%= 0.05-0.85 OR=0/20). Also, patients with diabetes had more infection rate (22.4%) than non-diabetic patients (14.3%) (p=0.021).

CONCLUSION: According to results, the prevalence rate of SSI was considerable in this study. Age, durations of hospitalization and surgery, type of anesthesia (general), history of diabetes and smoking were determined as risk factors for SSI.

KEY WORDS: *Surgical site infection, Orthopedics, Prevalence, Risk factor*.

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* **Corresponding Author: S.M. Esmaeilnejad-Ganji (MD)**
Address: Department of Orthopedics, Babol University of Medical Sciences, Babol, I.R.Iran
Tel: +98 1132199936
E-mail: smsnganji@yahoo.com

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Introduction

Surgical site infections are cutaneous, organ or space infections that occur after surgery (2,1). These infections are the most common and costly infections in the hospital and are estimated to be between 2% and 5% in patients undergoing surgery. In the United States, the annual incidence is estimated to be between 160,000 and 300,000 (3). While the infection is usually limited to the local incisional site, the surgical site infection can spread to adjacent deeper structures. Also, infection is associated with significant morbidity and mortality (6-4). A surgical site infection in orthopedic surgeries can be seen more than other courses (7). About 50% of hospital infections are reported in orthopedic surgery sites (8).

These infections can increase the duration of admission for up to 20 days, increase by about 2 times more re-admission, and increase the cost of treatment by more than 300%. In addition, patients with orthopedic surgical site infection have more physical restrictions and lower quality of life (11-9). Various factors can be involved in increasing or decreasing the incidence of such infections, including factors related to the patient (such as high age, diabetes, obesity, previous surgery, inappropriate nutrition, etc.) and factors associated with surgery (such as duration of operation, wound classifying, high blood loss and prophylaxis antibiotics) (12). Considering the importance of the subject and also because of the fact that there has been no study in Babol with the aim of evaluating the rate of infection site of orthopedic surgeries, in this study the prevalence of surgical site infection and its related factors among traumatic patients admitted to the orthopedic ward of Shahid Beheshti Hospital, Babol was studied to help for the next treatment, better control and care for patients, and reduce hospital and medical costs.

Methods

This cross-sectional study after approval by the Ethics Committee of Babol University of Medical Sciences with the code MUBABOL.REC.1391.1 during the years 2012-2016 was performed on all traumatic patients with hip and knee injuries and fracture of the femoral bone referred to Shahid Beheshti Hospital, Babol and underwent surgery by the orthopedic team. Patients suffered from burns, death, incomplete records, ICU admission, patients under the age of 15, and infections due to open fractures were excluded from the study. Information was collected based on checklists. Demographic information was collected as oral questions from patients or relatives, including age (over 15 years of age), gender, history of diabetes, history of smoking, and the time when the site of surgery was infected. The height and weight of patients were also measured. Information about the type of surgery (emergency or non-emergency), duration of surgery (from surgical incision to suturing) and type of anesthesia (general or spinal) from medical records of patients were collected. The duration of hospitalization was recorded after surgery. All information was entered into the orthopedic trauma software bank, then, due to the reporting system in the bank, all references to this center were gathered due to the complication of post-orthopedic infection.

The criterion for site infection was defined as surgical infections that occurred at the site of the incision or near the surgical incision within 30 days of surgery (13). The criterion for presence of surgical site infection in addition to the time limit, was the clinical judgment of the doctor based on clinical manifestations such as heat, redness and swelling, pain and infectious discharges. The duration of follow up of patients varied from two weeks to three months according to their conditions. In association with antibiotic prophylaxis for patients up to 48 hours after surgery, intravenous cefazolin was given at a dose of 1 g every 6 hours.

After collecting the data, the data were analyzed using SPSS software, chi-square, independent sample T-test and logistic regression tests. $P < 0.05$ was considered significant.

Results

In this study, 516 patients with an average age of 41.21±55.49 years participated in this study, of which 381 (73.8%) were men and 135 (26.2%) were women. 213 (41.3%) patients had general anesthesia. In 174 (33.7%) patients, there was a history of diabetes. In 390 (75.6%) patients, non-emergency surgery was performed. Hypertension was also seen in 242 patients (46.9%). The duration of hospitalization was 14.33±9.15 days (Table 1).

Surgical site infection was detected in 88 (17.1%) patients and 428 (82.9%) had no problem. The mean infection incidence rate was 1.95 ± 1.36 months after surgery. All surgical wounds were clean. There was a direct and significant correlation between the treated infection site and the variables of age, duration of operation and duration of hospitalization (Table 2) ($p=0.005$, $p = 0.043$, $p <0.001$), but there was no relation between infection and BMI.

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Table 1. Basic information of patients undergoing orthopedic surgery (n = 516).

Variable	N(%)
gender	
men	381(73.8)
women	135(26.2)
anesthesia	
general	213(41.3)
spinal	303(58.7)
History of diabetes	
yes	174(33.7)
no	342(66.3)
History of hypertension	
yes	242(46.9)
no	274(53.1)
Type of surgery	
Non emergent	390(75.6)
emergent	126(24.4)
smoking	
yes	168(32.6)
no	348(67.4)
	Mean±SD
Age (year)	41.55±21.49
Duration of hospitalization (day)	14.33±9.15
BMI* (kg/cm 2)	27.59±5.16
Duration of surgery (hour)	2.38±1.74

*** Body Mass Index**

Table 2. Relationship between quantitative variables and surgical site infection in patients undergoing orthopedic surgery (n = 516).

Variable	Infection Mean±SD		P-value
	yes (n=88)	No(n=428)	
Age (year)	43.11±19.08	39.22±9.54	0.005
BMI*	27.46±5.56	27.66±4.39	0.711
Duration of hospitalization(day)	17.59±6.23	13.08±5.77	<0.001
Duration of surgery (hour)	2.1±42.62	2.1±11.23	0.043

*** Body Mass Index**

There was a significant relationship between infection and type of anesthesia, and patients who underwent general anesthesia had more surgical site infection than the patients who underwent spinal anesthesia (23% vs. 12.9%, p = 0.003) (Table 3). The location of the infection was also higher in diabetic patients than non-diabetics (22.4% vs. 14.3%, p = 0.021). There was no significant association between infection and other variables including sex, smoking, blood pressure and type of surgery (Table 3). Regarding the logistic regression test, the type of emergency surgery was negatively associated with infection (0.5-0.85: 95% CI, OR = 0.20).

Table 3. Relationship between qualitative variables and surgical site infection in patients undergoing orthopedic surgery (n=516)

Variable	Infection	yes(n=88) N(%)	No(n=428) N(%)	CrudeOdds ratio (CI-95%*)	P-value	Adjusted** Odds ratio (CI-95%)	P-value
anesthesia	general	49(23)	164(77)	1	0.003	1	0.997
	spinal	39(12.9)	264(87.1)	0.49(0.0-31.79)		-(-)	
gender	man	63(16.5)	318(83.5)	1	0.599	1	0.102
	woman	25(18.5)	110(81.5)	1.15(0.69-1.91)		3.17(0.8-12.64)	
smoking	yes	37(22)	131(88)	1	0.06	1	0.232
	no	51(14.7)	297(85.3)	064(0.1-40.02)		2.2(0.1-45.84)	
History of diabetes	yes	39(22.4)	135(77.6)	1	0.021	1	0.069
	no	49(14.3)	293(85.7)	0.58(0.0-36.92)		0.184(0.1-03.14)	
History of hypertension	yes	43(17.8)	198(82.2)	1	0.656	1	0.997
	no	45(16.4)	230(83.6)	0.9(0.1-57.43)		∞	
Type of surgery	Non-emergent	67(17.2)	323(82.8)	1	0.894	1	0.029
	emergent	21(16.7)	105(83.3)	0.96(0.1-56.65)		0.2(0.0-05.85)	

* Confidence interval ** In the presence of other variables in the logistic regression model

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Discussion

In this study, the prevalence of infection in patients after orthopedic surgeries was 17.1%. In the study of Hojat et al., out of 420 patients, 37(8.8%) were re-admitted due the surgical site infection (14). In one study in Saudi Arabia performed on 3096 patients undergoing orthopedic surgery, the infection rate was 2.5% (15). In a study conducted in Nigeria, the infection rate was 9.9% (16). The reason for these differences can be due to various factors, such as the number of people studied, the time and place of the study, the type of hospital, the surgical team, and a series of other factors that we will mention below.

In this study, age was identified as a risk factor for surgical site infection. This finding was also found in previous studies (17,18). This can be due to the fact that, as the age increases, other factors, such as a decrease in the immune system are observed in individuals (19). In relation to sex, however, no significant association was found in our study. Other studies have also contradicted this issue (20, 21). In the present study, there was no significant correlation between BMI and surgical site infection. A recent meta-analysis reported that obesity can increase the risk of surgical site infection in orthopedic patients by approximately 2 times (22). Some pathophysiological mechanisms have been proposed. For example, it has been suggested that levels of TNF-alpha and interleukin-1 beta decreased in obese subjects compared with lean subjects, and interleukin -1 Ra increased (23). Based on previous results, adipose tissue is actively involved in inflammatory mechanisms, which can justify a higher risk of infection in obese people (24). In this study, the duration of hospitalization had a significant direct correlation with the surgical site infection. A study by Hojat et al. found that patients with infection significantly had longer hospitalization period than patients without surgical site infection infected (14), which was consistent with the present study. Previous studies have also indicated that the risk of infection can increase with the duration of hospitalization (4,25). In addition, Ikeanyi et al., indicated that the risk of infection in patients who were admitted more than a week before surgery was approximately five times higher than that of other people with fewer hospitalization (26). Since the hospital environment has never been free from pathogens, long-term exposure can predispose hospitalized patients for surgical site infection.

In our study, the mean duration of surgery in infected patients was significantly higher than other patients, suggesting a direct relationship between the duration of surgery and the risk of infection. In earlier investigations also pointed to this direct relationship (25,27). In general, prolonged duration of surgery means increased risk of blood loss, surgical trauma, and prolonged exposure to pathogens. In this study, there was no significant association between high blood pressure and infection. Previous research has also provided contradictory results (12,28). The role of high blood pressure in increasing the chance of infection can be due to internal hemorrhage and poorer perfusion of soft tissue. Also, in the present study, the history of diabetes increased the chance of infection. Previous reports also indicate that diabetes can increase the risk of infection in the site (29,30). The study of Richards et al. also showed that stress due to hyperglycemia increases the risk of infection in non-diabetic patients (31). Wukich et al. also considered diabetes as a risk factor for surgical site infections. It has been argued that this is more common in cases of diabetes complications and with ulcers and neuropathies of the organs (17,32). In our study, patients with general anesthesia had a 2 times higher chance of surgical site infection than patients with spinal anesthesia. This result is also mentioned in previous reports (33,34).

The probable mechanism that the risk of surgical site infections is higher in general anesthesia than spinal anesthesia can be justified by the fact that in general anesthesia nerves and the autonomic response are not completely blocked, which leads to an increase in stress responses. The Vasoconstriction caused damage to tissue perfusion resulting a reduction in the oxygen content of the tissue. On the other hand, spinal anesthesia or epidural inhibits sympathetic nerves and causes vascular dilatation, which results in better oxygenation of tissues (33). In this study, there was no significant correlation between cigarette smoking and surgical site infection. The results of previous studies indicate that cigarette smoking can be considered as a risk factor for surgical site infection in orthopedic surgeries (35-37). Various factors can contribute to increasing the risk of infection in smokers. Nicotine, nitric oxide and carbon monoxide can directly change the wound healing process (38, 39). Smoking has also been shown to reduce levels of immunoglobulins and macrophage activity in smokers and may impair their immune system (39). In the present study, some cases were incomplete and access to the patient was not possible and was forced to be removed from the study. Also, the number of people present in the operating room was not available in this study. It is recommended that a study be conducted to determine the number of

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people in the operating room and its relationship with infection. Also, all surgical wounds were clean in this study and it is suggested to compare the infection rate of clean and dirty wounds in the future. Based on the findings of this study, the prevalence of surgical site infection is significant in this study. Therefore, the need to implement care and treatment plans and identify the risk factors for surgical site infections are more accurately understood in order to better control the level of infections.

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