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A Study on Chances of Surgical-site Infection after Orthopedic Surgery with Factors Related to the Hospital

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Study Area: Jahrom, Iran

Coordinates: 28°30'00"N; 53°33'38"E

Keywords: Shavers, Shifts, Wound, Caretakers

Abstract

Apart from failure in the treatment of patients postoperative infections after orthopedic surgery, resulting in the death of patients. The present study designed and carried out for predicting surgical site infection after orthopedic surgery with hospital factors on 420 orthopedics patients who needed surgery. Data were collected by filled-up the questionnaire (during the hospitalization period). Using the multivariable logistic regression test with the Enter model, the following variables were able to predict the risk of the surgical wound. The variety of surgical operations, simultaneous orthopedic surgery in operating rooms, can increase the risk of wound infection by 1.317 times more than that of just done orthopedic surgery in the operating rooms. The high average of the mean shift of personnel in a month increases the risk of wound infections by 1.235 times higher than that of normal staff working hours. And most importantly, the need for postoperative dressing more than 1 time during the first 48 hours increases the risk of wound infection by 39.297 times. Conclusively, the reducing staff overtime, reducing the need for postoperative dressings, reducing non-orthopedic surgery in the operating room on orthopedic surgery day can reduce the incidence of orthopedic wound infections.

Introduction:

In spite of the fact that tremendous advances have been made in surgical techniques, the pathogenesis of surgical wound infections have been identified and prophylactic antibiotics are in wide use for overcome the surgical-site infection (SSI), with an incidence of about 2-5% and a 24% share in-hospital infections. It is considered to be among the major challenges in orthopedic surgeries. Surgical site infections have the second-highest number of nosocomial infections (Favero *et al.*, 1995). SSI can increase the cost of treatment, increase the number of post-operative days of admission, increase absenteeism from the workplace for the family and caregivers, reduce patient satisfaction and deteriorate the patient's condition (Hojat *et al.*, 2013; Taheri *et al.*, 2015). According to CDC, 500,000 cases in the United States each year sustain with surgical site infections. On average, hospitalization period for these patients increases by 7.5 days with the estimated cost of \$ 845-800 million (Leaper *et al.*, 2004; Pugliese & Favero, 2000). Several factors including clinical conditions of the patient, prolonged preoperative hospitalization, duration of

surgery, prepare the skin, the technique of sterilizing the hands by the surgeon and the surgical team, operating room conditions, the type of prosthesis and so on can affect the post-orthopedic infection (Hojjat *et al.*, 2012). Developing an effective care system is always the first step in dealing with the problem of nosocomial infection. The most important and primary goal of treatment is must be to reduce the amount of infection in the surgical site and thus reduce mortality and discomfort of patients and improve the care of patients. In order to achieve this goal, firstly, the predictive and effective variables in the incidence of surgical infection should be identified. Although various studies have been conducted to evaluate the incidence of post-operative infections in orthopedic patients, the causes of these infections are still open to be examined (Brandt *et al.*, 2008; Yokoyama *et al.*, 2009; Bhuachalla *et al.*, 2015; Kokavec & Fristáková, 2008; Akbari *et al.*, 2003). In addition to doing physical and psychological damage to the patient, the surgical site infection, especially in orthopedic patients, increases the cost of treatment, the bed occupancy rate, the length of hospitalization of the patient, and even

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the incidence of complications after orthopedic surgery (Hojat *et al.*, 2010). Identification of effective hospital factors in the development of orthopedic wound infection can be considered as an important alarm for the treatment team (Jahromi *et al.*, 2015).

Therefore, any study that can predict the risk of infection in these patients, predict the predictor factors and have high predictive power can be a good guide for planning to correct, eliminate or reduce the impact of risk factors to prevent orthopedic wound infection. The present study was conducted with the aim of predicting wound infection after orthopedic surgery with hospital factors. .

Methodology:

This analytic study was conducted in Jahrom University of Medical Sciences in 2013-2011. Total of 420 orthopedics patients who needed surgery was included in this study. Patients who died of severe trauma had previous anemia or weakened the immune system, comportment syndrome, previously had post-operative infections did not tend to participate in the study and patients requiring intensive care before or after surgery were not included in the study. Data was collected by a researcher-making questionnaire (during the hospitalization period) with written consent. The form and content validity of the tool was obtained with the help of 10 university professors (IS:0.89, CVI: 0.93, CVR: 0.85) and the reliability of the tool was calculated using the test-retest method (0.83). SPSS16 software was used for data analysis

Result:

Total 88.6% of patients were having diploma and other education, lower than a diploma. 85% of cases shavers were the caregivers, 69.5% of shaves were performed in the morning shift. 72.9% of them underwent surgery in the evening shift. 51.4% of the applied prosthesis was Iranian. 42.6% received general anesthesia. The average number of admission day's pre-operation 1.39 (.553). Only 26.2% of the patients were admitted to the surgical ward before surgery. 10.4% of the patients were transferred from other hospitals before surgery. 97.4% of the patients were admitted to the surgery ward after the surgery. The average postoperative days were 4.63(3.786). Using the multivariable logistic regression test with the Enter model showed the following variables could not predict the incidence of surgical wound infection (Table-1).

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hours. Most importantly, the need for postoperative dressing more than 1 time during the first 48 hr. increases the risk of wound infection by 39.297 times (Table-2).

Log?=-41.975-.118 variable6-2.147 variable4-.367 variable1+3.671 variable5+.211 variable3+.275 variable2

Table 1: Variables independent to the incidence of surgical wound infection

Model inter	Unstand. Coeff. B	Stand Coeff. SE	Beta	t	Sig.
●The shaver	-.005	.029	-.007	-.175	.861
●The education level of shaver	-.020	.011	-.068	-1.796	.073
●The shaving shift	.007	.022	.015	.319	.750
●The mean time between surgery to discharge	.043	.030	.069	1.439	.151
●Average time between shaving to surgery	.002	.007	.011	.286	.775
●Types of prosthesis	.029	.021	.054	1.399	.163
●Day of the week on which the surgery was performed	.027	.022	.047	1.198	.232
●Mean time of hospitalization	.057	.022	.111	2.622	.009
●Types of anesthesia	.002	.010	.010	.208	.836
●Transfer from other hospital	-.017	.019	-.035	-.908	.365
●Wards before and after surgery	.095	.069	.053	1.378	.169
●Antibiotics applied before & after surgery	.000	.003	-.006	-.086	.932
●Antibiotics at discharge time	-.274	.169	-.094	-1.619	.106
●Skin or bone traction before operation	.069	.055	.068	1.261	.208
●Average time between shaving to surgery	.001	.001	.040	1.063	.289
●Average time between hospitalization to surgery	.000	.009	-.003	-.042	.967
●The shift of surgery	-.011	.010	-.170	-1.166	.244
●The average of surgery time	.001	.000	.074	1.873	.062
●The mean time of admission before and after surgery	.002	.004	.016	.410	.682

Table 2: Multivariate logistic regression model for variables affecting surgical site infection

Variables	B	S.E.	Wald	Sig.	Exp(B)
●Mean number of operations performed in the shifts in OR	-.367	.080	21.126	.000	.693
●Type of operations done in the shifts in OR	.275	.091	9.157	.002	1.317
●Mean shift of personnel in a month	.211	.077	7.467	.006	1.235
●Infected patients in the room	-2.147	1.099	3.820	.051	.117
●Frequency of postoperative dressing	3.671	.707	26.939	.000	39.297
●Need to dressing in home	-.118	.060	3.887	.049	.889
●Constant	-41.975	16.356	6.586	.010	.000

Discussion:

In this study, none of the variables related to surgical site shaving, such as the person who performs shaving (patient, care givers, nurse), the education level of the person who does the shave, the shift in which shaving is done, the mean time

ORIGINAL ARTICLE

interval between shaving and surgery did not relate the incidence of orthopedic wound infection. While Maksimovic's study conducted in Belgrade reported that in patients who were shaved with a razor, the period of 12 or more hours between shaving and intervention was also an independent risk factor (OR, 2.77; 95% CI, 1.22-6.28) (Maksimovic *et al.*, 2008). In the Guide to the Elimination of Orthopedic Surgical Site Infections published by the Association for Professionals in Infection Control and Epidemiology (APIC), it is announced that the shorter the interval between shaving the surgery site and the operation, the lower the risk of infection with orthopedic wound (Rosenbaum *et al.*, 2010). The mean surgical time was not also an effective predictor in the incidence of surgical site infections. As per Soroush *et al.* (2007) in Iran, the duration of surgery was introduced as the risk factor for the incidence of surgical wounds. While in the review of Cheng *et al.* (2017), specifically for orthopedic surgeries, an increase in the mean operative time by 20% or greater (3 h) was reported to be associated with adjusted odds ratios ranging from 3.63 to 7.40. Pooled analyses for orthopedic surgery, irrespective of operative time threshold, demonstrated a statistically significant association, with an increased 84% likelihood of SSI. Prolonged operative time can increase the risk of SSI. In addition, the study demonstrates comprehensively that prolonged operative time can increase the likelihood of developing SSI across a broad array of surgical procedures and surgical specialties. Overall, pooled analyses demonstrated that patients with extended operative times across a wide range of procedures had approximately twice the likelihood of developing SSI, and on average, the mean operative time was approximately 30 min longer in patients with SSIs as compared with those patients without SSIs. Nevertheless, given the importance of SSIs on patient outcome and health care economics including hospital reimbursement penalties, hospitals should focus efforts to reduce operative time. Further, contrary to our study, the duration of surgeries longer than 3 hours (OR, 3.633) was reported by Li *et al.* (2013).

In the study of Ribeiro *et al.* (2013) among the variables studied by the logistic regression model, only the total time of admission in the hospital could affect the incidence of surgical site infection, while in this study this variable could not have shown such an effect on the incidence of surgical wound infections. They also found that the type of anesthesia was also not effective in the incidence of orthopedic wound infections. In our study, like the study of Ribeiro *et al.* (2013) and de Boer *et al.* (1999), the use of prophylaxis antibiotics was not found as a good predictor of the incidence of orthopedic wound infections, even for clean wounds. Nevertheless, Li *et al.* (2013) reported the use of prophylactic antibiotics as a preventative factor in the incidence of orthopedic wound infection.

Like our study, the variables that could predict the incidence of surgical site infections were far less investigated in other studies. Therefore, there was less possibility to make a comparison with the results of other studies. However, in the case of the variables 1, 2 and 4 listed in Table-1, it can be stated

that the increase in the number of operations in a specific shift in the operating room, operations other than orthopedic surgery in the same shifts in the operating room, and the presence of an infected patient in the orthopedic not-infected patient room within the first four days after surgery can increase the risk of surgical wound infections. The APIC Orthopedic Infection Removal Guide states that air quality in the operating room is one of the factors affecting the incidence of orthopedic wound infections.

Traffic Patterns were also considered as another important risk factor, and it was said that studies have also shown that the number of individuals in the operating room and the amount of movement of these individuals within the OR both increase the number of colony-forming units as measured by settle plates within the room. Olsen *et al.* (2003) reported that two or more residents participating in the operative procedure were an independent risk factor for SSIs in spine surgery. Therefore, it is important that movement of personnel is kept to a minimum while invasive procedures are in progress.

With respect to variable 3 in Table-1, it could be stated that the higher the number of personnel shifts, the greater the incidence of orthopedic wound infection. This issue has been highlighted in different aspects of other studies in nursing management, where the increase in the average number of personnel shifts in each ward can endanger the patient's safety and increase hospital complications. As a result, the number of hospital admission days will be higher, the professional commitment will decrease and job burnout will increase (Hojat *et al.*, 2010, 2012, 2013; Karimyar & Hojat, 2014). Based on variables 5 & 6 of Table-1, it could be stated that to minimize the infection, when the more secretions and bleeding from the wound, the more changes in the dressing and would be required in both; in the hospital and at home. Finally, reducing staff overtime, reducing the need for postoperative dressings, reducing non-orthopedic surgery in the operating room on orthopedic surgery day can reduce the incidence of orthopedic wound infections.

Acknowledgment:

We appreciate to all patients and staff that helped us with this study. The present study was conducted with the financial support of Jahrom University of Medical Sciences (HSR.90 / 6).

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