Evaluation of Prescription Pattern of Antibiotic Prophylaxis in Patients Undergoing Orthopedic Surgical Procedures and Their Clinical Outcomes in Jahrom

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Abstract

Introduction: Surgical site infection (SSI), after orthopedic surgery and arthroplasty, is associated with serious outcomes, including significant increases in length of stay, re-admissions, health costs, and mortality rates, many of which can be prevented. The aim of the present study was to investigate the clinical outcomes of prescription pattern of antibiotic prophylaxis in adult patients undergoing orthopedic surgical procedures at Peymanieh Hospital in Jahrom, Iran. **Materials and Methods**: The present cross-sectional study was carried out on 280 patients referred to the Orthopedic Department of Peymaniyeh Hospital of Jahrom in 2016. Data collection was carried out using a researcher-made checklist, which included three parts: demographic information, prescription characteristics of prophylactic antibiotics, recording side effects, and clinical outcomes. Data analysis was carried out using Chi-square or Fisher's exact test for qualitative variables and independent-samples t-testi n SPSS ver. 19. **Results**: A total of 280 subjects with a mean age of 38.4 ± 20.3 years were investigated. The mortality rate was zero percent, and no pulmonary and renal complications, wound dehiscence, and secondary nosocomial infections were observed. The only complication observed and recorded among individuals was superficial wound infection, which was observed in 8.3% of patients (n=25 patients). There was a significant relationship between superficial wound infection with sex, type of surgery, and site of injury ($P<0.05$). **Conclusion**: The antibiotic prophylaxis protocol used prior to orthopedic surgery in Jahrom was based on standard patterns, but there was a significant wound infection and it is recommended to carry out further studies in this regard.

Keywords: Orthopedic surgery, Wound infection, Hospitalization, Nosocomial infection, antibiotic prophylaxis

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Introduction

Nosocomial infections are one of the most important health issues worldwide. Nosocomial infection is a local or general condition caused by adverse reactions due to an infectious agent or its toxin, and the patient doesn't contract it upon admission and is not in the latent period, and is often developed 48-72 hours after hospitalization (1). Surgical site infection (SSI) is the second most common cause of nosocomial infections and the most common cause of mortality after surgery (2, 3). SSI has always been a costly and troublesome problem and can have devastating consequences and can occur as an infectious problem in 3% to 10% of cases. SSI is associated with side effects and increases health care costs (4).

The in cadence of SSI following orthopedic surgery and arthroplasty is associated with serious clinical outcomes, including significant increases in length of stay, re-admissions, health costs, and mortality rates, many of which can be prevented (5). These infections account for 22% of infections and add to health-related costs by 1-10 billion dollars a year. On the other hand, postoperative infections cause a lot of damage to the economy, so that a study has shown that most patients are not able to return to work after surgery (6).

Bacteria are one of the most common causes of nosocomial infections, especially in the surgical wards. Postoperative SSI pathogens often include gram-positive cocci such as staphylococcus aureus and staphylococcus epidermidis and gram-negative coagulases, etc. SSI is an infection that occurs

within 30 days after surgery, which is a major cause of postoperative morbidity and mortality (7). Since the introduction of prophylactic antibiotics in the 1960s, there has certainly been a significant effect on the control of SSI as compared to time of the introduction of the aseptic technique. However, the widespread use of prophylactic antibiotics, which mainly account for 50% of antimicrobial use in hospitals, has led to changes in microbial flora in hospitals and the antibiotic resistance pattern worldwide. There are evidenced-based guidelines on the proper use of prophylactic antibiotics, but prophylactic antibiotics are still used inappropriately in the surgical community. Prophylactic agents are likely to target specific microorganisms in the surgical site and will vary depending on the range of bacteria targeted and the required time (8, 9). There is a general trend toward using shorter courses of antibiotics to prevent surgery in order to reduce toxicity, counteract antibiotic resistance, and reduce costs. Modern surgical procedures have not reduced the infection rate in the late twentieth century, because advances in surgical techniques have not led to advances in antimicrobial prophylaxis (10).

Duration and timing of antibiotic administration for surgical prophylaxis is one of the factors influencing the effectiveness of the administration process. Since the late 1970s, the duration of the antimicrobial regimen was reduced from 7 to 4 days (11). National surgical infection prevention project (SIP) of the United States of America has suggested that the first dose of antibiotics should be administrated within 60 minutes preoperatively and discontinued 24 hours postoperatively (12). The use of prophylactic antibiotics in orthopedic surgery is also well accepted. A study on the effect of prophylactic antibiotics in patients undergoing pelvic and knee joint replacement surgery showed that they reduced the absolute risk of SSI by up to 80% (13).

There have also been many studies on the effect of prophylactic antibiotics on SSI prevention in open fractures and the results showed that it led to a significant reduction in SSI. Other studies on closed fractures have shown that the use of a single dose of prophylactic antibiotics significantly reduces deep wound infection as well as superficial wound infections, urinary tract infections, and respiratory tract infections (7, 8, 11).

Various antibiotics have been recommended to prevent infections occurring after orthopedic surgeries. Some studies have identified first-generation cephalosporins as safe, effective, and preferred drugs. However, many physicians today use vancomycin as a prophylactic antibiotic against SSI due to methicillin-resistant Staphylococcus aureus (MRSA) infection. On the other hand, there are several side effects associated with using vancomycin such as anaphylactic reaction, thrombophlebitis, renal, hepatic, and auditory toxicity. On the other hand, vancomycin can accelerate vancomycin resistance (14, 15). The effect of aminoglycosides such as gentamicin as a secondary prophylaxis has not been well proved. Recent studies recommended the use of other antibiotics instead of aminoglycosides, because the important thing about aminoglycosides is that they are nephrotoxic, which is currently one of the most common causes of Iatrogenic renal disease (4, 16).

Considering the fact that illogical and inappropriate use of prophylactic antibiotics, in addition to increasing the incidence of drug-induced side effects and imposing additional costs on the patient and the health system, increases antimicrobial resistance and reduces the effectiveness of antibiotics, the researchers of the present study decided to investigate the clinical outcomes of the administration pattern pg prophylactic antibiotics in adult patients undergoing orthopedic surgery at Peymanieh Hospital in Jahrom, Iran.

Materials and Methods

The present cross-sectional study was carried out on 280 patients referred to the Orthopedic Department of Peymaniyeh Hospital in Jahrom City in 2016. Inclusion criteria included all people undergoing orthopedic surgery, including open and closed fracture surgery, pelvic and knee replacement surgery, and the age range of 10-80 years. Exclusion criteria also included previous history of antibiotic use for any reason, patients undergoing hemodialysis, patients who usually needed reoperation less than 72 hours after surgery, or patients undergoing immunosuppressive therapy, corticosteroids, and chemotherapy.

Data collection was carried out using non-random method. A researcher-made checklist was used to collect data, and the face and content validity of the checklist were reviewed and approved by faculty members. This tool is a three-part checklist, the first and third parts of which are related to demographic information, characteristics of the antibiotic prophylaxis, recording of side effects and clinical outcomes, respectively. The first part includes demographic information (including age, sex, education, and marital status), cause of hospitalization, type of surgery, risk factors (infection before wound surgery, weakened immune system, history of immunosuppressive drug), and other underlying diseases. The second part of the checklist includes information about prescribed antibiotics, including: the name, dose, and duration of the antibiotic. The third part consists of information on the incidence of complications, including renal complications (need for dialysis of pulmonary complications

Table 1. Demographic information of patients undergoing orthopedic surgery

Variable	Variable components	Absolute frequency	Relative frequency
Sex	Male	206	6.7%
	Female	94	31.3%
Marital status	Single	103	34.3%
	Married	197	65.7%
Type of surgery	Elective	270	90%
	Emergency	5	7.1%
	The second action	25	3.8%
Type of diagnosis	Upper limb disorders	116	38.7%
	Lower limb disorders	157	52.3%
	Arthroplasty	27	9%
Age	Mean ± SD	38.20± 4.3	
Length of hospital stay	Mean ± SD	3.1 ± 1.6	

Table 2. Relative and absolute frequency of superficial wound infection

Superficial wound infection	Absolute frequency	Relative frequency
Yes	25	8.3%
No	275	91.7%

Table 3. The relationship between frequency of superficial wound infection with sex, type of surgery, and type of injury variables

Wound infectionVariables	Yes	No	df	*P*-value
Sex	Male	180 (88.7%)	df=1	0.007
	Female	95 (97.9%)		
Type of surgery	Elective	251 (93%)	df=2	0.01
	Emergency	3 (60%)		
	Second surgery	21 (84%)		
Category of surgery	Upper limbs	107 (93.9%)	df=2	0.05
	Lower limbs	137 (88.4%)		
	Arthroplasty	97 (100%)		

(pneumonia), secondary nosocomial infections (wound infection, wound dehiscence and secondary infections), as well as outcomes such prolonged length of stay in ward and hospital.

The information was collected by the researcher through the study of patients' cases and recorded in the relevant checklist until discharge. Finally, data analysis was carried out using chi-square and Fisher's exact test for qualitative variables and independent-samples t-test for quantitative data in SPSS ver. 19 (p-value <0.05). The present study was approved after obtaining permission from the University's Ethics Committee with the code of ethics IR.JUMS.REC.1395.028.

Results

Among the study subjects, 206 (67.8%) were male and the rest were female, and their mean age was 38.4 ± 20.3 years (Table 1).

The routine prescription pattern includes one antibiotic from first-generation cephalosporins+one antibiotic from the aminoglycoside group as follows:

Cephalothin (keflin) (20mg / kg) ampoule every 6 hours (not more than 1 gr in adults) + gentamicin (1mg / kg) ampoule every 8 hours and if necessary, ciprofloxacin, ceftriaxone and clindamycin were also used.

According to the results, the frequency of antibiotics used among the 300 patients studied was as follows: keflin (98.7%, n=296 people), gentamicin (71%, n=213 people), ciprofloxacin (12%, n=36 people), clindamycin (1.4%, n=4), and ceftriaxone (1%, n=2 people). The mortality rate was zero percent, and no pulmonary and renal complications, wound dehiscence, and secondary nosocomial infections were observed. The only complication observed and recorded among individuals was superficial wound infection, which was observed in 8.3% of patients (n=25 patients) (Table 2).

The present study also revealed a significant relationship between superficial wound infection with sex, type of surgery and site of injury, and the incidence of superficial wound infection was higher in males, emergency surgical procedures, and lower limb injuries, respectively (*P*-value<0.05) (Table 3).

Discussion

The results of the present study showed that the common preoperative prophylactic antibiotic protocol pattern used before orthopedic surgery in Jahrom city was one antibiotic from the first-generation cephalosporins along with one antibiotic from the aminoglycosides. Also, keflin and gentamicin are the most widely used antibiotics used in the prophylactic antibiotic protocol before orthopedic surgery, followed by ciprofloxacin, clindamycin, and ceftriaxone, respectively. Bratzler *et al.* referred to cefazolin and cefuroxime as the preferred antibiotic for patients undergoing orthopedic surgery (3). Reineke *et al.*'s study, the most common prescription pattern of prophylactic antibiotics was the use of cefuroxime (second-generation cephalosporins) along with clindamycin (8). The use of second-generation cephalosporins and sometimes in combination with aminoglycosides was recommended in a study by Delinger *et al.* (4). Kurokawa *et al.* (2017) referred to only a single dose of a first-generation cephalosporin before surgery and its three doses after orthopedic surgery as the most common prophylactic pattern (17). Most previous studies have shown that is unnecessary to use prophylactic antibiotics after surgical wound closure, and when comparing the use of single dose versus multiple dose of antibiotic prophylaxis, no evidence was indicative of the superiority of the multiple dose (3, 18).

Effective antibiotic prophylaxis depends on a few basic points: The history of the allergy must first be considered in the patient; a first- or second-generation cephalosporin antibiotic is usually sufficient, and when there is a MRSA infection, a glycopeptide antibiotic such as vancomycin is recommended. Another important point is that the prophylaxis should be prescribed at least half to one hour preoperatively, and a single dose is usually sufficient, except in cases where the surgery lasts more than 4 hours or the patient has lost a significant amount of blood and redosing may be required, and almost all conditions were met in the present study (20).

In the present study, the side effects of this antibiotic regimen were investigated and complications such as pulmonary and kidney complications, wound dehiscence, as well as secondary nosocomial infections were investigated. The results showed none of these side effects. However, the only complication was superficial wound infection, which was observed in 8.3% of the subjects. Moreover, the above infection was more common in men, people undergoing emergency surgery, and traumatic patients with lower limb injuries. The incidence of nosocomial infection in two hospitals located in the west of the country was reported to be 3.8%, which was significantly higher in males and those undergoing emergency surgery (Mardanpour *et al.* (19). This figure was reported to be 6.8% in the study by Kheyri *et al.* (20). Lee's reported that the incidence rate of SSI after orthopedic surgery was 2.18% (21). In the study by Al-Mulhim *et al.*, the incidence rate of SSI was reported to be 2.55%, which was more common in younger age groups and people undergoing emergency surgery and less common in those who undergoing arthroplasty (22).

In the present study, the incidence rate of SSI was zero in patients undergoing arthroplasty and was higher in trauma patients with lower limb injuries. Also, the incidence of SSI was higher in patients undergoing emergency surgery than those undergoing elective surgery. These different incidence rates can be attributed to the difference in intraoperative and postoperative care of patients undergoing arthroplasty compared to trauma and emergency patients. Also, considering the nature of the surgery and the greater tendency to infection, surgeons and staff take extra care during arthroplasty to limit infection. One of the limitations of the present study was the use of non-random sampling and that information was received from patients' case that could not be comprehensive and complete.

Conclusion

The results of the present study revealed that the prophylactic antibiotic admonstration protocol used before orthopedic surgery in Jahrom city followed the standard patterns, but the SSI incidence rate was significantly high and should be considered in surgery, especially emergency surgery, which is generally performed in trauma patients and attention should be paid to the necessary measures to reduce SSI rate by surgeons and personnel. However, further studies are needed in this regard.

Suggestions

-Further research on surgical infections

-A study that investigates prophylactic antibiotics separately in urgeries

-A clinical trial study on the effect of prophylactic antibiotics on orthopedic surgery

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