

## Type and Rate of Prophylactic Antibiotic Use in the Orthopedic Patients Underwent Elective Surgeries in Shahid Beheshti Hospital in Babol

A. Shabanian (MD)<sup>1</sup>, M. Hossein Karimi Nasab (MD)<sup>2,3</sup>, M. Shayesteh Azar (MD)<sup>2,3</sup>,  
S. M. Esmailnezhad Ganji (MD)<sup>4\*</sup>

1.Student Research Committee, Health Research Institute, Babol University of Medical Sciences, Babol, I.R.Iran

2.Research Center of Orthopedics, Mazandaran University of Medical Sciences, Sari, I.R.Iran

3.Department of Orthopedics, Mazandaran University of Medical Sciences, Sari, I.R.Iran

4.Clinical Research Development Center, Shahid Beheshti Hospital, Babol University of Medical Sciences, Babol, I.R.Iran

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### ABSTRACT

**BACKGROUND AND OBJECTIVE:** Postoperative infection has been one of the most frequent problems in orthopedics that the prescription of antibiotics to prevent surgical infection is an effective strategy to reduce infections after surgery. The aim of this study was investigating type and amount of prophylactic antibiotics used in the orthopedic cases administered in Shahid Beheshti Hospital in Babol, northern Iran.

**METHODS:** This cross-sectional study was conducted on 450 traumatic and non-traumatic patients underwent elective orthopedic surgeries and received antibiotic prophylaxis during 2015-2016. The necessary data were collected from the patients' records using a predesigned checklist. This checklist consisted of demographic information, type and mechanism of trauma and information related to prophylaxis (name of antibiotic, dosage, administration method, time to start prophylaxis, administration intervals and overall prophylaxis duration).

**FINDINGS:** Out of 450 patients, 300 (66.7%) were male and others were female. The mean age was 42.37±21.53. The most commonly used antibiotic was cefazolin (n=437, 97.3%) and gentamycin (n=276, 62%), and the lowest was amikacin (n=8, 1.8%). Mean duration of use was 4.92±1.8 days, ranging from 1 to 15 days.

**CONCLUSION:** The results showed that the use of prophylactic antibiotics is high and they should be administered with more precise control. The most commonly used antibiotic for prophylaxis was cefazolin and the least was amikacin.

**KEY WORDS:** Antibiotic Prophylaxis, Infection, Orthopedics.

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\*Corresponding Author: S. M. Esmailnezhad Ganji (MD)

Address: Department of Orthopedics, Babol University of Medical Sciences, Ganjafrooz Street, Babol, I.R.Iran.

Tel: +98 11 321999360

E-mail: smsnganji@yahoo.com

## Introduction

Prescribing antibiotics to prevent surgical infections is an effective strategy to reduce post-operative infections, if provided appropriate antibiotics are given at the right time and for a sufficient minimum duration with surgical procedures (1).

In different countries, strategies have been developed to prevent the onset of surgical site infections. The recommendations are the same in all protocols, including the selection of antibiotics appropriate to the type of surgery, prescribing an hour before surgery, and discontinuing it within 24 hours after surgery.

If antibiotic prophylaxis is not performed according to the correct principles, there are several complications such as decrease of the natural microbial flora of the body, the addition of a new infection, the growth of bacteria resistant to antibiotics and infection with these bacteria, increased risk of drug toxicity and therefore increase of unnecessary costs (2-7). In recent years, the Ministry of Health and Medical Education has issued a national injunction to prevent with antibiotics in surgery that is required for all hospitals (8).

It is said that between 30% and 50% of antibiotics are used in hospitals for prophylaxis of surgery, while between 30-90% of prophylaxis are inappropriate and in most cases the antibiotics are mistaken for the patient or continue them for a very long time (9). According to expert opinions, due to the excessive consumption of antibiotics in Iran and the microbial resistance to these drugs, the impact of their first generation (such as ampicillin and penicillin) in Iran is declining, and this could seriously threaten the health of the inhabitants of the country in the future.

According to statistics, the drug letter in 2007, the total pharmaceutical sales of the country is about 1,900 billion toman, of which 300 billion toman is related to antibiotic drugs. Also, antibiotics account for 10% of the per capita health share and 30% of the per capita share of the pharmaceutical industry in the country (10). Therefore, considering the complications of antibiotics and the costly burden imposed on the health system of the country, as well as the lack of information on the status of prescribing them in the educational centers of Babol University of Medical Sciences, this study was conducted to determine the rate of prophylactic antibiotic administration in orthopedic surgery operations of Shahid Beheshti Medical Center of Babol in order to this report can help to plan for better health management.

## Methods

This cross-sectional study after approval by the Ethics Committee of Babol University of Medical Sciences with code MUBABOL.RE.1395.147 was performed on all traumatic and nontraumatic patients that were subjected to elective orthopedic surgeries in 2015 and carried out by a surgeon at the Shahid Beheshti hospital in Babol. Patients treated through the skin or external fixation, known cephalosporin sensitivity, signs of infection, or used antimicrobial agents one week before surgery, pregnant women, patients treated with immunosuppressive drugs, patients With open fractures, people with underlying illnesses, such as diabetes and chronic obstructive airway disease were excluded. Information was collected using a checklist.

This checklist includes the individual characteristics of the patients (age, sex, and smoking), type and mechanism of trauma causing injury, type of fracture (location) and characteristics of the wound as well as medical records, disease, indication of antibiotic prophylaxis, type of prescribed antibiotic, the dosage, the route of administration, the start time of the antibiotic, the interval between the meals of antibiotics and the total duration of antibiotic administration. Data were analyzed by SPSS software using descriptive and chi-square tests.  $P < 0.05$  was considered as meaningful level.

## Results

Of 874 patients undergoing surgery, at last, 450 people were enrolled in the study and the rest were excluded. 300 of them (66.7%) were male and the rest were women. The mean age of the subjects was  $42.37 \pm 21.53$  years. The most common cause was the fracture surgery (90%) (Table 1).

Cefazolin (97.3%, 438), followed by gentamicin (62%, 276), were the most commonly used antibiotics in hospitalized patients. In contrast, amikacin had the lowest usage (1.8%, 8). Ciprofloxacin was also used for a longer period than other antibiotics (Table 2). The mean number of days of antibiotic use in this study was  $4.92 \pm 1.8$  days (minimum 1 day and maximum 15 days). The rate of antibiotic use of amikacin, gentamicin, ciprofloxacin, clindamycin and vancomycin was significantly higher in patients with lower limb surgery than in patients with upper limb surgery ( $p = 0.001$ ,  $p < 0.001$ ,  $p = 0.001$  and  $p = 0.009$ ). Also, cefalexin in patients with upper extremity surgery was significantly higher than the lower extremity ( $p = 0.022$ ) (Table 3).

The levels of antibiotic use of cefazolin, cefalexin, clindamycin and vancomycin were significantly higher in patients who were admitted to the emergency

department and then to the orthopedic ward more than those referred to the clinic and admitted to the orthopedic ward ( $p=0.001$ ,  $p<0.001$  and  $p=0.016$ ).

**Table 1. Specifications of studied patients**

| Variable                            | N(%)        |
|-------------------------------------|-------------|
| Age(Mean±SD)                        | 42.37±21.53 |
| man                                 | 300(66.7)   |
| woman                               | 150(33.3)   |
| <b>Previous fracture history</b>    |             |
| yes                                 | 13(2.9)     |
| no                                  | 437(97.1)   |
| <b>History of smoking / alcohol</b> |             |
| yes                                 | 43(9.5)     |
| no                                  | 47(90.5)    |
| <b>Underlying disease</b>           |             |
| hypertention                        | 19(4.2)     |
| Heart disease                       | 6(1.3)      |
| <b>Cause of surgery</b>             |             |
| fracture                            | 405(90)     |
| Joint disease                       | 28(6.23)    |
| Soft tissue disease                 | 17(3.77)    |

**Table 2. Number and duration of antibiotic use in patients**

| Antibiotic      | Consumption No. | Duration per day (Mean±SD) | Min (day) | Max (day) |
|-----------------|-----------------|----------------------------|-----------|-----------|
| gentamycine     | 276             | 3.37±1.12                  | 1         | 7         |
| vancomycine     | 11              | 2.72±2.61                  | 1         | 9         |
| amikacine       | 8               | 5.82±1.01                  | 4         | 15        |
| clindamycine    | 16              | 3.42±2.32                  | 3         | 9         |
| cefazoline      | 438             | 3.19±2.01                  | 1         | 15        |
| ciprofloxacin   | 253             | 9.92±0.74                  | 5         | 15        |
| cefalexin       | 409             | 9.9±0.64                   | 3         | 10        |
| Oral antibiotic | 422             | 9.89±0.83                  | 3         | 15        |

**Table 3. Distribution of antibiotic use in the studied groups**

| Total number of patients in the group |             | cefazolin N(%) | gentamycin N(%) | amikacin N(%) | ciprofloxacin N(%) | cefalexin N(%) | vancomycin N(%) | clindamycin N(%) |
|---------------------------------------|-------------|----------------|-----------------|---------------|--------------------|----------------|-----------------|------------------|
| age                                   | 15≤         | 55             | 52(94.5)        | 20(36.4)      | 0(0)               | 4(7.3)         | 40(72.5)        | 0(0)             |
|                                       | 15 >        | 395            | 385(97.5)       | 259(34.4)     | 8(2)               | 249(63)        | 369(93.4)       | 11(2.8)          |
| gender                                | man         | 300            | 290(96.7)       | 184(61.3)     | 4(1.3)             | 158(63.3)      | 276(92)         | 6(2)             |
|                                       | woman       | 150            | 147(98)         | 95(63.3)      | 4(2.7)             | 95(52.7)       | 133(88.7)       | 5(3.3)           |
| limb                                  | upper       | 258            | 250(96.9)       | 99(38.4)      | 0(0)               | 74(28.7)       | 228(88.4)       | 2(0.8)           |
|                                       | lower       | 192            | 187(97.4)       | 180(93.8)     | 8(4.2)             | 179(93.2)      | 181(94.3)       | 9(4.7)           |
| Upper limb                            | proximal 1* | 188            | 186(98.9)       | 63(33.5)      | 0(0)               | 42(22.3)       | 184(97.9)       | 2(1.1)           |
|                                       | distal 2*   | 70             | 64(91.4)        | 36(51.4)      | 0(0)               | 32(45.7)       | 44(62.9)        | 0(0)             |
| Lower limb                            | proximal 3* | 127            | 124(97.6)       | 121(95.3)     | 3(2.4)             | 115(90.6)      | 118(92.9)       | 6(4.7)           |
|                                       | distal 4*   | 65             | 63(96.9)        | 59(90.8)      | 5(7.7)             | 64(98.5)       | 63(96.9)        | 3(4.6)           |
| hospitalized                          | emergency   | 406            | 399(98.3)       | 257(63.3)     | 0(0)               | 224(55.2)      | 381(93.8)       | 7(1.7)           |
|                                       | clinic      | 44             | 38(86.4)        | 22(50)        | 8(18.2)            | 29(65.9)       | 28(63.6)        | 4(9.1)           |

\* 1: From shoulder to elbow \* 2: From elbow to fingers \* 3: From hip to knee \* 4: From knee to toe

## Discussion

The most commonly used antibiotics in this study were cefazolin (97.3% of patients) and gentamicin (62% of patients), and amikacin was the lowest (1.8% of patients). The results of this study were in accordance with the country guidelines that recommended cefazolin as a prophylaxis for patients (8). In a study reported by Gans et al., after questioning members of the orthopedic trauma association, it was stated that 96% of surgeons use cefazolin as the first line of prophylaxis, indicating a high degree of compliance with instructions (11). This is consistent with the high consumption of cefazolin in our study. While there is strong evidence for the need for prophylaxis, there is little evidence to indicate the superiority of the effect of an antibiotic on another antibiotic.

Cephalosporins can cope with more infections of *Staphylococcus aureus* and Gram-negative organisms. They also have a half-life and good penetration in the bone, joint and muscle (13,12). In 2008, the American Academy of Orthopedic Surgeons recommended cefazolin or cefuroxime for patients under arthroplasty (14). In UK, cephalosporins are no longer the first line of prophylaxis due to concerns about colostrum diphilic infection (15).

Aminoglycosides, even with precise doses, are likely to cause kidney toxicities and complications in the ear. Also, the onset of resistance in *Serratia* and *Pseudomonas* to gentamicin could lead in the presence of prophylaxis. These drugs can also accelerate the production of methicillin-resistant staphylococci. This causes a faulty process. Vancomycin is used to treat these staphylococci, which itself will cause vancomycin-resistant enterococci. Therefore, caution should be exercised in choosing aminoglycosides as prophylaxis (16).

Prophylactic antibiotics can reduce the risk of wound infections and are used routinely in orthopedic surgeries. Despite their widespread use, there are still questions about the choice of prophylaxis antibiotics in terms of duration and dose. The average number of days of antibiotic use in this study was  $4.92 \pm 1.8$  days. In most of the previous studies, the most unfavorable prophylactic variable with antibiotics was the duration of antibiotic administration (17-19).

There is little evidence regarding the decision about prophylaxis. The American Academy of Orthopedic

Surgeons recommends that prophylaxis should not exceed 24 hours (20). A retrospective study of 1341 patients with complete hip and knee replacement showed that there was no significant difference in the rate of infection between the group receiving prophylaxis for one day (0.67%) and the group received for 3 days (0.6%) (21).

In a study by Alizadeh et al. (22), performed on 453 orthopedic patients undergoing soft tissue surgery, none of the patients received prophylaxis antibiotics before, during and after surgery, and only two cases had surgical infection and other patients did not show any signs of infection, and concluded that in order to prevent infection, only observing the principles of aspiration and performing surgery based on the correct techniques can prevent the infection in clean procedures and do not require the use of antibiotics as prophylaxis.

Long-term administration of prophylactic antibiotics has a harmful effect on the economy of the health system of each country. With regard to the type of antibiotic prophylaxis, each surgeon may operate on the basis of his experience. However, regarding the duration of use of prophylactic antibiotics, the economic aspects and the induction of drug resistance, as well as unwanted drug reactions that are a serious problem in the health system should be considered.

Regarding the study limitations, it should be noted that some of the cases were excluded from the study due to incomplete information. Also, data on the combined use of antibiotics were not provided and it is suggested that in further studies be considered. The results of the study showed that the duration of administration of prophylactic antibiotics is high and does not conform to some health guidelines.

Therefore, it is recommended that prescribing the antibiotics as prophylaxis should be more precise in order to prevent the side effects of drugs, the spread of resistant infections and the higher cost of treatment in the country.

However, since the existing guidelines are not reported regionally, but have provided a modest amount of prophylaxis for the country, and given that these guidelines are for a limited range of orthopedic surgeries, it is necessary that a standardized instruction in accordance with the socio-economic status, availability of medication and regional health policy for orthopedic surgeries will be provided.

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