Prophylactic Antibiotic Pattern in Open Reduction Internal Fixation for Closed Fractures at Dr. Hasan Sadikin General Hospital Bandung in 2013

Deviana Suciani Edwiza,[1] Ike Rostikawati Husen,[2] Widya Arsa[3]
[1]Faculty of Medicine, Universitas Padjadjaran, [2]Departmen of Pharmacology and Therapy Faculty of Medicine Universitas Padjadjaran, [3]Department of Orthopaedic and Traumatology, Faculty of Medicine, Universitas Padjadjaran/Dr. Hasan Sadikin General Hospital, Bandung, Indonesia

Abstract

Background: Surgical site infection remains a serious complication of a surgery. Prophylactic antibiotics should be used in open reduction and internal fixation to prevent surgical site infection. This study aimed to study the pattern of prophylaxis used in internal fixation of closed fractures as this surgery is considered as a high-risk orthopedic procedures.

Methods: This retrospective-descriptive study was performed from August to October 2014. Subject was closed fracture patient who underwent open reduction and internal fixation at Dr. Hasan Sadikin General Hospital Bandung in 2013. Data about characteristics of patients and pattern of the use of prophylactic antibiotics were obtained from patients' medical record.

Results: Medical records from 76 patients who underwent ORIF were analyzed. Sixty eight patients (68.4%) were given 1 gram cefazolin intravenously as preoperative antibiotic prophylaxis. Timing for administration of antibiotics was 30–60 minute preoperatively in 34 (44.2%) patients. All Patients were given postoperative prophylaxis for 4.09 ± 1.36 days in average. The antibiotic most commonly used was cefazolin in 51 (63%) patients. All patients were prescribed an oral antibiotic at discharge. Cefadroxil was the most common antibiotic prescribed for patients at discharge.

Conclusions: Cefazolin is the most common preoperative prophylactic antibiotic given to patients. All Patients are given postoperative prophylaxis and prescribed an antibiotic at discharge.

Keywords: Antibiotic prophylaxis, closed fractures, internal fixation

Introduction

Surgical site infection (SSI) is a serious complication after surgery. The SSI is the most common cause of nosocomial infection and defined as an infection in body cavity, bones, joints, meninges, and other tissues involved in a surgery within 30 days after surgery or within 1 year if the surgery involves an implant. The SSI causes disadvantages to the patient by prolonging postoperative hospital stay, increasing morbidity and mortality, giving additional hospital cost, and reducing productivity and quality of life.[1]

Internal fixation for closed fractures is considered as a high risk orthopedic surgery because it involves implantation of prosthetic materials that can act as a source of infection.[2] Hence, Centers for Disease Control and Prevention (CDC) recommends the use of antibiotic prophylaxis to reduce risk of infection. Antibiotic prophylaxis is the use of antibiotics with the goal of reducing intraoperative microbial contamination to prevent harm to patient's body.[1] Selection of antibiotics used for surgery prophylaxis is based on the local resistance pattern of antibiotic and pathogens that possibly causes infection in respective operative site.[3] Dose, timing, and duration of prophylactic administration should be considered, so that the antibiotic can be cost-effective to reduce the risk of infection.[1,3] In Indonesia, due to the lack of guideline and information about use of surgery prophylaxis, data collection to obtain information about patterns of prophylactic

Correspondence: Deviana Suciani Edwiza, Faculty of Medicine, Universitas Padjadjaran, Jalan Raya Bandung-Sumedang Km. 21, Jatinangor, Sumedang, West Java, Indonesia, Email: deviedwiza@yahoo.com

 ISSN 2337-4330 || doi: http://dx.doi.org/10.15850/amj.v4n3.1191

antibiotic use is necessary. Therefore, this study aimed to study the pattern of prophylaxis used in internal fixation of closed fractures as this surgery considered as a high-risk orthopedic procedures.

Methods

This retrospective-descriptive study was conducted at Department of Orthopaedics and Traumatology, Dr. Hasan Sadikin General Hospital (*Rumah Sakit Hasan Sadikin*, RSHS) Bandung from August to October 2014. The data were collected from patients' medical records. This study was approved by the Health Research Ethics Committee Dr. Hasan Sadikin General Hospital.

The population of this study was closed fracture patients who underwent open reduction and internal fixation (ORIF) conducted by Department of Orthopaedics and Traumatology, RSHS in 2013. Using total sampling method, all patients with closed fractures and underwent ORIF became the samples of this study. Patients with open fractures, infection before surgery, antibiotics administration before surgery, and patients with incomplete or missing medical records were excluded from this study. From each medical record, information about age, sex, location of surgery, duration of surgery, preoperative and postoperative prophylactic antibiotics, length of postoperative hospital stay, and clinical examination on the second postoperative day and time of discharge were collected. The detailed information about antibiotics used including name of drug, regimen dose, time of administration, and duration of administration were also documented.

Fracture location is the location of bone where the surgery performed. It is anatomically differentiated into the humerus, radius, ulna, and others. The duration of the surgery is a length of time of surgery seen from surgery report. Types of antibiotics consist of the name of the antibiotics used both preoperative, postoperative, and at home. Regimen dose is a dose of antibiotic administered to the patients and expressed in grams. The route of administration was also documented. Time of administration was divided into >60 minutes prior to incision, 30–60 minutes prior to incision, <30 minutes before incision, and after incision. Duration of administration was categorized into ≤24 hours,> 24 hours–48 hours,> 48 hours–72 hours, and> 72 hours after the first dose.

Table 1 Characteristics of Subject

Variable	(n=76)
Sex	
Male	68.4%
Female	31.6%
Age (mean±SD)	33.75±16.9
Fracture Location	
Single	
Femur	27.6%
Clavicle	9.2%
Radius	7.9%
Others	18.4%
Multiple	
Radius and Ulna	15.8%
Fibula and Tibia	3.9%
Others	15.8%
Surgery Duration (minutes) (mean±SD)	162.30±77.039
Length of Postoperative Hospital Stay (days) (mean±SD)	3.91±1.277

Table 2 Preoperative Prophylactic Antibiotics

Variable	Result (n=76)
Preoperative Antibiotics	
Single	
Cefazolin	68.4%
Ceftazidime	18.4%
Others	10.5%
Combination	
Cefazolin and Fosfomycin	1.3%
Cefazolin and Gentamicin	1.3%
Regimen Dose (n=78)*	
Cefazolin	
1 gram IV	61.5%
2 gram IV	6.4%
500 mg IV	1.3%
Ceftazidime	
1 gram IV	2.6%
2 gram IV	14.1%
500 mg IV	1.3%
Others	12.8%
Time of Administration (n=77)*	
>60 minutes before incission	27.3%
30–60 minutes before incission	44.2%
<30 minutes before incission	24.7%
After incission	3.9%

Note: *Total exceeded number of samples because some patients received more than 1 kind of antibiotic.

Length of postoperative hospital stay of patients is the duration of hospitalization after surgery until the patients are discharged. The results of clinical examination were all the findings on clinical examination such as fever, hyperemia, swelling, pain, tenderness, and pus obtained from the medical records of patients on the second postoperative day and at the time of discharge.

Data in the forms of frequency, percentage, mean, and standard deviation were presented in tables. The data were analyzed using Microsoft Excel 2007

Results

In 2013, 132 open reduction and internal fixation (ORIF) procedures were conducted by Department of Orthopaedics and Traumatology, RSHS for closed fracture patients. During this study, 76 medical records that met the inclusion criteria became sample of the study and were analyzed. Patient characteristics were shown in Table 1. The patients included 52 males and 24 females with an average age of 33.75 years old. The most frequent location of the fracture was the femur. All patients underwent surgery in the average duration of 162.70 minutes and underwent postoperative hospital stay in the average duration of 3.91 days.

Preoperative prophylactic antibiotic usage pattern was shown in Table 2, postoperative antibiotic prophylaxis in Table 3, and antibiotics at time of discharge in Table 4. The

Table 3 Postoperative Prophylactic Antibiotics during Hospital Stay

Variable	Result (n=76)
Postoperative Antibiotics	
Single	
Cefazolin	63.0%
Ceftazidime	7.4%
Others	14.8%
Combination	
Cefazolin and Gentamicin	11.1%
Cefazolin and Ceftazidime	2.5%
Others	1.2%
Regimen Dose (n=81)*	
Cefazolin	
2x1 gram IV	66.7%
2x500 mg IV	1.1%
Ceftazidime	
2x1 gram IV	7.5%
2x300 mg IV	1.1%
Gentamicin	
2x80 mg IV	9.7%
Others	14.1%
Duration of Administration (days) (mean±SD)	4.09±1.368
Duration of Administration	
≤24 hours after preoperative dose	1.3%
>24–48 -hours after preoperative dose	6.6%
>48–72 hours after preoperative dose	22.4%
>72 hours after preoperative dose	69.7%

Note: *Total exceeded number of samples because some patients received more than 1 kind of antibiotic.

most common antibiotics used as preoperative and postoperative prophylaxis were cefazolin, while the most common antibiotics prescribed at time of discharge were cefadroxil (51.3%) and cefditoren (36.8%).

Discussion

The principle of use of antibiotic prophylaxis is to prevent the surgical site infection (SSI). The selection of types of antibiotics should consider the possible bacteria that could cause infections in the operative site, patterns of bacteria and its sensitivity to antibiotics at hospital.[3,4] In orthopedic surgery, most infections are caused by the normal flora of the skin, most often Staphylococcus aureus.[2,5] *Staphylococcus aureus* is one of bacteria that is often found in body fluid culture including joint fluid and pus in 2012 at RSHS.[6] In patients who underwent ORIF at RSHS, cefazolin was most commonly used as the preoperative and postoperative prophylactic antibiotic because it was effective against both gram-positive and gram-negative microorganisms. In addition, based on the pattern of bacterial sensitivity to antibiotics at RSHS, cefazolin was 100% sensitive to Staphylococcus aureus.[6]

Another frequently used antibiotic was ceftazidime (18.4%) which is the third generation cephalosporin. Based on a study in India, ceftriaxone which is a third generation cephalosporin, is the most common choice as a preoperative prophylactic antibiotic.[7]

Table 4 Postoperative Clinical Examination Result

Clinical Examination	Day 2 Result (%)	At Discharge Result (%)
Pain	13.1%	11.8%
Tenderness	7.9%	15.8%
Swelling	1.3%	0
Fever, pain	1.3%	0
Pain, Tenderness	43.4%	34.2%
Pain, Swelling	1.3%	0
Tenderness, Swelling	2.6%	1.3%
Hyperemia, Tenderness, Swelling	1.3%	0
Pain, Tenderness, Swelling	22.4%	10.5%
No Finding	5.2%	26.3%

However, a survey in Canada among orthopedic surgeons proved that cefazolin is used as a first-line prophylaxis.[8] The use of cefazolin is still preferred compared to ceftazidime, because cefazolin has better activity against bacteria which often causes postoperative infection, has longer half-life, and is cheaper.[9] Moreover, cefazolin is bactericidal, safe, and rarely causes fatal side effects compared to aminoglycosides.[9]

Some patients got antibiotics in combination. The purpose of giving antibiotics as a combination was to strengthen the antimicrobial effect. The combination of gentamicin and beta-lactam group can cause a synergistic effect that can strengthen the bactericidal effect.[9] However, the use of antibiotics in combination can increase the risk of toxicity and may lead to eradication of the normal flora. Thus, a single antibiotic is more commonly used.

All patients were given preoperative prophylactic antibiotics intravenously. Thus, the medications could reach high concentrations in the tissues within short period.[1] This finding was similar to a study in India that showed prophylactic intravenous antibiotics are most commonly used, in as much as 96.4% of the patients.[7] Patients are mostly often given 1 gram of preoperative antibiotics for cefazolin. This finding was recorded in 66.7% of the patients. This dose, when administered intravenously, is adequate to achieve the minimal inhibitory concentration of the pathogens that may cause infection in a short period.[8] Exception was done for pediatric patients and patients who were obese. Dose adjustments according to patient body weight were required so that the optimal concentration could be achieved in those patients.[10]

In this study, the antibiotics were most often given in a span of 30–60 minutes prior to surgery in 44.2% of patients. This result was in contrast to a study by Mistry, et al.[7] in India. Mistry et al.[7] reported that preoperative prophylaxis is given 12 hours before surgery and during induction anesthesia. Administration of antibiotic that is too early or too late will reduce the effectiveness of antibiotics and may increase the risk of infection. Hence, the time of administration should be considered in such a way so that the concentration of antibiotics in serum and tissues at incision reaches the minimum inhibitory concentration of bacteria and can be maintained until the end of surgery.[3]

The most common dose of postoperative prophylactic antibiotic regimen given to patients was 2x1 gram of cefazolin in 62 patients (66.7%). Cefazolin was given in the frequency of 2 times a day because it has a long half-life that is enough to be maintained in a minimum inhibitory concentration within 12 hours.[8] In addition, cefazolin, as time-dependent antibiotic, should be kept at a constant concentration in order to work optimally. Thus, giving 2 doses in a day will be more effective than a single dose.[9]

Postoperative prophylactic antibiotics were most commonly given more than 72 hours after the administration of preoperative antibiotic dose. This was slightly different from the results of study in French that stated postoperative antibiotics are most commonly administered in 24–48 hours after

preoperative dose. Meanwhile, a study in Canada showed that most doctors prescribe postoperative antibiotics up to 24 hours after surgery.[8,11] Average duration of postoperative antibiotics administration is 4.09±1.36 days. This result was slightly different from the study conducted by Mistry et al.[7] in India which has an administration average duration of 5.05 ± 1.14 days.

The most frequent antibiotic given at the time of discharge was oral cefadroxil in a total of 39 (51.3%) patients. Cefadroxil can be absorbed well after oral administration.[9] Thus, it is reasonable to give cefadroxil as an oral prophylaxis. Most patients were given antibiotic for 5 days. This was consistent to the results of study in India by Mistry et al.[7] but the type of antibiotic that is most commonly given is cefixime (55.4%).

In this study, patients were hospitalized for 1 until 8 days. The average length of postoperative hospital stay for patients after undergoing surgery was 3.91 days. Duration of postoperative hospital stay might be longer if the patients have SSI.[1,12]

On clinical examination findings in the second postoperative day and at discharge, some patients were found suffering from signs of inflammation such as fever, pain, swelling, tenderness, and redness at surgical wound. There was no patient with pus on physical examination. Local inflammation is a common normal tissue healing response to trauma due to fracture and to the additional trauma as a result of a surgery.[13] However, if the signs are persistent, the presence of the SSI can be suspected. SSI can be defined as the presence of at least one sign of inflammation accompanied by pus in the surgical wound.[14] Based on the results of the clinical examination, this study supposed that there was no patient with SSI during hospitalization. However, SSI cannot be diagnosed solely based on clinical findings alone. It requires a combination of clinical examination and laboratory tests to diagnose infections such as C-Reactive Protein (CRP), microbiological tissue culture, and others.[2,15]

It is possible to get an infection in the next few months although there is no sign of infection during hospitalization. Postoperative infection can be obtained exogenously from bacterial contamination at operative site during surgery or hematogenously from distant focus of infection.[2] Contaminating bacteria during surgery can survive in the host tissue and be attached to the implant material for a long time. This happens because the implant is free from blood circulation that carries antibacterial components such as macrophages and neutrophils and is free from antibiotic distribution. Bacteria that have formed inoculum on the implant are able to form biofilms that constantly grow due to their resistance to antibiotic.[5] Thus, SSI after implantation of implants can occur slowly up to a year.[1,2]

This study describes the pattern of use of prophylactic antibiotics in open reduction and internal fixation of closed fracture patients. Most of the patients are given 1 gram of cefazolin as preoperative prophylactic antibiotics. The most frequent time of administration is 30–60 minutes before incision. All patients are given antibiotics postoperatively with an average duration of 4.09 days. Antibiotic for postoperative administration is cefazolin. All patients are given antibiotics at the time of discharge. Cefadroxil is the most common antibiotic given at the time of discharge.

Limited time for research led to difficulty to follow up the patient to monitor healing progression and the risk of infection. Further prospective studies should be performed to determine the effectiveness of the use of prophylactic antibiotics. Thus, a guideline about the use of antibiotic prophylaxis in accordance with the pattern of bacteria and susceptibility to antibiotics at RSHS can be made. This study was conducted only with the data from medical records, so the completeness, accuracy, and systematic recording system can support better study results.

References

1. Mangram AJ, Horan TC, Pearson ML. Guideline for prevention of surgical site infection: Centers For Disease Prevention and Control; 1999.
2. Trampuz A, Widmer AF. Infections associated with orthopedic implants. Curr Opin Infect Dis. 2006;19(4):349–56
3. Bratzler DW, Dellinger EP, Olsen KM, Perl TM, Auwaerter PG, Bolon MK, et al. Clinical practice guidelines for antimicrobial prophylaxis in surgery. Am J Health Syst Pharm. 2013;70(2):195–283.
4. Purghel F, Badea R, Ciuvica R, Anastasiu A. The use of antibiotics in traumatology and orthopaedic Surgery. MAEDICA A Journal of Clinical Medicine. 2006;1(3):58–65.
5. Zimmerli W, Moser C. Pathogenesis and treatment concepts of orthopaedic biofilm infections. Fems Immunol Med Microbiol. 2012;65(2):158–68.

6. Parwati Ida, Turbawaty Dewi Kartika, Sugianli Adhi Kristianto, editors. Peta bakteri dan kepekaannya terhadap berbagai antibiotika di Rumah Sakit Umum Pusat Dr. Hasan Sadikin Bandung semester 1 tahun 2012. Bandung: Departement of Clinical Pathology Dr. Hasan Sadikin General Hospital; 2012.
7. Mistry V, Pandya A, Chaudhari J, Sondarva D, Pillai A, Hotchandani S. Use of antimicrobial prophylaxis in clean elective orthopedic surgical procedures and identifying common infective organisms. Int J Med Sci Public Health. 2013;2(4):994–1000.
8. Lundine KM, Nelson S, Buckley R, Putnis S, Duffy PJ. Adherence to perioperative antibiotic prophylaxis among orthopedic trauma patients. Can J Surg. 2010;53(6):367–72.
9. Petri WA. Penicillins, cephalosporins, and other β-lactam antibiotics. In: Brunton LL, Lazo JS, Parker KL, editors. Goodman and gilman's the pharmalogical basis of therapeutics. 11st ed. USA: Mc Graw Hill; 2006. p. 1127–52.
10. Prokuski L. Prophylactic antibiotics in orthopaedic surgery. J Am Acad Orthop Surg. 2008;16:283–93.
11. Merrer J, Girou E, Lortat-Jacob A, Montravers P, Lucet JC. Surgical site infection after surgery to repair femoral neck fracture: a French multicenter retrospective study. Infect Control Hosp Epidemiol. 2007;28(10):1169–74.
12. Jodra VM, Soler LSdlT, Pérez CDA, Requejo CMS, Farrás NP. Excess length of stay attributable to surgical site infection following hip replacement: A Nested Case-Control Study. Infect Control Hosp Epidemiol. 2006;27(12):1299–303.
13. Claes L, Recknagel S, Ignatius A. Fracture healing under healthy and inflammatory conditions. Nat Rev Rheumatol. 2012;8(3):133–43.
14. Mathur P, Trikha V, Farooque K, Sharma V, Jain N, Bhardwaj N, et al. Implementation of a short course of prophylactic antibiotic treatment for prevention of postoperative infections in clean orthopaedic surgeries. Indian J Med Res. 2013;137(1):111–6.
15. Bauer TW, Parvizi J, Kobayashi N, Krebs V. Diagnosis of periprosthetic infection. J Bone Joint Surg Am. 2006;88(4):869–82.