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Bacterial growth from the surgical wound base smear at the end of the operation and superficial surgical site infection in the administration of cefazolin single dose, ceftriaxone single dose, and ceftriaxone 3 days as prophylactic antibiotics in cases of closed long bone fractures post implant surgery

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ABSTRACT

Background: The use of prophylactic antibiotics in hospitals still often found to be not in accordance with the guidelines of prophylactic antibiotics used and therapy published by the hospital itself. This study aims to compare the effectiveness of prophylactic antibiotics between cefazolin and ceftriaxone in single-dose administration in patients with closed long bone fractures after implant surgery in Sanglah General Hospital on the incidence of Surgical Site Infection (SSI) and germ growth on the base of the surgical wound.

Methods: This study used a randomized clinical trial design from a population of closed long bone fracture patients who underwent implant surgery at Sanglah General Hospital. The sample selection was carried out by consecutive sampling during the period July-August 2020. The statistical test was the Chi-Square Test or Fisher Exact Test using the SPSS version 20 for Windows.

Results: It was found that there was no growth of germs, or in other words, negative culture results were obtained in all study subjects (growth of N (%) 0 (0%), p = -) bacteria in all three groups on a single dose and 3-days dose. SSI did not occur in all study subjects in the three groups so that it could automatically be concluded that there was no difference in the proportion of SSI incidents in the three groups (SSI incidence N (%) 0 (0%), p = -) on single-dose and 3 days dose antibiotics administration, so that the proportional comparison test, either the Chi-Square test or the Fisher Exact test, cannot be performed.

Conclusion: The prophylactic antibiotics (which are the cephalosporins, namely single dose generic cefazolin and single-dose generic ceftriaxone and 3 days dose) have the same effectiveness in preventing the growth of germs on the surgical wound base smear and prevent the occurrence of superficial SSI on the 30th postoperative day.

Keywords: Bacterial Growth, Surgical Wound, Superficial Surgical Site, Ceftriaxone, Cefazolin, Long Bone Fractures.
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INTRODUCTION

Prophylactic antibiotics in hospitals are still not in accordance with the guidelines of prophylactic antibiotics used and therapy published by the hospital itself.[1] There are many prophylactic antibiotics used in clean operations for more than 24 hours.[1] Postoperative infection still a complication that causes significant morbidity for postoperative orthopedic patients.[2] The choice of antibiotic should be based on the pathogens associated with infection at the surgical site in certain operations.[1,2]

Diagnosis of infection can be confirmed by isolating bacteria from peri-implant fluid cultures, sinus wounds or discharge, or blood.[3] The results of the culture examination will be taken into selecting the appropriate antibiotic regimen. The difference in duration and type of antibiotic will directly affect patient care cost-efficiency in the hospital.[4]

Surgical site infection rates have become an important marker for quality of care and, as such, are closely monitored, reported, and linked to the cost efficient.[5]

Table 1. Baseline characteristics of respondents

Variable	Total	Groups (N=36)		
		Cefazolin Single Dose (N=12)	Ceftriaxone Single Dose (N=12)	Ceftriaxone Dose in 3 Days (N=12)
Gender, n (%)				
Male	21 (58.30)	6 (50.00)	8 (66.70)	7 (58.30)
Female	15 (41.70)	6 (50.00)	4 (33.30)	5 (41.70)
Age (Years) (mean±SD)	44.90±21.01	46.20±21.40	45.30±21.40	43.00±22.00

Table 2. The comparison of culture Results among groups

Variable	Culture Results (N=24)		p
	Positive (N=0)	Negative (N=24)	
Comparison 1, n (%)			
Cefazolin Single Dose	0 (0.00)	12 (50.00)	-
Ceftriaxone Single Dose	0 (0.00)	12 (50.00)	
Comparison 2, n (%)			
Cefazolin Single Dose	0 (0.00)	12 (50.00)	-
Ceftriaxone Dose 3 days	0 (0.00)	12 (50.00)	

Table 3. The comparison of SSI incidence between groups receiving cefazolin single dose and ceftriaxone single dose

Groups	SSI Incident		p
	Yes (N=0)	No (N=24)	
Days 3-5th, n (%)			
Cefazolin Single Dose	0 (0.00)	12 (50.00)	N/A
Ceftriaxone Single Dose	0 (0.00)	12 (50.00)	
Days 10-14th, n (%)			
Cefazolin Single Dose	0 (0.00)	12 (50.00)	N/A
Ceftriaxone Single Dose	0 (0.00)	12 (50.00)	
Days 30th, n (%)			
Cefazolin Single Dose	0 (0.00)	12 (50.00)	N/A
Ceftriaxone Single Dose	0 (0.00)	12 (50.00)	

Table 4. The comparison of the incidence of SSI between groups receiving ceftriaxone single dose and 3 days of ceftriaxone

Groups	SSI Incident		p
	Yes (N=0)	No (N=24)	
Days 3-5th, n (%)			
Ceftriaxone Single Dose	0 (0.00)	12 (50.00)	N/A
Ceftriaxone 3-Days Dosage	0 (0.00)	12 (50.00)	
Days 10-14th, n (%)			
Ceftriaxone Single Dose	0 (0.00)	12 (50.00)	N/A
Ceftriaxone 3-Days Dosage	0 (0.00)	12 (50.00)	
Days 30th, n (%)			
Ceftriaxone Single Dose	0 (0.00)	12 (50.00)	N/A
Ceftriaxone 3-Days Dosage	0 (0.00)	12 (50.00)	

The risk of SSI in a previous operations is affected by several factors such as age, sex, smoking, Body Mass Index (BMI), as well as potentially modifiable operative factors such as minimally invasive surgery and length of operation.[6] The effect of procedure type on the risk of SSI has not been fully determined. Rates of, as well as risk factors for, incisional Surgical Site Infections (SSI) have been shown to differ widely between operational procedures.[7,8]

Based on those mentioned above, this study aims to evaluate the bacterial growth from the surgical wound base smear at the end of the operation and superficial surgical site infection in the administration of cefazolin single dose, ceftriaxone-single dose, and ceftriaxone 3 days as prophylactic antibiotics in cases of closed long bone fractures post-implant surgery at Sanglah General Hospital, Bali, Indonesia. Infection and germ growth at the base of the surgical wound, so it is expected that prophylactic antibiotics can be given in a single dose, reducing the risk of resistance and increasing the efficiency of patient care costs.

METHODS

This study used a randomized clinical trial design from a population of closed long bone fracture patients who underwent implant surgery at Sanglah Central General Hospital Denpasar. The sample selection was carried out by consecutive sampling during the period July-August 2020.

Inclusion criteria Samples were orthopedic patients aged 18-75 years, both gender in sex, patients who would undergo implant surgery in closed long bone fractures, and patients agreed to participate in this study. Exclusion criteria were including the patient that had a systemic infection, the patient that had chronic osteomyelitis at the surgery site, and the patient who was allergic to the prophylactic antibiotics that would be used (ceftriaxone or cefazolin depending on the patient intervention group).

The sample size calculation uses the Hosmer - Lemeshow formula for a comparative study/comparison of two

Table 5. The comparison of the incidence of SSI between groups receiving cefazolin single dose and 3 days of ceftriaxone

Groups	SSI Incident		p
	Yes (N=0)	No (N=24)	
Days 3-5th, n (%)			
Cefazolin Single Dose	0 (0.00)	12 (50.00)	N/A
Ceftriaxone 3-Days Dosage	0 (0.00)	12 (50.00)	
Days 10-14th, n (%)			
Cefazolin Single Dose	0 (0.00)	12 (50.00)	N/A
Ceftriaxone 3-Days Dosage	0 (0.00)	12 (50.00)	
Days 30th, n (%)			
Cefazolin Single Dose	0 (0.00)	12 (50.00)	N/A
Ceftriaxone 3-Days Dosage	0 (0.00)	12 (50.00)	

proportions, up to 12 samples for each group. The first group received a single dose of cefazolin (single dose), the second group received a single dose of ceftriaxone (single dose). In contrast, the third group received a three-day dose of ceftriaxone as a prophylactic antibiotic.

The diagnosis of SSI in this study was made based on clinical criteria. SSI assessments on the 3-5th days and 30th days periods were carried out at the Sanglah Central General Hospital Denpasar Polyclinic, Orthopedics, and Traumatology. In contrast, for the assessment on days 10-14, because some patients controlled surgical wounds to the primary care center, SSI was assessed and conducted subjectively through data collection from the patients or their family by telephone.

The statistical test is the Chi-Square test or Fisher Exact test if the Chi-Square test requirements are not met. The data collected is then entered into a table and then grouped based on the similarity of characteristics in the sample. Finally, an analysis of the collected data was carried out using the SPSS version 20 for Windows.

RESULTS

Each group has the same number of research subjects, namely as many as 12 people (33.3%). In general, all research subjects consisted of 21 (58.30%) males and 15 (41.70%) females with a mean age of 44.90±21.01 years (Table 1). However, based on the groups, the male was predominant in the Ceftriaxone Single Dose group (66.70%) and female in the Cefazolin Single Dose group (50.00%) (Table 1).

It was found that there was no germ growth, or in other words, a negative culture result was obtained in all study subjects in the three groups (Table 2). The proportion comparison test, either by the Chi-Square test or the Fisher Exact test, could not be done (Table 2).

It was found that there was no SSI in all research subjects in the three groups so that it could automatically be concluded that there was no difference in the proportion of SSI incidents in the three groups (all three groups showed an SSI incidence of 0%) (Table 3). Similar results were also found in comparing the incidence of SSI between groups who were receiving ceftriaxone single dose and 3 days of ceftriaxone (Table 4) and SSI between groups receiving cefazolin single dose and 3 days of ceftriaxone (Table 5).

DISCUSSION

The results of several previous studies showed a tendency for the proportion of males to be predominant in the study subjects with an average age that was not much different from this study. The study by Maksimović J et al. found that in a total of 277 patients after all orthopedic operations performed at the hospital, the study population's mean age was 51.2±2.7 years and 56.3% were males.[9]

Another study conducted by Lalka SG et al., stated that cefamandole and cefazolin were more effective to be given in higher doses with more frequent to get better results.[10] Within two hours of surgery, it was also said that the serum cefazolin concentration was higher than that of cefamandole, and the culture yield of staphylococcus was said to decrease significantly.[11,12] A previous study also stated that prophylactic antibiotics had an insignificant impact on culture results, especially in chronic infection cases.[11] A systematic review conducted by Wouthuyzen-Bakker M et al., suggests that in patients with chronic prosthetic joint infection (PJI), positive culture analysis results were obtained in 88.00% of cases receiving prophylactic antibiotics and positive culture results as much as 91.00% in cases not receiving prophylactic antibiotics.[11] In patients with suspected Chronic Heart Disease (CHD), there was a maximum culture difference of 4.00% between the groups receiving prophylactic antibiotics and those who did not.[11]

In this study, it was found that there was no incidence of SSI among the groups that received single-dose cefazolin prophylactic antibiotics, single-dose ceftriaxone, and 3-days ceftriaxone dose on the 30th postoperative day. This is because the incidence of SSI was not found in all study subjects, so that the proportion of SSI incidence in the three groups was the same, namely 0%. In general, prophylactic antibiotics are able to reduce the incidence of SSI and the required medical costs.[12] From various previous studies, it was found that no significant differences were found related to the incidence of surgical site infection (SSI) in the use of single-dose antibiotic prophylaxis or for five days during clean surgery.[13,14] What distinguishes it is the reduced duration of patient hospitalization and lower treatment costs using a single dose. Excessive use of antibiotics has no benefit but can lead to increased patient costs and increase the emergence of resistant microorganisms and also increase the side effects seen with overuse of antibiotics without any additional benefit.[15] In resource-deficient countries such as Indonesia, implementing a single-dose antibiotic prophylactic protocol can result in enormous savings.

Regarding the type of antibiotic used, it was found that there was no difference in the risk of infection between ceftriaxone and cefazolin in the postoperative setting. A study conducted by Kalawar RPS et al., comparing the ability of cefazolin with ceftriaxone as a prophylactic antibiotic for clean and planned orthopedic surgery

found that there was no significant difference in the incidence of SSI in the group receiving the prophylactic antibiotics cefazolin and gentamicin and the group receiving ceftriaxone and gentamicin in standard dose for 48 days.[16] This study concluded that ceftriaxone and cefazolin were equally effective in preventing SSI in planned clean orthopedic operations.[16]

In addition, other studies also obtained results that were not much different. A study conducted by Manohar T et al., on 62 patients who underwent percutaneous nephrolithotomy (PCNL) and received ceftriaxone and cefazolin as prophylactic antibiotics found that there was no incidence of severe infection (in this case, the incidence of systemic inflammatory response syndrome/SIRS and sepsis) among the group that got ceftriaxone and cefazolin.[17] In this regard, cefazolin with a narrower antimicrobial spectrum may be preferred for use as a prophylactic antibiotic. The same result was also obtained by Phoolcharoen N et al., whereas no significant difference between ceftriaxone and single-dose cefazolin as prophylactic antibiotics against the incidence of infection in patients undergoing hysterectomy surgery.[18]

CONCLUSION

Based on the results of this study coupled with previous studies' results, it can be concluded that prophylactic antibiotics (which in this case are the cephalosporins, namely single dose generic cefazolin and single-dose generic ceftriaxone and 3 days dose) have the same effectiveness in preventing the growth of germs on the surgical wound base smear and prevent the occurrence of superficial SSI on the 30th postoperative day.

CONFLICTS OF INTEREST

The author states that there are no conflicts of interest regarding the material discussed in the manuscript.

RESEARCH ETHICS

The research protocol for Ethical Clearance from the Research Ethics Commission of the Medical Faculty, Universitas Udayana, Sanglah Hospital Denpasar, has been submitted prior to the study being conducted. Subjects who met the research criteria were explained the research objectives and asked to fill out the informed consent.

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AUTHOR CONTRIBUTION

Mario Daniel Simatupang is responsible for finding research samples, carrying out samples, analyzing data, and reporting research results. Putu Astawa and I Wayan Suryanto Dusak were in charge of the research concept design and were the supervisor in this study.

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