The Use of Prophylactic Antibiotics on Orthopaedic Procedures in an Academic Hospital in Indonesia

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ARTICLE INFO	ABSTRACT
Keywords: Compliance, Prophylactic Antibiotic, Surgical Site Infection (SSI), Orthopedic Operation, Antibiotics Guideline Submission: June 16th, 2021 Review: June 28th, 2021 Publish: July 25th, 2021	Background: Surgical site infections (SSIs) are common surgical complications that will increase cost of treatment. The incidence of SSI can be prevented with antibiotic prophylactic. Uncompliance using of prophylactic antibiotics is one of the factors leading to the occurrence a microbes resistance. The data on the using of prophylactic antibiotics in Indonesia is still limited. Objective: This study aims to analyze the using of prophylactic antibiotic guideline on orthopaedic surgery. Methods: The study was conducted retrospectively using data from medical records on patients who had clean and clean-contaminated orthopedic procedures from 2013 to 2016 in the standard operating room of Dr. Soetomo hospital Surabaya. We analyzed the use of prophylactic antibiotics in terms of antibiotic selection, timing of administration, and the compliance to the prophylactic antibiotic local guidelines on orthopaedic surgery. Results: Overall, patient data from 2013 to 2016 was 5246 patients. The compliance rate of prophylactic antibiotics from 2013 to 2016 was 48.3%. This level of compliance uses a selection of antibiotics, dose of administration, delivery mode, delivery time, and route of administration. Conclusion: The results of this study have shown that the prophylactic antibiotic compliance rate on orthophaedic procedures in Soetomo Hospital from 2013 to 2016 was 48,3%. Antibiotic resistance control program quite effective at increasing compliance with the use of the prophylaxis antibiotics.

Introduction

Surgical Site Infection (SSI) is a frequent infection in the surgical area of postoperative patients within 30 days of surgery or within a year after the implant surgery (Al-Mulhim *et al.,* 2014). Although standard prophylactic antibiotics have been used on surgical techniques, (SSI) case is still a serious complication of surgery.

In the United States, the incidence rate of SSI reached 1.07%, of which 8000 patients died from wound infections. US government also has spent over US$ 10bn on medical expenses (NHDS, 2010). UK should provide an additional fee of around £ 2500 to deal with SSI problems. The rough estimates indicate that the SSI increased the Long of Stay (LOS) for approximately 10 days and increased

additional costs up to US$ 2000 (NHDS, 2010). In Indonesia, the SSI case varies between 2-18% in all surgical procedures (Ong and Paraton, 2014). SSI problems in Dr. Soetomo hospital Surabaya ranged from 2-4% for clean wound operation and 5-15% for contaminated clean operation (Baktijasa *et al.,* 2014). The Surgical Site Infection (SSI) prevalence rate from PPI report of Dr Soetomo hospital in 2016 was 0.41% (Baktijasa *et al.,* 2014).

The overall methods to control infection case including improving correct hand washing campaign, operating room ventilation, sterilization methods, barriers, surgical techniques and the availability of prophylactic antibiotics. The Surgical Site Infection (SSI) remains the primary cause of morbidity, prolonged hospitalization, and increased mortality (Bratzler *et al.,* 2013). An infection mainly affects the implant surgery (orthopedic) operations patients (Mistry *et al.,* 2013). The complications common occur, particularly in the case of Surgical Site Infection (JP, 2012). The use of antimicrobials in orthopedic surgery is routinely used in prosthesis surgery either total-hip replacement (THR) or total-knee replacement (TKR), or surgery for implantation like nail, wire, plate, and screw (Mistry *et al.,* 2013). Nevertheless, the level of compliance with guidelines in the international scale ranged from 0 to 71.9%, while in Indonesia compliance with prophylactic antibiotic guidelines is limited (Syachroni, 2015).

The Surgical Site Infection more frequently happened among patient with immunodeficiency, diabetes mellitus, obesity, severe malnutrition and malignancy. SSI can be influenced by the factors including the use of prophylactic antibiotics, operating room ventilation, and

surgery techniques (Tieman and Hofmann, 2009). In pre-operation, it includes skin preparation by not cleaning the surgical area or not shaving in the surgery area (Mistry *et al.,* 2013). The intra-operation factors a surgical technique must be done carefully to avoid excessive tissue damage, bleeding, infection, and drainage. The nutrition, personal hygiene, mobilization and wound care are the factors in the post-operation (Gagliardi *et al.,* 2009).

This study aims is to analyze the using of prophylactic antibiotic guideline orthopaedic surgery on clean and clean contaminated orthopedic procedure in 2013-2016 at Dr. Soetomo hospital Surabaya.

Methods

This research design was observational with retrospective study conducted in Dr. Soetomo hospital Surabaya. The orthopedic patients who underwent clean or clean contaminated surgery in the operating room of GBPT Dr. Soetomo hospital Surabaya were all included. Data were collected from patient's medical records from January 2013 until December 2016. The inclusion criteria were all orthopedic patients who underwent clean operation and or clean contamination at operating room RSUD Dr. Soetomo hospital Surabaya, from January 2013 to December 2016. The exclusion criteria were patients who had open fractures, multiple trauma, second surgery, history of open fractures, had preoperative infectious diseases at admission, an allergic history to all antibiotics, and received administration antibiotics more 24 hours before surgery.

We categorized the use of prophylactic antibiotics following the local guideline as the compliant group, while the non-

compliant group did not adhere to at least one of the following three criteria. Firstly, antibiotic selection for prophylactic treatment should entail intravenous cefazolin 1 gram (2 grams for a patient with an estimated body weight of 86 kg or more), or intravenous cefuroxime at 1.5 gram. If patients were intolerant to penicillin antibiotics, intravenous aminoglycosides were considered as alternative agents. Secondly, the prophylactic antibiotic should be administered between 30 and 60 minutes before the initial incision to achieve the optimal concentration in the incision area. Thirdly, the prophylactic antibiotic was used as a single dose. Repeated dosing could be allowed for surgical procedures with a prolonged operation (more than 4 hours) or a massive bleeding case (more than 1,500 ml). We analyzed the use of prophylactic antibiotics and devide it in the compliant group and non-compliant group.

In addition the collected *Case Report Form* (CRF) data, fieldwork researchers, who were firstly trained for conducting data collection and study management training, namely essential document training, manual procedure training, and data management training, were then filled them. The research stages covered the preparation, training for data collection team, conducting research, supervision, data analysis, editing, coding, processing, cleaning, and tabulation. The study has been approved by the ethical committee of Dr. Soetomo Hospital (No. 0654/KEPK/IX/2018).

Results

The study collected the data of 5246 patients: 3187 were male (61%) and 2059 were female (39%) (Picture 1).
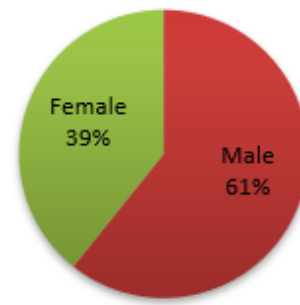

Figure 1. Pie Chart of Patient's Frequency

The age of groups are divided in 3 categories: < 20 years old, 20 – 60 years old and > 60 years old. The age distribution of the patients can be seen from the following table.

Table 1. Frequency Distribution of Patient Age Group

Age category	Total of the patients	
	Total	**Percentage (%)**
< 20	1201	22,9
20-60	3948	75,3
> 60	97	1,8
Total	**5246**	**100,0**

Table 1. informs that the patients in 20-60 years old group were the most dominant respondent, 3948 out of 5246. On the contrary, patients older than 60 years old group were 97.
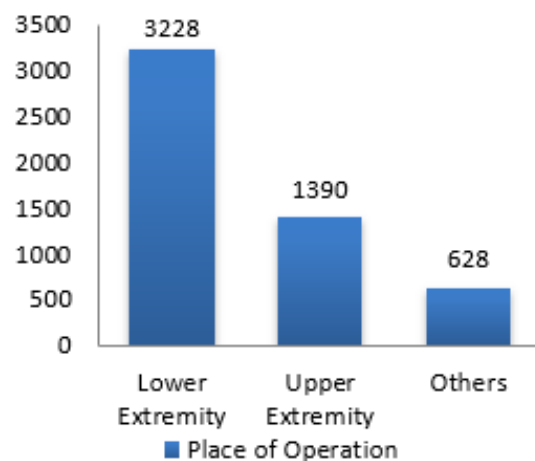
Figure 2. The Locations of Clean and Clean Contaminated Procedures

The most regio operation was *lower extremity* (3228 patients) followed by *upper extremity*, (1390 patients) (Picture 2).

Table 2. Frequency Distribution of Antibiotics

Type of antibiotics	Patient	
	Total	Percentage (%)
Cefazolin	4928	94,0
Ceftriaxone	318	6,0
Total	**5246**	**100,0**

Table 2. shows that cefazolin was the mostly used antibiotics, to 4928 patients. On the other hand, ceftriaxone was only given to 318 patients.

Table 3. Frequency Distribution Antibiotic Giving Time

Antibiotic giving time	Patient	
	Total	Percentage (%)
< 30 minutes	1936	36,9
30 - 60 minutes	2620	50,0
> 60 minutes	690	13,2
Total	5246	100,0

The prophylactic antibiotics were mostly given in 30-60 minutes (2620 patients, 50%).

Table 4. Level of antibiotic use compliance toward prophylaxis

Year	Compliant		Not compliant	
	Total	Percentage (%)	Total	Percentage (%)
2013	659	50,8	638	49,2
2014	688	51,6	646	48,4
2015	576	44,6	715	55,4
2016	610	46,1	714	53,9
Total 2013-2016	**2533**	**48,3**	**2713**	**51,7**

Based on table 4, we can infer that the level of antibiotic use compliance in 2013 was 50, 8%, 51,6% in 2014, 44,6% in 2015, and 46,1% in 2016. In total, the level of prophylactic antibiotic compliance from 2013 to 2016 was 48,3%.

Discussion

Several factors examined in this study were gender, age group, time of antibiotic administration, level of compliance to prophylactic antibiotics. The data demonstrated that the total of the patients were 3187 males (61%) and 2059 females (39%). This is likely related to most of the orthopedic surgeries caused by trauma or musculoskeletal injuries. The risk of trauma or musculoskeletal injuries in male might cause such percentage differences. It is correspondence with Tangarajah et al.'s examining open reduction internal fixation ankle complications (p= 0, 33) (Thangarajah *et al.,* 2009).

The infection mostly occured in the age of 32-40 years old. This result, however, was not significant using Chi Square (p= 0,845). The previous studies claimed that such infection case frequently occurs in > 60 years old group, for instance, reporting that there was a significant effect of post-operation infection in > 60 years old group, and Anderson's work notifying that there was a higher complication effect in > 60 years old group than others (Agodi *et al.,* 2015).

Prophylactic antibiotics in this study used 2 types of antibiotics, namely Cefazolin (4928 patients) and Ceftriaxon (318 patients). The level compliance of Cefazolin from 2013 to 2016 as a prophylactic antibiotic was 94%. Cefazolin is a first class cephalosporin antibiotic that is recommended for use as a prophylactic antibiotic in the field of orthopedics (Sanchez-Santana et al., 2017). Musmar (2014) found that the use of first generation cephalosporins as prophylactic antibiotics for clean surgery was 18.5% (Musmar et al., 2014). Nevertheless, Ong et all at Soetomo Hospital found that the

use of first-generation cephalosporins as antibiotic prophylaxis for clean surgery was 60.2% (Ong and Paraton, 2014). Meanwhile, Syachroni's study at hospital in Jakarta (2015), prophylactic antibiotics in clean and clean contaminated operations were Ceftriaxon as much as 49.8%. Ceftriaxon is a third generation cephalosporin (Syachroni, 2015).

According to Mistry et all (2013), first generation cephalosporins have high activity against Gram positive cocci (S. aureus) and moderate activity against Gram negative bacteria (E. Coli, Klebsiella), while second and third generation cephalosporins have higher activity in Gram negative compared to Gram positive bacteria Mistry et al., 2013). Second and third generation cephalosporins are more expensive, their use increases the risk of resistance, especially against Gram negative rods. Therefore, the use of second or third generation cephaloporins as prophylactic antibiotics in orthopedics should be avoided.

The prophylactic antibiotics administration time before incision in this study, under 30 minutes was 36,9%, 30-60 minutes was 50% and over 60 minutes was 13,2%. Prophylactic antibiotics are mostly given within 60 minutes before the incision. According to Bratzler et al (2013), the optimal time for prophylactic antibiotics is 60 minutes before the incision begins. Some drugs, such as fluoroquinolone and vancomycin, need 1 to 2 hours of administration before the incision (Bratzler et al., 2013).

Hawn et al (2013) explained that the selection time for 60 minutes of prophylactic antibiotics was based on two points of evidence, antibiotic pharmacokinetics and one cohort study which analyzed the relationship between antibiotic administration and the incidence of SSI. The basic principle of prophylactic antibiotics in surgery is to achieve adequate serum and tissue drug levels during surgery (Musmar et al., 2014).

Almost all guidelines recommended the use of SAP (Surgical Antimicrobial Prophylaxis) should be discontinued for less than 24 hours (Baktijasa et al., 2009). Previous research in Spain compared the use of single-dose Cefazolin (2 g) and 24-hour Cefazolin use (2 g initial dose, followed by 1 g every 8 hours) at heart surgery. The result was that SSI occurred twice more in the single-dose group (8.3% vs 3.6%, respectively, P = 0.004). However, most of the other studies comparing single-dose use to multiple doses have failed to show advantages in multiple-dose uses (Mannien et al., 2006).

The compliance prophylactic antibiotic on orthopedic surgery in Soetomo Hospital between 2013-2016 was 48% among all procedures. Syachroni (2015) explains that the level of compliance to prophylactic antibiotics is associated with cultural factors, educational background, personal preferences, training, influence from institutions and drug supplies (Syachroni, 2015).

According to the ASHP, antibiotics for surgical prophylaxis should (1) prevent Surgical Wound Infection, (2) prevent Surgical Wound Infection-related morbidity and mortality, (3) reduce duration and health care costs, (4) no side effects, and (5) no have adverse consequences for the normal flora of the patient or hospital (ASHP, 2013). Cephalosporins, such as Cefazolin are first-line agents suitable for most surgical procedures, targeting organisms causing surgical wound infection by avoiding

broad-spectrum antimicrobial therapy that can lead to the development of antimicrobial resistance (Misrty *et al.,* 2013).

Sanchez et al.'s conducted a study on the effects of prophylactic antibiotic compliance which the results showed that adherence to antibiotic prophylaxis led into 4.2% of SSI cases. This lower occurrence indicates the administration of prophylactic antibiotics will reduce the SSI matter (Sanchez-Santana, 2107). The prophylactic antibiotic giving showed the efficacy to prevent and reduce the frequency of local infection surgery. In some study reports, the infection reduction of local surgery at the location of the operation reaches 56 % (Lin et al., 2104).

Conclusion

The results of this study have shown that the prophylactic antibiotic compliance rate on orthophaedic procedures in Soetomo Hospital from 2013 to 2016 was 48,3%. Antibiotic resistance control program quite effective at increasing compliance with the use of the prophylaxis antibiotics.

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