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by Lili Musnelina

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EVALUATION OF CEPHALOSPORIN ANTIBIOTICS IN *INTENSIVE CARE UNIT* (ICU) GENERAL HOSPITAL CENTRE SOUTH JAKARTA

Lili Musnelina, Irma Dini Pratiwi

Department of Pharmacy, Institute of Science and Technology of National

Abstract

The cephalosporin group is the most used antibiotic in treating infections and is widely administered in the ICU. The purpose of this study was to obtain an overview of the use of these drugs in terms of dosage and level of use, as well as the sensitivity of germs by looking at the results of culture and sensitivity tests. Data were collected by using a purposive sampling survey, which was taken from medical record data at a hospital in South Jakarta. The results showed 90% of ICU patients were given cephalosporin antibiotics, namely ceftriaxone (83.02%) in patients aged between 21-45 years, with a duration of administration between 1-3 days. Most patients were diagnosed with respiratory tract infection (9.43%). Ceftriaxone and metronidazole cephalosporins were associated with resistance to *Klebsiella pneumonia* ($\alpha > 0.05$). This study concludes that the high use of cephalosporin antibiotics is associated with the occurrence of bacterial resistance.

Keywords: antibiotic, cephalosporin, bacterial resistance

Introduction

Antibiotics are drugs that are most often used today. It is estimated that up to a third of hospitalized patients receive antibiotics with the cost of using antibiotics up to 50% of the budget for drugs in hospitals. According to the Centers for Disease Control and Prevention, approximately 150 million antibiotic prescriptions are written in the United States a year. Gonzalez's research results show that 30% of antibiotic prescriptions are widely used for respiratory tract infections. Overuse of antibiotics and in some cases inappropriately can cause problems with antimicrobial immunity.⁽¹⁾

Nosocomial infections in the intensive care unit are more common than among inpatients. Research from various universities in the United States that ICU patients often experience 5 to 8 times higher Nosocomial Infections with high gram-negative infections. The mortality rate due to Nosocomial pneumonia (37%) in the ICU in the United States (2003). Incidence 37-54% with 50-57% mortality, which is associated with the use of ventilator-associated pneumonia ventilators.⁽²⁾

Patients in the ICU require complex health services related to the variety of patient diseases and critical conditions in addition to the decreased physiological state of the body. In addition, patients in the ICU often receive invasive measures (medical actions that can directly affect the integrity of body tissues) such as the installation of CVC (Central Vent Catheter), mechanical ventilators which are at risk of causing an infection, so antibiotic treatment is given.⁽⁴⁾

Method

Data were collected by using a purposive sampling survey method with descriptive analytic data from medical records, results of culture, and sensitivity tests. The samples were taken were patients who used cephalosporin antibiotics, had culture and sensitivity test results, urea and creatinine levels. Data were analyzed using the chi-square method.

Result

Table 1.
Classification of cephalosporin antibiotics in the ICU

Cephalosporin antibiotics		Sample	
		<i>n</i>	%
Generation III	Cefoperazone	4	7.55
	Ceftriaxone	44	83.02
	Ceftazidime	3	5.66
Generation IV	Cefepime	1	1.89
	Cefpirome	1	1.89
Total		53	100.00

The most widely administered cephalosporin antibiotic was ceftriaxone as much as 83.02%. This is because ceftriaxone (a third-generation cephalosporin) is effective against gram-negative bacteria and is not destroyed by cephalosporins (an enzyme that degrades some cephalosporins). coagulase, the longest half-life compared to other cephalosporin antibiotics (i.e. 6-8 hours), and no dose adjustment is required in patients with renal failure or hepatic function disorders^(6,7).

Table 2.
Use of cephalosporin antibiotics in the ICU based on age

Cephalosporin antibiotics		Age				Total Usage
		Children	Adult	Mature	Old	
Generation III	Cefoperazone	-	-	1	3	4
	Ceftriaxone	4	2	16	22	44
	Ceftazidime	-	-	-	3	3
Generation IV	Cefepime	-	-	-	1	1
	Cefpirome	-	-	-	1	1
Total						53

The most used antibiotic is the third generation cephalosporin class of antibiotics, namely ceftriaxone, and mostly given to adults as many as 16 patients. This is because the activity of ceftriaxone is quite good against gram-negative bacteria which usually cause an infection in adult and elderly patients.⁽⁷⁾

Table 3.
Use of cephalosporin antibiotics in the ICU based on antibiotic generation and duration of administration

Cephalosporin antibiotics		Length delivery (days)				Total usage
		1-3	4-5	6-8	9-12	
Generation III	Cefoperazone	1	2	1	-	4
	Ceftriaxone	32	6	3	3	44
	Ceftazidime	1	-	-	2	3
Generation IV	Cefepime	1	-	-	-	1
	Cefpirome	1	-	-	-	1
Total						53

The third-generation cephalosporin class of antibiotics ceftriaxone was given 1-to 3 days to 32 patients. This is probably because patients who are admitted to the ICU are usually only 1-to 3 days before being transferred to a regular ward, also for postoperative monitoring of therapy,

or the patient then dies. In addition, surgical antimicrobial prophylaxis should be continued for only 1 day after surgery, to prevent superinfection.⁽⁸⁾ About 9- to 12 days of administration is generally given for severe infections such as meningitis that require 7- to 14 days of antibiotic therapy.⁽⁹⁾

Table 4.
The use of Antibiotics based in combination with other antimicrobial

The combination of cephalosporin	Number of combinations	
	<i>n</i>	%
Ceftriaxone – class of aminoglycoside	1	1.89
Ceftriaxone – class of quinolones	1	1.89
Ceftazidime - class of quinolones	1	1.89
Cefoperazone - class of quinolones	2	3.77
Ceftriaxone - class of Macrolide	2	3.77
Ceftriaxone - Metronidazole	7	13.21
Ceftazidime - Metronidazole	1	1.89
Ceftriaxone – class of aminoglycoside - Metronidazole	1	1.89
Ceftriaxone – class of quinolone - Metronidazole	4	7.55
Not combined	33	62.26
Total sample	53	100.00

The most widely used combination is the combination of the antibiotic ceftriaxone with the antimicrobial metronidazole as much as 13.21%. This is because the cephalosporin class of antibiotics is effective for aerobic bacterial infections, whereas metronidazole includes most Gram-negative anaerobic bacteria and protozoa.⁽¹¹⁾

Table 5.
The sensitivity of bacteria to cephalosporin antibiotics

Isolates	Cephalosporin antibiotic sensitivity			Frequency of testing	%		
	<i>R</i>	<i>I</i>	<i>S</i>		<i>R</i>	<i>I</i>	<i>S</i>
<i>Escherichia coli</i>	-	1	6	7	0.00	14.29	85.71
<i>Klebsiella pneumoniae</i>	27	1	-	28	96.43	3.57	0.00
<i>Pseudomonas aeruginosa</i>	15	3	3	21	71.43	14.29	14.29
<i>Enterobacter aerogenes</i>	20	1	-	21	95.24	4.76	0.00
<i>Serratia liquefaciens</i>	3	1	3	7	42.86	14.29	42.86

<i>Klebsiella ozaneae</i>	12	1	1	14	85.71	7.14	7.14
<i>Staphylococcus epidermidis</i>	4	1	2	7	57.14	14.29	28.57

The highest germ sensitivity was *Klebsiella pneumoniae* isolated at as much as 96.43%. This is because the *Klebsiella* strain has an R-plasmid that can inactivate antibiotics and can produce beta-lactam enzymes.⁽¹²⁾

Table 6.

Cross tabulation data of analysis of the relationship between the level of the use of cephalosporin antibiotics class antibiotic sensitivity of bacteria to antibiotics with cephalosporin class

Level of Use		sample	
		<i>n</i>	%
Exactly	Right dosage and interval	46	86.79
	Right dose but not exactly interval	1	1.89
Not exactly	Less precise dose and interval exactly	6	11.32
	Total	53	100.00

The accuracy of the dose of a cephalosporin class of antibiotics with the interval of administration is done properly. If the dose was given is less than the recommended dose, it can cause the maximum therapeutic effect not to be achieved and cause resistance, whereas if the dose exceeds the recommended dose it can increase side effects in the form of an impaired renal function of the patient. Administration intervals that are too short can cause the accumulation of antibiotics in the body.⁽¹³⁾

Table 7.

The relationship between the level of use of cephalosporin antibiotics with bacterial susceptibility

Usage Rate	Cephalosporin antibiotics	Sensitivity			<i>df</i>	<i>p-value</i>
		<i>R</i>	<i>I</i>	<i>S</i>		

Low	Ceftazidime	2	-	-	2	0.701
High	Ceftriaxone	8	2	1		

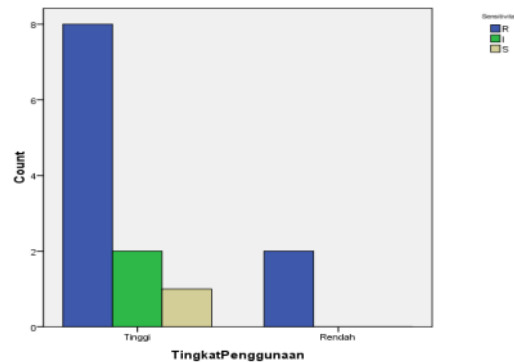


Figure 1.

The relationship between the level of use of cephalosporin antibiotics sensitivity of bacteria to antibiotics with cephalosporin class

From the results of the chi-square test, the P-value of 0.701 is greater than 0.05, which means that the H_1 hypothesis is accepted or that there is a relationship between the level of use of cephalosporin antibiotics and the sensitivity of bacteria to cephalosporin antibiotics. This is because the high use of antibiotics in one place for a certain period can cause resistance to bacteria and reduce the sensitivity of these antibiotics.⁽¹⁴⁾ The high level of use of ceftriaxone can increase the resistance of bacteria to ceftriaxone. It can be predicted that if its use continues to increase in the next few months, the sensitivity of ceftriaxone will decrease.

Conclusion

1. The most widely used cephalosporin antibiotics were ceftriaxone (83.02%), with an average age of 21–45 years, duration of administration 1-3 days (9.43%) used in the diagnosis of respiratory tract infections, and (13.21%) combined with other antimicrobials, namely metronidazole.
2. The sensitivity of germs to cephalosporin group antibiotics was mostly resistant to *Klebsiella pneumonia* isolates (96.43%). The highest sensitivity to bacteria was in cefepime and ceftazidime.

3. There is a significant relationship between the level of use of cephalosporin antibiotics and the sensitivity of bacteria to cephalosporin antibiotics.

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