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Original Article

Antibiotic Susceptibility Pattern in Clinical Isolates of *Pseudomonas aeruginosa*

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ABSTRACT

Introduction: *Pseudomonas aeruginosa is an opportunistic pathogen and causes of nosocomial infections in hospitals. Due to high antibiotic resistance and the ability to develop new resistance during antibiotic treatment, P. aeruginosa infection is difficult to eradicate because physical therapy becomes difficult and ineffective. This study aims to evaluate the antibiotic sensitivity pattern of P. aeruginosa strains at two different hospitals in Makassar.* ***Methods:*** *The research samples are from the results of the antibiotic sensitivity test conducted at two different hospitals, Hasanuddin University Hospital and Dr. Wahidin Sudirohusodo Hospital, from January 1 to September 30, 2019. A total of 84 samples were cultured and tested for antibiotic sensitivity of Pseudomonas aeruginosa.* ***Results:*** *Antibiotic sensitivity of P. aeruginosa was best with gentamicin (100%) at Hasanuddin University Hospital and amikacin (95.8%) at Dr. Wahidin Sudirohusodo Hospital. Hasanuddin University Hospital, followed by antibiotics amikacin (92.3%) and meropenem (84.6%). At Dr. Wahidin Sudirohusodo Hospital, P. aeruginosa showed good gentamicin sensitivity (91.5%) and meropenem (77.5%). The sensitivity of P. aeruginosa was lowest to*

piperacillin/tazobactam. ***Conclusions:*** *This study shows that the effectiveness of meropenem, amikacin, and gentamicin are great. It can use as a treatment option in P. aeruginosa infection.*

1. INTRODUCTION

Pseudomonas aeruginosa is an obligate aerobic bacterium and can survive well in the environment, such as soil, water, plants, animals, moist surfaces, including in hospitals and medical equipment because of its ability to survive with minimal nutritional requirements and can tolerate a variety of physical conditions.[i] *P. aeruginosa* is also known as an opportunistic pathogen in animals and humans. Several reports indicate that these bacteria also cause infection in healthy hosts.[ii] *P. aeruginosa* is a bacterium that can inhabit patients with various diagnoses, especially in immunocompromised patients. It causes infections such as pneumonia, gastrointestinal diseases, urinary tract infections, sepsis, peritonitis, skin infections, and burns.[iii]

Antibiotic resistance is the ability of microorganisms to withstand the effects of antibiotics. Pathogenic infections that are resistant to antibiotics require a longer, more complex, and expensive treatment. Currently, antibiotic resistance is a global health problem, both in developed and developing countries.[iv]

Due to high antibiotic resistance and the ability to develop new resistance during antibiotic treatment, *P. aeruginosa* infections are challenging to eradicate. They can become persistent or even chronic, as physical therapy becomes difficult and ineffective.[v] Several mechanisms that affect resistance that influence β-lactam resistance in *P. aeruginosa* is the destruction of the β-lactamase enzyme in antibiotics, changes in the target of antibiotics, decreased intracellular uptake of antibiotics.[vi]

Assessment of the antibiotic susceptibility of nosocomial infectious agents, especially *P. Aeruginosa,* can lead to selecting appropriate treatment and prevention and control of the emergence of antibiotic resistance in the hospital environment. This study aims to describe the antibiotic sensitivity pattern in clinical isolates of Pseudomonas aeruginosa.

2. METHODS

The research data were from the antibiotic sensitivity tests conducted at two hospitals, the Microbiology Laboratory of Hasanuddin University Hospital and the Clinical Pathology Laboratory of Dr. Wahidin Sudirohusodo Hospital. The samples were all culture data and antibiotic sensitivity tests from various clinical specimens of patients identified as *P. aeruginosa* at Hasanuddin University Hospital and Dr. Wahidin Sudirohusodo Hospital, from 1 to September 30, 2019. The inclusion criteria are the sample with the results of the identification test using VITEK 2-Compact was Pseudomonas aeruginosa and the exclusion criteria for the study were incomplete data from both the antibiotic sensitivity test and the patient's diagnosis. There are 13 clinical isolates from the Hasanuddin University Hospital 71 clinical isolates of *P. aeruginosa* from Dr. Wahidin Sudirohusodo Hospital.

Samples of clinical isolates of *P. aeruginosa* bacteria are from several specimens, such as sputum, urine, pus, blood, body fluid, ear secretions, and tissues

which were detected using the VITEK 2-Compact. Antibiotic sensitivity tests were also carried out with the VITEK 2-Compact. The antibiotics used were ceftazidime (CAZ), meropenem (MEM), amikacin (AK), gentamicin (GN), and piperacillin/tazobactam (TZP).

Data on culture examination and antibiotic sensitivity tests were obtained from patient medical records at Hasanuddin University Hospital and Dr. Wahidin Sudirohusodo Hospital. The data recorded included name, date of birth, medical record number, gender, antibiotic therapy for patient diagnosis, the antibiotic sensitivity pattern, and type of specimen. Then re-examination of the completeness of the data in the laboratory of each hospital.

3. RESULTS

In this study, there were 13 clinical isolates of *P. aeruginosa* from Hasanuddin University Hospital, which were isolated from pus (23.1%), sputum (53.8%), ear secretions (15.4%), and tissue (7.7%). In Dr. Wahidin Sudirohusodo Hospital, there were 71 clinical isolates isolated from several specimens, including pus (40.8%), sputum (33.8%), tissue (7.1%), blood (7.1%), ear secretions (4.2 %), urine (2.8%), and body fluids (4.2%). From a total sample of two hospitals, each 7 (53.8%) isolates and 45 (63.4%) isolates were taken from male patients, 6 isolates (46.2%) and 26 (36.6%) isolates were taken from female patients. The most age group was between 46-65 years as many as 6 (46.2%) isolates from Hasanuddin University Hospital and 26 (36.6%) isolates from Dr. Wahidin Sudirohusodo Hospital. The distribution of *P. aeruginosa* samples based on the type of specimen, sex, and age group shows in table 1.

Table 1. Distribution of Pseudomonas aeruginosa

Variable	Category	Universitas Hasanuddin Hospital n = 13	%	Dr. Wahidin Sudirohusodo Hospital n = 71	%
Gender	Male	7	53,8	45	63,4
	Female	6	46,2	26	36,6
Specimen	Pus	3	23,1	29	40,8
	Sputum	7	53,8	24	33,8
	Tissue	1	7,6	5	7,1
	Blood	0	0	5	7,1
	Urine	0	0	2	2,8
	Ear discharge	2	15,5	3	4,2
	Body fluid	0	0	3	4,2
Age group	0-5	0	0	11	15,5
	5-11	0	0	1	1,5
	12-25	0	0	10	14,2
	26-45	3	23,1	16	22,5
	46-65	6	46,2	26	36,6
	>65	4	30,7	7	9,8

**Age group based on Depkes, 2009*
Source: Primary Data, 2019

The distribution of *P.aeruginosa* samples was also grouped based on the category of patient diagnosis. For Hasanuddin University Hospital, the diagnosis of most patients was respiratory disease as many as 6 (46.2%) isolates followed by ear nose and throat disease is 2 (15.4%) isolates. Most diagnoses from Dr. Wahidin Sudirohusodo Hospital, with 13 (18.3%) isolates of nervous disease followed by 12 (17%) isolates of

respiratory illness. The distribution of *P. aeruginosa* samples based on the type of patient's diagnosis shows in table 2.

Table 2. Distribution of Pseudomonas aeruginosa based on patient's diagnosis

Diagnostic	Universitas Hasanuddin Hospital n = 13	%	Dr. Wahidin Sudirohusodo Hospital (%) n = 71	%
Respiratory system diseases	6	46,2	12	17
Nervous disease	1	7,6	13	18,3
genitourinary system diseases	0	0	3	4,2
Malignancy	1	7,6	9	12,7
Digestive system and liver diseases	0	0	6	8,4
Heart and blood vessel disease	0	0	5	7,1
Skin diseases and burns	0	0	7	9,8
Endocrine, nutritional and metabolic diseases	2	15,5	3	4,2
Trauma	0	0	4	5,6
ENT disease	2	15,5	4	5,6
Etc	1	7,6	5	7,1

***Etc: Sepsis, Hematological Disease, Abscess*
Source: Primary Data 2019

The antibiotic sensitivity pattern of *P. aeruginosa* shows in Figure 1. Of the five types of antibiotics, the sensitivity of *P. aeruginosa* is best with the aminoglycoside antibiotics, including gentamicin (100%) at Hasanuddin University Hospital and amikacin (95.8%) at Dr. Wahidin Sudirohusodo Hospital. At Hasanuddin University Hospital followed by antibiotics amikacin (92.3%) and meropenem (84.6%). The sensitivity of *P. aeruginosa* was lowest to piperacillin/tazobactam antibiotics, but the figure was 69.2%. At Dr. Wahidin Sudirohusodo Hospital, *P. aeruginosa* also showed good sensitivity to gentamicin (91.5%) and meropenem (77.5%), while the lowest sensitivity shows in piperacillin/tazobactam (60.5%).

Pseudomonas aeruginosa which was resistant to several antibiotics also linked based on the type of specimen. Dr. Wahidin Sudirohusodo Hospital obtained samples with the most resistance from pus specimens that were resistant to ceftazidime (34.5%), meropenem (27.6%), and tazobactam/piperacillin (24.1%), followed by samples from sputum specimens which resistant to ceftazidime (20.8%). At Hasanuddin University Hospital, the sample with the most resistance was sputum specimens with the highest resistance to tazobactam/piperacillin (14,3%). The distribution of resistance samples of Pseudomonas aeruginosa based on the type of specimen is shown in table 3.

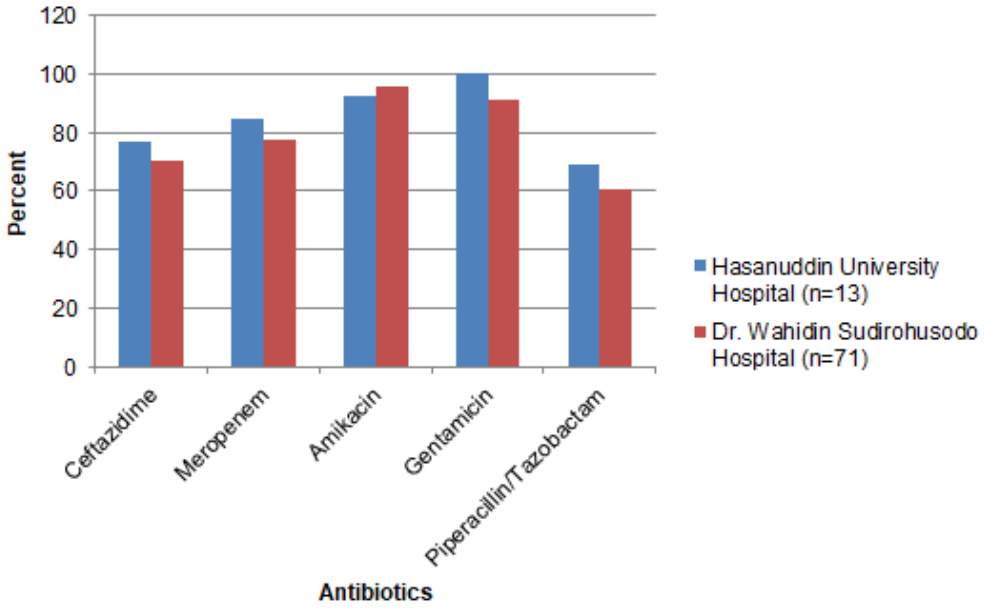

Figure 1. Antibiotic sensitivity pattern in clinical isolates of Pseudomonas aeruginosa

Table 3. Distribution of resistance samples of Pseudomonas aeruginosa based on the type of specimen

Specimen	Hasanuddin University Hospital (n=13)						Dr. Wahidin Sudirohusodo Hospital (n=71)					
	Antibiotik						Antibiotik					
	n	CAZ (%)	MEM (%)	AK (%)	GN (%)	TZP (%)	n	CAZ (%)	MEM (%)	AK (%)	GN (%)	TZP (%)
Pus	3	1 (33,3)	0 (0)	0 (0)	0 (0)	0 (0)	29	10 (34,5)	8 (27,6)	3 (10,3)	3 (10,3)	7 (24,1)
Sputum	7	0 (0)	0 (0)	0 (0)	0 (0)	1 (14,3)	24	5 (20,8)	4 (16,7)	0 (0)	0 (0)	4 (16,7)
Tissue	1	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	5	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Blood	-	-	-	-	-	-	5	2 (40)	1 (20)	0 (0)	0 (0)	1 (20)
Urine	-	-	-	-	-	-	2	0(0)	1 (50)	0 (0)	0 (0)	0 (0)
Ear discharge	2	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	3	1 (33,3)	0 (0)	0 (0)	0 (0)	0 (0)
Body fluid	-	-	-	-	-	-	3	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

***CAZ=ceftazidime, MEM=meropenem, AK=amikacin, GN=gentamicin, TZP=tazobactam-piperacillin*
Source: Secondary Data 2019

4. DISCUSSIONS

Pseudomonas aeruginosa is a nosocomial and opportunistic pathogen that is often isolated because it causes several infections, including respiratory tract infections, burns, otitis media, and other diseases with high mortality prevalence, especially in immunocompromised patients who are hospitalized.[vii] *P. aeruginosa* has intrinsic resistance to various antibiotics and can acquire resistance to other antibiotics during therapy.[viii] The ability of *P. aeruginosa* resistance is known to increase and become a global public health problem worldwide.[ix]

This study showed that *P. aeruginosa* was more isolated from male patients where from a total sample of two hospitals, 7 (53.8%) isolates and 45 (63.4%) isolates were taken from male patients, respectively. The highest age group was between 46-65

years in both hospitals, which is in line with research conducted by Omar B. Ahmed in 2017 in Saudi Arabia, which showed that out of 28 isolates, there were 18 (64.3%) isolates from male patients. However, it is contrary to the age group wherein the dominant age group is above 60 years.[5] For the origin of the specimens in this study, most samples came from pus and sputum at both hospitals. National Antimicrobial Resistance Surveillance, Thailand (NARST) also reported that *P. aeruginosa* was most commonly found in pus, urine, and sputum specimens.[x]

In this study, the isolated *P. aeruginosa* isolates had different levels of sensitivity to several antibiotics. The highest level of sensitivity was to the antibiotic gentamicin (100%) for the Hasanuddin University Hospital and amikacin (95.8%) at Dr. Wahidin Sudirohusodo Hospital. These results are in line with the research conducted by Dewi et al in Pekanbaru, which showed the level of sensitivity to amikacin (76.9%) from a total of 121 isolates of Pseudomonas aeruginosa; 93 isolates were sensitive to amikacin.[xi] Nahid Bavasheh et al. in Iran also showed a good level of sensitivity to amikacin (19.4%) that from 72 isolates, 58 isolates were sensitive to amikacin.[4]

The resistance of several antibiotics in this study is most likely due to the prolonged hospitalization time in infectious patients, the use of broad-spectrum drugs at the start of hospitalization, the lack of routine screening for ESBL-producing P. aeruginosa strains, and colonization of multidrug-drug strains resistant. Possible mechanisms of resistance to antibiotics in this study including overproduction of AmpC, a cephalosporinase expressed by the P. aeruginosa chromosomal gene, which causes the most common resistance mechanisms to b-lactams including ESBLs (eg, ceftazidime) and penicillins. Several studies have reported the increasig resistance of P. aeruginosa isolates to cephalosporins.[xii,xiii,xiv]

Carbapenem antibiotics are currently considered the drug of choice to treat the infections caused by ESBL-producing organisms, including Pseudomonas aeruginosa. In this study, 11 (84.6%) isolates at Hasanuddin University Hospital and 55 (77.5%) isolates at Dr. Wahidin Sudirohusodo Hospital are sensitive to meropenem. The result is in line with research conducted by Martina C. Agbo et al. in May until August 2018 at a Hospital in Nigeria, which stated that of 34 clinical isolates of *P. aeruginosa* there were 29 isolates (85.3%) sensitive to the antibiotic meropenem.[xv] Another study that is in line with the results of this study is the study of Mohammad Yousef Alikhani in Iran where from 106 isolates, sensitivity to the antibiotic meropenem was shown by 87 isolates (82.1%).[xvi] This proves that the introduction of carbapenems as a therapy for infection is a significant advance. Carbapenems have become the drug of choice in infections caused by bacteria resistant to penicillin or cephalosporins, especially ESBL-producing strains.[xvii]

5. CONCLUSION

This study shows that the level of effectiveness of meropenem, amikacin, and gentamicin are great. It can use as a treatment option in *P. aeruginosa* infection. This study can help as a reference to prevent mortality and morbidity associated with *P. aeruginosa* infection.

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Conflict of Interest Statement:

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.