Health Biotechnology and Biopharma (2018), 2(1): 28-37

Original Research Article

Study of drug resistance pattern of *Pseudomonas aeroginosa* at Shahid Sadoughi and central laboratories of Yazd in Iran

Jamshid Ayatollahi [1], Alireza Dehghani *[2], Seyed Hossein Shahcheraghi *[1,3]

[1] Infectious Diseases Research Center, Shahid Sadoughi Hospital, Shahid Sadoughi University of Medical Sciences, Yazd, Iran
[2] Shahid Sadoughi Hospital, Shahid Sadoughi University of Medical Sciences, Yazd, Iran

[3] Department of Modern Sciences & Technologies, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran

***Corresponding authors:** *Alireza Dehghani*, Shahid Sadoughi Hospital, Shahid Sadoughi University of Medical Sciences, Yazd, Iran. *Email: dehghani13622@gmail.com; Seyed Hossein Shahcheraghi*, Infectious Diseases Research Center, Shahid Sadoughi Hospital, Shahid Sadoughi University of Medical Sciences, Yazd, Iran. *Email: shahcheraghih@gmail.com*

DOI: 10.22034/HBB.2018.12
Received: June 27, 2018; **Accepted:** July 15, 2018

ABSTRACT

This research aims to assess drug resistance pattern of *Pseudomonas aeroginosa*. This study cross-sectional was done on 151 positive culture tests of *P. aeroginosa* from May 2016 until May 2017 in Shahid Sadoughi and central laboratories of Yazd. In this study the sensitivity was evaluated according to the type of antibiotics and then according to location of sampling, type of the specimen and type of reception. The bacteria had most sensitivity to colistin (92.8 %) and then tobramycin (74.2 %). Also the most resistance was to ceftriaxone (70.4 %). The rate of the bacterial resistance to some types of antibiotics was as follow: cefotaxime (64%), ceftazidime (33.1 %), ciprofloxacin (30.3 %) and meropenem (27.5 %). There were not significant differences between antibiotic sensitivities according to the type of specimen while there were significant differences between antibiotic sensitivities based on the location of clinic.

Keywords: *Pseudomonas aeroginosa*, resistance, Yazd

INTRODUCTION

Antibiotics were considered as a phenomenal medication. Although, the majority of the less expensive anti-toxins lost their adequacy because of rise of obstruction among microscopic organisms. Costly and muddled anti-infection agents were acquainted with handle basic diseases [1]. Across the board anti-microbial utilize has quickened the frequency of antibiotic resistance (ABR). In spite of the fact that the correct greatness of this worldwide issue and its impact on human health are to a great extent obscure, ABR against basic bacterial pathogens has come to concerning levels in numerous parts of the world [2]. ABR is perplexing and driven by numerous interrelated elements, including information, states of mind, recognitions, desires, time limitations, monetary impetuses, social components, wellbeing framework qualities, and directions [3-6]. Though, anti-microbial abuse assumes a crucial part, underuse through poor adherence likewise assumes a vital part in ABR [2].

Pseudomonas aeruginosa is a standout amongst the most difficult life forms associated with an assortment of infections. It is a main source of nosocomial contaminations may cause an assortment of nosocomial diseases especially in immunocompromised patients or in individuals with other chronic diseases for example cystic fibrosis with CFTR gene mutation [7-11] and is related with a high death rate. The purpose behind this high mortality is the quickly developing protection from numerous at present accessible antibiotics [12]. Most contaminations caused by *P. aeruginosa* are regularly extreme, dangerous and are untreatable due to the high protection from antimicrobial specialists and the absence of new medication improvement [13].

Territorial varieties in antibiotic resistance patterns for various creatures including *P. aeruginosa* happened which could be because of contrasts in anti-infection endorsing hones [12]. Also, *P. aeruginosa* is naturally impervious to a few anti-infection agents in view of the poor penetrability of its external film, the fundamental articulation of different bacterial pumps, and the creation of antibiotic-in-effecting enzymes [14]. The primary operators have been discovered that can be powerful against MDR *P. aeruginosa* strains and these are the antibiotic colistinhas [15].

Better comprehension of worldwide patterns in anti-microbial obstruction for *P. aeruginosa* is acquired via local and regional surveillance studies. Therefore, the aim of

our investigation was to assess drug resistance pattern of *P. aeroginosa* in Shahid Sadoughi and central laboratories of Yazd in Iran.

MATERIALS AND METHODS

From May 2016 to May 2017, a total of 151 positive culture samples for *P.aeroginosa* collected from Shahid Sadoughi laboratories were investigated about their drug resistance pattern.

In this cross-sectional study, the samples were collected from all positive cultures of *P. aeruginosa* by a checklist that was previously provided by the researchers.

Samples were obtained in a sequential census of all positive cultures in terms of *P. aeruginosa* in two laboratories at the designated time.

Data collection was carried out based on a questionnaire that was previously designed in terms of the type of antibiotic, according to the objectives.

The information contained in this questionnaire was divided into four parts including, sampling site, in Shahid Sadoughi hospital laboratory, sample source, in blood, urine and also antibiotic type. In this study, the disc diffusion sensitivity was used to evaluate the sensitivity and resistance of *P. aeruginosa* to antibiotics. In the disc diffusion method, a certain amount of bacteria is set according to the existing standards in terms of the degree of dilution and has already been identified. Special culture media add to the same plates in terms of diameter, depth. Then it takes to grow the microbes, if the antibiotic is able to prevent the growth of the microorganism, it does not grow around the bacterial disk, and the bacteria to the antibody the biotype is more sensitive.

It compares them to the special table, and ultimately comments on antibiotic susceptibility or resistance to the antibiotic.

Detection and differentiation of sensitive, semi-sensitive and resistant conditions from each other is performed based on the diameter of the colony by millimeters and according to the relevant table in each laboratory. The data were collected, recorded in SPSS software version 16 and analyzed by chi-square test.

RESULTS

At the time of the study, 151 positive cultures from *P. aeruginosa* were investigated. In general, 56 samples (37.1 %) belonged to the laboratory of Shahid Sadoughi hospital in Yazd and 95 samples

(62.9 %) belonged to Central Laboratory. Also, 21 samples were urine specimens, 23 specimens of blood, 49 specimens of burn wound specimens, 32 specimens of other wounds, 18 specimens related to lung part, 3 specimens of shunt, and 5 samples were related to sputum.

The bacteria had most sensitivity to colistin (92.8 %) and then tobramycin (74.2 %). Also the most resistance was related to ceftriaxone (70.4 %). The bacterial resistances to some other types of antibiotics were as following: cefotaxime (64 %), ceftazidime (33.1 %), ciprofloxacin (30.3 %) and meropenem (27.5 %) are shown in Table 1. Antibiotic resistance pattern based on the type of sample has been given in Table 2 and Table 3.

Table 1. The frequency distribution of *Pseudomonas aeruginosa* resistance pattern, based on the type of antibiotic (n=151)

		Resistant		Semi-sensitive		Sensitive		Total
Antibiotic		N	%	N	%	N	%	
1	Colistin	1	3.6	1	3.6	26	92.8	28
2	Tobramycin	10	15.2	7	10.6	49	74.2	66
3	Piperacillin/tazobactam	10	14.3	11	15.7	49	70	70
4	Imipenem	35	25	12	8.6	93	66.4	140
5	Amikacin	33	25.2	12	9.2	86	65.6	131
6	Meropenem	38	27.5	12	8.7	88	63.8	138
7	***Ciprofloxacin***	43	30.3	12	8.4	87	61.3	142
8	Ceftazidime	46	33.1	13	9.3	80	57.6	139
9	Cefotaxime	64	64	5	5	30	30.3	99
10	Ceftriaxon	76	70.4	11	10.2	21	19.4	108

N: number of sample

Table 2. Antibiotic resistance pattern based on the type of sample (urine, blood, burn and other wounds)

Type of Sample	**Urine**			**Blood**			**Burn wound**			**Other wounds**		
Result	Sensitive	Semi-sensitive	Resistant	Sensitive	Semi-sensitive	Resistant	Sensitive	Semi-sensitive	Resistant	Sensitive	Semi-sensitive	Resistant
Antibiotic	N(%)	N(%)	N(%)	N(%)	N(%)	N(%)	N(%)	N(%)	N(%)	N(%)	N(%)	N(%)
Colistin	5(100)	0(0)	0(0)	5(100)	0(0)	0 (0)	6 (75)	1(12.5)	1(12.5)	6(100)	0 (0)	0 (0)
Tobramycin	9 (81.8)	2(18.2)	0(0)	12(85.7)	1(7.1)	1 (7.1)	11(55)	2(10)	7 (35)	10(71.4)	2(14.3)	2(14.3)
Piperacillin/tazobactam	9 (75)	3 (25)	0 (0)	11(78.6)	2(14.3)	1 (7.1)	10(45.4)	4(18.2)	8 (36.4)	14(87.5)	1(6.25)	1(6.25)
Imipenem	16 (84.2)	1 (5.3)	2(10.5)	17 (80.9)	1 (4.8)	3(14.3)	16 (35.6)	6(13.3)	23 (51.1)	23 (76.7)	4(13.3)	3 (10)
Amikacin	15 (83.3)	1(5.6)	2(11.1)	17 (85)	1(5)	2 (10)	15(36.6)	5(12.2)	21(51.2)	20(71.4)	3(10.7)	5(17.9)
Meropenem	15 (83.3)	1 (5.6)	2(11.1)	17 (81)	2 (9.5)	2 (9.5)	13(28.9)	5(11.1)	27 (60)	23 (79.3)	3(10.4)	3(10.4)
Ciprofloxacin	15(78.9)	1(5.3)	3(15.8)	18 (81.8)	2 (9.1)	2 (9.1)	13 (28.9)	3 (6.7)	29 (64.4)	22 (73.3)	2 (6.7)	6 (20)
Ceftazidime	14(70)	2(10)	4(20)	15(68.2)	3(13.6)	4(18.2)	15(33.3)	3(6.7)	27(60)	18(62.1)	7(24.1)	4(13.8)
Cefotaxime	5(33.3)	1(6.7)	9(60)	6(42.9)	1(17.1)	7(50)	6(17.6)	2(5.9)	26(76.5)	7(38.8)	1(5.6)	10(55.6)
Ceftriaxon	5(31.25)	2(12.5)	9(56.25)	4(25)	3(18.75)	9(56.25)	3(7.9)	2(5.3)	33(86.8)	5(27.8)	2(11.1)	11(61.1)

N: number of sample

Due to the small size of the sample in each group there was no possibility of test, so, we could not state our opinion about the relationship between the sensitivity rates of antibiotics in terms of the type.

According to *P-Value*, it was a significant relation between antibiotics of imipenem, amikacin, meropenem, ciprofloxacin, ceftazidime and laboratory place in Table 4. In fact, colistin antibiotic was not used in the central laboratory therefore there was no comparability between the two laboratories.

Table 3. Antibiotic resistance pattern based on the type of sample (lung, shunt, angiocate and sputum)

Type of Sample	**Lung**			**Shunt**			**Angiocate**			**Sputum**		
Result	Sensitive	Semi-sensitive	Resistant	Sensitive	Semi-sensitive	Resistant	Sensitive	Semi-sensitive	Resistant	Sensitive	Semi-sensitive	Resistant
Antibiotic	N(%)	N(%)	N(%)	N(%)	N(%)	N(%)	N(%)	N(%)	N(%)	N(%)	N(%)	N(%)
Colistin	4(100)	0(0)	0(0)	0(0)	0 (0)	0 (0)	0(0)	0(0)	0 (0)	0 (0)	0 (0)	0 (0)
Tobramycin	7 (100)	0(0)	0(0)	0(0)	0 (0)	0 (0)	0 (0)	0(0)	0 (0)	0 (0)	0 (0)	0 (0)
Piperacillin/tazobactam	5 (83.3)	1(16.7)	0(0)	0(0)	0 (0)	0 (0)	0 (0)	0(0)	0 (0)	0 (0)	0 (0)	0 (0)
Imipenem	16(94.1)	0 (0)	1(5.9)	1(33.3)	0(0)	2(66.7)	1 (50)	0 (0)	1 (50)	3(100)	0 (0)	0 (0)
Amikacin	14(87.5)	1(6.25)	1(6.25)	2(66.7)	0(0)	1(33.3)	1 (50)	0(0)	1 (50)	2(66.7)	1(33.3)	0 (0)
Meropenem	15 (88.2)	0 (0)	2(11.8)	2(66.7)	1(33.3)	0 (0)	1(50)	0 (0)	1 (50)	2(66.7)	0(0)	1(33.3)
Ciprofloxacin	13(72.2)	3(16.7)	2(11.1)	3(100)	0 (0)	0 (0)	0 (0)	1 (50)	1 (50)	3 (100)	0 (0)	0 (0)
Ceftazidime	13(72.2)	1(5.6)	4(22.2)	3(100)	0 (0)	0 (0)	0 (0)	0 (0)	2 (100)	2(66.7)	0 (0)	1(33.3)
Cefotaxime	6(42.9)	0(0)	8(57.1)	0(0)	0 (0)	1 (100)	0 (0)	0 (0)	1 (100)	0 (0)	0 (0)	2 (100)
Ceftriaxon	4(25)	2(12.5)	10(62.5)	0(0)	0 (0)	1 (100)	0 (0)	0 (0)	1 (100)	0 (0)	0 (0)	2 (100)

N: number of sample

DISCUSSION

The results of our study demonstrated that the bacteria had most sensitivity to colistin (92.8 %) and then tobramycin (74.2 %). Also the most resistance was related to ceftriaxone (70.4 %). The antibiotics with less than 10% resistance were cefepime, amikacin and piperacillin-tazobactam, which showed lowest resistance (4.9%) [12]. Resistance rate to piperacillin-tazobactam was also low in the present study. A study led to investigate the distribution rate, prevalence and antimicrobial resistance patterns of *P. aeruginosa* in Kosovo. It proved the rate of resistance increased significantly from 2013 to 2015: cefepime 31.6 % to 64.5 %; gentamicin 47.2 % to 56.6 %; amikacin 38.3 % to 52.7 %; tobramycin 35.9 % to 54.5 %;

ciprofloxacin 32.8 % to 45 %; piperacillin 56.2 % to 68.4 %; and piperacillin-tazobactam 26.6 % to 44.1 % [16]. The present study showed that most sensitivity was first about colistin and then tobramycin. Therefore, in this study, the high sensitivity was reported for these antibiotics in comparison with Lila G study [17]. Resistance rate was also low for amikasin in the present study, but, the sensitivity rate was almost 70 % for piperacillin and tazobactam. In another study that was performed in Tabriz, resistance to ampicillin, ceftizoxime, cotrimoxasol and cefotoxime was more than 95 %. Resistance to ceftazidime was proved in 50 % and lowest resistance was related to ciprofloxacin [18,19].

In our study, the bacteria had most susceptibility to colistin (92.8 %) and then tobramycin (74.2 %).

Resistance rates were almost 25 % or very lower than this rate for tobramycin and gentamicin [20]. In the present study, the high sensitivity was obtained for antibiotics. Resistance rates were low about more antibiotics other than ceftriaxone.

Table 4. Resistance pattern based on laboratory place

Place	**Shahid Sadoughi laboratory**			**Central laboratory**			***P- Value***
Result	Resistant	Semi-sensitive	Sensitive	Resistant	Semi-sensitive	Sensitive	
Antibiotic	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	
Colistin	1 (3.6)	1 (3.6)	26(92.8)	-	-	-	-
Tobramycin	4 (15.4)	1 (3.8)	21(80.8)	6 (15)	6 (15)	28 (70)	.350
Piperacillin/tazobactam	3 (12.5)	3 (12.5)	18 (75)	7(15.2)	8 (17.4)	31 (67.4)	.790
Imipenem	6 (12)	4 (8)	40 (80)	29 (32.2)	8 (8.9)	53 (58.9)	.024
Amikacin	4 (10.8)	3 (8.1)	30 (81.1)	29 (31)	9 (9)	56 (60)	.045
Meropenem	4 (8.3)	3 (6.3)	41 (85.4)	34 (37.8)	9 (10)	47 (52.2)	.0003
Ciprofloxacin	9 (16.7)	6 (11.1)	39 (72.2)	34 (38.6)	6 (6.8)	48 (54.6)	.020
Ceftazidime	7 (15.6)	5 (11.1)	33 (73.3)	39 (41.5)	8 (8.5)	47 (50)	.009
Cefotaxime	22 (64.7)	1 (2.9)	11 (32.4)	42 (64.6)	4 (6.2)	19 (29.2)	.760
Ceftriaxon	29 (76.3)	3 (7.9)	6 (15.8)	47 (67.2)	8 (11.4)	15 (21.4)	.600

N: number of sample

CONCLUSION

The bacteria had most sensitivity to colistin (92.8 %) and then tobramycin (74.2 %). Also the most resistance was related to ceftriaxone (70.4 %). Since this study is limited to only two laboratories in Yazd, it is prescribed to plan an expansive scale to discover the genuine opposition example of our country population.

ACKNOWLEDGMENT

The authors wish to thank the staff of infectious diseases research center of Shahid Sadoughi university of medical sciences in Yazd.

REFERENCES

[1]. Rajat RM, Ninama GL, Mistry K, Parmar R, Patel K, Vegad MM. Antibiotic resistance pattern in *Pseudomonas aeruginosa* species isolated at a tertiary care hospital, Ahmadabad. *Natl J Med Res*, 2012; 2(2):156-59.

[2]. Liu L, Liu B, Li Y, Zhang W. Successful control of resistance in *Pseudomonas aeruginosa* using antibiotic stewardship and infection control programs at a Chinese university hospital: a 6-year prospective study. *Infect Drug Resist*, 2018; 11: 637-46.

[3]. Vallin M , Polyzoi M , Marrone G , Rosales-Klintz S , Tegmark Wisell K , Stålsby Lundborg C. Knowledge and attitudes towards antibiotic use and resistance a class analysis of a Swedish population-based sample. *PLoS One*, 2016; 11(4).

[4]. Björkman I, Berg J, Röing M, Erntell M, Lundborg CS. Perceptions among Swedish hospital physicians on prescribing of antibiotics and antibiotic resistance. *Qual Saf Health Care*, 2010; 19(6).

[5]. Sahoo KC, Tamhankar AJ, Johansson E, Lundborg CS. Antibiotic use, resistance development and environmental factors: a qualitative study among healthcare professionals in Orissa, India. *BMC Public Health*, 2010; 10: 629.

[6]. Laxminarayan R, Duse A, Wattal C, Zaidi AK, Wertheim HF, Sumpradit N, Vlieghe E, Hara GL, Gould IM, Goossens H, Greko C, So AD, Bigdeli M, Tomson G, Woodhouse W, Ombaka E, Peralta AQ, Qamar FN, Mir F, Kariuki S, Bhutta ZA, Coates A, Bergstrom R, Wright GD, Brown ED, Cars O. Antibiotic resistance: the need for global solutions. *Lancet Infect Dis*, 2013; 13(12): 1057-98.

[7]. Vincent JL. Nosocomial infections in adult intensive-care units. *Lancet*, 2003; 361: 2068–77.

[8]. Oliver A, Mulet X, Lopez-Causape C, Juan C. The increasing threat of *Pseudomonas aeruginosa* high-risk clones. *Drug Resist Updat*, 2015; 21: 41–59.

[9]. Lyczak JB, Cannon CL, Pier GB. Establishment of *Pseudomonas aeruginosa* infection: lessons from a versatile opportunist. *Microbes Infect*, 2000; 2: 1051–60.

[10]. Potron A, Poirel L, Nordmann P. Emerging broad-spectrum resistance in *Pseudomonas aeruginosa* and *Acinetobacter baumannii*: Mechanisms and epidemiology. *Int J Antimicrob Agents*, 2015; 45: 568–85.

[11]. Von Klitzing E, Ekmekciu I, Kühl AA, Bereswill S, Heimesaat MM. Multidrug resistant *Pseudomonas aeruginosa* aggravates inflammatory responses in murine chronic colitis. *Sci Rep*, 2018; 8(1): 6685.

[12]. Khan MA, Faiz A. Antimicrobial resistance patterns of *Pseudomonas aeruginosa* in tertiary care hospitals of Makkah and Jeddah. *Ann Saudi Med*, 2016; 36(1): 23-28.

[13]. Khan F, Khan A, Kazmi SU. Prevalence and susceptibility pattern of multidrug resistant clinical isolates of *Pseudomonas aeruginosa* in Karachi. *Pak J Med Sci*, 2014; 30: 951-54.

[14]. Mesaros N, Nordmann P, Plésiat P, Roussel-Delvallez M, Van Eldere J, Glupczynski Y, Van Laethem Y, Jacobs F, Lebecque P, Malfroot A, Tulkens PM, Van Bambeke F. *Pseudomonas aeruginosa*: resistance and therapeutic options at the turn of the new millennium. *Clin Microbiol Infect*, 2007; 13(6): 560-78.

[15]. Gill MM, Rao JU, Kaleem F, Hassan A, Khalid A, Anjum R. In vitro efficacy of colistin against multidrug resistant *Pseudomonas aeruginosa* by minimum inhibitory concentration. *Pak J Pharm Sci*, 2013; 26: 7-10.

[16]. Lila G, Mulliqi-Osmani G, Bajrami R, Kurti A, Azizi E, Raka L. The prevalence and resistance patterns of Pseudomonas aeruginosa in a tertiary care hospital in Kosovo. *Infez Med*, 2017; 25(1): 21-26.

[17]. Samad A, Ahmed T, Rahim A, Khalil A, Ali I. Antimicrobial susceptibility patterns of clinical isolates of *Pseudomonas aeruginosa* isolated from patients of respiratory tract infections in a Tertiary Care Hospital, Peshawar. *Pak J Med Sci*, 2017; 33(3): 670-74.

[18]. Ghorashi Z, Nizami N, Ghotaslou R, Ghorashi S. Pattern of *Pseudomonas aeruginosa* drug resistance in Tabriz children hospital. *Pak J Biol Sci*, 2010; 13: 400-44.

[19]. Pathmanathan SG, Samat NA, Mohamed R. Antimicrobial susceptibility of clinical isolates of *Pseudomonas aeruginosa* from a Malaysian hospital. *Malaysian J Med Sci*, 2009; 16 (2): 27-32.

[20]. Brown PD, Izundu A. Antibiotic resistance in clinical isolates of *Pseudomonas aeruginosa* in Jamaica. *Rev Panam Salud Publica*, 2004; 16: 125–30.