Quick Response Code:

Indian J Med Res 149, February 2019, pp 295-298
DOI: 10.4103/ijmr.IJMR_14_18

Pathogen burden & associated antibiogram of *Pseudomonas* spp. in a tertiary care hospital of India

Minu Kumari[1], Surbhi Khurana[2], Nidhi Bhardwaj[2], Rajesh Malhotra[3] & Purva Mathur[2]

[1]Division of Trauma Surgery & Critical Care, [2]Department of Laboratory Medicine, Jai Prakash Narayan Apex Trauma Centre & [3]Department of Orthopaedics, All India Institute of Medical Sciences, New Delhi, India

Received January 2, 2018

Antimicrobial resistance particularly in Gram-negative bacilli is an increasing problem worldwide. *Pseudomonas* spp. is one the most common Gram-negative bacteria associated with nosocomial infections and therefore, its trend of antimicrobial resistance needs to be studied. The aim of this study was to evaluate the rate of antimicrobial resistance and changes in resistance pattern over a period of five years (2012-2016) in *Pseudomonas* spp. isolated from trauma patients attending a tertiary care hospital in north India. During the study, a total of 2444 *Pseudomonas* spp. were isolated from the various clinical sample. The most common species isolated was *P. aeruginosa* (2331, 95%). The highest level of resistance was observed against levofloxacin (1678, 69%) and the lowest level of resistance was observed against tobramycin (1254, 51%). Irrational and inappropriate use of antibiotics was found to be responsible for multidrug resistance in *Pseudomonas* spp. Hence, there is an urgent need to emphasize strict antibiotic policy to minimize the misuse of antimicrobials.

Key words Antimicrobial - infection - resistance - surveillance - susceptibility

Pseudomonas is an aerobic, motile, Gram-negative bacterium and has been implicated in diverse healthcare associated infections (HCAIs) such as pneumonia, urinary tract infection, skin and soft-tissue infections, in severe burns and in infections among immunocompromised individuals[1-5]. Multidrug-resistant *Pseudomonas* is especially associated with increased mortality because no adequate therapeutic options exist[6-8]. Therefore, there is a need to conduct monitoring studies of *Pseudomonas* spp. for its resistance pattern. The present study was undertaken to find out the drug resistance and antibiotic susceptibility patterns in *Pseudomonas* spp. isolated from different clinical specimens of trauma patients at a tertiary care hospital of India.

This retrospective cross-sectional study comprised clinically significant isolates of *Pseudomonas* spp. that were isolated from trauma patients from January 2012 to December 2016. The study was approved by the Institutional Ethics Committee with written consent. Demographic details including age, gender and clinical history of patients were recorded from laboratory maintained computerized database. The isolates were collected from different clinical specimens such as blood, pus, tracheal aspirate, urine and sputum from wards, intensive care units (ICUs) and follow up

patients. All these samples were processed as per standard microbiological methods. The bacterial isolates were identified to the species level by the VITEK2 system (BioMérieux, Lyon, France). The antimicrobial susceptibility data were derived from VITEK 2 system according to clinical and laboratory standard institute guidelines[9]. The standardized custom sensitivity panel used in the VITEK 2 system included 25 different antimicrobials for susceptibility testing of all Gram-negative isolates, but for the present study, only the susceptibilities of *Pseudomonas* spp. to common anti-pseudomonal agents were analyzed. The resistance of *Pseudomonas* spp. to individual antimicrobials was presented in absolute numbers and percentages and was analyzed year-wise. Statistical analysis was done by SPSS version 21 software (IBM SPSS Statistics, Version 21.0. Armonk, NY: IBM Corp.).

During the study period (January 2012 to December 2016), a total of 16,210 bacterial isolates were obtained, of which *Pseudomonas* spp. accounted for 2444 (15%). Of the total 2444 clinical isolates, *P. aeruginosa* (2331, 95%) was the most common species followed by *P. luteola* (22, 1%), *P. putida* (62, 2.5%), *P. stutzeri* (12, 0.4%), *P. mendocina* (15, 1%) and *P. pseudoalcaligenes* (2, 0.1%). The mean age of the patients was 34±1.94 yr (range 1-87 yr). *Pseudomonas* spp. were most commonly isolated from tracheal aspirate (420, 23.3%) followed by pus/wound swab (409, 22.7%), urine (375, 20.9%), blood (225, 12.5%), bronchoalveolar lavage (212, 11.8%), cerebrospinal fluid (50, 2.8%), tissue (42, 2.3%), drain fluid (21, 1.2%), central venous pressure tips (18, 1%), pleural fluid (7, 0.4%), bones (6, 0.3%), sputum (3, 0.2%) and other samples (12, 0.7%).

The prevalence of *Pseudomonas* spp. in our hospital setting was maximal in neurosurgery ward (590, 31 %), followed by surgery ward (417, 22%), surgical ICU (367, 19%), neurosurgical ICU (284, 15%), follow up outpatient department (163, 9%), emergency department (39, 2%) and orthopaedics ward (37, 2%). The year-wise and the total resistance pattern of the *Pseudomonas* isolated from 2012 to 2016 are described in the Table. All isolates were multidrug resistant. The highest level of resistance was observed against levofloxacin (1678, 69%) followed by gentamicin (1657, 68%), ciprofloxacin (1639, 67%), ceftazidime (1623, 66%), meropenem (1533, 63%), cefepime (1541, 63%), amikacin (1419, 58%), piperacillin (1363, 56%), imipenem (1301, 53%) and the lowest level of resistance was noted against tobramycin (1254, 51%). A decreasing rate of antimicrobial resistance was observed in amikacin, cefepime, piperacillin and ceftazidime from 2012 to 2016. The level of resistance of levofloxacin was constant during 2014-2016. Although ciprofloxacin, gentamycin, imipenem and meropenem showed an elevated level of resistance, no trend of resistance was observed.

Infections with multidrug-resistant *Pseudomonas* are not only associated with considerable morbidity and mortality, but it also presents an economic burden as these are associated with high treatment costs and longer duration of hospital stay when compared

Table. Resistance pattern of *Pseudomonas* spp. against different antimicrobials, n (%)

Antimicrobials	Year					Total (%)	*P*
	2012 (n=540)	2013 (n=538)	2014 (n=546)	2015 (n=423)	2016 (n=397)		
Amikacin	389 (72)	301 (56)	300 (55)	211 (50)	218 (55)	1419 (58)	<0.001
Cefepime	415 (77)	355 (66)	333 (61)	228 (54)	210 (53)	1541 (63)	<0.001
Ciprofloxacin	410 (76)	328 (61)	371 (68)	300 (71)	230 (58)	1639 (67)	<0.001
Gentamicin	405 (75)	344 (64)	371 (68)	275 (65)	262 (66)	1657 (68)	<0.001
Imipenem	318 (59)	247 (46)	333 (61)	224 (53)	179 (45)	1301 (53)	<0.001
Piperacillin	340 (63)	307 (57)	289 (53)	228 (54)	199 (50)	1363 (56)	0.009
Tobramycin	416 (77)	441 (82)	N/A	N/A	397 (100)	1254 (51)	<0.001
Ceftazidime	410 (76)	409 (76)	333 (61)	241 (57)	230 (58)	1623 (66)	<0.001
Meropenem	394 (73)	317 (59)	355 (65)	241 (57)	226 (57)	1533 (63)	<0.001
Levofloxacin	410 (76)	339 (63)	371 (68)	288 (68)	270 (68)	1678 (69)	<0.001

N/A, not available

to those associated with their drug-susceptible counterparts[10,11]. Identification and selection of an appropriate antibiotic to initiate therapy are essential to optimize the clinical outcome[12]. The isolation rate of *Pseudomonas* spp. in our trauma setting was 15 per cent which was similar to results published earlier[13,14]. The rates in this study were different from our previous report[15]. In the present study, the *Pseudomonas* isolates were mainly obtained from tracheal aspirate followed by pus/wound samples that were similar to some previous studies[16]. The highest level of resistance was observed in levofloxacin, and the lowest level of resistance was observed against tobramycin. The observed rate of antibiotic resistance in our study against aminoglycosides such as amikacin and gentamicin was consistent with earlier studies[17,18]. Drug resistance against quinolones such as ciprofloxacin and levofloxacin showed high resistance in our study which was in contrast with a previous study where clinical isolates were more susceptible to these antibiotics[19]. Cephalosporins are regarded as anti-pseudomonal drugs, particularly ceftazidime which is a third generation cephalosporin and shows efficacy in such infections. However, this drug also encountered higher resistance (66%) in our study as shown earlier[20]. The major limitation of our study was that molecular characterization of resistant isolates (genes and clones) could not be performed as the study was based on laboratory-maintained database.

Multidrug resistance in bacterial population is a great challenge in the treatment of patients with pseudomonal infections. This calls for monitoring and optimization of antimicrobial use. The strengthening of laboratory services at national and international levels will ensure effective surveillance of antimicrobial resistance. Further studies should focus on better administration of the existing antibiotic armamentarium, along with antibiotic stewardship programme.

***Financial support & sponsorship*:** None.

***Conflicts of Interest*:** None.

References

1. de Bentzmann S, Plésiat P. The *Pseudomonas aeruginosa* opportunistic pathogen and human infections. *Environ Microbiol* 2011; *13* : 1655-65.
2. Tadvi J, Javadekar TB, Bhavsar R, Garala N. Prevalence & antibiogram of *Pseudomonas aeruginosa* at SSG Hospital, Baroda, Gujarat, India. *J Res Med Dent Sci* 2017; *3* : 204-7.
3. Siddiqua M, Alam AN, Akter S, Ferdousi RS. Antibiotic resistance pattern in *Pseudomonas aeruginosa* isolated from a private medical college hospital. *KYAMC J* 2018; *9* : 16-9.
4. Rao S, Subbarayudu S. Surveillance of *Pseudomonas* in COPD patients in a tertiary care hospital. *Int J Res Med Sci* 2017; *3* : 1209-12.
5. Prasad RR, Shree V, Kumar R, Kala K, Kumar P. Prevalence and antibiotic sensitivity of *Pseudomonas aeruginosa* isolated from CSOM in NMCH, Patna, India. *Int J Curr Microbiol App Sci* 2017; *6* : 2912-6.
6. Giske CG, Monnet DL, Cars O, Carmeli Y; ReAct-Action on Antibiotic Resistance. Clinical and economic impact of common multidrug-resistant gram-negative bacilli. *Antimicrob Agents Chemother* 2008; *52* : 813-21.
7. Montero M, Domínguez M, Orozco-Levi M, Salvadó M, Knobel H. Mortality of COPD patients infected with multi-resistant *pseudomonas aeruginosa*: A case and control study. *Infection* 2009; *37* : 16-9.
8. Kalantar E, Taherzadeh S, Ghadimi T, Soheili F, Salimizand H, Hedayatnejad A, *et al*. *Pseudomonas aeruginosa*, an emerging pathogen among burn patients in Kurdistan province, Iran. *Southeast Asian J Trop Med Public Health* 2012; *43* : 712-7.
9. Clinical and Laboratory Standards Institute. *Performance standards for antimicrobial susceptibility testing*; *20*th *informational supplement*. CLSI Document M100-S20. Wayne, PA: CLSI; 2010.
10. Livermore DM. Multiple mechanisms of antimicrobial resistance in *Pseudomonas aeruginosa*: Our worst nightmare? *Clin Infect Dis* 2002; *34* : 634-40.
11. Mauldin PD, Salgado CD, Hansen IS, Durup DT, Bosso JA. Attributable hospital cost and length of stay associated with health care-associated infections caused by antibiotic-resistant Gram-negative bacteria. *Antimicrob Agents Chemother* 2010; *54* : 109-15.
12. Khan JA, Iqbal Z, Rahman SU, Farzana K, Khan A. Report: Prevalence and resistance pattern of *Pseudomonas aeruginosa* against various antibiotics. *Pak J Pharm Sci* 2008; *21* : 311-5.
13. Gad GF, El-Domany RA, Zaki S, Ashour HM. Characterization of *Pseudomonas aeruginosa* isolated from clinical and environmental samples in Minia, Egypt: Prevalence, antibiogram and resistance mechanisms. *J Antimicrob Chemother* 2007; *60* : 1010-7.
14. Al-Kabsi AM, Yusof MY, Sekaran SD. Antimicrobial resistance pattern of clinical isolate of *Pseudomonas aeruginosa* in the University of Malaya Medical Center, Malaysia. *Afr J Microbiol Res* 2011; *5* : 5266-72.
15. Rajkumari N, John NV, Mathur P, Misra MC. Antimicrobial resistance in *Pseudomonas* sp. causing infections in trauma patients: A 6 year experience from a South Asian country. *J Glob Infect Dis* 2014; *6* : 182-5.
16. Ali Z, Mumtaz N, Naz SA, Jabeen N, Shafique M. Multi-drug resistant *Pseudomonas aeruginosa*: a threat of nosocomial infections in tertiary care hospitals. *J Pak Med Assoc* 2015; *65* : 12-6.
17. Jombo GT, Jonah P, Ayeni JA. Multiple resistant *Pseudomonas aeruginosa* in contemporary medical practice: Findings from urinary isolates at a Nigerian university teaching hospital. *Niger J Physiol Sci* 2008; *23* : 105-9.

18. Amadi ES, Uzoaru PN, Orji I, Nwaziri AA. Antibiotic resistance in clinical isolates of *P. aeruginosa* in Enugu and Abakalilki, Nigeria. *Internet J Infect Dis* 2009; *8* : 2.

19. Fadeyi A, Akanbi AA 2nd, Nwabuisi C, Onile BA. Antibiotic disc sensitivity pattern of *Pseudomonas aeruginosa* isolates obtained from clinical specimens in Ilorin, Nigeria. *Afr J Med Med Sci* 2005; *34* : 303-6.

20. Oguntibeju OO, Rau N. Occurrence of *Pseudomonas aeruginosa* in post-operative wound infection. *Pak J Med Sci* 2004; *20* : 187-92.

For correspondence: Dr Purva Mathur, Room No. 211, 2nd Floor, Microbiology Laboratory, Jai Prakash Narayan Apex Trauma Centre, All India Institute of Medical Sciences, New Delhi 110 029, India
e-mail: purvamathur@yahoo.co.in