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Research Article

ANTIBIOTIC RESISTANCE PATTERN OF *PSEUDOMONAS AERUGINOSA* ISOLATED FROM VARIOUS CLINICAL SAMPLES IN A TERTIARY CARE HOSPITAL, PUDUCHERRY

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ABSTRACT

Objective: One of the most common bacteria known to cause nosocomial infection and found to be multidrug-resistant is *Pseudomonas aeruginosa.* The objective of the study was to know the prevalence of the *P. aeruginosa* isolates with varied clinical conditions and specimens and to assess the antimicrobial susceptibility patterns of *P. aeruginosa* as well as its magnitude of multidrug resistance (MDR).

Methods: A total of 229 biochemically tested and confirmed isolates of *P. aeruginosa* from various clinical samples were studied. Antibiotic susceptibility testing was determined by Kirby-Bauer disc diffusion method.

Results: Out of the 229 isolates of *P. aeruginosa*, majority (60.70%) were from pus sample. Resistance to amikacin and tobramycin was 23.6% and 20.1%, ciprofloxacin was 33.2%. Resistance to ceftazidime, cefoperazone and cefepime were 21.8%, 45.9%, and 25.7%. Imipenem and meropenem showed 26.2% and 20.5% resistance, respectively. Resistance to piperacillin was 18.3% while piperacillin-tazobactam was only 13.5%. The MDR was observed in 33.7% of the isolates.

Conclusion: There is increased resistance to cephalosporins as compared to aminoglycosides, carbapenems and beta lactamase inhibitor. To restrict the inappropriate use of antimicrobial agents, the development of MDR, needs to be continuously monitored and documented.

Keywords: Multidrug resistance, *Pseudomonas aeruginosa*, Antimicrobial susceptibility pattern.

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INTRODUCTION

Pseudomonas aeruginosa is the bacterium that is known to cause persistent infections for prolonged duration that could end up in serious outcomes in terms of morbidity and mortality. The introduction of a variety of sanitation facilities and antimicrobial agents with antipseudomonal activities has not reduced the life-threatening hospital based infections caused by it [1]. *P. aeruginosa* is inherently resistant to many antimicrobial agents, thus posing a great challenge in community acquired and nosocomial infections [2]. The occurrence of multidrug resistance (MDR) in these isolates is of serious concern as it poses a problem in therapy and infection control management [3,4]. The prevalence and antimicrobial susceptibility pattern of the resistant isolates in different geographical settings by epidemiological studies would give useful information to add to the global picture of antimicrobial resistance thereby guiding the clinicians in their choice of antimicrobial therapy [1]. In view of these facts, the present study was undertaken to find out the prevalence of multi drug resistance and antibiotic susceptibility patterns of pathogenic *P. aeruginosa* isolated from various clinical specimens in a tertiary care hospital.

METHODS

The study was conducted in the Microbiology Department of Indira Gandhi Medical College and Research Institute, Puducherry, after obtaining the Institute Ethics Committee approval. A record based retrospective analysis of data of all samples received over a 1 year period from January 2017 to December 2017 yielding a growth of *P. aeruginosa* was under taken. Identical report from the same patient was excluded from the study.

The isolates were identified by conventional methods. The strains were identified as *P. aeruginosa*, based on the colony morphology, gram staining, oxidase reaction, the production of the pyocyanin pigment, fruity odor, nitrate reduction, the use of citrate and malonate as carbon sources, and its ability to grow at 42°C [5]. *P. aeruginosa* ATCC 27853 was used as control.

Antibiotic susceptibility for *P. aeruginosa* was performed using the Kirby-Bauer disk diffusion method according to Clinical and Laboratory Standards Institute guidelines using commercially available disks (HiMedia, Mumbai): amikacin (30 µg), ciprofloxacin (5 µg), ceftazidime (30 µg), cefoperazone (75 µg), piperacillin (100 µg), tobramycin (10 µg), cefepime (30 µg), imipenem (10 µg), meropenem (10 µg), and piperacillin-tazobactam (100/10 µg) [6]. Isolates with intermediate levels of resistance in disk diffusion were included in the percentage of resistant organisms for final analysis. Isolates were considered multidrug resistant (MDR) if they showed resistance to three or more classes of the tested antibiotics [7]. All the data were entered and analyzed in Microsoft Excel 2010 and expressed as percentages.

RESULTS

A total of 229 *P. aeruginosa* isolates from various clinical samples comprised of 120 (52.4%) males and 109 (47.6%) females, with a male: female ratio of 1.1:1. The age of the patients ranged between 1 month and 105 years, with a median of 45 years. Age-wise and sex-wise distribution of *P. aeruginosa* isolates is shown in Table 1.

Out of the 229 isolates of *P. aeruginosa*, 139 (60.70%) were from pus, 33 (14.41%) were from sputum, 27 (11.79%) were from urine, 16 (6.99%) were from blood, and 14 (6.11%) were from other samples. The distribution of *P. aeruginosa* among various clinical samples is shown in Fig. 1.

The antimicrobial resistance pattern of *P. aeruginosa* isolates is shown in Table 2. Resistance to amikacin and tobramycin were 23.6% and 20.1%, ciprofloxacin was 33.2%. Resistance to ceftazidime, cefoperazone and

cefepime were 21.8%, 45.9%, and 25.7%. Imipenem and meropenem showed 26.2% and 20.5% resistance, respectively. Resistance to piperacillin was 18.3% while piperacillin-tazobactam was only 13.5%. The MDR was observed in 33.7% of the isolates.

DISCUSSION

The ubiquitous Gram-negative bacterium belonging to the family Pseudomonadaceae, *P. aeruginosa,* has the ability to survive in a wide range of environments and thereby complicating the therapeutic approaches for treatment. In the present study, a total of 229 *P. aeruginosa* isolates were isolated from various clinical samples. There was no difference in sex-wise distribution, with a male: female ratio of 1.1:1. This was concordance to the study conducted by Dash *et al*. [8] who reported the male: female ratio as 1.4:1. Both men and women were equally affected with *P. aeruginosa* infection. The predominant age group distribution was between 19 and 50 years (50.6%) followed by the elderly age group >50 years (36.7%). This was similar to the study reported by Chander *et al*. [7] in which most of them belonged to older age group of 21–40 years (41.4%) and elderly age group of >60 years (31%). The factors such as low-level of immunity, prolonged hospitalization and other associated comorbidities could be the possible reasons for the elderly people being affected.

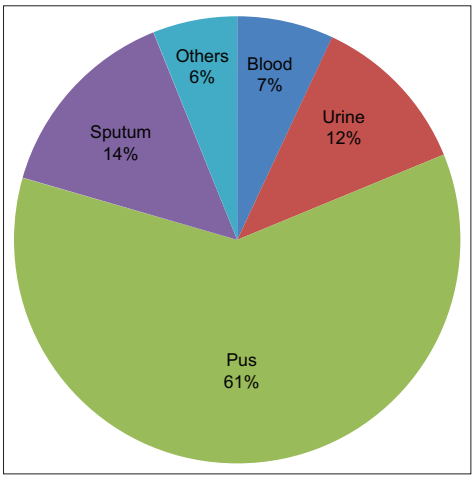

Fig. 1: Distribution of *Pseudomonas aeruginosa* among various clinical isolates

Table 1: Age-wise and sex-wise distribution of *Pseudomonas aeruginosa* isolates

Age (years)	No. of Male (%)	No. of Female (%)	Total (%)
0–18	18	11	29 (12.7)
19–50	53	63	116 (50.6)
>50	49	35	84 (36.7)
Total	120 (52.4)	109 (47.6)	229 (100)

Table 2: Resistance pattern of *Pseudomonas aeruginosa* isolates

Antibiotics	*Pseudomonas aeruginosa* n=229 (% of resistance)
Amikacin	54 (23.6)
Ciprofloxacin	76 (33.2)
Ceftazidime	50 (21.8)
Cefoperazone	105 (45.9)
Piperacillin	42 (18.3)
Tobramycin	46 (20.1)
Cefepime	59 (25.7)
Imipenem	60 (26.2)
Meropenem	47 (20.5)
Piperacillin-tazobactam	31 (13.5)

Out of the 229 isolates of *P. aeruginosa*, 60.70% were from pus sample, followed by sputum (14.41%), urine (11.79%), blood (6.99%), and other samples (6.11%). This defines the fact that it is commonly isolated from wound infection. This was concordance to the other studies conducted from different parts of India [1,2,9].

The resistance pattern of *P. aeruginosa* isolates was evaluated with ten different antimicrobial agents. The fluoroquinolone, ciprofloxacin showed 33.2% resistance. This was partly concordance to the studies conducted by Hoque *et al.* [10], Chander *et al*. [7] and Kaur *et al.* [2] who reported the resistance as 54%, 51.72%, and 44.2%, respectively.

Among the aminoglycosides, amikacin and tobramycin showed 23.6% and 20.1% of resistance. Tiwari *et al.* [11] reported higher level of resistance to amikacin and tobramycin as 41% and 39% compared to our study. However, resistance to amikacin varied from as low as 13.3% and as high as 81% in other studies [10,12]. This could be due to choice of the antimicrobials used in their health setup.

In our study, the carbapenems, imipenem, and meropenem exhibited 26.2% and 20.5% of resistance. This was partly concordance to the study conducted by Kaur *et al.* [2] who reported the resistance as 17.8% and 33.1%, respectively. In contrast, Kumari *et al.* [13] reported the resistance as 53% and 63% for imipenem and meropenem, respectively. As carbapenems remain the main stay of antimicrobial of choice especially to MDR *P. aeruginosa,* the lower level of resistance to them is eventually essential. Even a lower percentage of resistance is quite mindful.

Among the beta lactams, the third generation cephalosporins, ceftazidime showed 21.8% of resistance while cefoperazone showed high level of resistance (45.9%), which may be contributed to the fact that it is the commonly used antimicrobial agent. In a study conducted by Rustini *et al.* [14], ceftazidime showed 26.32% of resistance while cefoperazone showed 39.89% of resistance on par with our study. In our study, the fourth generation cephalosporin namely cefepime exhibited 25.7% of resistance. Very low level of resistance was reported by Saroj *et al.* [12] to ceftazidime (8.92%) and cefepime (4.46%) and high level of resistance was reported by Kaur *et al.* [2] as 62.8% to ceftazidime and 61.1% to cefepime. Similarly, Mohanasoundaram [1] reported higher level of resistance for ceftazidime (63.3%) and cefepime (72.3%). The commonly used cephalosporins develop higher level of resistance rapidly and it is evident that judicious use of the cephalosporins is mandated to prevent the development of resistance.

The beta lactam agent, piperacillin showed 18.3% of resistance. However, piperacillin-tazobactam (beta lactamase inhibitor agent) showed only 13.5% of resistance similar to the study conducted by Tiwari *et al*. [11] who reported 32% of resistance to piperacillin and 26% of resistance to piperacillin-tazobactam. As evidenced by the study conducted by Choudhary *et al*. [3] the metallo beta lactamase producing *P. aeruginosa* were found to be 80.55% resistant to piperacillin-tazobactam compared to non metallo beta lactamase producing *P. aeruginosa* which showed 38.88% of resistance to piperacillin-tazobactam [3]. This signals the importance of MDR.

The prevalence of MDR, i.e., resistance to more than three classes of antimicrobial agents, among *P. aeruginosa* isolates were 33.6% (77/229). This was concordance to the study conducted by Pramodhini *et al*. [15] and Saroj *et al*. [12] in which the MDR rate was 25% and 8.92%, respectively, but in contrast to the study reported by Mohanasoundaram [1], the MDR rate was 71%. This highlights the fact that the resistance rate needs a constant check.

It is welcoming that the aminoglycosides (amikacin and tobramycin), carbapenems (imipenem and meropenem), and beta lactamase inhibitor (piperacillin-tazobactam) have shown lower level of resistance (<26%) to *P. aeruginosa* isolates, but the resistance exhibited by cephalosporins in specific cefoperazone is 45.9%, is quite alarming.

CONCLUSION

The limited susceptibility to antimicrobial agents and high frequency of emergence of antibiotic resistance during therapy has complicated the treatment of *P. aeruginosa* infections. Therefore, it is of prime importance to continuously monitor the development of drug resistance in this group of organisms. Furthermore, judicious use of antimicrobial agents is the need of the hour to combat the development of antimicrobial resistance.

AUTHORS' CONTRIBUTIONS:

Mr. Kanthakumar. A was involved in the planning and execution of the study. Dr. Jayavarthinni. M was involved in writing, reviewing of the manuscript and also in execution of the study.

CONFLICT OF INTEREST

The authors have no known conflicts of interest to declare.

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