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Original Research Article

Study of Antibiotic Susceptibility Profile of *Pseudomonas Aeruginosa* in a Tertiary Care Hospital

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ABSTRACT

Background: *Pseudomonas aeruginosa* is one of the most important cause of Health care associated infections and it develops resistance to most of the commonly used antimicrobials and even to reserve drugs like Carbapenems and Colistin. The antimicrobial resistance mainly develops due to misuse and overuse of antimicrobials.
Aim: Hence the present study was undertaken to study antibiotic susceptibility profile of *Pseudomonas aeruginosa*, isolated from different clinical samples. Material & methods: *Pseudomonas aeruginosa* strains were isolated from different clinical samples and were characterized by conventional methods. Antibiotic susceptibility test of *Pseudomonas aeruginosa* strains were done by Kirby Bauer disc diffusion method as per CLSI Guidelines.
Results: The highest 99.3% *Pseudomonas aeruginosa* strains were sensitive to Colistin, followed by Aztreonam (97%). The lowest sensitivity was observed with Ceftazidime (16%) and Piperacillin (40%) respectively. Maximum 40% *Pseudomonas aeruginosa* strains were isolated from pus and wound swab.
Conclusion: Antibiotic susceptibility test for *Pseudomonas aeruginosa* strains should be routinely done to get a good therapeutic outcome for the patient.

Key words: *Pseudomonas aeruginosa,* Antibiotic susceptibility test, Kirby Bauer method.

INTRODUCTION

The discovery of Penicillin, in 1928 and its clinical use in 1941 in an Oxfordshire constable, Albert Alexander, led the people to think that man has won the war against microbes. But within one year of clinical use of penicillin Rammelkamp reported the *Staphylococcus aureus* strain resistant to this magic bullet. [1] Within a short span of 70 years, from discovery of Penicillin to Tigecycline mankind is facing the problem with some hospital strains resistant to almost all antimicrobials and is busy in writing the obituary for antimicrobials. Presently antimicrobial resistance (AMR), is a major threat to patient care in any healthcare set up worldwide. Many studies have reported the relation between multidrug resistance and increased morbidity and mortality, increased hospital stay and hospital costs. Considering all the achievements of mankind in Medical Sciences, actually the pace in which bacteria develop resistance, is much higher than the rate of development of newer antimicrobials. [2] *Pseudomonas aeruginosa* is one of the most important causes of Health-care associated infections especially in patients of Intensive Care Units (ICUs), Postoperative wards, Burn units, Trauma units, Oncology units etc. Pseudomonas aeruginosa is usually associated with

Surgical site infections (SSI), Hospital acquired pneumonia (HAP), Ventilator associated pneumonia (VAP), Urinary tract infections (UTI) especially Catheter associated UTIs (CAUTIs), Skin and soft tissue infections, Eyes and ear infections, Septicaemia, Central line related blood stream infection (CLRBSI) and infections in immunocompromised individuals etc .

Pseudomonas aeruginosa is not only responsible for severe infections but also present with high rate of antimicrobial resistance. The development of antimicrobial resistance in *Pseudomonas aeruginosa* is multifactorial, with mutations in genes encoding porins, efflux pumps, penicillin-binding proteins, and chromosomal Beta-lactamase, contributing to resistance to β-lactams including carbapenems, aminoglycosides, and fluoroquinolones. [3] The antibiotic resistance is mainly developed due to inappropriate and irrational use of antibiotics there is a need to emphasize the rational use of antimicrobials and strictly adhere to the concept of "reserve drugs" to minimize the misuse of available antimicrobials.

Hence the present study was undertaken to study antibiotic susceptibility profile of *Pseudomonas aeruginosa*, isolated from different clinical samples in the Department of Microbiology.

MATERIALS AND METHODS

A total number of 150 *Pseudomonas aeruginosa* strains were isolated from different clinical specimens like blood, urine, pus and wound swab, sputum, tracheal secretions, body fluids etc. and were identified by conventional methods in the Department of Microbiology. [4]

The study was approved by Institutional Ethical Committee (IEC). The type of study was cross sectional observational study. The clinical specimens from outdoor patient departments (OPD) as well as Indoor Patient departments (IPD) were only included in the study.

Pseudomonas aeruginosa strains isolated from different clinical samples only were identified by conventional methods e.g. Gram staining, motility, pigment production and biochemical tests especially catalase and oxidase test etc. were included in the study. [5]

Antibiotic susceptibility profile of *Pseudomonas aeruginosa* strains was detected by Kirby-Bauer disc diffusion method [6] as per Clinical Laboratory Standard Institute (CLSI) guidelines. [7] Lawn culture of *Pseudomonas aeruginosa* strains (turbidity adjusted to 0.5 Mc Farland standard) was done on Muller Hinton (MH) agar plate. With all aseptic precaution, the antibiotic discs like Ceftazidime (CAZ-30 µg), Ceftazidime/Clavulanic acid (CAC-30/10µg) Ciprofloxacin (CIP-10µg), Amikacin (AK-30µg), Imipenem (IPM-10µg), Meropenem (MRP-10 µg), Piperacillin (PI-30 µg), Piperacillin/ Tazobactam (PIT-100/10 µg), Netillin (NET-30 µg), Aztreonam (AT-30 µg) and Colistin (CL- 10 µg) etc. were put on inoculated Mueller Hinton (MH)agar plate. Six antibiotic discs were put on 90 mm diameter plate. After overnight incubation at 37^0 C, sensitivity to different antibiotics were noted. Nitrofurantoin (NIT-300 µg) was put as an additional disc for urine specimens. The control strain used for antibiotic susceptibility test was *Pseudomonas aeruginosa* ATCC 28753. All the antibiotic discs and culture media were procured from HiMedia Laboratories, India.

RESULTS

Table 1. Antibiotic susceptibility profile of *Pseudomonas aeruginosa* strains (n=150)

ANTIBIOTICS	SENSITIVE	
	NUMBER	PERCENTAGE %
Amikacin	133	89
Ciprofloxacin	129	86
Netillin	131	87.3
Ceftazidime	24	16
Ceftazidime + clavulanic acid	129	86
Piperacillin	60	40
Piperacillin + Tazobactam	116	77.3
Imipenem	136	91
Meropenem	143	95.3
Aztreonam	145	97
Colistin	149	99.3

*Nitrofurantoin discs were put for 20 urine samples only and 8 (40%) strains were sensitive

A total number of 150 *Pseudomonas aeruginosa* strains were isolated from different clinical samples e.g. pus and wound swab, urine, blood, body fluids etc. and were characterized by conventional methods. All 150 strains were bluish green pyocyanin pigment.

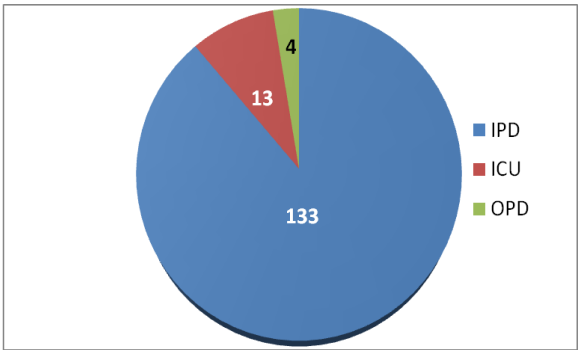
Table 1 shows the antibiotic susceptibility profile of *Pseudomonas aeruginosa* strains. 149 (99.3%) strains were sensitive to Colistin. One (1) *Pseudomonas aeruginosa* strain was even resistant to Colistin. The lowest sensitivity was observed with Ceftazidime (16%). Carbapenem resistance was observed in 7 strains with Meropenem and in 14 strains with Imipenem.

Table 2. Isolation of *Pseudomonas aeruginosa* strains from different clinical samples (n=150)

SPECIMEN	NO. (%)
Pus and wound swab	60 (40)
Blood	21 (14)
Urine	20 (13.3)
Body fluids	14 (9.3)
Medical devices	19 (12.7)
Others*	16 (10.7)

*Others include sputum (7), tracheal secretion (9).

Table 2 shows the isolation of *Pseudomonas aeruginosa* strains from different clinical samples. 60 *Pseudomonas aeruginosa* strains were isolated from pus and wound swab followed by 21 and 20 from blood and urine respectively. Out of 19 medical devices 2 were neocan tip, 4 were tip of endotracheal tube, 4 were foley's catheter tip and 9 were central line intra-catheter tip.



Figuare 1. Isolation of *Pseudomonas aeruginosa* from IPD, ICU and OPD.

Figure 1 shows among 150 Pseudomonas aeruginosa strains studied, 133 were isolated from IPDs, 13 from different ICUs and 4 from OPD patients. Out of 13 strains isolated from ICUs, 7 were from NICU and 6 were from MICU respectively.

Table3: Isolation of *Pseudomonas aeruginosa* strains from different clinical specialities (IPD) (n=146)

WARDS	NO.	PERCENTAGE(%)
Surgery	33	23
Orthopedics	27	19
Medicine	20	15
Obstretics & Gynaecology	28	19
Pediatrics	12	8
Respiratory medicine	5	3.3
ICUs	13	9
Others*	8	5.3

*Others include Neurosurgery (4), ENT (2) and Psychiatry ward (2).

Table 3 shows the isolation of *Pseudomonas aeruginosa* strains from different clinical specialities of Indoor Patient Departments (IPD). Maximum 33 (23%) *Pseudomonas aeruginosa* strains were isolated from Surgery ward followed by 28 (19%) from Obstetrics & Gynaecology wards and 27 (19%) from Orthopedics ward respectively.

DISCUSSION

Pseudomonas aeruginosa distribution varies within each hospital as the environmental condition varies. In our study, we found that more than 70 % of the *Pseudomonas aeruginosa* isolates were obtained from pus and wound swab which depicts similar reports from different studies in other parts of the country reported by Mohanasoundaram [8] and Arora et al. [9]

In our study, among the aminoglycosides, sensitivity to Amikacin was seen in 89% of the isolates, while lower rate of sensitivity (8.8-19%) was reported by Sharma et al. (2010), [10] Picao et al. (2008). [11] While higher rates of sensitivity to Amikacin was reported by Hocquet et al. 93.3% (2007) [12] and Jamasbi et al. 97% (2008). [13]

In our study sensitivity to third generation Cephalosporins (Ceftazidime) was seen to be only 16%, which correlated well with the reports of Franco et al. (14.5%) (2010). [14]

Two combination drugs Piperacillin/Tazobactam and Ceftazidime/Clavulanic acid were used in our study. The Piperacillin/Tazobactam combination was effective in 77.3 % of isolates which is comparable to that of Kumar et al. 74% (2014) [15] and Javiya et al. 64.29% (2008) [16] and sensitivity to Ceftazidime/Clavulanic acid was observed in 86% Pseudomonas aeruginosa isolates.

We found that about 91 % were sensitive to Imipenem and 95.3 % to Meropenem in our study, which correlated well with reports of Manjunath P. Salmani et al (2015) showing sensitivity to carbapenems like imipenem (88.2%) and meropenem (87.1%) [17] and Raja and Singh (2007) reported sensitivity to imipenem as (90.1%). [18]

In our study only 1 strain was resistant to colistin, which is used as a last resort in carbapenem resistant Pseudomonas aeruginosa strains in severe infections.

In the present study, *Pseudomonas aeruginosa* strains showed lower sensitivity to commonly used antipseudomonal antibiotics. Our hospital is a tertiary care hospital in a rural set up. The patients from adjoining villages, districts or even states attend our hospital. Because of lack of awareness most of the patients receive 2-3 classes of antibiotics often in inappropriate doses before coming to our hospital and this may be the reason for low higher antibiotic resistance rate.

CONCLUSION

Hence, to conclude, all *Pseudomonas aeruginosa* strains, which is one of the most common isolate in Clinical Microbiology Laboratory should be tested for antibiotic sensitivity routinely to prevent the overuse and misuse of antibiotics.

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