ISSN- 2394-5125 VOL 08, ISSUE 02, 2021

COMPARISON OF IN – VITRO EFFICACY OF ANTIBIOTICS AGAINST 103 CLINICAL ISOLATES OF PSEUDOMONAS AERUGINOSA

[1]Qandeel Abbas Soomro, [2] Nabi Mirjut, [2]Babar Aijaz Memon, [2]Asim Patrick, [3]Abdul Sami Dahri, [4]Bushra Hussain

[1]Department of Pathology, Indus Medical College Tando Muhammad Khan
[2]Institute of Microbiology, University of Sindh, Jamshoro
[3]Government College University, Hyderabad
[4]Sukkur IBA University

Corresponding Author:
Qandeel Abbas Soomro
Email: drqandeelsoomro@gmail.com

ABSTRACT

Introduction: Pseudomonas aeruginosa is one of the most common hospital – acquired infections in our setups. Due to increasing resistance of the organism, the mortality and morbidity of the patient is also increasing. Detection of the organism is very important to manage the diseases caused by organism.

Objective: To evaluate the in vitro efficacy of various anti-Pseudomonas antibiotics by paper disk diffusion method against Pseudomonas aeruginosa isolated from various clinical specimens and to identify appropriate antimicrobial in our setups.

Patients and Methods: It was a prospective study conducted at Department of Pathology, Indus Medical College Tando Muhammad Khan for the period of 6 months. A total of 103 strains of Pseudomonas aeruginosa were studied using various clinical specimens. Antimicrobial agents used were Carbenicillin (CAR), Piperacillin (PIP), Imipenem (IMI), Aztreonam (AZT), Gentamicin (GEN), Tobramycin (TOB), Amikacin (AMI), Ceftazidine (CAZ), Ofloxacin (OFL), Cipiprofloxacin (CIP) and Enoxacin (ENO).

Results: Amikacin, Ceftazidime, Imipenem, Pipercillin, Aztreonam, Ciprofloxacin, Enoxacin, Carbenicillin, Ofloxacin, Tobramycin and Gentamicin were sensitive in percentages as92.23%, 87.3%), 83.5%, 80.6%, 73.7%, 64%, 60%, 53.3%, 47.5%, 40.7% and 39.8 % respectively.

Conclusion: This study shows that use of Carbenicillin, Ciprofloxacin, Enoxacin, Ofloxacin, Tobramycin and Gentamicin against Pseudomonas aeruginosa on empirical basis will not be without the risk of treatment failure.

Keywords: Pseudomonas aureginosa, antibiotics, hospital – acquired infections.

Introduction

Hospital acquired infections are one of the major health problems globally due to increased morbidity and mortality. Patients admitted for prolonged duration in hospital are more prone to be infected by Pseudomonas aeruginosa. Pseudomonas aeruginosaa has the capability of high – level resistance to many antimicrobial drugs. (1,2) It is major contributing factor in patients of otitis externa, ventilator – associated pneumonia, burn, urinary tract infection, cystic fibrosis and neutropenia. With the widespread use of 3rd generation cephalosporins in hospitals setups, many isolated of Pseudomonas aeruginosa are resistant to this class also. (3–5) Pseudomonas aeruginosa is not the part of normal human microbiota. Prolonged colonization due to variation in the composition of normal microbiota due to treatment by antibiotics or presence of previous severe disease. The increase in the resistance cases of Pseudomonas aeruginosa has directed to appearance of strains, which are defined as multidrug resistant, extended – drug resistant or pan – drug resistant. (6–8)

Timely evaluation and detection and appropriate treatment in management of different infections are necessary to reduce the morbidity and mortality of the patients. (9) Main objective of this study is to evaluate the in vitro efficacy of various anti-Pseudomonas antibiotics by paper disk diffusion method against Pseudomonas aeruginosa isolated from various clinical specimens and to find out the appropriate antimicrobial in our clinical settings.

Patients and Methods

It was a prospective observational study conducted at Department of Microbiology, Indus Medical College Tando Muhammad Khan. The study was conducted for the period of 6 moths (July 2018 to December 2018). A total of 103 strains of Pseudomonas aeruginosa were studied. These strains were isolated from various clinical specimens. These isolates were preserved in Nutrient agar slope in Beijou bottles and refrigerated. At the time of study organisms were sub-cultured on nutrient agar plate. The identification criteria were:

Gram stain, Gram negative bacilli, non-lactose fermenter, motile, oxidase-positive, pyocyanin pigment production, growth at 42 C .***Pseudomonas aeruginosa*** ATCC 27853 was included as a control strain.

ISSN- 2394-5125 VOL 08, ISSUE 02, 2021

Antimicrobial agents used were Carbenicillin (CAR), Piperacillin (PIP), Imipenem (IMI), Aztreonam (AZT), Gentamicin (GEN), Tobramycin (TOB), Amikacin (AMI), Ceftazidine (CAZ), Ofloxacin (OFL), Ciprofloxacin (CIP) and Enoxacin (ENO). All drugs were testedfor their susceptibility, as PIP (100 mcg), CAR (100 mcg), AZT (30 mcg), IMI (10 mcg), CAZ (10 mcg), GEN (10 mcg), TOB (10 mcg), AMI (30 mcg), OFL (5 mcg), CIP (5 mcg) and ENO (30 mcg). Results were interpreted according to Kirby – Bauer method. Paper disk diffusion method was adopted using Mueller – Hinton agar and paper disks of antibiotics from **Oxoid distributors**. The inhibition zone of antibiotics was according to **CLSI M7-A10.** Sensitive zones of antibiotics was adopted showing in table. Due to financial problem only Amikacin and Ceftazidime were tested with few strains and control organism by **Eteststrip** (bioMerieux) and showed nearly same results.

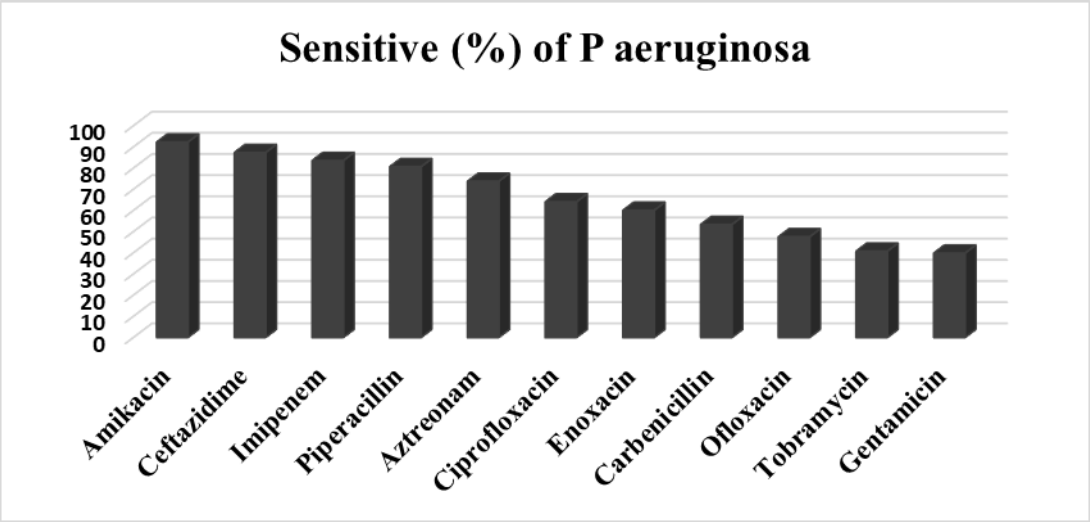
Results

95 (92.23%) strains were sensitive to Amikacin, 90 (87.3 %) were sensitive to Ceftazidime, 86 (83.5 %) were sensitive to Imipenem, 83 (80.6%) were sensitive to Piperacillin, 76(73.7 %) were sensitive to Aztreonam, 66 (64 %) were sensitive to Ciprofloxacin, 62 (60 %) were sensitive to Enoxacin, 55 (53.3 %) were sensitive to Carbenicillin, 49 (47.5 %) were sensitive to Ofloxacin, 42 (40.7%) were sensitive to Tobramycin and 41 (39.8 %) were sensitive to Gentamicin showing results in table 1, and performing wise in figure 1.

Table 1
Susceptibility results of Pseudomonas Aeruginosa (n=103)

No.	Antibiotics	Concentration Mcg/ml	Sensitive Zone Diameter/mm	Sensitive (%)
1.	**Amikacin**	30 mcg	≥14	92.23
2.	**Aztreonam**	30 mcg	≥23	73.7
3.	**Carbenicillin**	100 mcg	≥17	53.3
4.	**Ceftazidime**	10 mcg	≥16	87.3
5.	**Ciprofloxacin**	5 mcg	≥25	64
6.	**Enoxacin**	30 mcg	≥18	60
7.	**Gentamicin**	10 mcg	≥12	39.8
8.	**Imipenem**	10 mcg	≥20	83.5
9.	**Ofloxacin**	5 mcg	≥15	47.5
10.	**Piperacillin**	100 mcg	≥17	80.6
11.	**Tobramycin**	10 mcg	≥15	40.7

Figure 1



Discussion

Pseudomonas aeruginosa is the major and leading cause of hospital – acquired infections. Due to emerging resistance, treatment is a challenging milestone. Combination of antimicrobials is being used in different settings, but combination drugs are expensive. (10,11) Resistance to antibiotic drugs in various strains of Pseudomonas aeruginosa occurs through a number of mechanisms, such as production of different enzymes,

ISSN- 2394-5125 VOL 08, ISSUE 02, 2021

variation in permeability of cell membrane and very active efflux system. The development of resistance has been reported to occur at an alarming high speed. (12,13)

Various studies have been performed to see the different patterns of sensitivity and resistance to various groups of antimicrobial drugs. Kapoor et al showed in his study that ciprofloxacin was the most effective drug among all isolated drugs applied. (14) Pawar et al worked on different mutants of Pseudomonas aeruginosa and found that ciprofloxacin and
Tobramycin were unable to eliminate the Pseudomonas aeruginosa; though combination of antimicrobial agents was effective in these resistance cases. (15) Nazil et al performed a study on different isolated of Pseudomonas aeruginosa and shows that Amikacin – Ceftazidime combination was found to have synergistic effect in 15% of strains. (12) Hanna et al showed Amikacin – Ceftazidime combination had 58.3% synergistic activity. (16) Farwa e al showed high sensitivity of combination drugs in different strains of Pseudomonas aeruginosa. (10) Different studies showed different spectrum of sensitivity patterns in isolated samples of Pseudomonas aeruginosa.

In our study, Amikacin showed highest sensitivity than other drugs, followed by Ceftazidime, Imipenem and Piperacillin. Although gentamicin, tobramycin, and quinolones did not show any significant sensitivity.

Conclusion:

Amongst beta – lactam antimicrobials used, Ceftazidime was found more effective. Amongst the quinolones group, Ciprofloxacin was more sensitive. Amikacin was more sensitive than other aminoglycosides. Pseudomonas aeruginosa showed different sensitivity and resistance pattern in this as well as other studies, so proper work up is mandatory to reduce the morbidity and mortality of patients.

This study clearly indicates that use of Carbenicillin, Ciprofloxacin, Enoxacin, Ofloxacin, Tobramycin and Gentamicin against Pseudomonas aeruginosa on empirical basis will not be without the risk of treatment failure.

1. Dundar D, Otkun M. In-Vitro Efficacy of Synergistic Antibiotic Combinations in Multidrug Resistant Pseudomonas Aeruginosa Strains. Yonsei Med J. 2010;51(1):111–6.

2. Crabbé A, Liu Y, Matthijs N, Rigo P, Fuente-nùñez CD La, Coenye T, et al. Antimicrobial efficacy against Pseudomonas aeruginosa biofilm formation in a three-dimensional lung epithelial model and the influence of fetal bovine serum. Sci Rep. 2017;1–13.

3. Satti L, Abbasi S, Qumar TA, Khan MS, Hashmi ZA. In Vitro Efficacy of Cefepime Against Multi-Drug Resistant Pseudomonas aeruginosa – An Alarming Situation in our Setup. Open Drug Resist J. 2011;1:12–6.

4. Masadeh MM, Alzoubi KH, Ahmed WS. In Vitro Comparison of Antibacterial and Antibiofilm Activities of Selected Fluoroquinolones against Pseudomonas aeruginosa and Methicillin-Resistant Staphylococcus aureus. Pathogens. 2019;8(12):1–9.

5. Rajiv D. The Rationale and Evidence for Use of Inhaled Antibiotics to Control Pseudomonas aeruginosa Infection. J Aerosol Med Pulm Drug Deilivery. 2018;31(3):121–38.

6. Soriano A, Llinares P, Marco F, Cantón R, González J, Maseda E. Antibiotic selection in the treatment of acute invasive infections by Pseudomonas aeruginosa : Guidelines by the Spanish Society of Chemotherapy. Rev Esp Quim. 2018;31(1):78–100.

7. Grassi L, Batoni G, Ostyn L, Rigole P, Bossche S Van Den, Rinaldi AC, et al. The Antimicrobial Peptide lin-SB056-1 and Its Dendrimeric Derivative Prevent Pseudomonas aeruginosa Biofilm Formation in Physiologically Relevant Models of Chronic Infections. Front Microbiolo. 2019;10:1–14.

8. Loho T, Sukartini N, Astrawinata DAW, Immanuel S, Aulia D, Priatni I. In Vitro Antibacterial Interaction of Doripenem and Amikacin against Multidrug-Resistant Acinetobacter baumannii , Pseudomonas aeruginosa , and Klebsiella pneumoniae Isolates. Can J Infect Dis Med Microbiol. 2018;1–9.

9. Gill MM, Rao JU, Kaleem F, Hassan A, Khalid A, Anjum R. In Vitro Efficacy of Colistin Against Multi - Drug Resistant Pseudomonas Aeruginosa by Minimum Inhibitory Concentration. Pak J Pharm Sci. 2013;26(1):7–10.

ISSN- 2394-5125 VOL 08, ISSUE 02, 2021

10. Umme F, Ali MI, Ahmed AS, Alina A, Ahmed QZ, Bushra S. In Vitro Efficacy of Piperacillin/Sulbactam, Piperacillin/Tazobactem and Cefoperazone/Sulbactam Against Clinical Isolates of Pseudomonas Aeruginosa - A Comparative Study. Pak Armed Forced Med J. 2011;61(4):546–50.

11. Poulsen BE, Yang R, Clatworthy AE, White T, Osmulski SJ, Li L. Defining the core essential genome of Pseudomonas aeruginosa. PNAS. 2019;116(20):10072–80.

12. Nazli E, Zer Y, Eksi F. In vitro efficacy of various antibiotic combinations against Pseudomonas aeruginosa isolates. Int J Med Res. 2015;43(2):217–25.

13. Poulakou G, Lagou S, Karageorgopoulos DE, Dimopoulos G. New treatments of multidrug-resistant Gram-negative ventilator- associated pneumonia. Ann Transl Med. 2018;6(21):423–43.

14. Kapoor P, Murphy P. Combination antibiotics against Pseudomonas aeruginosa , representing common and rare cystic fi brosis strains from di ff erent Irish clinics. Heliyon.

15. Pawar V, Komor U, Kasnitz N, Bielecki P, Pils MC, Gocht B, et al. In Vivo Efficacy of Antimicrobials against Biofilm-Producing Pseudomonas aeruginosa. Antimicrob Agents Chemother. 2015;59(8):4974–81.

16. Hannan A, Gondal AJ, Saleem S, Arshad MU, Lateef W. In-vitro Efficacy of Ceftazidime in Combinations with Meropenem , Piperacillin / Tazobactam , Amikacin and Ciprofloxacin against Extensively Drug-Resistant Pseudomonas aeruginosa. Pakistan J Zool. 2014;46(4):1111–6.