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Original Research Article

Antibiotic resistance pattern of *Pseudomonas aeruginosa* isolated from pus samples at tertiary care cancer hospital

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ABSTRACT

Background: *Pseudomonas aeruginosa* is one of the most frequent opportunistic microorganisms causing infections in cancer patients. The aim of the study was to determine the antibiotic susceptibility of *Pseudomonas aeruginosa* and multidrug-resistant (MDR) isolates in cancer patients.
Methods: A retrospective study was conducted from January 2022 to December 2022 at Government Cancer Hospital, Aurangabad. A total of 143 pus samples were collected from both IPD and OPD patients. Pus samples were collected as per standard procedure and were inoculated on blood and MacConkey agar. The isolates were identified by standard protocols using biochemical tests. The antibiotic susceptibility pattern of each isolate was checked as per Clinical and Laboratory Standards Institute (CLSI) guidelines 2022 using Kirby-Bauer's disc diffusion method and VITEK 2 Automation. Data analysis was done by statical method with statistical software SPSS version 22.
Results: Out of 143 clinical samples 33 samples (23%) were positive for *Pseudomonas aeruginosa* growth. mean age of patients was 50 years old out of 33 isolates 12 (36%) isolates were multidrug-resistant, 11 (33%) isolates were extensively drug-resistant and 1 (3%) were pan-drug-resistant. The majority of isolates were responsive to polymyxin B 32 (96%) and colistin 32 (96%); However, the resistance to gentamycin, ceftazidime, and amikacin was higher, at 66%, 60%, and 57%, respectively.
Conclusions: This hospital-based retrospective study will help to implement better infection control strategies and improve the knowledge of antibiotic resistance patterns among clinicians. Thus, there is a need for an antibiotic stewardship program to monitor the resistant pattern in a tertiary care cancer hospital.

Keywords: Multidrug resistance, Extensively drug resistance, *Pseudomonas aeruginosa*

INTRODUCTION

Pseudomonas aeruginosa is classified as non-fermentative gram-negative bacilli. it is an aerobic oxidase-positive Gram-negative bacterium that is unable to ferment carbohydrates.[1] It is a common organism that is extensively dispersed across hospital environments.[2] and is the primary source of opportunistic hospital-acquired infection in cancer patients, it also accounts for 10% of all infection-acquired in hospitals specially multi-drug resistant (MDR) strains are responsible for hospital-acquired infections.[3-6] Many mechanisms, including multidrug resistance efflux pumps, resistance genes, biofilm formation, aminoglycoside modifying enzymes, and mutation in chromosomal genes, have been implicated in the development of resistance against nearly all antibiotics.[1,7,8] Furthermore, exposures to broad-spectrum antibiotics and patient-to-patient spread have added to the rapid increase in the isolation of resistant strains.[9] Despite advances in health care and a wide variety of antipseudomonal agents, life-threatening infections caused by *Pseudomonas aeruginosa* are still considered one of the

major health problems. The emergence of infections caused by MDR and PDR strains increases morbidity, and mortality and imposes an enormous burden on healthcare costs.[1,10] Among cancer patients, the wide prescription of broad-spectrum antibiotics as prophylaxis has altered the composition of normal flora and resulted in the emergence of arrays of MDR isolates.[4,11]

Therefore, there is a need to investigate the prevalence and antibiotic resistance profile of multidrug-resistant *Pseudomonas aeruginosa* in the regional cancer care institution. Therefore, the objective of this study was to determine the antibiogram and prevalence of MDR *Pseudomonas aeruginosa* in clinical specimens obtained from the cancer hospital associated with the care facility.

METHODS

A retrospective study was conducted from January 2022 to December 2022 in the Department of Microbiology, Government Cancer Hospital, Aurangabad. A pus sample was collected using a sterile disposable swab. A total of 143 pus samples were collected from both in and out-patients. Since this is a retrospective study ethical approval was not needed.

Inclusion and exclusion criteria

Both male and female patients of all age groups with *Pseudomonas aeruginosa* infection with confirmed malignancy were included in the study. While cancer patients having an infection other than *Pseudomonas* were excluded from the study.

Pus samples were collected as per the standard procedure. the swab was transported to the microbiology laboratory and processed as per standard guidelines; pus samples were inoculated on blood and MacConkey agar. the isolates were identified morphologically and confirmed by standard protocols using biochemical tests.[12] The antibiotic susceptibility pattern of each isolate was checked as per the Clinical and Laboratory Standards Institute.[13] CLSI guidelines 2022 using Muller Hinton Agar by Kirby-Bauer's disc diffusion method and VITEK 2 (Biomerieux) Automation with 0.5% McFarland suspension standard from the colonies using the identification card and antimicrobial susceptibility testing card as per CLSI guidelines 2022 and manufactures instructions. A minimal inhibitory concentration (MIC) of each isolate for colistin was performed by the broth microdilution method.[14]

The antibiotic susceptibility test was performed against different classes of antimicrobials, and commercially available discs (Hi-media) were used. Meropenem (10 µg), amikacin (30 µg), ceftazidime (30 µg), ciprofloxacin (5 µg), levofloxacin (5 µg), gentamicin (10 µg), tobramycin (10 µg), imipenem (10 µg), piperacillin/tazobactam (100/10 µg). Amoxicillin /clavulanate (20/10 µg) and polymyxin B (300 units). Data analysis was done by statical method with statistical software SPSS version 2022.

RESULTS

Out of 143 clinical samples, 100 (70%) were IPD, 30 (20%) and 13 (9%) were in the OPD and intensive care unit, respectively (Figure 1). The average age of the patients was fifty years old, with a higher proportion of females than males (Figure 2) among the 143 samples analyzed, 33 of them, accounting for 23% of the total, tested positive for *Pseudomonas aeruginosa* culture (Figure 3). The incidence of *Pseudomonas aeruginosa* varies among different types of cancer. MDR *Pseudomonas aeruginosa* was detected in all cancer types in adult patients receiving chemotherapy. The study revealed a significant occurrence of *P. aeruginosa* in patients diagnosed with buccal mucosa cancer, as indicated in Figure 4 out of 33 positive isolates 12 (36%) was multi-drug resistant, 11 (33%) were extensively drug-resistant, and 1 (3%) was pan-drug-resistant (Figure 5). The majority of isolates were responsive to polymyxin B 32 (96%) and colistin 32 (96%); refer Figure 6 showing for colistin MIC value. However, the resistance to gentamycin, ceftazidime, and amikacin was higher, at 66%, 60%, and 57%, respectively. Refer Figure 7-9 for a detailed antibiogram.

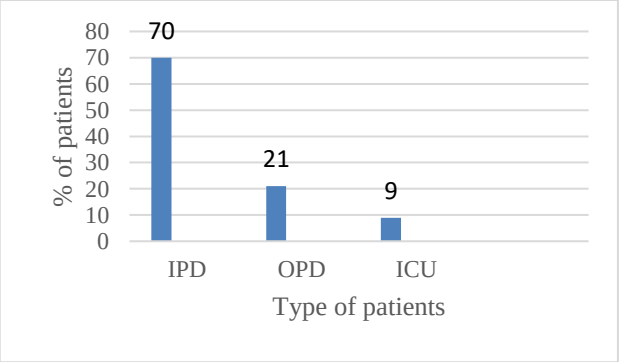

Figure 1: Types of patients.

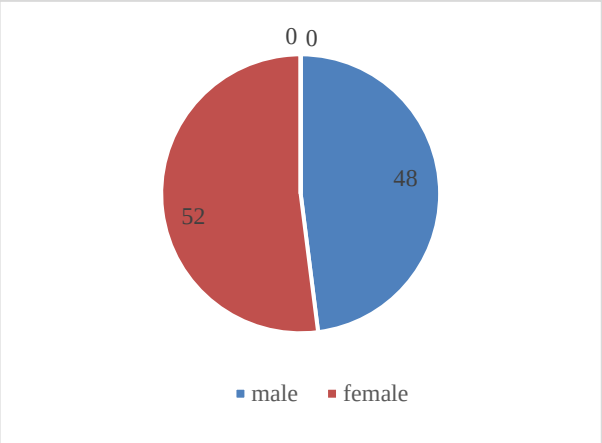

Figure 2: Gender of patients.

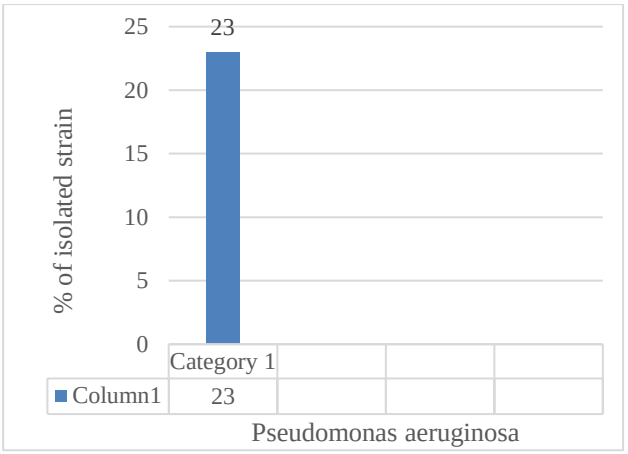

Figure 3: Percentage of isolated positive culture of Pseudomonas.

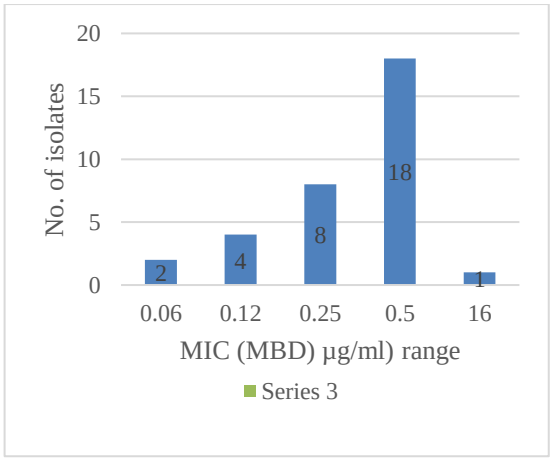

Figure 6: Colistin MIC (MBD) value among Pseudomonas strain.

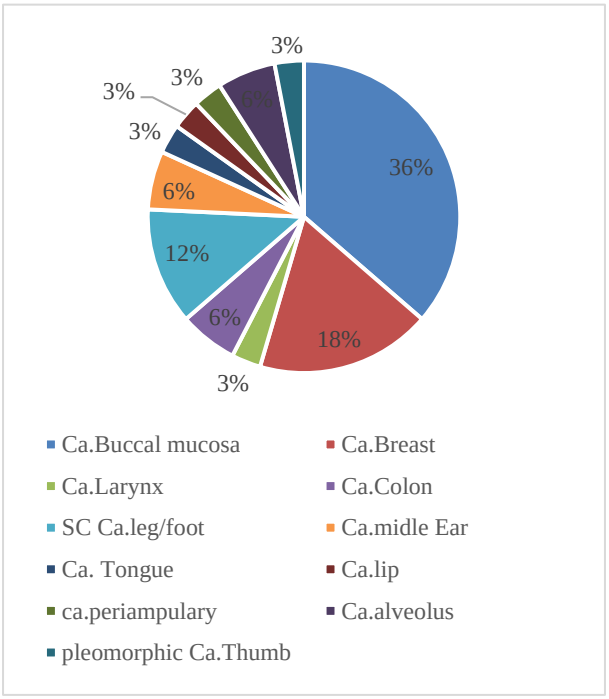

Figure 4: Prevalence of *P. aeruginosa* based on cancer type.

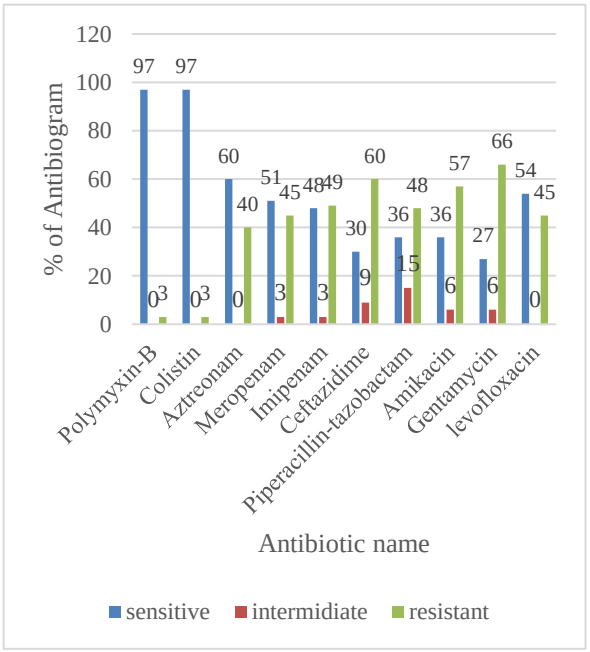

Figure 7: Antibiogram of *Pseudomonas aeruginosa*.

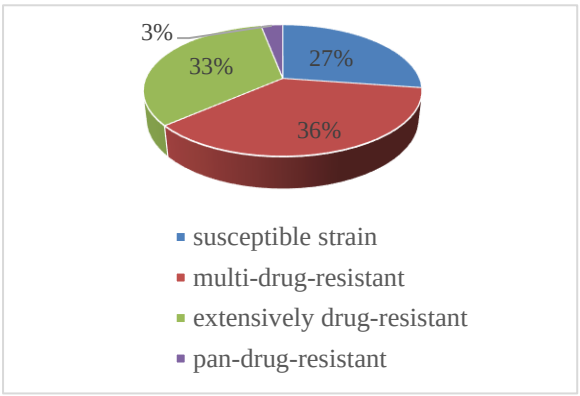

Figure 5: Pattern of multi-drug-resistant isolates.

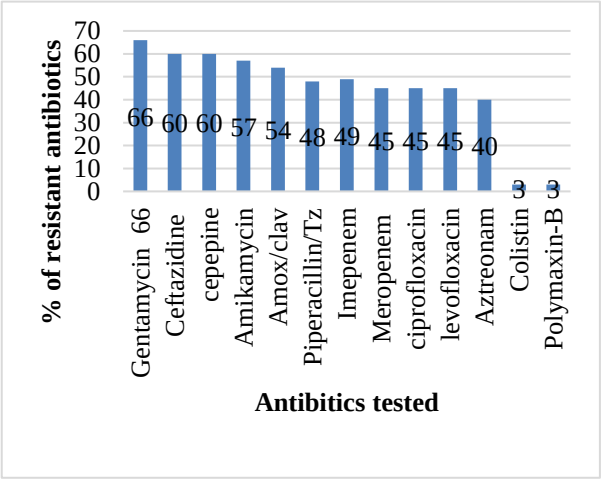

Figure 8: Resistance pattern.

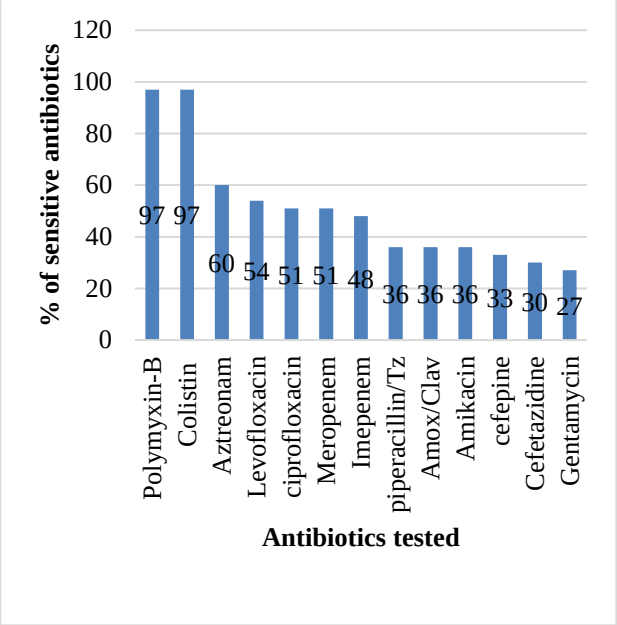

Figure 9: sensitivity pattern.

DISCUSSION

The most common pathogen responsible for a variety of infections in patients with impaired immune systems is *P. aeruginosa*.[8] *P. aeruginosa* has evolved a more complex resistance mechanism to withstand several antibiotics.[11] The usage of broad-spectrum antibiotics was a major factor in the emergence of antibiotic resistance.[6] Medical professionals must keep an eye out for these resistant bacteria to effectively provide healthcare to patients.[3]

Pseudomonas aeruginosa MDR strains are spreading around the globe these days. Over 10% of *P. aeruginosa* strains globally are multidrug resistant.[9] *P. aeruginosa* that is MDR can mediate a variety of methods, including altered target locations, bacterial efflux pumps, enzyme synthesis or inhibition, loss of membrane protein, etc.[14] This investigation demonstrated the pattern of drug susceptibility and the prevalence of MDR *P. aeruginosa*.

Currently, there is no standard definition for MDR *Pseudomonas aeruginosa*. Gill et al and Fatema et al defined MDR.[1-9] *Pseudomonas aeruginosa* as isolates that are resistant to an anti-microbial agent in three or more categories of anti-pseudomonal anti-microbials. XDR *Pseudomonas aeruginosa* refers to isolates that are resistant to at least one antimicrobial agent in six or more categories of anti-Pseudomonal antimicrobials. Pan-drug resistant (PDR) Pseudomonas aeruginosa refers to isolates that are resistant to all antimicrobial drugs effective against *Pseudomonas aeruginosa*.

Our study found that *P. aeruginosa* was present in 23% of cases, suggesting its potential significance in causing infection among cancer patients. The incidence of *Pseudomonas* in males was 54%, but in females, it was 46%, our study found that the incidence in males was greater than in females.

Among the 33 isolates examined in our study, 12 (36%) were found to be resistant to several drugs, 11 (33%) were resistant to a wide range of drugs, and 1 (3%) were resistant to all tested drugs. The vast majority of isolates exhibited a high level of responsiveness to polymyxin B 32 (96%) and colistin 32 (96%). Nevertheless, the prevalence of resistance to gentamycin, ceftazidime, and amikacin was notably higher, reaching 66%,60%, and 57% respectively. Bakir et al reported that there was a similar or almost identical occurrence of MDR, extensively drug-resistant (XDR), and PDR cases, with proportions of 45%, 50%, and 5% respectively.[2] Research undertaken in Iran and by Gill et al and Swati Tiwari in northern India has demonstrated that colistin and polymyxin B display the greatest susceptibility among medications.[1,3,21] The findings are consistent with our study, which produced comparable outcomes for antibiotics. The resistance rates were highest for gentamycin (65%), ceftazidime (60%), ciprofloxacin (45%), and levofloxacin (45%). The results are consistent with a study conducted by Ali et al which documented resistance rates of 65% for gentamycin, 40% for ceftazidime, 45% for ciprofloxacin, and 39% for levofloxacin.[6] The investigations conducted by Mukta et al and Rao et al also yield similar findings and conclusions.[17]

Limitations

Due to the retrospective nature of our study, we were unable to get specific information regarding the date of sample submission, whether it occurred before or during antibiotic treatment, as well as the underlying condition and past exposure to antibiotics. these parameters may exhibit distinct epidemiological, clinical features, and antimicrobial patterns. The present study provides a restricted number of Pseudomonas-positive samples for antibiotic sensitivity data, which is considered inadequate as it is necessary to regularly assess a wide range of positive samples to determine the sensitivity pattern.

CONCLUSION

Pseudomonas aeruginosa has now emerged as a highly multidrug-resistant MDR pathogen with a concomitant high multiple antibiotic resistance index in our hospital setting from pus samples of neutropenic cancer patients undergoing chemotherapy. The lengthening of IPD and ICCU patients' stay is associated with pseudomonas infection with worsened results. Ensuring the prevention and early detection of infectious complications is crucial for maximizing clinical oncological outcomes. Despite implementing effective infection prevention practices in our hospital, our study helps to judicial use of antibiotics should be emphasized, especially restricted antibiotics like polymyxin-B and colistin to prevent the spread of MDR Isolates of *P. aeruginosa* infections in high-risk cancer patients with neutropenia. It also provides valuable insights into the hospital's policy on the hospital cleaning

environment. Additionally, we will analyze various treatment modalities such as chemotherapy, radiation, surgery, and targeted therapies to determine their impact on antibiotic policy and cost reduction of prolonged patient stays.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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