PREVALENCE AND ANTIMICROBIAL SUSCEPTIBILITY PATTERN OF PSEUDOMONAS AERUGINOSA ISOLATED FROM WOUND INFECTIONS: A HOSPITAL-BASED STUDY AT PJMCH, DUMKA, JHARKHAND

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Abstract:
Background: Pseudomonas aeruginosa is a common opportunistic pathogen frequently associated with hospital-acquired infections, particularly wound and pus infections. Its increasing resistance to multiple antibiotics poses a significant therapeutic challenge. This study was undertaken to evaluate the prevalence and antibiotic susceptibility pattern of P. aeruginosa isolated from pus samples in a tertiary care hospital.

Methods: A total of 376 pus samples were processed in the Department of Microbiology, PJMCH, Dumka, Jharkhand, from January to December 2023. Isolates were identified using standard microbiological methods, and antimicrobial susceptibility testing was performed by Kirby–Bauer disc diffusion according to CLSI guidelines.

Results: Out of 376 samples, 37 (9.84%) yielded P. aeruginosa. The highest prevalence was noted in the 40–49 years age group (37.84%) with male predominance (67.57%). Antibiotic susceptibility testing revealed highest sensitivity to piperacillin/tazobactam (78.38%), imipenem (78.38%), aztreonam (78.38%), and meropenem (75.68%), while resistance was most frequent against ofloxacin (48.65%) and ciprofloxacin (37.84%). The overall prevalence of multidrug-resistant (MDR) isolates was 21.62%.

Conclusion: P. aeruginosa remains an important cause of wound infections with considerable antimicrobial resistance. Continuous surveillance of antibiograms and judicious use of antimicrobials are essential to guide empirical therapy and prevent the emergence of MDR strains.

Keywords: Pseudomonas aeruginosa, Antibiotic susceptibility

Introduction:

Pseudomonas aeruginosa is an opportunistic, non-fermenting, gram negative bacteria which causes a extensive spectrum of infections ranging from Bacteremia, Urinary tract infection (UTI), Respiratory tract infection, skin and soft tissue infections.

Most of the non-fermenters have their natural habitat in several environments that serve as potential reservoirs that are prevalent in hospitals such as- water reservoir in hospital-humidifiers, distilled water, mist, forceps, tents, water baths, nebulisers, disinfectants, irrigation solutions, hand creams and body lotions, anaesthesia equipments, and thermometers, that may be stored in disinfectant solutions, mops, sponges and towels patient's moist creases of skin, infections from these sources tend to be more prevalent in summer. Various host factors like-immune status, environmental factors, nutritional status, respiratory viral infections like influenza and measles causing transient immunosuppression contribute further for enhancing their role as pathogens to humans. Its role as an effective opportunistic pathogen can be attributed to minimal nutrition requirements, tolerance to wide verify of physical condition and extreme adaptability to adverse conditions.[1]

Antibiotic resistance is a steadily increasing entity worldwide in P. aeruginosa. [2] This may be due to direct effect of individual antimicrobial exposure or due to the indirect effect of transmission of multidrug resistant organisms from other patients as a result of higher colonization process. This trend of increased antibiotic resistance severely limits the choice of effective antimicrobial agents.[3]

PUS samples represent a Pyogenic infection which is characterised by local inflammation usually caused by any pyogenic bacteria, it leads to accumulation or dead leucocytes and infection agent.[4] Wound infections start with the invasion of microorganism into the tissue, damage them by interfering their defence mechanism leads to discharge PUS which cause serious complication in wound healing. Antibiotic resistance is increasing drastically among the Pseudomonas aeruginosa are considered as grave threats to the public health worldwide. Several mechanisms may contribute to antimicrobial resistance to pseudomonas aeruginosa, one of them is permeability in lower outer membrane in combination with multidrug efflux systems account for its intrinsic resistance.

Rapid emergence of multidrug resistance bacteria Poses a serious threat to public health globally due to the limited treatment option and Lukewarm discovery of new classes of antibiotics.[5,6]

Drug resistant bacteria evolved because of the misuse of antibiotics, posing a significant burden to the health care system.[7] Great challenges exist if there is an emergence of MDR pseudomonas aeruginosa as clinicians are left with limited therapeutic options.

Materials and Methods :

This study was conducted in Department of Microbiology in PJMCH, Dumka, Jharkhand during the period of January 2023 to December 2023. A total of 376 pus sample were received from various departments of which 37 were found to be positive with pseudomonas aeruginosa The study included pus samples collected from patients of all age groups and both sexes presenting with clinically suspected wound infections and admitted to different hospital departments during the study period. Samples that were contaminated, inadequately collected, or obtained from patients who had received systemic antibiotics within 48 hours prior to collection were excluded from the study.

Pus samples were collected using two sterile swab sticks, with the first swab used for Gram staining and the second for culture. For primary isolation 2nd swab was inoculated on routine culture media nutrient agar (Himedia, Mumbai, India), MacConkey agar (Himedia, Mumbai, India), blood agar (Himedia, Mumbai, India). Pigment production was interpreted on the basis of growth on nutrient agar.

For the confirmation of these isolates colonies the biochemical tests like catalase, oxidase, indole, citrate utilization, triple sugar iron test was performed.

Antimicrobial susceptibility testing of isolates was performed by standard kirby Bauer disc diffusion method according to CLSI guidelines on Mueller-Hinton agar media (MHA) (Himedia, Mumbai, India). All the isolates was tested against the following Antibiotics impregnated paper discs (Himedia) of standard strengths: Amikacin (30 mcg/disc), Gentamycin (10mcg/disc), Pipracillin/Tazobactam

(100/10mcg/disc), Imipenam (10mcg/disc), Meropenem (10mcg/disc), Ceftazidime (30mcg/disc), Cefepime (30mcg/disc), ciprofloxacin (5mcg/disc), Levofloxacin (5mcg/disc), Pipracillin (100mcg/disc). Ofloxacin (5mcg/disc), Aztreonam (30mcg/disc).

RESULT

During the study period 37 strains pseudomonas aeruginosa were isolated among 376 PUS sample received from various departments of PJMCH, Dumka Jharkhand.

Table 1 shows the age and gender wise distribution of clinical isolates of Pseudomonas aeruginosa. This isolation rate of pseudomonas aeruginosa was formed to be 9.84%. In the present study, a total of 37 clinical isolates of Pseudomonas aeruginosa were identified. The highest number of isolates was seen in the 40–49 years age group (14 cases, 37.84%), followed by 9 cases (24.32%) in the 50–59 years group and 7 cases (18.92%) in the 20–29 years group. The lowest frequency was recorded in the 60–69 years age group with 2 cases (5.41%). Males accounted for the majority of cases (25 cases, 67.57%) compared to females (12 cases, 32.43%). Male predominance was evident in most age groups, being highest in the 30–39 years group (80%), while equal distribution of cases was observed among males and females in the 60–69 years group.

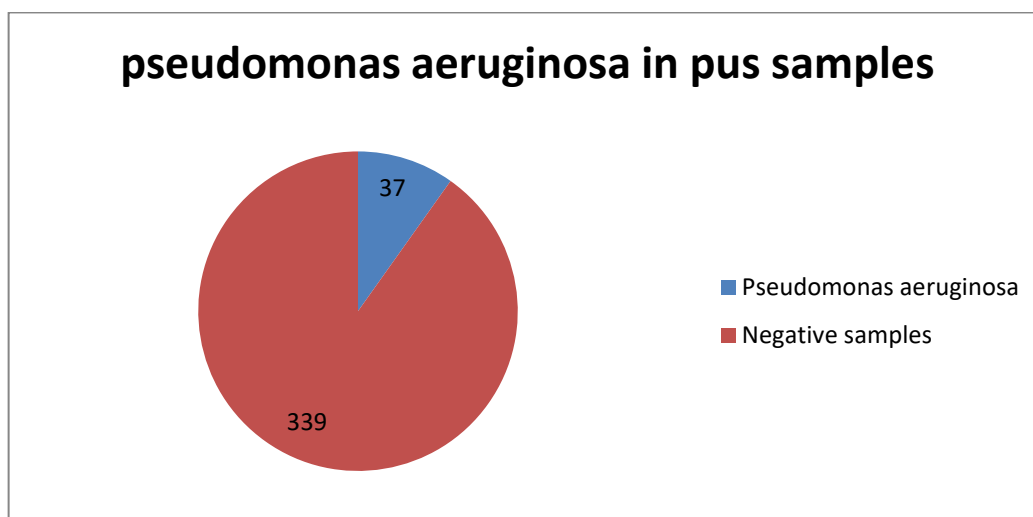**Table 1: Age and gender wise distribution of clinical isolates of Pseudomonas aeruginosa.**

Age Group	Total	Male	Female
20-29	7 (18.92%)	5 (71.43%)	2 (28.57%)
30-39	5 (13.51%)	4 (80%)	1 (20%)
40-49	14 (37.84%)	9 (64.29%)	5 (35.71%)
50-59	9 (24.32%)	6 (66.67%)	3 (33.33%)
60-69	2 (5.41%)	1 (50%)	1 (50%)
TOTAL	**37 (100%)**	**25 (67.57%)**	**12 (32.43%)**

Antibiotic susceptibility pattern against Pseudomonas aeruginosa is shown in table 2. Antibiogram analysis of pseudomonas aeruginosa was carried out of 37 isolates the antibiogram of revealed that piperacillin/ tazobactam (78.38%), imipenem (78.38%), aztreonam (78.38%) has most susceptable followed by meropenem (75.68%), Piperacillin (72.97) , amikacin (70.27%).

Antibiotic resistance rate of the isolates were ofloxacin 48.65% followed by ciprofloxacin (37.84%),levofloxacin (35.14%), gentamycin (35.14%). In present study rate of MDR of pseudomonas aeruginosa was 21.62%.

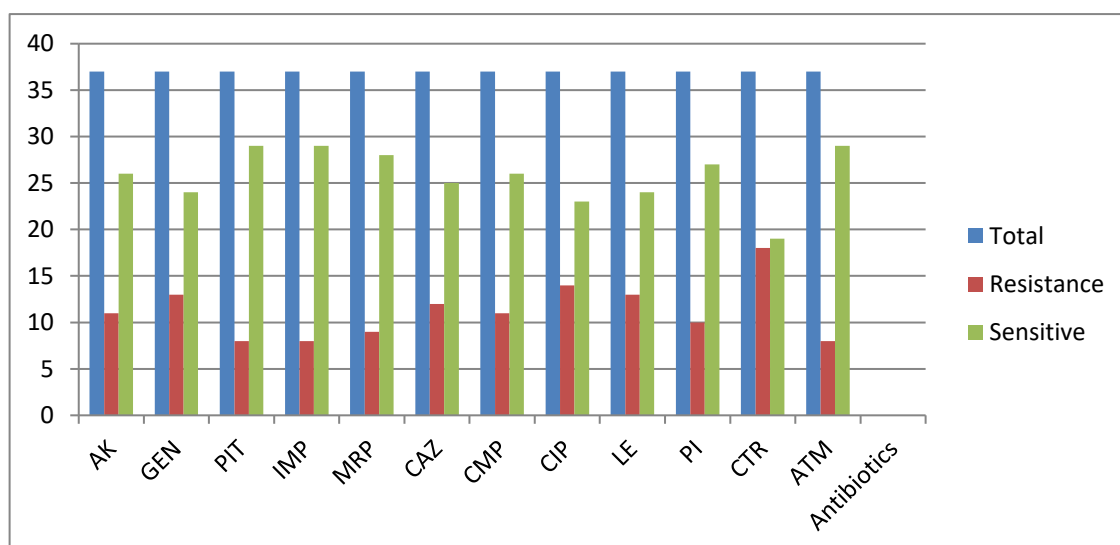**Table 2 : Antibiotic susceptibility pattern against Pseudomonas aeruginosa.**

Antibiotics	Abbreviation	Concentration used (µg)	n (%) bacterial isolates showing resistance n = 37	n (%) bacterial isolates showing sensitivity n = 37
Amikacin	AK	30	11 (29.73%)	26 (70.27%)
Gentamicin	GEN	10	13 (35.14%)	24 (64.86%)
Piperacillin/ Tazobactam	PIT	100/10	08 (21.62%)	29 (78.38%)
Imipenem	IMP	10	08 (21.62%)	29 (78.38%)
Meropenem	MRP	10	09 (24.32%)	28 (75.68%)
Ceftazidime	CAZ	30	12 (32.43%)	25 (67.57%)
Cefepime	CMP	30	11 (29.73%)	26 (70.27%)
Ciprofloxacin	CIP	05	14 (37.84%)	23 (62.16%)
levofloxacin	LE	05	13 (35.14%)	24 (64.86%)
Piperacillin	PI	100	10 (27.03%)	27 (72.97%)
Ofloxacin	OF	05	18 (48.65%)	19 (51.35%)
Aztreonam	ATM	30	08 (21.62%)	29 (78.38%)

Figure 1: Prevalence of Pseudomonas aeruginosa in pus samples.
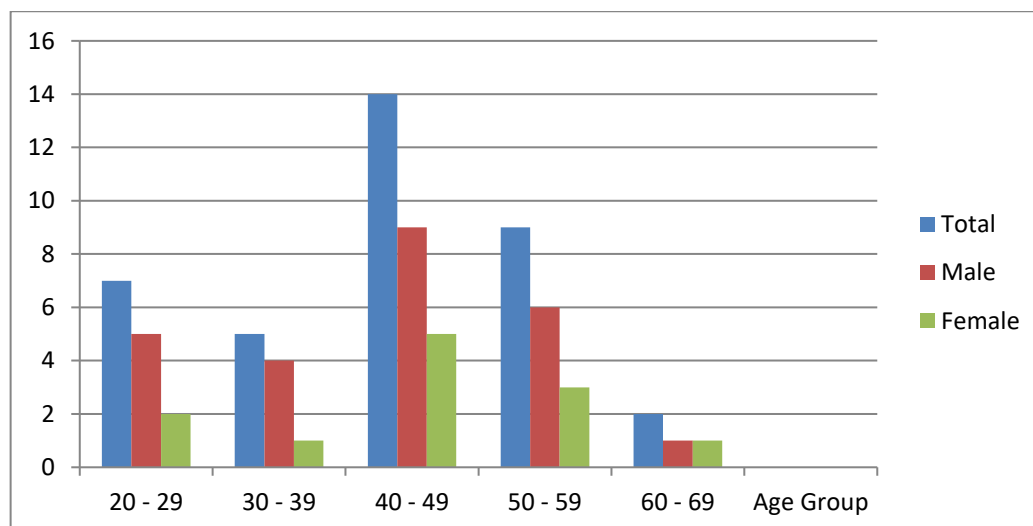
Figure 2: Age and gender wise distribution of clinical isolates of Pseudomonas aeruginosa.

Figure 3: Antibiotic susceptibility pattern of Pseudomonas aeruginosa.

DISCUSSION

P. aeruginosa is a prototypical "multidrug resistant (MDR) pathogen" recognized for its ubiquity, its intrinsically advancedantibiotic resistancemechanisms. P. aeruginosa is a reason for high fatality rate, as it has arisenas avital pathogen for nosocomial infection in hospital settings.[8] Life threatening infection rate caused by P. aeruginosa continue to rise though there is improvement in sanitation facilities and the introduction of a wide variety of antimicrobial agents with antipseudomonal activities.[9] Due to the use of various invasive devices the first line of defense like normal skin and mucosal barrier are more prone to infection hence contributes to susceptibility of hospital patients towards nosocomial infection.[10] Gram negative bacilli dominance in the aerobic growth in pus has been highly recorded by studies reported by Ghoshet al. and Zubair et al.[11,12]

In the present study attempt was made to isolate pseudomonas aeruginosa from PUS samples revealed the prevalence rate pseudomonas aeruginosa was 9.84%. The present study discloses the prevalence of infections due to P. aeruginosa and their propensity for drug resistance. Multidrug resistant bacteria are usually complicating course of therapy and thus are causing major public health problems-an emerging challenge to health care

pseudomonas aeruginosa isolates were higher in patients of age group 40-49 yrs.

In present study sex were corelation of pseudomonas aeruginosa prevalence revealed that male patients has high prevalence than female. As per the Antibiogram data of present study P.aeruginosa (N=37) (78.38%) sensitivity was observed for piperacillin/ tazobactam, imipenem (78.38%), aztreonam (78.38%) followed by meropenem (75.68%),Piperacillin (72.97) , amikacin (70.27%). As per earlier study sharma et al. reported 100% sensitivity to Amikacin and Ciprofloxacin (60%) in their study.[13]

Al-Ibran E et al. stated reduction in sensitivity to Amikacin (44%), Ceftazidime, Ciprofloxacin showed on average < 30%.[14]

In present study rate of MDR or pseudomonas aeruginosa was 21.62% which is similar to the reports in India by Doi et al.[15] were 27%.

Conclusion:

The most common causative agents of infections and their antimicrobial susceptibility pattern is a crucial step for the empirical therapy. Pseudomonas aeroginosa which is a common Gram negative bacteria isolated from wound infections and also highly resistant to different types of antibiotics could be a reason for high morbidity and mortality in hospitalised patients. The prevalence of Pseudomonasaeruginosa is high in male than the female patients. Multi drug resistant P.aeruginosastrains were observed. The drug resistance to Pseudomonas aeruginosa is rapidly increasing. Pseudomonas aeruginosa is intrinsically resistant to several antibiotics because of the low permeability of its outer-membrane to the antibiotics and also the constitutive expression of various efflux pumps, and beside this they also produce antibioticinactivating enzymes (e.g., cephalosporinases). Irrational and inappropriate use of antibiotics is responsible for the development of resistance of Pseudomonasspecies to antibiotic monotherapy. Hence, 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. In addition, regular antimicrobial susceptibility surveillance is essential for area-wise monitoring of the resistance patterns. An effective national and state level antibiotic policy and draft guidelines may be introduced to preserve the effectiveness of antibiotics for better patient management. The relatively high resistance of P.aeruginosa isolates to commonly used antibiotics is a great concern for India, were most of these antibiotics still serve as first line drugs.

Conflict of interest: None

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