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Original Research Article

Occurrence of *Pseudomonas aeruginosa* isolated from surgical site infections and wound infections and their antimicrobial susceptibility profile

Rinki Kumari Singh[1], Shweta R Sharma[1,*], Asok Kr Singh[2], Umar Farooq[1], Sudhir Singh[1], Vasundhara Sharma[1], Imran Ahamad[1]

[1]*Dept. of Microbiolog, Teerthanker Mahaveer Medical College & Research Centre, Moradabad, Uttar Pradesh, India*
[2]*Dept. of General Surgery, Teerthanker Mahaveer Medical College & Research Centre, Moradabad, Uttar Pradesh, India*

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ABSTRACT

Introduction: *Pseudomonas aeruginosa* is a major cause of health care associated infections. It has natural resistance as well as acquired multidrug resistance to various antibiotics leading to increased morbidity and mortality, which lead to problematic condition and increased medical expenses. The main aim of this study was to study the resistance pattern of *Pseudomonas aeruginosa* isolated from samples received from surgical site infections and wound infections.
Materials and Method: This study was conducted at Microbiology laboratory of Teerthanker Mahaveer Medical College and Research Centre. Pus and wound swab samples were collected from surgical site infections (SSIs) and wound infections. Samples were cultured on MacConkey and Nutrient agar and incubated at 37°C aerobically. Identification of *Pseudomonas aeruginosa* was done by using conventional method and antibiotic sensitivity was determined with automated Vitek2 compact system.
Results: From January 2021 to November 2021 during this study period, out of 117 positive samples 32 (27.35%) *Pseudomonas aeruginosa* were isolated. The susceptibility pattern showed the organism to be most commonly susceptible to Colistin, Doripenem, followed by Piperacillin/Tazobactam, Imipenem, Amikacin, and was less susceptible to Ciprofloxacin, Ceftazidime.
Conclusion: Presences of multidrug resistance strains have raised significant concern and judicious use of antibiotics is the only option to reduce drug resistance and preventing resistance against reserve antibiotics.

1. Introduction

Centers for Disease Control and Prevention (CDC) define surgical site infections (SSIs) as infections that occur at the site of incision within 30 days of any surgery. Despite of having advance techniques in surgery SSIs is become predominant reason for hospital-acquired infection, which causes mortality, Morbidity and increase in medical expenses.[1] Uncontrolled, spreading of antibacterial resistance among bacterial agents creates more challenge in clinical and surgical practice for management to treat surgical site infections. Increasing resistance in microbes directly affected the effectiveness of antimicrobials and causes worldwide problem. In developing countries, the surgical site infection and wound infection is more serious due to the irrational prescription of antibacterial agents.[2] *P. aeruginosa* is the Gram-negative bacteria that have nearly replaced Gram-positive bacteria Staphylococcus aureus in hospital acquired infections with Gram-negative rods, which become more common in recent years. When compared to a decade long retrospective investigation *Pseudomonas aeruginosa* has an increased prevalence of wound infections.[3] In order to better understand the

* *Corresponding author*.
E-mail address: drshwetamicro@gmail.com (S. R. Sharma).

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occurrence and antimicrobial susceptibility patterns of *P. aeruginosa* in SSIs and wound infections in both Inpatients and outpatients the current study was designed.

2. Materiala and Methods

This study was conducted in India, at Microbiology laboratory of Teerthanker Mahaveer University hospital from January 2021 to November 2021. Pus and wound swabs samples were collected from surgical site infection and wound infections. Samples were cultured on MacConkey and Nutrient agar and incubated aerobically at 37°C. Identification of *Pseudomonas aeruginosa* were done on the basis of conventional methods like colony morphology in culture plate, gram's stain of organism and biochemical reactions such as Indole test, Methyl red test, Triple sugar iron test, Urease test, Citrate test, motility test, oxidative-fermentative test and Oxidase test while AST was performed with automated Vitek2 compact system.[4,5]

2.1. Inclusion criteria

Patients affected by surgical site infection and wound infections are included in this study.

2.2. Exclusion criteria

Patients who are less than eighteen years old were not considered in this study and patients who deny consent are also excluded from this study.

2.3. Ethics approval

This investigation was carried out with the permission of the Institutional Ethical Committee (IEC) TMMC Moradabad, ref. no. TMU/IEC/20-21/135.

2.4. Sample collection and processing

Pus or exudate and swabs were collected in sterile conditions. Pus and exudate collected in different sterile container such as screw capped bottle, securely closed tube or sealed capillary tube and sterile syringe. In case of swabs, two swab samples were collected from same patient one for direct smear preparation for microscopy and another one for seeding the culture on MacConkey and nutrient agar. After obtaining pure growth identified the organism with appropriate biochemical tests and then isolated *P. aeruginosa* from the samples AST were performed by Automated Vitek2 Compact System.

3. Results

All the samples suspected for surgical site infection and wound infections were obtained from both indoor and outdoor patients from respective departments. Out of 194 samples from suspected surgical site infections and wound infections 117 samples shows positive growth for pathogenic organism. Among the 117 culture positive cases in SSIs and wound infections gram-negative bacteria *Pseudomonas aeruginosa* 32 (27.35%) were predominantly isolated from pus and wound swab samples. In SSIs and wound infections department wise analysis, *P. aeruginosa* was isolated maximally from General Surgery 19 (59.38%) followed by Orthopaedics 5(15.63%) and General Medicine 4 (12.5%) (Table 1). Greater number of *P. aeruginosa* isolated from age group 41-50 and 51-60 (25%) years each. *Pseudomonas aeruginosa* infection in surgical site and wound infection males 18(56.25%) are more common than females 14(43.75%) (Table 1). Antimicrobial sensitivity pattern of *P. aeruginosa* showing in the Figure 1.

Table 1: *P. aeruginosa* distribution by department

S.No.	Department	*P. aeruginosa*
1.	General surgery	19 (59.38%)
2.	Orthopaedics	5 (15.63%)
3.	OBG	2 (6.25%)
4.	General medicine	4 (12.5%)
5.	ENT	1 (3.13%)
6.	Emergency	1 (3.13)
Total		32 (100%)

Table 2: Distribution of patients on the basis of age

S.No.	Age group (in years)	No. of isolates	(%)
1.	21-30	5	15.6%
2.	31-40	4	12.5%
3.	41-50	8	25%
4.	51-60	8	25%
5.	>60	7	21.9%
	Total	32	100%

4. Discussion

Antimicrobial resistance in SSI is becoming a worldwide problem, resulting in longer hospital stay for patients as well as higher mortality and morbidity.[6] In gram-negative non-fermentative bacteria *P. aeruginosa* play major role in surgical site infection and wound infection.[7] It is the most common bacteria isolated from SSIs and wound infections and due to the presence of resistant strain, the treatment of both community acquired and hospital acquired infections has become a serious challenge.[8] It is important to correctly identify the organism and choosing an appropriate antibiotics on the basis of AST results to start the right treatment. The objectives of our study was to determine the occurrence of *P. aeruginosa* isolated from surgical site infections and wound infections and to find out their current antimicrobial susceptibility patterns against commercially used antipseudomonal antibiotics.

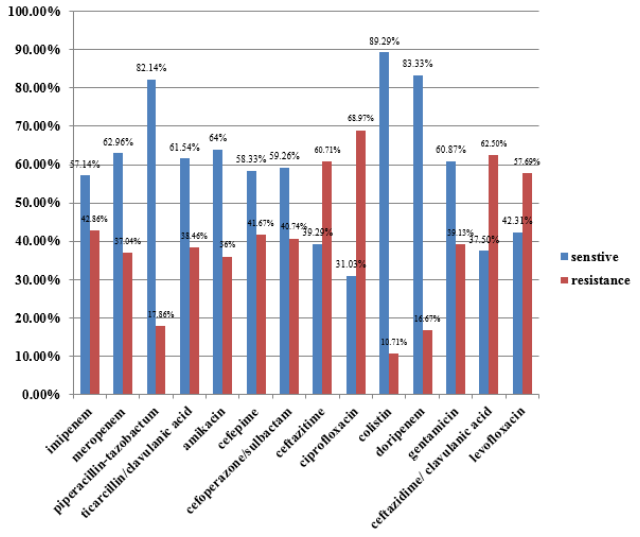

Fig. 1: Antimicrobial sensitivity pattern of *P. aeruginosa*

In the present study out of 194 clinical samples from SSIs and wound infections, 60.31% significant pathogenic organisms were isolated from samples while 39.69%, samples showed no growth for any organism. Similar study were conducted by Khan et al.,[9] Bhatt et al.[10] Our study shows that among all the isolates *P. aeruginosa* was the most prevalent (27.35%) pathogenic organism obtained from the SSIs and wound infections. Our findings similar to those comparable investigations conducted by Sharma et al.[11] (22.44%) and Tadvi et al.[12] (22.67%). In contrast, Negi et al.[13] found *E. coli* as most common isolate and Mundhada et al.[14] determines *S. aureus* as most prevalent organism isolated in their studies.

The distribution of *P. aeruginosa* from surgical site infection and wound infection by department revealed that Surgery (59.38%) was the leading contributor followed by Orthopaedics (15.63%), General Medicine (12.5%), OBG (6.25%) and others (3.13%). These observations are in line with studies of Rajat et al.[15] and Khan et al.[9]

When factors such as patient age and gender considered, *P. aeruginosa* infection were found to be more common among males (56.25%) than females (43.75%), and it was determined to be most common in the age group 41-60 years. This study suggests males to be more susceptible to SSI and wound infections due to the fact that males are more likely vulnerable to trauma because of their outdoor activities.[8] These findings are comparable to those of Ranjan et al.,[16] More et al.,[17] Mundhada et al.,[14] Yadav et al.[8] and Patel et al.[18] The analysis of the drug susceptibility pattern of the *P. aeruginosa* will help in proper treatment to the patients. From the current study susceptibility outcome revealed that Colistin, Piperacillin-Tazobactam and Doripenem were 89.29%, 82.14% and 83.33% sensitive, which are most effective antibiotics against the *P. aeruginosa* isolated from pus and wound swab samples. Another study done by Patel et al.,[18] Solanki et al.,[19] Tiwari et al.[20] and Volvoikar et al.[21] reported similar results. For other drugs, sensitive pattern was as follows: Amikacin (64%), Meropenem (62.96%), Ticarcillin/Clavulanic acid (61.54%), Cefoperazone-Sulbactam (59.26%), Gentamicin (60.87%), Cefepime (58.33%) and Imipenem (57.14%). Previous studies from different places were showed the similar reports by Tiwari et al.,[20] Sharma et al.,[11] Chandy et al.[22] and Khan et al.[9] Antibiotics, which are least susceptible to *P. aeruginosa* isolated from SSI and wound infection are as Ciprofloxacin (31.01%), Ceftazidime/Clavulanic acid (37.5%), Ceftazidime (39.29%), and Levofloxacin (42.31%) which are similar in study done by Afroz et al.,[23] Sharma et al.[11] and Tiwari et al.[20]

5. Conclusion

Despite of having advances in the medical procedure such as in surgical field and sterilization techniques along with modified prophylactic antibiotics use at the time of surgery, infection at the surgical site is a major risk in surgery. SSI and wound infection cause a significant illness burden not only on patients but also for the health-care facilities regarding economic cost, morbidity and motility. The recent study shows that the most isolated organism from surgical site infection and wound infection were *P. aeruginosa*. This organism is one of the important causes of nosocomial infection and community acquired infections. The occurrence and antimicrobial sensitivity pattern of *P. aeruginosa* varies geographically and within units of a hospital settings. This study found that *P. aeruginosa* isolates from SSIs and wound infections are developing resistant to the most routinely used antibiotics, while also increasing resistance to newer medicines. Therefore, it is necessary to have understanding of the occurrence of *P. aeruginosa* and their AST pattern. We should prevent selection and spread of resistant strains of *P. aeruginosa* by taking all preventive measures. The current study will provide initial guidance to the clinician in selecting of proper antibiotics for *P. aeruginosa* that will help in better treatment of the patients. Judicious and appropriate use of antimicrobial agents for the proper duration of the procedure can help in reducing the number of surgical site infections.

6. Conflict of Interest

The authors declare no relevant conflicts of interest.

7. Source of Funding

None.

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Author biography

Rinki Kumari Singh, Student

Shweta R Sharma, Associate Professor

Asok Kr Singh, Associate Professor

Umar Farooq, Professor and Head

Sudhir Singh, Professor

Vasundhara Sharma, Associate Professor

Imran Ahamad, Assistant Professor

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