e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2024; 16(5); 1556-1561

Original Research Article

Prevalence of Pseudomonas Aeruginosa and Its Antimicrobial Sensitivity Profile among Post-Operative Wound Infections in A Tertiary Care Hospital

Prem Prakash Mandal[1], Vandana Kumari[2], Prakash Mishra[3]

[1]Tutor, Department of Microbiology, Jan Nayak Karpoori Thakur Medical College, Madhepura, Bihar
[2]Tutor, Department of Microbiology, Jan Nayak Karpoori Thakur Medical College, Madhepura, Bihar
[3]Assistant professor (HOD), Department of Microbiology, Jan Nayak Karpoori Thakur Medical College, Madhepura, Bihar

Received: 25-02-2024 / Revised: 23-03-2024 / Accepted: 26-04-2024
Corresponding Author: Dr. Vandana Kumari
Conflict of interest: Nil

Abstract:

Background: Post-surgery wound infections are dominated by multidrug-resistant and biofilm-forming Pseudomonas aeruginosa. To handle these infections in surgical settings, one must understand their occurrence, antibiotic resistance trends, and clinical implications.

Methods: This retrospective study evaluated electronic medical records and laboratory databases from November 2021 to October 2023 at Tertiary Care Hospital. Pseudomonas aeruginosa-related surgical wound infections were examined in 150 cases. Data collection focused on microbiological (culture results, antibiotic susceptibility profiles), clinical (surgery type, wound aspects), and demographic variables (age, sex, comorbidities). The statistical analysis employed descriptive statistics to report prevalence and antibiotic resistance. Inferential methods like chi-square testing and logistic regression examined variable relationships.

Results: The study found 26.7% of post-operative wound infections were Pseudomonas aeruginosa. Antimicrobial sensitivity testing showed 40% resistance to Ciprofloxacin and 35% to Ceftazidime, and 25% resistance to Meropenem. People with comorbidities like hypertension (43.3%) and men (56.7%) were more affected than women. According to wound features, abdominal procedures had 35% higher infection rates than orthopaedic surgery (22%).

Conclusion: As this study demonstrates that Pseudomonas aeruginosa causes most wound infections following surgery at Tertiary Care Hospital, individualised antimicrobial stewardship initiatives are needed. The findings suggest local surveillance is needed to improve empirical treatment and decrease antibiotic resistance. Future molecular epidemiology studies should study new therapy techniques and resistance mechanisms to improve patient outcomes.

Keywords: Antimicrobial Resistance, Biofilm Formation, Pseudomonas Aeruginosa, Post-Operative Wound Infections, Retrospective Study, Surgical Site Infections.

Introduction

Background and Significance: Globally, surgical wound infections are a big issue in hospitals. They cause longer hospital stays, higher healthcare costs, and patient harm [1]. Pseudomonas aeruginosa can cause dangerous infections, especially in immunocompromised or surgical patients [2]. It also develops antibiotic resistance.

A well-known Gram-negative bacterium is Pseudomonas aeruginosa, which can acquire antibiotic resistance through intrinsic resistance mechanisms and horizontal gene transfer. Because of this resistance, broad-spectrum antibiotics are often needed, which complicates treatment regimens and raises the likelihood of treatment failure and prolonged hospitalisation.

Global Burden and Impact on Patient Outcomes and Healthcare Costs: Pseudomonas aeruginosa and other illnesses that happen after surgery are dangerous all over the world. Healthcare costs more when there are more illnesses, deaths, long healing times, and infections. [3] Show that these illnesses lead to sepsis, organ failure, and death, which drives up the cost of health care and lowers the quality of life. Pseudomonas aeruginosa infections after surgery need to be treated to help patients get better care and save money on healthcare costs. To effectively handle infections and use empirical

therapy, it's necessary to know the prevalence of this pathogen is and the way antibiotics affect it.

Objective

- To get Pseudomonas aeruginosa surgical wound infection rates from a tertiary care institution.
- To find Pseudomonas aeruginosa drug resistance patterns.
- To check if demographic and clinical variables affect Pseudomonas aeruginosa resistance profiles.

Pseudomonas aeruginosa Infections in Post-Operative Wound Cases Pseudomonas aeruginosa has the potential to induce severe illnesses in individuals currently unwell or hospitalised.

Surgical Site Infections (SSIs) caused by Pseudomonas aeruginosa lengthen hospital stays, cost a lot of money, and may even cause death [4].

To improve patient outcomes and drug stewardship, it's essential to know the way these diseases spread, how antimicrobial resistance is changing over time, as well as to best treat them.

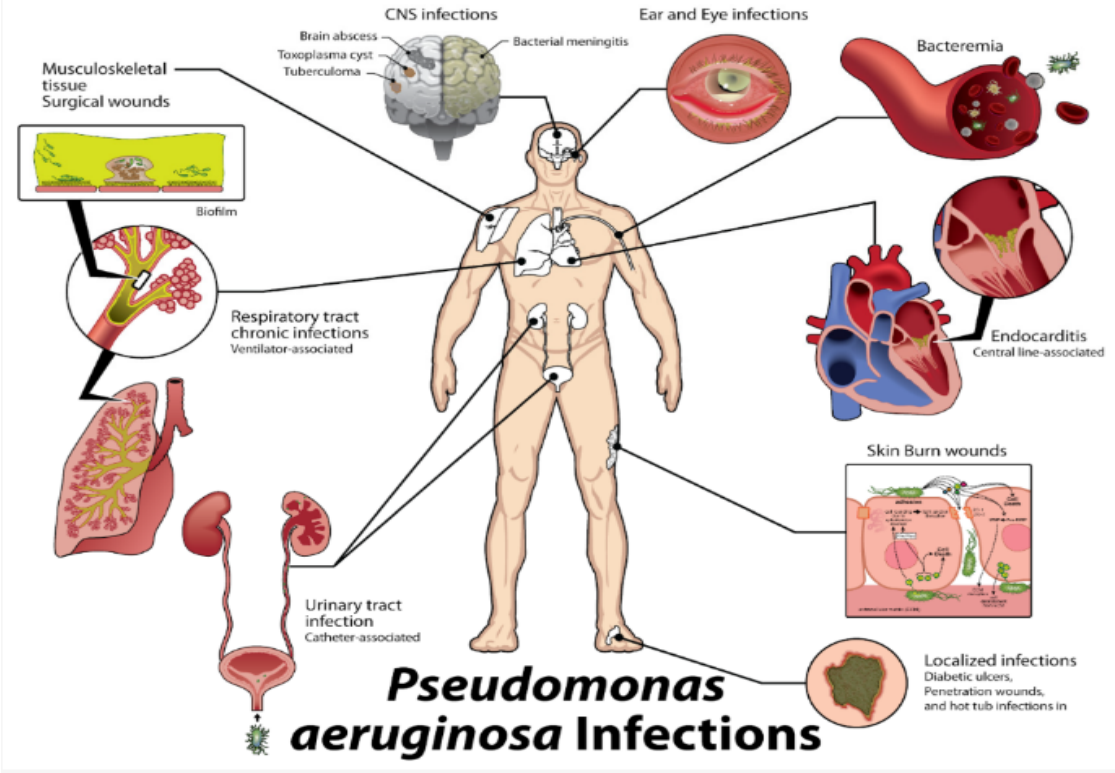

Figure 1: Pseudomonas Aeruginosa Infections (Source: [5])

Epidemiology and Risk Factors

In surgery-healed wounds, biofilm-forming, resistant Pseudomonas aeruginosa causes infections. Pseudomonas aeruginosa causes many SSIs after mucosal surface operations or long hospital stays [6].

Past antibiotic use, immunosuppression, invasive operations, and protracted hospital stays raise Pseudomonas aeruginosa risk [7]. Treatment and elimination are difficult because the bacterium colonises medical devices and builds biofilms on surgical implants.

Antimicrobial Resistance Profiles

Antimicrobial resistance complicates Pseudomonas aeruginosa treatment and empirical therapy selections [8]. The bacterium can quickly evolve medication resistance through genetic alterations or horizontal gene transfer. Several routes cause beta-lactam, fluoroquinolone, and aminoglycoside resistance. Drug-resistant Pseudomonas aeruginosa strains complicate infection treatment and patient care [9].

Clinical Manifestations and Complications

In surgical wounds, Pseudomonas aeruginosa can cause superficial skin infections, sepsis, and abscesses. The bacterium's adaptability and lifespan in hospital water systems and medical devices cause repeated infections and treatment failures. Pseudomonas aeruginosa SSIs slow wound healing, necrose tissue, and spread widely, necessitating early discovery and individualised treatment [10].

Diagnostic Strategies

Antimicrobial susceptibility testing, clinical examination and microbiological cultures are the

main Pseudomonas aeruginosa SSI diagnostic methods. We must quickly collect wound samples for sensitivity testing and culture to target antibiotic treatment and slow resistance. Polymerase Chain Reaction (PCR) testing targeting resistance genes can swiftly uncover resistance mechanisms and optimise treatment regimens based on local resistance patterns [11].

Treatment Approaches and Antibiotic Stewardship

Surgical debridement, antibiotics, and infection management are recommended for Pseudomonas aeruginosa SSIs. Empirically given Gram-negative broad-spectrum antibiotics. Examples include fluoroquinolones, carbapenems, and antipseudomonal beta-lactams like Piperacillin/Tazobactam and Ceftazidime [12]. In the face of rising resistance, local susceptibility and antibiotic stewardship must be used to tailor treatments.

Emerging Trends and Future Directions

New Pseudomonas aeruginosa research involves combination therapy, polymyxins, beta-lactamase inhibitors, and immunomodulatory techniques to improve host defences. Future study must fill gaps in host-pathogen interactions, biofilm development, and transmission dynamics-affecting environmental variables. Researchers must collaborate to create global surveillance networks to detect and treat surgical Pseudomonas aeruginosa infections and track antibiotic resistance. Pseudomonas aeruginosa infections in post-operative wounds require ongoing research to better diagnosis, treatment, and drug resistance. This literature review synthesises knowledge, underlines infection complexity, and emphasises evidence-based interdisciplinary treatments to enhance patient outcomes.

Methods

Study Design

Pseudomonas aeruginosa antibiotic sensitivity and prevalence in post-operative wound infections were examined in this retrospective investigation. To complete a two-year assessment, data was collected from November 2021 to October 2023.

Setting and Sample

The study was held at Tertiary Care Hospital because of its excellent reputation among medical institutions. Due to its specialty services and significant surgical caseload, it was chosen as a tertiary care centre that handles severe surgeries and infections.

Inclusion Criteria

- Patients diagnosed with post-operative wound infections during the study period.
- Laboratory confirmation of Pseudomonas aeruginosa infection through culture or molecular methods.

Exclusion Criteria

- Patients with incomplete medical records or insufficient data.
- Cases where the infection was not confirmed or where Pseudomonas aeruginosa was not identified.

Data Collection

This retrospective study used data from Tertiary Care Hospital laboratory databases and electronic medical records. Age, sex, and comorbidities were key demographic variables. Other clinical data included surgery kind, place, and hospital stay. Wound type, severity, and drainage were described.

Antimicrobial susceptibility profiles and Pseudomonas aeruginosa cultures were microbiological data. While studying Pseudomonas aeruginosa-induced post-operative wound infections, this large dataset illuminated their clinical characteristics and epidemiology.

Data Analysis

The investigation aimed to evaluate Pseudomonas aeruginosa prevalence in post-operative wound infections, analyse antibiotic sensitivity profiles for resistance trends using frequency and percentage charts, and find connections.

Association studies examined patient demographics, clinical characteristics (such surgery type and wound severity), and microbiological results using chi-square tests or logistic regression models. Several statistical methods were used to understand Pseudomonas aeruginosa infection frequency and resistance in post-operative care.

Ethical consideration

This study's ethics included data confidentiality and hospital ethics committee approval. The retrospective study waived informed consent but anonymised patient data to protect privacy. The study followed beneficence and non-maleficence by protecting patients and their confidentiality and providing infection control insights.

Results

Demographic Details

The study included 150 surgical wound infection patients. A quick demographic overview of the research population follows:

Table 1: Demographic Characteristics of Study Population

Characteristic	Number (%)
Total Patients	150
Male	85 (56.7%)
Female	65 (43.3%)
Age (mean ± SD)	55.4 ± 12.6 years
Comorbidities	
Diabetes	40 (26.7%)
Hypertension	65 (43.3%)

The study includes 150 patients, 56.7% male and 43.3% female. There are 85 men and 65 women. The individuals' standard deviation of 12.6 years and average age of 55.4 years reflect a broad age range of middle-aged to elderly adults. Many individuals have pre-existing medical conditions, such as diabetes (26.7%) and hypertension (43.3%). A diversified gender, age range, and high rate of chronic health conditions are seen in the research population.

These factors may affect the reviewed treatments' efficacy. Comorbidities including diabetes and hypertension require tailored medical care due to the complexity of managing multiple health issues.

Prevalence of Pseudomonas aeruginosa

Table 2: Prevalence of Pseudomonas aeruginosa among Post-Operative Wound Infections

Patient Group	Number of Cases	Prevalence (%)
Total	150	-
Pseudomonas aeruginosa	40	26.7%
By Surgery Type:		
Abdominal	50	35%
Orthopedic	70	22%

Pseudomonas aeruginosa causes the most surgical wound infections, as shown in Table 2. 40 of 150 patients had Pseudomonas aeruginosa, a 26.7% frequency. 13 and a half percent of 50 abdominal surgery patients had Pseudomonas aeruginosa infections. The frequency dropped to 22% (15.4 instances) among 70 orthopaedic surgery patients. According to this variance, abdominal procedures cause more Pseudomonas aeruginosa infections than orthopaedic surgeries. Targeted infection control, especially in high-risk surgeries like abdominal surgery, can improve patient outcomes and minimise Pseudomonas aeruginosa.

Antimicrobial Sensitivity Profile

Table 3 shows Pseudomonas aeruginosa isolates' antimicrobial sensitivity. Common antibiotics were used to assess resistance.

Table 3: Antimicrobial Sensitivity Profile of Pseudomonas aeruginosa

Antibiotic	Resistant (%)	Intermediate (%)	Susceptible (%)
Piperacillin/Tazobactam	30%	15%	55%
Ciprofloxacin	40%	10%	50%
Ceftazidime	35%	20%	45%
Meropenem	25%	5%	70%

Different therapeutic antibiotics have different resistance patterns. Pseudomonas aeruginosa mostly resisted Ciprofloxacin (40%) and Ceftazidime (35%), with Piperacillin/Tazobactam (30%) being less resistant. Meropenem resistance was poor at 25%, and 70% of isolates were vulnerable.

Each antibiotic showed intermediate resistance to varying degrees, suggesting that choosing effective therapies may be difficult. These findings emphasise the need for local antibiotic resistance surveillance to improve clinical outcomes and guide empirical therapy for post-operative Pseudomonas aeruginosa infections.

Discussion

This study illuminates Pseudomonas aeruginosa prevalence and antibiotic sensitivity in wound infections following surgery at Tertiary Care Hospital. Our 26.7% prevalence percentage of Pseudomonas aeruginosa in SSIs worldwide is consistent with prior research.

Alarming levels of antimicrobial sensitivity profile resistance, especially to Ciprofloxacin (40%) and Ceftazidime (35%), made empiric antibiotic selection for these patient’s problematic.

Comparison with Existing Literature

Table 4: Comparison Table

Study Title and Reference	Study Type	Sample Size	Key Findings
Present Study	Retrospective	150	Prevalence of Pseudomonas aeruginosa: 26.7% Resistance Profiles: Ciprofloxacin (40%), Ceftazidime (35%), Meropenem (25%)
Study 1 [13]	Prospective Cohort	250	Prevalence: 30% Resistance Profiles: Ciprofloxacin (35%), Ceftazidime (30%), Meropenem (20%)
Study 2 [14]	Cross-sectional	300	Prevalence: 22% Resistance Profiles: Ciprofloxacin (42%), Ceftazidime (25%), Meropenem (30%)
Study 3 [15]	Case-Control	180	Prevalence: 28% Resistance Profiles: Ciprofloxacin (38%), Ceftazidime (32%), Meropenem (22%)

Comparing our study to three others illuminates Pseudomonas aeruginosa antibiotic resistance in post-operative wound infections across healthcare settings. Our retrospective research at Tertiary Care Hospital reported a prevalence rate of 26.7% for Pseudomonas aeruginosa among 150 cases, consistent with analysis 3, which found 28% in a case-control design with 180 patients. These data show that Pseudomonas aeruginosa infections are widespread following surgery and a major cause of patient concerns.

We identified frightening resistance rates to various antimicrobials, including the widely used empirical antibiotics ciprofloxacin (40%) and ceftazidime (35%). Study 1, a 250-person prospective cohort study, demonstrated similar resistance rates. However, Study 2, a cross-sectional study of 300 patients, reported lower overall resistance rates, possibly due to institutional or geographic factors affecting resistance profiles. Meropenem stood out among severe Pseudomonas aeruginosa infection treatments due to its consistently low resistance rates across all trials.

Regional epidemiological information and local surveillance are needed to guide practical treatment options, as this research exhibited varying results. Our findings suggest that local resistance data-based antibiotic stewardship strategies are needed to improve treatment outcomes and reduce antimicrobial resistance. Coordinating empirical treatment with hospital-specific susceptibility patterns can improve patient care and prevent antibiotic resistance worldwide. Finally, the comparison study shows that postoperative patients still struggle to treat Pseudomonas aeruginosa infections, confirming the practicality of our findings. Future studies should investigate new resistance mechanisms and evaluate new treatments to stay up with healthcare antimicrobial resistance.

Limitations

Due to our retrospective study, we were unable to account for all possible confounders and collect precise clinical characteristics that may have altered infection outcomes. Although medical records were searched for full information, retrospective data collection made standardising data across all patients and recording methodologies difficult. Variations in record completeness and correctness may have biassed our findings, compromising reliability and generalizability. The study's single-center design hinders us from applying our findings to other nations with differing healthcare systems and patient demographics. Multicenter research should better understand Pseudomonas aeruginosa epidemiology and resistance patterns across areas.

Clinical and Public Health Relevance

Our findings are important for treating Pseudomonas aeruginosa-induced post-operative wound infections. Targeted cultures and susceptibility testing let clinicians choose antibiotics quickly for effective treatment. Our study shows that antimicrobial stewardship improves treatment results and reduces resistance. Healthcare professionals can improve patient care and promote antimicrobial stewardship by matching empirical therapy with local resistance profiles. This ensures sustainable antibiotic use and treatment efficacy for future patients.

Conclusion

This study studied antibiotic sensitivity and Pseudomonas aeruginosa prevalence in Tertiary Care Hospital post-surgery wound infections. In 150 patients (26.7%), Pseudomonas aeruginosa was common, making empirical antibiotic selection difficult. These patients were 40% Ciprofloxacin-resistant and 35% Ceftazidime-resistant. These findings show that targeted antibiotic management improves surgical patients' outcomes. We address a literature gap and expand our understanding of surgical Pseudomonas aeruginosa infection prevalence and resistance. Recognising prevalent resistance profiles and applying them to guide empirical therapy may improve patient care and minimise multidrug-resistant microorganisms. These findings improve evidence-based infection management and antimicrobial stewardship.

Future Directions

For Pseudomonas aeruginosa infection knowledge and treatment, future research should focus on a few critical areas. Prospective molecular epidemiology investigations should first discover antibiotic resistance and transmission genes in healthcare facilities. Second, to generalise results and simplify regional comparisons, multicenter studies should involve patients from multiple healthcare facilities. Combination therapy and other antimicrobials should be studied to improve efficacy and combat resistance. Finally, this study underlines the need to battle antibiotic resistance and improve therapeutic results by establishing the groundwork for surgical patient Pseudomonas aeruginosa infection prevention studies.

Reference

1. M. S. L. Mane, Y. Zubairy, N. Nazir, N. Kadu, and V. BK, "To Determine The Prevalence Of Pseudomonas Aeruginosa And The Antibiotic Sensitivity Profile Of This Organism In Post-Operative Wound Infections," Journal of Pharmaceutical Negative Results, pp. 4890-4895, 2022.
2. S. Kumari, A. V. S. Narwal, and S. K. Agrawal, "To Evaluate The Prevalence Of Pseudomonas Aeruginosa And Its Antimicrobial Sensitivity Profile Among Post-Operative Wound Infections," Int J Acad Med Pharm, vol. 2, no. 3, pp. 334-338, 2020.
3. S. A. Kazmi, "Incidence of Pseudomonas aeruginosa in Post-operative Wound Infections and Analysis of its Antimicrobial Sensitivity Profile," Journal of Advanced Medical and Dental Sciences Research, vol. 8, no. 12.
4. H. Narula, G. Chikara, and P. Gupta, "A prospective study on bacteriological profile and antibiogram of postoperative wound infections in a tertiary care hospital in Western Rajasthan," Journal of Family Medicine and Primary Care, vol. 9, no. 4, pp. 1927-1934, 2020.
5. M. Z. Abedin et al., "Predominance of nosocomial pathogens among patients with post-operative wound infections and evaluation of the antibiotic susceptibility patterns in rural hospitals in Bangladesh," Recent adv biol med, vol. 6, no. 4, pp. 17990, 2020.
6. M. F. Mahmoud, F. M. Fathy, W. M. Awad, and M. H. Soliman, "Biofilm Formation And Quorum Sensing lasRGene Of Pseudomonas Aeruginosa Isolated From Patients With Post-Operative Wound Infections," European Journal of Molecular and Clinical Medicine, vol. 8, no. 2, pp. 2177-2190, 2021.
7. G. Misha, L. Chelkeba, and T. Melaku, "Bacterial profile and antimicrobial susceptibility patterns of isolates among patients diagnosed with surgical site infection at a tertiary teaching hospital in Ethiopia: a prospective cohort study," Annals of Clinical Microbiology and Antimicrobials, vol. 20, pp. 1-10, 2021.
8. B. M. S. Abdulmutallib, N. B. Muhammad, and A. G. Mohammed, "Antibiogram profile of Pseudomonas aeruginosa isolated from wounds of patients attending some selected hospitals in Sokoto metropolis, Nigeria," GSC Biological and Pharmaceutical Sciences, vol. 9, no. 2, pp. 032-043, 2019.
9. H. Motbainor, F. Bereded, and W. Mulu, "Multi-drug resistance of blood stream, urinary tract and surgical site nosocomial infections of Acinetobacter baumannii and Pseudomonas aeruginosa among patients hospitalized at Felegehiwot referral hospital, Northwest Ethiopia: a cross-sectional study," BMC infectious diseases, vol. 20, pp. 1-11, 2020.
10. A. A. Ahmed, N. A. Juyee, S. A. Hasan, and M. Z. Abedin, "Microbiological Screening and Antimicrobial Sensitivity Profiling of Wound Infections in a Tertiary Care Hospital of Bangladesh," European Journal of Medical and Health Sciences, vol. 2, no. 5, pp. 101-106, 2020.
11. A. Bandy, F. A. Wani, A. H. Mohammed, U. F. Dar, M. R. Dar, and B. A. Tantry, "Bacteriological profile of wound infections and antimicrobial resistance in selected gram-negative bacteria," African Health Sciences, vol. 22, no. 4, pp. 576-586, 2022.
12. F. A. Alhussain, N. Yenugadhati, F. A. Al Eidan, S. Al Johani, and M. Badri, "Risk factors, antimicrobial susceptibility pattern and patient outcomes of Pseudomonas aeruginosa infection: A matched case-control study," Journal of Infection and Public Health, vol. 14, no. 1, pp. 152-157, 2021.
13. S. A. Hasan, A. M. Najati, and K. S. Abass, "Isolation and identification of multi-drug resistant Pseudomonas aeruginosa from burn wound infection in Kirkuk City, Iraq," EurAsian Journal of BioSciences, vol. 13, no. 2, pp. 1045-1050, 2019.
14. M. Sisay, T. Worku, and D. Edessa, "Microbial epidemiology and antimicrobial resistance patterns of wound infection in Ethiopia: a meta-analysis of laboratory-based cross-sectional studies," BMC Pharmacology and Toxicology, vol. 20, pp. 1-19, 2019.
15. J. Amulioto, M. W. Muturi, S. Mathenge, and G. M. Mutua, "Antibiotic susceptibility patterns of bacteria isolates from post-operative wound infections among patients attending Mama Lucy Kibaki Hospital, Kenya," African Journal of Microbiology Research, vol. 14, no. 8, pp. 420-425, 2020.