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Original Research

Incidence of Pseudomonas aeruginosa in Post-operative Wound Infections and Analysis of its Antimicrobial Sensitivity Profile

Seema Akhtar Kazmi

Associate Professor, Department of Microbiology, Noida International Institute of Medical Sciences, Greater Noida, India

ABSTRACT:

Background:Post-operative wound infection, also known as surgical site infection (SSI), stands as a notable contributor to nosocomial infections in individuals who have undergone surgery. The objective of this prospective study is to assess the prevalence of Pseudomonas aeruginosa within the isolates of post-operative wound infections and to examine their antimicrobial sensitivity profile.**Methods**:The research was conducted in the Microbiology department, where 200 post-operative wound swabs were processed using standard microbiological techniques.**Results**:Out of the 200 wound swabs examined, 93% exhibited growth, while 7% of the samples were sterile. Pseudomonas aeruginosa was the predominant bacterium isolated, accounting for the highest proportion among infected wound swabs (26%). Notably, a higher incidence (61.53%) of P. aeruginosa was observed among male patients and those aged between 60 and 80 years (46.15%).**Conclusion**:Among the 200 analyzed wound swabs, 93% displayed positive growth, contrasting with 7% of samples that were sterile. Pseudomonas aeruginosa emerged as the predominant bacterium, constituting the highest percentage among infected wound swabs (26%). Notably, a heightened prevalence of P. aeruginosa was evident among male patients, with a notable incidence of 61.53%, particularly among individuals aged 60 to 80 years (46.15%).

Keywords:Antibiotic, nosocomial infection, postoperative wound infection, Pseudomonas aeruginosa.

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Corresponding author: Seema Akhtar Kazmi, Associate Professor, Department of Microbiology, Noida International Institute of Medical Sciences, Greater Noida, India

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INTRODUCTION

Post-operative wound infection, often referred to as surgical site infection (SSI), constitutes a significant concern in the realm of healthcare, particularly among patients undergoing surgical procedures.[1] This type of infection can manifest in two primary forms: primary and secondary. Primary infection occurs during the surgical procedure itself and may become apparent within the first week following surgery. It is linked to factors such as the endogenous flora of the patient and environmental sources within the operation theater. The intricate interplay of these elements during the surgical process can lead to the development of infections in the immediate post-operative period.

On the other hand, secondary infection emerges after the surgical intervention, typically within 30 days post-surgery. It can be attributed to sources within the hospital ward or arise due to complications that arise during the recovery period.[2] This form of infection extends beyond the immediate surgical setting and can pose additional challenges in managing patient recovery.Understanding the distinction between primary and secondary post-operative wound infections is crucial for healthcare professionals to implement targeted preventive measures and effective treatment strategies. Timely identification and management of these infections play a pivotal role in ensuring favorable outcomes for patients undergoing surgical procedures.[3]

The development of wound infections represents a complex interplay of factors, where the virulence and invasiveness of microorganisms play a crucial role. However, equally significant are the physiological conditions of the wound tissue and the host's immune response. Understanding that the occurrence of Surgical Site Infections (SSI) is not solely determined by microbial characteristics but also by the overall health status of the patient and the tissue involved is pivotal in addressing and preventing these complications.

SSI imposes a considerable financial burden on both patients and healthcare settings. The increased healthcare costs associated with prolonged treatments, additional medications, and extended hospital stays create challenges for patients, as well as strain healthcare resources. Moreover, the prolonged hospitalization required for managing SSI contributes significantly to the overall morbidity and mortality rates among patients undergoing post-operative care.The impact of SSI extends beyond financial considerations.[4] The prolonged hospital stay can have detrimental effects on the physical and psychological well-being of patients. It may lead to complications, compromise the effectiveness of the recovery process, and elevate the risk of secondary infections. Addressing SSI is not only a matter of clinical concern but also has broader implications for the overall quality of healthcare delivery and patient outcomes.Even in healthcare settings equipped with advanced facilities and stringent protocols for pre-operative preparation and antibiotic prophylaxis, the persistence of SSI highlights the need for continuous improvement. Ongoing research, innovation, and the adaptation of evolving best practices are essential to mitigate the challenges posed by post-operative complications, ultimately enhancing the overall success of surgical interventions and ensuring the well-being of patients.

The identification of common pathogenic bacteria in Surgical Site Infections (SSI) is crucial for understanding and managing post-operative complications.[5] Among the frequently isolated culprits are Staphylococcus spp, Streptococcus spp, Enterococcus spp, Escherichia coli, Klebsiella spp, Enterobacter spp, Citrobacter spp, Proteus spp, Pseudomonas spp, Acinetobacter spp, Burkholderiaspp, and various others. However, an alarming trend has emerged, particularly in developing nations, with the escalating incidence of Pseudomonas aeruginosa (P. aeruginosa) in SSI cases.P. aeruginosa poses a substantial threat due to its capacity to cause life-threatening infections, compounded by its intrinsic resistance to many commonly prescribed antibiotics. This resilience makes infections caused by P. aeruginosa challenging to treat, underscoring the need for a comprehensive understanding of its prevalence and antimicrobial sensitivity profile. As a response to this growing concern, our present study is designed to investigate the prevalence of P. aeruginosa among isolates from post-operative wound infections within our hospital setting.[6]Furthermore, the study seeks to explore the antimicrobial sensitivity profile of P. aeruginosa. Unraveling the resistance patterns of this bacterium is pivotal for tailoring effective treatment strategies and ensuring the judicious use of available antibiotics. By elucidating the prevalence and resistance mechanisms of P. aeruginosa in post-operative wounds, our research aims to provide valuable insights that can inform evidence-based clinical practices, facilitate the development of targeted therapeutic approaches, and contribute to the global efforts in combating antibiotic resistance.

MATERIALS AND METHODS

The prospective study conducted within the Department of Microbiology was meticulously executed, focusing on the analysis of clinical specimens in the form of post-operative wound swabs. Throughout the investigative period, a systematic and detailed approach was employed to unravel the microbial composition of these specimens.Upon receipt, the post-operative wound swabs underwent aerobic processing. To delve into the microscopic details, Gram and Zeihl Nelsen staining techniques were meticulously applied. Simultaneously, the samples were cultured on a range of media, encompassing blood agar, MacConkey agar, and nutrient agar. These diverse media plates were carefully incubated under aerobic conditions at a temperature of 37°C for a duration of 16-18 hours, fostering an environment conducive to bacterial growth.

Following the incubation period, the isolated bacteria underwent a two-fold identification process. Standard biochemical techniques were initially employed, offering foundational insights into the biochemical characteristics of the bacterial strains. Subsequently, automated techniques were harnessed to enhance the precision and efficiency of bacterial identification, ensuring a comprehensive understanding of the microbial profile present in the post-operative wound samples.Antimicrobial Susceptibility Testing (AST) served as a pivotal component of the study. The Mueller Hinton agar, acting as the substrate for the Kirby Bauer's disc diffusion method, provided the platform for assessing the susceptibility of the isolated pathogens to various antibiotics. Pseudomonas aeruginosa, isolated from patients' surgical sites, was uniformly inoculated onto the agar. Filter paper discs, saturated with specific concentrations of antibiotics, were strategically positioned on the medium.Following an incubation period, the resulting "zone of inhibition" surrounding each antibiotic-impregnated disc was meticulously observed and measured. This critical observation facilitated the determination of the susceptibility of the isolated pathogen to each tested antibiotic, providing essential data to guide tailored antimicrobial treatment strategies.The intricate and thorough process of microbiological analysis and susceptibility testing outlined in this study not only contributes to the scientific understanding of post-operative wound infections but also offers practical insights for clinicians in formulating effective and targeted treatment protocols in the realm of clinical healthcare.

The study encompassed a comprehensive evaluation of antibiotic susceptibility for isolated pathogens, utilizing a diverse range of antibiotics. The antibiotics tested included familiar choices such as Amikacin, Gentamicin, and Tobramycin, along with others like Ampicillin, Piperacillin, and Ticarcillin. Fluoroquinolones such as Levofloxacin, Ciprofloxacin, and Norfloxacin were also part of the panel, along with cephalosporins like Ceftazidime, Cefepime, and Cefoxitin. The combination antibiotic Piperacillin-tazobactam was assessed, and carbapenems such as Imipenem, Doripenem, and Meropenem were included. Notably, Colistin, a last-resort antibiotic for multidrug-resistant infections, underwent evaluation using the Epsilon-test to determine the minimum inhibitory concentration value. This extensive antibiotic panel provides a thorough understanding of the antimicrobial sensitivity profile of the isolated pathogens, offering valuable insights for clinicians in tailoring effective treatment strategies, particularly in the context of post-operative wound infections where antibiotic resistance poses significant challenges.

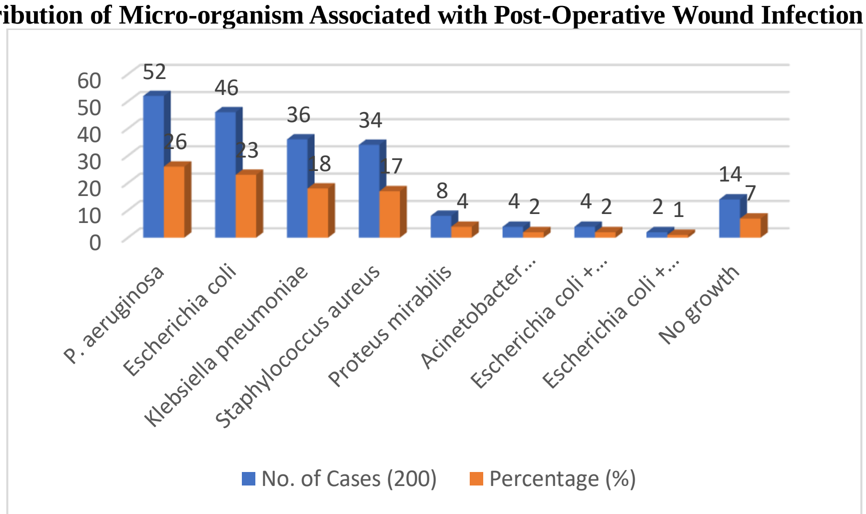
RESULTS

In this comprehensive investigation, a total of 200 wound swabs were meticulously collected from post-operative patients who were admitted in the surgery, orthopaedics, and obstetrics &gynecology departments. The findings of this study shed light on the microbial landscape and prevalence of post-operative wound infections within these clinical domains.A noteworthy 93% of the obtained specimens exhibited microbial growth, signifying a substantial incidence of post-operative wound infections among the examined patient population. In contrast, 7% of the samples were sterile, suggesting a smaller proportion of cases where no microbial presence was detected. The detailed breakdown of identified pathogens revealed Pseudomonas aeruginosa as the predominant culprit, constituting 26% of the samples. Escherichia coli closely followed, being present in 23% of the specimens, while Klebsiella pneumonia, Staphylococcus aureus, Proteus mirabilis, and Acinetobacter baumannii were identified in 18%, 17%, 4%, and 2% of the samples, respectively.
Furthermore, a noteworthy observation was the detection of mixed infections in 3% of the samples, emphasizing the complexity of post-operative wound infections and the potential coexistence of multiple pathogens in certain cases. The data derived from this study provides a comprehensive understanding of the microbial composition associated with post-operative wound infections in diverse clinical departments. Such insights are crucial for developing targeted and effective interventions, including antibiotic strategies and infection control measures, to enhance patient care and reduce the burden of post-operative complications.

Table 1: Distribution of Micro-organism Associated with Post-Operative Wound Infection

Microorganism	No. of Cases (200)	Percentage (%)
P. aeruginosa	52	26
Escherichia coli	46	23
Klebsiella pneumoniae	36	18
Staphylococcus aureus	34	17
Proteus mirabilis	8	4
Acinetobacter baumannii	4	2
Escherichia coli + Proetus mirabilis	4	2
Escherichia coli + Klebsiella pneumoniae	2	1
No growth	14	7

Figure 1: Distribution of Micro-organism Associated with Post-Operative Wound Infection



The study revealed that Pseudomonas aeruginosa stood out as the predominant pathogen, being isolated in the highest number of infected wound swabs, accounting for 26% of the cases under investigation. Notably, a higher incidence of P. aeruginosa was observed among male patients, with a substantial percentage of 61.53%. This gender-specific prevalence underscores the potential influence of biological and contextual factors on the susceptibility to P. aeruginosa infections in the post-operative setting.The elevated occurrence of P. aeruginosa, particularly among male patients, suggests a need for further exploration into the underlying factors contributing to this gender-based variation. It could involve considerations such as differences in immune response, anatomical factors, or other demographic and lifestyle elements that may play a role in the susceptibility to this specific pathogen. Understanding these nuances is vital for tailoring effective preventive measures and targeted treatment strategies to address the unique characteristics of post-operative wound infections in different patient populations.

Table 2: Sex wise distribution of P.aeruginosa isolates

Gender	Number of *P.aeruginosa*isolates (26)	Percentage(%)	p-value
Male	32	61.53	0.000215
Female	20	38.46	

Figure 2: Sex wise distribution of P.aeruginosa isolates

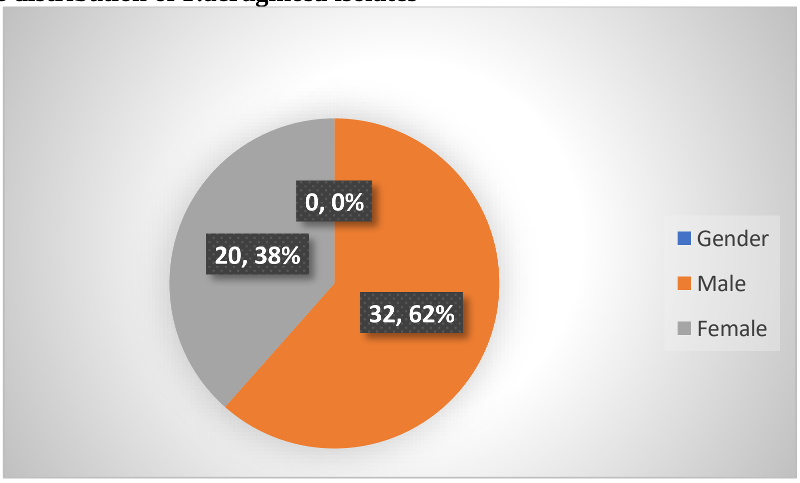
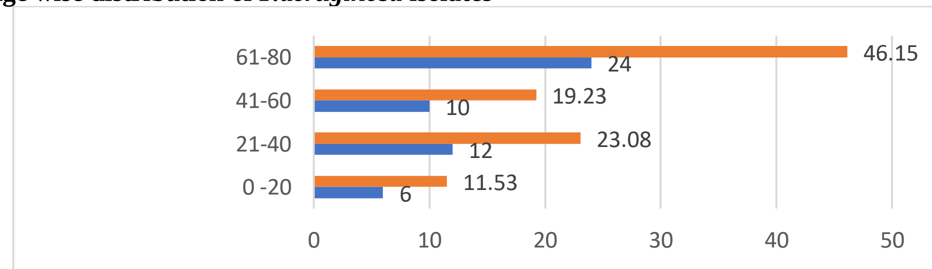


Figure 3: Age wise distribution of *P.aeruginosa* isolates



	0 -20	21-40	41-60	61-80
Percentage(%)	11.53	23.08	19.23	46.15
Number of P.aeruginosa isolates(26)	6	12	10	24

DISCUSSION

The central objective of our study was to delve into the prevalence of Pseudomonas aeruginosa in post-operative wound infections and to comprehensively elucidate its susceptibility pattern to commonly employed antibiotics. Our findings revealed that in 93% of the samples, there was the discernible presence of aerobic bacteria, aligning closely with the outcomes of prior research. For instance, a study led by Ranjan et al reported a 91% culture-positive rate in wound swabs, thereby reinforcing the consistency in the occurrence of aerobic bacterial growth across various research scenarios.[7] Another investigation by Agrawal et al documented a slightly lower culture-positive rate of 77.22%, highlighting the variability in microbial colonization rates in post-operative wounds.Pseudomonas aeruginosa took center stage in our study, emerging as the most prevalent bacterial pathogen, constituting 26% of the cases. This prevalence was not isolated to our study alone; it resonated with parallel investigations conducted by Ranjan et al (29.6%), More et al (27.8%), and Masaadeh& Jaran (27.7%). These congruent findings emphasize the noteworthy role of P. aeruginosa in post-operative wound infections, transcending geographical and clinical diversities. Nevertheless, comparisons with the studies of Oguntibegri and Nwobu (33.3%) and Anupurba& colleagues (32%) unveiled variations in isolation rates, underscoring the complex epidemiological nature of P. aeruginosa infections in different healthcare settings.

Our study underscores the significant impact of P. aeruginosa on wound-related morbidity and mortality on a global scale.[8] The virulence factors exhibited by this bacterium play a pivotal role in the colonization and infection of host tissues, designating it as a clinically significant pathogen among non-fermenters. These results not only affirm the persistent relevance of P. aeruginosa in post-operative wound infections but also underscore the urgency of ongoing research endeavors to unravel the intricate dynamics of P. aeruginosa infections. Such insights are pivotal for tailoring targeted therapeutic interventions and formulating effective antibiotic strategies to mitigate the far-reaching consequences of post-operative wound infections in diverse clinical contexts.In the course of our present study, a noteworthy gender-related trend emerged, revealing a higher occurrence of Pseudomonas aeruginosa in male patients compared to their female counterparts. This aligns with findings reported in studies by Ranjan et al., Agrawal et al., and Stephan et al., indicating a consistent observation of gender-based disparities in the prevalence of P. aeruginosa infections. However, it is intriguing to note that Oguntibegri and Nwobu reported a higher prevalence of P. aeruginosa among female patients in their study, highlighting the complexity and potential variability in gender distribution across different research contexts.Delving further into the age distribution, our study unveiled that the highest number of P. aeruginosa isolates was identified among patients in the age group of 60 to 80 years.[9] This contrasts with the age-related prevalence reported by Ranjan et al., where the maximum isolates were found in the age group of 20 to 40 years. Conversely, Oguntibegri and Nwobu reported a higher number of P. aeruginosa isolates among both the young (0-29 years) and elderly subjects. These variations underscore the multifaceted nature of P. aeruginosa epidemiology, suggesting that differences in age-related prevalence may be influenced by factors such as immunological status, underlying illnesses, and the unique demographic composition of the study cohorts.The diverse outcomes observed across different studies emphasize the necessity for a nuanced understanding of the factors contributing to P. aeruginosa prevalence based on age and gender. Immunological variations, the presence of comorbidities, and other contextual elements likely play a role in shaping the observed differences. Recognizing these demographic and clinical nuances is crucial for tailoring targeted preventive measures and treatment strategies. Such an approach takes into account the diverse characteristics of patient populations, thereby enhancing our ability to effectively manage and mitigate the impact of P. aeruginosa infections in various healthcare settings.

In our current investigation, the isolation rate of Pseudomonas aeruginosa was notably highest among patients who underwent abscess drainage, followed by those with diabetic foot conditions and those who underwent caesarean sections.[10] This pattern aligns closely with findings reported in studies conducted by Ranjan et al. and Anupurba et al., indicating a consistent association between specific surgical procedures and the increased likelihood of P. aeruginosa colonization and subsequent infection. This trend may be attributed to the prolonged hospital stay typically associated with these surgical interventions, creating an environment conducive to microbial colonization and subsequent infection.

The heightened isolation rate in patients undergoing abscess drainage suggests a potential vulnerability associated with this procedure, possibly due to the nature of the wounds and the increased risk of exposure to environmental pathogens during the drainage process.[11] Similarly, diabetic foot surgeries and caesarean sections involve unique clinical contexts, and the susceptibility to P. aeruginosa infections in these cases may be influenced by factors such as compromised immune status, altered wound healing, and the presence of pre-existing conditions.The observed similarities with findings from previous studies underscore the reproducibility of these trends across different research contexts. The prolonged hospital stay following surgeries, regardless of the specific procedure, appears to be a common factor contributing to the increased isolation of P. aeruginosa. Recognizing these associations is pivotal for clinicians and healthcare practitioners in implementing targeted preventive measures, enhancing infection control strategies, and optimizing patient care to mitigate the risk of P. aeruginosa infections in post-operative settings.

The overall high frequency of Pseudomonas aeruginosa occurrence observed in this study is indicative of a broader issue in healthcare practices.[12] This phenomenon is often linked to the widespread and indiscriminate use of antibiotics without adequate reliance on thorough culture and antibiotic sensitivity testing. The overuse or misuse of antibiotics can disrupt the normal microbial flora, creating an environment conducive to the colonization and unchecked growth of P. aeruginosa. This bacterium's intrinsic nature of resistance to antimicrobial agents, coupled with its remarkable nutritional versatility, further contributes to its ability to persist and thrive in compromised environments.In addition to antibiotic-related factors, the substandard hygienic practices of personnel involved in wound dressing and general patient care also play a significant role in the high rates of P. aeruginosa infection.[13] Inadequate hygiene measures may facilitate the transfer and spread of this opportunistic pathogen, increasing the risk of infections, particularly in vulnerable post-operative patients.Moreover, the prolonged hospital stay following surgical procedures, as observed in this study, emerges as a critical contributing factor to the establishment of Pseudomonas infections. Extended hospitalization provides an extended window for potential exposure to nosocomial pathogens, and the compromised immune state of patients during the post-operative period can further elevate susceptibility to infections.Addressing these multifaceted contributors to P. aeruginosa infections involves implementing more prudent antibiotic prescribing practices, emphasizing stringent hygiene protocols among healthcare personnel, and adopting infection control measures to curtail the spread of opportunistic pathogens.[14] Recognizing the role of prolonged hospital stays in infection risk highlights the importance of developing strategies to minimize the duration of hospitalization where possible, ultimately working towards reducing the incidence of P. aeruginosa infections in post-operative settings.

CONCLUSION

Post-operative wound infections present a substantial burden, impacting not only the affected patients but also straining healthcare services in terms of increased morbidity, mortality, and economic costs. The findings observed in the present study, particularly the common occurrence of Pseudomonas infection, underscore the significance of this issue, especially in healthcare settings where hygienic measures may be less stringent. Moreover, the prevalence of Pseudomonas infection is demonstrated to be influenced by factors such as age, gender, and the duration of hospital stay, indicating the multifaceted nature of this problem.The implications of post-operative infections extend beyond individual patient outcomes to broader public health concerns. Pseudomonas infections, often associated with compromised hygiene practices, highlight the importance of maintaining rigorous infection control measures in healthcare settings. The observed dependence on age, sex, and hospital stay duration further emphasizes the need for tailored preventive strategies considering the diverse patient demographics and characteristics.In conclusion, addressing the challenges posed by post-operative wound infections, particularly those involving Pseudomonas aeruginosa, requires a comprehensive and dynamic approach. This involves not only treating individual cases but also adopting proactive measures such as surveillance, antibiotic policy formulation, and stringent infection control practices. By doing so, healthcare facilities can contribute significantly to reducing the incidence of post-operative infections, enhancing patient outcomes, and mitigating the broader societal and economic impact of these infections.

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