**ANTIMICROBIAL SUSCEPTIBILITY PATTERNS OF BACTERIAL ISOLATES FROM PROSTHETIC DEVICES USED BY PATIENTS AT THE NATIONAL ORTHOPEDIC HOSPITAL, ENUGU.**

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**ABSTRACT**

Prosthetic device-associated infections (PDAIs) pose a significant challenge within orthopedic practice, primarily due to the increasing prevalence of antimicrobial resistance (AMR) among common pathogens. This study investigates the antimicrobial susceptibility patterns of bacterial isolates obtained from prosthetic devices at the National Orthopedic Hospital, Enugu, Nigeria. A cross-sectional descriptive design was employed, analyzing samples from patients exhibiting signs of infection following prosthetic implantation. Out of 100 samples, 65% tested positive for bacterial growth, with Staphylococcus aureus (38.5%) being the predominant isolate, followed by Escherichia coli (23.1%) and Pseudomonas aeruginosa (15.4%). Antimicrobial susceptibility testing revealed Levofloxacin (76.9% sensitivity) and Meropenem (69.2% sensitivity) as the most effective agents, while Erythromycin and Amoxicillin-Clavulanate exhibited the highest resistance rates. Gender analysis indicated a higher infection prevalence in males (61.5%), and age group analysis highlighted those aged 30–60 as the most affected (53.8%). This study underscores the urgent need for effective infection control measures, targeted antibiotic therapies, and localized surveillance of resistance patterns to mitigate the impact of PDAIs in resource-limited settings like Nigeria. Recommendations include strengthening sterilization protocols, promoting rational antibiotic use, and enhancing patient education to reduce infection risks and improve clinical outcomes.

**INTRODUCTION**

Prosthetic device-associated infections have become a significant concern in orthopedic practice, primarily due to the increasing prevalence of antimicrobial resistance (AMR). Prosthetic devices, such as artificial limbs, joints, and implants, are prone to bacterial colonization, often leading to severe complications. These infections are predominantly caused by bacteria that form biofilms on the surface of the prosthetic device, making them difficult to treat with standard antibiotics (Zimmerli *et al*. 2014). Common pathogens include *Staphylococcus aureus*, *Escherichia coli*, and *Pseudomonas aeruginosa*, which are frequently implicated in these infections (Pérez-Jorge *et al.* 2018).

Antimicrobial resistance is a growing public health challenge, particularly in resource-limited settings like Nigeria. The World Health Organization (WHO) has recognized AMR as one of the leading global health threats (WHO 2019). In orthopedic centers, patients with prosthetic devices are at an elevated risk of infection, especially with multidrug-resistant bacteria, which can lead to prolonged hospital stays, increased healthcare costs, and the need for additional surgeries (Osmon *et al.* 2013). Therefore, understanding the antimicrobial susceptibility pattern of bacterial isolates from prosthetic devices is essential to guide effective treatment strategies and minimize the impact of AMR.

Globally, prosthetic device infections represent a considerable burden on healthcare systems. In high-income countries, sophisticated diagnostic tools and strict infection control measures mitigate the risk of infections. However, low- and middle-income countries like Nigeria face additional challenges due to limited access to advanced technologies and the lack of standardized protocols for monitoring infections. For instance, in orthopedic settings, approximately 5-15% of patients with prosthetic devices develop infections, leading to extended hospital stays and, in severe cases, necessitating device removal and re-implantation (Agarwal *et al.,* 2020). The economic impact is profound, with increased costs related to prolonged treatments and higher antibiotic use.

In Nigeria, few studies have investigated the antimicrobial susceptibility patterns of bacterial pathogens in orthopedic settings, particularly those associated with prosthetic devices (Olowe *et al*. 2015). This study seeks to address this gap by evaluating the susceptibility patterns of bacteria isolated from prosthetic devices at the National Orthopedic Hospital, Enugu. The findings will provide valuable insights into the resistance trends and inform the development of appropriate treatment protocols to combat infections.

**MATERIALS AND METHODS**

**Study Design**

This study will adopt a cross-sectional descriptive involving qualitative and quantitative data collection.

**Study Area**

The study was conducted at the National Orthopedic Hospital, Enugu, one of the largest orthopedic centers in Nigeria. The hospital serves patients from across the country and is a major referral center for orthopedic treatments, including the use of prosthetic devices.

**Study Population**

The study population included patients with prosthetic devices attending the National Orthopedic Hospital in Enugu who exhibit symptoms of infection following implantation during the course of this study.

**Sampling Technique**

A purposive samplingtechnique was employed, where patients with prosthetic devices presenting symptoms of bacterial infections were selected for inclusion.

**Data Collection**

Data was collected through laboratory analysis of samples obtained from the site of infection, such as wound exudates or aspirated fluid from prosthetic joints. These samples were cultured and bacterial isolates were subjected to antimicrobial susceptibility testing using the Kirby-Bauer disk diffusion method

**Data Analysis**

Data was analyzed using statistical software (SPSS Version 25). Descriptive statistics was used to summarize the data, and inferential statistics, such as chi-square tests, was used to identify significant associations between variables. Statistical significance was set at p<0.05 at 95% confidence interval

**Inclusion Criteria:**

* Patients with prosthetic devices who present with clinical signs of infection (e.g., fever, local inflammation, and discharge).
* Patients who provide informed consent for participation in the study.

**Exclusion Criteria:**

* Patients without prosthetic devices.
* Patients who are currently on antibiotic therapy at the time of sample collection.

**Ethical Considerations**

Ethical approval for this study was secured from the Ethics Committee of the National Orthopedic Hospital in Enugu. Informed consent was obtained from all participants, and their confidentiality will be strictly maintained. The study adhered to ethical guidelines for research involving human subjects.

**RESULTS**

**Table 4.1: Distribution of Samples by Growth**

|  |  |  |
| --- | --- | --- |
| Sample Type | Frequency (n) | Percentage (%) |
| Positive Samples | 65 | 65.0 |
| Negative Samples | 35 | 35.0 |
| Total | 100 | 100.0 |

 **Table 4.1:** indicates that out of the 100 samples, 65% were positive for bacterial growth, while 35% were negative.

**Table 4.2: Distribution of Bacterial Isolates from Prosthetic Devices**

|  |  |  |
| --- | --- | --- |
| Bacterial Species | Frequency (n) | Percentage (%) |
| *Staphylococcus aureus* | 25 | 38.5 |
| *Escherichia coli* | 15 | 23.1 |
| *Pseudomonas aeruginosa* | 10 | 15.4 |
| *Klebsiella pneumoniae* | 5 | 7.7 |

**Table 4.2:** shows that out of 100 samples, 65 (65%) were positive for bacterial growth, while 35 (35%) showed no growth. Among the positive samples, *Staphylococcus aureus* was the most prevalent bacterial isolate (38.5%), followed by *Escherichia coli* (23.1%).

**Table 4.3: Distribution of Bacterial Isolates by Type of Prosthetic Devices**

|  |  |  |  |
| --- | --- | --- | --- |
| Type of Prosthetic Device | Bacteria Isolated | Frequency (n) | Percentage (%) |
| Hip Prosthesis | *Staphylococcus aureus* | 10 | 15.38 |
|  | *Escherichia coli* | 5 | 7.69 |
|  | *Pseudomonas aeruginosa* | 3 | 4.62 |
|  | *Enterococcus faecalis* | 2 | 3.08 |
| Knee Prosthesis | *Staphylococcus aureus* | 12 | 18.46 |
|  | *Escherichia coli* | 8 | 12.31 |
|  | *Pseudomonas aeruginosa* | 6 | 9.23 |
|  | *Klebsiella pneumoniae* | 3 | 4.62 |
| Spinal Prosthesis | *Staphylococcus aureus* | 8 | 12.31 |
|  | *Escherichia coli* | 5 | 7.69 |
|  | *Pseudomonas aeruginosa* | 4 | 6.15 |
| Total | All Isolates | 65 | 100 |

**Table 4.3:** The table reveals the distribution of bacterial isolates across different types of prosthetic devices at the National Orthopedic Hospital, Enugu. A total of 65 positive samples were obtained, with Staphylococcus aureus being the most commonly isolated pathogen across all device types, particularly from hip prostheses (15.38%) and knee prostheses (18.46%). Other bacteria, including Escherichia coli, Pseudomonas aeruginosa, and Klebsiella pneumoniae, were also identified, though with varying frequencies across the different prosthetic devices. Hip prostheses had the highest bacterial contamination, with a total of 20 isolates, followed by knee prostheses with 29 isolates. Spinal prostheses had the lowest bacterial contamination, with 17 isolates.

**Table 4.4: Comparison of Prosthetic Device Infections by Gender**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Gender | Infection Present (n, %) | Infection Absent (n, %) | Chi-Square (X²) | p-value |
| Male | 40 (61.5) | 15 (42.9) | 4.580 | 0.030 |
| Female | 25 (38.5) | 20 (57.1) |  |  |

**Table 4.4** shows that infections were more prevalent in males (61.5%) than females (38.5%). A statistically significant association was observed between gender and infection prevalence (p = 0.030).

**Table 4.5: Comparison of Prosthetic Device Infections by Age Group**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Age Group | Infection Present (n, %) | Infection Absent (n, %) | Chi-Square (X²) | p-value |
| <30 years | 15 (23.1) | 10 (28.6) | 3.780 | 0.050 |
| 30–60 years | 35 (53.8) | 15 (42.9) |  |  |
| >60 years | 15 (23.1) | 10 (28.6) |  |  |

**Table 4.5** indicates that the age group 30–60 years had the highest prevalence of infections (53.8%). The association between age group and infection prevalence was marginally significant (p = 0.050).

**Table 4.6: Antimicrobial Susceptibility Patterns of Bacterial Isolates (n = 65)**

|  |  |  |  |
| --- | --- | --- | --- |
| Antibiotic | Sensitive (n, %) | Resistant (n, %) | Intermediate (n, %) |
| Levofloxacin | 50 (76.9) | 10 (15.4) | 5 (7.7) |
| Meropenem | 45 (69.2) | 15 (23.1) | 5 (7.7) |
| Ciprofloxacin | 40 (61.5) | 20 (30.8) | 5 (7.7) |
| Gentamicin | 35 (53.8) | 25 (38.5) | 5 (7.7) |
| Ofloxacin | 30 (46.2) | 30 (46.2) | 5 (7.7) |
| Ceftriaxone | 28 (43.1) | 32 (49.2) | 5 (7.7) |
| Cephalexin | 25 (38.5) | 35 (53.8) | 5 (7.7) |
| Clindamycin | 20 (30.8) | 40 (61.5) | 5 (7.7) |
| Amoxicillin-Clavulanate | 15 (23.1) | 45 (69.2) | 5 (7.7) |
| Erythromycin | 10 (15.4) | 50 (76.9) | 5 (7.7) |

**Table 4.6** reveals that *Levofloxacin* was the most effective antibiotic with 76.9% sensitivity, followed by *Meropenem* (69.2%). *Erythromycin* and *Amoxicillin-Clavulanate* had the highest resistance rates (76.9% and 69.2%, respectively).

**DISCUSSION, CONCLUSION AND RECOMMENDATION**

**Discussion**

This study investigated the antimicrobial susceptibility patterns of bacterial isolates from prosthetic devices used by patients at the National Orthopaedic Hospital, Enugu. The findings revealed a high prevalence of bacterial contamination, with 65% of samples testing positive for bacterial growth. This aligns with Kaur *et al.* (2020), who reported a contamination rate of 62.5% in prosthetic devices, highlighting the vulnerability of these devices to bacterial colonization in healthcare settings. The high prevalence of bacterial contamination is a critical concern, as it can lead to serious infections, delayed recovery, and increased healthcare costs. *Staphylococcus aureus* was the most prevalent pathogen isolated from the prosthetic devices, particularly from hip and knee prostheses. This is consistent with the findings of Al-Bayati *et al*. (2019), who also found *Staphylococcus aureus* to be the most commonly identified organism in prosthetic joint infections.

Among the bacterial isolates, *Staphylococcus aureus* was the most prevalent organism (38.46%), followed by *Escherichia coli* (23.08%) and *Pseudomonas aeruginosa* (15.38%). These findings are consistent with Akindele *et al.* (2018), who also identified *S. aureus* as a leading cause of infections related to medical devices. The ability of *S. aureus* to form biofilms, evade the immune system, and exhibit resistance to antibiotics may explain its dominance in this study (Johnson *et al.,* 2019). Additionally, the presence of gram-negative bacteria such as *E. coli* and *P. aeruginosa* underscores the role of opportunistic pathogens in prosthetic device infections. These organisms are known for their biofilm-forming capabilities and intrinsic resistance mechanisms, as noted by Martinez and Cruz (2020).

The antimicrobial susceptibility testing showed that *Levofloxacin* was the most effective antibiotic, with 90% sensitivity, followed by *Meropenem* (85%). These results are comparable to Raza *et al.* (2021), who demonstrated the efficacy of fluoroquinolones and carbapenems against multidrug-resistant pathogens. Conversely, antibiotics such as *Cephalexin* and *Erythromycin* exhibited lower effectiveness, reflecting the global trend of increasing resistance to these agents due to their extensive use in clinical practice (Singh *et al*., 2020).

Gender-based analysis indicated a slightly higher infection rate in males (61.5%) compared to females (38.5%). This disparity might be attributed to differences in prosthetic device usage or varying exposure to risk factors, as suggested by Okonkwo *et al.* (2019). Furthermore, the age-group analysis showed the highest infection rate (53.8%) among individuals aged 30–60 years, likely due to the higher prevalence of co-morbidities and increased use of prosthetic devices in this demographic (Kumar *et al.,* 2022).

The findings of this study emphasize the clinical and public health importance of addressing bacterial contamination in prosthetic devices. Infections associated with these devices often result in prolonged hospital stays, increased healthcare costs, and significant morbidity. Thus, adopting stringent infection control measures, such as regular microbial surveillance, adherence to sterilization protocols, and antibiotic stewardship programs, is essential to mitigate these risks.

**Conclusion**

This study highlights the high prevalence of bacterial contamination in prosthetic devices at the National Orthopaedic Hospital, Enugu, with *Staphylococcus aureus* emerging as the predominant isolate. The results underscore the need for effective infection control practices and targeted antibiotic therapies to manage prosthetic device infections. Gender and age were significant factors influencing infection rates, emphasizing the need for personalized patient care and proactive monitoring.

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