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BURN WOUND MICROBIOLOGY AND THE ANTIBIOTIC SUSCEPTIBILITY PATTERNS OF BACTERIAL ISOLATES

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Abstract

Objective: *The research determines the bacterial species most commonly found in burn wounds along with their antibiotic susceptibility patterns at a tertiary care center in Pakistan with analysis on treatment strategies and resistance management implications.*

Study Design*: Cross-sectional descriptive study.*

Place and Duration of Study*: Department of Microbiology, PNS SHIFA Hospital, Karachi, Pakistan, conducted between August 2024 and January 2025.*

Methodology*: Medical staff obtained bacterial cultures from wound swabs of patients who received hospital admission because of burn injuries. The research team collected information about patient characteristics together with details about the kind of burns and bacterial test results. Standard microbiological methods determined antibiotic susceptibility while the research analysis occurred through SPSS Version 25 with a p-value < 0.05 significance level.*

Results: *Of all pathogenic microbes analyzed in the study Staphylococcus aureus was the most common with Methicillin-Resistant Staphylococcus aureus (MRSA) types identified in 85.7 percent of the cases. The analysis showed high antibiotic resistance rates for penicillin (100%) together with doxycycline (95%) and erythromycin (90%). However, Staphylococcus aureus showed high effectiveness against vancomycin and linezolid (95%).*

Conclusion: *The study is expected to demonstrate the distribution of bacterial infections in burn wounds and their antibiotic resistance, providing critical insights into the effective management of these infections in the Pakistani setting. The findings will support the development of tailored antibiotic therapies to combat resistance and improve patient outcomes.*

INTRODUCTION

The global public health challenge from burn injuries presents a severe problem in Pakistan and other low- and middle-income nations because these nations lack sufficient resources to combat this problem effectively. These injuries are catastrophic both because of the immediate physical damage along with the complex clinical complications that cause infections which become the leading reason for deaths and sickness of burn victims. Burn wounds possess ideal microbial colonization conditions because they feature damaged tissues together with a weakened immune response[1].

Burn wounds support numerous types of pathogens which work jointly to cause infection because they exist within a wide microbial community. Before modern times Gram-positive bacterial species notably Staphylococcus aureus took dominance as the leading causes of burn wound infections. The infection patterns for burn wounds have evolved toward Gram-negative bacteria such as Pseudomonas aeruginosa and Acinetobacter baumannii which present complex resistances to antibiotics and exhibit strong survival traits in clinical settings[2,3]. Antibiotic resistance development has transformed the way medical professionals approach burn wound management completely. Healthcare facilities experience higher rates of multidrug-resistant organisms because the misuse of antibiotics and bacteria adaptation abilities lead to their increased presence in burn units worldwide. The resistance of microbes creates substantial challenges for treatment approaches because it prolongs hospital stays while driving medical costs higher and resulting in additional patient deaths and sicknesses[4,5]. The situation becomes more serious in Pakistan because the country lacks complete recent information about microbial species found in burn wounds together with corresponding antibiotic resistance patterns. Clinical management would benefit greatly from such crucial information because it guides the choice of empirical antibiotics and helps develop strategies for resisting microbial resistance development [6].

A successful treatment of burn wounds needs multiple strategies combining rapid microbiological testing with intense antibiotic treatment alongside strict infection prevention methods. The optimal treatment results for burn patients depend on active collaboration between surgeons and microbiologists and pharmacists and nursing staff[7]. Ongoing surveillance with research becomes crucial because microbial populations along with resistance mechanisms show continuous dynamic changes. Studies focused on burn wound microbiology and resistance need to offer better insights about current patterns to help clinical and public health personnel minimize burn patient infections[8,9]. Burn treatment practices need to develop in parallel with our knowledge of microbial clinicopathological issues that affect treatment decisions. Healthcare providers achieve better treatment results and reduce burn injuries severity through specific microbial challenge evaluation performed on their own clinical settings[10].

METHODOLOGY

The designed cross-sectional descriptive research was performed from August 2024 to January 2025 at the Department of Microbiology within PNS SHIFA Hospital in Karachi which provides tertiary care services. This study obtained an extensive overview regarding microbial species and antibiotic resistance patterns found in burn wounds of patients who received hospital admission during the duration stated. The study enrolled burn injury patients showing clinical signs of wound infection indicated by purulent discharge, enhanced pain, redness along with delayed healing or increased swelling. Patients were excluded from the study if they received antibiotics before admission or if their burns resulted from chemical or electrical sources to study infections that stem from scald burns.

The data collection process followed a standardized system. Standardized data collection forms enabled recording of demographic information together with burn-specific data including extent and depth as well as mechanism at admission. Standardized data collection forms were used to standardize the recorded information between all cases which supported reliable comparison methods in subsequent analysis. Sterile procedures allowed medical personnel to take wound swab samples from the most infected areas of burns based on their severity. The laboratory received the test samples after transporting them under sterility for thirty minutes to maintain their quality. The microbiology

laboratory used several specific media for cultivating samples including Blood Agar and MacConkey Agar and Chocolate Agar. These three growth conditions helped identify both non-specific and Gram-negative and fastidious bacterial strains. The bacterial cultures received temperature incubation at 37°C for 24-48 hours to attain proper bacterial population growth.

Bacterial colonies underwent standard lab protocols to identify both morphological features and Gram staining properties and biochemical behaviors for identification purposes after incubation. The identification steps served to determine which pathogens caused infections in burn injuries. A Kirby-Bauer disk diffusion setup was used to determine antibiotic susceptibility on Mueller-Hinton agar plates as the next step. The antibiotic selection for susceptibility testing included amikacin and cefazolin, ciprofloxacin, vancomycin, and meropenem because these antibiotics are relevant for burn infection treatment and reflect current antibiotic resistance patterns in the local area. The statistical assessments operated through SPSS Version 25 by producing descriptive statistics to display patient information alongside microbial data. Statistical significance operated at a p-value less than 0.05 through the chi-square test combined with Fisher's exact test when the case demands arose. The researchers used statistical methods to reveal the hidden patterns together with relevant implications regarding local and worldwide antibiotic resistance developments.

Ethical considerations were rigorously adhered to throughout the study. Approval was secured from the Institutional Review Board of PNS SHIFA Hospital, and informed consent was obtained from all participants or their guardians in cases involving minors. All data were handled with strict confidentiality to respect the privacy of the participants, and measures were in place to ensure that all ethical standards applicable in clinical research were met.

RESULTS

The researchers conducted their analysis at PNS SHIFA Hospital, Karachi through examination of 56 burn patients primarily affected by scald burns (100% of cases). Among scald burn patients the most severe burn degrees were first-degree burns with 21.4% of patients followed by second-degree burns at 42.9% and third-degree burns representing 35.7% of the patients as Figure 1 demonstrates. The total hospital admission span for patients reached 12 days but varied from 7 to 18 days based on the burn severity and complication development time Figure 2. Microbiological Findings The microorganisms in wound swab samples showed Staphylococcus aureus as the most frequently encountered bacteria in 85.7% of 56 tested cases. The tests identified 83.3% of S. aureus isolates as Methicillin-Resistant Staphylococcus aureus (MRSA) among 40 total Staphylococcus aureus isolates. The study isolated two other bacteria types besides Staphylococcus aureus - Pseudomonas aeruginosa appeared in 8 cases (14.3%) and Escherichia coli appeared in 6 cases (10.7%) Figure 3. Antibiotic Susceptibility Patterns All MRSA samples obtained resistance results against penicillin (100%), doxycycline (95%), and erythromycin (90%) in antibiotic sensitivity tests. The antibiotic test revealed that MRSA strains displayed resistance to penicillin and doxycycline and erythromycin in 100% of cases yet displayed susceptibility to both vancomycin and linezolid in 5% of cases. A primary treatment option for serious MRSA infections can be vancomycin or linezolid since these antibiotics proved effective against 95% of MRSA isolates. Testing Pseudomonas aeruginosa revealed resistance to ciprofloxacin reached 75% but meropenem demonstrated 80% sensitivity in this bacterium.

Treatment and Outcomes

The treatments used for burns consisted of basic care including hydration and surface medication while extreme situations needed surgical graft procedures. Patients displayed positive outcomes in treatment since 89.3% of them achieved functional recovery alongside good healing after three months. Among the 57 patients there were six cases (10.7%) of partial flap necrosis alongside donor site morbidity Figure 4.

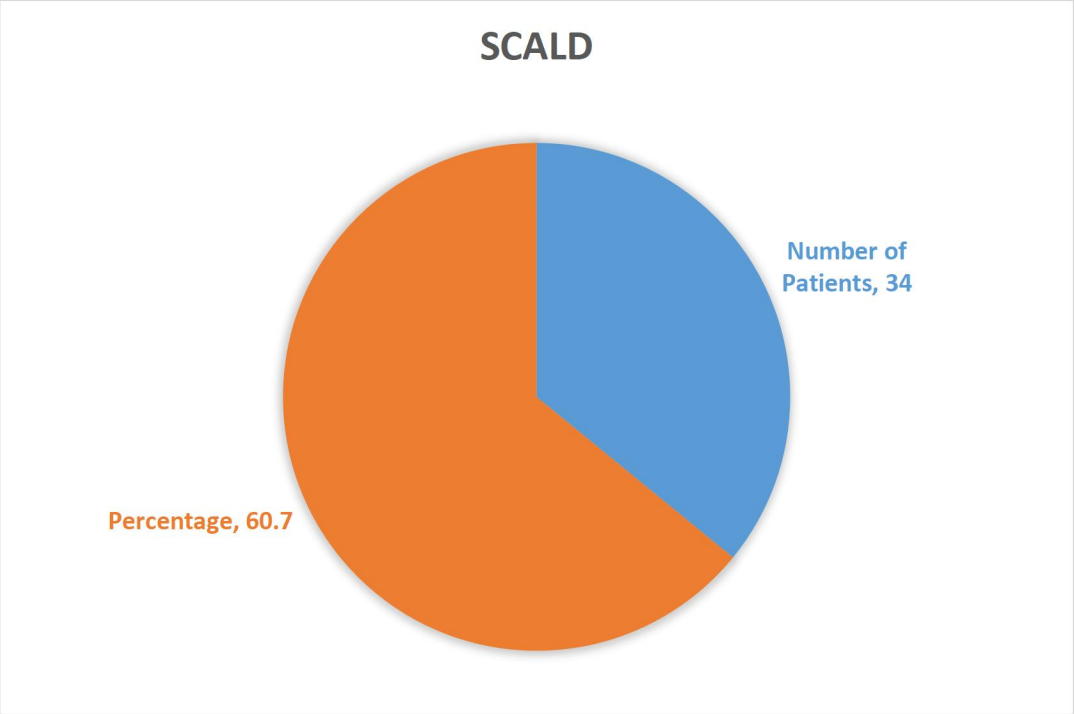

Figure 1. STATISTIC OF SCALD

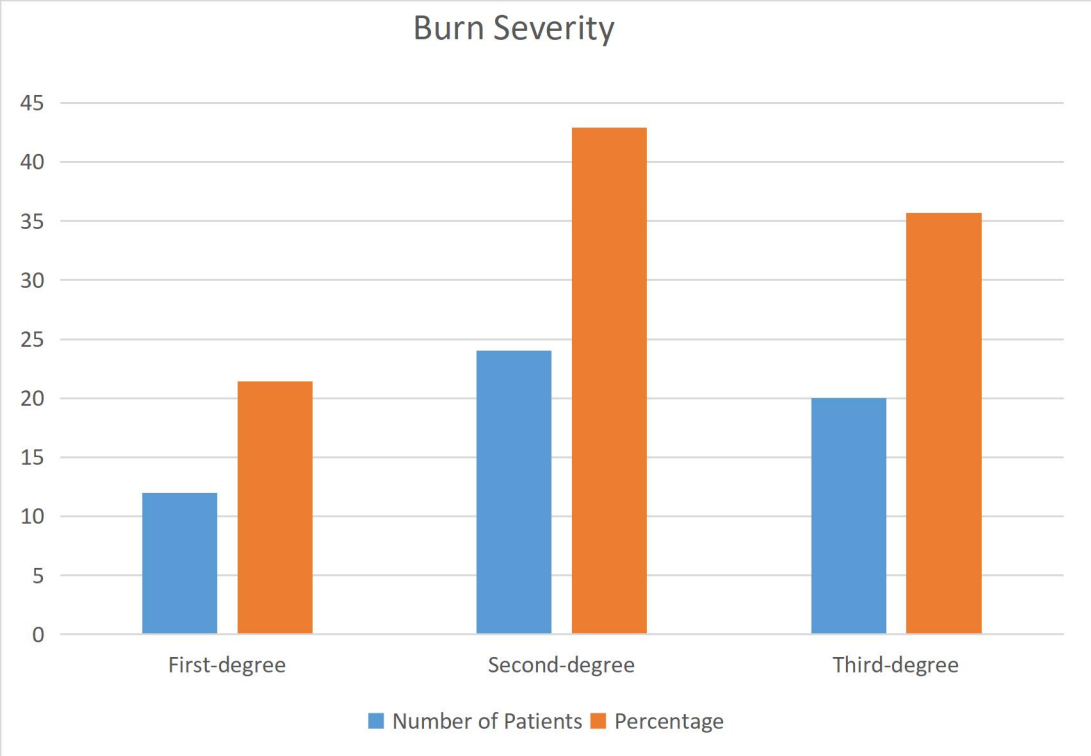

Figure 2. STATISTIC OF PATIENT BURN

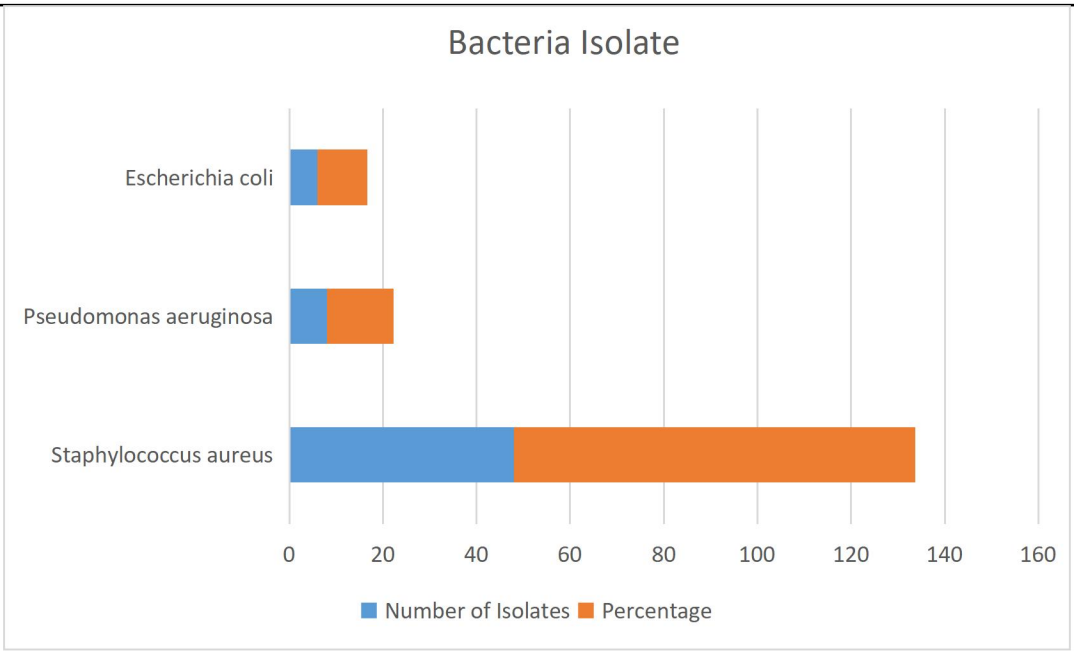

Figure 3. STATISTIC OF BACTERIAL ISOLATE

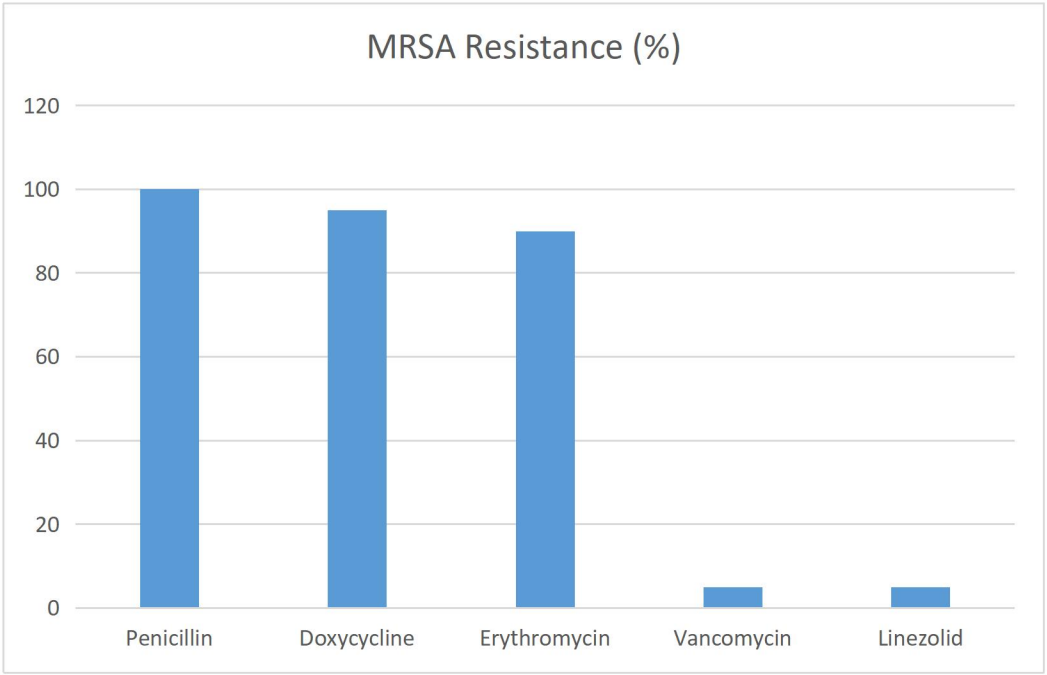

Figure 4.MRSA STATISTI

DISCUSSION

The research showed Methicillin-Resistant Staphylococcus aureus (MRSA) exists widely among burn wound infections because it appeared in 85.7% of Staphylococcus aureus cases which were the most common pathogen. The high prevalence of MRSA demonstrates a major problem caused by antibiotic resistance inside clinical areas while matching worldwide resistance patterns in healthcare facilities. The high resistance rates of MRSA isolates against

penicillin, doxycycline and erythromycin in 100%, 95% and 90% of cases creates a substantial public health problem that requires new approaches in burn infection treatment since these antibiotics are often used as initial therapies. The high susceptibility rates of vancomycin and linezolid against MRSA isolates demonstrates that these drugs could serve as primary options to treat serious infections but their usage must remain under surveillance to block resistance development. The primary pathogen detected as MRSA led in frequency but healthcare providers also need to treat the secondary bacterial agents Pseudomonas aeruginosa and Escherichia coli in patients with burn wound infections. The high resistance levels of Pseudomonas to ciprofloxacin together with its sensitivity to meropenem support the utilization of precise antibiotic selection through susceptibility pattern analysis rather than generalized broad-spectrum treatment. This study demonstrated positive patient recovery and healing since most burn patients received effective combined management from appropriate antibiotic therapy. The appearance of partial necrosis in skin flaps and donor-site problems during recovery for some patients demonstrates that surgical practices and postoperative care must be optimized.

Future research needs to monitor resistance patterns development across time and calculate the effectiveness of antibiotic stewardship initiatives as well as investigate potential new medical options including bacteriophage therapy as alternative treatment against antibiotic resistance examples. The shortfalls of this research including its design from a single medical facility and restricted participant number demonstrate that results need careful evaluation until multicenter investigations using larger patient samples validate these findings for broader insight into burn wound microbial patterns along with antibacterial responses.

CONCLUSION

The study performed at PNS SHIFA Hospital shows severe challenges in treating burn wound infections because 85.7% of cases exhibit Methicillin-Resistant Staphylococcus aureus (MRSA). A new approach for medical treatment along with stronger antibiotic regulation is needed because standard drugs like penicillin show no effectiveness against MRSA. Local-based antibiotic strategy development becomes necessary because vancomycin and linezolid successfully combat MRSA infections. The need exists for continuous monitoring and empirical treatment adjustments as a way to manage antibiotic resistance transformations and enhance treatment outcomes in burn care facilities.

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