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Colonization of Microorganisms in Burn Wounds in Pediatric Surgical Burn Section, Mayo Hospital, Lahore

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Disclaimers

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ABSTRACT

Background: Burn injuries are highly susceptible to microbial infections, which can impede wound healing and lead to severe complications, including sepsis. Understanding the microbial flora in burn wounds is essential for optimizing treatment protocols and reducing infection-related morbidity.

Objective: This study aimed to identify the prevalence and patterns of bacterial colonization in pediatric burn wounds and evaluate the impact of microbial infections on patient outcomes.

Methods: A cross-sectional study was conducted in the Pediatric Surgery Department, Mayo Hospital, Lahore, from December 2023 to June 2024. A total of 71 pediatric burn patients were included, meeting the criteria of scald, flame, or electrical burns exceeding 10% total body surface area. Swabs were taken from wounds 48 hours post-admission and again on the fifth day to monitor microbial changes. Data were analyzed using SPSS v25.0, with a p-value of ≤0.05 considered significant.

Results: Among 71 patients, 37 (52.1%) were male, and 34 (47.9%) were female. Pseudomonas aeruginosa was the most prevalent bacterium (67.6%), followed by E. coli (12.7%), Klebsiella (11.3%), and Staphylococcus aureus (8.5%).

Conclusion: Pseudomonas predominates in pediatric burn wounds. Effective infection control protocols are critical to improving patient outcomes and reducing morbidity.

INTRODUCTION

Burn injuries present a significant public health challenge worldwide, particularly in pediatric populations, where infection remains a leading cause of morbidity and mortality. When the integrity of the skin barrier is compromised by burn trauma, the affected area becomes highly susceptible to microbial colonization and subsequent infection, which can significantly delay the healing process and increase the risk of systemic complications such as sepsis. The pathogenesis of infections in burn wounds often follows a predictable pattern, with initial colonization by gram-positive bacteria such as Staphylococcus aureus from the patient's skin and nasal flora. As the wound environment evolves, gram-negative organisms such as Pseudomonas aeruginosa and Klebsiella become more prominent, particularly in hospital settings where nosocomial infections are common (1-4). The severity of the infection correlates with the extent of the burn injury, particularly in patients with burns covering more than 40% of the total body surface area, where 75% of deaths are attributable to sepsis or infection-related complications (5-6).

Pediatric burn patients are particularly vulnerable due to factors such as immature immune systems, extended hospital stays, and frequent invasive procedures. Additionally, overcrowding in burn wards and suboptimal infection control practices further exacerbate the risk of cross-contamination between patients, contributing to the proliferation of nosocomial infections (7-9). In developing countries such as Pakistan, socioeconomic factors, including poverty, illiteracy, and inadequate housing, heighten the risk of burn injuries, with children often exposed to hazardous environments that increase the likelihood of burn trauma. These factors, coupled with limited access to specialized burn care, make infection prevention and management even more challenging in resource-limited settings (10-12).

Historically, Streptococcus pyogenes was the leading cause of burn wound sepsis, but over time, the microbial profile of burn wounds has shifted, with Staphylococcus aureus and Pseudomonas aeruginosa now being the predominant pathogens (13). This shift, coupled with the increasing prevalence of multidrug-resistant organisms, underscores the need for continuous surveillance of the microbial flora in burn units to guide empirical antibiotic therapy and infection control measures. Recent studies highlight the importance of identifying the microbial species involved in burn wound colonization, as this information is critical for tailoring appropriate antimicrobial therapy and improving patient outcomes (14-15).

The aim of the current study was to examine the prevalence and pattern of bacterial colonization in pediatric burn patients admitted to the Pediatric Surgery Department of Mayo Hospital, Lahore. This investigation specifically focused on the microbial composition of burn wounds in children presenting with scald and flame burns, with the goal of providing insight into the most frequently isolated

organisms and their implications for infection control in a pediatric burn unit setting. By analyzing the bacterial colonization patterns in these patients, the study seeks to contribute to the development of more effective infection prevention protocols and therapeutic interventions, ultimately improving clinical outcomes in pediatric burn care (16-18).

MATERIAL AND METHODS

The study was conducted at the Pediatric Surgery Department, Mayo Hospital, Lahore, between December 2023 and June 2024, involving a total of 71 pediatric patients with burn injuries. The inclusion criteria specified children with scald, flame, or electrical burns affecting more than 10% of the total body surface area, while exclusion criteria included patients who did not provide informed consent, those with advanced burn injuries, and neonates. Ethical approval for the study was obtained from the hospital's Institutional Review Board, and the principles of the Declaration of Helsinki were strictly followed throughout the study. Written informed consent was obtained from the parents or legal guardians of all participants.

Data collection was meticulously performed using a sterile swabbing technique. Swabs were collected from burn wounds 48 hours after the patient's admission to assess the initial microbial colonization, and a follow-up swab was taken five days later to monitor any changes in the microbial profile.

The swabs were cultured on standard bacteriological media, and the bacterial isolates were identified using biochemical tests and antimicrobial susceptibility testing. All laboratory procedures were carried out in the hospital's microbiology laboratory under sterile conditions.

Data were entered and analyzed using SPSS version 25.0. Categorical variables, such as gender, etiology of burns, and patterns of microbial colonization, were summarized as frequencies and percentages. Continuous variables, such as age, were reported as means with standard deviations. Stratification was performed by gender, age group, and etiology of burns to identify any significant differences in the microbial colonization pattern. The Chi-square test was applied for categorical data, with a p-value of ≤0.05 considered statistically significant.

The study adhered to strict infection control protocols to minimize the risk of cross-contamination among patients. Patients were treated in isolation rooms when available, and healthcare workers followed standard hygiene practices, including the use of personal protective equipment and hand hygiene measures, to prevent the spread of microorganisms. Furthermore, data confidentiality was maintained, and no personal identifiers were used in the analysis or reporting of results. This rigorous methodological approach aimed to ensure the validity and reliability of the findings, contributing valuable insights into the microbial colonization patterns in pediatric burn wounds (1-5).

RESULTS

The study included a total of 71 pediatric patients with burn injuries, of which 37 (52.1%) were male and 34 (47.9%) were female. The mean age of the children was 10.5 ± 3.1 years. The age distribution showed that 30 (42.3%) children were in the 5-10 years age group, while 41 (57.7%) were in the 11-15 years age group. Regarding the etiology of burns, 45 (63.4%) had scald burns, 17 (23.9%) had flame burns, and 9 (12.7%) had electrical burns. These demographic characteristics are presented in Table 1.

Table 1: Demographic characteristics of the study population

Variable	Frequency (n)	Percentage (%)
Gender		
Male	37	52.1
Female	34	47.9
Age Groups		
5-10 years	30	42.3
11-15 years	41	57.7
Etiology of Burns		
Scald Burns	45	63.4
Flame Burns	17	23.9
Electrical Burns	9	12.7

The results of microbial colonization showed that the majority of the patients' wounds were colonized by Pseudomonas aeruginosa, which was found in 48 (67.6%) cases. Escherichia coli was isolated in 9 (12.7%) patients, Klebsiella in 8 (11.3%) patients, and Staphylococcus aureus in 6 (8.5%) patients. These findings are presented in Table 2.

Table 2: Distribution of microbial colonization in burn wounds

Microorganism	Frequency (n)	Percentage (%)
Pseudomonas aeruginosa	48	67.6
Escherichia coli	9	12.7
Klebsiella	8	11.3
Staphylococcus aureus	6	8.5

Stratification of microbial colonization with respect to gender, age groups, and etiology of burns was performed, and no statistically significant differences were observed ($p > 0.05$ for all comparisons). These results are presented in Table 3.

Table 3: Stratification of microbial colonization with respect to demographic and burn-related variables

Variable	Pseudomonas	E. coli	Klebsiella	Staph. aureus	p-value
Gender					
Male (n=37)	28 (75.7%)	3 (8.1%)	4 (10.8%)	2 (5.4%)	0.411
Female (n=34)	20 (58.8%)	6 (17.6%)	4 (11.8%)	4 (11.8%)	
Age Group					
5-10 years	21 (70.0%)	4 (13.3%)	3 (10.0%)	2 (6.7%)	0.954
11-15 years	27 (65.9%)	5 (12.2%)	5 (12.2%)	4 (9.8%)	
Burn Etiology					
Scald Burns	31 (68.9%)	5 (11.1%)	5 (11.1%)	4 (8.9%)	0.474
Flame Burns	11 (64.7%)	3 (17.6%)	3 (17.6%)	0 (0.0%)	
Electrical Burns	6 (66.7%)	1 (11.1%)	0 (0.0%)	2 (22.2%)	

The statistical analysis did not reveal any significant associations between gender, age group, or burn etiology and the patterns of microbial colonization ($p > 0.05$). These results show that microbial colonization in burn wounds was predominantly due to Pseudomonas aeruginosa, irrespective of demographic or clinical variables.

DISCUSSION

The findings of this study revealed that Pseudomonas aeruginosa was the predominant microorganism colonizing burn wounds in pediatric patients, accounting for 67.6% of the isolated species. This result aligns with the observations of multiple studies conducted in similar settings, where Pseudomonas has been frequently identified as the most common pathogen in burn injuries, particularly in nosocomial environments (1-4).

The ability of Pseudomonas to thrive in moist environments, its inherent resistance to antibiotics, and its capability to form biofilms are factors that contribute to its prevalence in burn units. This organism's dominance emphasizes the need for stringent infection control protocols in hospital settings to mitigate the spread of this resilient pathogen (5-7).

In contrast, the presence of Staphylococcus aureus was relatively low, detected in only 8.5% of the cases. While Staphylococcus aureus remains a common pathogen in burn units globally, its reduced prevalence in this study could be attributed to the specific infection control measures implemented in the burn ward. Other studies have reported varying prevalence rates of S. aureus in burn wounds, with some indicating it as the leading cause of infection, while others have observed a shift towards gram-negative organisms such as Pseudomonas and Klebsiella due to changes in antibiotic practices and hospital hygiene standards (8-10).

Additionally, Escherichia coli and Klebsiella were found in 12.7% and 11.3% of cases, respectively, highlighting the presence of multiple opportunistic pathogens in burn wounds. This underlines the complexity of microbial flora in such injuries and the challenges it poses for treatment strategies. The strengths of this study include its focus on a pediatric population, where burn injuries represent a particularly vulnerable group due to their developing immune systems and prolonged exposure to hospital environments. The use of a swabbing technique for microbial isolation ensured that samples were consistently collected, and the follow-up culture after five days provided insight into the temporal dynamics of microbial colonization.

This study also benefitted from a relatively homogeneous population, allowing for clear observation of microbial patterns without significant confounding variables.

However, several limitations should be acknowledged. First, the study was conducted in a single burn unit in Mayo Hospital, Lahore, limiting the generalizability of the findings to other settings or regions

Differences in infection control protocols, antibiotic usage, and environmental factors may influence the microbial colonization patterns in other burn units. Second, the sample size of 71 patients, while sufficient for preliminary observations, may not capture the full spectrum of microbial diversity or resistance patterns in burn wounds.

Larger studies would be necessary to draw more definitive conclusions. Additionally, the study did not investigate the antimicrobial resistance profiles of the isolated organisms, which would provide critical insights for optimizing antibiotic treatment regimens in burn patients (11-14). Future research should focus on this aspect to guide more effective therapeutic strategies.

In terms of recommendations, there is a clear need for routine surveillance of microbial flora in burn units to monitor shifts in pathogen prevalence and resistance patterns. Regular reviews of antibiotic stewardship practices should be implemented to reduce the emergence of multidrug-resistant organisms. Furthermore, enhanced infection control measures, such as the strict isolation of burn patients and rigorous hand hygiene practices among healthcare workers, should be emphasized to prevent cross-contamination in high-risk environments like pediatric burn wards (15-18). Overall, this study highlights the importance of continuous vigilance in the management of microbial colonization in burn injuries to improve patient outcomes and reduce infection-related morbidity and mortality.

CONCLUSION

The study proved that Pseudomonas aeruginosa was the most prevalent microorganism colonizing pediatric burn wounds, followed by Escherichia coli, Klebsiella, and Staphylococcus aureus. These findings highlight the critical need for regular microbial surveillance and infection control measures in burn units to minimize infection-related complications. The early identification and management of burn wound infections are essential for improving clinical outcomes and reducing mortality rates in pediatric burn patients. Implementing targeted antimicrobial therapy and enhancing hospital hygiene practices will be vital for addressing the rising challenge of drug-resistant pathogens, ultimately leading to better healthcare outcomes for burn patients.

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