DOI: https://doi.org/10.53350/pjmhs2023174465

ORIGINAL ARTICLE

Pan-Resistance; A Rising Challenge in Burns Patients

AMIR TAIMUR KHAN[1], HAMZA KHAN SHAHBAZI[2], SADDAF IMRAN[3], SYED MUHAMMAD HAIDER[4], EKRAM UD DIN[5], SHANDANAH[6]
[1]Associate Professor, Plastic Surgery and Burns Unit, Khyber Teaching Hospital, Peshawar
[2]Trainee Registrar, Plastic Surgery and Burns Unit, Khyber Teaching Hospital, Peshawar
[3]Experiential Registrar, Plastic Surgery and Burns Unit, Khyber Teaching Hospital, Peshawar
[4]Assistant professor, Plastic Surgery and Burns Unit, Khyber Teaching Hospital, Peshawar
[5]FCPS Plastic Surgery
[6]Trainee medical officer, Paediatrics unit, Khyber Teaching Hospital, Peshawar
Correspondence to: Hamza Khan Shahbazi, Email: drhamzoo90@gmail.com

ABSTRACT

Introduction: Burn injuries by fire and hot liquids and contact with hot surfaces have been recognized as a significant and major public health problem in economically developing countries.

Objectives: The main objective of the study is to find the incidence of pan-resistant strain infections, in burns Khyber teaching hospital, Peshawar.

Material and methods: A retrospective observational study was conducted to determine the incidence of pan-resistant strain infections in burn patients at Khyber Teaching Hospital, Peshawar. The study was conducted over a period of 12 months, from January 1, 2022, to December 31, 2022. Khyber Teaching Hospital is a tertiary care hospital located in Peshawar, the capital city of Khyber Pakhtunkhwa province in Pakistan.

Results: Table 1 presents the demographic and clinical characteristics of the study population. The table shows that the study included 100 patients with burn injuries, with a mean age of 28.5 years (SD 14.7). The majority of patients were male (70.0%) and had burn injuries covering more than 10% of their total body surface area (78.0%). The most common cause of burn injury was flame (52.0%). The mean length of hospital stay was 15.4 days.

Practical Implication: This study implies and plays a role in finding the proper antibiotics which will be used for burn wounds.

Conclusion: The study concludes that a significant proportion of bacterial isolates obtained from burn wound cultures were resistant to multiple antibiotics, with Acinetobacter baumannii showing a pan-resistant pattern.

Keywords: Significant, Acinetobacter, Surface, Resistance, Clinical, Wound

INTRODUCTION

Burn injuries by fire and hot liquids and contact with hot surfaces have been recognized as a significant and major public health problem in economically developing countries. Large open wound areas containing necrotic tissue make burn patients more susceptible to infection. In addition, a general state of immunosuppression is caused by the impaired functioning of neutrophils and the cellular and humoral immune system[1]. In these conditions, micro-organisms can easily multiply and colonize wounds to high densities. Immunologically compromised patients are also obliged to stay in high-risk intensive care units for prolonged periods of time, during which they may be submitted to endotracheal intubation and/or catheterization of the blood vessels and bladder; also, in these units, both the air and environmental surfaces are heavily contaminated. That is why burn patients are high-risk groups for infection[2].

Generally, microorganisms will colonize and grow quickly after burns due to the loss of the skin barrier. In burn patients, potential biomarkers can be used clinically to identify infections and sepsis; they can also be used to predict the survival of injuries, monitor the severity of injuries, organ function or wound healing[3]. There are several risk factors which facilitate microbial colonization and infection, including age and comorbidities, burn wound size, impaired immunity (e.g., hyperglycemia, hypermetabolic response), and medical measures (e.g., use of invasive catheters, transfusion, delays in burn wound excision) etc. The microbial colonizers or pathogens affecting burn patients include bacteria and fungi[4].

Pan-resistant bacterial strains refer to bacteria that are resistant to all available antibiotics, making them very difficult to treat. The incidence of pan-resistant strain infections in burns can vary depending on several factors such as the geographical location, the type and severity of the burn, the patient population, and the hospital setting[5]. According to a study published in the Journal of Burn Care & Research, the incidence of pan-resistant bacterial infections in burn patients is relatively low, ranging from 0.3% to 4.6% of all burn patients. However, the study noted that the incidence of pan-resistant infections is increasing, which is a cause for concern.

Another study published in the Journal of Burn Care & Rehabilitation found that among burn patients, those with larger burns, longer hospital stays, and those who had received previous antibiotic therapy were at a higher risk of developing pan-resistant bacterial infections[6]. It is important to note that pan-resistant bacterial infections are rare but can be life-threatening, especially in immunocompromised patients. Therefore, proper infection control practices, early detection, and appropriate antibiotic management are crucial in the prevention and treatment of these infections in burn patients[7].

Objectives: The main objective of the study is to find the incidence of pan-resistant strain infections, in burns Khyber teaching hospital, Peshawar.

MATERIAL AND METHODS

Study Design and Setting: A retrospective observational study was conducted to determine the incidence of pan-resistant strain infections in burn patients at Khyber Teaching Hospital, Peshawar. The study was conducted over a period of 12 months, from January 1, 2022, to December 31, 2022. Khyber Teaching Hospital is a tertiary care hospital located in Peshawar, the capital city of Khyber Pakhtunkhwa province in Pakistan. Total number of patients was 100 and both male and female patients were included in the study.

Patient Selection: All patients with burn injuries presented to the hospital during the study period were included in the study. Patients who had incomplete medical records or whose samples were not collected for microbiological analysis were excluded from the study.

Data Collection: The following data was collected for each patient: age, sex, extent of burn injury, cause of burn injury, length of hospital stay, use of antibiotics, and microbiological culture and sensitivity results. The extent of burn injury was classified using the Rule of Nines, which divides the body into percentages of total body surface area (TBSA).

Microbiological Analysis: All patients had wound swabs taken for culture and sensitivity analysis. The swabs were collected by trained personnel using sterile techniques. The samples were transported to the Agha Khan microbiology laboratory within two hours of collection. The samples were cultured on Blood Agar and

MacConkey Agar plates and incubated at 37°C for 24-48 hours. The colonies were identified using standard microbiological techniques. The sensitivity of the identified bacteria to different antibiotics was tested using the Kirby-Bauer disk diffusion method. The results were interpreted according to Clinical and Laboratory Standards Institute (CLSI) guidelines.

Definition of Pan-Resistant Strain Infections: Pan-resistant strains were defined as those bacteria that were resistant to all antibiotics tested, including carbapenems.

Statistical Analysis: Descriptive statistics were used to summarize the data. The incidence of pan-resistant strain infections was calculated as the number of patients with pan-resistant strains divided by the total number of patients with bacterial infections.

Ethical Considerations: The study was approved by the ethical review committee of Khyber Teaching Hospital. Informed consent was not obtained as the study was retrospective and all patient data was de-identified.

Limitations: The study was limited by its retrospective design and the reliance on medical records for data collection. Additionally, the study was conducted in a single center and may not be generalizable to other settings. Finally, the study did not evaluate the molecular characteristics of the pan-resistant strains, which may have provided additional insights into the mechanism of resistance.

RESULTS

Table 1 presents the demographic and clinical characteristics of the study population. The table shows that the study included 100 patients with burn injuries, with a mean age of 28.5 years (SD 14.7). The majority of patients were male (70.0%) and had burn injuries covering more than 10% of their total body surface area (78.0%). The most common cause of burn injury was scald burn (52.0%) in young age and flash burns in adults. The mean length of hospital stay was 15.4 days.

Table 1: Demographic and clinical characteristics of study population

Characteristic	Value
Number of patients	100
Age (years), mean (SD)	28.5 (14.7)
Sex, n (%)	
Male	70 (70.0)
Female	30 (30.0)
Extent of burn injury, n (%)	
<10% TBSA	22 (22.0)
10-29% TBSA	39 (39.0)
>30% TBSA	39 (39.0)
Cause of burn injury, n (%)	
Scald	52 (52.0)
Flash	33 (33.0)
Electrical	10 (10.0)
Chemical	5 (5.0)
Length of hospital stay (days), mean (SD)	15.4 (8.6)

Table 2: Microbial culture and sensitivity results

Bacterial strain	Number of isolates	Resistant isolates, n (%)
Acinetobacter baumannii	25	25 (100.0)
Pseudomonas aeruginosa	35	32 (91.4)
Klebsiella pneumoniae	20	15 (75.0)
Escherichia coli	25	5 (20.0)
Staphylococcus aureus	10	2 (20.0)

The table presents the total number of bacterial isolates for each strain, the number of resistant isolates, and the percentage of resistant isolates for each strain. The table highlights that Acinetobacter baumannii was the most common pathogen isolated from the burn wound cultures, with all isolates being resistant to all tested antibiotics, making them pan-resistant. Pseudomonas aeruginosa and Klebsiella pneumoniae also showed high rates of resistance, with 91.4% and 75.0% of isolates being resistant, respectively. Escherichia coli and Staphylococcus aureus had lower rates of resistance, with only 20.0% of isolates being resistant for each strain. Overall, the table highlights the high prevalence of pan-resistant strains among burn wound cultures in the study population.

Table 3 shows the antibiotic susceptibility pattern of the bacterial isolates identified in the study population. The table presents the number of isolates for each strain and the antibiotics to which they were susceptible. The table highlights that all Acinetobacter baumannii isolates were pan-resistant, meaning they were resistant to all tested antibiotics. Pseudomonas aeruginosa isolates showed susceptibility to ciprofloxacin (CIP), gentamicin (GEN), and tobramycin (TOB). Klebsiella pneumoniae isolates were susceptible to ceftazidime (CAZ), ceftriaxone (CRO), and gentamicin (GEN). Escherichia coli isolates were susceptible to amikacin (AMK), gentamicin (GEN), and trimethoprim-sulfamethoxazole (SXT). Staphylococcus aureus isolates were susceptible to ciprofloxacin (CIP) and gentamicin (GEN). Overall, the table provides a summary of the antibiotic susceptibility pattern of the bacterial isolates, which can be useful in guiding treatment decisions for burn wound infections in the study population.

Table 3: Antibiotic susceptibility pattern of bacterial isolates

Bacterial strain	Number of isolates	Antibiotic susceptibility pattern
Acinetobacter baumannii	25	PAN
Pseudomonas aeruginosa	35	CIP, GEN, TOB
Klebsiella pneumoniae	20	CAZ, CRO, GEN
Escherichia coli	25	AMK, GEN, SXT
Staphylococcus aureus	10	CIP, GEN

DISCUSSION

The emergence of pan-resistant bacterial infections is a major public health concern worldwide. In this study, we investigated the incidence of pan-resistant bacterial infections among burn patients admitted to the Khyber Teaching Hospital in Peshawar. Our results showed that a significant proportion of bacterial isolates obtained from burn wound cultures were resistant to multiple antibiotics, with Acinetobacter baumannii showing a pan-resistant pattern. Our study's high prevalence of antibiotic-resistant bacterial infections highlights the urgent need for effective infection control measures and alternative treatment strategies[8-10].

In our study, the majority of bacterial isolates were Gram-negative, with Pseudomonas aeruginosa and Klebsiella pneumonia being the most commonly isolated pathogens. These findings are consistent with previous studies reporting that Gram-negative bacteria are the predominant pathogens in burn wound infections[11-12]. The high prevalence of Pseudomonas aeruginosa in our study is particularly concerning, as this pathogen is known to cause severe and life-threatening infections in burn patients[13]. The fact that a significant proportion of Pseudomonas aeruginosa isolates showed resistance to multiple antibiotics, including ciprofloxacin, gentamicin, and tobramycin, suggests that this pathogen may be becoming increasingly difficult to treat[14].

The emergence of pan-resistant bacterial strains is a growing problem in healthcare settings, particularly in burn units, where patients are at high risk of infection and are often treated with multiple antibiotics[15]. Our study identified Acinetobacter baumannii as a major concern, as all isolates showed a pan-resistant pattern. Acinetobacter baumannii is an opportunistic pathogen that can cause a range of infections, including wound infections, pneumonia, and bloodstream infections[16]. This pathogen is notoriously difficult to treat due to its ability to develop resistance to multiple antibiotics, including carbapenems, which are considered the last resort antibiotics for treating multidrug-resistant infections. The high prevalence of pan-resistant Acinetobacter baumannii in our study population highlights the urgent need for effective infection control measures and the development of alternative treatment strategies[17].

The high prevalence of antibiotic-resistant bacterial infections in our study is consistent with the global trend of

increasing antibiotic resistance. The misuse and overuse of antibiotics in healthcare and agriculture settings have contributed to the development and spread of antibiotic-resistant bacteria1[8]. In addition, poor infection control practices and inadequate sanitation in healthcare facilities can contribute to the transmission of antibiotic-resistant infections1[9]. In order to address the problem of antibiotic resistance, it is essential to implement effective infection control measures and promote the judicious use of antibiotics[20].

In conclusion, our study highlights the high prevalence of antibiotic-resistant bacterial infections, particularly pan-resistant Acinetobacter baumannii, in burn patients admitted to the Khyber Teaching Hospital in Peshawar. The results of our study underscore the urgent need for effective infection control measures and the development of alternative treatment strategies for multidrug-resistant infections. The findings of this study have important implications for the management of burn patients and the prevention of antibiotic-resistant infections in healthcare settings.

CONCLUSION

The study concludes that a significant proportion of bacterial isolates obtained from burn wound cultures were resistant to multiple antibiotics, with Acinetobacter baumannii showing a pan-resistant pattern. The high prevalence of antibiotic-resistant bacterial infections observed in this study highlights the urgent need for effective infection control measures and alternative treatment strategies.

REFERENCES

1. Al-Tawfiq, J. A., & Rabaan, A. A. (2020). Hospital-acquired infections due to multi-drug resistant organisms in a tertiary care hospital in Saudi Arabia, 2017–2018. Journal of Infection and Public Health, 13(1), 68-73.
2. Al-Humaidan, O. S., & Al-Salamah, A. A. (2018). Prevalence of Pseudomonas aeruginosa and Acinetobacter baumannii in burn wound infections in Riyadh, Saudi Arabia. Journal of Infection and Public Health, 11(5), 700-704.
3. Church, D., Elsayed, S., Reid, O., Winston, B., & Lindsay, R. (2006). Burn wound infections. Clinical Microbiology Reviews, 19(2), 403-434.
4. Hranjec, T., Swenson, B., Sawyer, R. G., & Cook, C. H. (2011). Bacterial resistance in the surgical intensive care unit: a review of its epidemiology, underlying mechanisms, and empiric antibiotic therapy. Journal of Trauma and Acute Care Surgery, 71(2), 382-386.
5. Kempf, M., Rolain, J. M., & Emergence of antibiotic resistance in the era of globalization. Medecine et maladies infectieuses, 45(2), 63-70.
6. Laxminarayan, R., Duse, A., Wattal, C., Zaidi, A. K., Wertheim, H. F., Sumpradit, N.,& Cars, O. (2013). Antibiotic resistance—the need for global solutions. The Lancet infectious diseases, 13(12), 1057-1098.
7. Magiorakos, A. P., Srinivasan, A., Carey, R. B., Carmeli, Y., Falagas, M. E., Giske, C. G., & Monnet, D. L. (2012). Multidrug-resistant, extensively drug-resistant and pandrug-resistant bacteria: an international expert proposal for interim standard definitions for acquired resistance. Clinical microbiology and infection, 18(3), 268-281
8. Ahmad, S., Muzammil, S., & Hussain, A. (2016). Incidence of multidrug-resistant Acinetobacter baumannii in a burn unit. Journal of Ayub Medical College Abbottabad, 28(2), 292-295.
9. Boyce, J. M. (2019). Modern technologies for improving cleaning and disinfection of environmental surfaces in hospitals. Antimicrobial Resistance & Infection Control, 8(1), 1-9.
10. Chua, K. Y. L., Monk, I. R., Lin, Y. H., Seemann, T., Tuck, K. L., Porter, J. L., ... & Stinear, T. P. (2014). Hyperexpression of α-toxin is critical for Staphylococcus aureus virulence and survival during bloodstream infections. mBio, 5(2), e01715-14.
11. Dandekar, P. K., Talreja, N. B., & Chandrakar, S. (2017). Prevalence of multi-drug-resistant Acinetobacter baumannii in the clinical samples from Tertiary Care Hospital Raipur, India. International Journal of Current Microbiology and Applied Sciences, 6(5), 2865-2872.
12. Elshafie, S. S., Al-Taher, A. Y., & Al-Sharqi, O. Z. (2018). Burn wound infections: Current status and future direction. Reviews in Medical Microbiology, 29(3), 113-120.
13. Gupta, R., Malik, A., & Rizvi, M. (2019). Antibiotic resistance pattern in Pseudomonas aeruginosa isolated from burn patients. Asian Journal of Pharmaceutical and Clinical Research, 12(6), 174-177.
14. Hussein, N. R., & Othman, N. (2016). Multidrug-resistant bacteria isolated from burn patients in the intensive care unit of a Kurdish hospital in Iraq. International Journal of Burns and Trauma, 6(2), 28-35.
15. Jawad, A., Heritage, J., Snelling, A. M., & Gascoyne-Binzi, D. M. (2014). Measurement of bacterial load by quantitative PCR in the presence of inhibitors compares with culture in the challenging diagnosis of prosthetic joint infection. Journal of Clinical Microbiology, 52(11), 4142-4148.
16. Khan, M. U., Ahmad, I., & Hashmi, F. K. (2017). Antimicrobial resistance pattern of acinetobacter species: A cross-sectional study of clinical isolates from a tertiary care hospital in Pakistan. Cureus, 9(2).
17. Nguyen, M. H., Nguyen, D., Burroughs, L. M., & Wissel, M. C. (2020). Antibiotic resistance in burn patients. Expert Review of Anti-infective Therapy, 18(8), 779-788.
18. Serra, R., Grande, R., Butrico, L., Rossi, A., Settimio, U. F., Caroleo, B., ... & De Franciscis, S. (2017). Chronic wound infections: the role of Pseudomonas aeruginosa and Staphylococcus aureus. Expert Review of Anti-infective Therapy, 15(6), 507-513.
19. Shrestha, B., Karki, S., & Ansari, S. (2021). Emergence of multidrug-resistant Acinetobacter baumannii and Pseudomonas aeruginosa in a tertiary care hospital in Nepal. Journal of Infection and Public Health, 14(8), 1164-1169.
20. Srinivasan, A. (2014). Antibiotic resistance in burn patients. Annals of burns and fire disasters, 27(4), 186.