RESEARCH ARTICLE

Prevalence of micorganisms and antibiotics susceptibility at burn unit of tertiary care hospital in southern Punjab - A Retrospective Study

Iftikhar Alam[1], Abdul Malik Mujahid[2], Hamad Ghafoor[3]

Abstract

Objective: To determine the frequency of micro-organisms and their antibiotic susceptibility in acute burn wounds.

Method: The retrospective, descriptive, cross-sectional study was conducted at the Department of Burn and Plastic Surgery, Allama Iqbal Teaching Hospital/Dera Ghazi Khan Medical College, Dera Ghazi Khan, Pakistan, and comprised data from January 2020 to December 2022 of patients of either gender aged 1-70 years with acute partial and full thickness burns. Those aged 1-14 years were designated as the paediatric group. Surface swab cultures were collected after 72 hours or upon signs of infection, and analysed using standard microbiological techniques. The prevalence of micro-organisms and antibiotic susceptibility was assessed using the disc diffusion method. Data was analysed using SPSS 22.

Results: Of the 450 patients, 167(37.1%) were males and 179(39.8%) were females. The overall mean age was 23.95±11.83 years, and there were 104(23.1%) patients of paediatric age. Pseudomonas aeruginosa was the most common finding 157(34.9%), followed by klebsiella pneumonia 68(15%), methicillin-resistant staphylococcus aureus 68(15%), methicillin-sensitive staphylococcus aureus 45(10%), escherichia coli 23(5.1%), acinetobacter 13(2.9%) and proteus 5(1.1%). Among the pan-drug resistant strains, 67(14.9%) were pseudomonas and 22(4.9%) were klebsiella. Imipenem and linezolid were the most effective antibiotics overall.

Conclusion: The most frequently isolated bacteria in burn wounds were pseudomonas aeruginosa, klebsiella pneumonia and staphylococcus aureus. Linezolid and imipenem were found to be the most effective against these isolates.

Key Words: Burn wound infection, Antibiotic sensitivity, Culture sensitivity

(JPMA 75: 1575; 2025) **DOI: https://doi.org/10.47391/JPMA.11604**

Introduction

Burn wound infection remains a major cause of morbidity and mortality globally[1,2]. Despite considerable improvement in the treatment of burn injuries, infection continues to be a challenge. There is >50% mortality amongst burn patients due to septicaemia. After the initial phase of resuscitation, burn victims suffer various infection-related complications.[3]

For a variety of reasons, like large exposed total body surface area (TBSA), immunosupresive effects of burns, infection related infusion lines, invasive diagnostic and therapeutic procedures and prolonged length of hospital stay (LOS), burn patients are at high risk of infections. Patient factors, such as age, extent/pattern of injury, and depth of burns, coupled with microbial factors, such as number and type, virulance characteristics of organisms (enzyme/toxin production and motility of organisms), are major determinants of invasiveness of infection. Wound contamination by superficial bacteria can easily succumb to intrutive infection in such population. Risk of sepsis is directly related to the degree of bacterial wound infection.[4]

Following colonisation, surface micro-organisms start to invade burn eschar to the extent possible, and the viable tissue below the eschar is invaded. In fact, in the absence of appropriate care, the burn wound is an ideal culture medium for the colonisation and proliferation of all kinds of endogenous and exogenous microbes. The skin that normally serves as a physical barrier against microbes is disrupted, thus making the individual susceptible to microbial invasion. Additionally, the underlying vasculature of the skin is damaged to variable extents, making it difficult for various components of the immune response to reach the affected site. Blood-borne and skin surface wound infections can be life-threatening if not timely diagnosed and treated properly in burn patients. Overcrowding is a major cause of cross-infection in burn centres in developing countries. Monitoring the bacterial flora of these wounds and their antibiotic sensitivity

[1,2]Department of Plastic Surgery, D.G. Khan Medical College, Dera Ghazi Khan, [3]Department of Plastic Surgery, Allama Iqbal Teaching Hospital, Dera Ghazi Khan, Pakistan

Correspondence: Iftikhar Alam. **Email:** alamiftikhar86@yahoo.com

ORCID ID: 0000-0002-4960-1494

Submission complete: 21-06-2024 **First Revision received:** 25-10-2024

Acceptance: 06-08-2025 **Last Revision received:** 05-08-2025

patterns on a regular basis is important so that proper drug therapy is initiated at an appropriate time. Determining the sensitivity of bacteria to antibiotics may help the clinician to rationalise the use of antibiotics.[5]

The current study was planned to determine the frequency of micro-organisms and their antibiotic susceptibility in acute burn wounds.

Materials and Methods

The retrospective, descriptive, cross-sectional study was conducted at the Department of Burn and Plastic Surgery, Allama Iqbal Teaching Hospital/Dera Ghazi Khan Medical College, Dera Ghazi Khan in southern Punjab, Pakistan, and comprised data from January 2020 to December 2022. After approval form the institutional ethics review board, the sample size was calculated using the Cochrane's formula n = z2 p (1- p)/ d2, where n was the required sample size, Z was the level of 95% confidence (1.96), P was 50% proportion (0.5), and d was the margin of error (0.05). The sample was raised using consecutive random sampling technique. Those included were patients of either gender aged 1-70 years with acute partial and full thickness burns. Those aged 1-14 years were designated as the paediatric group. The surface swab culture specimens had been collected using standard collection techniques from burn wounds after 72 hours of burn, or when a patient developed high-grade fever or showed any sign of infection. Patients outside this age range, those with negative culture reports, or having bleeding diathesis and diabetes mellitus were excluded. Written informed consent had been obtained from all the patients.

All the collected samples had been analysed at the institutional pathological laboratory. After inoculation on appropriate culture media, the specimens were incubated for 24 hours at 37°C for obtaining aerobic, anaerobic, fungal and any other growths. The microbes were identified by their colonial morphology and characteristic biochemical tests using standard antibiotic discs.

Antibiotic susceptibility was tested by employing disc diffusion method for culture and sensitivity. Data was collected and outcome measures were noted for frequency pattern of micro-organism and its sensitivity to antibiotics.

Data was analysed using SPSS 22. Data was expressed as frequencies and percentages or as means ± standard deviation as appropriate. Chi-square test was used for comparision. P>0.05 was regarded statistically significant.

Results

Of the 450 patients, 167(37.1%) were males and 179(39.8%) were females (Table 1, Fig 1). The overall mean age was 23.95±11.83 years (range: 2-70 years), and there were 104(23.1%) patients of paediatric age out of these 450 patients. Mean TBSA was 21.53±9.59% (range: 5-40%).

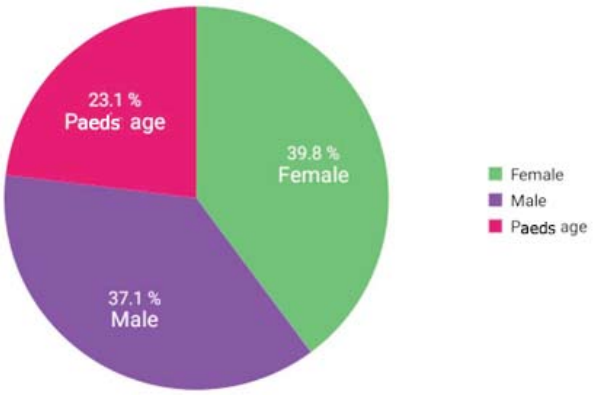

Figure-1: Gender distribution.

Table-1: Gender distribution.

	Men	Women	Paediatric group.
Frequency	167	179	104
percentage	37.1	39.8	23.1

Of the 450 patients, 241 (53.68%) were male and 259 (46.31%) were female (Table 1). The overall mean age was 23.95±11.83 years (range: 2–70 years), and 150 (33.3%) patients belonged to the paediatric age group. The mean total body surface area (TBSA) burned was 21.53±9.59% (range: 5–40%).

The types of initial burn injuries included flame burns in 338 (75.1%) patients, electrical burns in 43 (9.5%), scalds in 58 (12.9%), and acid burns in 11 (2.4%).

There were 379 (84.21%) patients with burn wounds of more than 7 days' duration, while 71 (15.79%) patients had wounds of less than 2 weeks' duration (p=0.001). Out of the 450 isolates obtained, 415 (92.22%) were monomicrobial, while 35 (7.78%) were polymicrobial. Pseudomonas (P.) aeruginosa was the most common finding 157(34.9%), followed by klebsiella (K.) pneumonia 68(15%), methicillin-resistant staphylococcus aureus (MRSA) 68(15%), methicillin-sensitive staphylococcus aureus (MSSA) 45(10%), escherichia (E.) coli 23(5.1%), acinetobacter 13(2.9%) and proteus 5(1.1%).Among the pan-drug resistant (PDR) strains, 67(14.9%) were pseudomonas and 22(4.9%) were klebsiella (Table 2).

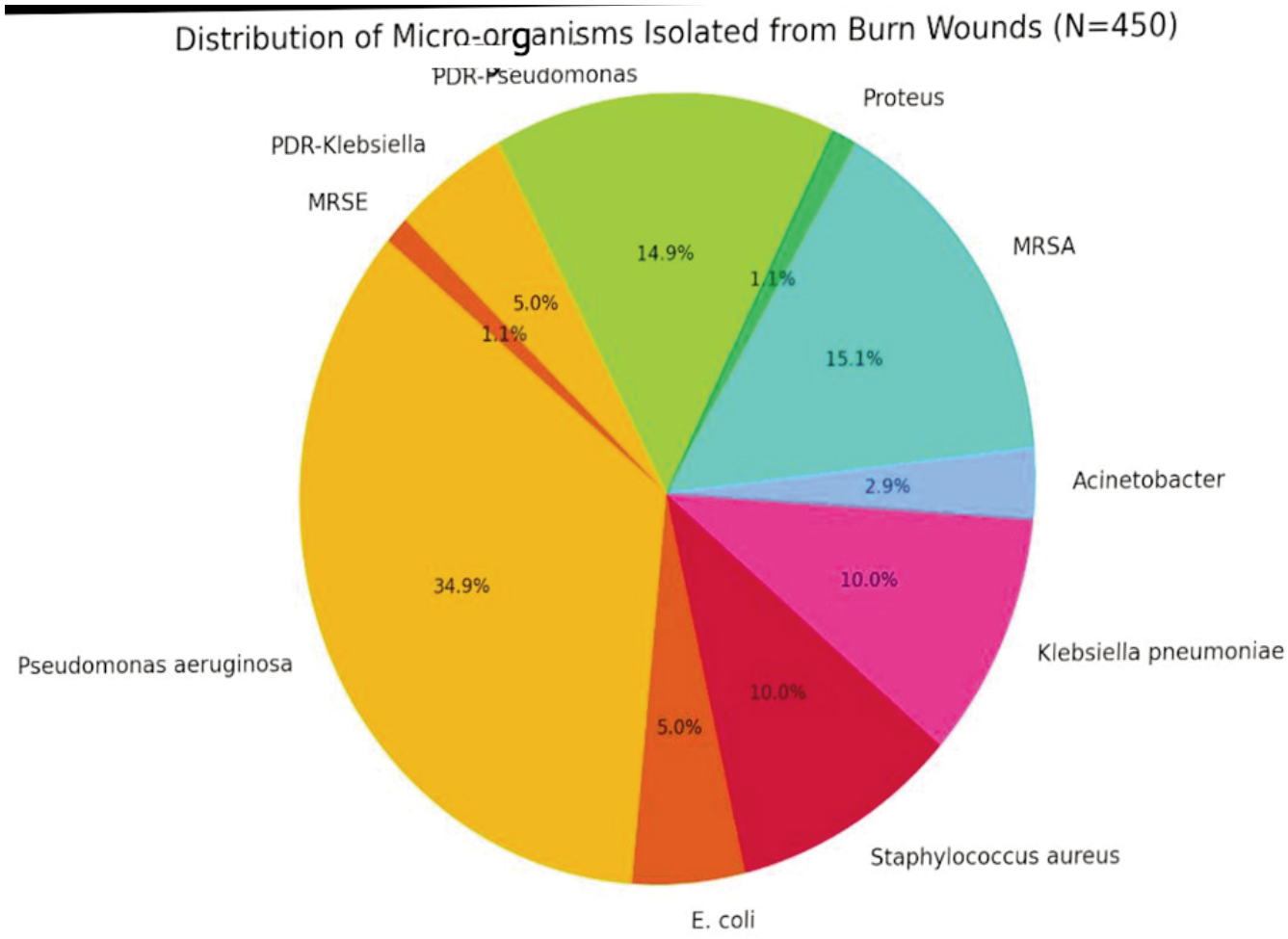

Table-2: Frequency of micro-organisms isolated from burn wounds.

Micro-organism	N	%age
Pseudomonas aeruginosa	157	34.9
E-coli	22.5	5
Staphylococcus aureus	45	10
Klebsiella pneumonia	45	10
Acinetobacter	13	2.9
MRSA	68	15.1
Proteus	5	1.1
PDR-Pseudomonas	67	14.9
PDR-Kebsiella-	22.4	5%
MRSE	5	1.1
Total	450	100

E: Escherichia, MRSA: Methicillin-resistant staphylococcus aureus, PDR: Pan-drug resistant, MRSE: Methicillin-resistant staphylococcus epidermidis

A variable antibiotic susceptibility pattern was observed among the microbes with predominant imipenum and linzolid sensitivity (Table 3).

Discussion

Burn size and depth are direct risk factors for infections. The virulence and number of microbes per gram of tissue can influence the frequency of invasive infections and their clinical severity. The American Burn Association consensus concensus conference has identified colonisation, infection, invasive infection, cellulitis and necrotizing infection/fasciitis as wound infections. The presence of proliferating bacteria without a host response has been described as colonisation. Bacterial count of $>10^5$ per gram has been labelled as invasive infection. Suppuration of the eschar, graft loss, involvement of unburned tissue are evidence of systemic sepsis. Necrotising infection is aggressive incisive infection with the involvement of underlying structures. In the current study, wound swab culture was performed to ascertain the frequency of micro-organism and their antibiotics susceptibility. P. aeruginosa was the most frequent microbial reported in the patients, which is comparable to earlier studies[6]. In some studies S. aureus has been found

Table-3: Dominant sensitivity pattern of the frequently cultured microbes (n=450).

Antibiotics tested	Pseudomoas aeruginosa (n=157) %33	Klebsiella pneumoniae (n=68) %15	Proteus (n=5) % 1	MRSA (n=68) 15%	E-coli (n=22.5) %(5)	Acinetobacter	PDR-Pseudomonas
Piperacillin+Tazobactum	10(17.5)	13(8.8)	-	-	-	-	-
Imipenum	42.28 (65)	6.5(4.4)	-	-	-	33.66(4.50)	-
Ciprofloxacin	14.28(22.41)	19.5(13.6)	-	-	3 (50)	33.33(4.50)	-
Polymyxin B	1(4.8)	6.5(8.8)	-	-	-	-	-
Cefoperazone+Salbactum	1(3)	-	-	-	-	-	-
Amikicin	14.28(22.41)	13(8.8)	-	5(3.4)	-	33.33(4.50)	-
Levofloxacin	5.71(9)	6.5(4.4)	100 (5)	-	-	-	-
Ceftazidime	-	-	-	-	-	-	-
Vancomycin	-	-	-	10(6.8)	-		-
Fusidic acid	1(3)	-	-	-	-	-	-
Linezolid	-	-	-	65(44)	-		-
Moxifloxacin	-	-		15(10.2)			-
					10(6.8	-	
Doxycyclin	-	-	-	-	-	-	-
Azizthromycin	5(8)	13(8.8)				-	-
Meropanum	-					-	-
Colistin(PDR-organism)	-	19.5(13.6)				-	100(67)

E: Escherichia, MRSA: Methicillin-resistant staphylococcus aureus, PDR: Pan-drug resistant.

as the main microbe in burn wounds. Imipenem was the most common antibiotic in relation to pseudomonas infection in the current study, according to literature, second-generation cephalosporin were the most common antibiotics to this organism. Klebsiella was the second most frequently isolated pathogen in the present study, coinciding with literature, but some studies have reported Klebsiella species as the most common microbe in Klebsiella species as the predominant microorganism in the bacteriology of burn wounds. The third most frequently isolated organism was *S. aureus.* The gram-positive bacteria in deeper part of sweat glands and hair follicles has been reported to survive the heat of initial burn in the absence of topical antimicrobial agents. These bacteria heavily colonise wounds within the first 48 hours post-injury. Strategies to prevent and treat infection are essential for the survival of patients with extensive burns.[8]

MRSA constituted an alarmingly high percentage (60%) among the staphylococcal infections. Large reservoirs of MRSA exist outside healthcare facilities, both healthcare-associated and community-associated infections, which are real threat to burn injury patients who are managed on an outpatient department (OPD) basis with conventional dressings instead of standard wound excision and skin grafting. Contact with cases, cleanliness, compromised skin, contaminated fomites, and crowded living increase the chances of such infections. Good hand hygiene and barrier nursing by all healthcare providers can effectively minimise cross-infection among hospitalised patients[12].

The MRSA isolates in the current study were generally multidrug resistant (MDR). Linezolid and imipenem would be employed on an empirical basis to combat life-threatening infections caused by non-resistant and MDR strains. In the current study, no fungus isolates were found. There was a variable percentage of antibiotic resistance among the cultured organisms. The findings were in line with published studies[13,15]. The risk of the emergence of resistant strains and all other kinds of microbial invasion (bacteraemia) is more common among patients who are managed at home for >10 days. In fact, ultra-early or early excision and re-surfacing has become the standard of care for deep burns in the modern era[14].

The current study has limitations of being a single-centre, retrospective research. Also, the study only comprised patients who were found to be initially positive. However, pathogens in one patient may change over time and after antibiotic exposure. Systematic reviews and meta-analysis studies are needed to confirm the current findings, and further research is needed to explore the association between wound infection and mortality.

Conclusion

The most common frequent organisms found in burn wounds were S. aureus, P. aeruginosa and K. pneumoniae. Antibiotic susceptibility pattern was variable among the microbes. Frequency of positive cultures was significant and more among patients with duration of >10 days of burn wounds. Early or ultra-early tangential excision of deep burns and re-surfacing with skin graft/skin substituents can help reduce infection-related complications.

Disclaimer: None.

Conflict of Interest: None.

Source of Funding: None.

References

1. Saaiq M, Ahmad S, Zaib MS. Burn wound infections and antibiotic susceptibility patterns at Pakistan Institute of Medical Sciences, Islamabad, Pakistan. World J Plast Surg 2015;4:9-15.
2. Schaefer TJ, Nunez Lopez O. Burn Resuscitation and Management (Archived). Treasure Island, FL: StatPearls Publishing; 2025.
3. Zhang P, Zhang Z, Huang Y, Li J, He X, Wang Z. The pathogenesis and diagnosis of sepsis post burn injury. Burns Trauma 2021;9:tkaa047. doi: 10.1093/burnst/tkaa047.
4. Chaudhary NA, Khan AA, Javed A, Waris S, Iqbal M, Ijaz A. Epidemiology, bacteriological profile, and antibiotic sensitivity pattern of burn wounds in the burn unit of a tertiary care hospital. Cureus 2019;11:e4824. doi: 10.7759/cureus.4824.
5. Jeschke MG, van Baar ME, Choudhry MA, Chung KK, Gibran NS, Logsetty S. Burn injury. Nat Rev Dis Primers 2020;6:11. doi: 10.1038/s41572-020-0145-5.
6. Roy S, Baidya S, Das P, Biswas S, Saha S, Chowdhury S. Microbial infections in burn patients. Acute Crit Care 2024;39:214-20. doi: 10.4266/acc.2023.01052.
7. Pasalar M, Mohammadi AA, Rajaeefard AR, Neghab M, Tolidie HR, Mehrabani D. Epidemiology of burns during pregnancy in southern Iran: Effect on maternal and fetal outcomes. World Appl Sci J 2013;28:153-8.
8. Lemiech-Mirowska E, Kiersnowska ZM, Michałkiewicz M, Depta A, Marczak M. Nosocomial infections as one of the most important problems of healthcare system. Ann Agric Environ Med 2021;28:411-6. doi: 10.26444/aaem/122629.
9. Özdemir B, Akıncı E, But A, Kazancıoğlu S, Yastı AÇ, Yüksek YN, et al. Bloodstream Infections in Severe Burn Patients: Epidemiology, Microbiology, Laboratory Features, and Risk Factors Associated with Mortality. Mediterr J Infect Microb Antimicrob. 2022;11:47. doi: 10.4274/mjima.galenos.2022.2022.47.
10. Weinand C. Associated bacterial and fungal infections in burn wounds: common factors, distribution in etiology, age groups, bacterial and fungal strains–evaluation of a single burn center experience of 20 years. Burns Open 2024;8:100363. doi: 10.1016/j.burnso.2024.100363.
11. Maillard JY, Kampf G, Cooper R. Antimicrobial stewardship of antiseptics that are pertinent to wounds: the need for a united approach. JAC Antimicrob Resist 2021;3:dlab027. doi: 10.1093/jacamr/dlab027.
12. Shukla V, Khare A, Bisen J, Darshan BY. Antimicrobial Susceptibility Pattern of Bacterial Isolates in Burn Patients in a Tertiary Care Centre: A Prospective Study. Int J Sci Stud 2020;8:113-20.
13. Rafla K, Tredget EE. Infection control in the burn unit. Burns 2011;37:5-15. doi: 10.1016/j.burns.2009.06.198.
14. Ponce de Leon A, Merchant S, Raman G, Avendano E, Chan J, Tepichin Hernandez G, et al. Pseudomonas infections among hospitalized adults in Latin America: a systematic review and meta-analysis. BMC Infect Dis 2020;20:250. doi: 10.1186/s12879-020-4935-4.
15. Jordan KC, Di Gennaro JL, von Saint André-von Arnim A, Stewart BT. Global trends in pediatric burn injuries and care capacity from the World Health Organization Global Burn Registry. Front Pediatr 2022;10:954995. doi: 10.3389/fped.2022.954995.
16. Rashid Mahmood A, Mansour Hussein N. Study of antibiotic resistant genes in Pseudomonas aeruginosa isolated from burns and wounds. Arch Razi Inst 2022;77:403-11. doi: 10.22092/ari.2021.356681.1893.
17. Puca V, Marulli RZ, Grande R, Vitale I, Niro A, Molinaro G, et al. Microbial species isolated from infected wounds and antimicrobial resistance analysis: data emerging from a three-year retrospective study. Antibiotics (Basel) 2021;10:1162. doi: 10.3390/antibiotics10101162.
18. Reynolds D, Kollef M. The epidemiology, pathogenesis and treatment of Pseudomonas aeruginosa infections: an update. Drugs 2021;81:2117-31. doi: 10.1007/s40265-021-01638-y.
19. Altoparlak U, Erol S, Akcay MN, Celebi F, Kadanali A. The time-related changes of antimicrobial resistance patterns and predominant bacterial profiles of burn wounds and body flora of burned patients. Burns 2004;30:660-4. doi: 10.1016/j.burns.2004.03.005.
20. David MZ, Daum RS. Community-associated methicillin-resistant Staphylococcus aureus: epidemiology and clinical consequences of an emerging epidemic. Clin Microbiol Rev 2010;23:616-87. doi: 10.1128/CMR.00081-09.

AUTHOR'S CONTRIBUTION:
IA: Concept, design, data acquisition, analysis and interpretation.
AMM: Drafting and revision.
HG: Final approval and agreement to be accountable for all aspects of the work.