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ORIGINAL ARTICLE

Prevalence of MRSA (Methicillin-Resistant *Staphylococcus Aureus*) in Burn Wound Infections and its Antibiotic Susceptibility Patterns

ZUBEDA IRSHAD[1], MAHNOOR KHAN[2], RABBIA MAHBOOB[3]
[1]Assistant Professor Microbiology, Department of Pathology, Burns and Plastic Surgery Centre, MTI-HMC, Hayaytabad Peshawar, Pakistan*
[2]Trainee Medical Officer, Department of General Surgery, Khyber Teaching Hospital - MTI, Peshawar, Pakistan
[3]Microbiology Technician, Department of Pathology, Burns and Plastic Surgery Center, MTI-HMC, Hayatabad Peshawar, Pakistan
Correspondence to: Zubeda Irshad, Email: zubedasamar@yahoo.com

ABSTRACT

Background: Burn injuries provide an ideal environment for bacterial colonization and infection, particularly by resistant strains such as methicillin-resistant *Staphylococcus aureus* (MRSA). Once established, MRSA infections can delay wound healing, prolong hospitalization, and increase the risk of sepsis and mortality. This study aimed to determine the prevalence of MRSA among burn wound infections and to assess the antibiotic susceptibility patterns of the isolates.

Methods: A descriptive cross-sectional study was conducted over two year, from January 2020 to December 2021, involving 751 isolates of *Staphylococus aureus* from burn patients in a tertiary care burn hospital. Wound swabs from clinically infected burn sites were cultured and analyzed for bacterial identification. MRSA was detected using cefoxitin disc diffusion method, and antibiotic susceptibility testing was performed using the Kirby-Bauer disc diffusion technique according to Clinical and Laboratory Standards Institute (CLSI) guidelines.

Results: Out of 751 *Staphylococcus aureus* isolates from burn patients, 421 (56%) were identified as methicillin-resistant *Staphylococcus aureus* (MRSA), while 330 (43.9%) were methicillin-sensitive *S. aureus* (MSSA). MRSA infections were significantly associated with larger total body surface area (TBSA) burns, ICU admissions, prior antibiotic use, and the presence of comorbidities ($p< 0.05$). Antibiotic susceptibility testing showed 99.6% sensitivity to vancomycin and 91.7% to linezolid. Resistance was highest against trimethoprim-sulfamethoxazole (TMP-SMX) (99.6%), ciprofloxacin (95.8%), and clindamycin (87.5%). Amikacin and tetracycline demonstrated limited effectiveness, with sensitivity rates of 29.2% and 16.7%, respectively.

Conclusion: MRSA remains a prevalent and clinically significant pathogen in burn wound infections, especially among patients with extensive burns, prior antibiotic exposure, ICU admissions, and comorbidities. Vancomycin (99.6% sensitivity) and linezolid (91.7%) continue to be the most effective therapeutic options against MRSA in this setting. The high resistance to commonly used antibiotics such as TMP-SMX, ciprofloxacin, and clindamycin underscores the urgency for routine microbiological surveillance, judicious antibiotic prescribing, and strict infection control measures. Implementing targeted antimicrobial stewardship and evidence-based protocols is essential to curb the spread of multidrug-resistant organisms in burn care units.

Keywords: MRSA, burn wound infection, antibiotic resistance, *Staphylococcus aureus*, susceptibility pattern, vancomycin, amikacin, infection control.

INTRODUCTION

Burn injuries rank among the harshest types of trauma: they destroy skin and deeper tissues while also opening the door to an array of complicated, overlapping problems. Perhaps the most pressing issue doctors face once the flames have been stilled is the threat of infection. Burn wounds are raw and open, the patients immune system is often depressed, and the frequent use of catheters, ventilator tubes, or grafting materials gives bacteria an easy pathway into the body. Under these circumstances, *Staphylococcus aureus*-especially the stubborn strain known as methicillin-resistant *Staphylococcus aureus*, or MRSA- often emerges as the top troublemaker[1-3].

MRSA earned its bad reputation because it survives beta-lactam drugs, the very medicines most physicians instinctively reach for in a hospital. That hardiness stems from the mecA gene, which rewrites the structure of penicillin-binding proteins and turns them into targets that penicillin and its cousins can no longer seize. The upshot is that MRSA infections demand longer therapy, more expensive resources, and the kind of vigilant nursing care that many hospitals struggle to provide. For burn patients, whose wounds must close quickly if they are to avoid life-long disability, a single MRSA culture can slow healing, prolong hospital stays, and trigger emergency debridement or even full-thickness grafting[4-6].

The rise and ongoing presence of MRSA within hospital wards, particularly in burn units, mirrors the dual impact of heavy antibiotic use and weaknesses in basic infection control. In numerous low- and middle-income countries, clinicians frequently initiate empirical therapy without reliable microbiological data, further fuelling patterns of resistance. For this reason, regular local surveillance of MRSA prevalence and its drug susceptibility remains crucial in shaping appropriate treatment and curbing the onward spread of resistant strains[7-9].

This study was undertaken to evaluate the frequency of MRSA infections in burn wounds and to determine the resistance and sensitivity patterns of these isolates. The results are intended to support more informed antibiotic prescribing and to aid in the development of protocols that reduce the burden of MRSA in burn care settings.

MATERIALS AND METHODS

This was a descriptive, cross-sectional study conducted over a period of two years,from January 2020 to December 2021.The research was carried out in the burn unit of a tertiary care facility. Informed verbal or written consent was obtained from all patients or their guardians before sample collection. The study received ethical approval from the Institutional Review Board of the study location. All data were kept confidential and used solely for research purposes.

A total of 751 burn patients with *Staphylococcus aureus* isolated from suspected burn wounds who were admitted during the study period were included in the study. All patients, irrespective of gender and all ages were included. Patients were excluded if they had received systemic antibiotics for more than 48 hours prior to admission or had non-burn-related skin infections.

A non-probability consecutive sampling technique was employed. All patients meeting the inclusion and exclusion criteria during the specified study period were enrolled until the desired sample size was achieved.

Demographic and clinical information was recorded using a pre-structured data collection form. Variables included age, gender, type and depth of burn injury, percentage of total body surface area (TBSA) involved, comorbidities, prior antibiotic use, ICU admission status, and any surgical interventions.

Wound swabs were collected aseptically from clinically suspected infected burn sites—such as those showing purulent discharge, foul odor, increased redness, or delayed healing. Samples were obtained using sterile saline-moistened cotton

swabs and were promptly transported to the microbiology laboratory for analysis.

Swabs were cultured on blood agar and mannitol salt agar and incubated at 37°C for 24–48 hours. Identification of *Staphylococcus aureus* was based on Gram staining, colony morphology, catalase, and coagulase tests. Methicillin resistance was determined using cefoxitin (30 µg) disc diffusion method, as per Clinical and Laboratory Standards Institute (CLSI) guidelines. MRSA was confirmed if the zone of inhibition was ≤21 mm.

Antibiotic susceptibility testing of confirmed MRSA isolates was carried out using the Kirby-Bauer disc diffusion method. The antibiotics tested included vancomycin, linezolid, clindamycin, ciprofloxacin, trimethoprim-sulfamethoxazole (TMP-SMX), tetracycline, and amikacin. Gentamicin and erythromycin were excluded in the final analysis due to inconsistent data.

All results were interpreted according to CLSI standards. Data were analyzed using SPSS version 25. Descriptive statistics were used to summarize categorical variables as frequencies and percentages, while continuous variables were expressed as mean ± standard deviation. Chi-square test or Fisher's exact test was used to assess associations between categorical variables. A p-value of less than 0.05 was considered statistically significant.

RESULTS

In the 751 *S. aureus*-positive burn patients included in the study, the associated demographics were as follows: the most commonly affected age groups were 21–30 years (25.3%) and above 40 years (26.6%). The gender distribution showed a slight male predominance, with 55.7% of the patients being male and 44.3% female. Regarding the types of burns, flame burns were most frequent, affecting 51.9% of patients, followed by scald burns in 30.4%. The type of burn showed a statistically significant association with MRSA infection (p = 0.027), whereas no significant association was found with age group (p = 0.321) or gender (p = 0.118).

Table 1: Demographic Characteristics of Burn Patients (n = 751)

Variable	Frequency (n)	Percentage (%)	p-value
Age Group (years)			0.321
0–10	95	12.7	
11–20	124	16.5	
21–30	190	25.3	
31–40	143	19.0	
>40	199	26.6	
Gender			0.118
Male	418	55.7	
Female	333	44.3	
Burn Type			0.027*
Flame	390	51.9	
Scald	228	30.4	
Electrical	76	10.1	
Chemical	57	7.6	

Table 2: Clinical Variables and MRSA Status

Variable	MRSA Positive (n=421)	MRSA Negative (n=330)	p-value
Mean TBSA (%)	35.2 ± 10.3	23.7 ± 8.6	0.004
ICU Admission (Yes)	246 (58.3%)	90 (27.3%)	0.012
Prior Antibiotic Use (Yes)	368 (87.5%)	120 (36.4%)	0.001
Comorbidities (e.g., diabetes)	123 (29.2%)	36 (10.9%)	0.048

Table 3: Prevalence of MRSA Among S. aureus Isolates (n = 751)

Staphylococcus aureus Isolate	Frequency (n)	Percentage (%)
MRSA (within S. aureus)	421	56.0
MSSA	330	43.9

Table 4: Antibiotic Susceptibility Pattern of MRSA Isolates (n = 421)

Antibiotic	Sensitive n (%)	Resistant n (%)
Vancomycin	419 (99.6%)	2 (0.4%)
Linezolid	386 (91.7%)	35 (8.3%)
Clindamycin	53 (12.5%)	368 (87.5%)
Ciprofloxacin	17 (4.2%)	404 (95.8%)
TMP-SMX	2 (0.4%)	419 (99.6%)
Tetracycline	70 (16.7%)	351 (83.3%)
Amikacin	123 (29.2%)	298 (70.8%)

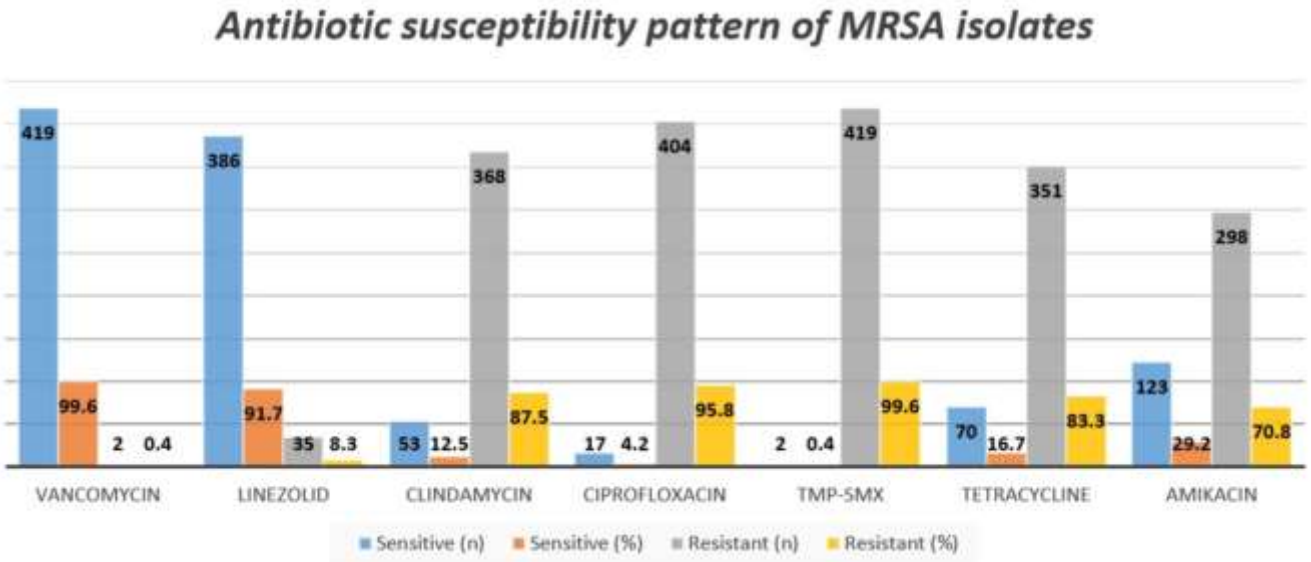

Figure 1: Antibiotic susceptibility pattern of MRSA isolates (n = 421). The bar chart illustrates the number and percentage of MRSA isolates that were sensitive and resistant to various antibiotics. Vancomycin and linezolid showed the highest sensitivity (99.6% and 91.7% respectively), whereas TMP-SMX, ciprofloxacin, and clindamycin exhibited the highest resistance rates. Tetracycline and amikacin showed limited effectiveness with moderate resistance levels.

A comparison of clinical variables between MRSA-positive and MRSA-negative patients is shown in Table 2. Patients with MRSA had significantly higher mean total body surface area (TBSA) involvement (35.2% versus 23.7%, p = 0.004). ICU admission was more frequent among MRSA-positive patients (58.3%) compared to MRSA-negative ones (27.3%), which was statistically significant (p = 0.012). Prior antibiotic use was also significantly associated with MRSA positivity (87.5% vs 36.4%, p = 0.001). Comorbid conditions, including diabetes and hypertension, were more common in MRSA-infected individuals (p = 0.048).

From the 751 patients, *Staphylococcus aureus* was isolated; 421 isolates were found to be MRSA representing 56% of the total, while 330 isolates (43.9%) were identified as MSSA. These findings emphasize the significant burden of MRSA among burn wound pathogens in this population.

Antibiotic susceptibility testing of the 421 MRSA isolates showed near-complete sensitivity to vancomycin (99.6%) and high sensitivity to linezolid (91.7%). Resistance was high against ciprofloxacin (95.8%), clindamycin (87.5%), and TMP-SMX (99.6% sensitive). Tetracycline and amikacin showed limited efficacy with sensitivities of 16.7% and 29.2%, respectively.

The susceptibility pattern of MRSA isolates, as shown in Figure 1, reveals that vancomycin remains the most effective antibiotic, with 99.6% of isolates showing sensitivity. Linezolid also demonstrated high efficacy (91.7% sensitive), making both drugs suitable for empirical and targeted treatment in MRSA-related burn wound infections.

In contrast, TMP-SMX, ciprofloxacin, and clindamycin showed alarmingly high resistance rates (99.6%, 95.8%, and 87.5% respectively), indicating limited clinical utility. Amikacin and tetracycline displayed moderate effectiveness, with sensitivity rates of 29.2% and 16.7% respectively. These findings highlight the growing antimicrobial resistance in MRSA and reinforce the need for antibiotic stewardship and routine surveillance in burn care settings.

DISCUSSION

This study evaluated the prevalence of methicillin-resistant *Staphylococcus aureus* (MRSA) among burn wound infections over a two-year period and analyzed the antibiotic susceptibility patterns of the isolated strains. The findings underscore the ongoing threat MRSA can pose in burn units, particularly among patients with extensive burns, ICU admissions, and comorbid conditions such as diabetes.

Among 751 *Staphylococcus aureus* isolates from the wound of burn patients MRSA was isolated in 56 % of cases, and 43.9% were MSSA. In a study in Karachi, Pakistan in 2007 the prevalence of MRSA among the *S. aureus* isolates from burn patient was around 24 %[10] In relatively recent studies in 2019 in other cities of Pakistan prevalence of 40% and 59% was reported.[11,12]

The proportion of MRSA in our study aligns with existing local literature as well as from South Asia and the Middle East, where MRSA prevalence in burn wounds ranges from 50% to 70%[13-15]. Studies from similar healthcare settings have reported MRSA isolation rates exceeding 60%, reinforcing the notion that MRSA remains a major pathogen in hospital-acquired infections in burn patients[16-18].

A significant association was observed between MRSA positivity and greater total body surface area (TBSA) involvement, consistent with previous studies. Larger burn areas create a more extensive site for microbial colonization and are often linked with prolonged healing, both of which increase the risk of infection. Furthermore, prior antibiotic exposure and ICU admission were also found to be statistically significant predictors of MRSA infection. These factors are well-recognized contributors to antimicrobial resistance, as they create selective pressure and provide entry points for colonization. Comorbidities such as diabetes further compromise immunity, making patients more vulnerable to resistant pathogens[19-21].

The antibiotic susceptibility patterns demonstrated that vancomycin remains uniformly effective against almost all MRSA isolates, followed closely by linezolid, which retained over 90% sensitivity. This was in agreement with multiple regional and international studies that continue to support vancomycin and linezolid as first-line treatments for serious MRSA infections[22,23]. On the contrary, resistance was notably high to ciprofloxacin (95.8%), TMP-SMX (99.6%), and clindamycin (87.5%), indicating limited utility of these agents in empirical therapy.

Amikacin and tetracycline showed moderate to poor sensitivity, with only 29.2% and 16.7% of MRSA isolates responsive, respectively. While these antibiotics may be considered for targeted or combination therapy, their reduced efficacy limits their standalone use. The overall findings highlight the need for routine antibiograms to guide therapy and stress the importance of antimicrobial stewardship, particularly in high-risk units such as burns.

CONCLUSION

This study confirms that MRSA remains a significant pathogen in burn wound infections, with a high prevalence rate among *Staphylococcus aureus* isolates. Patients with extensive burns, prior antibiotic exposure, ICU admission, and comorbidities were at greater risk of developing MRSA infections.

Vancomycin (99.6% sensitivity) and linezolid (91.7%) remain the most effective antibiotics, while widespread resistance to commonly used agents such as ciprofloxacin, TMP-SMX, and clindamycin is concerning. The limited susceptibility to tetracycline and amikacin further narrows therapeutic options.

These findings underscore the urgent need for routine microbiological surveillance, early and accurate diagnosis, rational antibiotic prescribing, and robust infection control strategies in burn care settings. Implementing local antibiotic policies based on resistance trends can significantly reduce the emergence and spread of multidrug-resistant organisms, ultimately improving patient outcomes.

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