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FREQUENCY OF METHICILLIN RESISTANT STAPHYLOCOCCUS AUREUS (MRSA) COLONIZATION IN PATIENTS WITH RECURRENT SKIN AND SOFT TISSUE INFECTIONS IN TERTIARY CARE HOSPITAL

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ABSTRACT

Background: A growing number of cases of skin and soft tissue infections (SSTIs) are caused by Methicillin-resistant Staphylococcus aureus (MRSA). Unfortunately, there is a lack of information regarding the frequency of MRSA in SSTIs among our local population.

Objective: To determine the frequency of nasal MRSA colonization in patients with recurrent SSTIs and assess its association with lesion-confirmed MRSA infection.

Methodology: This descriptive cross-sectional study was conducted at tertiary care hospital, Malir Cantt. Karachi from March 2025 to June 2025. Patients aged 10-60 years with recurrent community-associated SSTIs were included. Skin lesion samples were taken to detect infection, and nasal swabs were taken to detect colonization. Conventional microbiology methods and CLSI-recommended susceptibility tests were performed. Patients with MRSA received antimicrobial treatment followed by repeat microbiological assessment. Recurrent SSTIs were defined as ≥2 episodes within 6 months. SPSS 25.0 was used for statistical analysis.

Results: Among 195 patients, 59% (n=115) of lesion samples had MRSA, suggesting a high prevalence of MRSA-related SSTIs. Recurrent folliculitis (38.46%) and furunculosis (22.05%) were the most common types. Nasal MRSA colonization was identified in 32 patients (16.4), Follow-up cultures showed microbiological clearance in most treated patients.

Conclusion: Recurrent SSTIs are highly endemic for MRSA, with concurrent nasal colonization observed in a subset of patients. It's crucial to differentiate between infection and colonization, further prospective studies are required to evaluate long-term treatment outcomes.

KEYWORDS: Antimicrobial resistance, Frequency, Infectious**,** Methicillin-resistant Staphylococcus aureus, Soft tissue infections, Skin Diseases.

INTRODUCTION

Skin and soft tissue infections (SSTIs) represent the second most prevalent category of dermatological conditions, impacting around 14 million of individuals pursuing outpatient dermatological treatment. Bacterial infections account for 5.7% to 8.4% of these cases.[1] SSTIs are categorized into uncomplicated (simple) and complicated (necrotizing) groups. Folliculitis, cellulitis, impetigo, erysipelas, ecthyma, furuncles, and abscesses are common examples of uncomplicated or simple SSTIs, which are restricted to the skin and the superficial soft tissues[2-4]. Complicated (necrotizing) SSTIs involve deeper soft tissues and typical examples are necrotizing fasciitis, carbuncle, infected ulcers, diabetic foot ulcers and deep infected burns.[4] These infections can also be classified as purulent or non-purulent. Folliculitis, impetigo, cellulitis ecthyma, and erysipelas are examples of non-purulent infections that do not present with a drainable abscess. Conversely, purulent infections include cellulitis, abscess, carbuncle, and furuncle.[5]

The main pathogenic species that causes skin infections is Staphylococcus aureus. Methicillin-sensitive and Methicillin-resistant Staphylococcus aureus are two major phenotypic categories/strains[3,5]. The pathophysiology of MRSA is based on its genetic flexibility. The mecA gene encodes penicillin-binding protein 2a (PBP2a), which imparts resistance to beta-lactam antibiotics by diminishing their binding affinity. This resistance is exacerbated by biofilm development, which protects bacteria from host immunological responses and drugs. Methicillin-resistant Staphylococcus aureus (MRSA) is detected in the microbiology laboratory using the cefoxitin disc diffusion method, employing a 30 µg cefoxitin disc. As per CLSI guidelines, a zone of inhibition ≤21 mm is interpreted as cefoxitin-resistant, indicating the presence of mecA-mediated methicillin resistance (i.e., the isolate is reported as MRSA). A zone diameter ≥22 mm is interpreted as cefoxitin-susceptible (MSSA). Cefoxitin is

preferred over oxacillin as the surrogate marker in this test because it is a stronger inducer of the mecA gene, resulting in more reliable and reproducible detection of heteroresistant strains. MRSA strains are resistant to all beta-lactam antibiotics including penicillins, cephalosporins, carbapenems, and monobactams. Therefore, beta-lactam antibiotics are not preferred for the treatment of MRSA infections.[2] The diagnosis and classification of SSTIs in this study were aligned with established clinical guidelines such as those of the Infectious Diseases Society of America (IDSA), which provide standardized criteria for differentiating purulent and non-purulent infections.

In Pakistan, the prevalence of MRSA varies quite a bit, with local studies reporting prevalences ranging from 5.5% to 89% .[6] MRSA is a frequent cause of infections acquired within healthcare settings. In the present era, community acquired MRSA (CA-MRSA) has emerged as a prevalent pathogen responsible for disease in otherwise individuals with no underlying comorbidities who have no conventional predisposing factors for MRSA acquisition.[7,8].

Several studies from Pakistan have reported variable MRSA prevalence in SSTIs, ranging widely across different regions and healthcare settings, highlighting the need for localized epidemiological data, particularly in recurrent infections.[9] Nonetheless, there is still paucity of data that specifically deals with MRSA colonization in patients with recurring community-associated skin and soft tissue infections both in the global and local context. Recurrent infections may be associated with persistent colonization and repeated antimicrobial exposure. Thus, the proposed study will identify frequency of MRSA infection in lesion samples and concurrent nasal colonization among patients with recurrent SSTIs. Although the study title emphasizes MRSA colonization, lesion cultures were additionally performed to evaluate concurrent active MRSA infection among patients with recurrent SSTIs.

METHODS

This descriptive cross-sectional study was conducted in the Dermatology outpatient clinics and Microbiology Department of a tertiary care hospital, Malir Cantt, Karachi, from March 2025 to June 2025, following formal approval from the Institutional Ethical Review Committee, CMH Malir, via letter No: 117/2023/Trg/ERC, issued on 1st December, 2023. A total of 195 patients were enrolled using non-probability consecutive sampling technique and after signed a well explained written consent by the patient or their caregivers. Sample size was calculated using the Open Epi sample size calculator for cross-sectional studies. The formula used was:

$$n = \frac{Z^2 P(1-P)}{d^2}$$

where Z = 1.96 at 95% confidence interval, P = expected prevalence of MRSA (54.1%), and d = margin of error (7%). The calculated sample size was approximately 195 patients as mentioned by Habibi et al[10]. Definitions of SSTIs such as folliculitis, furunculosis, impetigo, and cellulitis were based on standard clinical criteria as outlined in dermatological and infectious disease guidelines (IDSA). Recurrent SSTIs were defined as two or more episodes within six months requiring medical evaluation. Lesion swabs represented active MRSA infection, whereas nasal swabs represented MRSA colonization. Patients between ages 10 to 60 years visiting dermatology outpatient clinic with repeated episodes of community-onset bacterial skin infections such as impetigo, abscess, ecthyma, erysipelas, cellulitis. folliculitis, recurrent folliculitis, furuncle, furunculosis, carbuncle, infected scabies and recurrent infective eczema. Individuals with a recent history of healthcare contact, including the administration of local or oral/injectable antibiotics, hospitalization or surgical procedures, pregnant or lactating mothers and patients with history of autoimmune skin conditions were excluded from the study. Samples were obtained from the skin lesions and nasal mucosa of patients and dispatched to the microbiology section. Swabs obtained from active skin lesions were used to identify MRSA infection, whereas nasal swabs (anterior nares) were collected to assess MRSA colonization, thereby clearly differentiating infection from colonization. Clinical samples were inoculated onto blood agar (enriched medium) to support the growth of Staphylococcus aureus and other fastidious organisms, and Mac Conkey agar (selective and differential medium) to identify and exclude concurrent gram-negative bacterial growth, particularly relevant in polymicrobial skin and soft tissue infections. Plates were incubated aerobically at 37°C for 18–24 hours, and colony characteristics were recorded. Isolates suspicious for S. aureus on blood agar were further confirmed by Gram staining and biochemical tests, including catalase, coagulase, and DNase. Antimicrobial susceptibility testing was performed using the Kirby-Bauer disc diffusion method as per Clinical and Laboratory Standards Institute (CLSI) 2024 guidelines for the applicable antibiotics. The antimicrobial panel evaluated included penicillin (10 U), cefoxitin (30 µg; a surrogate marker for oxacillin /methicillin resistance), erythromycin (15 µg), ciprofloxacin (5 µg), cotrimoxazole (25 µg), doxycycline (30 µg), and linezolid (30 µg). Vancomycin susceptibility was assessed by minimum inhibitory concentration (MIC) determination using the E-test strip method. The susceptibility results were interpreted according to CLSI-recommended breakpoints and criteria. For agents such as mupirocin, for which CLSI breakpoints are not established, interpretation was based on available literature and manufacturer standards.[12] Susceptibility was assessed using a tiered disc diffusion approach: isolates were initially screened for resistance using a 5 µg mupirocin disc, and those found resistant were subsequently tested with a 200 µg disc to determine high-level resistance. Additionally, 200 µg testing was performed in isolates from patients demonstrating clinical non-response to mupirocin therapy, to rule out emergent high-level resistance. Diagnosis of skin and soft tissue infections (SSTIs) was based on clinical criteria in accordance with IDSA guidelines. Patients with confirmed MRSA received antimicrobial treatment according to institutional clinical practice, with repeat culture performed

two weeks post-treatment to assess microbiological status. Linezolid was reserved for selected recurrent MRSA infections in which first-line agents were ineffective, as per institutional practice. Study outcomes were evaluated at the end of 12 weeks. Primary outcome was frequency of nasal MRSA colonization among patients with recurrent SSTIs. Secondary outcomes included lesion-confirmed MRSA infection patterns and post-treatment microbiological findings. The researcher recorded data in the proforma as required. Statistical Package of the Social Sciences (SPSS) version 25.0 was used to analyze the data. Mean and standard deviation (SD) were calculated for quantitative variables such as age. Qualitative variables (gender, type of infection, and MRSA status) were summarized by calculating frequency and percentages. The chi-square test was used to assess the association between MRSA positivity and infection type. A p-value ≤0.05 was considered statistically significant.

RESULTS

A total of 195 patients were included into the study. Male patients accounted for 79% (n = 154), while female patients comprised 21% (n = 41). The average age of the patients was 31.65±10.745 years, with the majority aged between 30 and 40 years. There Recurrent folliculitis (38.46%; n=75) was the predominant infection, succeeded by furunculosis (22.05%; n=43), impetigo (15.38%; n=30), and recurrent pyoderma (6.15%; n=12). The other identified skin infections are listed in Figure 1. All MRSA isolates demonstrated variable susceptibility across the tested antibiotic panel. Notably, complete (100%) susceptibility was observed for vancomycin and linezolid, whereas low-level mupirocin resistance was detected in 2% of isolates only. Despite this, a significant clinical response was achieved with linezolid combined with topical 2% mupirocin nasal ointment, administered for treatment and eradication of MRSA. Nasal MRSA colonization was identified in 32/195 patients (16.4%). MRSA was isolated in 59% (n=115) of lesion samples, representing MRSA infection. Nasal swab analysis demonstrated MRSA colonization among a proportion of patients, suggesting concurrent colonization in a subset of patients. The incidence of MRSA isolates in recurrent folliculitis was 36.5% (n=42), in furunculosis 29.5% (n=34), and in impetigo 15.6% (n=18). The prevalence of MRSA isolates in patients with cellulitis was 4.34%, and in those with abscesses, it was 1.7%, as shown in [Table 1]. The p-value was 0.029 (<0.05).

Out of 115 patients with **MRSA infection and/or colonization**, Follow-up cultures after antimicrobial treatment were negative in 111 patients (96.5%), while persistent MRSA positivity was observed in 4 patients (3.5%) [Table 2].

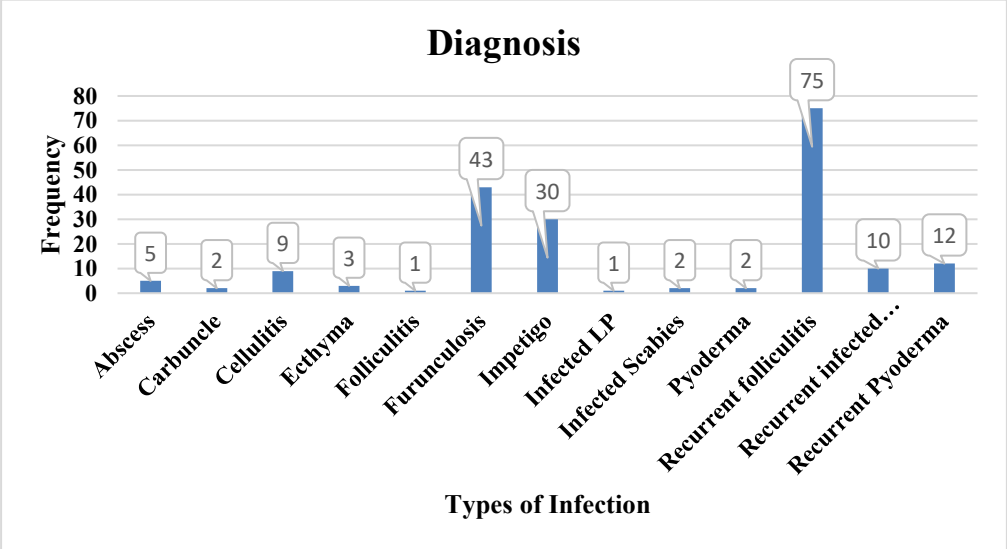

Figure 1: Frequency of Different types of skin and soft tissue infection (n=195)

Table 1: MRSA infection based on lesion swabs before treatment (n=195)

Diagnosis	MRSA before treatment on swab		Total Patients	p-Value
	-VE (%)	+VE(%)		
Abscess	5(100%)	0(0%)	5 (2.6%)	
Carbuncle	2(100%)	0	2(1.0%)	
Cellulitis	9(100%)	0(0%)	9(4.6%)	
Ecthyma	3(100%)	0(0%)	3 (1.5%)	**0.029**
Folliculitis	1(100%)	0	1(0.5%)	

Furunculosis	9(20%)	34 (79.%)	43(22.1%)	
Impetigo	12(40%)	18 (60%)	30(15.4%)	
Infected LP	0	1 (100%)	1(0.5%)	
Infected Scabies	1(50%)	1 (50%)	2(1.0%)	
Pyoderma	2(100%)	0	2(1.0)	
Recurrent folliculitis	33(44%)	42 (**56%**)	75 (38.5%)	
Recurrent infected Eczema	8(80%)	2 (20%)	10(5.1%)	
Recurrent Pyoderma	4(33.3%)	8 (66%)	12(6.2%)	
Total	**80**	**115 (59.0%)**	**195(100%)**	

p-value < 0.001

Table 2: Post-treatment microbiological culture findings among MRSA-positive patients (n=115)

MRSA status	No. of patients (n)	Total Percentage
Negative	111	96.5%
Positive	04	3.5%
Total	115	100%

A statistically significant association was observed between infection type and MRSA positivity (p=0.029), with higher prevalence in recurrent folliculitis and furunculosis compared to other SSTIs.

DISCUSSION

The present study evaluated MRSA colonization among patients with recurrent SSTIs and identified concurrent lesion-confirmed MRSA infection in a substantial proportion of patients. The results of this study offer local epidemiological information on MRSA associated recurrent SSTIs in our population and underline the need to assess the microbiological profile of recurrent cases.

MRSA was isolated from lesion swabs from 59% of patients in this study, a significant proportion, and indicating a considerable burden of MRSA infection in recurrent SSTIs. Similar results have been observed in regional studies. MRSA was detected in 54.1% of uncomplicated SSTIs in Pakistan, similar to the frequency of MRSA in our cohort.[10] The prevalence of MRSA in SSTIs is widely geographically and environmentally dispersed and is dependent on the setting of the SSTI. Prevalence ranged from 17.1% to 32% in Canadian surveillance studies of emergency department patients[11,13] and significantly lower colonization rates were reported in community-based studies from Brazil.[14] The variations may be related with the differences in patient selection, exposure to antibiotics, or differences in the care given or local antimicrobial resistance patterns.

The most common clinical presentations in the current study were recurrent folliculitis and recurrent furunculosis. The percent of MRSA positivity was significantly higher for recurrent folliculitis and furunculosis than for other SSTIs. This has been reported in previous studies where furunculosis, abscesses and recurrent purulent SSTIs are frequently reported to be associated with MRSA infection.[15,16] These results indicate that when patients have recurrent purulent skin infections, their clinical history should raise clinical suspicion for MRSA infection and might require microbiological investigation.

Assessment of concurrent nasal colonization was an important part of the present study. Nasal swabs were used as a proxy for colonization status while lesion swabs were used as a proxy for active infection with MRSA. A subset of patients had concurrent nasal colonization that may represent a potential reservoir associated with recurrent SSTIs. However, the descriptive cross sectional study did not allow for causal inferences to be drawn between nasal colonization and recurrence. The results must thus be considered as associations and not as proof of causality.

Microbiological clearance was achieved in most patients in follow-up cultures following the antimicrobial treatment. Previous studies have reported similar susceptibilities and microbiological responses to anti-MRSA agents like linezolid and vancomycin. [17,18] However, interpretation of these findings needs to be done carefully as the study was not a properly designed comparative therapeutic trial and did not have a control arm or a long-term follow-up period to assess long-term prevention of sustained recurrence. Furthermore, small numbers of patients with persistent positive culture make it difficult to draw definite conclusions about the effectiveness of treatment.

There are clinical implications of the increasing burden of CA-MRSA reported globally and regionally. There have been several studies reporting the presence of community associated MRSA strains in patients who do not necessarily have risk factors associated with hospital healthcare.[19] Continued surveillance of the antimicrobial

resistance pattern of recurrent SSTIs, especially in tertiary care settings is warranted as the high frequency of MRSA seen in the current study reiterates the need for such surveillance.
This study has certain limitations. First, the single center design and limited sample size may limit the generalizability of results. Second, because of the cross-sectional study design, the association of MRSA colonization with recurrence is difficult to assess. Third, the molecular characterization of the MRSA strains and resistance genes was not done, which reduced further analysis of the epidemiological distribution of MRSA circulating clones. Furthermore, long-term follow-up was not available to look for long-term microbiological clearance or recurrence after treatment. The study offers some helpful contemporary local information about MRSA infection and concurrent nasal colonization among patients presenting with recurrent SSTIs at a tertiary care unit despite these limitations.

CONCLUSION

This study demonstrated a high prevalence of nasal MRSA colonization among patients with recurrent skin and soft tissue infections (SSTIs), with concurrent lesion-confirmed MRSA infection observed in a substantial proportion of cases. These findings contribute valuable local epidemiological data on MRSA colonization patterns and their association with recurrent SSTIs, and may inform region-specific decolonization and infection-control strategies.

ETHICAL APPROVAL:

Approval was obtained from the Ethical Review Committee of the hospital (Ref no: 117/2023/Trg/ERC).

PATIENT'S CONSENT:

Written informed consent was provided by the patients.

CONFLICT OF INTEREST:

The authors declared no conflict of interest.

CONTRIBUTION OF AUTHORS

Ommaya Irshad: Study design, conduction of study, acquisition, analysis, and interpretation of the data and article writing.
Sameena Kausar: Drafting of work, critical review and final approval of the manuscript.
Nida Khalid: Data collection and article writing.
Fatima Sana: Guided about methodology, helped in manuscript formatting and MRSA identification and culture based reporting susceptibility testing .
Elvina Erum: Provided data of the patients where follow-up was done.
All authors approved the final version of the manuscript to be published.

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