**STAPHYLOCOCCUS AUREUS INFECTIONS AND THEIR ANTIBIOTIC SUSCEPTIBILITY PROFILE AT A TERTIARY CARE HOSPITAL**

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**INTRODUCTION**

Staphylococcus aureus is an important bacterial pathogen responsible for a wide spectrum of clinical infections causing both community-acquired and healthcare-associated infections [1]. They cause skin and soft tissue infections (STIs) including impetigo, folliculitis, furunculosis, cutaneous abscesses, cellulitis, necrotizing fasciitis, and surgical site infections; pleuropulmonary infections; bone and joint infections and device-related infections. S. aureus also one of the most frequent causes of infective endocarditis and bacteremia [1,2]. Toxin-mediated illnesses, scalded skin syndrome, toxic shock syndrome, and food poisoning are also caused by S. aureus [1].

S. aureus frequently colonizes skin and mucosa and about 30% individuals being persistent nasal carriers. The extra nasal carriage sites include skin, perineum, and pharynx. S. aureus anterior nasal carriage is also associated with subsequent staphylococcal disease [1,3].

Increasing resistance to different antibiotics including the glycopeptides among S. aureus isolates is a cause for concern. Methicillin-resistant S. aureus (MRSA), vancomycin-intermediate S. aureus (VISA), and vancomycin-resistant S. aureus (VRSA) are being increasingly encountered [4]. Significantly high rates of MRSA have been reported from India and various parts of the globe along with increasing reports of community-acquired MRSA infections [4-6]. Increasing resistance rates limit therapeutic options for S. aureus infections.

As S. aureus is one of the most frequent pathogens in a clinical setting and in view of its increasing resistance to common antibiotics, a prospective, observational study was conducted to analyze the spectrum of infections caused by S. aureus and its antibiotic susceptibility profile in a tertiary care teaching hospital setting.

**METHODS**

Following Institutional Ethics Committee approval, a prospective observational study was conducted of 4 months duration from January to April 2017, to study S. aureus isolates from various clinical specimens and to analyze their susceptibility pattern to various antibiotics. Duplicate isolates of S. aureus isolated from the same patient during the study period were excluded.

Specimens from various clinical sites received in the laboratory for culture and sensitivity were processed as per standard techniques [7]. The specimens were subjected to Gram stain and culture on 5% sheep blood plates [5]. S. aureus anterior nasal carriage is also associated with subsequent staphylococcal disease [1,3]. The inoculated culture plates were incubated at 37°C for 18-24 hrs. S. aureus isolates were identified based on colony morphology, Gram stain, catalase, slide coagulase test and by automated identification system - matrix-assisted laser desorption/ionization time-of-flight mass spectrometry (Vitek MS, bioMerieux Inc.). Antimicrobial susceptibility testing was done using the automated system (Vitek, bioMerieux Inc.). MRSA was identified with cefoxitin (6 µg/ml). Data were analyzed using standard statistical software - Statistical package for the social sciences (SPSS), version 17.0 (SPSS Inc., Chicago, Ill., USA). Quantitative variables were expressed as percentages.

**RESULTS**

A total of 234 S. aureus isolates were obtained during the study period from various infection sites. Males accounted for 70.1% (n=164) of patients with S. aureus infections. Patients with S. aureus infections were uniformly distributed across all age groups. Majority of these patients were from surgical departments (65.6%) in the hospital. S. aureus was most commonly (64.5%) isolated from pus and exudates (swabs,
isolates (100%) were found to be infections such as uncomplicated infections like SSTIs [15-17]. Majority of our isolates (n=137) [13]. Use of quinolones for various infections leads to the selection of resistant mutants among the S. aureus colonizing flora which acts as a reservoir for future infections, and quinolone resistance are more predominantly noted in MRSA isolates [14].

Lower rate of resistance to trimethoprim/sulfamethoxazole was noted (12%) in our study. Trimethoprim-sulfamethoxazole can be used for the treatment of S. aureus infections such as uncomplicated SSTI [15-17]. Majority of our S. aureus isolates (77.1%) were sensitive to clindamycin, an important alternative to a beta-lactam antibiotic for S. aureus SSTIs [11,19]. Inducible clindamycin resistance (iMLS\textsubscript{B}) was seen in 22.4% of our S. aureus isolates. Prabhu et al. and Deotale et al. have reported lower rates of 10.5% (n=20) and 14.5% (n=36), respectively, for iMLS\textsubscript{B} [18,19].

In our study, S. aureus was most commonly isolated from SSTIs (56%). Ray et al., in their retrospective analysis found S. aureus as the etiological agent in 81% of positive cultures from SSTI specimens [8]. Globally, S. aureus is recognized as the most frequent pathogen isolated from SSTIs [9]. Apart from S. aureus, Pseudomonas aeruginosa, Enterococcus spp., Escherichia coli, and beta-hemolytic Streptococci are other important causes of SSTIs [8]. Most SSTIs occur when the innate immune barrier, the skin is breached by trauma or surgery. Infections may also spread from a distant site [10].

Analyzing the antimicrobial susceptibility data of S. aureus isolates, high rate of resistance to ciprofloxacin was seen (88.8%). Bouchiat et al., in their analysis of 92 S. aureus clinical isolates, found 70.6% (n=65) of them to be resistant to ciprofloxacin [11]. Gade and Qazi have reported 57.6% (n=144) isolates of S. aureus to be ciprofloxacin resistant [12]. High rates of quinolone resistance have also been noted earlier by Metri et al., among S. aureus isolates (n=137) [13]. Use of quinolones for various infections leads to the selection of resistant mutants among the S. aureus colonizing flora which acts as a reservoir for future infections, and quinolone resistance are more predominantly noted in MRSA isolates [14].

In our study, 97.8% of S. aureus isolates were resistant to benzylpenicillin. This is because the majority of the clinical isolates of S. aureus produce beta-lactamase enzyme which inactivates the penicillin antibiotic [7]. The rate of MRSA was high in our study (47%). Varying rates of MRSA prevalence have been reported across different centers [11]. A multi-centric study by the Indian Network for Surveillance of Antimicrobial Resistance group involving 15 tertiary care centers found a MRSA prevalence rate of 41% (n=10769) [5]. Bouchiat et al. found 52.2% (n=48) isolates of S. aureus to be methicillin-resistant [11]. Thali et al. recorded 79.6% (n=285) S. aureus isolates to be methicillin-resistant [20]. Other studies have found lower rates of MRSA prevalence [21,22]. Dilnessa and Bitew have reported MRSA rates of 17.5% (n=34) in their analysis of 194 S. aureus isolates over several years by Ragbetli et al., 21% of them were methicillin-resistant [22]. S. aureus is commonly transmitted by skin-to-skin contact with either a colonized or infected individual. Indirect contact through fomites also plays a role in the transmission of MRSA. The 5 Cs for MRSA spread proposed by Centers for Disease Control and Prevention, USA includes crowding, frequent skin-to-skin contact, compromised skin integrity, contaminated items and surfaces, and lack of cleanliness [6]. We did not find a significant difference in infection profile between MRSA and MSSA isolates, mirroring the finding of Dilnessa and Bitew [21]. MRSA strains were found to be more resistant to non-beta lactam antibiotics compared to MSSA (Table 2), similar to findings of earlier studies [5,11,12]. Infection control practices need to be further strengthened and complemented with judicious antimicrobial prescribing to reduce the burden of MRSA infections.
infections: Epidemiology, pathophysiology, empirical antibiotic therapy based on the clinical presentation. It is estimated that <1% of clinical isolates of S. aureus were sensitive to vancomycin, linezolid, and teicoplanin. There were no cases of VISA or VRSA in our study. All isolates of MSSA and MRSA were sensitive to vancomycin with a median MIC of 0.5 µg/ml. A clinical isolate of VISA was initially reported from Japan in 1997, and the first report of VRSA was from the United States in 2002 [23]. Since then, even though less frequent, studies from India and globally are increasingly reporting the occurrence of both VISA and VRSA among clinical isolates of S. aureus [20,24,25]. Large multi-centric studies are needed to analyze the prevalence and implications of VISA and VRSA in the clinical setting. It is estimated that <1% of S. aureus isolates are linezolid-resistant [26].

We did not analyze the antimicrobial prescription data and prognosis of patients with S. aureus infections. Analysis of risk factors for MRSA infections and colonization status was not done.

CONCLUSION

S. aureus was more frequently associated with SSTIs. A high frequency of MRSA was found in our study: Generating local data on antimicrobial resistance among the S. aureus isolates will help in choosing appropriate empirical antibiotic therapy based on the clinical presentation.

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