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Original Article

A Study on the Prevalence and Susceptibility Pattern of MRSA in a Tertiary Care Hospital of Haroti Region

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ABSTRACT

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Background and Aims: Emerging antimicrobial resistance is one of the major public health threats worldwide. It can result in increased morbidity and mortality rates along with increased treatment costs and hospitalization stays. Methicillin-resistant *Staphylococcus aureus* (MRSA) has become a global challenge. It is a major cause of nosocomial and community-acquired infections. Its prevalence varies with country and within hospitals within a country. The current study estimates the prevalence of MRSA.

Materials and Methods: A total of 162 *Staphylococcus aureus* strains were isolated from various clinical specimens, and antibiotic susceptibility tests and identification by cefoxitin disc (30 µg) were performed as per Clinical and Laboratory Standards Institute guidelines.

Results: Among 162 *Staphylococcus aureus* 92 isolates were found to be MRSA. The highest rate of resistance was detected for penicillin (100), followed by erythromycin (97%), clindamycin (57%), tetracycline (13%), sulfamethoxazole-trimethoprim (SXT) (55%), ciprofloxacin (23%), and gentamicin (2%). All of the isolates were susceptible to linezolid and vancomycin.

Conclusions: Treatment of multi-drug resistant MRSA is still problematic because of the limited choice of antibiotic. This analysis will assist clinicians to choose an appropriate course of action for MRSA infections.

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Introduction

Staphylococcus aureus (*S. aureus*) is by far the most important human pathogen among the staphylococci. It is found in the external environment as well as in the anterior nares of 20 to 40% of adults. Other sites of colonization include the intertriginous skin fold, the perineum, the axilla, and the vagina. Although this organism is frequently a part of the normal human microflora, it can cause significant opportunistic infections. It can cause a variety of infectious processes ranging from benign skin infections to life-threatening systemic illnesses.

The emergence of multi-drug-resistant Methicillin-resistant *S. aureus* (MRSA) has posed a serious therapeutic challenge. Risk factors for MRSA infection include recent and prolonged hospitalization, dialysis, weakened immune systems like diabetes, human immunodeficiency virus infection, recent antibiotic therapy, catheter use, and carriage of MRSA in the nose, axilla, perineum, and hands of patients, and healthcare workers. These increase the chance of the emergence and spread of resistant strains [1]. Since trends in antibiotic susceptibility are changing constantly, continuous monitoring of prevalence and antimicrobial resistance patterns is important for the development and implementation of infection control programs.

Therefore, the present study estimates the percentage of MRSA strains and investigates their antibiotic resistance profiles in this region.

Materials and Methods

This is a one-year study during which a total of 162 strains of *S. aureus* were isolated from various clinical specimens consisting of urine, pus, and blood. The specimens were inoculated onto blood agar and MacConkey agar. Coagulase-positive organisms that also grew on mannitol salt plates with oxacillin were presumptively identified as MRSA. Disc diffusion by Kirby-Bauer methods on Mueller-Hinton agar plates was done. MRSA was confirmed by the cefoxitin interpretation criteria as per the Clinical and Laboratory Standards Institute (CLSI) recommendations.

Results

Among 162 *S. aureus*, 92 isolates were MRSA. Antibiotic susceptibility results are summarized in Table 1. The highest rate of resistance was detected for penicillin (100%), followed by erythromycin (97%), clindamycin (57%), tetracycline (13%), sulfamethoxazole-trimethoprim (SXT) (55%), ciprofloxacin (23%), and gentamicin (2%). All of the isolates were susceptible to linezolid and vancomycin.

Discussion

S. aureus is one of the most common pathogens causing a variety of infections ranging from minor skin diseases, deep-seated abscesses, osteoarthritis, necrotizing pneumonia, sepsis, meningitis, and so on to life-threatening endocarditis.

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Table 1. The study of antibiotic susceptibility (%) pattern of MRSA isolated from clinical samples

Antibiotics	Resistance (%)	Sensitive (%)
Penicillin	0	100
Erythromycin	3	97
Clindamycin	43	57
Ciprofloxacin	23	77
Levofloxacin	25	75
Amikacin	98	2
Gentamicin	98	2
Cotrimoxazole	45	55
Tetracycline	87	13
Linezolid	100	0

Multidrug resistance among gram-positive bacteria, especially MRSA, has been a major healthcare concern worldwide. The prevalence of infections by multidrug-resistant gram-positive bacteria is growing. Increased use and misuse of antibiotics are among the foremost contributors to the development of antibiotic resistance, especially in India.

Penicillin was the original drug of choice. So, the emergence of resistance was due to the acquisition of plasmid-borne genetic elements encoding beta-lactamases. Subsequently, semisynthetic penicillin was developed for treatment in 1959. Unfortunately, resistance to these agents also emerged during 1980. Methicillin resistance is due to the presence of an altered penicillin-binding protein called penicillin-binding protein 2a that results from the acquisition of a chromosomal gene called mecA which is located within the large mobile staphylococcal chromosomal element known as the SCCmec.

Many SCCmec types and subtypes have been identified. Type 1,11 and 111 are found in hospital-acquired MRSA (HAMRSA) strains, while type 1V, V, and VII are predominantly among community-acquired MRSA (CAMRSA). Staphylococcus. aureus strains that contain SCCmec are termed MRSA [2].

Recently, three types of MRSA could be recognized: Healthcare-associated MRSA, community-acquired MRSA, and Livestock associated MRSA, a new type that arose from animals. CAMRSA strains can spread in the general population with or without exposure to the healthcare environment. It causes infections like soft tissue infections (including necrotizing fasciitis), severe necrotizing pneumonia, sepsis, and bone and joint infection. It is increasingly being observed that CAMRSA is gradually resembling HAMRSA in being more invasive and transmissible than before [3]. CAMRSA outbreaks have occurred among populations such as prisoners, daycare centers, military recruits, and participants in contact sports. HAMRSA infections occur mostly among the elderly, individuals at risk factors like recent hospitalization, living in a long-term care facility, indwelling catheter in place, or recent surgery, and are generally multidrug resistant. The pattern of antibiotic susceptibility of MSSA and MRSA isolates

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differed significantly. The MSSA isolates were susceptible to most of the antibiotics while MRSA posed a serious therapeutic challenge and can lead to increased mortality and morbidity of the patients. It is resistant to beta-lactam antibiotics, cephalosporins, beta-lactamase inhibitors, and carbapenems. It can further exhibit resistance to other classes of antibiotics. As a result, it can cause an increased overall length of stay in the hospital, more complications, requirement of therapy by multiple antimicrobial agents. These results in an overall increase in the treatment cost, which can be disastrous in a country like India where most of the healthcare expenditure is borne out-of-pocket [4, 5].

The prevalence of MRSA strains has increased worldwide. In India, high rates of MRSA have been reported in clinical isolates from various studies, with rates as high as 54.8% (ranging between 32% and 80% among the *S. aureus* pool. Studies showed that MRSA among invasive *S. aureus* isolates was estimated to be 29% in 2009, which increased to around 47% in 2014 [6]. In the present study, the MRSA prevalence rate was 56.79%. A similar prevalence of 54.85% and 59.3% were observed by Anupurba et al. and Tiwari et al., respectively [7, 8]. The MRSA prevalence rates vary in various countries, with some reporting rates higher than ours [9-13]. Whereas the studies done by various author has also found a lower prevalence rate of 41%, 32.22%, 32.12%, and 30% [14-16]. The factors responsible for the rate of variations seen with different studies could be the different geographical areas, variation in sample sizes and length of study, specimens, methods, and status of infection control.

While comparing the gender distribution of MRSA infections, males (67.9%) were more affected than female patients (32.1%). Similar trends were observed by Rao et al. in 2012 [17]. Vancomycin remains the most important drug for the treatment of MRSA [18]. Daptomycin is another useful drug for invasive MRSA infections [19]. Telavancin, ceftaroline, and linezolid may be used for second-line therapy of MRSA [20]. Ceftobiprole is a new broad-spectrum, a "5th generation" cephalosporin activating against gram-positive bacteria, including MRSA [21].

There have been reports from different parts of India isolating MRSA strains with additional resistance to linezolid (Linezolid-resistant MRSA-LRMRSA) [22] and multiple antibiotics such as vancomycin, linezolid, and tigecycline (multidrug-resistant *S. aureus*-MDRSA) [23]. The emergence of multiple drug resistance among *S. aureus* isolates may be significant, though the exact prevalence and clinical implications remain to be known. The spread of MRSA infection is promoted by contacts comprising close skin-to-skin contact, skin lesion like cuts or abrasions, contaminated items and surfaces, crowded living conditions, like hospitals and prisons, and poor hand hygiene. Therefore, MRSA can be prevented by the following methods:

1. Wash hands thoroughly;
2. Cover cuts with antibacterial cream and a clean bandage. This will help the wound heal and also prevent it from spreading bacteria to other people;

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3. Do not share personal items like towels or razors;
4. Washing clothes and linens with regular detergents at the hottest temperature that is safe for the fabric;
5. Shower after athletic games or practice.

Conclusion

Antimicrobial resistance is an important communicable disease and a global health and development threat. It is widely considered to be the next global pandemic. Increased use and misuse of antibiotics are among the foremost contributors to the development of antibiotic resistance, especially in India. As reported in 2014, India was the largest consumer of antibiotics for human health in the world at 12.9 × 109 units [24]. Treatment of multi-drug resistant MRSA is still problematic because of the limited choice of antibiotics. The option of the drug for empirical therapy for staphylococcal infections depends on susceptibility data for the local geographic area. Knowledge of MRSA prevalence and their antimicrobial profile in a healthcare setup is crucial to implement control measures like cleanliness, hygiene, and aseptic precaution for these infections and minimize the usage of second-line antimicrobials. The findings of the study have helped us to recommend the empirical therapy schedule to clinicians and implement stringent hospital infection control programs.

Conflict of Interest

The authors have no conflicts of interest to declare.

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