Original Article

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Microbiology Section

Nosocomial Infections and Drug Susceptibility Patterns in Methicillin Sensitive and Methicillin Resistant *Staphylococcus aureus*

NITISH KUMAR SHARMA[1], RAINA GARG[2], SHRIKALA BALIGA[3], GOPALKRISHNA BHAT K.[4]

ABSTRACT

Aim: *Staphylococcus aureus* is one of the leading causes of nosocomial infections and is known for its ability to develop resistance to antibiotics. The drug susceptibility pattern of Methicillin Sensitive *S. aureus* (MSSA) and Methicillin Resistant *S. aureus* (MRSA) may vary.

Aims and Objectives: This study was carried out to determine and compare the drug susceptibility patterns in nosocomial MSSA and MRSA.

Material and Methods: The study was conducted between September 2009 and August 2011. Standard conventional methods were used for the isolation and identification of *S. aureus*. MRSA was identified by the cefoxitin (30 µg) disk method. Antibiotic susceptibility test was done using Kirby-Bauer disk diffusion method and the interpretation of the results was done using CLSI guidelines.

Results: Out of 685 strains of *S. aureus* studied, 173(25.25%) were MRSA and 512 (74.25%) were MSSA. Out of 173 MRSA strains, 114(65.89%) were isolated from pus, 22(12.71%) from vaginal swab, 18(10.40%) from central catheter tip and the remaining from other specimens. All isolates were susceptible to vancomycin and least number of isolates were susceptible to penicillin. MRSA displayed significantly higher resistance to other antibiotics. 45.7% of MRSA strains were resistant to clindamycin, 64.7% to ciprofloxacin, 87.3% to cotrimoxazole, 54.3% to erythromycin, 17.3% to gentamicin, 16.8% to netilmycin, and 58.38% to tetracycline. Inducible clindamycin resistance was detected in 37 (21.38%) strains of MRSA.

Conclusion: Nosocomial infections caused by MRSA is a significant problem. MRSA and MSSA differ with their susceptibility to antibiotics. All MRSA isolates in our hospitals were susceptible to vancomycin. Proper selection of the antibiotics based on antibiotic susceptibility test results is needed for effective treatment and prevention of emergence of resistance in MRSA and MSSA.

Key words: Nosocomial Infections, Drug Susceptibility, Methicillin-Resistant *Staphylococcus aureus*

INTRODUCTION

Staphylococcus aureus is the leading cause of a variety of hospital infections, ranging from minor skin infections to fatal septicemia[1]. *S. aureus* is known for its ability to develop resistance to antibiotics. Infections caused by it is used to respond to ß-lactam and related group of antibiotics, but the emergence of methicillin-resistant *S. aureus* (MRSA) has posed a serious therapeutic challenge [2]. The possible predisposing factors that increase the chance of emergence and spread of MRSA are prolonged and repeated hospitalization, indiscriminate use of antibiotics, lack of awareness, intravenous drug abuse, and presence of indwelling medical devices [3].

Hospital-acquired MRSA (HA-MRSA) infections have been recognized since the 1960s and are generally resistant to the multiple antimicrobial drugs. HA-MRSA strains are usually susceptible to vancomycin, linezolid and daptomycin [4]. Infected patients and colonized hospital personnel are the main source of MRSA [5]. The drug susceptibility pattern of MRSA may vary from region to region and this knowledge is crucial in selecting the antibiotics for treatment [6].

The objectives of the present study were to find out the rate of MRSA and MSSA in hospital infections and to determine and compare the antibiotic susceptibility pattern.

MATERIAL AND METHODS

The present study was conducted between September 2009 and August 2011 in the Department of Microbiology, Kasturba Medical College, Mangalore, India by using clinical specimens collected from the patients admitted in tertiary care hospitals and suspected to have nosocomial infections. The CDC criteria were used for defining nosocomial infections. The study had the approval of Institutional Ethics Committee.

The clinical samples were processed by using standard bacteriological methods. Smears were stained by gram staining. The specimens were inoculated on blood agar and MacConkey's agar and incubated at 37ºC for 24 hours. *S. aureus* was identified by colony morphology, gram staining, catalase test and coagulase test. Methicillin resistance was detected using cefoxitin disk (30 µg) diffusion method [7]. *S. aureus* ATCC 25923 and ATCC 43300 were used as negative and positive controls respectively. Inducible clindamycin resistance was detected using Disk approximation test (D-test) [7].

Antibiotic susceptibility testing was done by Kirby - Bauer disk diffusion method, following CLSI-2012 guidelines [7]. Antibiotics that used were amoxiclav (20 µg), ciprofloxacin (5 µg), clindamycin (2 µg), cotrimoxazole (25 µg), erythromycin (15 µg), gentamicin (10 µg), linezolid (30 µg), netilmycin (30 µg), penicillin (10 u), vancomycin (30 µg). *S. aureus* ATCC 25923 was used for quality control. The data were analysed by using descriptive statistical analysis and Chi-square test.

RESULTS

A total of 685 strains of *S. aureus* were isolated from different clinical samples from hospitalized patients with nosocomial

infection. Methicillin resistance was observed in 173 (25.25%) of *S. aureus* isolates. The distribution of 173 MRSA isolates in relation to various specimens is given in [Table/Fig-1]. Pus accounted for 65.89% of the MRSA isolates. The antibiotic resistance pattern of MRSA and MSSA and comparison is shown in [Table/Fig-2]. As compared to MSSA, MRSA strains were more resistant to antibiotics. Inducible clindamycin resistance was observed in 37 (21.38%) of MRSA as shown in [Table/Fig-3].

Clinical specimen	Number (%) of MRSA isolated (n=173)	Number (%) of MSSA isolated (n=512)
Pus	114 (65.89%)	377 (76.63%)
High Vaginal Swab	22 (12.71%)	70 (13.67%)
Central Catheter Tip	18 (10.40%)	29 (5.66%)
Urine Catheter Tip	7 (4.04%)	1 (0.19%)
Suction Tip	5 (2.89%)	14 (2.73%)
Sputum	2 (1.15%)	4 (0.78%)
Tissue	1 (0.58%)	3 (0.58%)
Pleural Fluid	1 (0.58%)	3 (0.58%)
Placenta	1 (0.58%)	7 (1.36%)
CSF	2 (1.15%)	4 (0.78%)

[Table/Fig-1]: Isolation of MRSA and MSSA from clinical specimens

	No. (%) of *S.aureus* strains resistant	
Antibiotic	**MRSA (n=173)**	**MSSA (n=512)**
Amoxiclav	135 (78.0%)	413 (80.7%)
Ciprofloxacin*	112 (64.7%)	158 (30.8%)
Clindamycin*	79 (45.7%)	71 (13.9%)
Co-trimoxazole*	151 (87.3%)	142 (27.7%)
Erythromycin*	94 (54.3%)	156 (30.5%)
Gentamicin*	30 (17.3%)	8 (1.56%)
Linezolid	3 (1.73%)	5 (0.97%)
Netilmycin*	29 (16.8%)	20 (3.9%)
Penicillin	155 (89.6%)	449 (87.7%)
Tetracycline*	101 (58.38%)	160 (31.25%)
Vancomycin	0 (0%)	0 (0%)

[Table/Fig-2]: Comparison of antibiotic resistance of MRSA and MSSA. *found to be statistically significant [p < 0.05]

D-Test for inducible clindamycin resistance	MRSA (n=173)
Positive	37 (21.38%)
Negative	136 (78.62%)

[Table/Fig-3]: Inducible clindamycin resistance in MRSA

DISCUSSION

The present study showed that MRSA is a problem as a nosocomial pathogen in our hospitals. Studies around the world have shown that the prevalence of MRSA is increasing [8]. This finding was supported by a previous study, in which the prevalence rate was found to be 51.8% in 2010 as compared to 30.6% in 1997 [9]. However, our study did not corroborate this finding, as it revealed a prevalence rate of 25.25% which was comparable to previous studies done in this area. A study conducted at a tertiary-care hospital in Mangalore (Southern India) found that 29.1% of clinical isolates of *S. aureus* were MRSA[10].

Community-associated MRSA(CA-MRSA) infections are emerging problem in many parts of the world. These infections originate in communities as opposed to HA-MRSA infections, which are nosocomial. Unlike HA-MRSA, CA-MRSA is susceptible to multiple classes of antibiotics, except β-lactams and occasionally to erythromycin [11]. Vancomycin and other glycopeptide antibiotics are the current mainstay of therapy for serious infections caused by MRSA. However, the high prevalence of MRSA has led to increase uses of vancomycin in chronic and seriously ill patients and has thus resulted in the emergence of MRSA with reduced susceptibility or resistance to glycopeptides [12-14].

A study conducted in Mangalore, India in 1997 had found the prevalence of MRSA to be 21% [15], while a more recent study done in 2010 showed the prevalence rate to be 29.1% [10]. The present study also revealed a lower rate of MRSA than results reported in studies Northern India such as New Delhi (44% - 51%) [6,16], Sikkim (38.14%) [17], Varanasi (38.44%) [18]. Different areas of Southern India, showed prevalence rates that were similar to our study - Coimbatore (31.1%) [19] and Vellore (24%) [20]. Studies conducted in different countries of South Asia like – Karachi (43%) [21], Nepal (38%-40%) [22,23] also revealed a higher prevalence rate.

Our study revealed that 45.7% of MRSA strains were resistant to clindamycin, 64.7% to ciprofloxacin, 87.3% to co-trimoxazole, 54.3% to erythromycin, 17.3% to gentamicin, 16.8% to netilmycin, and 58.38% to tetracycline. The sensitivity of MRSA to penicillin and amoxiclav was found to be very low in our study–approximately 10% and consistent with other studies conducted in India [6,9,18,19]. We found a high level of resistance to ciprofloxacin, although not as high as reported by other studies in different parts of India such as the Vellore, Central India and Varanasi study, which reported resistances of 90% [20], 84% [9] and 75.75% [19] respectively. Amongst the macrolide group of antibiotics susceptibility to erythromycin was around 45% in our study, which was much higher as compared to studies done in other parts of India where the erythromycin sensitivity was as low as 4% in the Sikkim study [18]. A study from central India and Varanasi reported a sensitivity of 25.5% [9] and 21% [19] respectively, which were significantly lower than that reported by our study. Same was the case for sensitivity to gentamicin and netilmycin, which was found to be more than 80% in our study, and much higher than that reported from Varanasi (44.2% sensitivity to gentamicin and 34.2% sensitivity to netilmycin) [19] and Sikkim (9.28% sensitivity to netilmycin amongst cases) [18]. All MRSA isolates were sensitive to vancomycin, a finding consistent with many studies in India [6,16,19]. A recent study by Indian Network for Surveillance of Antimicrobial Resistance (INSAR) included 26310 isolates of *S. aureus* and found that 41% were MRSA [24]. This study also reported that the MSSA strains were more susceptible to clindamycin, co-trimoxazole, erythromycin and gentamicin, observations that are similar to the results of the present study.

CONCLUSION

Nosocomial infections caused by MRSA is a significant problem. MRSA and MSSA differ with their susceptibility to antibiotics. All MRSA isolates in our hospitals were susceptible to vancomycin at the time of this study. Proper selection of the antibiotics based on antibiotic susceptibility test results is needed for effective treatment and prevention of emergence of resistance in MRSA and MSSA.

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PARTICULARS OF CONTRIBUTORS:
1. Intern, Department of Microbiology, Kasturba Medical College, Mangalore, India.
2. Intern, Department of Microbiology, Kasturba Medical College, Mangalore, India.
3. Professor and Head, Department of Microbiology, Kasturba Medical College, Mangalore, India.
4. Additional Professor, Department of Microbiology, Kasturba Medical College, Mangalore, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Gopalkrishna Bhat K.,
Additional Professor, Department of Microbiology,
Kasturba Medical College, Manipal University, Mangalore-575001, India.
Phone: +91-9844141574, E-mail: gopalkrishna.bhat@manipal.edu

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