Research Article

Prevalence of methicillin-resistant Staphylococcus aureus in various clinical samples in a tertiary-care hospital

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Abstract

Introduction: *Staphylococci* are the normal inhabitants of human skin and mucous membranes. *Staphylococci* play a role in bacteremia, endocarditis, urinary tract infection, surgical site infections, and so on. Methicillin-resistant *Staphylococcus aureus* (MRSA) is prevalent worldwide and is an important cause of nosocomial infections, resulting in an increased morbidity and mortality in the hospital settings worldwide.

Objective: To know the prevalence of MRSA among hospitalized patients and to guide in minimizing the spread of systemic or deep MRSA infections in high-risk patients, such as those in the intensive care unit (ICU) or other key clinical area

Materials and Methods: This study was carried out in the Department of Microbiology in BJ Medical College, Ahmedabad. Various clinical samples sent for culture sensitivity examination were collected over a period of 6 months from June to November 2012. *Staphylococcus* was identified using standard methods. Then, methicillin-resistant strains were identified by using screening and confirmatory techniques recommended by the Clinical and Laboratory Standards Institute (CLSI). Data were collected, and the prevalence was estimated.

Result: We collected a total of 5,046 samples, and *Staphylococcus* were identified from 232 samples. Of the 232 samples containing *S. aureus* recovered from the different clinical samples, 20.25% (47) of them were found to be methicillin resistant.

Conclusion: The health-care institutions face constant and evermore problems, because of MRSA. Minimizing the emergence of this organism and its spread remain to be the challenges that need to be addressed. A regular surveillance of hospital-associated infections is mandatory.

KEY WORDS: Methicillin resistant, antibiotic, prevalence, *Staphylococcus,* infection

Introduction

Methicillin-resistant strains of *Staphylococcus aureus* (MRSA) are implicated in serious infections and nosocomial outbreaks. The choices of treatment are reduced, as they are resistant to various antibiotics. *Staphylococci* are the normal inhabitants of human skin and mucous membranes. *Staphylococci* play a role in bacteremia, endocarditis, urinary tract infections, surgical site infections, and so on. MRSA are prevalent worldwide and are an important cause of nosocomial infections, resulting in an increased morbidity and mortality in the hospital settings worldwide. In order to treat the penicillin-resistant *S. aureus*, methicillin was first introduced in human medicine in the 1960s, but within a few years, MRSA emerged. The extent to which *S. aureus* causes its effect on human ranges from minor skin diseases to life-threatening infections.[1] Several mechanisms for the methicillin resistance seen in *S. aureus* have been detected. The most important is the production of an altered penicillin-binding protein (PBP)

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that has a low affinity for β-lactam antibiotics and whose effects are determined by several structural genes (*mecA*).[2,3] Other known mechanism of methicillin resistance is the hyperproduction of penicillinase enzyme.[3,4]

Life-threatening sepsis and osteomyelitis caused by MRSA have also been reported.[5] The *S. aureus* infections commonly showed response to β-lactam and the related group of antibiotics, but the emergence of MRSA has exerted a serious therapeutic challenge.[6] The MRSA strains are spread through the infected and colonized patients in hospitals, and the main source of transmission is the hospitals staff.[7] 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 of proper hygiene, intravenous drug abuse, and the presence of indwelling medical devices.[8] As the MRSA are multidrug resistant, it is difficult to eradicate them.[1] It has been found that resistance to glycopeptides drugs was also observed in several parts of the nation.[9,10] The proper treatment for these infections requires the knowledge of prevalence of MRSA and their antimicrobial-susceptibility pattern. This study was undertaken to assess the prevalance rate of MRSA in our hospital.

Materials and Methods

This study was carried out in the Department of Microbiology, BJ Medical College, Ahmedabad, Gujarat, India. Various clinical samples sent for culture sensitivity examination from tertiary-care civil hospital, Ahmedabad, were included in the study for over a period of 6 months from June to November 2012. All age group patients were included.

All the samples were processed and inoculated on blood agar, nutrient agar, and MacConkey agar. *S. aureus* was diagnosed by their growth characteristics on MacConkey agar (pink color colony), on nutrient agar (large, circular, and opaque colony), and on blood agar; (grayish white colony), gram-stain morphology (gram-positive cocci in clusters); positive catalase test; positive coagulase test (slide and tube coagulase test); growth on mannitol salt agar; and pigment characteristics (golden yellow).

Antibiotics Susceptibility Testing

The antibiotic susceptibility pattern of all the *S. aureus* strains were determined by modified Kirby–Bauer disc diffusion method against the following antibiotics: cotrimoxazole (25 µg), ampicillin–sulbactam (20 µg), tetracycline (30 µg), cephalexin (30 µg), ciprofloxacin (5 µg), cloxacillin (1 µg), gentamycin (10 µg), erythromycin (15 µg), clindamycin (2 µg), and linezolid (2 µg). All the tests were performed on Mueller–Hinton agar and were interpreted after incubation for 24 h at 37°C. The zone diameters measured around each disc were interpreted on the basis of guidelines published by the Clinical and Laboratory Standards Institute (CLSI).

Detection Method for MRSA

Screening was performed according to the CLSI guidelines using cefoxitin disc (30 µg) diffusion testing method. From each strain, a suspension equivalent to 0.5 McFarland was prepared. Then, a swab was dipped and streaked on the surface of a Mueller–Hilton agar supplemented after incubation for 24 h at 35°C. If the zone of inhibition was ≤21 mm in diameter, the isolate was considered as MRSA [Figure 1]. Confirmation was done by oxacillin minimum inhibitory concentration (MIC) test, Epsilometer test (E-test) on 2% NaCl Mueller–Hinton agar plates; MIC > 4 was considered as methicillin resistance. For this, quality control used were ATCC 25923 *S .aureus* as negative control and ATCC 43300 *S. aureus* as positive control [Figure 2].

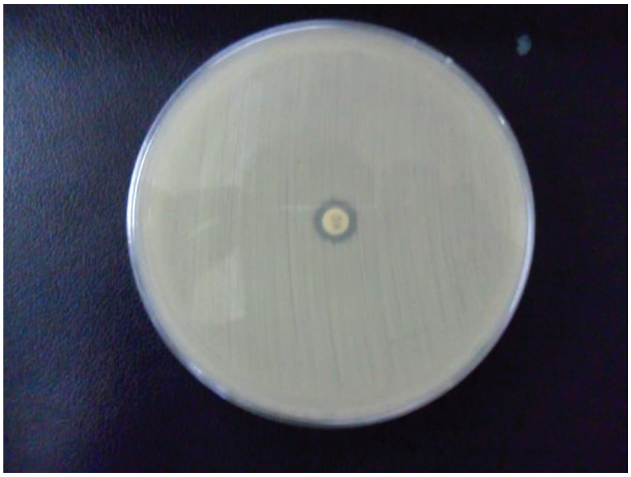

Figure 1: Cefoxitin disc diffusion test.

Figure 2: Oxacillin *E*-test.

Result

We received a total of 5,046 samples over the duration of 6 months from June to November 2012. Of these, S. *aureus* was isolated in 232 samples. Forty-seven (20.25%) of these 232 samples were found to be methicillin resistant.

MRSA isolated were in majority form skin and soft tissue samples (71%), followed by blood cultures (15%), miscellaneous (5.26%), and respiratory specimens (4.09%) [Figure 3].

Methicillin-resistant strains were resistant to multiple antibiotics. Resistance to other antibiotics were more encountered in MRSA strains when compared with methicillin-susceptible *Streptococcus aureus* (MSSA) strains. MRSA strains were highly susceptible to vancomycin, linezolid, and teicoplanin. All MRSA strains isolated were sensitive to vancomycin in our study [Figure 4].

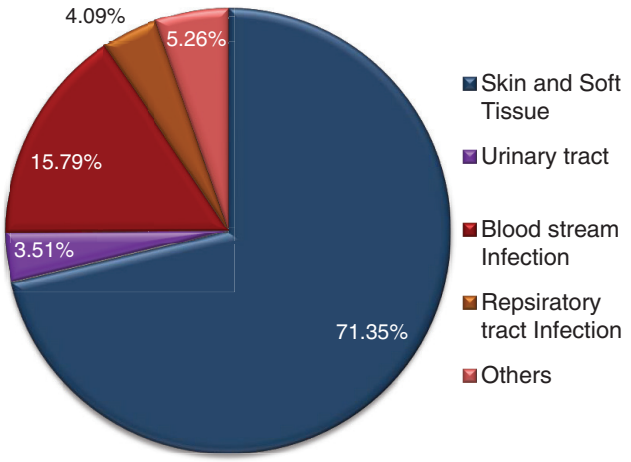

Figure 3: Percentage distribution of MRSA according to different sites.

Discussion

MRSA is a major nosocomial pathogen causing significant morbidity and mortality. MRSA is a persistent and ever growing problem for health-care institutions. Data on prevalence of MRSA are variable. Our study showed the prevalence of MRSA as 20% in our hospital.

In our study, MRSA isolated were in majority from skin and soft tissue samples (71%), followed by blood cultures (15%), miscellaneous (5.26%), and respiratory specimen (4.09%); which can be compared with the study done by Shah et al.,[11] in which MRSA isolated were in majority from pus samples (74.13%), followed by blood cultures (18.97%), miscellaneous (5.17%), and sputum (1.72%). In the study carried out by Shah et al. and in this study, MRSA were found to be 30.37% and 20.25% of the total isolates of *S. aureus*, respectively.

In India, the incidence of MRSA shows a large variation, from 6.9% to 81%. Some studies have reported comparable prevalences: 54.8% in Uttar Pradesh,[8] 52.9% in Assam,[12] 80.89% in Indore,[13] and 19.56% in Nagpur.[14] According to a different study carried out by Tesring et al.,[15] the prevalance rate was 38.14%, and in the study of Joshi et al.[16] and Arora et al.,[17] the prevalance rates were 41% and 46%, respectively.

When compared with few studies described earlier, the prevalence of MRSA in our hospital was found to be quite less. This could be explained on the basis that regular surveillance of hospital-associated infections including antimicrobial susceptibility pattern of MRSA is performed, and infection control measures are taken to prevent the spread of MRSA. Another reason could be that our study included only those samples that were sent for suspected cases. No random samples were selected from patients to detect the presence of MRSA who were not clinically suspected. Thus, this study only detects the prevalence of MRSA in clinically suspected cases whose

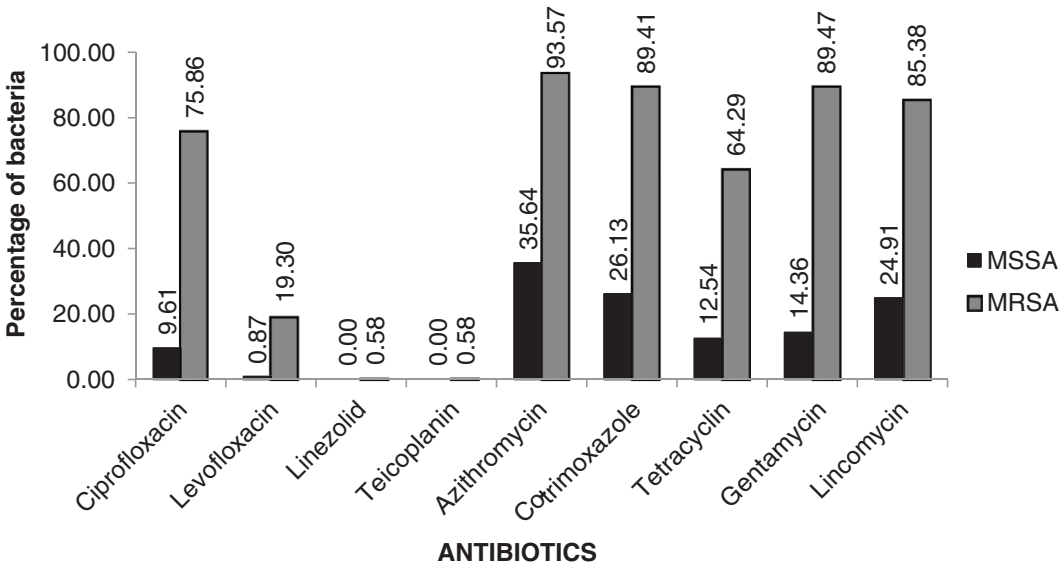

Figure 4: Comparison of resistance patterns of MRSA and MSSA with various antibiotics.

samples were received for culture and sensitivity examination and not prevalence of MRSA as whole.

With the help of this study, we found out the prevalence of MRSA in our hospital setup. These data will help us further to formulate a better antibiotic policy and to take appropriate infection control measures.

Conclusion

The health-care institutions face constant and evermore problems, because of MRSA. Data on prevalence of MRSA are variable. Our study showed the prevalence of MRSA as 20% in our hospital. The prevalence varies depending on the infection control policy of hospitals. Minimizing the emergence of this organism and its spread remains a challenge that needs to be addressed. A regular surveillance of hospital-associated infection, including monitoring antibiotic sensitivity pattern of MRSA, is mandatory to control the spread in the hospital and strict drug policy are mandatory. Vancomycin use should be limited to those cases where they are clearly needed. However, owing to the increasing use of vancomycin, regular monitoring of vancomycin sensitivity by MIC for MRSA and routine testing of other new glycopeptides should be carried out further. Prevention and infection control strategies should be applied in tertiary-care hospitals such as general measures (hand hygiene, cleanliness, proper disinfection, use of contact precautions, and education and training of all health-care workers) and specific measures (patient isolation and cohorting, eradication of MRSA carriage, and surveillance and screening of patients and health-care workers).

References

1. Tiwari HK, Das AK, Sapkota D, Sivrajan K, Pahwa VK. Methicillin-resistant *Staphylococcus aureus*: prevalence and antibiogram in a tertiary care hospital in western Nepal. J Infect Dev Ctries 2009;3(9):681–4.
2. Hackbarth CJ, Chambers HF. Methicillin-resistant *Staphylococci*: genetics and mechanisms of resistance. Antimicrob Agents Chemother 1989;33(7):991–4.
3. Tomasz A, Drugeon HB, de Lancester HM, Jabes D, McDougall L, Bille J. New mechanism for methicillin-resistance in *Staphylococcus aureus*: clinical isolates that lack the *PBP—2a* gene and contain normal penicillin-binding proteins with modified penicillin-binding capacity. Antimicrob Agents Chemother 1989;33(11):1869–74.
4. Fluit AC, Wielders CL, Verhoef J, Schmitz FJ. Epidemiology and susceptibility of 3,051 *Staphylococcus aureus* isolates from 25 university hospitals participating in the European SENTRY study. J Clin Microbiol 2001;39(10):3727–32.
5. Cox RA, Conquest C, Mallaghan C, Marples RR. A major outbreak of methicillin-resistant *Staphylococcus aureus* caused by a new phage-type (EMRSA-16). J Hosp Infect 1995;29(2):87–106.
6. Muralidharan S. Special article on methicillin-resistant *Staphylococcus aureus*. J Acad Clin Microbiol 2009;11:15–6.
7. Rajaduraipandi K, Mani KR, Panneerselvam K, Mani M, Bhaskar M, Manikandan P. Prevalence and antimicrobial susceptibility pattern of methicillin-resistant *Staphylococcus aureus:* a multicentre study. Indian J Med Microbiol 2006;24(1):34–8.
8. Anupurba S, Sen MR, Nath G, Sharma BM, Gulati AK, Mohapatra TM. Prevalence of methicillin-resistant *Staphylococcus aureus* in a tertiary referral hospital in eastern Uttar Pradesh. Indian J Med Microbiol 2003;21(1):49–51.
9. Menezes GA, Harish BN, Sujatha S, Vinothini K, Parija SC. Emergence of vancomycin-intermediate *Staphylococcus* species in southern India. J Med Microbiol 2008;57:911–2.
10. Tiwari HK, Sen MR. Emergence of vancomycin resistant *Staphylococcus aureus* (VRSA) from a tertiary care hospital from northern part of India. BMC Infect Dis 2006;6:156.
11. Shah VP, Mundra N, Vachhani N, Shah HY, Gadhvi H, Shingala H, et al. All prevalence and antibiotic susceptibility pattern of methicillin-resistant *Staphylococcus aureus* in a tertiary care hospital, Jamnagar, Gujarat. Int J Sci Res 2012;1(3):2277–9.
12. Assadullah S, Kakru DK, Thoker MA, Bhat FA, Hussain N, Shah A. Emergence of low level vancomycin resistance in MRSA. Indian J Med Microbiol 2003;21(3):196–8.
13. Verma S, Joshi S, Chitnis V, Hemwani N, Chitnis D. Growing problem of methicillin-resistant *Staphylococci*—Indian scenario. Indian J Med Sci 2000;54:535–40.
14. Tahnkiwale SS, Roy S, Jalgaonkar SV. Methicillin resistance among isolates of *Staphylococcus aureus*: antibiotic sensitivity pattern and phage typing. Indian J Med Sci 2002;56(7):330–4.
15. Tsering DC, Pal R, Kar S. Methicillin-resistant *Staphylococcus aureus:* prevalence and current susceptibility pattern in Sikkim. J Glob Infect Dis 2011;3(1):9–13.
16. Joshi S, Ray P, Manchanda V, Bajaj J, Gauatm V, Goswami P, et al. Methicillin-resistant *Staphylococcus aureus* (MRSA) in India: prevalence and susceptibility pattern. Indian J Med Res 2013; 137(2):363–9.
17. Arora S, Devi P, Arora U, Devi B. Prevalence of methicillin-resistant *Staphylococcus aureus* (MRSA) in a tertiary care hospital in Northern India. J Lab Physicians 2010;2(2):78–81.

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