Original Research Article

Prevalence of Methicillin-resistant *Staphylococcus aureus* and its antibiotic sensitivity in clinical samples in Tertiary Care Hospital

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Abstract

Introduction: *Staphylococcus aureus* is responsible for causing a variety of human infections, which may range from minor skin diseases to life-threatening infections. It colonizes healthy individuals and causes severe infection in hospitalized patients. *Staphylococcus aureus* infections 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. The present study aimed to determine prevalence of *Methicillin-resistant Staphylococcus aureus* in Dhiraj General Hospital, Gujarat and to determine antibiotic sensitivity pattern of Methicillin resistant *Staphylococcus aureus* in various samples and to determine inducible clindamycin resistance strains out of Methicillin resistant *Staphylococcus aureus* at Dhiraj General Hospital.

Materials and methods: The present study was conducted in Microbiology Department of SBKS MI and RC during January 2022 to December 2022. The study comprised of 114 coagulase-positive staphylococci (COPS), isolated from a total of 1470 clinical specimens (like pus, blood, urine, high vaginal swab, sputum, etc.) of patients admitted in Dhiraj General hospital attached to SBKS MI and RC, Hospital, Waghodia, Gujarat. All the isolates were identified by standard procedures.

Antimicrobial susceptibility test was carried out on each bacterial isolate using the disc diffusion method on Muller Hinton agar (MHA). Data were entered and analyzed statistically.

Results: During one year of study period, a total of 1470 positive culture samples were there. Out of that, 114 positive samples of *Staphylococcus aureus* were isolated. Out of total *Staphylococcus aureus* positive samples, 24 strains of Methicillin resistant *Staphylococcus aureus* (MRSA) were detected. Out of total MRSA, 10 inducible clindamycin resistant *Staphylococcus aureus* were detected.

Conclusion: To conclude, we can say that Vancomycin and Teicoplanin is the drug of choice in MRSA patients. As MRSA is an alarming issue for the health system, one should always think about drug sensitivity test before starting treatment.

Key words

Staphylococcus aureus, *Methicillin-resistant Staphylococcus aureus*, Antimicrobial susceptibility.

Introduction

Staphylococcus aureus is responsible for causing a variety of human infections, which may range from minor skin diseases to life-threatening infections [1]. It colonizes healthy individuals and causes severe infection in hospitalized patients. Staphylococcus aureus infections 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]. Methicillin-resistant S. aureus acquires its resistance via the methicillin resistance gene mecA, which encodes a low affinity penicillin-binding protein (PBP2a) that is absent in susceptible S. aureus strains [3, 4]. +is resistant penicillin binding protein receptor does not bind well to most β-lactams and therefore allows MRSA to grow in their presence [4]. Methicillin-resistant S. aureus strains were recently classified as two groups by epidemiologic as well as molecular characteristics, namely, community-associated (CA) MRSA and healthcare-associated (HA) MRSA. Community-associated MRSA isolates are usually less resistant than HA-MRSA isolates [5]. Methicillin-resistant *S. aureus* is a major problem worldwide causing hospital-acquired infections [6] The present study aimed to determine prevalence of Methicillin-resistant *Staphylococcus aureus* in Dhiraj General Hospital, Gujarat and to determine antibiotic sensitivity pattern of Methicillin resistant *Staphylococcus aureus* in various samples and to determine inducible clindamycin resistance strains out of Methicillin resistant *Staphylococcus aureus* at Dhiraj General Hospital.

Materials and methods

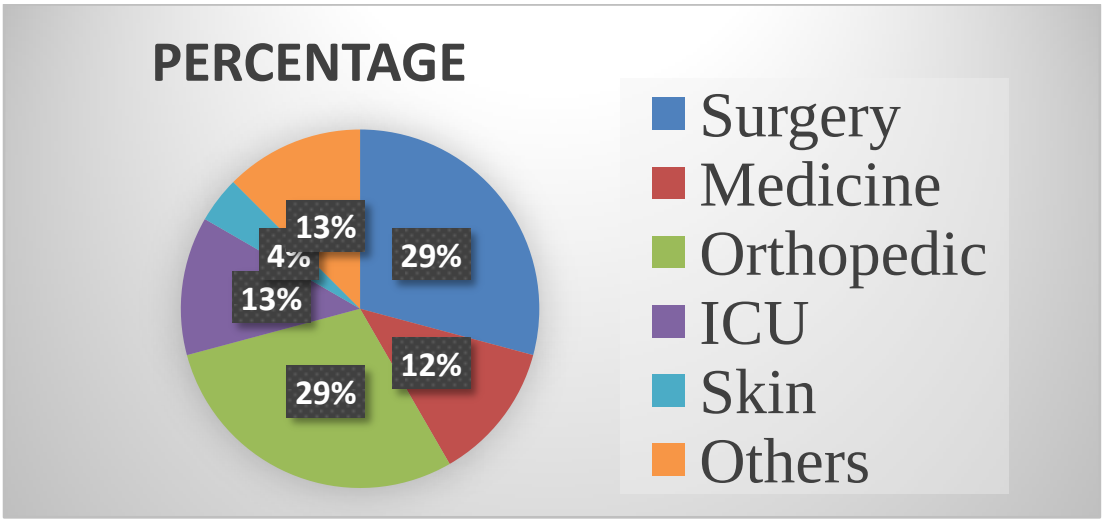
The present study was conducted in Microbiology Department of SBKS MI and RC during January 2022 to December 2022. The study comprised of 114 coagulase-positive staphylococci (COPS), isolated from a total of 1470 clinical specimens (like pus, blood, urine, high vaginal swab, sputum, etc.) of patients admitted in Dhiraj General hospital attached to, SBKS MI and RC, Hospital, Waghodia, Gujarat. All the isolates were identified by standard procedures [7] (gram staining, catalase test, mannitol fermentation, slide coagulase and tube coagulase test). Tube coagulase was taken as the main criteria of identification and was performed by diluting rabbit plasma in freshly prepared normal saline (1:6). Three to four colonies were emulsified in 1 ml of diluted plasma and the tubes were incubated at 37ºC. Readings were taken at 1, 2, 3 and 4 h and further incubated at room temperature if no clot formation was observed. Antimicrobial susceptibility test was carried out on each bacterial isolate using the disc diffusion method on Muller Hinton agar (MHA). Three to five pure colonies of each bacterium were picked and transferred to a tube containing 5 ml sterile nutrient broth. The preparation was mixed thoroughly to make the

suspension homogeneous. +e suspension was incubated at 37°C until the turbidity of the suspension adjusted to a 0.5 McFarland turbidity standard (bacterial concentration of 1.5 ×108 colony-forming unit/ml) [8]. A sterile swab was dipped in the suspension, and the entire surface of the MHA plates was uniformly flooded with the suspensions and allowed to dry for about 15–30 minutes. The antimicrobial impregnated disks were placed on the media using sterile forceps in such a way that each disk was placed at least 24 mm away from each other to avoid the overlapping zone of inhibition. After the disk was placed on the inoculated media, the plates were allowed to stand for 30 minutes so that the antibiotic will diffuse into the media. The plates were inverted and incubated at 35 ± 2°C for 24 h and observed for the zone of inhibition. Data were entered and analyzed statistically.

Results

During one year of study period, a total of 1470 positive culture samples were there. Out of that, 114 positive samples of *Staphylococcus aureus* were isolated. Out of total *Staphylococcus aureus* positive samples, 24 strains of Methicillin resistant *Staphylococcus aureus* (MRSA) were detected. Out of total MRSA, 10 inducible clindamycin resistant *Staphylococcus aureus* were detected. Prevalence rate of MRSA was found to be 21.05% at Dhiraj Hospital, Vadodara. In Dhiraj Hospital, Methicillin resistant *Staphylococcus aureus* was found majorly in Surgery (29%) and Orthopedic department (29%) followed by ICUs (13%) and others (13%), Medicine (12%) and Skin (4%) (**Graph - 1**). Methicillin resistant *Staphylococcus aureus* was predominantly found in pus samples (83%) followed by blood (13%) and others samples (4%) (**Graph - 2**). The most sensitive drug was Vancomycin (100%) and Teicoplanin (100%), followed by Linezolid (95.83%), Rifampicin (95.83%), Tetracycline (87.5%), Daptomycin (66.66%), Gentamicin (58.33%), Trimethoprim-sulfamethoxazole (58.33%), Clindamycin (41.66%), Erythromycin (25%) (**Graph - 3**).

Graph – 1: Department wise distribution of MRSA cases.

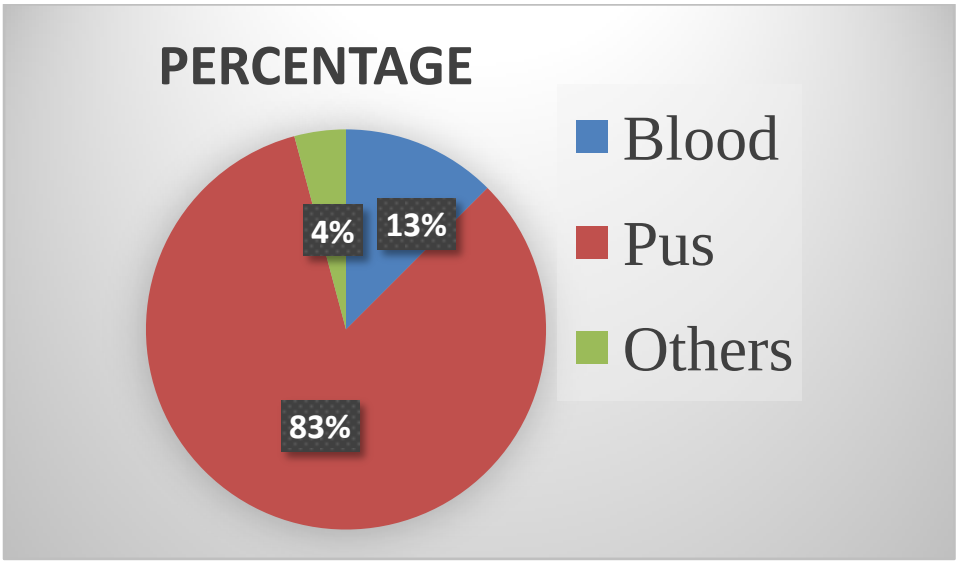


Discussion

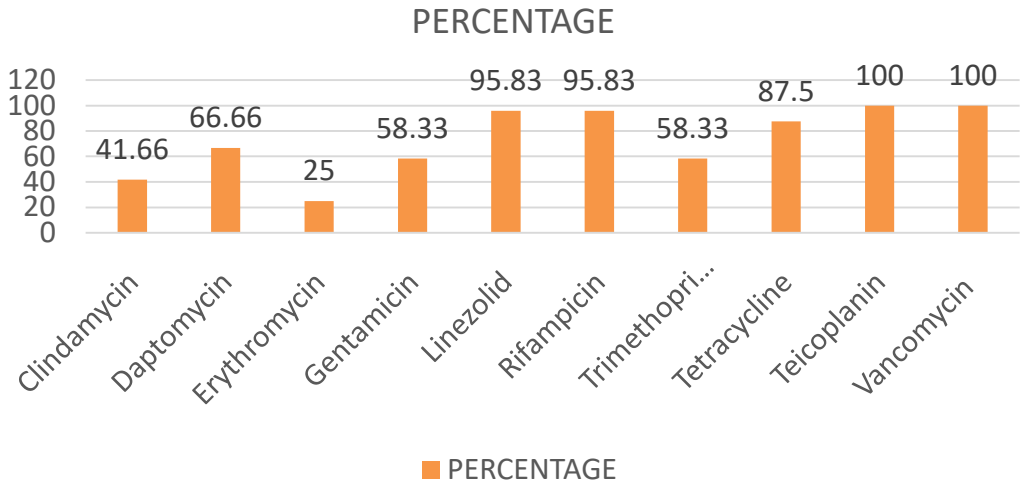
It is worrisome that the present study reports an alarmingly high prevalence 21.05% of MRSA infection. Other studies have also shown such a high MRSA prevalence in various parts of the country ranging from 40.6% to 54.85% to 59.3% [2, 9, 10]. In addition to that, 31.1 and 23.6% MRSA prevalence has also been reported,[3,10] which is comparatively high than that reported in the present study. This variation might be because of several factors like efficacy of infection control. Practices, healthcare facilities

and antibiotic usage that vary from hospital to hospital. In the present study 21% MRSA strains were isolated from surgical units. Srinivasan S, et al. also found that surgical units accounted for 80% of the MRSA isolates and postoperative infections [11].

Graph – 2: Sample wise distribution of MRSA.



Graph – 3: Drug sensitivity for MRSA.



Regarding the possible associated risk factors, MRSA wound infections were significantly associated with occupation (farmers), patients with low BMI, and those patients who are currently admitted (inpatient) as compared to their counterparts. This might be because farmers may not have knowledge of utilizing healthcare services; in addition, their occupation may expose them to wound infection and make them use antibiotics without prescription. High prevalence of MRSA in admitted patients may be attributed by resistant strain bacterial cross-contamination in health institutions. Patients who have low BMI had higher odds of developing wound infection due to MRSA. Healthy people may carry MRSA asymptomatically for long periods of time, but patients with compromised immune system are at a significantly greater risk of symptomatic infections [12, 13]. The most sensitive drug in the present study was Vancomycin (100%) and Teicoplanin (100%), followed by Linezolid (95.83%), Rifampicin

(95.83%), Tetracycline (87.5%), Daptomycin (66.66%), Gentamicin (58.33%), Trimethoprim-sulfamethoxazole (58.33%), Clindamycin (41.66%), Erythromycin (25%). The main variation in drug resistance patterns among different studies might be due to the indiscriminate use and availability of these antibiotics in a certain area. The variation of resistance rate among different areas indicates the resistance pattern of antibiotics varies according to regional and geographical location and also changes through time.

Conclusion

To conclude, we can say that Vancomycin and Teicoplanin is the drug of choice in MRSA patients. As MRSA is an alarming issue for the health system, one should always think about drug sensitivity test before starting treatment.

References

1. Tiwari HK, Das AK, Sapkota D, Sivarajan K, Pahwa VK. Methicillin resistantStaphylococcus aureus: Prevalence and antibiogram in a tertiary care hospital in western Nepal. J Infect Dev Ctries., 2009; 3: 681-4.
2. Muralidharan S. Special article on methicillin resistant Staphylococcus aureus. J Acad Clin Microbiol., 2009; 11: 15-6.
3. K. Hiramatsu, L. Cui, M. Kuroda, T. Ito. "+e emergence and evolution of methicillin-resistant Staphylococcus aureus." Trends in Microbiology, 2001; 9(10): 486–493.
4. D. M. Sievert, J. T. Rudrik, J. B. Patel, L. C. McDonald, M. J. Wilkins, J. C. Hageman. "Vancomycin-resistant Staphylococcus aureus in the United States, 2002–2006." Clinical Infectious Diseases, 2008; 46(5): 668–674.
5. Y. C. Kang, W. C. Tai, C. C. Yu, J. H. Kang, Y. C. Huang. "Methicillin-resistant Staphylococcus aureus nasal carriage among patients receiving hemodialysis in Taiwan: prevalence rate, molecular characterization and de-colonization." BMC Infectious Diseases, 2012; 12(1): 284.
6. R. Baldan, C. Tassan Din, G. Semeraro, et al. "Severe community-onset infections in healthy individuals caused by community-acquired MRSA in an Italian teaching hospital, 2006–2008." Journal of Hospital Infection, 2009; 72(3): 271–273.
7. Baird D. Staphylococcus: Cluster forming gram positive cocci. In: Collee JG, Fraser AG, Marmion BP, Simmons A, editors., Mackie and McCartney Practical Medical Microbiology, 14th edition, Vol. 2, London: Churchill Livingstone; 1996, p. 245-61.
8. M. Cheesbrough. District Laboratory Practice in Tropical Countries, Cambridge University Press, Cambridge, UK, 2006.
9. 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: 49-51.
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. Srinivasan S, Sheela D; Shashikala, Mathew R, Bazroy J, Kanungo R. Risk factors and associated problems in the management of infections with methicillin resistant Staphylococcus aureus. Indian J Med Microbiol., 2006; 24: 182-5.
12. N. L. B. Zakour, C. M. Guinane, J. R. Fitzgerald. "Pathogenomics of the staphylococci: insights into niche adaptation and the emergence of new virulent strains." FEMS Microbiology Letters, 2008; 289(1): 1–12.

13. A. Holmes, M. Ganner, S. McGuane, T. L. Pitt, B. D. Cookson, A. M. Kearns. "Staphylococcus aureus isolates carrying Panton-Valentine leucocidin genes in England and Wales: frequency, characterization, and association with clinical disease." Journal of Clinical Microbiology, 2005; 43(5): 2384–2390.