Study of Methicillin-resistant Staphylococcus aureus (MRSA) isolated from clinical samples in a tertiary care hospital

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ABSTRACT

INTRODUCTION: Isolation of Staphylococcus aureus and phenotypic characterization of MRSA. A total of 545 isolates were studied. The MRSA strains were classified as MRSA based on their resistance to penicillins and cephalosporins of the beta-lactum group of antibiotics. Methicillin-resistant Staphylococcus aureus (MRSA) is an important human pathogen associated with nosocomial and community-acquired infections.

METHODS: A total of 545 MRSA isolates were isolated and antimicrobial susceptibility testing (AST) was performed by the Kirby-Bauer diffusion method using cefoxitin.

RESULTS: The AST revealed that vancomycin had a sensitivity of 100%, followed by teicoplanin (93.57%) and linezolid (89.17%). The least sensitive was erythromycin (12.84%), followed by azithromycin (20%), trimethoprim and ciprofloxacin (34.49%), gentamicin (36.88%), chloramphenicol (38.16%) and amikacin (38.34%).

CONCLUSION: Cefoxitin disc diffusion is rapid, simple and inexpensive and can therefore be routinely used for the detection of MRSA.

KEY WORDS: MRSA, AST, cefoxitin.

INTRODUCTION: Staphylococcus aureus (S. aureus) is the causative agent of a variety of human diseases, including endocarditis, food poisoning, toxic shock syndrome, septicemia, skin infections, soft tissue infections, and bone infections.[1] Methicillin-resistant Staphylococcus aureus has emerged as an important pathogen of nosocomial and community-acquired infections.[2] Accurate and rapid

identification of MRSA in clinical samples is crucial for timely decisions on effective antimicrobial chemotherapy.[3]

MATERIAL & METHODS:

Samples were cultured aerobically on 5% sheep blood agar. MRSA was identified by characteristic growth on blood agar based on colony morphology, hemolysis and pigment production. The isolates were also confirmed by Gramme stain and various biochemical tests, namely catalase test, tube and slide coagulase test and mannitol-salt agar fermentation test. Phenotypic methods for the detection of MRSA Cefoxitin disc diffusion method: All strains were tested using Cefoxitin discs (Hi-Media) on Mueller–Hinton agar plates. A bacterial suspension adjusted to 0.5 McFarland was used for each strain. The zone of inhibition was determined after 24 hours of incubation at 35°C. Zone size was interpreted according to CLSI guidelines, i.e. sensitive >22 mm; resistant.

RESULT:

A total of 545 isolates were isolated from various clinical samples and analysed for MRSA using the cefoxitin diffusion method. The distribution of MRSA among different clinical specimens was highest in pus (33.39%), followed by blood (32.29%), urine (17.6%), ET secretion (8.80%) and lowest in sputum (8.44%).

Most MRSA were isolated in the medical department (35.59%), followed by ICU (16.51%), surgery (14.86%), ENT (13.76%), O & G (8.25%), orthopaedics (6.42%) and least from the tuberculosis and chest department (4.58%). Of the total 545 MRSA isolates, the highest proportion was obtained from male patients (56.88%), while the lowest proportion was from female patients (43.11%). In addition, men in the age group of 31 to 40 years were more frequently infected (20.3%), while women in the age group of 21 to 30 years were infected in 31.91%.

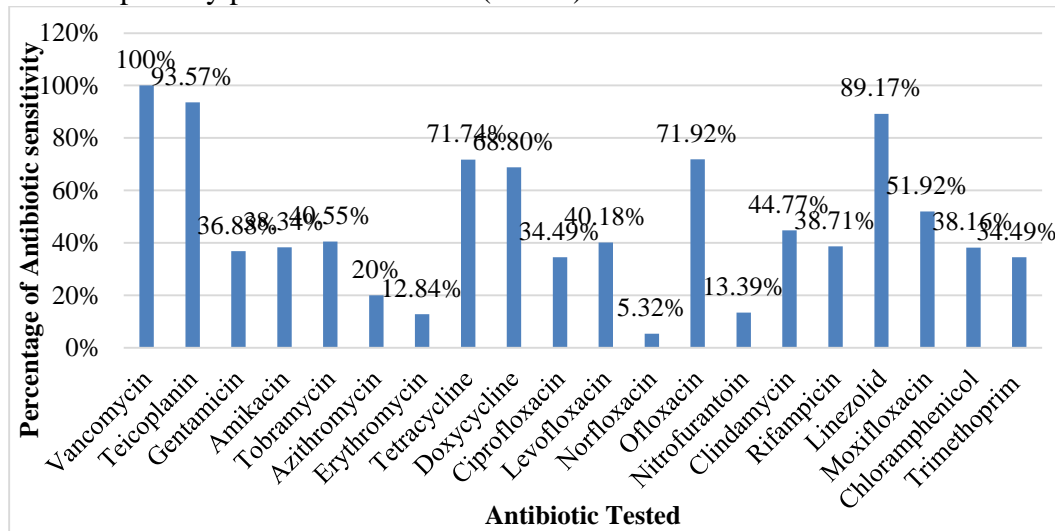1. Antibiotic susceptibility patterns of MRSA. (n=545)

Figure 1: Antibiotic susceptibility patterns of MRSA. (n = 545)

Vancomycin showed 100% sensitivity followed by teicoplanin (93.57%) and linezolid (89.17%) in the AST patterns of isolated MRSA. The least sensitive was erythromycin (12.84%), followed by azithromycin (20%), trimethoprim or ciprofloxacin (34.49%), gentamicin (36.88%), chloramphenicol (38.16%) and amikacin (38.34%). The antibiotic resistance patterns among the MRSA isolates showed that erythromycin had the highest resistance (75.22%), followed by azithromycin (67.70%), ciprofloxacin (64.77%), trimethoprim (64.58%), amikacin (61.46%) and gentamicin (62.01%). No

vancomycin resistance was reported and the lowest number of resistances was seen with teicoplanin (6.23%) and linezolid (7.88%).

DISCUSSION

The distribution of MRSA among various clinical specimens was highest in pus (33.39%), followed by blood (32.29%), urine (17.6%), ET secretion (8.80%) and lowest in sputum (8.44%).

Other Indian studies by Puthiya Purajil Preeja et al. showed that most of the MRSA were isolated from pus (84.09%) and blood (13.6%).[4] Various other studies from Myanmar by Pan Ei Soe et al. showed a similar result with a high prevalence of 52 from blood.[5] Tsering et al, from Sikkim showed a prevalence of 56.52% in sputum, 50% in blood, 45.83% in urine, 41 in throat swab and 27.05% in pus.[6] Tiwari et al, from Bhuneswar reported 45 in pus and 20.05% in urine.[7] Khan et al, from Lucknow reported pus 24%, blood 4.29%, urine 43.71%, sputum 11.14%.[8] Arora et al, from Punjab reported pus 51.2%, blood 31.06%, urine 10.08%, sputum 0.02%.[3] Pai et al, from Mangaluru reported pus 27.07%, blood 22.22%, urine 42.8%, sputum 29.4%.[9] Kauret al, from Pune reported pus 13.56%, blood 5.56%, urine 5.32%, sputum 7.69%.[10] According to the INSAR group, MRSA was isolated from pus 40% of the time, followed by blood 48 of the time, urine 52 of the time and sputum 41%.[11]

Most MRSA was isolated from the medical department (35.59%), followed by the ICU (16.51%), surgery (14.86%), ENT (13.76%), O & G (8.25%), orthopaedics (6.42%) and least from the tuberculosis and chest department (4.58%). According to a study by Wilfred Gitau et al., the internal medicine department had the highest number of isolates (20%).[12] A study by Pan Ei Soe et al. found that medical departments had 49%, surgical departments 38%, paediatric departments 50%, intensive care units 74%, dermatology departments 66% and emergency departments 51%.[13]

Of the total of 545 MRSA isolates, the highest proportion was obtained from male patients (56.88%), while the lowest proportion came from female patients (43.11%). Moreover, males in the age group of 31 to 40 years were more frequently infected (20.3%), while females in the age group of 21 to 30 years were infected in 31.91%. According to a study conducted by Sajina Dhungel et al. in Nepal, MRSA isolates were more common in male patients (70.6%) than in female patients (29.4%), with male patients accounting for 70.6% of all isolates. Patients aged over 60 years had the highest proportion of MRSA isolates (35.4%), followed by patients aged between 46 and 60 years (29.4%).[14] According to another study by Tebelay Dilnessa et al, a higher number of MRSA was isolated in men (19.9%) than in women (17.0%), and the highest number of MRSA was detected in the age group 35–44 years (30.8%), followed by 45–64 years (27.8%), over 64 years (22.2%), 15– 24 years (17.4%), 1–14 years (14.6%) and 25–34 years (10.5%).[15]

Vancomycin showed a sensitivity of 100%, followed by teicoplanin (93.57%) and linezolid (89.17%) in the AST patterns of isolated MRSA. The least sensitive was erythromycin (12.84%), followed by azithromycin (20%), trimethoprim or ciprofloxacin (34.49%), gentamicin (36.88%), chloramphenicol (38.16%) and amikacin (38.34%).

The antibiotic resistance patterns of MRSA isolates showed that erythromycin had the highest resistance (75.22%), followed by azithromycin (67.70%), ciprofloxacin (64.77%), trimethoprim (64.58%), amikacin (61.46%) and gentamicin (62.01%). No vancomycin resistance was reported and the lowest number of resistances was seen with teicoplanin (6.23%) and linezolid (7.88%).

The results of the antimicrobial resistance patterns are quite worrying, as the majority of the isolated bacteria are highly resistant to commonly available antimicrobial drugs.[16] In agreement with previous studies, cotrimoxazole showed a high level of resistance (63%) and ciprofloxacin showed a high level of resistance (57.8%).[17] Kaur et al. showed the antibiotic resistance of MRSA isolates of which gentamycin, ciprofloxacin, moxifloxacin, erythromycin were 100% resistant and clindamycin was 97.22% resistant while vancomycin, teicoplanin were 100% sensitive followed by linezolid 97.22%.[10] Saikia et al, showed that gentamicin and ciprofloxacin (91.5%) were resistant, followed by trimethoprim (96.88%) and erythromycin (81.25%).[18] When linezolid was first introduced, researchers assumed that

resistance to this drug would not develop because of the molecule's unique mode of action. However, in 2006, Rajaduraipandi et al.[19] reported a prevalence of 2.4% linezolid-resistant S. aureus in the southern Indian state of Tamil Nadu. In addition, Thool et al. reported a 24% incidence of linezolid resistance in orthopaedic patients, which they attributed to nosocomial transmission and overuse of this antibiotic.[18]

CONCLUSION

The pattern of antibiotic sensitivity shows that vancomycin has a sensitivity of 100%, followed by teicoplanin (93.57%) and linezolid (89.17%). The least sensitive is erythromycin (12.84%), followed by azithromycin (20%), trimethoprim or ciprofloxacin (34.49%), gentamicin (36.88%), chloramphenicol (38.16%) and amikacin (38.34%). Cefoxitin disc diffusion is fast, simple and cheaper and can therefore be used routinely for the detection of MRSA.

REFERENCES

1. Mandell LA, Wunderink R. Methicillin-resistant Staphylococcus aureus and community-acquired pneumonia: an evolving relationship. Clin Infect Dis. 2012.
2. Jevons MP. Celbenin-resistant staphylococci: Br Med J. 1961.
3. Datta P, Gulati N, Singla N, Vasdeva HR, Bala K, Chander J, et al. Evaluation of various methods for the detection of meticillin resistant Staphylococcus aureus strains and susceptibility patterns. Journal of Medical Microbiology. 2011.
4. PuthiyaPurayilPreeja, Sanath H. Kumar and Veena Shetty. Prevalence and characterization of methicillin-resistant Staphylococcus aureus from community- and hospital-associated infections: A study at a tertiary care centre. Antibiotics 2021.
5. Soe, P.E.; Han, W.W.; Sagili, K.D.; Satyanarayana, S.; Shrestha, P.; Htoon, T.T.; Tin, H.H. High Prevalence of Methicillin-Resistant Staphylococcus aureus among Healthcare Facilities and Its Related Factors in Myanmar (2018–2019). Trop. Med. Infect. Dis. 2021.
6. Tsering DC, Pal R, Kar S. Methicillin-resistant Staphylococcus aureus: prevalence and current susceptibility patterns in Sikkim. J Glob Infect Dis 2011.
7. Tiwari S, Sahu M, Rautaraya B, Karuna T, Mishra SR, Bhattacharya S. Prevalence of methicillin-resistant Staphylococcus aureus and its antibiotic susceptibility pattern in a tertiary care hospital. J Indian Med Assoc 2011.
8. Khan N, Khare V, Farid R, Yaqoob S. Prevalence and antimicrobial resistance pattern of methicillin resistant Staphylococcus aureus isolated from different clinical samples. Int J Adv Res 2017.
9. Pai V, Rao VI, Rao SP. Prevalence and antimicrobial susceptibility pattern of methicillin-resistant Staphylococcus aureus [MRSA] isolates in a tertiary care hospital in Mangaluru, South India. J Lab Physicians, 2010.
10. Kaur DC, Chate SS. Study on the pattern of antibiotic resistance in methicillin-resistant Staphylococcus aureus with special reference to newer antibiotics. J Glob Infect Dis 2015.
11. Indian Network for Surveillance of Antimicrobial Resistance (INSAR) group, India. Methicillin-resistant Staphylococcus aureus (MRSA) in India: prevalence and susceptibility patterns. Indian J Med Res 2013.
12. Wilfred Gitau, Moses Masika, Moses Musyoki, Beatrice Museve and Titus Mutwiri. Antimicrobial susceptibility patterns of Staphylococcus aureus 87 isolates from clinical samples at Kenyatta National Hospital. BMC Res Notes. 2018.
13. Pan Ei Soe, Wai Wai Han, Karuna D. Sagili, Srinath Satyanarayana, Priyanka Shrestha, ThiHtoon and Htay Tin. High prevalence of methicillin-resistant Staphylococcus aureus in healthcare facilities and associated factors in Myanmar (2018–2019). Tropical Medicine and Infectious Diseases.2021.
14. SajinaDhungel, Komal Raj Rijal, Bindeshwar Yadav, Binod Dhungel, Nabaraj Adhikari, et al, Methicillin-Resistant Staphylococcus aureus (MRSA): Prevalence, Antimicrobial Susceptibility

Pattern, and Detection of mecA Gene among Cardiac Patients from a Tertiary Care Heart Centre in Kathmandu, Nepal. Infectious Diseases: Research and Treatment. 2021.

15. TebelayDilnessa and AdaneBitew. Prevalence and antimicrobial susceptibility patterns of methicillin-resistant Staphylococcus aureus isolated from clinical samples at Yekatit 12 Hospital Medical University, Addis Ababa, Ethiopia. BMC Infectious Diseases, 2016.

16. Ojulong J, Mwambu TP, Jalooba M, Bwanga F, Kaddu-Mulindwa DH. Relative prevalence of methicillin-resistant Staphylococcus aureus and its susceptibility pattern in Mulago Hospital, Kampala, Uganda. Tanzania J Health Research. 2009.

17. Rajaduraipandi K, Mani KR, Paneerselvam K, Mani M, Bhaskar M, Manikandan P. Prevalence and antimicrobial susceptibility pattern of methicillin resistantStaphylococcus aureus: A multicenter study. Indian Journal of Medical Microbiology. 2006.

18. Saikia L, Nath R, Choudhury B, Sarkar M. Prevalence and antimicrobial susceptibility pattern of methicillin-resistant Staphylococcus aureus in Assam. Indian J Crit Care Med. 2009.

19. Thool VU, Bhoosreddy GL, Wadher BJ. Evidence of resistance to linezolid in Staphylococcus aureus infecting orthopedic patients. Indian J PatholMicrobiol 2012.