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Research Article

Changing Patterns of Methicillin-Resistant *Staphylococcus aureus* in a Tertiary Care Hospital

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Abstract

Background: Methicillin resistance in *Staphylococcus aureus* is associated with multi drug resistance. In hospitals and community mortality and morbidity rate increases due to MRSA. Methicillin resistant *Staphylococcus aureus* (MRSA) results in serious complications. Methicillin sensitive strains are less problematic than MRSA.

Aim: To study the changing trends in resistance patterns of MRSA.

Materials and Methods: Fifty eight clinical isolates of MRSA which were obtained in 2017 - 2020 were identified by using Cefoxitin disc according to CLSI guidelines.

Results: MRSA isolates showed high resistance to ciprofloxacin, gentamicin in comparison with other drugs. Sensitivity to Vancomycin and Linezolid was 100%. Recently resistance among MRSA has increased for most antibiotics.

Conclusion: As the rate of drug resistance in MRSA is increasing, resistance should be evaluated after a period of time and antibiotic therapy should be guided accordingly.

Keywords: Methicillin Resistant *Staphylococcus aureus;* Multi Drug Resistance; Cefoxitin

Abbreviations

MRSA: Methicillin Resistant *Staphylococcus aureus;* MDR: Multi Drug Resistance

Introduction

Staphylococcus aureus is among one of the most common pathogens which causes pyogenic local and systemic infections [1]. In 1880, Alexander Ogston first isolated *S. aureus.* Later he described its role in localized infection and septicemia [2]. In 1970s MRSA strains draw attention when they caused outbreaks of hospital infections throughout the world [3].

S. aureus has virulence factors to cause several infections which involve several organ systems, especially meningitis, endocarditis and blood stream infections [4]. Drug restricted infections which were restricted to hospitals are now becoming common in community, described as community acquired MRSA (CA-MRSA) [5]. MRSA strains show chromosomal resistance to penicillins and cephalosporins and other antibiotics which are commonly prescribed in hospitals [6].

In a country local variations are seen in hospital and community strains of MRSA [7,8]. The resistant pattern of CA-MRSA differs from that of hospital acquired MRSA (HA-MRSA). Hospitals strains display more drug resistance in order to survive in hospital environment. Changes in antibiotic prescription patterns, infection control measures and drug resistance awareness among health care workers results in changes in resistance pattern. As the use of antibiotics is increasing hospitals, higher antibiotic resistance strains are emerging and replacing the old strains [9]. High prevalence of MRSA is an emerging problem in India. It has increased from 12% in 1992 to 40% in 2009 [10,11].

Materials and Methods

58 MRSA strains were analyzed and studied from August 2017 to May 2020. All clinical samples were processed in the laboratory according to prescribed guidelines. Standard laboratory procedures were used to identify *S. aureus*. Disc diffusion test was performed which used a 30 µg Cefoxitin disc and was also subjected to D-test to detect MRSA strains (according to Clinical and Laboratory Standards Institute guidelines) [5]. Commonly used antibiotics of Himedia, Mumbai, India were used, which comprised of Ciprofloxacin (5 µg), Gentamicin (10 µg), Amikacin (30 µg), Erythromycin (15 µg), Vancomycin (30 µg), Linezolid (30 µg), Clindamycin (5 µg) were tested by Kirby Bauer disc diffusion method.

Results and Discussion

58 MRSA isolates from patients were taken. Among these, 18 (31.03%) were outpatients and 40 (68.97%) were inpatients and they were predominantly females (60.34%). All patients belonged to 16 to 60 years age group. The most frequent samples were pus swabs from skin and soft tissue lesions and aspirates from superficial and deep abscesses, which accounts for 64% and 20% samples respectively, followed by endotracheal aspirates 6.5%, blood 5%, urine 2.5% and sputum 2% as shown in figure 1. MRSA infections were mostly linked with abscesses. Out of 58 patients 46 had pyogenic lesions such as postoperative infections, wound infection, superficial abscess, deep abscess and other surgical conditions. 5 medical and 3 ICU patients had medical conditions like urinary tract infections, pneumonia, puerperal sepsis and endocarditis. Patients who were admitted to general surgery and orthopaedic wards were the main source of MRSA.

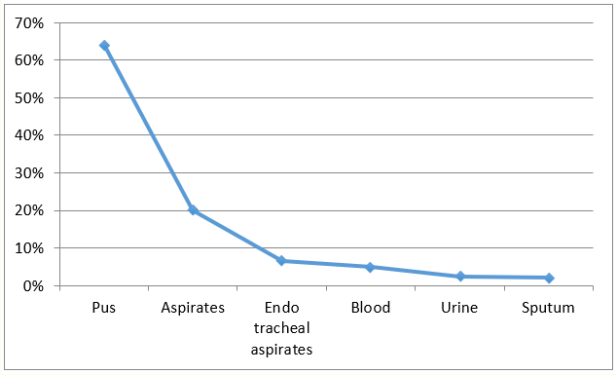

Figure 1: Distribution of MRSA isolates from various clinical samples

The resistance patterns of MRSA isolates to anti-Staphylococcal drugs have been mentioned in table 1. Increase in Clindamycin resistance from 2017 (37.5%) to 2020 (81.8%) was observed. Isolates showed highest resistance to Clindamycin, Ciprofloxacin and Penicillin in both inpatients and outpatients. Sensitivity to Linezolid and Vancomycin was 100%.

Antibiotics	Aug 2017-Aug 2018 N = 16 (%)	Sep 2018-Aug 2019 N = 20 (%)	Sep 2019-May 2020 N = 22 (%)
Vancomycin	00	00	00
Linezolid	00	00	00
Ciprofloxacin	08 (50)	12 (60%)	16 (72.7)
Erythromycin	09 (56.2)	14 (70)	17 (77.2)
Clindamycin	06 (37.5)	13 (65)	18 (81.8)
Cefoxitin	16 (100)	20 (100)	22 (100)
Penicillin	12 (75)	16 (80)	21 (95.45)
Amikacin	06 (37.5)	14 (70)	18 (81.8)
Gentamicin	07 (43.75)	15 (75)	19 (86.3)

Table 1: Comparison of resistance pattern of MRSA isolates in 3 years.

Clindamycin is an option for treatment of Staphylococcus skin, soft tissue and bone infections, it has proven effective, cheap, its available in oral and parenteral forms, excellent tissue penetration, it accumulates in abscess and adjustments in renal dosage are not required. It inhibits the Staphylococcal toxin production. Clindamycin is an alternative for patients who are Penicillin allergic [12]. It is important in the therapy of outpatients due to its good oral absorption and as a follow up after an intravenous (IV) therapy [13]. It works against for methicillin resistant as well as methicillin sensitive Staphylococcal infections [14].

A majority of multi-resistant MRSA (MORSA) strains had resistance to 3-7 drugs (Figure 2). All strains were sensitive to Vancomycin by both disc diffusion and HiComb strip methods (Table 2).

S. aureus is recognized as one of the most frequent causative agents of hospital-associated and device associated infections [15]. In the last 50 years the mortality rate due to these infections has reduced because of antibiotics. The bacteria is undergoing mutation and have developed resistance to all the available antibiotics [2]. Research on the dynamics of resistance development, identifica-

tion of high-risk strains and molecular basis of resistance are very important and required. The association of *S. aureus* with antimicrobial resistance profiles can provide useful information for the clinical treatment if infection caused by this microorganism [16].

	0.001 µg/ml	0.01 µg/ml	0.05 µg/ml	0.1 µg/ml	1 µg/ml	2 µg/ml
OPD (n = 18)	1	10	4	1	2	0
IPD (n = 40)	3	8	17	7	1	3

Table 2: Vancomycin MIC distribution of multi drug resistance in MRSA strains.

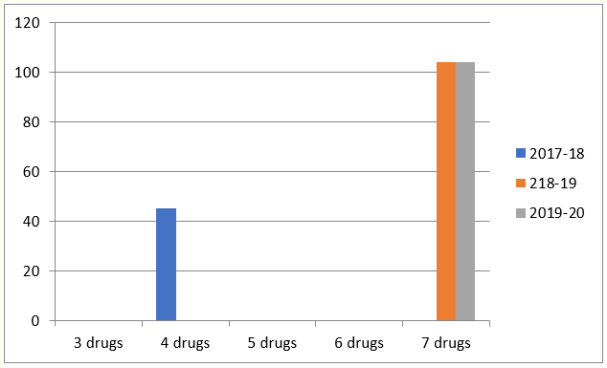

Figure 2: Year wise distribution of multi drug resistance in MRSA strains.

In present study, we found more number of MRSA cases among surgical patients. This may be due to the poor environmental cleaning, operation theatre surveillance and infection control measures of hospitals in Indian setup. According to a study, 80% MRSA isolates were isolated from surgical units, due to higher number of post-operative wound infections [8]. Asymptomatic colonization were also reported to be significantly high in surgical (18%) and orthopaedic (34%), patients as compared to medical unit (1%) patients [17].

Development in antibiotic resistance was found in 3 years. Firstly, increased resistance to Ciprofloxacin in outpatients was observed, then drugs such as Ciprofloxacin, Amikacin and Penicillin showed a greater increase in resistance from 2017 - 2020 and we also found a slow emergence of a reduced susceptibility to Vancomycin. This reflects slow development of bacterial antimicrobial tolerance in response to increasing use of antibiotics in recent years, especially fluoroquinolones, in outpatients [18].

Verma., *et al*. has reported a rapid increase in MRSA prevalence, from 12% to 80.89%, over seven years, in a tertiary care centre at Indore [10]. According to current Indian Network for Surveillance of Antimicrobial Resistance (INSAR) group's report, the prevalence of MRSA differs from 22% to 68% in Indian hospitals, which is higher than previous estimates [11]. According the report of INSAR, 79.3%, 70.8%, 58.3%, 55.6% and 46.6% isolates of MRSA showed resistance to ciprofloxacin, erythromycin, gentamicin, cotrimoxazole and clindamycin respectively. Thind., *et al*. reported only 12.5% isolates to be resistant to tetracycline and 37% isolates to be resistant to cotrimoxazole, while they were 100% sensitive to chloramphenicol, ciprofloxacin, gentamicin, amikacin, netilmicin and rifampicin [19]. In contrast to this, Anupurba., *et al*. submitted a higher resistance of 84.1%, 47.5%, 89.7% and 60.5% against ciprofloxacin, netilmicin, gentamicin and amikacin respectively [20]. The resistance which was detected in other studies was intermediate of these two reports [17,21-23].

Universally studies have reported sensitivity of MRSA to Vancomycin, Linezolid and Mupirocin. Although, from northern India, Deep., *et al*. had reported Linezolid resistance in 9% MRSA [24]. Studies on reduced Vancomycin sensitivities are not uncommon. Though, we found that all MRSA strains had MICs in sensitive range (Table 2).

Conclusion

To conclude, we studied the changing patterns of antimicrobial resistance of MRSA strains in a tertiary care hospital. Increased resistance was observed in most of the antibiotics. All strains were sensitive to Vancomycin and Linezolid. Resistance to Ciprofloxacin, Penicillin and Cefoxitin was high in all MRSA isolates. These drugs are not ideal for empirical therapy of Staphylococcal infections. Among 3 years MRSA had an increase of Clindamycin resistance from 37.5% to 81.8%. Treatment of multi drug resistant MRSA is difficult because antibiotics in these cases are very limited. The available drugs must be tested against the isolate to determine which ones can be used to treat infections, it will control the spread of multidrug resistant bacteria.

Conflict of Interest

No conflict of interest.

Bibliography

1. Arunava S., *et al*. "Changing Trends in Resistance pateern of methicillin resistant *Staphylococcus aureus"*. *Journal of Clinical and Diagnostic Research* 7.9 (2013): 1979-1982.

2. Bhatt MJ., *et al*. "Antimicrobial susceptibility profile of methicillin-resistant *Staphylococcus aureus* at a tertiary care centre". *Archives of Clinical Microbiology* 6 (2015): 3-6.

3. Shanson DC., *et al*. "Outbreak of hospital infection with a strain of *Staphylococcus aureus* resistant to gentamicin and methicillin". *Lancet* 2 (1976): 1347-1348.

4. SR More., *et al*. "Changing trends in resistance pattern of methicillin resistant *Staphylococcus aureus* in burn patients". *International Journal of Current Microbiology and Applied Sciences* 8.1 (2019) 22-27.

5. Pantosti A and Venditti M. "What is MRSA?" *European Respiratory Journal* 34 (2009): 1190-1196.

6. Pavillard R., *et al*. "Epidemic of hospital-acquired infection due to methicillin-resistant *Staphylococcus aureus* in major Victorian hospitals". *Medical Journal of Australia* 1 (1985): 451-455.

7. Simor AE., *et al*. "Antimicrobial susceptibilities of health care-associated and community associated strains of methicillin-resistant *Staphylococcus aureus* from hospitalized patients in Canada, 1995 to 2008". *Antimicrobial Agents and Chemotherapy* 54 (2010): 2265-2268.

8. Srinivasan S., *et al*. "Risk factors and associated problems in the management of infections with methicillin resistant *Staphylococcus aureus"*. *Indian Journal of Medical Microbiology* 2006 24 (2006): 182-185

9. Kumar S., *et al*. "Prevalence and current antibiogram of staphylococci isolated from various clinical specimens in a tertiary care hospital in Pondicherry". *The Internet Journal of Microbiology* 10 (2010).

10. Verma S., *et al*. "Growing problem of methicillin resistant staphylococci –Indian scenario". *Indian Journal of Medical Science* 54 (2000): 535-540.

11. Indian Network for Surveillance of Antimicrobial Resistance group, India. "Methicillin resistant *Staphylococcus aureus* (MRSA) in India: Prevalence and susceptibility pattern". *Indian Journal of Medical Research* 137 (2019): 363-369.

12. Kasten MJ. "Clindamycin, metronidazole, and chloramphenicol". *Mayo Clinic Proceedings* 74 (1999): 825-833.

13. Ruebner R., *et al*. "The complications of the central venous catheters which were used for the treatment of acute hematogenous osteomyelitis". *Pediatrics* 117 (2006): 1210-1215.

14. Fiebelkorn KR., *et al*. "The practical disc diffusion method for the detection of inducible clindamycin resistance in *Staphylococcus aureus* and coagulase negative Staphylococcus". *Journal of Clinical Microbiology* 41 (2003): 4740-4744.

15. Danzmann L., *et al*. "Health care workers causing large nosocomial outbreaks: a systematic review". *BMC Infection Disease* 13.1 (2013): 98.

16. European Centre for Disease Prevention and Control/European Medicines Agency (ECDC/EMEA). Joint technical report The bacterial challenge: time to react. Stockholm: ECDC/EMEA 2009.

17. Sarma JB and Ahmed GU. "Characterisation of methicillin resistant *S. aureus* strains and risk factors for acquisition in a teaching hospital in northeast India". *Indian Journal of Medical Microbiology* 28 (2010): 127-129.

18. Lafaurie M., *et al*. "Reduction of fluoroquinolone use is associated with a decrease in methicillin-resistant *Staphylococcus aureus* and fluoroquinolone-resistant Pseudomonas aeruginosa isolation rates: a 10 year study". *Journal of Antimicrobial Chemotherapy* 67 (2012): 1010-105.

19. Thind P., *et al*. "Bacteriological profile of community-acquired pyodermas with special reference to methicillin resistant *Staphylococcus aureus"*. *Indian Journal of Dermatology, Venereology and Leprology* 76 (2010): 572-574.

20. Anupurba S., *et al*. "Prevalence of methicillin resistant *Staphylococcus aureus* in a tertiary referral hospital in eastern Uttar Pradesh". *Indian Journal of Medical Microbiology* 21 (2003): 49-51.

21. Vidhani S., *et al*. "Study of methicillin resistant *S. aureus* (MRSA) isolates from high risk patients". *Indian Journal of Medical Microbiology* 9 (2001): 13-16.

22. Shenoy MS., *et al*. "Significance of MRSA strains in community associated skin and soft tissue infections". *Indian Journal of Medical Microbiology* 28 (2010): 152-154.

23. Saikia L., *et al*. "Prevalence and antimicrobial susceptibility pattern of methicillin-resistant *Staphylococcus aureus* in Assam". *Indian Journal of Critical Care Medicine* 13 (2009): 156-158.

24. Deep A., *et al*. "Quinpristin dalfopristin resistance in gram Positive bacteria: Experience from a tertiary care referral center in North India". *Journal of Infectious Diseases and Antimicrobial Agents* 25 (2008): 117-121.