

Antimicrobial Susceptibility Pattern of Methicillin-Resistant *Staphylococcus aureus* in Clinical Samples from a Tertiary Care Center in Central Bihar

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Abstract

Objective: The objective of this study was to evaluate the Methicillin resistance *Staphylococcus aureus* isolates resistance pattern among the patients attending a tertiary care in central Bihar.

Materials & Method: The study included the clinical samples from the patients of either sex and across all age groups that had been submitted at the microbiology laboratory and processed. Bacterial growth identified as *S aureus* (based on colony morphology, Gram staining, catalase test and coagulase test) were subjected to Antimicrobial susceptibility testing (AST) by Modified Kirby-Bauer disk diffusion method and using 0.5 McFarland as turbidity standard. Cefoxitin disk (30 µg) was used to identify MRSA isolates. Isolates with a zone of inhibition ≤ 21 mm were considered MRSA. Vancomycin MIC was determined by Vitek 2 compact according to CLSI guidelines.

Result: Among 122 *S aureus* isolates, 39 (31.9%) were reported as MRSA. All isolates were sensitive to vancomycin (100%) followed by chloramphenicol (97%), linezolid (92%), teicoplanin (90%), clindamycin (79%) and tetracycline (76%). The isolates were resistant to penicillin (100%), followed by ofloxacin (92.30%), ciprofloxacin (87.17%), erythromycin (69.23%) gentamicin (43.58%) and levofloxacin (66.66%).

Conclusion: This study shows the incidence of MRSA and their susceptibility pattern in central part of Bihar. This will help the clinicians and epidemiologists to know the local susceptibility pattern and also for monitoring resistance trends over time. It will also help the hospitals in formulating their antibiogram and antibiotic policy over the time and to choose empirical treatment wisely.

Key words: MRSA, Susceptibility Pattern, Tertiary Care Center, Clinical Samples.

Introduction

Staphylococcus aureus remains a major cause of both community- and hospital-acquired infections,

posing significant challenges due to its evolving resistance¹. Methicillin resistant *S. aureus* (MRSA) is now endemic in India. The incidence of MRSA varies

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from 25 per cent in western part of India² to 50 per cent in South India³. Despite ongoing development of new treatments, active surveillance efforts, and advancements in infection control, the incidence of methicillin resistance has emerged as a major source of morbidity, higher costs of healthcare delivery services, and increased mortality in hospitals over the past decades⁴. Clinical outcomes from methicillin resistant infections are rather worse than those from methicillin-sensitive *S. aureus* infections⁵. While MRSA has become endemic in India with regional variations in prevalence, its growing resistance to multiple antibiotics is a global concern, making treatment increasingly difficult. Changes in the drug susceptibility profile of *S. aureus* have been reported worldwide; thereby making treating infections caused by *S. aureus* more difficult^{3,5}. Public health is seriously threatened by the pathogen's prevalence in many nations today, with isolates' resistance to the majority of anti-staphylococcal antibiotics including Penicillin, Gentamicin, Erythromycin, Ciprofloxacin, Rifampicin, Cotrimoxazole, Chloramphenicol, Norfloxacin and Tetracycline⁶. Moreover, once established, MRSA is frequently difficult to eradicate because it spreads more quickly than the other varieties when brought into hospitals⁷. Methicillin-resistant *Staphylococcus aureus* is one of the most important nosocomial pathogens and has emerged as a serious threat to public health worldwide⁸. Once a *S. aureus* isolate is characterized as an MRSA, it is presumed to be multi drug resistance. Resistance to Oxacillin or Cefoxitin confers nonsusceptibility to all categories of β -lactam antimicrobials⁹. Thus, MDR-MRSA is an example of a continually evolving paradigmatic pathogen¹⁰. Several studies have reported the resistance to the newer antimicrobial agents like Linezolid, Vancomycin, Teicoplanin, and Daptomycin^{11,12,13}. Reports of resistance to last-line antibiotics such as vancomycin and daptomycin suggest the potential emergence of pan-drug-resistant *S. aureus*, similar to challenges observed in Gram-negative bacteria¹⁴.

AIM

The antimicrobial susceptibility pattern of Methicillin-resistant *Staphylococcus aureus* (MRSA) can vary depending on factors such as geographic location, hospital setting, and local resistance trends.

The knowledge of antibiotic sensitivity pattern of MRSA in any environment becomes necessary for selection of appropriate treatment for these patients. The aim of this study is to determine the antimicrobial susceptibility pattern of MRSA in a tertiary care hospital in Central Bihar.

Materials & Methods

The study was approved by Ethics Committee via letter number CREC/2022/015, dated 14/07/2022. A prospective study was carried out in the Department of Microbiology NSMCH during the period July 2022 to June 2023.

The study included the clinical samples from the patients of either sex and across all age groups that had been submitted at the microbiology laboratory & processed. Bacterial growth identified as *S. aureus* (based on colony morphology, Gram staining, catalase test and coagulase test) were subjected to Antimicrobial susceptibility testing (AST) by Modified Kirby-Bauer disk diffusion method and using 0.5Mc Farland as turbidity standard. Cefoxitin disk (30 μ g) was used to identify a MRSA isolates. Isolates with a zone of inhibition \leq 21 mm were considered MRSA. For Vancomycin MIC was determined by Vitek 2 compact according to CLSI guidelines.

A total of 122 nonduplicate MRSA isolated from various clinical specimens like pus, blood, urine, central venous catheters tips, tracheal aspirates, and sputum were selected from different departments

The antibiotics tested were Chloramphenicol (30 μ g), Ciprofloxacin (5 μ g) Clindamycin (2 μ g), Cotrimoxazole (25 μ g), gentamicin (10 μ g), levofloxacin (5 μ g) Linezolid (30 μ g), Ofloxacin (5 μ g) Penicillin (10 μ g) Teicoplanin (30 μ g), Tetracycline (30 μ g) and Vancomycin (30 μ g) (not used in urinary isolates) and Erythromycin (15 μ g).

Result

Out of the 122 Isolates 39 were found to be MRSA which was 31.9% of total isolates. (Table: 1) All isolates were seen sensitive to Vancomycin. They showed 97% susceptibility to Chloramphenicol, Linezolid (92%), Teicoplanin (90%), clindamycin (79%), Tetracycline (76%)

The isolates were resistant to Penicillin(100%), Ofloxacin (92.30%), Ciprofloxacin (87.17%) Erythromycin (69.23%) Gentamicin (43.58%) and Levofloxacin (66.66%).

Table 1: Distribution of isolates

Total Isolates	Mssa	Mrsa
122	83	39
	68.03%	31.96%

Table 2: Antibiotic susceptibility pattern

Name of antibiotic	%SENSITIVITY	% Resistant
VANCOMYCIN	100	0
CHLORAMPHENICOL	97	03
LINEZOLID	92	08
TEICOPLANIN	90	10
CLINDAMYCIN	79	21
TETRACYCLINE	76	24
CO-TRIMOXAZOLE	69.2	20.8
GENTAMICIN	56.41	43.59
LEVOFLOXACIN	33.33	66.66
ERYTHROMYCIN	30.76	69.23
CIPROFLOXACIN	12.82	87.17
OFLOXACIN	7.60	92.30
PENICILLIN	0	100

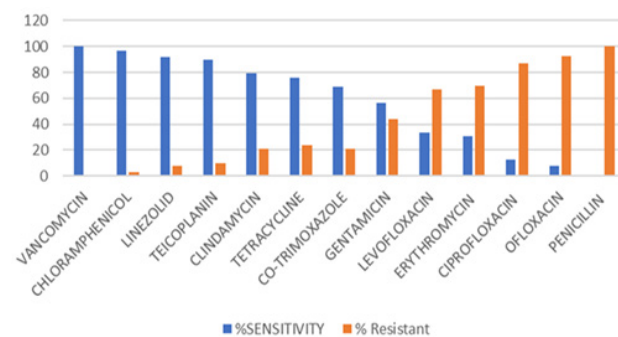


Figure 1: Diagram representing AST pattern

Discussion

The primary sources of MRSA transmission are hospital staff and patients who are infected or colonized with MRSA strains, predominantly through contact transmission. Risk factors that enhance the emergence and spread of MRSA include prolonged and repeated hospitalization, indiscriminate antibiotic use, lack of awareness, misuse of intravenous drugs, and the presence of indwelling medical devices.

The epidemiology of MRSA over different parts of India is not uniform. In our study the isolation of MRSA was (31.9%) of the total isolates from all

clinical samples which is slightly lower than a similar study done by Rajkumar B. et al¹⁵(2005) where a total of 140 (37.83%) MRSA were isolated from various clinical samples. MRSA frequency was reported to be around 37% in India by Patil S et al¹⁶(2022). In a study by Yasha Mukim et al¹⁷ (2024) and Umar et al¹⁸ (2024), methicillin resistance was seen among (58.2%) and (64.67%) respectively, which was higher than that found in our study. In a similar Study by Kandhakumari Gandhi et al¹⁹ (2020) Methicillin resistance was seen in 67.3% of the total isolates. Better infection control practices in our hospital may have contributed to lower isolation of MRSA.

In our study, all the isolates were sensitive to Vancomycin. They showed 97% Susceptibility to Chloramphenicol, Linezolid (92%) Teicoplanin (90%), Clindamicin (79%), Tetracycline(76%), cotrimoxazole (69.2%). The isolates were resistant to Penicillin(100%), Ofloxacin (92.30%), Ciprofloxacin (87.17%) Erythromycin (69.23%) Gentamicin (43.58%) and Levofloxacin (66.66%).

The result of our study tallied with a similar study done by Rajkumar B. et al¹⁵, Kandhakumari Gandhi et al²⁰ and Indrani Mohanty, et al¹⁹ where the isolated strains were 100% sensitive to Vancomycin. In our study Sensitivity to Linezolid was 92% and Teicoplanin(90%), which was less than that found in the study by Umar et al¹⁸ which showed strains to be 100.00% sensitive to Linezolid and Teicoplanin. Study by Kandhakumari Gandhi et al also showed 97% susceptibility to Linezolid. Linezolid resistance is a matter of concern. It is obvious from the studies undertaken so far that the increasing resistance to linezolid shown by MRSA strains leaves the clinicians with fewer choices. Glycopeptides, including Vancomycin, are the mainstay of the treatment of MRSA but high resistance to vancomycin has been reported from different parts of the country.

In our study chloramphenicol susceptibility rate was 97% and can be an excellent choice for treating MRSA isolated from ocular samples. The susceptibility to cotrimoxazole (69.2%) which was Among the various antibiotics tested Cotrimaxazole, tetracycline, showed less resistance pattern similar to study done by Indrani et al. but significantly higher than shown in study by Rajkumar B. et al.

All stains were resistant to penicillin which was in concordance with almost all the studies. The isolates were resistant to Ofloxacin (92.30%), Ciprofloxacin (87.17%) Erythromycin (69.23%) Gentamicin (43.58%) and Levofloxacin (66.66%).

In study by Umar et al, MRSA isolates showed 100% sensitivity to Teicoplanin and Linezolid. Sensitivity of isolates to Vancomycin was (95.88%), to Gentamicin (70.10%), and Tetracycline (60.82%). Resistant to Ciprofloxacin (97.94%), Erythromycin (79.38%), and Clindamycin (55.67%) was seen among the isolates. Antimicrobial resistance is a significant problem that threatens to diminish our therapeutic armamentarium. Misuse of antibiotics results in increased antibiotic selection pressure that can affect resistance locally or even globally by clonal dissemination.

Conclusion

This study shows the incidence of MRSA and their susceptibility pattern in Central part of Bihar. In our study chloramphenicol susceptibility rate was 97% and can be an excellent choice for treating MRSA isolated from ocular samples topically. By focussing on careful antibiotic stewardship, infection control, and Surveillances, the emergence of Vancomycin resistance and spread of Linezolid resistance can be minimized. Additional strategies like decolonization can be undertaken. This study will help the clinicians and epidemiologists to know the local susceptibility rates and also for monitoring resistance trends over time. It will also help the hospitals in formulating their antibiogram and antibiotic policy over the time and to choose empirical treatment.

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