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Original Research Article

The Prevalence of Methicillin Resistant Staphylococcus Aureus (MRSA) and its Antimicrobial Susceptibility Pattern at Tertiary Care Hospital

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ABSTRACT

Background: Staphylococcus aureus is a very common human pathogen isolated from various clinical specimens. Staphylococcus aureus can cause various infectious diseases like endocarditis, skin and soft tissue infections, osteomyelitis, pneumonia and bacteremia. Methicillin resistant Staphylococcus aureus (MRSA) can cause a major trouble mostly in tertiary care center. The present study is aimed to determine the prevalence of Methicillin Resistant Staphylococcus aureus (MRSA) and its antimicrobial susceptibility pattern at Tertiary Care Hospital, Vadodara.

Material and Methods: Present study was conducted from October 2023 to April 2024 at tertiary care hospital, Vadodara. Total 1127 clinical specimens were tested for the study. The isolates were identified as per laboratory standard protocol including staining, colony morphology & biochemical reactions. All isolates were subjected to antibiogram study by modified Kirby Bauer disk diffusion method. Among 1127 clinical specimens, 361 Staphylococcus aureus were isolated and tested for MRSA by Cefoxitin disc diffusion test.

Results: Among 361 Staphylococcus aureus isolates, 159 were positive for MRSA. Overall prevalence rate for MRSA isolates was 44.04%. Maximum number of MRSA was isolated in Orthopedic ward (53, 33.33%), Surgery ward (39, 24.52%), Intensive Care Unit (28, 17.61%), Medicine ward (17, 10.69%) Pediatric ward (15, 9.43%). Maximum MRSA isolated from Pus and swab (81, 50.94%) followed by Urine (36, 22.64%), Blood (27, 16.98%). MRSA were most sensitive to Vancomycin (159, 100%) followed by Teicoplanin (149, 93.71%), Linezolid (142, 89.30%), Clindamycin (71, 44.65%) and least sensitive to Ciprofloxacin (29, 18.23%) followed by Erythromycin (42, 26.41%) and Gentamycin (62, 38.99).

Conclusion: Prevalence of MRSA in our study is 44.04%, which are multidrug resistance though Vancomycin, Linezolid and Teicoplanin are still effective treatment option. Screening of MRSA and their antibiogram is very essential for early detection of MRSA and for management of the condition.

Keywords: Antimicrobial resistance, MRSA, Vancomycin

INTRODUCTION

Staphylococcus aureus (S. aureus) is a member of family Micrococcaceae. They are gram-positive cocci, spherical in shape, arranged characteristically in grape like clusters. The characteristic grape like cluster is due to the cell division occurring in three planes, with daughter tending to remain in close to each other.

Infections caused by S. aureus include, skin and soft tissue lesion like abscesses and carbuncles, osteomyelitis, pyoderma, pneumonia, endocarditis and septicemia.[1] Staphylococcus aureus bacteria have a long history as a cause of human disease around the world. Invasive S. aureus infections were almost always fatal in prior antibiotic era. The introduction of penicillin greatly improved prognosis for these serious

cases of infection; however, resistant strains of bacteria appeared within a few years, due to bacterial production of β-lactamases. In 1960, methicillin was introduced as an alternative treatment for penicillin-resistant bacteria, but in 1961, the first case of MRSA has been reported. Methicillin resistance in the Staphylococcus aureus is develop by mutation in mecA gene, which make changes to penicillin-binding protein (PBP) present on S. aureus cell membrane to PBP2a.[2,3] Because of this change the new penicillin-binding protein binds beta-lactam antibiotics with lower avidity and results in resistance to all the antimicrobial agents of that class and leads to limited antimicrobial options for this pathogen. Clindamycin was used as alternative in treatment of MRSA, but clindamycin resistance cases were also increase in last 10 year.[4] Now a day vancomycin widely used antibiotic for management of MRSA. But resistance towards to vancomycin has been reported in many studies.[5]

MRSA are of two types, HA & CA. HA means 'Hospital Associated' or 'Hospital Acquired' and CA means 'Community Associated' or 'Community Acquired'. CA also known as 'Community onset' or 'Community derived'. For the Active Bacterial Core Surveillance Program, the CDC has defined a community-associated MRSA (CA-MRSA) case as a patient with a MRSA infection and no history of the surgery, hospitalization, residence in a long-term health care facility or dialysis within one year prior to infection; has no percutaneous device or indwelling catheter; hospitalization < 48 hours before the culture; or no history of previous MRSA infection or colonization.[6] While a case of HA-MRSA can be defined as any MRSA infection that does not qualify as CA-MRSA. MRSA can be detected in the lab by using cefoxitin disc as per CLSI guidelines. It can also be detected by Nucleic acid amplification tests, like polymerase chain reaction (PCR), which can detect the mecA gene.

MATERIAL AND METHODS

This study was conducted at from October 2023 to April 2024 at tertiary care hospital, Vadodara. Total 1127 Clinical specimens were tested in the study. The isolates were identified as per laboratory standard protocol including staining, colony morphology & biochemical reactions. All the clinical samples were inoculated into nutrient agar, sheep blood agar, and mannitol salt agar plates. All were incubated aerobically at 37°C for 24 hours. Next day, identified the isolates by performing Gram staining and colony characteristics. Isolated colonies were processed for various biochemical tests like catalase test, Coagulase test (Both slide and tube). All isolates were subjected to antibiogram study by modified Kirby Bauer disk diffusion method. Among 1127 clinical specimens, 361 Staphylococcus aureus were isolated and tested for MRSA by Cefoxitin disc diffusion test. Mueller Hinton Agar (MHA) plates were inoculated with standardized inoculum (0.5 Mc Farland standard) of the Staphylococcus aureus by sterile swab. A 30 µg cefoxitin disc was placed in the center of the plate. Plates were incubated at 37º C for 24 h and zone diameters were measured as per CLSI guidelines.[7] The zone diameter must be measured in reflected light. An inhibition zone diameter of ≤ 22 mm was reported as methicillin resistant and ≥ 22 mm was considered as methicillin susceptible. As a Quality control strains, Methicillin sensitive S. aureus (MSSA) ATCC 25923 and methicillin resistant S. aureus (MRSA) ATCC 43300 were used.

RESULTS

1127 clinical specimens were received during October 2023 to April 2024 at tertiary care hospital, Vadodara. Out of 1127 clinical specimens, 361 Staphylococcus aureus and 159 MRSA were isolated. Thus, overall prevalence rate for MRSA isolates was 44.04%. Maximum number of MRSA were isolated from the in patients (123, 77.35 %) than out patients (36, 22.64 %) (Table-1). Most number of MRSA were isolated from old age patients (> 60 years) was 66 (41.50%) followed by 46 - 60 years of age group (42, 26.41%), 0 - 15 years of age group (31, 19.49%), 31 - 45 years of age group (14, 8.8%) and in 16 - 30 years of age group (6, 3.77%) (Table-2). Maximum numbers of MRSA were isolated from Orthopedics ward (53, 33.33%), Surgery ward (39, 24.52%), Intensive Care Unit (28, 17.61%), Medicine ward (17, 10.69%) Pediatric ward (15, 9.43%) and Others (7, 4.4%) (Table-3). Maximum numbers of MRSA were isolated from Pus and swab (81, 50.94%) followed by Urine (36, 22.64%), Blood (27, 16.98%), Sputum (9, 5.66%) and Others (6, 3.77%) (Table-4). Maximum numbers of MRSA were most sensitive to Vancomycin (159, 100%) followed by Teicoplanin (149, 93.71%), Linezolid (142, 89.30%), Clindamycin (71, 44.65%) and least sensitive to Ciprofloxacin (29, 18.23%) followed by Erythromycin (42, 26.41%) and Gentamycin (62, 38.99) (Table-5).

Table-1: OPD & IPD wise distribution of MRSA

OPD	36 (22.64%)
IPD	123 (73.35%)

Table-2: Age wise distribution of MRSA

Age Group	MRSA % (n=159)
0 - 15	19.49 % (31)
16 - 30	3.77 % (6)
31 - 45	8.8 % (14)
46 - 60	26.41 % (42)
> 60	41.50 % (66)

Table-3: Ward wise distribution of MRSA

Ward	Number	%
Orthopedics	53	33.33
Surgery	39	24.52
Intensive Care Unit (ICU)	28	17.61
Medicine	17	10.69
Pediatric	15	9.43
Others	7	4.4
Total	**159**	**100**

Table 4: Specimen wise distribution of MRSA

Specimen	Number	%
Pus and Swab	81	50.94
Urine	36	22.64
Blood	27	16.98
Sputum	9	5.66
Other	6	3.77
Total	159	100

Table-5: Antibiotic Sensitivity Pattern of MRSA

Antibiotic	Sensitive (n=159)	Resistant (n=159)
Vancomycin	159 (100%)	0
Linezolid	142 (89.3%)	17 (10.69%)
Teicoplanin	149 (93.71%)	10 (6.28%)
Clindamycin	71 (44.65%)	88 (55.34%)
Co-trimoxazole	68 (42.76%)	91 (57.23%)
Ciprofloxacin	29 (18.23%)	130 (81.76%)
Gentamycin	62 (38.99%)	97 (61.01%)
Erythromycin	42 (26.41%)	117 (73.58%)

Table-6: Prevalence of MRSA in different studies

Author	Prevalence
Chaudhary et al[13] (2022)	57.82%
Lohan K et al[9] (2020)	33.7%
Gupta S et al[1] (2024)	45.5%
Kaup Set al[11] (2017)	45.42%
Archana G et al[12] (2022)	56.79%
Avinash K[14] (2018)	60.9%
Sharlee R et al[10] (2020)	43.3%
Pradeep K et al[8] (2021)	29.1%
Present Study	44.04%

Table-7: Comparison of Antibiotic-Resistant Pattern of MRSA in different studies

Antibiotic	Present Study	Lohan K et al[9]	Gupta S et al[1]	Kumar G et al[16]	Prashant A et al[15]
Vancomycin	0	12.3%	0	-	0
Linezolid	10.69%	7.4%	6.8%	0	-
Teicoplanin	6.28%	12.3%	5.1%	-	-
Clindamycin	55.34%	66.7%	53%	56.4%	58.5%
Co-trimoxazole	57.23%	53.1%	45.3%	33.4%	61.1%
Ciprofloxacin	81.76%	59.2%	74.4%	53.8%	80.5%
Gentamycin	61.01%	46.9%	56.4%	32.1%	27.4%
Erythromycin	73.58%	76.5%	67.5%	82.1%	79.8%

DISCUSSION

The pathogenic organisms and their antibiotic sensitivity patterns may change from time to time and place to place. The prevalence rate of MRSA in present study was 44.04%, is compared with the different studies in Table-6. It is higher than the study of Pradip K et al[8] (29.1%), Lohan K et al[9] (33.7%) and Sharlee R et al[10] (43.3%), almost similar to the study of Kaup S et al[11] (45.42%) and Gupta S et al[1] (45.5%), while few studies like Archana et al[12] (56.79%), Chaudhary et al[13] (57.82%) and Avinash Kumar et al[14] (60.9%) showed much higher prevalence rates. Table-7 shows the comparison of antibiotic resistance pattern of MRSA with other studies. In our study, MRSA was found most sensitive to Vancomycin (159, 100%) followed by Teicoplanin (149, 93.71%), Linezolid (142, 89.30%), Clindamycin (71, 44.65%). In our study, Vancomycin showed 100% sensitivity to MRSA similar results were found by Gupta S et al[1] and Prashant A et al[15]. While study of Lohan K et al [9] showed 12.3% resistant. In our study, Teicoplanin (149, 93.71%) showed higher sensitivity than the study of Lohan K[9] (12.3% Resistant) and almost

similar to Gupta S et al[1] (5.1% Resistant). In our study, Linezolid (142, 89.30%) showed less sensitivity than the study of Lohan K et al[9] (7.4% Resistant) and Gupta S et al[1] (6.8% Resistant).

CONCLUSIONS

Irrational and inappropriate use of antimicrobials medicines provides favorable conditions for resistant microorganisms to emerge, spread and persist and is by far the biggest driver of drug resistance worldwide. No action today means no cure tomorrow. According to our study, Vancomycin is the only antimicrobial agent which showed 100% sensitivity even with multi drug resistance isolates. Vancomycin remains the first choice of treatment for MRSA. Vancomycin use should be limited to those cases where there are clearly needed. Screening of MRSA and their antibiogram is very essential for early detection of MRSA and for management of the condition. For prevention of MRSA, we can do regular screening of health care workers, hand hygiene practice, implementation of antibiotic policy, antimicrobial stewardship and strengthened infection control practices at least in tertiary care hospitals.

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