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Antibiogram of Clinical Isolates of *Staphylococcus aureus* from a Tertiary Care Centre

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ABSTRACT

Background: *Staphylococcus aureus* causes wide variety of infections. Methicillin resistant *Staphylococcus aureus* (MRSA) is of a great concern. It has developed resistance to non β-lactam antibiotics also and its treatment should be guided by antibiotic susceptibility testing.
Aim: To study the antibiotic susceptibility pattern of clinical isolates of *Staphylococcus aureus*.
Material & methods: A total of 300 clinical isolates of *S. aureus* were subjected to antimicrobial susceptibility testing by modified Kirby Bauer disc diffusion method as per the CLSI guidelines. MIC for vancomycin and linezolid was performed by agar dilution method.
Results: Most of the strains of *S. aureus* were resistant to penicillin and methicillin resistance was as high as 35%. Resistance to non β-lactam antibiotics was found to be significantly more in MRSA strains as compared to methicillin sensitive *S. aureus* (MSSA). For prevention of increase in resistance, appropriate use of antibiotics guided by antibiotic sensitivity is necessary.

Key words- *S. aureus*, Methicillin resistant *Staphylococcus aureus*, MRSA

INTRODUCTION

S. aureus is recognized as a causative agent of wide array of infections ranging from minor skin infections, chronic bone infections to devastating septicemia & endocarditis. [1] Although *S. aureus* infections were earlier treatable with common antibiotics like penicillin, emergence of drug-resistant organisms is now a major concern. The choice of antimicrobial agents to treat staphylococcal infection has become increasingly problematic because of the emergence of multidrug resistant strains mainly in Methicillin resistant *Staphylococcus aureus* (MRSA).

MRSA is prevalent worldwide both in hospital and community. MRSA was endemic in hospitals by the late 1960s and appeared rapidly in communities in the 1990s. [2,3] Prevalence rate of MRSA differs from 19.56% to 80.89%. [4,5]

On comparison, MRSA isolates have higher drug resistance than MSSA isolates. [6] Majority of MRSA exhibit resistance to both widely used antibiotics i.e. quinolones and aminoglycosides. [7] Knowledge of prevalence of MRSA and their antimicrobial sensitivity profile becomes necessary in the selection of appropriate empirical treatment of these infections. Present study was designed to study the antibiotic susceptibility pattern of *Staphylococcus aureus* in a tertiary care hospital in Central India.

MATERIAL & METHODS

S aureus isolates were identified by standard microbiological techniques. Antimicrobial susceptibility testing of these clinical isolates was performed by disc diffusion method as per the CLSI guidelines. [8] Their minimum inhibitory concentration testing for vancomycin and linezolid was done by agar dilution method. [8]

RESULTS

S. aureus strains were found to be responsible for various infections i.e. abscesses and wound infections, bacteremia, osteomyelitis, lower respiratory tract infection, mastitis, urinary tract infection and keratitis.

Antimicrobial sensitivity pattern of clinical isolates of *S aureus* is shown in Table 1.

Table 1.Antimicrobial sensitivity pattern of *S. aureus* isolates by disc diffusion method (n=300)

Antibiotic	Sensitive no. (%)	Resistant no. (%)		
		Intermediate	Resistant	Total
Penicillin G	15 (05.0)	-	285 (95.0)	285 (95.0)
Cefoxitin	195 (65.0)	-	105 (35.0)	105 (35.0)
Oxacillin	201 (67.0)	15 (05.0)	84 (28.0)	99 (33.0)
Gentamicin	221 (73.7)	7 (02.3)	72 (24.0)	79 (26.3)
Amikacin	274 (91.3)	0 (0)	26 (08.7)	26 (08.7)
Tobramycin	269 (89.7)	2 (0.6)	29 (09.7)	31 (10.3)
Netilmicin	294 (98.0)	0 (0)	6 (02.0)	6 (02.0)
Nitrofurantoin	300 (100)	0 (0)	0 (0)	0 (0)
Ciprofloxacin	100 (33.3)	10 (03.3)	190 (63.4)	200 (66.7)
Norfloxacin	91 (30.3)	12 (04.1)	197 (65.6)	209 (69.7)
Erythromycin	87 (29.0)	0 (0)	213 (71.0)	213 (71.0)
Clindamycin	160 (53.3)	8 (02.7)	132 (44.0)	140 (46.7)*
Rifampicin	300 (100)	0 (0)	0 (0)	0 (0)
Tetracycline	230 (76.7)	3 (01.0)	67 (22.3)	70 (23.3)
Chloramphenicol	282 (94.0)	0 (0)	18 (06.0)	18 (06.0)
Co-trimoxazole	96 (32.0)	5 (01.7)	199 (66.3)	204 (68.0)
Linezolid	300 (100)	-	0 (0)	0 (0)
Tigecycline	300 (100)	-	0 (0)	0 (0)

* Includes inducible resistant isolates

Table 1 shows that maximum resistance was with penicillin G (95.0 %). Resistance to cefoxitin was 35.0% while resistance to oxacillin was found to be 33.0%. Aminoglycosides showed good susceptibility ranging from 73.7% to 98.0%. Among urinary antibiotics, nitrofurantoin showed complete susceptibility. Beside this drug, rifampicin, linezolid and tigecycline also showed complete susceptibility to *S. aureus* isolates.

Table2 . Comparison of resistance to non β-lactam antibiotics in MRSA and MSSA

Antibiotics	No. of isolates showing resistance (%)*	
	MSSA (n=195)	MRSA (n=105)
Gentamicin#	3 (01.5)	76 (72.3)
Amikacin#	6 (03.1)	20 (19.0)
Tobramycin#	4 (02.0)	27 (25.7)
Netilmicin¥	0 (0)	6 (05.7)
Ciprofloxacin#	105 (53.8)	95 (90.4)
Norfloxacin#	109 (55.9)	100 (95.2)
Erythromycin¥	118 (60.5)	95 (90.4)
Clindamycin¥	71 (36.4)	69 (65.7)
Tetracycline#	2 (01.0)	68 (64.7)
Chloramphenicol£	8 (04.1)	10 (09.5)
Co-trimoxazole#	111 (56.9)	93 (88.5)

* Includes both intermediate and complete resistant
# p< 0.0001, ¥ p < 0.001, £- not significant

Comparison of resistance to non β-lactam antibiotics in MRSA and MSSA is shown in Table 2. It shows that, among MRSA and MSSA, there was a significant difference in resistance to different antibiotics viz. gentamicin, amikacin, tobramycin, netilmicin, ciprofloxacin, norfloxacin, erythromycin, clindamycin, tetracycline and co-trimoxazole.

Table 3. Vancomycin and Linezolid MIC of *S. aureus* isolates (n=300)

MIC (µg/ml)	No. of *S. aureus* isolates (%)	
	Vancomycin (%)	Linezolid (%)
≤0.125	156 (52.0)	42 (14.0)
0.25	67 (22.3)	192 (64.0)
0.5	64 (21.3)	37 (12.3)
1	10 (03.3)	25 (08.3)
2	3 (01.0)	3 (01.0)
4	0	1 (0.3)

Vancomycin Sensitive ≤ 2, Intermediate 4-8, Resistant ≥ 16
Linezolid Sensitive ≤ 4, Resistant ≥ 8

Table 3 shows vancomycin and linezolid MIC of *S. aureus* isolates. It shows that for vancomycin, all the *S. aureus* isolates had MIC ≤ 2 µg/ml indicating their vancomycin susceptibility. Further, as many as 156 (52.0%) isolates had MIC ≤ 0.125 µg/ml. For linezolid all the *S. aureus* isolates had MIC ≤ 4 µg/ml indicating linezolid susceptibility of all the isolates. Further, as many as 234 (78.0%) isolates had MIC ≤ 0. 25 µg/ml.

DISCUSSION

In our study, maximum *S. aureus* isolates were from abscesses and wound infections (73.4%) followed by bacteremia (8%) and lower respiratory tract infections (5%). Other infections from which *S. aureus* were isolated include osteomyelitis, mastitis, urinary tract infection and keratitis. This indicates prominent role of *S. aureus* in abscess and wound infections.

More than 90% of staphylococcal isolates now produce the enzyme penicillinase, and it became pandemic in community and hospital setup. [9,10] In the present study, 95% strains of *S. aureus* were found to be resistant to penicillin (Table 1). It correlates with the findings of Duran et al [11] who reported 92.8% penicillin resistance in *S. aureus*.

Importance of MRSA lies in the fact that it become resistant to other β –lactam agents i.e. penicillins, β -lactam and β lactamase inhibitor combinations, cephems (with the exceptions of the cephalosporins with anti MRSA activity) and carbapenems. The global and Indian scenarios of prevalence of MRSA varies from 6.9 % - 69 %.

In the present study, of the total 300 *S. aureus* strain studied, 35% strains were MRSA by testing with cefoxitin disc, while 33% MRSA were detected by oxacillin disc. As per CLSI, oxacillin disc testing is not reliable. Cefoxitin is tested as a surrogate for oxacillin. In this study also, of the 21 strains found resistant with cefoxitin disc, 6 were found sensitive & 15 intermediate sensitive with oxacillin disc. So in reporting with oxacillin disc, very major error is 2% (=6/ 300 X 100) & minor error is 5% (=both 15/300 X 100). Hence cefoxitin disc should be used instead of oxacillin.

Aminoglycosides showed good susceptibility ranging from 73.7% to 98.0%. Of the 300 *S. aureus* isolates, 92 (30.6%) were resistant to at least one of the four aminoglycosides. Hauschild et al [12] reported that 38.1% of their *S. aureus* isolates were resistant to one of the aminoglycosides tested and among aminoglycosides resistance to gentamicin, tobramycin, amikacin and netillin was 24.4%, 71.1%, 24.4% and 0% respectively. Study from South Maharashtra reported that more than 90% of *S. aureus* isolates were resistant to gentamicin and tobramycin. [13]

Among urinary antibiotics, nitrofurantoin showed complete susceptibility to *S. aureus*. Beside this, rifampicin, linezolid, vancomycin and tigecycline also showed complete susceptibility. Complete sensitivity to vancomycin to *S. aureus* isolates was also reported by Datta et al, [14] Anupurba et al [15] and Rajduraipandi et al. [16]

For linezolid and vancomycin, though most of the *S. aureus* isolates have low MIC value, some of the isolates' MICs were reaching to borderline indicating emergence of resistance to these antibiotics in the near future. .

MRSA isolates carry resistance genes to other different group of antibiotics also. [9] In present study, resistance to different antibiotics among MRSA strains was significantly higher than those, which were sensitive to methicillin. Majumdar et al [17] also reported high resistance in MRSA strains as compared to MSSA. Schimtz et al [18] reported that, the proportion of MRSA that showed resistance to the aminoglycosides tested was 15–18 times higher than that of the MSSA isolates.

CONCLUSION

To conclude, penicillin the wonder drug has become almost useless for treating *S. aureus* infections. Aminoglycosides group is still effective for *S. aureus* with the added advantage of its synergistic activity with β lactam antibiotics and vancomycin. Resistance to different antibiotics among MRSA strains was significantly higher than those MSSA worsening the situation. Though vancomycin and linezolid showed complete sensitivity for *S. aureus*, their judicious use is needed for delaying the emergence of resistant strains.

REFERENCES

1. Lowy FD. Staphylococcal infection In: Fauci AS, Braunwald E, Kasper DL, Hauser SL, Longo DL, Jameson JL, Loscalzo J (eds). Harrison's principles of internal medicine, 16th ed, vol 1, New York: MC Graw Hill: 2005, p.814-23.
2. DeLeo FR, Chambers HF. Reemergence of antibiotic-resistant *Staphylococcus aureus* in the genomics era. J Clin Invest. 2009; 119:2464–74.
3. Liebowitz LD. MRSA burden and interventions. Int J Antimicrob Agents. 2009; 34:S11–3.
4. Tankhiwale SS, Roy S, Jalgaonkar SV. Methicillin resistance among isolates of *Staphylococcus aureus*: Antibiotic sensitivity pattern and phage typing. Ind J Med Sci. 2002;56:330–4.
5. Verma S, Joshi S,Chitnis V et al. Growing problem of methicillin resistant staphylococci: Indian Scenario. Ind J Med Sci. 2000;54:535–40.
6. Joshi S et al. Methicillin resistant *Staphylococcus aureus* (MRSA) in India: Prevalence & susceptibility pattern. Indian J Med Res. February 2013;137: p.363-69.
7. Thornsberry C. The development of antimicrobial resistance in staphylococci. J AntimicrobChemother 1998;21(Suppl.C):9-16.
8. CLSI 2013: Performance standard for Antimicrobial Susceptibility Testing; Twenty-third informational supplement; M100-S23. Vol.33 No.1 Clinical and laboratory standard institute, Wayne, Pa, USA.
9. Lowy FD. Antimicrobial resistance: the example of *Staphylococcus aureus*. J Clin Invest. 2003;111(9):1265–73.
10. Chambers HF. The changing epidemiology of *Staphylococcus aureus.* Emerging Infect Dis. 2001;7:178-82.
11. Duran N, Ozer B, Duran GG et al. Antibiotic resistance genes & susceptibility patterns in staphylococci. Indian J Med Res. 135,March 2012;pp 389-396.
12. Hauschild T, SachaP ,Wieczorek P et al. Aminoglycosides resistance in clinical isolates of *Staphylococcus aureus* from a university hospital in Bialystok, Poland. Folia Histochemica et Cytobiologica 2008; 46(2):225-28.
13. Kandle SK, Ghatole MP, Takpere AY et al. Bacteriophage typing and antibiotic sensitivity pattern of *Staphylococcus aureus* from clinical specimen in and around Solapur (South Maharashtra). J Commun Dis. 2003;35:17–23.
14. Datta P et al. Evaluation of various methods for the detection of methicillin-resistant *Staphylococcus aureus* strains and susceptibility patterns. Journal of Medical Microbiology. 2011;60:1613–1616.
15. Anupurba S, Sen MR, Nath G et al. Prevalence of methicillin resistant *Staphylococcus aureus* in a tertiary referral hospital in eastern Uttar Pradesh. Indian J Med Microbiol. 2003;21:49-51.
16. Rajaduraipandi K, Mani KR, Panneerselvam K et al. Prevalence and antimicrobial susceptibility pattern of methicillin resistant *Staphylococcus aureus*: A multicentre study. Ind J Med Microbiol. 2006;24:34–8.
17. Majumder D, Bordoloi JN, Phukan AC et al. Antimicrobial susceptibility pattern among methicillin resistant staphylococcus isolates in Assam. Indian J Med Microbiol. 2001; 19:138–40.
18. Schmitz FJ, Fluit AC, Gondolf M et al. The prevalence of aminoglycoside resistance and corresponding resistance genes in clinical isolates of staphylococci from 19 European hospitals. Journal of Antimicrobial Chemotherapy. 1999;43:253-59.

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