Comparison of antimicrobial resistance among community acquired and hospital acquired staphylococcal infections

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ABSTRACT

Background: Antimicrobial resistance once confined to hospital associated infections, is now a potential threat in the community too.
Aim: To compare and assess the differences in anti microbial resistance shown by community acquired and hospital acquired Staphylococcal strains.
Methods: The study included 107 Staphylococcal isolates through samples collected from both in-patients and out-patients in Chengalpattu Medical College Hospital. Anti microbial susceptibility of the organism was tested separately for both groups using Kirby Bauers disc diffusion method and Minimum Inhibitory Concentration of Vancomycin determined by Agar dilution method.
Results: Prevalence of resistance to all routinely used antibiotics is higher among the hospital acquired strains for Staphylococcus aureus while for Coagulase negative Staphylococci(CoNS) resistance is higher among the community acquired strains.
Conclusion: Our result emphasizes the need for consideration of resistant Staphylococcal strains as a potential pathogen and a strict antibiotic surveillance system to be established.

Keywords: resistance, staphylococcus aureus, coagulase negative staphylococci, hospital and community settings.

INTRODUCTION

Staphylococci have been the most prevalent cause of bloodstream, skin, soft-tissue infections, and pneumonia posing a concern for better investigations, early diagnosis and efficient treatment.[1] More than a dozen species of Staphylococci colonise humans, of which three are clinically important; S.aureus, S.epidermidis and S.saprophyticus, the latter two commonly referred together as Coagulase Negative Staphylococci (CoNS). S.aureus is now the leading overall cause of nosocomial infections and is an increasing concern in the community as well.[2]

Over the past decade, the changing pattern of resistance in S. aureus has underscored the need for new antimicrobial agents.[3] Glycopeptide agents (Vancomycin and Teicoplanin) have been considered the only available antibiotics uniformly active against multidrug-resistant Staphylococci. But this can no longer be assumed, and vigilance is necessary to monitor this emerging problem.[1] Coagulase-negative staphylococci (CoNS) are less pathogenic than S. aureus but are important in line-associated bacteraemias and prosthetic device infections. They are more often resistant than S. aureus, notably to teicoplanin.[4] Methicillin-resistant Staphylococcus aureus (MRSA) isolates came into existence soon after the introduction of Methicillin.[5] In India, MRSA ranges from 27% in Bombay, to 47% in Delhi.[6] Once confined to health care–associated environments and in patients with established risk factors, MRSA has now recently been described in patients living in the community without any risk factors. However, the most common community-associated strains are characterized by resistance to only a limited set of antibiotics, but there seems to be only a negligible reduction in the growth rate relative to non-resistant strains.[7,8] This could account for its wide dissemination in the community and the

assumption that it is more easily transmitted than nosocomial MRSA strains[9].

The epidemiological and microbiological differences between community-associated and nosocomial MRSA infections necessitate different strategies to prevent and treat the 2 types of infections. Vancomycin non-susceptibility in S. aureus is also on the increase, further complicating therapy.[4] Thus to avoid clinical complications from Staphylococcal infections, clinicians should now consider resistant strains as a potential pathogen in patients with suspected *S. aureus* infections[10].

This study focuses on comparing the emergence of antimicrobial resistance among nosocomial and community acquired Staphylococcal strains, reflects the need for global strategies to control the emergence and spread of multi-resistant Staphylococci.

MATERIALS AND METHODS

The study design was a hospital based cross-sectional study. It was conducted in the Department of Microbiology, Chengalpattu Medical College and Hospital, Chengalpattu, Tamilnadu from June 2013 to August 2013 (2 months). Sample size was 100 clinical isolates of Staphylococci (50+50). Ethical clearance for the study was obtained from Institutional Ethical Committee.

Sample specifications:

Community acquired infections: Micro organisms recovered from specimens of patients who were not on admission in the hospital or been in contact with someone who had been recently in health care facility.

Nosocomial infections: Pathogens recovered from specimens of patients who have been admitted for more than 48 hours for which features of bacterial colonisation were not present at the time of initial presentation to the hospital.

Clinical samples such as pus, purulent exudates, wound swab, blood, CSF, sputum, BAL and body fluids were collected from 50 patients with Staphylococcal skin and soft tissue infections attending the OPD of Chengalpattu Medical College Hospital and 50 hospitalised patients undergoing treatment in ICU, medical, surgical and paediatrics ward with clinically suspected Staphylococcal diseases.

The collected samples were processed separately for both the groups (community acquired and hospital acquired infections) and cultured on routine bacteriological media such as Nutrient agar medium, Blood agar medium and Mannitol salt agar. The isolates of Staphylococci were identified by Gram stain, mannitol fermentation and coagulase test and categorised separately.

Anti-microbial susceptibility testing: After isolating the Staphylococci from the samples, their anti microbial susceptibility pattern was performed separately for both groups of isolates using Kirby Bauer's disc diffusion method as per NCCL guidelines.

MIC determination: The MIC of the selected anti microbials for both the group of isolates was also determined by Agar dilution method as per NCCL guidelines.

Detection of Oxacillin/Methicillin resistant Staphylococci (MRSA): Here 1 micro gram Oxacillin disc was used. Muller Hinton agar supplemented with an additional 5% Nacl was used and incubated at 35 degree Celsius and results were read as follows:

OXACILLIN	SUSCEPTIBLE	INTERMEDIATE	RESISTANT
ZONE SIZE	>13mm	11-12 mm	<10mm

Patients with Staphylococcal skin and soft tissue infections attending the OPD of Chengalpattu Medical College Hospital as well as hospitalised patients undergoing treatment in ICU, medical, surgical and paediatrics ward with clinically suspected Staphylococcal diseases were included in this study. The specimens sent from the patients who were on antibiotic therapy and recovering from infections were excluded from the study

Statistical differences were analysed using conventional chi-squared test and a P value <0.05 was considered significant. The data obtained was analysed using SPSS statistical software.

RESULTS

A total of 56 isolates of Staphylococcal species from Hospital acquired infections and 51 isolates of Staphylococci from community acquired infections were obtained.

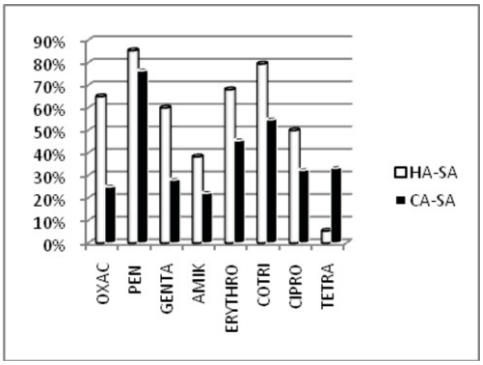
Table.1. Prevalence of Staphylococcal infections between the Hospital and Community acquired isolates.

S.N	STUDY GROUP	S.AUREUS	CoNS
1.	Hospital acquired infections	48 (85.71%)	8 (14.29%)
2.	Community acquired infections	35 (68.63%)	16 (31.37%)

Chi-square value = 4.479 ;P = 0.034 (P = <0.05); S.aureus - Staphylococcus aureus, CoNS - Coagulase negative Staphylococci.

Fig.1. Comparison of antimicrobial resistance between Hospital acquired (HA-SA) and Community acquired Staphylococcus aureus (CA-SA).

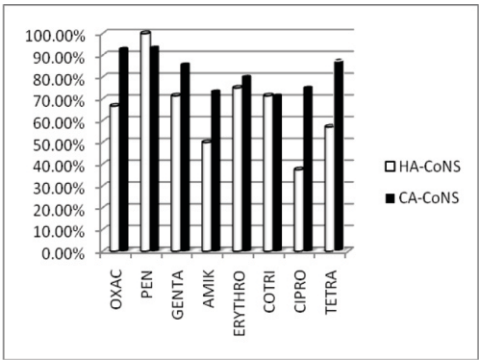
Chi square value = 10.067 ; P = 0.002 (P<0.05)



HA-SA: Hospital acquired S.aureus; CA-SA: Community acquired S.aureus; OXAC: Oxacillin; PEN: Penicillin; GENTA: Gentamicin; AMIK: Amikacin; ERYTHRO: Erythromycin; COTRI: Cotrimoxazole; CIPRO: Ciprofloxacin; TETRA: Tetracycline.

Fig.2. Comparison of antimicrobial resistance between hospital acquired (HA-CoNS) and community acquired CoNS (CA-CoNS).

Chi-squared value: 0.047, P value: 0.828



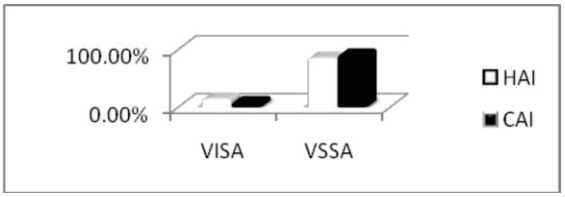
HA-SA: Hospital acquired S.aureus; CA-SA: Community acquired S.aureus; OXAC: Oxacillin; PEN: Penicillin; GENTA: Gentamicin; AMIK: Amikacin; ERYTHRO: Erythromycin; COTRI: Cotrimoxazole; CIPRO: Ciprofloxacin; TETRA: Tetracycline.

Table.2. Prevalence of Methicillin resistant S.aureus and CoNS in the hospital acquired and community acquired strains.

	HOSPITAL ACQUIRED		COMMUNITY ACQUIRED	
	n	%	n	%
MRSA	26/40	65	8/32	25
MR-CoNS	4/6	66.7	13/14	92.9

MRSA – Methicillin Resistant Staphylococcus aureus, MR-CoNS – Methicillin Resistant Coagulase negative Staphylococci

Fig.3. Comparison of MIC of Vancomycin for HA-SA and CA-SA:



HAI: Hospital acquired infections; CAI: Community acquired infections; VISA: Vancomycin intermediate S.aureus; VSSA: Vancomycin sensitive S.aureus.

All isolates of CoNS obtained from both community acquired and hospital acquired infections were sensitive to Vancomycin with a Minimum Inhibitory Concentration of <4µg/ml.

DISCUSSION

The present study was aimed at comparing the antimicrobial resistance pattern of Staphylococcal isolates from both hospital and community acquired infections. Among the HA-SA isolates maximum resistance was observed for Penicillin (88.4%) followed by Cotrimoxazole (79.5%) and the least resistance was against Tetracycline (5.4%). Similarly G.T.A. Jombo et al[11] also recorded maximum resistance for Pencillin and Cotrimoxazole.

In our study 50% isolates were susceptible to Ciprofloxacin and 50% showed resistance. Similar study done by Jombo et al[11], resistance to Amikacin was about 20%. But our study has recorded a resistance percentage of 60%. This clearly indicates a 3 fold increase in the resistance for this antibiotic in the hospital setup. Moreover, Amy V. Groom et al[12] showed 100% sensitivity to Gentamicin in their study. This is in contrast to 60% of our strains being resistant to Gentamicin. This showed variation of antibiotic resistance among the isolates in different regions.

Ciprofloxacin resistance recorded by Jombo et al[11] was just 5%, compared to the 50% resistance rate in our study. Amy V.Groom et al[12] have shown 100% sensitivity for Ciprofloxacin and nearly 100% (95%) susceptibility to Cotrimoxazole among the HA-SA isolates. In our study a reduced sensitivity to Ciprofloxacin (50%) and Cotrimoxazole (20%) was noted. Though these studies show a contradictory pattern of resistance, they highlight the dramatic decrease in the sensitivity of the organism against the previously effective antibiotics.

All of the HA-CoNS isolates in our study were resistant to Penicillin (100%), which is in accordance with a similar 100% resistance shown by Jombo et al.[11] 37.5% resistance was observed in our study against Ciprofloxacin. This is close enough to a 32.5% resistance observed by Jombo et al[11] in their study. Gentamicin has shown a twofold higher resistance (71.4%) in the present study as against 55% shown by Jombo et al.[11]

Among the CA-SA isolates, Tetracycline resistance pattern in our study (33.3%) was in similar comparison with that of BVS Krishna et al[13] (33%). A similar pattern was observed for Amikacin in our study (22.2%) and that of Ashish Pathak et al.(26%). [14]

42.9% resistance to Erythromycin was reported by Rahul Patil et al[15]. This is almost in unison to our resistance of 45.5% to Erythromycin. The susceptibility of 64.1% to Ciprofloxacin given by Rajendra Goud.N et al,[16] is more or less in coherence with our finding of 67.6% sensitivity among our CA-SA isolates. The study by Jombo et al[11] have shown 100% sensitivity to both Amikacin and Ciprofloxacin among the CA-SA strains. This is not so with our study showing a resistance of 22.2% and 32.4% to Amikacin and Ciprofloxacin respectively.

91% sensitivity to Cotrimoxazole was

observed by Amy V. Groom et al[12] to a mere 45.2% sensitivity in our study. Also, in the case of Gentamicin Rahul Patil et al[15] showed just 1.4% resistance, while the same is 28.1% in our study. This once again emphasises the increasing resistance to these drugs in the community setup as well.

In correlation with our results for Erythromycin (20%) and Cotrimoxazole (28.6%) sensitivity among the CA-CoNS isolates, is the study of G. T. A. Jombo et al[11], who recorded 18% sensitivity to Erythromycin and 27% to Cotrimoxazole. The same study of Jombo et al[11] recorded a 100% sensitivity of CA-CoNS strains for Ciprofloxacin. But, the susceptibility was found to be only 25% among our isolates. In contrast to the 81% sensitivity of strains to Amikacin and 72% sensitivity to Gentamicin in their study, only 26.7% and 14% sensitivity respectively was recorded in the present study. The prevalence of MRSA strains was found to be 65% and 25% in the hospital acquired and community acquired groups respectively. This is in part an alarming rate, especially in the hospital acquired group. This is stressed in turn by the study by Amy V. Groom et al[12] who recorded 100% sensitivity to Oxacillin among their HA-SA strains.

The Methicillin resistance among the CoNS strains is an area often overlooked. Our study showed 66.7% of hospital acquired strains and 92.9% of community acquired strains to be MR-CoNS. This percentage is definitely on rise compared to that of MRSA isolates. Comparing the resistance profile of the two groups highest resistance in both S.aureus and CoNS is towards Pencillin one of the oldest drugs used for treatment of Staphyococcal infections.

In case of sensitivity to Vancomycin, no resistant strains were observed in our study, based on MIC determination. This finding of 100% Vancomycin sensitivity is similar to the observations of Amy V. Groom et al[12] and Rahul Patil et al.[15]

This study clearly indicates the dramatic increase in antibiotic resistance both in hospital acquired and community acquired infections. Also, the prevalence of Methicillin Resistant Staphylococci in the hospital acquired infections is on the rise. Though CoNS was considered a non-pathogen it is now developing resistance even to the higher antibiotics. So the great concern is the rising resistance among community setups too.

CONCLUSION

There is variation in the resistance pattern of different antibiotics among Staphylococcal isolates of both groups.

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AUTHOR NOTE

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