

Antimicrobial Resistance Pattern of *Staphylococcus aureus* causing Skin and Soft Tissue Infections in a Tertiary Care Hospital of North Karnataka, India.

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Abstract

Background-

Skin & soft tissue infections (SSTIs) are a common problem encountered in clinical practice and warrant judicial antibacterial therapy.

Aims –

To find the profile of Gram positive bacteria causing skin and soft tissue infections & the antibiotic resistance pattern of *Staphylococcus aureus* among the isolates.

Material and methods –

It was a prospective study from April 2014 to September 2014. A total of 200 pus samples from SSTIs received in bacteriology laboratory were analysed.

Results –

A total of 216 bacteria were isolated from 200 pus samples, with some samples showing growth of more than one bacteria. There were 92 (42.59%) Gram positive cocci and 124 (57.40%) of Gram negative bacilli. Among the Gram positive cocci *Staphylococcus aureus* was the most common isolate (82.6%) followed by *Enterococcus* species and *Streptococcus pyogenes*. 73.65% of *Staphylococcus aureus* were methicillin resistant. The most effective drug against *Staphylococcus aureus* was linezolid followed by tetracycline and vancomycin.

Conclusion :

With the knowledge of the likely Gram positive organisms causing SSTIs and their resistance pattern the most suitable antibiotic can be started without waiting for antibiogram.

INTRODUCTION

Skin and soft tissue infections (SSTI) are a common problem encountered in clinical practice. Bacterial SSTI may range from superficial epidermal infections to life threatening necrotising fasciitis. Although SSTI can be managed on outpatient basis, physicians must remain alert for signs and symptoms indicative of a more serious infection requiring hospital evaluation. They are the common cause of morbidity in both community and hospital.¹

Common examples of SSTI are cellulitis, abscess, carbuncle, furuncle, diabetic foot infections and surgical site infections. An SSTI is classified as complicated if the infection spreads to deeper soft tissues, if surgical intervention is necessary or the patient has co morbid conditions hindering treatment response (eg. Diabetes mellitus or human immunodeficiency virus).²

SSTI can be caused by broad range of pathogens. Gram positive bacteria includes *Staphylococcus aureus*, *Enterococcus species*, *CONS*, *Streptococcus pyogenes*, Gram negative bacteria includes *Escherichia coli*, *Pseudomonas aeruginosa*, *Acinetobacter species*, *Klebsiella species*, *Citrobacter* and *Proteus species*.³

Localised pus producing lesions such as boils, abscess,

carbuncles and localised wound sepsis are usually caused by *Staphylococcus* while rapidly spreading infections like erysipelas, lymphangitis or cellulitis are usually caused by beta haemolytic *Streptococci*.⁴

Staphylococcus is almost the universal cause of furuncles, carbuncle, skin abscess and worldwide the most commonly identified agent responsible for skin and soft tissue infections. Strains resistant to beta lactam antimicrobial drugs termed methicillin resistant *S.aureus* (MRSA) were recognised in 1960. The emergence of MRSA in 1960s occurred predominantly in patients exposed to health care facilities. Community acquired MRSA were identified in 1990.^{5,6}

There is a growing concern about a rapid rise in resistance of *S.aureus* to antimicrobial agents. Resistance has been seen against gentamicin, clotrimoxazole, erythromycin, clindamycin. Maximum susceptibility has been seen against Vancomycin and linezolid.^{7,8}

It is important to monitor the changing trends in bacterial infection and their antimicrobial susceptibility pattern to provide appropriate antimicrobial therapy for controlling infection, preventing morbidity and improve the quality of life. Since limited data are available concerning soft tissue infection, mortality rate and antibiotic susceptibility

of *Staphylococcus aureus* in our hospital settings, the present study will be taken to determine types, frequency of Gram positive bacterial isolates and the antibiotic susceptibility pattern of *Staphylococcus aureus* among Gram positive isolates.

MATERIAL AND METHODS

The current study was a prospective study conducted from April 2014 to September 2014 which included a total of 200 culture positive samples. Patients of both sexes irrespective of age groups suffering from SSTIs attending or admitted in general surgery, orthopedics, dermatology, gastroenterology, gynaecology and intensive care units of Shri B.M. patil medical college were included in the study.

Inclusion criteria: Single and mixed growth with Gram positive cocci were included in the study.

Exclusion criteria: Single and mixed growth which were not showing Gram positive cocci were excluded from the study.

The lesions were cleaned with sterile normal saline. Special care was taken to avoid contamination by normal flora of skin or mucus surface, where possible pus was aspirated or exudates collected. The specimens were transported in sterile, leak-proof containers. The specimen were inoculated on nutrient agar, Mac-conkey agar and blood agar plates. Nutrient agar and Mac-conkey agar plates were incubated aerobically and blood agar plates were incubated in the presence of 5% CO₂ at 37°C overnight. The isolates were identified by gram staining, colony morphology and standard biochemical tests: catalase, slide and tube coagulase, mannitol salt agar test, phosphatase test, bile esculin hydrolysis and bacitracin sensitivity test.⁹

Antimicrobial susceptibility testing

Antibiotic susceptibility tests were done on these isolates using Mueller-Hinton agar by standard disc diffusion method according to CLSI guidelines. The following antibiotics were tested for Gram positive cocci: penicillin (10µg), azithromycin (15µg), cotrimoxazole (25µg), linezolid (30µg), tetracycline (30µg), ciprofloxacin (5µg), gentamicin (10µg), ampicillin (10µg), cloxacillin (10µg), cefuroxime (30µg) and vancomycin (30µg). The diameter of zone of inhibition was recorded and interpreted as susceptible or resistance by criteria of CLSI.¹⁰

Detection of MRSA¹¹

Methicillin resistant staphylococcus (MRSA) was detected by standard disc diffusion method using cefoxitin (30µg) and oxacillin (1µg) discs. The organisms were deemed methicillin resistant when zone of inhibition was ≤ 13 mm for oxacillin & ≤ 22 mm for cefoxitin discs.

Statistical analysis

Data was analysed by SPSS 14 software and by proper diagrammatic presentation.

RESULTS

Of the 200 culture positive samples the number of bacterial isolates obtained were 216. Gram positive cocci obtained was 92 and Gram negative bacilli were 124. Among the Gram positive bacteria 76 were *Staphylococcus aureus*.

Table 1 : Demographic characteristics of the study (n=76)

Age group in years	n%
0-10	3 (3.9%)
11-20	5 (6.5%)
21-30	21 (27.63%)
31-40	11 (14.47%)
41-50	10 (13.15%)
51-60	15 (19.73%)
>60	11 (14.47%)
Gender	
Male	48 (76.31%)
Female	28 (23.68%)

Most of the patients suffering from SSTIs were in 21-30 years of age group and majority were male patients. The demographic characteristics of the study is in (table 1)

Table 2 : Distribution of cases in SSTIs (n=76)

Abscess	38 (50%)
Carbuncle	14 (18.42%)
Cellulitis	10 (13.1%)
Diabetic foot ulcer	6 (7.89%)
Surgical site infection	4 (5.26%)
Wound infection	2 (2.63%)
Necrotising fasciitis	2 (2.63%)

Most of the isolates in our study were from abscess (50%) followed by carbuncle (29%) and cellulitis (12%). The distribution of cases in our study is given in (table 2).

Table 3 : Gram positive isolates of SSTIs (n=92)

Pathogen	n%
<i>Staphylococcus aureus</i>	76 (82.6%)
<i>Enterococcus</i> species	6 (6.52%)
<i>Streptococcus pyogenes</i>	6 (6.52%)
<i>Coagulase negative staphylococci (CONS)</i>	4 (4.34%)

The distribution of organisms is given in (table 3). *Staphylococcus aureus* (82.6%) was the most common organism followed by *Enterococcus species* and *streptococcus pyogenes* (6.52%).

Antimicrobial susceptibility pattern of *Staphylococcus aureus*

Resistance pattern of *Staphylococcus aureus* is shown in table 4. 73.6% of *staphylococcus aureus* were found to be methicillin resistant and cross resistance to other beta lactams ie: penicillin, ampicillin and cefuroxime was also seen. Methicillin resistant *Staphylococcus* was seen to be more resistant to other antibiotics like gentamicin, azithromycin and ciprofloxacin compared to methicillin sensitive *staphylococcus*. Minimum resistance was seen against linezolid (13.15%) followed by vancomycin (14.47%) and tetracycline (15.78%).

Table 4 : Antimicrobial Resistance pattern of *Staphylococcus aureus*

Antimicrobials	Number (% of resistance)
Penicillin	76 (100 %)
Azithromycin	50 (65.78 %)
Cotrimoxazole	20 (26.31 %)
Linezolid	10 (13.15%)
Tetracycline	12 (15.78 %)
Ciprofloxacin	62 (81.57 %)
Gentamicin	34 (44.73 %)
Ampicillin	76 (100 %)
Cloxacillin	30 (39.47%)
Cefuroxime	22 (28.94 %)
Vancomycin	11 (14.47 %)

DISCUSSION

In the present study majority of the patients suffering from SSTI were in the age group 21 -30 years and were male which is similar to the study conducted by Shenoy MS et al who also reported that most of the strains were isolated from 21-30 years of age group.¹²

Majority of the SSTIs isolates were obtained from abscess (50%) which is similar to the study conducted by Martin ES et al in San Francisco where it was found to be around (50-75%)¹³.

Staphylococcus aureus was the predominant gram positive organism in the present study similar to studies in India^{3,14} and outside^{2,15} where they were the most frequently isolated organism from skin and soft tissue infections in patient admitted to the hospital.

In the current study 73.6% of *Staphylococcus aureus* were methicillin resistant (MRSA) which was higher than study conducted in New Delhi (38.56%)³, Nagpur (19.56%)¹⁶ and Vellore (24%)¹⁴. It was also greater than the study conducted in USA and Europe where it was (44.4%) and (34.7%)¹⁷. This is because ours is a tertiary care hospital where patients had come after taking treatment in other primary and secondary health care centres. So they had developed resistance to many drugs. It was comparable to the study conducted by Shenoy MS *et al* where it was found to be around 66%.¹²

About 81% of MRSA were resistant to ciprofloxacin, 65% of MRSA were resistant to azithromycin & 54% of MRSA were resistant to gentamicin. High resistance has been noted in previous studies also^{3,16,18}. In the present study for the treatment of MRSA linezolid, tetracycline and vancomycin have proved to be the most effective drugs which is similar to a study conducted in India¹⁸ and San Francisco¹³. Other drugs like cotrimoxazole, clindamycin, quinapristin/ dalfopristin, quinapristin and newer generation fluoroquinolones have also proved to be beneficial¹⁹.

CONCLUSION

In this present study the most common isolate in skin and soft tissue infection among Gram positive isolates is *Staphylococcus aureus*. Most of the *Staphylococcus aureus* are methicillin resistant. Linezolid, vancomycin and tetracycline have proved to be the most useful drugs against *Staphylococcus aureus*. With this knowledge of Gram positive organisms causing SSTIs and their

sensitivity pattern, the most suitable antibiotic can be started without waiting for the result. This would help us to avoid unnecessary medication with ineffective antibiotics and thus prevent development drug resistance.

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