

Antibiotic sensitivity patterns of staphylococcal skin infections

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Abstract *Objectives* To determine the current sensitivity pattern against staphylococci found in skin and soft tissue infections.

Methods Patients were enrolled from OPD of Dermatology Department, PNS Shifa Hospital, Karachi. All the patients with skin infections showing growth of *Staphylococcus aureus* on culture medium were selected. After informed consent, swab specimens were collected under aseptic measures from skin lesions for microbial analysis and sensitivity pattern.

Results Among skin infections, furunculosis was found most common, comprising of 45.7% (n=43), cellulitis 15.0% (n=14), ecthyma 8.5% (n=8), erysipelas 8.5 % (n=8) and impetigo 22.3% (n=21). According to drug sensitivity patterns, vancomycin was found sensitive in 100%, linezolid 98.9%, mupirocin 96.8%, rifampicin 95.7%, chloramphenicol 94.7%, clindamycin 86.2%, amikacin 84%, moxifloxacin 83%, fusidic acid 79.8%, gentamicin 76.6%, oxacillin 69.1%, ciprofloxacin 68.1%, amoxicillin-clavulanic acid 62.8%, erythromycin 60.6% and trimethoprim-sulphamethaxazole 57.4% of cases

Conclusion Vancomycin, linezolid, rifampicin, clindamycin, moxifloxacin and chloramphenicol showed highest efficacy in this study. However, clinical studies are required to confirm in vivo efficacy and side effect profile of these drugs.

Key words

Staphylococcus aureus, antibiotic sensitivity.

Introduction

Staphylococci are the most common cause of skin and soft tissues infections, the most common cause of nosocomial cases of pneumonia and surgical wound infections,¹ endocarditis in patients with prosthetic valves² and of nosocomial bloodstream infections.³ Staphylococcal infections are significant cause of morbidity and mortality in tropical countries. If repeated cultures are performed, up to 80% adults harbor staphylococci in the nose at one

time or the other.⁴

Staphylococcus aureus makes up about 20% of microbial load in the air. It is also suggested that staphylococci are commonly disseminated from the nasal cavity during talking, breathing and even exercising.⁵ This important pathogen not only causes mild to severe skin infections like impetigo, furuncle, ecthyma, cellulitis etc., it may also cause some invasive infections including pneumonia, endocarditis, deep-seated abscesses, toxic shock syndrome etc.⁶

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Staphylococcus has developed resistance to antibiotics because of acquisition and transfer of antibiotic resistant plasmids. Some poorly

explained intrinsic resistance mechanisms are also important factor.^{4,7}

In case of *S. aureus*, the most common and important species of staphylococci, it produces Pantone-Valentine leukocidin (PVL) most commonly in community-acquired infections, which is related with high morbidity and mortality.⁸

S. aureus is developing a lot of resistance, among which methicillin-resistant *S. aureus* (MRSA) is very common. MRSA has two types: healthcare-acquired (HA-MRSA) and community-acquired (CA-MRSA). Both can cause serious and invasive infections; however, CA-MRSA is associated with more serious complications like sepsis, bone and joint infections and even death.⁹ It is suggested that all MRSA strains are resistant to penicillinase stable penicillins.¹⁰

According to Center for Drug Control report, 20-30% of population is colonized with *S. aureus*, 1% are MRSA among them, although all of them are not infected. MRSA sometimes called superbug, as it is difficult to treat.¹¹ According to two meta-analyses there is 23.4% mortality associated with methicillin-susceptible *S. aureus* (MSSA) vs. 36.4% with MRSA.¹²

Antimicrobial susceptibility patterns are important for clinicians for the selection of empirical antibiotic therapy, rationale formulation of healthcare policies and useful information on the global surveillance of this organism.⁶ The paucity of such data in Pakistan has led to injudicious use of antibiotics, which not simply produces economical loss to the developing country but also develops antibiotic resistance.¹³ Rationale of the present study is to acquire the current sensitivity pattern of antimicrobials against staphylococci so that

patients can be managed properly and injudicious use of antibiotics can be minimized.

Methods

Patients were enrolled from out-patient clinic of dermatology department, PNS Shifa Hospital, Karachi. All the patients with skin infections, showing growth of staphylococci on culture medium and meeting inclusion criteria were selected. After informed consent, swab specimens were collected under aseptic measures from skin lesions for microbial analysis and sensitivity pattern. Specimens were transported in microbiology department, PNS Shifa hospital within two hours of collection. Specimens were inoculated on 5% horse blood agar (Laboratories Britania®, Argentina)/mannitol salt agar (Oxoid Basingstoke®, UK). These plates were incubated at 35-37°C aerobically. Staphylococci and their species were identified by colony morphology, Gram staining, catalase, slide and tube coagulase and DNase tests under the supervision of consultant microbiologist. Antibiotic sensitivity pattern were tested by standard antibiotic discs using modified Kirby-Bauer disc diffusion method and read and classified as either sensitive or resistance as per recommendations of Clinical Laboratory Standards Institute.¹⁰

Results

Ninety-four of those who developed staphylococcus species on culture were further selected for sensitivity pattern. Gender distribution of patients (**Table 1**), showed 73 (77.7%) males and 21 (22.3%) females. Age distribution of the subjects of the study showed were 31 (33.0%) were in 25-30 years of age group, 33 (35.1%) from 31-40 years, and 30 (31.9%) were from 41-50 year age group. Mean age of patients was 36.73±3.78 years.

Table 1 Clinical data of patients (n=94).

| | N (%) |
|---------------------------|-----------|
| <i>Gender</i> | |
| Male | 73 (77.7) |
| Female | 21 (22.3) |
| <i>Age (years)</i> | |
| 25-30 | 31 (33) |
| 31-40 | 33 (35.1) |
| 41-50 | 30 (31.9) |
| <i>Clinical diagnosis</i> | |
| Furunculosis | 43 (45.7) |
| Impetigo | 21 (22.3) |
| Cellulitis | 14 (15.0) |
| Ecthyma | 8 (8.5) |
| Erysipelas | 8 (8.5) |

Table 2 Sensitivity and resistance pattern of drugs against *Staphylococcus aureus*.

| Drugs | Sensitivity | Resistance |
|-----------------|-------------|------------|
| Vancomycin | 94 (100%) | 0 (0.0) |
| Linezolid | 93 (98.9%) | 01 (1.1%) |
| Mupirocin | 91 (96.8%) | 03 (3.2%) |
| Rifampicin | 90 (95.7%) | 04 (4.3%) |
| Chloramphenicol | 89 (94.7%) | 05 (5.3%) |
| Clindamycin | 81 (86.2%) | 13 (13.8%) |
| Amikacin | 79 (84.0%) | 15 (16.0%) |
| Moxifloxacin | 78 (83.0%) | 16 (17.0%) |
| Fusidic acid | 75 (79.8%) | 19 (20.2%) |
| Gentamicin | 72 (76.6%) | 22 (23.4%) |
| Oxacillin | 65 (69.1%) | 29 (30.9%) |
| Ciprofloxacin | 64 (68.1%) | 30 (31.9%) |
| Amoxi-clav | 59 (62.8%) | 35 (37.2%) |
| Erythromycin | 56 (60.6%) | 38 (39.4%) |
| Tmp-smx | 54 (57.4%) | 40 (42.6%) |

Among cutaneous infections (**Table 1**), furunculosis was the most common disease, comprising of 43 (45.7%) patients. **Table 2** shows the drug sensitivity patterns. Of all the samples, vancomycin (100%) was found most sensitive, while trimethoprim-sulphamethaxazole (57.4%) was found least sensitive antimicrobial.

Discussion

In this study we compared the sensitivity of *S. aureus* against fifteen different antibiotics including the old conventional drugs and the novel available newer therapies in our set-up.

Hanif *et al.*¹³ in 2006 showed in their study that amikacin was 98.6% sensitive, oxacillin 91.7%, ciprofloxacin 97.2%, amoxi-clav 91.7%, fusidic acid 100%, chloramphenicol 90.3%, clindamycin 95.8%, trimethoprim-sulphamethaxazole 30.6% and gentamicin 90.3% against staphylococcus. While this study showed amikacin 84% sensitive, oxacillin 69.1%, ciprofloxacin 68.1% ciprofloxacin, amoxi-clav 62.8%, fusidic acid 79.8%, chloramphenicol 94.7%, clindamycin 86.2%, trimethoprim-sulphamethaxazole 57.4% and gentamicin 76.29% as shown in **Table 3**. Now these data suggest that except chloramphenicol and trimethoprim-sulphamethaxazole all drugs have shown reduced sensitivity against staphylococcus that may be because of injudicious use of these antibiotics in the community in last 6 years, especially by the quacks and general practitioners. While chloramphenicol and trimethoprim-sulphamethaxazole are the older drugs and are no longer in common use mainly because of their side effects. This may be the reason that their efficacy has gradually increased. Chloramphenicol was the fifth most sensitive drug of our study. National data (90.3%)¹³ also suggested that it was an effective antibiotic against staphylococci in 2006. It has shown 90% sensitivity, against MRSA according to one local study.¹⁴ Chloramphenicol is routinely used for the management of vancomycin-resistant enterococci (VRE) infections at some institutes.¹⁴ Further clinical studies specially against MRSA and vancomycin-resistant *S. aureus* should be carried on this cost effective precious drug, to see its efficacy and side effect profile, so that it may be utilized for the benefit of community.

Vancomycin showed (100%) sensitivity, results are comparable with national (100%)¹³ and international data (100%).¹⁵ It is suggested that it is still the most effective parenteral antibiotic

Table 5 Sensitivity data of drugs in this study and their comparison with local and international data.

| <i>Drugs</i> | <i>Present study (2014)</i> | <i>Local studies</i> | <i>International studies</i> |
|-----------------------------|-----------------------------|----------------------|------------------------------|
| Amikacin | 84.0% | 98.6% [13] | 63.6% [15] |
| Oxacillin | 69.1% | 91.7% [13] | 55.6% [5] |
| Ciprofloxacin | 68.1% | 97.2% [13] | 78.9% [4] |
| Amoxicillin-clavulanic acid | 62.8% | 91.7% [13] | 40.7% [5] |
| Moxifloxacin | 83.0% | 100% [20] | 99% [21] |
| Fusidic acid | 79.8% | 100% [13] | 50% [19] |
| Linezolid | 98.9% | 100% [20] | >95% [8] |
| Vancomycin | 100% | 100% [13] | 100% [15] |
| Rifampicin | 95.7% | 62% [20] | 89.5% [18] |
| Chloramphenicol | 94.7% | 90.3% [13] | 66.7% [5] |
| Clindamycin | 86.2% | 95.8% [13] | 36.4% [15] |
| Tmp-smx | 57.4% | 41.0% [14] | >95% [8] |
| Erythromycin | 60.6% | 42.4% [7] | 43% [22] |
| Gentamicin | 76.59% | 90.3% [13] | >95% [8] |
| Mupirocin | 96.80% | 98% [16] | 85.3% [17] |

against all type of staphylococci. Linezolid was the 2nd most sensitive drug in our study. It is effective drug against VRE and MRSA. Results of national data (100%)¹³ and international data (95%)⁵ are also well consistent with these results. Mupirocin was the third most sensitive drug in the present study. National data (98%)¹⁶ also supports its effectiveness; international data (85.3%)¹⁷ suggests that resistance is also emerging to this novel topical antibiotic. Rifampicin was fourth most sensitive drug. Staphylococci get resistance against it by alteration of enzymes. It is having comparable results with the international data (89.5%).¹⁸ As this is the mainstay of antituberculous therapy, this drug always being given along with some other antibiotic to prevent its resistance.

Fusidic acid (79.8%), is commonly prescribed topical antibiotic. This is also an effective oral antistaphylococcal agent. Just because of its injudicious use, especially in combination with steroid it is rapidly developing resistance. National data obtained 6 years back showed sensitivity of 100%.¹³ International data (50%)¹⁹ is indicating that it will lose its efficacy with progress of time in Pakistan, as well. Moxifloxacin 83.9% is still a good choice but comparison with national (100%)²⁰ and international data (99%)²¹ suggests that

resistance is emerging against this drug in our community. It may be because of substandard and poor-quality antibiotic preparations along with substandard dosages and quality in marketed tablets. Oxacillin was (69.1%) sensitive with comparison to the national data (91.7%).¹³ This suggests increased prevalence of MRSA in our community. Ciprofloxacin's resistance (68.%) is also emerging. This study has comparable results with international data (78.9%).⁴

Amoxi-clav is the most commonly prescribed antibiotic in our outpatient department. Staphylococcus has multiple mechanisms of getting resistance against it, like enzymatic inhibition, membrane impermeability, alteration of target enzymes etc. This drug has shown 62.8% efficacy, which is quite less than the 6 yrs old national data (91.7%).¹³ International data (40.7%)⁵ is indicating the future of this drug in Pakistan. Erythromycin showed increased sensitivity (60.6%) with comparison to the national (42.4%)⁷ and international data (43%),²² that may be because of decreased use of erythromycin in the clinical practice, nowadays. Aminoglycosides, amikacin (84.0%) and gentamicin (76.59%) are still having good efficacy against staphylococci. This is still a good choice to use them alone or in combination

with other antibiotic, in life threatening staphylococcal infection.

Conclusion

Vancomycin, linezolid, rifampicin, clindamycin, moxifloxacin and chloramphenicol showed highest efficacy in this study. However, clinical studies are required to confirm *in vivo* efficacy and side effect profile of these drugs. It is alarming that the most commonly prescribed antibiotic of our OPD, amoxicillin-clavulanic acid has developed a lot of resistance.

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