ORIGINAL ARTICLE

ANTIBIOGRAM OF STAPHYLOCOCCUS AUREUS AMONG CLINICAL ISOLATES AT A TERTIARY CARE HOSPITAL IN LAHORE

FATIMA KHALID[1], MARIAM DANISH IQBAL[2], TARIQ MAHMUD TARIQ[3], NAUREEN SAEED[4], SAFANA SADAF[5], ASMA AKHTAR[6]
Department of Pathology, Shalamar Institute of Health Sciences, Lahore

ABSTRACT

Background: *Staphylococcus aureus* has become an important cause of persistent nosocomial and community acquired infections. Consequently, it has become a global health concern. It has an uncanny ability of evolving means of resistance to common antimicrobial agents. Management of hospital-acquired infections is complicated by the worldwide spread of Methicillin Resistant *Staphylococcus aureus* (MRSA) in the modern day.

Objective: This study was conducted to screen and assess the antibiotic susceptibility pattern of *Staphylococcus aureus (S. aureus)* from different hospital specimens and determining prevalence of Methicillin Resistant *Staphylococcus aureus* (MRSA).

Methods: This was a retrospective descriptive study in which data of all clinical isolates reported as *S. aureus* from 1st November 2019 to 31stOctober 2020 was collected through the electronic medical records system of Shalamar Teaching Hospital. Record of antibiotic susceptibility profile was categorized and analyzed.

Results: During the mentioned period (1st November 2019 to 31stOctober 2020), 149 total isolates of S. *aureus* were reported. Out of those isolates 4.7% were sensitive to Ampicillin, 20% to Ciprofloxacin, 51% to Clindamycin, 40% to Cefuroxime, 14% to Erythromycin, 64% to Fusidic Acid, Fosfomycin showed 6.0% sensitivity, Nitrofurantoin 89%, Cefoxitin 45.0%, Gentamicin 72.5%, Linezolid 100%, Co-trimoxazole 33%, Teicoplanin 100%, and Vancomycin 100%.

Conclusions: According to this study Vancomycin, Teicoplanin and Linezolid are still the most appropriate drugs that could be chosen for the treatment of *S. aureus* infections, as all isolates show 100% susceptibility to these antibiotics.

Key words: *Staphylococcus aureus,* Antibiotic susceptibility, Antibiogram, MRSA

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Correspondence to: *Mariam Danish Iqbal*
Assistant Professor,
Shalamar Institute of Health Sciences, Lahore, Lahore, Pakistan.

Email: *dr.mariam.danish@gmail.com*

INTRODUCTION

The designation of '*Staphylococcus aurei* originated from the Greek word, "Staphyle" meaning cluster of grapes and "kokkos" meaning berry. The word "aureus" means the color of gold. Staphylococcus aureus are Gram-positive bacteria, having 0.5 – 1.5 μm diameter and occurring characteristically in groups in the form of grape like clusters, can also occur singly and in pairs.[1] Pathogenic *S. aureus* is identified by its ability to produce the enzyme "coagulase", whose function is to clot blood. [2] *S. aureus* pathogen is extraordinarily versatile that can thrive in harsh environmental conditions. It also is a colonizer of skin and mucous membranes. *S. aureus* is responsible for invasive pyogenic infections and toxin-mediated, non-purulent disease in humans.[3]

S. aureus causes hospital and community acquired pneumonia, Health Care Associated (HCA) bacteremia, soft tissue, skin, bone and urinary tract infections (UTI)as well as other invasive infections.[4]

S. aureus is considered to be one of the most resistant pathogens from amongst the non-spore forming organisms. The plasmids of *S. aureus* contain a diverse range of multi-drug resistant genes.[5] Two different types of MRSA exsist, Hospital Acquired (HA) and Community acquired (CA) *Staphylococcus aureus*. HA MRSA is usually present in Health care institutes and is a major cause of health care associated infections. CA MRSA infections are associated with more severe infections and have worse clinical outcomes when compared to infections that are caused by HA MRSA.[1]

Staphylococcal infections have been treated by various antibiotics starting from Penicillin in 1942. The emergence of penicillinase enzyme mediated resistance in *S. aureus* appeared in 1943, shortly after penicillin was available in the market.[6] In 1960, Methicillin was introduced, which was penicillinase resistant, and not surprisingly, in 1962 Methicillin resistant Staph aureus was detected. This resistance is caused by the mecA gene located in a mobile genetic component of *Staphylococcus aureus*. The drug of choice that the world is now left with for MRSA is Vancomycin.[7] Vancomycin is an antibiotic from the glycopeptide group, and acts by inhibiting bacterial cell wall biosynthesis. [8] In 2002, the first *S. aureus* to be reported resistant to vancomycin was isolated.[9]

S. aureus has an extraordinary ability of developing different mechanisms of resistance toward common antimicrobial agents. So, determining the antibiogram of *S. aureus* will help clinicians to treat cases with the most appropriate drug(s).

The main objective of this study is to survey and interpret the antibiotic susceptibility results of *Staphylococcus aureus* isolated from clinical specimens.

METHODS

This study is retrospective and descriptive in nature, conducted in Microbiology Laboratory, Pathology Department of Shalamar Teaching Hospital Lahore. This study lasted 6 months (December 2020 to May 2021). The data of samples that were reported as *S. aureus* received in Shalamar Hospital Laboratory during 1st November 2019 to 31st October 2020 were included. The sample size of this study was 149 and was based on electronic medical records (EMR) of *S. aureus* isolated from clinical specimens received in Shalamar Hospital Laboratory. After the approval of Shalamar Medical and Dental College Institutional Review Board (SMDC's IRB), the data was collected.

Records of patients' samples (nasal swab, blood, urine, pus, sputum etc.) reported as *S. aureus* received in Shalamar Hospital Laboratory were included. All age groups and both genders were included. Duplicate samples from the same patient during the same period of illness were excluded. Samples had been collected, transported, and cultured according to standard operating procedure as defined by Pathology Lab of Shalamar Teaching Hospital, which is based on CLSI standard.[10]

Identity of bacteria was determined by several methods. These include: morphology, gram staining, catalase test and Cefoxitin susceptibility disk test. Other biochemical tests included coagulase and DNase test. Guidelines of the Clinical and Laboratory Standards Institute (CLSI 2020) were used when evaluating antimicrobial susceptibility using disk diffusion technique.

Statistical Analysis: Mean and standard deviation was estimated for quantitative variables (such as age), and frequencies were determined for qualitative data (gender and antibiotic susceptibility). The data was collected and analyzed by SPSS 20.0 version

RESULTS

A total number of 149 isolates were reported as *S aureus* from 1st November 2019 to 31st October 2020 in Microbiology Section, Pathology Department of Shalamar Teaching Hospital, Lahore. Of all isolates 78 (52.3%) were recovered from female and 71 (47.7%) from male patients.

Table 1 shows the distribution of types of clinical specimens. Majority, about 35 % belong to pus, followed by wound specimens (33%).

Table 1: Distribution of Specimen Types (n=149)

Specimen	Frequency	Percentage
Ascitic Fluid	1	0.7
Blood	10	6.7
Bronchial Wash	1	0.7
CVP	1	0.7
Ear Swab	8	5.4
Fluid	1	0.7
HVS	2	1.3
Nasal Swab	1	0.7
Pus	52	34.9
Sputum	1	0.7
Swab	6	4
Tip	4	2.7
Tracheal Aspirate	3	2
Urine	9	6
Wound	49	32.9
Total	149	100

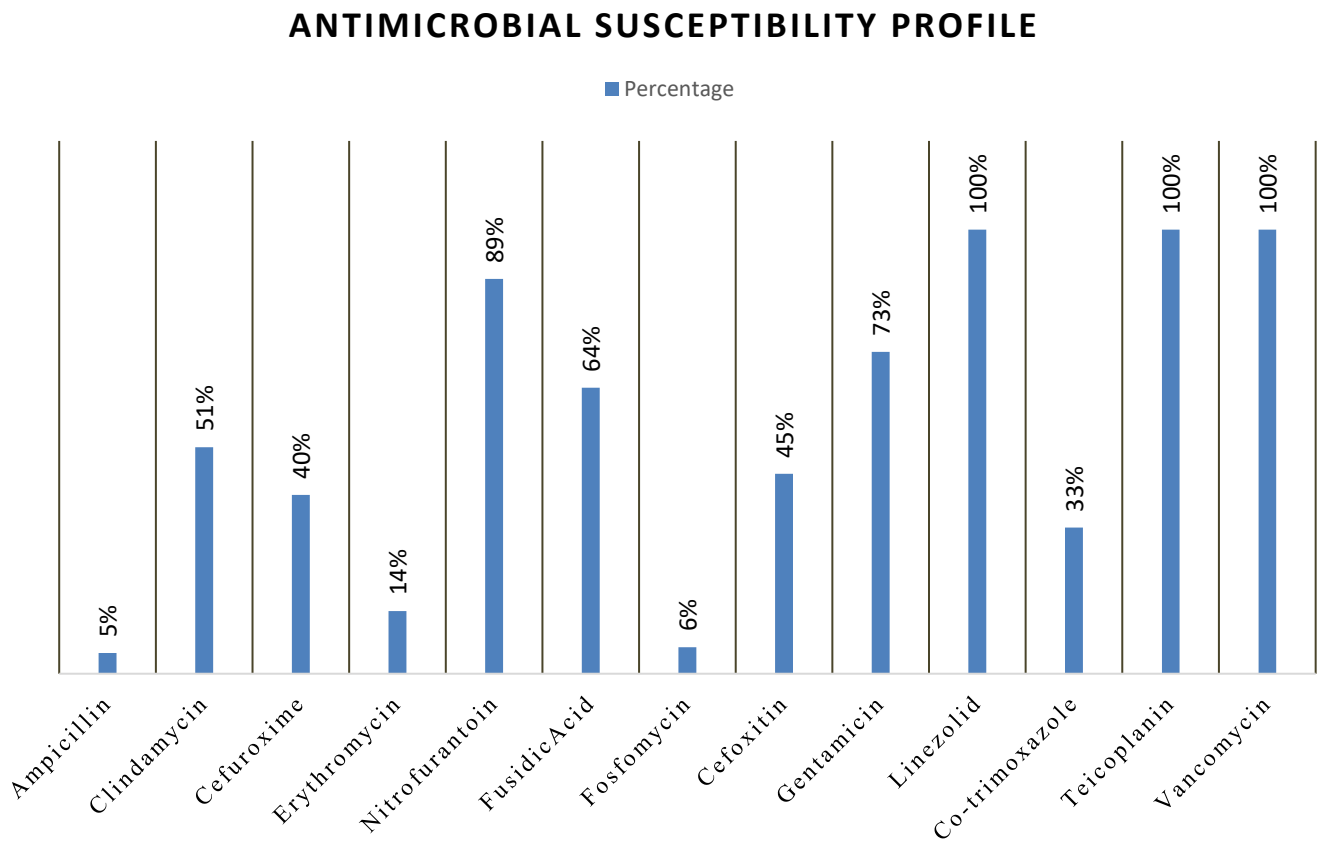

Figure. 1 Antimicrobial Susceptibility (n=149)

DISCUSSION

S. aureus is a widely known notorious cause of infection worldwide. It is recognized for its rapid development of resistance to widely used antibiotics.

In current study 149 samples were reported as S aureus during 1st November 2019 to 31st October 2020. In this study data of all age sets and both genders were included in which males were 47.7% and females were 52.3%. Data was taken from all types of clinical specimens including Pus, Wound swab, Blood, Ear Swab, Fluid, Urine, Sputum, Nasal Swab, Tip, Tracheal Aspirate, HVS, Ascitic Fluid, CVP and Bronchial Wash. Vancomycin resistance, reassuringly, was not found among the isolates. Ampicillin was recorded as the most resistant antibiotics.

The frequency of MRSA isolates in the present study was 82 (55.0%). Teicoplanin (TEC) and Vancomycin (VA) a Linezolid showed 100 % sensitivity to S. aureus and MRSA. In a study from 2017 conducted in Kabul, Afghanistan shows a MRSA rate of 56.2% which is comparable to our result of 55%. [11] A study in Peshawar Pakistan which was published in 2022, reports a surprisingly high percentage of MRSA of 78.3%. This is an alarming situation and highlights the need have antimicrobial stewardship programs in Peshawar. Along with a high MRSA percentage, there is also the start of resistance developing to Teicoplanin and Linezolid equaling to 2.14%.[12]

In 2021, a study conducted in Yemen revealed MRSA prevalence was 9.3% from the clinical specimens of skin and soft tissue sites. This number is significantly lower than present study (55%), probably due to the limited clinical sites of the study conducted in Yemen. Our study included all clinical specimens from numerous sites which had *S. aureus*. Vancomycin sensitivity rate was 100%, like our study. [13]

In 2017, research in Nepal was done on *S. aureus* isolates from wound swabs and pus. About 76 samples were positive for *S. aureus*, among which 36 (47.4%). These were slightly less than present study. Specimens were from limited clinical sites (pus and wound swabs). Linezolid and Vancomycin showed highest rates of sensitivity toward *S. aureus*. [14]

A Kenyan hospital in 2018 reported sensitivity against vancomycin and linezolid of 95% and 97.3% respectively. Prevalence of MRSA was 27.8%. This value is considerably lower than the percentage reported in our study.[4]

A retrospective study of 15 years was conducted in Boston at two tertiary care hospitals, in which *S. aureus* was isolated from various clinical specimens numbering

31,753. From 2000 to 2014 antibiotic resistance in *S. aureus* decreased by usage of antibiotics. Due to increase in PSSA (penicillin sensitive *S. aureus*), it makes Penicillin a viable treatment option for *S. aureus* infections, which is, unfortunately to us, not a viable option in this part of the world as demonstrated by present (Ampicillin sensitivity of 5%).[15]

A study from Islamabad in 2022 revealed that their MRSA rate was 10.4%. This shows that there is a difference in the MRSA prevalence pattern in various areas of the country. A reason for the difference in MRSA spectrum may be due to injudicious use of antibiotics.[16]

LIMITATIONS

Results may not be representative of the population because of limited sample size.

CONCLUSIONS

Current study drew attention to the high frequency of multidrug resistance in MRSA, especially in clinical settings of Shalamar tehsil region. Linezolid Teicoplanin and Vancomycin could be the choice of treating MRSA infection.

More comprehensive and detailed studies are needed in diverse geographical areas to better understand the epidemiology and mechanisms of drug resistance. Scrutinizing antibiotic sensitivity patterns and utilizing a strict drug policy for antibiotics used within and outside the hospital environment would help reduce antimicrobial resistance. Furthermore, consistent surveillance of hospital associated infections and a robust antimicrobial stewardship program will also aid in this respect.

Conflict of Interest: *Authors declare no conflict of interest.*

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