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Prevalence and Antibiotic Susceptibility Pattern of Staphylococcus Aureus in a Tertiary Care Hospital of Islamabad Pakistan

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Abstract

Background: Staphylococcus aureus mainly inhabits the skin and the mucosa of humans. It is regarded as a potential pathogen with the capability of causing diversity of infections after gaining entry to the host cell, initial mild infections of the skin can lead to invasive infections which can be threatening to life. Unlike other types of staphylococcus aureus, MRSA is challenging to treat because of its multidrug resistivity, the phenomena of antibiotic resistant in bacteria is called as "super bug".

Objectives: This study is planned to find out the anti-microbial susceptibility patterns and prevalence of staphylococcal infections in wound, pus, urine, and catheter tips samples in HBS hospital. Another aspect of our study is to find out the male and female ratio prevalence of SA in males and females & the male and female ratio of MRSA,

Methodology: This descriptive and prospective study was conducted at dept. of Pathology, HBS Medical &Dental College Laboratory from December 2017 to April 2019.

Overall samples received in the lab were 150 in number; in the microbiology section Swabs from wound, umbilical cord, eye, ear, throat, skin, and wound were considered for further analysis. Similarly, isolates of staphylococcus aureus from blood culture were collected and further analyzed. Isolates from a urine specimen, pleural aspirate, urine, high vaginal swab was also collected. S. aureus was isolated from samples of both male and females, belonging to all age groups of out or in patients hospitalized in different wards. These isolates were grown on MacConkey and blood agar media incubated for 24 hours at 370C. The susceptibility of all isolates was determined.

Results: Out of total 108 isolates of *S.aureus* 48(44.4%) were obtained from male and 60(55.5%) were from females. About 40.7% isolates resistant to cefoxatin and oxacillin were methicillin resistant *S.aureus* (MRSA) whereas 44.4% isolates sensitive to cefoxatin and oxacillin were methicillin sensitive *S.aureus* (MSSA).

Conclusion: Resistance to antibiotics has undoubtedly risen to extremely high levels. Certainly, the antibiotics should be prescribed cautiously for the treatment based on results of culture reports infections. This would help elude the consequences of the increase of Resistant *S. aureus* in our settings. Good hospital infection control measures prove to be the main stay against these infections because antibiotics can never be an effective alternate to good medical practice.

Keywords: *S.aureus*, MRSA, Resistance pattern

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Introduction

Staphylococcus aureus causes various infections. Staphylococcus aureus is gram positive coccus, it is known to be causing agent of infections of skin and soft tissue such as furuncle, carbuncles, boils, and skin abscesses. The infection caused by *S.aureus* may start from a small boil forming abscess extending to bone causing osteomyelitis, it can also cause disseminated infections of heart valves such as endocarditis. It can also cause urinary tract infections and bacteremia.[1] Positive catalase and coagulase reactions are shown by *S.aureus*.[2] As the organism is found as normal flora of the skin, nose, and nasopharynx it is likely to be spread through air and it can likely also be transmitted by fomites.[3] It is assessed that 20% of the population are nasal carriers of this bacterium which makes it an effective pathogen, it also possess immune-evasive properties. Among the

species of genus staphylococcus, the most infective is S. aureus. It can cause serious diseases such as toxic shock syndrome (TSS) which is caused by a superantigen produced by the organism likewise pneumonia and endocarditis are also diseases caused by it.[4] *S.aureus* often causes post-surgical wound infections being susceptible to almost every antibiotic which are in use in medical practice.[5]

Antibiotic resistance strains of *S.aureus* have reached to a level that now it is thought that infection caused by such strains have taken a form of an epidemic around the globe. It is now well-known that resistant strains of S. aureus are continuously developing and are found commonly in hospitals & community settings. Mechanisms producing resistance comprise inactivation of antibiotics due to action of enzymes, reduced affinity for the antibiotics because of variations of the target, action of efflux pumps also by mechanism of antibiotic trapping. Higher rates of disease and mortality are associated with Multidrug Resistant Staphylococcus aureus (MRSA) strains.[6] This might be due to use of antibiotics without any restriction in a particular setting. This makes infections caused by these pathogenic bacteria found to be very difficult to manage and expensive to treat. Multi drug resistance 'Superbug", status of MRSA has been recognized because of the resistance shown by the organism towards vancomycin and other antibiotics which are not structurally similar, thus making it more harmful than ever in hospital settings and recently, in the healthy community.[7] The objectives of this study were to detect the prevalence and susceptibility of staphylococcal infection in tertiary care hospital and to identify the Methicillin/Oxacillin resistant S. aureus (MRSA, ORSA) from clinical specimens using common used antibiotics.

Methodology

After approval from ethical review committee of institute, this study was descriptive and prospective and was conducted at HBS Medical College (Microbiology department). A total of one hundred and fifty clinical specimens, isolates of Staphylococcus aureus were obtained. In the microbiology section Swabs from wound, umbilical cord, eye, ear, throat, skin, and abscess were further investigated using standard protocls. Similarly, isolates of staphylococcus aureus from blood culture were collected. Isolates from urine specimen, pleural aspirate, urine, high vaginal swab were collected between December 2017 and April 2019. Isolates of S. aureus were obtained from both genders and all age groups of out or in patients hospitalized in different wards.

The standard collection technique was used for Specimen's collection. The blood cultures were done using an (BACTEC 9240 and 9050 BD) which is an automated blood culture system afterwards bacterial growth examination was done. Specimens were inoculated on bacteriological media, Mac-Conkey and Blood agar Media which is an enriched media were used. After inoculation, the plates were incubated aerobically for 24–48 hours at 37 °C.

The isolates were identified by using standard methods. Primarily identification was done using basic methods: study of colony morphology, performance of Gram staining, biochemical tests like catalase and coagulase tests were done for further identification. Antimicrobial susceptibility testing according to CLSI guidelines, Kirby–Bauer disk diffusion method was used.

The antibiotic susceptibility pattern of all isolates was done against the following antibiotics: penicillin, Amoxicillin, Ceftriaxone, Cefixime, Cefizox, Cefoperazone, Cephradine, azithromycin, Imipenem, Meropenem, Ciprofloxacin, Ofloxacin, chloramphenicol, gentamicin, trimethoprim-sulfamethoxazole, oxacillin, Methicillin, erythromycin, cefoxitin, linezolid, levofloxacin, tetracycline, clindamycin, and vancomycin. Antibiotic susceptibility tests were carried out by disc diffusion method. Using laboratory standards issued by national committee for clinical (NCCLS) The measurement of Zones of inhibition were made and compared. Resistant to methicillin isolates measured (<17mm) were named Methicillin resistant Staphylococcus aureus (MRSA), zone of inhibition as (17mm) were named susceptible.

Statistical Analysis: Data analysis was done with Statistical Package for Social Sciences (SPSS), version 21.0 (SPSS, Chicago, IL, USA) The differences in data at $p<0.05$ were termed statistically significant. Chi (X2) tool was used.

Results

By the use of different tests like culture, Gram staining and biochemical tests (coagulase and catalase), 108 clinical specimen of *S.aureus* were tested from different body sites. Among these clinical specimens 57(52.8%) from pus, 33(30.6%) from urine and 12(11.1%) were from blood. Other specimens include high vaginal swab 3(2.8%) and body fluid 3(2.8%).

Out of total 108 isolates of *S.aureus* 48(44.4%) were obtained from male and 60(55.5%) were from females.

About 40.7% isolates resistant to cefoxatin and oxacillin were methicillin resistant *S.aureus* (MRSA) whereas 44.4% isolates sensitive to cefoxatin and oxacillin were methicillin sensitive *S.aureus* (MSSA). The sensitivity and resistance pattern of different antibiotics was shown in table I. It was noted that most of MRSA were isolated from pus sample and then by urine samples. High susceptibility was seen with imipenem (92.5%).

High resistance was observed with penicillin (53.7%) and chloramphenicol (51.8%) and trimethoprim/sulfamethoxazole (53.9%). Imipenem showed high susceptibility pattern on isolates taken from all samples (Table III).

Table I: Frequency of s. Aureus according to sex.		
Organism	Male	Female
S.aureus	48(44.5%)	60(55.5%)

Table II: Frequency of *S.Aureus* In Clinical Isolates	
Specimen	Total S.aureus isolated
Blood Cultures	12 (11.1 %)
Pus	57(52.8 %)
Urine	33(30.6 %)
High Vaginal Swab (HVS)	3(2.8 %)
body fluid	3(2.8 %)

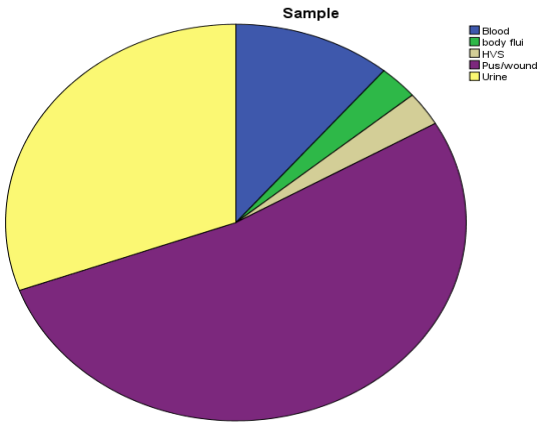

Figure 1. Distribution Pattern of Staphylococcus Aureus in Different Specimens

Table III: Antibiotic Susceptibility Patterns of *S.Aureus*			
Name of antibiotics	**Sensitive**	**Intermediate**	**Resistant**
Penicillin	42(38.8%)	08(7.4%)	58(53.7%)
Oxacillin	36(33.3%)	16(14.8%)	56(51.8%)
Imipenem	100(92.5%)	08(7.4%)	0
Cefoxitin	52(48.1%)	20(18.5%)	36(33.3%)
Clindamycin	52(48.1%)	20(18.5%)	36(33.3%)
Gentamycin	68(62.9%)	08(7.4%)	32(29.6%)
Tetracyclin	88(81.4%)	04(3.7%)	16(14.8%)
Chloremphenicol	48(44.4%)	04(3.7%)	56(51.8%)
Vancomycin	68(62.9%)	00	40(37%)
Co trimaxazole	40(37%)	O4(3.7%)	64(59.2%)
Ciprofloxacin	68(62.9%)	20(18.5%)	20(18.5%)
Linzolid	84(77.7%)	04(3.7%)	20(18.5%)

Discussion

Staphylococcus aureus is one of the main pathogens which cause various diseases in humans. Community health has been affected severely from the emergence of resistant strains. The pathogenicity of S. aureus is associated with its ability to produce numerous virulence factors.

It is one of the infectious agents showing high occurrence. MRSA is a term used for *S.aureus* that demonstrated resistant to following antibiotics namely methicillin, oxacillin, and cefoxitin. *S.Aureus* It is reported to be showing increased prevalence in healthcare settings causing different type of infections. The hospital spread of the infection with MRSA has shown been found to be the cause of increased hospital stay leading to a serious disease and mortality thus instigating high cost borne by the patient. [14]

In this study we assessed the antimicrobial susceptibility pattern of S. aureus from clinical samples at HBS general Hospital Islamabad. In our study, (52.3%) of *S.aureus* were isolated from pus samples. (Table II). An earlier study done at Nairobi also presented that most of the pus samples showed growth of *S.aureus*.[11] The high frequency of *S. aureus* isolated in pus may be ascribed to wounds which are exposed and more disposed to infections and poor hygiene. In Iran, a study was done to show the antimicrobial susceptibility pattern of S. aureus strains isolated from hospitalized patients, maximum number of the isolates were found to be detected from blood specimens (29%).[8] In Nigeria, a study showed that the majority of the isolates were from urine specimens (76%).[10] These studies are in compliance with our study in which in blood culture isolated percentage were 12 (11.1 %) and from urine samples was 33(30.6 %).

The numbers of clinical isolates obtained from females (55.5%) were greater than males (44.5%), shown ratio was 1.2:1 (Table I). The occurrence of *S.aureus* infection was more in elderly (> 50 years,). The occurrence was seen in both male and female mounting to 43.5% of total *S.aureus* infection.

Our study showed that MRSA rate in Islamabad region of or study is 40.7%. In a similar study on frequency of MRSA isolates in Kohat during 2012 was 44% while MRSA rate in Peshawar showed an increase of 54% from year 2009 – 2011.[6]

All the MRSA isolates (40.7%) were also multidrug resistant (MDR). Those isolates resistant to Cefoxitin were found to be co-resistant to Chloramphenicol (51.8 %), Penicillin (53.7%) and Cotrimoxazole (59.2%). All these isolates were 92.5% sensitive to imipenem. The *S.aureus* strains showed pronounced resistance against Cotrimoxazole 59.2%, chloramphenicol 51.8% and vancomycin 37%. (Table III)

In the present study 77.7% of the isolates were found to be sensitive to linezolid which is following a study done in Iran 2009. [7] In our study Linezolid are highly effective against MRSA. Tetracycline also have good in vitro efficacy. Because of the incessantly growing occurrence of Vancomycin Intermediate *S. aureus* (VISA), it is imperious to curtail the use of Vancomycin. Certainly, it should only be used for those patients who have shown resistant to other antibiotics proven by culture sensitivity reports. This step would help evade the consequences of the surge of Vancomycin Resistant S. aureus (VRSA) in our settings. Tigecycline was 100% in a study in Iran.[15,16] Oral use of linezolid and tetracycline should be encouraged as this would result in can allow shorter stay in hospitals.[8]

Conclusion

Resistance to antibiotics has undoubtedly risen to extremely high levels. Certainly, the antibiotics should be prescribed cautiously for the treatment on the basis of results of culture reports infections. This would help elude the consequences of the increase of Resistant *S. aureus* in our settings. Good hospital infection control measures prove to be the main stay against these infections because antibiotics can never be an effective alternate to good medical practice.

Recommendations

When *S.aureus* infections is suspected it is vital to send appropriate specimens for culture and sensitivity. Studies on epidemiology of multiple drug resistant S. aureus and MRSA is the need of the day Resistance genes should be evaluated in community and hospital strains

References

1. Salyers AA, Whitt DD, Whitt DD. Bacterial pathogenesis: a molecular approach. Washington, DC: ASM press; 1994 Apr.
2. Onwubiko NE, Sadiq NM. Antibiotic sensitivity pattern of Staphylococcus aureus from clinical isolates in a tertiary health institution in Kano, Northwestern Nigeria. Pan African Medical Journal. 2011;8(1):1-7.
3. Murray PR, Baron EJ, Pfaller MA, Orgensen JH, Yolken RH. Clostridium, Manual of Clinical Microbiology, Vol. 1.
4. Haslinger-Löffler B, Kahl BC, Grundmeier M, Strangfeld K, Wagner B, Fischer U, Cheung AL, Peters G, Schulze-Osthoff K, Sinha B. Multiple virulence factors are required for Staphylococcus aureus-induced apoptosis in endothelial cells. Cellular microbiology. 2005;7(8):1087-97.
5. Palavecino E. Clinical, epidemiological, and laboratory aspects of methicillin-resistant Staphylococcus aureus (MRSA) infections. InMethicillin-Resistant Staphylococcus aureus (MRSA) Protocols 2007 (pp. 1-19). Humana Press.
6. Akindele AA, Adewuyi IK, Adefioye OA, Adedokun SA, Olaolu AO. Antibiogram and beta-lactamase production of Staphylococcus aureus isolates from different human clinical specimens in a tertiary health institution in Ile-ife, Nigeria. American-Eurasian Journal of Scientific Research. 2010;5(4):230-3.
7. Hussain M, Basit A, Khan A, Rahim K, Javed A, Junaid A, Munir S, Niazi RH, Sohail M, Hussain T. Antimicrobial sensitivity pattern of methicillin resistant Staphylococcus aureus isolated from hospitals of Kohat district. Pakistan. J Inf Mol Biol. 2013;1(1):13-6.
8. Hannan A, Absar M, Usman M, Naeem T, Saleem S, Arshad M. In vitro activity of linezolid against clinical isolates of methicillin resistant Staphylococcus. J Ayub Med Coll Abbottabad. 2009 ;21(1):106-9.
9. Fatholahzadeh B, Emaneini M, Gilbert G, Udo E, Aligholi M, Modarressi MH, Nouri K, Sedaghat H, Feizabadi MM. Staphylococcal cassette chromosome mec (SCC mec) analysis and antimicrobial susceptibility patterns of methicillin-resistant Staphylococcus aureus (MRSA) isolates in Tehran, Iran. Microbial drug resistance. 2008;14(3):217-20.
10. India SJ, Ray P, Manchanda V, Bajaj J, Chitnis DS, Gautam V, Goswami P, Gupta V, Harish BN, Kagal A, Kapil A. Methicillin resistant Staphylococcus aureus (MRSA) in India: prevalence & susceptibility pattern. The Indian journal of medical research. 2013;137(2):363.
11. Iileka AE, Mukesi M, Engelbrecht F, Moyo SR. Antimicrobial susceptibility patterns of Staphylococcus aureus strains isolated at the Namibia Institute of Pathology from 2012 to 2014. Open Journal of Medical Microbiology. 2016;6(03):116.
12. Gitau W, Masika M, Musyoki M, Museve B, Mutwiri T. Antimicrobial susceptibility pattern of Staphylococcus aureus isolates from clinical specimens at Kenyatta National Hospital. BMC research notes. 2018 ;11(1):226.
13. Obiazi HA, Ekundayo AO. Prevalence and antibiotic susceptibility pattern of Staphylococcus aureus from clinical isolates grown at 37 and 44oC from Iran, Nigeria. African Journal of Microbiology Research. 2007;1(5):57-60.
14. Akindele AA, Adewuyi IK, Adefioye OA, Adedokun SA, Olaolu AO. Antibiogram and beta-lactamase production of Staphylococcus aureus isolates from different human clinical specimens in a tertiary health institution in Ile-ife, Nigeria. American-Eurasian Journal of Scientific Research. 2010;5(4):2
15. Noble WC, Virani Z, Cree RG. Cotransfer of Vancomycin and other resistant genes from Enterococcus faecalis NCTC 12201 toStaphylococcus aureus. FEMS Microbiol Lett.1992; 72: 195 – 198
16. Hakim ST, Arshed S, Iqbal M, Javaid SG. Vancomycin sensitivity of Staphylococcus aureus isolates from hospital patients in Karachi, Pakistan. Libyan Journal of medicine. 2007;2(4):176-9.

Authors Contribution:

[1,3]Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work & Final approval of the version to be published

[2,4,5] Drafting the work or revising it critically for important intellectual content;