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ANTIMICROBIAL SUSCEPTIBILITY PATTERN OF *STAPHYLOCOCCUS AUREUS* ISOLATED AT A TERTIARY CARE CENTER IN NORTH WEST REGION OF RAJASTHAN

Medical Microbiology

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ABSTRACT

Introduction: *Staphylococcus aureus* is an important pathogen responsible for hospital and community acquired infection(s). Emerging resistance to methicillin in this organism has left physicians with few therapeutic alternatives to treat infections caused by it. This study was aimed at determining the antibiotic susceptibility patterns of Staphylococcus aureus strains isolated at our tertiary care hospital,Bikaner.

Material and methods: The current study is a hospital-based cross sectional observational study. Duration of the study was 1 year and August 2018 to Jan 2021. An informed written consent was obtained from all the subjects. The sensitivity patterns of S. aureus were explored with different antibiotics for the treatment of S. aureus infections. We have studied the susceptibility pattern of various antibiotics including present all line therapies and other antibiotics using disk-diffusion method. A total of 254 Staphylococcus aureus strains have been taken for study from various clinical specimens like pus, blood, sputum, throat swab, ear swab, high vaginal swab, CSF, urine, pleural fluid, semen, bile, corneal swab, etc. clinically significant MRSA isolates were collected in Department of Microbiology at our tertiary care hospital,Bikaner.

Results: It is observed that the total 254 Staphylococcus aureus isolates were tested for antibiogram, in the present study Staphylococcus aureus has shown high sensitivity towards Vancomycin 99.61% , Amplicillin sulbactum 99.21%, and Teicoplanin 96.85% followed by Linazolid 82.28%, Doxycycline74.41%, Tetracycline 71.65%, Cefuroxime 60.63%, Ciprofloxacin 54.72%, Augmentin -53.54% and Gentamycin 44.48%, Rest of other primary antibiotics showed low sensitivity such as Penicillin 14.57%, Erythromycin 16.93% , Clindamycin 17.72, Azthromycin 21.26%, and Cotrimoxazole 24.01% revaealed.

KEYWORDS

Staphylococcus aureus, Antibiotic, Susceptibility

INTRODUCTION

Staphylococcus aureus is a Gram-positive bacterium living as a commensal on the skin, mouth and upper respiratory system, making it a risk factor for opportunistic and nosocomial infections. Resistance to commonly used antimicrobial drugs is frequently encountered with S. aureus. Some of the mechanisms in resistance include; inactivation of antibiotics by the enzymes, decreased affinity for the antibiotics caused by alteration of the target, efflux pumps, and trapping of the antibiotic [1].

Staphylococcus aureus causes skin, bone, soft tissue infections, urinary tract infections, pneumonia, healthcare- associated bacteremia in community and hospital settings and other invasive infections. Multidrug-resistant strains particularly Multidrug Resistant *Staphylococcus aureus* (MRSA) strains are common causes of nosocomial infections and are associated with increased morbidity and mortality [2, 3].

Report from the National Nosocomial Infections Surveillance System of the Centers for Disease Control and Prevention, (2013–2015) showed that MRSA in India and USA accounts for > 60% of S. aureus isolates causing nosocomial infection in ICUs [4].

There is no conclusive local data on the magnitude of multidrug resistance MRSA infection burden in Kenyan hospitals. In study done from patients in select hospitals in Nairobi, MRSA infections were mostly isolated at public healthcare facilities serving economically disadvantaged Nairobi's population, like those living in urban informal settlements [5].

Another study done in Kenya showed there was high number of genetically indistinguishable isolates, which suggested there was local transmission of MSSA and MRSA [6].

Multidrug-resistant strains limit the therapeutic options, creating an economic and social burden to the healthcare system. Horizontal gene transfer in the hospital setting is responsible for disseminating antibiotic resistant determinants. Chromosomal mutation antibiotics selection is also responsible for antibiotics resistance.

The aim of this study was to evaluate the antimicrobial susceptibility pattern of Staphylococcus aureus at KNH from April 2014 to February 2016. Previous studies done in Kenya were targeting specific locations in the hospital and were within short periods of time. This study gives a broader picture of the susceptibility pattern of *S aureus* in different locations in 3 years.

MATERIAL AND METHODS

It is a hospital-based cross sectional observational study. Duration of the study was 1 year and August 2018 to Jan 2021. The study was started after getting the ethical clearance from the Institutional Research Committee of the institution. An informed written consent was obtained from all the subjects. A total of 254 Staphylococcus aureus strains have been taken for study from various clinical specimens like pus, blood, sputum, throat swab, ear swab, high vaginal swab, CSF, urine, pleural fluid, semen, bile, corneal swab, etc. clinically significant MRSA isolates were collected in Department of Microbiology at our tertiary care hospital, between August 2018 to Jan 2021.

STUDY PROTOCOL

- **INCLUSION CRITERIA:**

All strains (non-repetitive) were collected from various specimens of patients attending outpatient departments and admitted in wards at P.B.M. hospital and associate group of hospitals. Specimens included are urine, blood, pus, wound swab, sputum and other respiratory tract specimen, high vaginal swab, and CSF etc.

Medical and demographic data of the patients were collected using a questionnaire. Data recorded were as follows: demographic characteristics (age, gender); underlying diseases ; presence of intravascular or urinary catheters; prolong hospitalization(>one week); history of intensive care unit (ICU) stay; nursing home residency; being on mechanical ventilation; prolong antibiotic use(> three week); and recent surgery (within one month); post operative wound infections; sepsis; poor nutritional status; haemodialysis etc.

- **EXCLUSION CRITERIA**

Three different organisms with no predominating organism and repeated isolate from same patient were excluded from study.

ANTIBIOTIC SUSCEPTIBILITY TESTING BY KIRBY BAUER DISC DIFFUSION METHOD:

Antibiotic susceptibility testing was performed for all the S.aureus isolates against a predetermined panel of antibiotics by Kirby Bauer disc diffusion method on Muller-Hinton agar (MHA) plates and the results were interpreted according to the guidelines of the CLSI.

Procedure:

A well isolated colony was taken for antibiotic sensitivity testing. 0.5 Mc Farland suspension of isolate is made and streaked on the Muller Hinton agar with the help of sterile cotton swab sticks. Then the antibiotic discs were placed onto the agar surface using all sterile precautions.

The plates were incubated at 37oC for 24 hour and next day; the zone diameter was measured, using the zone diameter scale. The zone of inhibition was measured and reported as susceptible, intermediate or resistant according to standard zone size. For statistical purposes data were categorized susceptible and non susceptible (including intermediate and resistant group).

Control:

Staphylococcus aureus ATCC 25923 and Escherichia coli ATCC 25922 were used to check the potency of the disc and were used with every batch of antibiotic sensitivity testing.

The antibiotics which were tested included Azithromycin (15µg), Penicillin (10u), Cefuroxime (30µg), Amoxycillin/Clavulanic acid (20/10 µg), Clindamycin (2µg), Co-trimoxazole (1.25/23.75µg), Tetracycline (30µg), Erythromycin(15µg), Ciprofloxacin (5µg), Gentamycin (10µg), Cefoxitin (30µg), Vancomycin(30µg), Linezolid (30µg), Teichoplanin (30µg), Doxycycline Hydrochloride (30µg), A,mpicillin sulbatam (10/10µg), Nitrofuranton (300µg) S.aureus ATCC25923 was used as a control strain.

STATISTICALANALYSIS

Detailed data of all subjects of case and control group were collected. After complete evaluation all findings were expressed in terms of Mean ± SD. Comparison between case group and control group was done using paired "t" test. All statistical analysis was done using SPSS software version 20.

RESULTS

A total of 254 isolates of Staphylococcus aureus were isolated from specimens of respiratory tract infection, wound infection, urinarytract infections, septicaemia, postoperative wound infections,e arinfections etc.,satisfying both inclusion and exclusion criteria. Total 254 clinical isolated Staphyloccous aureus, maximum isolates (43.31%) were found in pus samples, followed by blood samples 26.77%. Among pus samples 20.08% were MSSA and 23.23% were MRSA while in Blood Sample 17.72% were MSSA and 9.05% were MRSA. apart from staphyloccous aureus were found in urine 22.05%, sputum 3.15% CSF & Vaginal swab 1.97% each and 0.79% in pleural fluid.

Total 254 Staphylococcus aureus isolates were tested for antibiogram, in the present study Staphylococcus aureus has shown high sensitivity towards Vancomycin 99.61% , Amplicillin sulbactum 99.21%, and Teicoplanin 96.85% followed by Linazolid 82.28%, Doxycycline 74.41%, Tetracycline 71.65%, Cefuroxime 60.63%, Ciprofloxacin 54.72%, Augmentin -53.54% and Gentamycin 44.48%, Rest of other primary antibiotics showed low sensitivity such as Penicillin 14.57%, Erythromycin 16.93% , Clindamycin 17.72, Azthromycin 21.26%, and Cotrimoxazole 24.01%.(Table-1)

OBSERVATION TABLES

Table-1 Antibiogram of Staphylococcus aureus isolates among present study

Antibiotics	Sensitivity (n=254)	Sensitivity Percentage (%)
Penicillin	37	14.57
Azthromycin	54	21.26
Erythromycin	43	16.93
Clindamycin	45	17.72
Augmentin	136	53.54
Gentamycin	113	44.49
Ciprofloxacin	139	54.72
Cefuroxime	154	60.63
Tetracycline	182	71.65
Doxycycline	189	74.41
Linazolid	209	82.28
Vancomycin	253	99.61
Teicoplanin	246	96.85
Ampicillin sulbactum	252	99.21
Cotrimoxazole	61	24.01

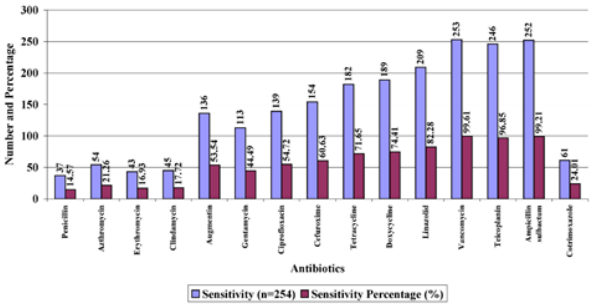

Fig-1 Antibiogram of Staphylococcus aureus isolates among present study

DISCUSSION

The aim of this study was to evaluate the antimicrobial susceptibility pattern of S. aureus from clinical specimens at North West Rajasthan. In our study, most S. aureus strains (62%) were isolated from pus specimen. This is consistent with a previous study done at KNH [8]. In a study done to determine the antimicrobial susceptibility pattern of S. aureus strains isolated from hospitalized patients in Iran, most of the isolates were from blood specimens (29%) [9]. Another study done on prevalence and antibiotic susceptibility pattern of S. aureus from clinical isolates in Nigeria showed a majority of the isolates were from urine specimens (76%) [10].The high number of S. aureus isolated in pus may be attributed to exposure of wounds which makes them more prone to infections and poor hygiene. Staphylococcus aureus isolates showed high sensitivity to quinupristin/ dalfopristin, imipenem, nitrofurantoin, tigecycline, ampicillin/sulbactam and linezolid. This is consistent with a similar study done in Iran [11]. Research done on antibiotics currently used in the treatment of infections caused by S. aureus in Australia indicates quinupristin/dalfopristin and linezolid have good antistaphylococcal activity but are very expensive [12-19].

In our study, Staphylococcus aureus isolates were tested for antibiogram, in the present study Staphylococcus aureus has shown high sensitivity towards Vancomycin 99.61% , Amplicillin sulbactum 99.21%, and Teicoplanin 96.85% followed by Linazolid 82.28%, Doxycycline74.41%, Tetracycline 71.65%, Cefuroxime 60.63%, Ciprofloxacin 54.72%, Augmentin -53.54% and Gentamycin 44.48%, Rest of other primary antibiotics showed low sensitivity such as Penicillin 14.57%, Erythromycin 16.93% , Clindamycin 17.72, Azthromycin 21.26%, and Cotrimoxazole 24.01%. In our study sensitivity of S. aureus isolates was observed against penicillin G (14.57%), and trimethoprim/ Tetracycline (71.65%). This finding is similar to those of studies done at KNH [13], in Eritrea [14], in Nigeria [25], and Namibia [26]. This resistance could be attributed to the mechanism of resistance like the permeability barrier, efflux pumps, mutational or recombinational changes in the target enzymes and acquired resistance by drug-resistant target enzymes in trimethoprim/ sulfamethoxazole and alteration of the target with decreased affinity for the antibiotic in penicillin [21].

CONCLUSIONS

The results of this study showed the importance of regular surveillance of hospital associated infections including monitoring antibiotic sensitivity pattern and strict drug policy for antibiotics used within and outside the hospital environments. Moreover, in-vitro susceptibility testing of every isolate of S. aureus in the clinical laboratories may be helpful for reducing the incidence of these infections.

DISCLOSURE STATEMENT

This study is investigator initiated. The authors declare that they have no competing/conflict of interests in relation to this article.

FUNDING

No financial support from an external agency was used for this study.

CONSENT FOR PUBLICATION

- Not applicable.

- Ethics approval and consent to participate.
- The study protocol was approved by the medical ethics committee of the Rajasthan University of Health Sciences, Jaipur, Rajasthan (State), India.

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