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Original Research Article

Prevalence and Antibiotic Susceptibility Pattern of Staphylococcus Aureus from Patients Attending Some Selected Hospitals in Samaru, Zaria, Nigeria

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ABSTRACT

Staphylococcus aureus (*S. aureus*) continues to be a major cause of community-acquired and healthcare related infections around the world. *Staphylococcus aureus* has the ability to cause diverse array of diseases ranging from minor infection to life threatening septicemia and its ability to adapt to adverse environmental conditions. *S. aureus* develops resistance very quickly and successfully to different antimicrobials over a period of time. A total of 300 samples were collected from both in-patient and out-patient attending Sickbay, Jama'a Hospital and Rangwame Hospital in Samaru and was analysed. The samples collected were urine, wound and pus swabs. *S. aureus* was identified using both conventional method and rapid kit system (Microgen Staph ID kit). The antibiotic susceptibility test was done according to Clinical Laboratory Standards Institute (CLSI).
The prevalence of *S. aureus* in 300 patients sampled was 20.3%. *S. aureus* was isolated most from wound swab (32.6%) followed by pus (24.4%) then wound swab (23.8%). Most of the isolates were from in-patient (24.7%) than out-patient (16.0%).The *S. aureus* strains showed a 100.00% susceptibility to vancomycin and gentamicin but showed resistance to ampicillin (90.2%), chloramphenicol (13.1%), erythromycin (27.9%), cefoxitin (32.8%), tetracycline (13.1%), and linezolid (9.8%).*S. aureus* is prevalent and highly resistant in in-patient than out-patient. The study showed that a significant percentage of the isolates were resistant to different antibiotics used suggesting the need for control strategies to avoid dissemination of resistant strains.

Key words: *Staphylococcus aureus*, antibiotic, susceptibility.

INTRODUCTION

Staphylococcus aureus (*S. aureus*) is a gram-positive cocci, catalase and coagulase positive bacterium. *Staphylococcus aureus* cause disease through the production of toxin or through direct invasion and destruction of tissue. Infections caused by *S. aureus* remain a significant cause of mortality and morbidity in tropical countries. [1] The principal site of staphylococcal colonization is the anterior nares. It has been observed that if repeated cultures are performed, up to 80% of adults are found to harbor *S. aureus* in the nose at one time or the other. However, in most persons, the carrier state is transient, but 20 to 40% of adults remain colonized for months or even years. [2] Increased nasal colonization rates have been noted in insulin dependent diabetes, [3] individuals on

haemodialysis, [4] those on ambulatory peritoneal dialysis, [5] intravenous drug users [6] and patients receiving routine allergy injections. [7] It has also been suggested that patients with symptomatic human immunodeficiency virus infection have an increased colonization risks. [8] Staphylococci have a record of developing resistance quickly and successfully to antibiotics. This defensive response is a consequence of the acquisition and transfer of antibiotic resistance plasmids and the possession of intrinsic resistance mechanisms. [9] Mechanisms of resistance to beta-lactam antibiotics and the fluoroquinolones have been documented. [9] The importance of *S. aureus* as a persistent nosocomial and community acquired pathogen has become a global health concern. It has a remarkable capability of evolving different mechanisms of resistance to most antimicrobial agents. [10] The emergence of antibiotic resistant bacteria constitutes a major problem in antibiotic therapy. This could be attributed to unrestricted use of antibiotics in a particular environment Classically, Methicillin resistant *S. aureus* (MRSA) has been a nosocomial problem associated with long hospital stays, numerous or prolonged antibiotic courses, the presence of invasive devices and proximity to an already infected or colonised patient. [11] The aim of the present study is to determine the prevalence of *S. aureus* in clinical specimens and its antibiotic susceptibility pattern to various antibiotics in our locality.

MATERIALS AND METHODS

The present study was carried out in three Hospitals (Sickbay, Jamaa Hospital and Rangwame Hospital). A total of 300 samples were collected from in-patients and out-patients attending these Hospitals. A random sampling technique was used for the collection. All age group was included in the study. Patients who did not give their consent were excluded in the study.

These samples were inoculated into blood agar and mannitol salt agar and incubated at 37 ^{o}c for 24 hours. Characteristics of *S. aureus* were identified by Gram stain, Catalase and coagulase test according to standard bacteriological techniques. [12] They were further confirmed using Microgen staph ID kits according to manufacturer's instructions. The antimicrobial susceptibility pattern was determined using Kirby-Bauer-CLSI modified single disc diffusion technique. [12] Single antibiotic disc of Ampicillin (10ug), Vancomycin (30ug), Tetracycline (30ug), Cefoxitin (30ug), Chloramphenicol (30ug), Erythromycin (10ug), Linezolid (10ug) and Gentamicin (10ug), all the discs were obtained from Oxoid England and all the results of the antimicrobial susceptibility were interpreted using CLSI (2008). [13] Twenty four (24) hours cultured organism was suspended into test tube of sterile normal saline using sterile wire loop to form turbidity that match with 0.5 scale of McFarland's standard (1.5 × 108 cells/ml) (Coyle, 2005). [14] The standard strains used as the antibiotics susceptible control were *Staphylococcus aureus* ATCC 25923. The cell suspensions was inoculated by streaking on prepared Mueller-Hinton agar using sterile swab sticks, then the antibiotic disc was placed on the inoculated medium aseptically with help of sterile forceps and incubate at 37^{o}C for 24 hours. The zones of inhibition created by each of the antibiotics against the test organisms and the standard strains were measured and the result was interpreted using guideline by CLSI (2008).

RESULTS

A total of 300 samples were collected from three Hospitals in Samaru and were analysed for *Staphylococcus aureus*. In all, 61 (20.3%) were positive for

Staphylococcus aureus (S. aureus) as shown in table 1.It also shows the prevalence (20.3%) of *S. aureus* from clinical samples. The result shows that 36 (23.8%) of the 151 urine samples collected were positive for *S. aureus* and 14 (32.6%) out of the 43 samples collected from wound swabs were positive for *S. aureus* while 11 (24.4%) out of 45 of the pus swabs collected were positive for *S. aureus*(Table 1).

However, on the in-patients and out-patient 150 samples were collected from in-patient with 37 (24.7%) positive for *S. aureus* while in Out-patient 24 (16.0%) out of the 150 samples collected were positive for *S. aureus* (Table 2).

Table 3 shows the antibiotic susceptibility profile of *S. aureus* isolates. All the 61 (100%) isolates were susceptible to vancomycin and gentamicin. For ampicillin, *S. aureus* had 55 (90.2%) resistance and 6 (9.8%) sensitive strains, while for tetracycline, *S. aureus* had 8 (13.1%) resistance, 1 (1.6%) intermediate strains and 52 (85.3%) susceptible strains, while for cefoxitin, *S. aureus* had 20 (32.8%) resistant and 41 (67.2%) susceptible strains. For linezolid, *S. aureus* had 6 (9.8%) resistant and 55 (90.2%) susceptible strains while for erythromycin, *S. aureus* had 17 (27.9%), 4 (6.6%) intermediate and 40 (65.6%) susceptible strains. For chloramphenicol, *S. aureus* had 8 (13.1%) resistant and 53 (86.9%) susceptible strains.

Table 1. The Prevalence of *S. aureus* from clinical samples analysed

Sample type	No of sample collected	No of positive	(%)
Urine	151	36	23.8
Wound	43	14	32.6
Pus	45	11	24.4
Total	300	61	20.3

Table 2. Distribution of *S. aureus* isolates in relation to patients

Patients	No of samples collected	no positive	(%)
IN	150	37	24.7
OUT	150	24	16.0
Total	300	61	20.3

Table 3. The antibiotic susceptibility profile of *S. aureus* isolates

ANTIBIOTICS	R	I	S
Ampicillin (10ug)	55(90.2%)	_	6 (9.8%)
Gentamicin (10ug)	_	_	61 (100%)
Tetracycline (30ug)	8 (13.1%)	1 (1.6%)	52 (85.3%)
Cefoxitin (30ug)	20 (32.8%)	_	41 (67.2%)
Vancomycin (30ug)	_	_	61 (100%)
Linezolid (10ug)	6 (9.8%)	_	55 (90.2%)
Erythromycin (15ug)	17 (27.9%)	4 (6.6%)	40 (65.6%)
Chloramphenicol(30ug)	8 (13.1%)	–	53 (86.9%)

Key R=resistant, i= intermediate sensitivity, s= sensitive

DISCUSSION

S. aureus has emerged as one of the mainly important pathogens and has over the past numerous decades been a leading foundation of hospital and community – acquired infections. [15-17] In the present study a prevalence of 20.3% (61 out of 400) detected in this study was similar to that detected by Opere *et al*. [18]

There is a higher prevalence of *S. aureus* among in-patient (24.7%) than out-patient (16.0%), this was similar to the work of Kitara *et al*. [19] who found a higher prevalence of *S. aureus* in in-patient than out-patient. The higher prevalence is expected due to long hospital stay, ward condition such as bed making, changing of clothes, sneezing, nose picking and other personal habits like poor hygiene which pollute every patient in the ward. [20]

Staphylococcus aureus was found to be a frequent cause of burns and wound sepsis. [21] A study by Ndip *et al*., [22] at Ilorin, Nigeria reported wound infection of 38% as the highest frequency of *S. aureus* isolates. This agrees with the result in the present study where *S. aureus* had the highest prevalence in wound followed by urine then pus.

Vancomycin and gentamicin were the only antibiotics with 0% resistance and thus remain the best therapeutic options in our settings. A 100% gentamicin susceptibility to antibiotics by *S. aureus* was reported by Assefa *et al*. [23] Many studies have reported complete sensitivity to

vancomycin. [24-27] The 100% susceptibility of *S. aureus* to linezolid reported by Terry-Alli et al. [28] was in contrast with our study. Linezolid has an advantage over vancomycin for treating MRSA because it has an intravenous preparation and an oral tablet that has excellent bioavailability. In this study Ampicillin recorded the highest rate of resistance of 90.2% with a sensitivity of 9.8%. The ability of *S. aureus* to resist this antibiotic is due to the ability of *S. aureus* to produce a plasmid encoded beta-lactamase that hydrolyses the beta-lactam ring of this class of antibiotic which is essential for its antimicrobial activities [29] and also the high resistance to ampicillin could be due to the misuses or abuse of antibiotics which is common phenomenon in developing countries. [30]

The antimicrobial profile of *S. aureus* showed that 32.8%, of the isolates were resistant to cefoxitin. Resistance to cefoxitin by disc diffusion can be used for the detection of MRSA strains in routine testing because cefoxitin is a potential inducer of the system that regulates mecA gene. [31] For this reason, the resistant of *S. aureus* to cefoxitin in this finding is considered resistant to methicillin. Resistance to chloramphenicol in this study was low (13.1%), however, its role in the management of *S. aureus* (MRSA) soft tissue infection is yet to be defined. There are certain reports of trial of usage of chloramphenicol in multi-drug resistant Gram positive organism like MRSA, Vancomycin-intermediate *S. aureus* (VISA), Vancomycin Resistant *S. aureus* (VRSA) and Vancomycin Resistant Enterococcus (VRE). [32]

In this study, erythromycin had a resistance of 17 (27.9%) and an intermediate resistance of 4 (6.6%) given a total resistance of 21 (34.5%), this is in contrast to the findings of Aluyi et al., [33] which recorded 5.2% resistance of *S. aureus* to erythromycin.

Tetracycline had a resistance of 8 (13.1%), intermediate resistance of 1 (1.6%) and a total resistance of 9 (14.8%). A finding of Shanmugam *et al*. [34] who reported a resistance of 50% which is in contrast with the present findings.

CONCLUSION

It can be concluded therefore, that there is a need to re-access policies on antimicrobials within and outside hospital environment in order to control the spread of antimicrobial resistant organisms. The control of multidrug resistance will provide a major challenge to both health care community and the public in general.

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