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The sensitivity status of community-acquired *Staphylococcus aureus* isolated from various infectious sites in Kano-City, Nigeria to selected antibacterial agents

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Community acquired *Staphylococcus aureus* was isolated from various infectious sites in two private laboratories in Kano-city, Nigeria. A total of 247 (11%) *Staphylococcu aureus* isolates were recovered from all infectious sites except cerebro-spinal fluid. The least *Staphylococcus aureus* isolates were found in urine specimens (5.4%). Twenty three (23) out of 62 (37.1%) and 10 out of 26 (38.5%) of the wound and pus specimens respectively incriminated *Staphylococcus aureus* as the major pathogens. High resistance rates were recorded with ciprofloxacin (55%), chloramphenicol (76.4%), amoxicillin (81.8%), nitrofurantoin (84.2%), erythromycin (93.1%), cotrimoxazole (94.3%), tetracycline (94.7%) and nalidixic acid (96.8%) but ofloxacin, co-amoxiclav, gentamicin and ceftriaxone showed moderate activity. The widespread resistance of community acquired *Staphylococcus aureus* was worst with the older antibacterial agents possibly due to their indiscriminate use after existence in the market for long. Thus, many older generation antibacterial agents are not appropriate for chemotherapy of community acquired *Staphylococcus aureus* infections.

Key words: Sensitivity status, Community-acquired infection, *Staphylococcus aureus*, *Kano-city*

INTRODUCTION

Infections caused by *Staphylococcus aureus* are common in any given environment owing to the ubiquitous nature of the organism and its ability to thrive and multiply in favourable sites due to its numerous virulence factors [1]. It is one of the pathogens most frequently isolated and causes serious, invasive infections including skin and soft tissue infections, endocarditis, osteomyelitis, bacteraemia, septic arthritis and nosocomial pneumonia [1,2]. Hospitalization resulting from community onset *Staph. aureus* infections is on the increase with a corresponding enhanced deaths [1,3]. Consequently, more and more strains are becoming methicillin and vancomycin resistant and multi-drug resistant cases have been reported thereby making it a serious problem in healthcare.

Several effective newer antibiotics like linezolid, daptomycin, tigecycline, quinipristin-dalfopristin are not available in poor community setting because they are too expensive They are also available as intravenous products which require special skills in their administrations. The older generations antibacterials have now been re-explored in many regions in order to resolve the problems of methicillin and vancomycin resistant microorganisms, particularly *Staphylococcus aureus* [2]. But the indiscriminate use and abuse of the older generation antibacterial agents especially in countries with poor antibiotics policy may present a worsening situation

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with respect to development of resistance. [4]. Some authors revealed that antibiotic consumption correlates with rates of antimicrobial resistance in both the hospital environment and outpatient settings [5,6]. Furthermore, there is geographical differences in antibiotic resistance arising from variations in antibiotic use [7,8] due to various factors including socio-economic settings, healthcare policies and legislative and cultural [9].

There are also many environmental activities that can reduce the potency of any given medication, thereby promoting the development of resistance. For instance, the storage of antibiotic affects it activity, potency and shelf-life. In addition these drugs are sometimes sold as over-the-counter products in some countries thus making them available for abuse. All these activities may have a negative impact on the activity of antibiotics.

The older generation antibacterial agents are still patronized through self medication in community settings in Nigeria. In the present study, the appropriateness of these drugs in the management of community acquired *Staphylococcus aureus* infections was studied. This was carried out in 2006, among patients living in Kano, a city in Northern Nigeria where antibiotics are hawked freely. There are also several unregulated medicine stores and open market harbours.

Staphylococcus aureus was chosen for the study because it is one of the most frequently isolated pathogens in any given community in Nigeria. Kano-city was surveyed because of its high prevalence of commercial activities on drugs with laxed regulation.

MATERIALS AND METHODS

A total of 2222 specimens consisting of urine (1102), ears swab (186), wounds swabs (62), urethra swabs (74), high vaginal swabs (233), throat swab (4), sputum (265), blood (74), semen (23), pus (26) and cerebrospinal fluid (9) were obtained under community settings and investigated for *Staphylococcus aureus* infection. The specimens were processed by performing Gram stain from the direct smear. Nutrient Agar and Macconkey Agar media were used to culture and isolate pathogens after inoculation and incubation at 37 ^{o}C for 48 hours. Conventional biochemical tests were used to confirm bacterial isolates. Susceptibility tests were performed using the disc diffusion techniques and tested against the disc concentrations of ciprofloxacin (30µg), co-trimoxazole (25µg), ofloxacin (10 µg), gentamicin (10 µg), nalidixic acid (30 µg), amoxicillin/clavulanic acid (30 µg), rifampicin (10 µg), erythromycin (15 µg), tetracycline (25 µg), ceftriaxone (30 µg), nitrofurantoin (300 µg), cloxacillin (30 µg) and chloramphenicol (20µg). Chi Square Tests were used to determine levels of significance difference between the activities of two or more agents.

RESULTS AND DISCUSSION

A total of 2222 specimens were assessed microbiologically and were found to contain 247 *Staph. aureus* (11%). The specimens were obtained from patients who presented with clinical signs and symptoms of *Staph. aureus* infections of the urinary tract, respiratory tract, skin and ear. The percentage distribution of *Staph. aureus* isolates is shown in Table 1. Out of 233 female patients suspected to have urinary tract infections (UTI), 36 (15.5%) cases were caused by *Staph. aureus* while 14 out of 74 (18.9%) men with UTI were similarly associated with *Staph. aureus* infection. Factors such as bacteria binding through fimbrae, low pH, high growth rates despite high osmolarity urea concentrations may favour the colonization of pathogens in the urinary tract [10].

About 37.1% and 38.5% of cases had *Staph. aureus* isolates obtained from wound and pus infection sites respectively. The skin and soft tissues are common infectious sites for S*taph. aureus* [11,12]. Although many Gram negative bacteria can cause otitis media, *Staph. aureus* is always the

major Gram positive agent incriminated. About 61 out of 186 (32.8%) of bacteria isolated from middle ear discharges were *Staph. aureus* making it one of the frequent pathogens causing otitis media.

Staph. aureus was further isolated in 5 out of the 23 (21.7%) cases of semen specimens of men with infertility. This bacteria species has been reported as the major bacterial isolates in semen specimens [13]. Infertility may be the outcome of microbial infection of the male genital system [13,14]. *Staph aureus* was also isolated in patients with other conditions like bacteraemia (10.8%), sore throat (25%) and respiratory tract infection (11.3%) but all the 9 cases of patients with meningitis showed no association with *Staph. aureus* .

The results for susceptibility tests for *Staph. aureus* are shown in Table 2. The organism showed partial resistance to all agents but the activities of gentamicin (59.9%), co-amoxiclav (59.5%) and ceftriaxone (74.2%) were within moderate levels. Although S*taph. aureus* is often susceptible *in-vitro* to cotrimoxazole, particularly those of community acquired strains [15,16], high resistance rates recorded as with other older generation antibiotics compared to reports from other regions of the world. For instance, the *in-vitro* resistant rates of *Staph. aureus* against cotrimoxazole (94.3%) in this study (Table 2) is in contrast to the high sensitivity patterns of 98.4% and 90.4% reported for methicillin sensitive and resistant *Staph. aureus* respectively in Europe [17]. The sensitivity rates for the USA have been reported as 96.9% for methicillin sensitive and 87.7% for methicillin resistant strains [18]. The reason for this discrepancy may be attributed to the high levels of antibiotic misuse and abuse, lack of proper policies on antibiotics use and the uncontrolled distribution of these agents in Nigeria.

Table 1: Community acquired *Staph. aureus* isolates from various infectious sites

Specimens	Total number of samples	*Staph aureus* isolates	Percentage	Clinical conditions
Urine	1102	59	5.4	UTI
High vagina swab	233	36	15.5	GUI
Sputum	265	30	11.3	RTI
Ear swab	186	61	32.8	Otitis media
Wound swab	62	23	37.1	Infectious wound
Blood	74	8	10.8	Bacteraemia
Urethra swab	74	14	18.9	GUI
Throat swab	4	1	25	Sore throat
Semen	23	5	21.7	GUI
Pus	26	10	38.5	Skin infection
CSF	9	0	0	
Total	**2222**	**247 (11%)**		

CSF=Cerebrospinal Fluid, UTI= urinary tract infection, RTI= respiratory Tract infection, GUI=Genito-urinary infection

Table 2: Susceptibility of *Staph. aureus* Tested Against Some Antibacterial Agents

Antibacterial agents	Total tested	Number sensitive	Percentage sensitive	Total Resistance	Percentage Resistance
Amoxicillin	247	45	18.2	202	81.8
Co-amoxiclav	247	148	59.9	99	40.1
Ceftriaxone	247	181	74.2	63	26.8
Cloxacillin	247	13	5.3	234	94.7
Gentamicin	247	147	59.5	100	40.5
Nitrofurantoin	247	39	15.8	208	84.2
Chloramphenicol	247	58	23.5	189	76.5
Cotrimoxazole	247	14	5.7	233	94.3
Tetracycline	247	13	5.3	234	94.7
Erythromycin	247	17	6.9	230	93.1
Nalidixic acid	247	8	3.2	239	96.8
Ofloxacin	247	153	62.0	94	38.0
Ciprofloxacin	247	111	45.0	136	55.0

The penicillins are susceptible to enzymatic inactivation by *Staph. aureus* [21], which may account for the low sensitivities of the bacterium to amoxicillin (18.2%). and cloxacillin (5.8%). However, the susceptibility to co-amoxiclav (59.9%) was much higher than amoxicillin ($P<0.005$) because clavulanic acid inhibits the β-lactamase enzyme produced by *Staph. aureus* [22]. This study showed that co-amoxiclav may still be applicable in community acquired Staphylococcal infections but will require a combination with other agents like the aminoglycosides when they are not contra-indicated for possible synergistic effects.

The aminoglycoside, gentamicin demonstrated moderate activity (59.5%) against *Staph. aureus.* This activity is lower than that recently recorded in a USA study (92%) [23, 24].

Although resistance to tetracycline has been reported elsewhere in the world, the high resistant rates observed in this study (94.3%) may also be attributed to extensive abuse in Nigeria. Previous reports have indicated that some tetracyclines like doxycycline and minocycline are always effective against *Staph. aureus* particularly those of community acquired methicillin resistant *Staph. aureus* [15]. However, our results showed that tetracycline may have lost relevance in community acquired Staphylococcal infections and is neither effective against methicillin sensitive nor methicillin resistant *Staphylococcus aureus* in the study area.

The resistance rate to erythromycin (93.1%) (Table 2) is slightly higher than that reported (87%) in community acquired methicillin resistant *Staph. aureus* [25]. Significance difference ($P<0.005$) were recorded between the *in-vitro* activity of ofloxacin (62%) and ciprofloxacin (45%) against *Staph. aureus* (Table 2). The susceptibility results obtained with ciprofloxacin is lower compared to values reported in Europe and U.S.A [17]. Although, wide variation in the susceptibility of the fluoroquinolones to CA-MRSA from one region to the other exists [15,26-28]. The low susceptibility results obtained in this study calls for immediate antibiotics policy to safeguard the future of antibiotics in Nigeria. The sensitivity of *Staph. aureus* to nalidixic acid is lower than ciprofloxacin and ofloxacin since it lacks the fluorine atom and the piperazinyl or cyclopropyl moiety that confer higher activities in the fluoroquinolones [29].

CONCLUSION

Community-acquired *Staphylococcus aureus* indicated high resistance against several antibacterial agents, particularly the older generation ones. The resistance rates were lower among injectables antibacterial agents compared to solid dosage formulations possibly because the latter formulations are liable to abuse and misuse in community settings than the former. There seems to be a link between the high resistance rates and the indiscriminate sale and the poor antibiotics regulatory policy in the studied area. Further studies in other cities are required to investigate such association. The study concludes that most older generation antibacterial agents have lost relevance in chemotherapy. There is therefore an urgent need to safeguard the future of newer agents through controlled dispensing and distribution policies.

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