American Journal of Infectious Diseases

Original Research Paper

Staphylococcus aureus Prevalence and Antibiotic Susceptibility Profile in Anyigba, North-Central Nigeria

Charles Kehinde Mofolorunsho, Monday Ocheni, Cornelius Arome Omatola and Ashem Godwin Agieni

Department of Microbiology, Faculty of Natural Sciences, Kogi State University Anyigba, Nigeria

Article history
Received: 02-04-2015
Revised: 03-06-2015
Accepted: 19-10-2015

Corresponding Author:
Charles Kehinde Mofolorunsho
Department of Microbiology,
Faculty of Natural Sciences,
Kogi State University, P.M.B
1008, Anyigba, Nigeria
Tel: +2348034793137
E-mail: ckmofolorunsho@gmail.com

Abstract: Infections with *Staphylococcus aureus*, a versatile human pathogen have continued to raise concerns particularly in hospital setting resulting in high rates of morbidity and mortality. For proper and adequate infection control and treatment in our environment, it has become necessary to determine the prevalence and antibiotic sensitivity profile of the organism. A total of 100 clinical specimens were collected from outpatients who visited hospitals in Anyigba. The samples were screened for *Staphylococcus aureus* by standard bacteriological procedures. Antibiotic sensitivity was determined by disc diffusion method. A total of 84 *Staphylococcus aureus* isolates were identified in this study. Females (61.9%) had a higher infection rate. Those within age group 0-10 years were most affected. Isolates were susceptible to Gentamicin (100%), Ofloxacin (81.8%), Ciprofloxacin (72.7%), Streptomycin (72.7%) and Erythromycin (63.6%). Eleven Methicillin Resistant *Staphylococcus aureus* (MRSA) isolates were identified by disc diffusion technique using Oxacillin. Fifty four percent of the isolates were resistant to Erythromycin and Amoxicillin/Clavulanate respectively. The study highlights the need for periodic surveillance of MRSA for effective infection control.

Keywords: *Staphylococcus aureus*, MRSA, Antibiotics, Anyigba

Introduction

Staphylococcus aureus, a Gram positive aerobe, has been implicated as the most notorious organism associated with nosocomial infection. Although a normal flora of the skin, *Staphylococcus aureus* when opportune causes many infections (Bhalakia and Morris, 2005; Cheesborough, 2004; Cui and Hiramatsu, 2003). It is versatile human pathogen responsible for nosocomial and community-associated infection and associated with high morbidity and mortality rates (Kleven *et al*., 2007). In the developing world, mortality associated with severe *Staphylococcus aureus* infections far exceeds that in developed countries (Nickerson *et al*., 2009a; 2009b).

Emerging reports revealed that *Staphylococcus aureus* infections have continued to rise in health care facilities increasing the rate of hospital acquired infections with increased emergence of strains resistant to Methicillin called Methicillin Resistant *Staphylococcus aureus* (MRSA). MRSA infection has resulted in prolonged hospital stay, increased medical expenses and difficulty in patient treatment and management (Naimi *et al*., 2003; Kleven *et al*., 2007; Okon *et al*., 2013).

The unique characteristic of MRSA strains is the multidrug resistance pattern to β-lactam and other classes, due to acquisition of mecA gene, key genetic determinant located on the Staphylococcal cassette chromosome (SCCmec). The mecA gene, encodes the PBP2a an inducible 75b PBP responsible for low-affinity to β-lactam and other drugs (Hiramatsu *et al*., 2001; Ito *et al*., 2001; Enright *et al*., 2002).

Recent reports from Nigeria have indicated that the prevalence of hospital-associated MRSA varies in health care institutions. Also, a number of investigations have reported that *Staphylococcus aureus* is among the most frequently encountered bacterial species in microbiology laboratories in Nigeria (Okon *et al*., 2009; Odetoyin *et al*., 2008; Ubani, 2009). For effective treatment of *Staphylococcus aureus* infections, adequate information and data on susceptibility patterns and characterization of the organism are of great importance (Esan *et al*.,

2009). However, available data are still relatively limited in this locality when compared to information from other parts of the country. This study therefore was aimed at determining the prevalence and antibiotic sensitivity pattern of *Staphylococcus aureus* in Anyigba North-central Nigeria.

Materials and Methods

Study Design and Setting

This cross-sectional study was conducted in Anyigba, north central Nigeria.

Study Population and Laboratory Methods

Subjects were 100 consenting individuals registered with three healthcare facilities in Anyigba, Kogi State. A total of 84 *Staphylococcus aureus* isolates were obtained from one hundred clinical specimens of wound, urine, high vaginal swabs and ear swabs. These were collected from outpatients attending the Maria Goretti Hospital, Grimard Hospital and the Kogi State University Teaching Hospital (KSUTH) all in Anyigba, Nigeria. Identification of this organism was based on growth in Mannitol Salt Agar media (Oxoid, UK), colonial morphology, Gram staining and coagulase and catalase test results (Cheesborough, 2004). Demographic information collected included age, sex and type of clinical specimens. Ethical approval was sought and obtained from KSUTH.

The antibiotic sensitivity testing was determined by disc-diffusion method in accordance to the Clinical Laboratory and Standard Institute interpretative guideline (CLSI, 2012). The antibiotics included Gentamicin (10 µg), Streptomycin (25µg), Ciprofloxacin (5 µg), Erythromycin (15 µg), Tetracycline (10µg), Ampiclox (30 µg), Co-trimoxazole (25 µg), Ofloxacin (5 µg) and Amoxicillin/Clavulanate (30 µg) (Oxoid, UK). Methicillin resistance was determined by disc-diffusion method using Oxacillin (1 µg) disc (Oxoid, UK).

Statistical Analyses

Results were presented using tables and analysed using Chi-square (χ^2) statistical test and percentages. The level of significance was set at $p<0.05$.

Results

Of the 84 *Staphylococcus aureus* isolates recovered, 20 (23.8%) were from wound specimens, 38 (45.3%) urine, 20 (23.8%) High vaginal swabs and 6 (7.1%) from ear swabs. Table 1 shows the age and sex distribution of patients infected with *Staphylococcus aureus* in Anyigba. Females (61.9%) had higher infection rate when compared with the males (38.1%). The highest rate of *Staphylococcus aureus* infection occurred in the age group 0-10 years while the least was in the 41-50 years age group ($p<0.0001$).

Table 2 shows the antibiotic sensitivity pattern of *Staphylococcus aureus* isolates to some antibiotics. All isolates were susceptible to Gentamicin ($p<0.0001$). Eleven isolates (13%) identified as MRSA were detected by Oxacillin. Five were recovered from urine samples, four from wound specimens and two from high vaginal swabs. The eleven MRSA isolates exhibited multi-resistant pattern (Table 3).

Table 1. Age and sex distribution of patients with *Staphylococcus aureus* infection in Anyigba, Nigeria

Age group (yrs)	Males (%)	Females (%)	Total (%)
0-10	22 (68.7)	10 (31.3)	32 (38.1)
11-20	8 (40.0)0	12 (60.0)	20 (23.8)
21-30	2 (18.2)0	9 (81.8)0	11 (13.1)
31-40	0.000000	19 (100)0	19 (22.6)
41-50	0.000000	2 (100)00	2 (2.4)00
Total	32 (38.1)	52 (61.9)	84 (100)0

Table 2. Antibiotic sensitivity pattern of *Staphylococcus aureus* isolates from outpatients in Anyigba, Nigeria

Type of antibiotics	No of isolates tested (22)	No sensitive (%)	No resistant (%)
Gentamicin	22	22 (100)	0 (0)00
Streptomycin	22	16 (72.7)	6 (27.3)
Ciprofloxacin	22	16 (72.7)	4 (18.2)
Erythromycin	22	14 (63.6)	4 (18.2)
Tetracycline	22	6 (27.3)	12 (54.5)
Ampiclox	22	10 (45.5)	4 (18.2)
Ofloxacin	22	18 (81.8)	4 (18.2)
Amoxicillin/clavulanate	22	12 (54.5)	8 (36.5)
Co-trimoxazole	22	4 (18.2)	14 (63.6)

$\chi^2 = 42.433$ df = 8 $P < 0.0001$

Table 3. Antibiotic resistance profile of MRSA isolates in Anyigba, Nigeria

	No of isolates tested = 11	
Type of antibiotics	No sensitive (%)	No resistant (%)
Tetracycline	5 (45.4)	6 (54.6)
Ofloxacin	8 (72.7)	3 (27.3)
Amoxicillin/Clavulanate	3 (27.3)	8 (72.7)
Erythromycin	4 (36.4)	7 (63.6)
Gentamicin	7 (63.6)	4 (36.4)
Ciprofloxacin	6 (54.6)	5 (45.4)

Discussion

Staphylococcus aureus is one of the most important etiological agents of many hospital acquired infections as wells as community acquired infections and poses a constant therapeutic problem to clinicians (Kleven *et al*., 2007).This study was therefore designed to highlight the antibiotic susceptibility pattern of *Staphylococcus aureus* in order to guide clinicians especially in this region as to the choice of antimicrobial agents.

It was observed from this study that out of the 84 *Staphylococcus aureus*. Isolates recovered, 38 (45.3%) were obtained from urine samples. This agrees with the findings of Akerele and Ahonkhai (2000) who reported a recovery rate of 35.6% *Staphylococcus aureus* in Benin City, Nigeria.

In this study, *Staphylococcus aureus* constituted 61.9% of cases in women compared to men (38.1%). This agrees with reports from a previous study reported by Akortha and Ibadin (2008) where 65.8% of cases with suspected UTI infection caused by *Staphylococcus aureus* were women. A similar study by Abdul and Online (2001) also reported the UTI is common among women in Ilorin and *Staphylococcus aureus* was among the frequently isolated organism. This increased rate may be due to proximity between the genital tract and the urethra/anus, which could facilitate auto-transmission as earlier suggested (Audu and Kudi, 2004).

Since *Staphylococcus aureus* is a very common cause of infection in hospital, new born babies and old and malnourished persons are most liable to get infected (Tuo *et al*., 1995). Report from this study showed high frequency rate in those within the age group 0-10 years. Factors such as contact with objects, interaction with playmates and developing immunity amongst this group, makes them vulnerable and easily infected especially when hospitalized (Nwankwo and Nasiru, 2011).

The knowledge of the local antibiotic susceptibility patterns of bacterial pathogens is essential to guide empirical and pathogen specific therapy (Esan *et al*., 2009). In this present study, *Staphylococcus aureus* isolates were resistant to tetracycline and cotrimoxazole. This compares favourably with reports published by some researchers (Shittu *et al*., 2011). Egah *et al*. (1999) in their work on antimicrobial susceptibility pattern of *Staphylococcus aureus* in Jos, documented *Staphylococcus aureus* as resistant to tetracycline. Also, Olowu and Oyetunyi (2003) showed *Staphylococcus aureus* as being resistant to cotrimoxazole. Tetracycline and cotrimoxazole are listed in many developing countries as antimicrobial agents that have been rendered ineffective or with serious concerns regarding bacterial resistance (Okeke, 2003). In Nigeria, they are orally administered and available from various sources where they are sold with or without prescription (Shittu *et al*., 2011). *Staphylococcus aureus* susceptibility to Gentamicin and Ofloxacin were 100% and 81.8% respectively. This is in agreement with previous reports (Obiazi *et al*., 2007; Uwazuoke and Aririatu, 2004; Nwankwo and Nasiru, 2011).

MRSA has become a major public health problem worldwide and recent reports have indicated that the prevalence of hospital –associated MRSA in health care institutions in Nigeria may vary from 1.5% to 20% (Okon *et al*., 2009). In this study, screening for MRSA revealed a prevalence rate of 13% which agrees with a study conducted in north-eastern Nigeria by Okon *et al*. (2013) who reported a prevalence of 12.5%. However, studies conducted in some African and Malta hospitals reported varying prevalence ranging between 20-34% (Kesah *et al*., 2003).

Antibiotic susceptibility profile of MRSA showed that all isolates exhibited multi-resistant pattern to some commonly prescribed antibiotics which conforms with other studies (Kesah *et al*., 1997). A proportion of MRSA were recovered from wound and urine samples (4 and 5 respectively). These results were similar to other reported studies (Akpaka *et al*., 2007; Robert *et al*., 2006).

Conclusion

Since the indiscriminate use of antibiotics without prescription in developing countries has been highlighted as a contributory factor in bacteria resistance (Uwazuoke and Aririatu, 2004), public enlightenment on the need for antibiotic susceptibility testing so as to prevent treatment failures should be emphasized. There is also the need for periodic

surveillance of MRSA in order to curtail it spread or importation particularly in this era of increased intercontinental travel.

Author's Contributions

Charles Kehinde Mofolorunsho: Conception and design of the study, drafting and review of article.

Monday Ocheni: Data collection analysis and drafting of article.

Cornelius Arome Omatola: Analysis and interpretation of data, review and contributing to context.

Ashem Godwin Agieni: Analysis and interpretation of data, review and contributing to intellectual context.

Ethics

This article is original and contains unpublished material. The corresponding author confirms that all of the other authors have read and approved the manuscript and no ethical issues involved.

References

Abdul, F. and A.B. Online, 2001. Bacterial isolate from the urine of woman in Ilorin and their Antibiotic susceptibility patterns. J. Obst. Gynae, 18: 16-16.

Akerele, J. and I.A. Ahonkhai, 2000. Urinary pathogen and antibacterial susceptibility. A retrospective study of private diagnostic laboratory in Benin City Nigeria. J. Med. Lab. Sci., 9: 47-48.

Akortha, E.E. and O.K. Ibadin, 2008. Incidence and antibiotic susceptibility pattern of *Staphylococcus aureus* amongst patients with Urinary Tract Infection (UTI) in UBTH Benin city, Nigeria. Afr. J. Biotech., 7: 1637-1640.

Audu, B.M. and A.A. Kudi, 2004. Microbial isolate and antibiogram from endocervical swabs of patients with pelvic inflammatory diseases. J. Obst. Gyne, 24: 161-164.

Akpaka, P.E., S. Kisson, C. Rutherford, W.H. Swansthon and P. Jayaratha, 2007. Molecular epidemiology of methicillin-resistant *Staphylococcus aureus* isolates from regional hospital in Trinidad and Tobago. Int. J. Infect. Dis., 11: 544-548.

Bhalakia, N. And D. Morris, 2005. Isolation and plasmid analysis of Vancomycin resistant *Staphylococcus aureus*. J. Young. Invest., 13: 4-4.

Cheesborough, M., 2004. District Laboratory Manual in Tropical Countries. 1st Edn., Cambridge University Press, ECBS.

CLSI, 2012. Performance standards for antimicrobial susceptibility testing twenty-second informational supplement 32: M100-S22. Clinical Laboratory Standards Institute.

Cui, L. and K. Hiramatsu, 2003. Vancomycin Resistant *Staphylococcus aureus*. In: MRSA Current Perspective. Fluit, A.C. and F. Schmitz (Eds.), Cuister Academic Press, Norfolk England, pp: 187-212.

Egah, D.Z., C.S. Bello and S. Betal, 1999. Antimicrobial susceptibility pattern of *Staph. aureus* in Jos Nigeria. J. Med., 8: 58-60.

Enright, M.C., D.A. Robinson, G. Randle, E.J. Feil and H. Grundmann *et al*., 2002. The evolutionary history of Methicillin-Resistant *Staphylococcus Aureus* (MRSA). Proc. Natil. Acad. Sci., U.S.A., 28: 7687-7692. PMID: 12032344

Esan, C.O., O. Famurewa, J. Lin and A.O. Shittu, 2009. Characterization of *Staphylococcus aureus* isolates obtained from healthcare institutions in Ekiti and Ondo states, South-Western Nigeria. Afr. J. Microbiol. Res., 3: 962-968.

Hiramatsu, K., L. Cui, M. Kuroda and T. Ito, 2001. The emergence and evolution of methicillin-resistant *Staphylococcus aureus*. Trends Microbiol., 9: 486-493.

Ito, T., Y. Katayama, K. Asada, N. Mor and K. Trutsumimoto *et al*., 2001. Structural comparison of three types of staphylococcal cassette chromosome mec intergrated on the chromosome of methicillin resistant *Staphylococcus aureus*. Antimicrob. Agents Ch., 45: 1323-1336.

Kesah, C., S.B. Redjeb, T.O. Odugbemi, C.S.B. Boye and M. Dosso *et al*., 2003. Prevalence of methicillin-resistant *Staphylococcus aureus* in eight African hospitals and Malta. Clin. Microbiol. Infec., 9: 153-156.

Kleven, R.N., J.R. Edwards, F.C. Tenover, L.C. McDonald and T. Huran *et al*., 2007. Changes in the epidemiology of methicillin-resistant *Staphylococcus aureus* in intensive care unit in US hospitals, 1992-2003. Clin. Infect. Dis., 42: 389-391.

Naimi, T.S., K.H. LeDell, K. Como-Sabetti, S.M. Borchardt and D.J. Boxrud *et al.*, 2003. Comparison of community and health care associated methicilin resistant *Staphylococcus aureus* infection. J. Am. Med. Assoc., 290: 2976-2984.

Nickerson, E.K., T.E. West, N.P. Day and S.J. Peacock, 2009a. *Staphylococcus aureus* disease and drug resistance in resource-limited countries in South and East Asia. Lancet. Infect. Dis., 9: 130-135. DOI: 10.1016/S1473-3099(09)70022-2

Nickerson, E.K., M. Hongsuwan, D. Limmathurotsakul, V. Wuthiekanun and K.R. Shah *et al*., 2009b. *Staphylococcus aureus* bacteraemia in a tropical setting: patient outcome and impact of antibiotic resistance. PLoS ONE, 4: 4308-4308.

Nwankwo, E.O. and M.S. Nasiru, 2011. Antibiotic sensitivity pattern of *Staphylococcus aureus* from clinical isolates in a tertiary health institution in Kano, Northwestern Nigeria. Pan. Afr. Med. J., 8: 1-7.

Obiazi, H.A.K., O.P.G. Nmorsi, A.O. Ekundayo and N.C.D. Ukwuandu, 2007. Prevalence and antibiotic susceptibility pattern of *Staphylococcus aureus* from clinical isolates grown at 37 and 44°C from Irrua, Nigeria. Afr. J. Microbiol. Res.

Odetoyin, W.B., A.O. Aboderin, R.T. Ikem, B.A. Kolawole and A.O. Oyelese, 2008. Asymptomatic bacteriuria in patients with diabetes mellitus in Ile-Ife, South-West, Nigeria. East. Afr. Med. J., 85: 18-23.

Okeke, I.N., 2003. Factors Contributing to the Emergence of Resistance. In: the Resistance Phenomenon in Microbes and Infectious Disease Vectors: Implications for Human Health and Strategies for Containment-Workshop Summary, Knobler, S.L., S.M. Lemon, M. Najafi and B.T. Washington, (Eds.), DC: The National Academies Press, pp: 132-139.

Okon, K.O., P. Basset, A. Uba, J. Lin and B. Oyawoye *et al*., 2009. Co-occurrence of predominant panton valentine leukocidin-positive Sequence Type (ST) 152 and multidrug-resistant ST241 *Staphylococcus aureus* clones in Nigerian hospitals. J. Clin. Microbiol., 47: 3000-3003.

Okon, K.O., A.O. Shittu, H. Usman, N. Adamu and S.T. Balogun *et al*., 2013. Epidemiology and antibiotic susceptibility pattern of methicillin-resistant *Staphylococcus aureus* recovered from tertiary hospitals in Northeastern, Nigeria. J. Medicine Med. Sci., 4: 214-220.

Olowu, W.A. and T.G. Oyetunji, 2003. Nosocomial significant bacteraemia: Prevalence and patterns of bacterial pathogens among children hospitalized for non-infecturing urinary tract disease. W. Afr. J. Med., 22: 72-74.

Robert, M.R., C. Brennen, D.J. Rihs, M.M. Wagener and A. Obman *et al*., 2006. Isolation of *Staphylococus aureus* from the urinary tract: Association of isolation with symptomatic urinary tract infection and subsequent Staphylococcal bacteremia. Clin. Infect. Dis., 42: 46-50.

Shittu, A.O., K. Okon, S. Adesida, O. Oyedara and W. Witte *et al*., 2011. Antibiotic resistance and molecular epidemiology of *Staphylococcus aureus* in Nigeria. BMC Microbiol., 11: 92-92.

Tuo, P., G. Montobbio, R. Vallarino, M. Tumolo and M.G. Calero *et al*., 1995. Nosocomial Staphylococci in a neonatal and pediatric intensive care unit. Pediatr. Med. Chir., 17: 117-22.

Ubani, U.A., 2009. Bacteriology of external ocular infections in Aba, South Eastern Nigeria. Clin. Exp. Optom., 92: 482-489.

Uwazuoke, J.C. and L.E. Aririatu, 2004. A survey of antibiotic resistant *Staphylococcus aureus* strains from clinical sources in Owerri. J. Appl. Sci. Environ. Managt., 8: 67-68.