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

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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; Odetoyn 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., 2013).
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 (25 µg), Ciprofloxacin (5 µg), Erythromycin (15 µg), Tetracycline (10 µg), 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 ($\chi^2$) 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)  | 12 (60.0)   | 20 (23.8) |
| 21-30          | 2 (18.2)  | 9 (81.8)    | 11 (13.1) |
| 31-40          | 0.000000  | 19 (100)    | 19 (22.6) |
| 41-50          | 0.000000  | 2 (100)     | 2 (2.4)   |
| Total          | 32 (38.1) | 52 (61.9)   | 84 (100)  |

### 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)0          |
| 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)       |

$\chi^2 = 42.533 \ df = 8 \ P < 0.0001$
patterns of bacterial pathogens is essential to guide due to proximity between the genital tract and the factors such as contact with objects, interaction with frequency rate in those within the age group 0-10 years. (Tuo et al., 1995). Report from this study showed high frequency rate in those within the age group 0-10 years.

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

| Type of antibiotics | No of isolates tested = 11 |
|---------------------|----------------------------|
|                     | 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 well 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).

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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.

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