

Prevalence of Methicillin–Resistant *Staphylococcus aureus* (MRSA) from Nasal Swabs of Hospitalized Children in Abakaliki

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Abstract

Staphylococcus aureus is a major bacterial pathogen that causes different community and hospital-acquired infections. Over time, strains of *S. aureus* have become resistant to different antibiotics including penicillinase-resistant penicillins. Having data on the local antimicrobial susceptibility pattern of this pathogen is necessary for selection of appropriate antibiotics for empirical treatment of infections due to it. This study was undertaken to determine the prevalence of methicillin resistant *Staphylococcus aureus* in nasal swabs of children admitted in the pediatric ward of Ebonyi State University Teaching Hospital, Abakaliki, Nigeria. One hundred and five consecutive isolates of MRSA were isolated from nasal swabs of children in pediatrics wards of EBSUTH using standard microbiology techniques. Susceptibility studies of MRSA isolates to various classes of antibiotics were determined by disc diffusion methods. The overall susceptibility of isolated MRSA strains to antimicrobial agents was 100% for vancomycin, 10% for ciprofloxacin, 40% for ceftazidime, 25% forcefotaxime, 48% forcefoxitin, 10% for penicillin, 65% for erythromycin, 75% for clindamycin, 37% for amikacin, 18% for co-trimoxazole, 15% for oxacillin and 29% for cloxacillin. In conclusion prevalence of MRSA was low and other than vancomycin, clindamycin and erythromycin, none of the tested antibiotics are appropriate for empirical treatment of serious MRSA infection in our area.

Keywords: MRSA, Antibiotics susceptibility, Nasal swab, Children, Pediatrics ward.

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Introduction

Staphylococcus aureus remains one of the most frequently isolated pathogens in both community and hospital practice. Methicillin resistant *Staphylococcus aureus* was first identified in the United Kingdom in 1961 (Jevon, 1961) and has assumed increasing importance internationally as a cause of serious infections in human. They cause blood stream infections, skin, and soft tissue infections, pneumonia, hospital-acquired postoperative wound infections, otitis media etc. which are difficult to treat (Giacometti, *et al.*, 2000; Doernet *et al.*, 19991; Sander, *et al.*, 1998; Pfaller, *et al.*, 1999). The development of such resistance does not cause the organism to be more intrinsically virulent than strains of *Staph. aureus* that have no antibiotic resistance, but resistance does make MRSA infections more difficult to treat with standard types of antibiotics and thus more dangerous (Jenson and Lyon, 2009). MRSA is especially troublesome in hospitals and nursing homes or long-term care facilities where patients with open wounds, invasive devices, and weakened immune system are at greater risk of infection than the general public (Hardy *et al.*, 2004). Prisons, military barracks and homeless shelters can be crowded and

confined and poor hygiene practices may proliferate, thus putting inhabitants at increased risk of contracting MRSA.

Methicillin resistant in *Staphylococci* is mediated by the Mec A gene which encodes for the penicillin-binding protein 2A (PBP-2A) resulting in reduced affinity for the beta-lactam antibiotics. MRSA is of concern not only because of its resistance to methicillin but also because it is generally resistant to many other chemotherapeutic agents such as the quinolones, aminoglycosides (Mansouri and Khaleghi, 1997), and a low level resistant to vancomycin (Assadullahet al., 2003). In the present study we determined the prevalence and *in-vitro* antimicrobial susceptibility pattern of MRSA isolated from nasal swabs of children admitted in pediatrics ward of EBSUTH.

Materials and Methods

Isolation of Bacteria: A total of 105 consecutive isolates of MRSA was isolated from nasal swabs of children from 0 to 12 years of age between September and December 2011. These swab samples cultured on blood agar, mannitol salt agar and DNase agar media incubated at 37°C for 18-24 h. Characteristic *Staph. aureus* colonies were identified further by Gram staining, catalase and coagulase testing according to standard bacteriological procedures (Chessbrough, 1993). A suspension of each confirmed *Staph. aureus* isolate was prepared in peptone water to match 0.5 McFarland turbidity standards and *S. aureus* ATCC 25923 was used as control strain. All confirmed *S. aureus* isolates were screened for methicillin resistance with 4% NaCl, then 5µg methicillin discs (Oxoid UK) were aseptically placed on the surface of the inoculated plates and incubated at 35°C for 18-24 h.

Antibiotics Susceptibility Testing: Antibiotic susceptibility testing was carried out as described by Kirby-Bauer disc diffusion method on Mueller-Hinton agar, according to Clinical and Laboratory Standards Institute recommendation (CLSI, 2006). The results were interpreted after 18-24 h incubation at 37°C as sensitive, intermediately sensitive and resistant according to the zone diameter around each antibiotic disc. The antibiotic discs were from Oxoid UK and included: vancomycin (30µg), ciprofloxacin (5µg), cefotaxime (30µg), amikacin (30µg), ceftazidime (30µg), erythromycin (15µg), clindamycin (2µg), ceftazidime (30µg), oxacillin (5µg), cloxacillin (30µg) and amikacin (30µg). *S. aureus* 25923 was used as the organism for quality control of antibiotic disks.

Results

MRSA producers were most prevalent among children within the age range of 0-6 yrs 77 (73.3%) (Table 1). Figure 1 shows the susceptibility of isolated MRSA from nasal swab to tested antibiotics. The overall susceptibility of isolated MRSA to antimicrobial agent was 100% for vancomycin, 10% for ciprofloxacin, 10% for penicillin, 40% for ceftazidime, 25% for cefotaxime, 48% for cefoxitin, 65% for erythromycin, 75% for clindamycin, 37% for amikacin, 29% for cloxacillin, 18% for co-trimoxazole and 15% for oxacillin. According to our results, prevalence of MRSA was low when compared to previously reported studies. Vancomycin, clindamycin and erythromycin were the most effective agent against isolated MRSA strains.

Table 1: Prevalence of MRSA isolated from nasal swab of children between the ages of 1-12 years.

Children age(yr)	Percentage of MRSA occurrence
1-6	77 (73.3%)
6-12	28 (26.7%)

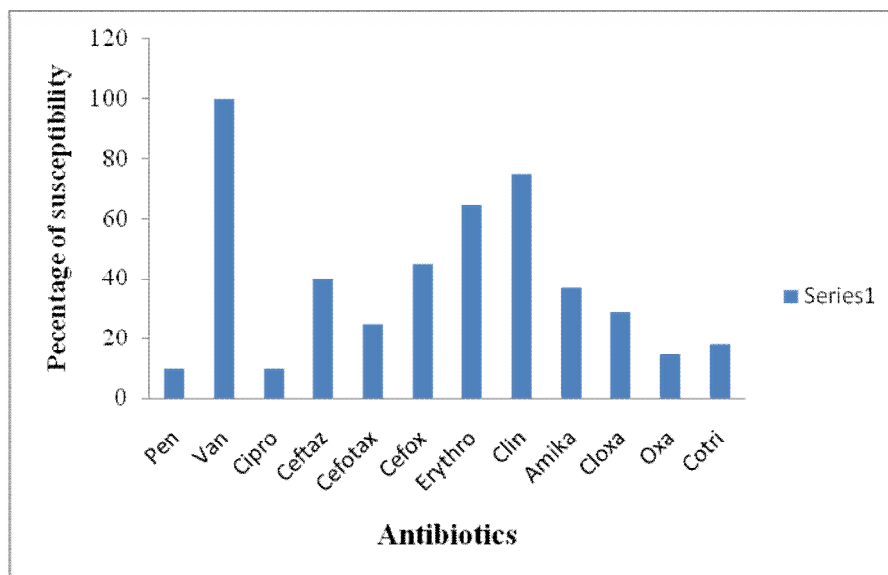


Figure 1: Percentage of susceptibility of methicillin resistance *Staphylococcus aureus* to antibiotics

Key: Van = Vancomycin, Cipro = Ciprofloxacin, Ceftaz = Ceftazidime, Cefotax = Cefotaximin, Cefox = Ceftoxitin, Erythro = Erythromycin, Clin = Clindamycin, Amika = Amikacin, Cloxa = Cloxacillin, Oxa = Oxacillin, Cotri = Co-trimoxazole, Pen = Penicillin.

Discussion

The susceptibility pattern of MRSA strains to antibiotics susceptibility to penicillin was very low (10%) and it is consistent with many reported results of other studies from different countries (Haghi-Ashteiiani et al., 2007; Alborzi et al., 2003, Farzana et al., 2006; Goff and Dowzicky, 2007). *Staphylococcus aureus* is a very common cause of infection in hospitals and is mostly liable to infect newborn babies, surgical patients, old and malnourished persons, persons with diabetes and other chronic diseases (Tuo et al., 1995). MRSA are recognized as a major cause of nosocomial infection which result in significant high morbidity and mortality rate in spite of the use of antibiotics (Schumacher-Perdreau, 1991). Methicillin and its derivatives were indicated for treatment of staphylococcal infection due to penicillinase production. However, these bacteria have become a major concern with the extraordinary ability to adapt to antibiotics stress (Layton et al., 1995).

The highest frequency of isolates of MRSA (73.3%) in the present study was observed in patients of 1-6 years of age in which neonates and infants were included. It is believed that their immunity is not properly developed at this stage to cope with bacteria infections hence, they are vulnerable and easily infected especially when hospitalized. The older children have also been observed to be more active than adults during their interaction with their playmates and while playing may come in contact with various objects. In this process, they become a target to ubiquitous bacteria such as *Staph aureus*. Screening for methicillin resistant isolates in the present study showed a low prevalence. The prevalence of MRSA varies among different countries and different areas of a country. Methicillin resistant *Staph. aureus* has emerged as a serious public health problem of global concern and has also emerged as an important endemic pathogen in our hospital. This was however; lower than the studies conducted in other areas of Nigeria such as Ilorin 34.7%, and Jos (26) 43.0% (Taiwo et al., 2005).

The prevalence of MRSA was found to be low in France (6%), Ireland (5%) and United Kingdom (2%) (Denton et al., 2008). In a study performed by Alborzi et al., in Shiraz Iran, 33% of all *Staph. aureus* isolated were reported to be MRSA. (Alborzi et al., 2000). Fridkin et al., reported a medium increase of 2.4% in the prevalence of oxacillin-resistant *Staph. aureus* in US hospitals from 1996-1999 (Fridkin et al., 2002). Another report showed that prevalence of MRSA has increased in Europe than was reported previously. In Austria 21.6%, Spain 30.3%, France 33.6% of isolated *Staph. aureus* strain are

methicillin resistant (Voss et al., 1994). In a survey performed in Pakistan 61.29% of isolated *Staph. aureus* strains were resistant to oxacillin (Farzana et al., 2006). *Staph aureus* develops resistance very quickly to different antimicrobials within a short period of time. Some years ago, cloxacillin was highly recommended in Staphylococcal infection in view of excellent *in vitro* sensitivity results. This could be seen from the reports at Ilorin Nigeria (Ndip et al., 1997) with 78% sensitivity and at Owerri, Nigeria (Uwazuoke and Ariratu, 2004) with 85.4% sensitivity. However, these results are at variance with current trends in MRSA susceptibility to cloxacillin and could be seen from the results of the present study. The high level of resistance could be associated with earlier exposure of these drugs to isolates which may have enhanced development of resistance. Resistant to cefotaxime, ceftazidime and ceftazidime both are (second generation cephalosporins), among the isolates were (60%), (75%) and (52%) respectively. It is noteworthy that in the current study about (75%) and (65%) of MRSA isolates were sensitive to clindamycin and erythromycin. This shows that cross-resistance between penicillinase resistant penicillin (e.g. oxacillin) and other classes of antibiotics are not absolute.

Resistance to co-trimoxazole was (82%). Co-trimoxazole is an inexpensive and available antibiotic in Nigeria and because of its broad spectrum of activity, it is prescribed for different infections. In contrast to our report, a study in Israel showed an increase in the susceptibility of MRSA isolates to co-trimoxazole from 31% in 1988 to 92% in 1997 (Fasching et al., 2008). The author attributed this increase sensitivity to significantly reduced usage of this drug in their institution. High resistance of isolated MRSA strains to ciprofloxacin (90%) recorded in the current study respectively is in consistent with other studies in other countries (Alborzi et al 2000; Goff and Dowzicky, 2007; Zhanel et al 2008; Fasching et al., 2008). Amikacin (37%) was less effective against isolated MRSA strains, however, the role of aminoglycoside as monotherapy in the treatment of infections due to Gram-positive organisms has not been well defined. Currently, this antibiotic is used as combination therapy with other effective antibiotics for synergistic action in the treatment of Gram-positive related infections.

There is high level of self-medication in Nigeria which is associated with inadequate dosage and failure to comply with treatment and availability of antibiotics to consumers across the countries with or without prescription ((Odugbemi, 1981; Paul et al., 1982). It has been observed that the indiscriminate use of antibiotics without prescription in the developing countries such as Nigeria contributes to upsurge of drug resistance strains of microorganism. This has rendered the commonly used antibiotics completely ineffective in the treatment of different kinds of infection (Odugbemi, 1981). It was encouraging to note that vancomycin resistance was not observed among the isolates.

Vancomycin is the most effective agent against isolated MRSA strains with susceptibility rate of 100%. These data show that antimicrobial resistance is increasing among *Staph. aureus* strains in our locality. This increase highlights the value of prudent prescribing of antibiotics (including vancomycin) and avoiding their irrational use. It is necessary to establish an antimicrobial susceptibility surveillance system and to improve current infection control programs in our hospitals to prevent the spread of resistant microorganisms including MRSA.

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