

SHORT COMMUNICATION

Nasal methicillin resistant *Staphylococcus aureus* associated post-surgical wounds infections

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ABSTRACT

Aims: *Staphylococcus aureus* nasal colonization is an important risk factor for developing a wide range of infections in clinical setting. This study was aimed at determining the extent of staphylococcal carriage including methicillin resistant *Staphylococcus aureus* (MRSA) in post-surgical patients and employees in a tertiary health facility.

Methodology and Result: Between April and July 2010, 240 post-surgical patients and 80 hospital personnel at the University of Calabar Teaching Hospital, Calabar were enrolled in the present study. All subjects consented to participation in the study and those who had previous medical history or treatment on antibiotic in the last six months prior to enrolment were noted. Nasal specimens collected from carrier and post-surgical sites in individuals (15-63yrs) who were hospitalized for at least 21 days were immediately placed in Staurts' transport medium and kept at 4 °C before being analyzed accordingly and screened for methicillin resistant *Staphylococcus aureus*. Out of a total number of 320 subjects examined within a period of 4 months 144 (45%) were carriers of *Staphylococcus aureus* and 55 (38%) of these were MRSA. Demographic and clinical data of subjects indicated more male carriers (60.7%) confined to older age groups above 35years. There was a significant difference ($p > 0.05$) in *Staphylococcus aureus* carriage for subjects with recent medical history of hospitalization or treatment with antibiotics. There also appears to be a considerable association (50.9%) between nasal carriage status and autoinfection of post-surgical wounds. A good proportion of all strains tested were resistant to commonly used antibiotics. Approximately 89% of MRSA were resistant to penicillin. Resistant rate against other antibiotics was largely below 30%.

Conclusion, significance and impact of study: An improved understanding of nasal carriage is needed to foster development of new strategies to reduce colonization and subsequent infection with bacteria.

Keywords: Nasal *Staphylococcus aureus*, methicillin resistance

INTRODUCTION

The nasal carriage of *Staphylococcus aureus* is widespread and of considerable epidemiological significance. Several studies (Wensal, 1995; Khalili *et al.*, 2009; Rahbor *et al.*, 2003) have suggested that carriers are more prone to skin sepsis and post-operative infections caused by *S. aureus* than are non-carriers. It is not known why some people carry the organism and others do not, although nasal carriage predisposes to skin carriage as a result of passive transfer. In immunocompromised individuals, infections associated with *S. aureus* can lead to numerous complications and in some cases can result in death.

Most strains of *Staphylococcus aureus*, even those acquired in the community (healthy) population are penicillin resistant (Jahl *et al.*, 2005; Madoni *et al.*, 2001). In most cases the resistance is attributable to β -

lactamase production. Some *S. aureus* that are penicillin resistant are also resistant to the newer β -lactamase resistant semi synthetic penicillins such as methicillins, oxacillin and nafcillin. This resistance is due primarily to the presence of an unusual penicillin binding protein in the cell wall of resistant strains. Methicillin resistant *Staphylococcus aureus* is being isolated with greater frequency in many countries and significantly affect patients morbidity (Jahl *et al.*, 2005; Herwaldt, 2003; Graffinder, *et al.*, 2006) People infected with antibiotic resistant organisms like MRSA are more likely to have longer and more expensive hospital stays.

The goal of this study is to establish the degree of nasal MRSA colonization and its associated skin contamination leading to post-operative infections.

MATERIALS AND METHODS

Between April and July 2010, 240 post-surgical patients and 80 hospital personnel at the University of Calabar Teaching Hospital, Calabar were enrolled in the present study. All subjects consented to participation in the study and those who had previous medical history or treatment on antibiotic in the last six months prior to enrolment were noted.

Nasal specimens were collected from each subject using 2 sterile cotton wool swabs. Swabs were rotated three times clockwise and 3 times anticlockwise in the anterior nares of the nose. At least 2 nasal specimens were obtained from each subject because nasal carriage is defined as at least 2 consecutive *S. aureus* isolates from the anterior nares in a 5-day period. Swab samples were also obtained from post-surgical sites in individuals (15-63yrs) who were hospitalized for at least 21 days. All swab samples upon collection were immediately placed in Stuart's transport medium and kept at 4 °C before being inoculated onto manitol salt agar. The plates were incubated at 37 °C for 48 h. All mannitol positive colonies were subcultured onto 5% blood agar and *S. aureus* isolates were defined as catalase producing Gram-positive cocci that were positive for tube coagulase and confirmed by a rapid *S. aureus* specific latex agglutination test (Plasmatic Lab. Products Ltd. Dorset, UK)

Screening for MRSA

A suspension equivalent to MacFarland 0.5 was prepared from each strain. A swab was dipped and streaked over an area approximately, 2 x 2.5cm on the surface of a Mueller-Hinton agar supplemented with 4% NaCl and 10 mg mL⁻¹ oxacillin (Sigma, Aldrich). Plates were incubated at 30 °C for 3 days. A growth indicates the strain is oxacillin resistant. Susceptibility patterns of MRSA strains against other selected antibiotics were determined according to Clinical Laboratory Standard Institute (CLSI, 2006) guidelines.

RESULTS

The demographic and clinical data of subjects with and without *S. aureus* carriage (**Table 1**) shows that more male subjects (60.7%) were carriers and at an average age slightly above 35 years. When nasal carriage *S. aureus* (NCSA) positive and negative subjects were compared by univariate analysis no statistical significant difference (p.>0.05) was obtained regarding factors such as age and sex. However, hospital admission and antibiotic usage within the last 6 months prior to sample collection were identified as significant risk factors in NCSA colonization.

Data of nasal carrier rate of hospitalized individuals and hospital personnel and the incidence of methicillin resistance are presented in **Table 2**. The quantum of isolates including methicillin resistant strains from post-

surgical patients when compared to those obtained from hospital staff shows a prevalence ratio of 2:1.

Table 1: Demographic and clinical data of subjects with and without nasal carriage of *Staphylococcus aureus* (NCSA)

Characteristics	NCSA (-) n (%)	NCSA (+) n (%)
Number	176 (55)	144 (45)
Male: Female	107 (60.7): 69 (39.2)	84 (58.9) : 60 (41.6)
Age (Years)	39 (15-63)	38.5 (17-60)
Antibiotic usage within the last 6 months	32 (18.1)	20 (13.8)

NCSA (-) = Non Nasal Carriage of *Staphylococcus aureus*; **NCSA (+)** = Nasal Carriage of *Staphylococcus aureus*

Table 2: Nasal and Post-surgical wound *Staphylococcus aureus* carriage rate and incidence of methicillin resistance

Subject group	Carriage site	Number of +ve recovery (%)	Number resistant to methicillin (%)
Post surgical patients n = 140	Nasal	55 (39.2)	19 (34.5)
	Post-surgical wounds	28 (20)	10 (35.7)
Hospital personnel n = 180	Nasal	61 (33.8)	26 (42.6)

The susceptibility pattern of MRSA and methicillin sensitive *S. aureus* (MSSA) against selected antibiotics (**Table 3**) shows that approximately 25% of MRSA and MSSA are resistant to both tetracyclin and gentamycin.

Table 3: Susceptibility pattern of MRSA and MSSA organism to selected antibiotics

Organism	Total number resistant to						
	Penicillin	Tetracycline	Erythromycin	Lincomycin	Gentamycin	Vancomycin	Ciprofloxacin
MRSA (n = 55)	49	15	5	0	5	0	6
MSSA (n = 89)	65	17	9	0	11	0	10

Approximately 89% and 73% of MRSA were respectively resistant to penicillin. While resistance to vancomycin and lincomycin was uncommon, there was a demonstrable low resistance to erythromycin and ciprofloxacin (9%).

DISCUSSION

Staphylococcus aureus is the single most important organism causing approximately 54% of post-surgical site infections (Herwaldt, 2003). Both MRSA and MSSA nasal carrier rates in this study are slightly lower than those reported from the Middle East and Central Asia (Madoni *et al.*, 2001; Khalili *et al.*, 2009; Rahbor, *et al.*, 2003) where carrier rates range between 23% and 65%. Differences in cultural milieu and large volume of hospital admissions in these regions amongst other factors may be responsible for this slight drop in carrier rate. Demographic data of nasal carriers compared with non-carriers depicted differences which did not reach statistical significance.

The carrier rate of MRSA was significantly higher in patients and hospital staff who had used antibiotics within the last 6 months. Previous studies (Lytkaimen, 2004; Graffinder *et al.*, 2006) have also suggested an association between antibiotic usage and nasal carriage. No Vancomycin and Lincomycin resistance was encountered. Both MRSA and MSSA showed multiple resistances to approximately 71% of selected antibiotics. Other studies (Xander *et al.*, 2006; Graffinder *et al.*, 2006) had reported 53% of multiple resistances. Inadequate antibiotic therapy is associated with poor outcome and particularly with bacterial resistance.

In general terms, a significant association (50.9%) between nasal status and *Staphylococcus aureus* surgical site infection was established in this study. Other studies (Lytkaimen *et al.*, 2004; Rahbor *et al.*, 2003) have reported higher rates (62%) of post-surgical sites infections in MRSA carriers than in MSSA subjects.

Why some individuals apparently are resistant to colonization and thus at lower risk of infection remains an open question. Understanding the biology of this pathogen, especially its ecological niche in humans and the initial step in infection colonization may therefore provide new modalities to limit pathogenesis.

CONCLUSION

The apparent high presence of MRSA (38%) recovered in this research poses a serious health concern for the safety and sanity of surgical procedures in Nigeria and other developing countries. It is not, however, a problem limited to developing countries only, as *S. aureus* is normally an abundant and environmental bacterium, however, with its pathogenicity potentials in place. The organism can be found on the skin and nasal passages, which renders it easy to transmit through hand movements and fomites in domestic and clinical enclosures, where they can easily contaminate surgical

wounds during surgical procedures or recuperation in the hospital or at home.

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