

The Prevalence of Nasal Carriage of *Staphylococcus Aureus* Among Healthcare Workers at a Tertiary Care Hospital in Assam with Special Reference to MRSA

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ABSTRACT

Background: The recent years have witnessed the increasing resistance of *Staphylococcus aureus* to many antimicrobial agents. The most notable example is the emergence of Methicillin-resistant *Staphylococcus aureus* (MRSA), which was reported just one year after the launch of methicillin. The ecological niches of the *S. aureus* strains are the anterior nares. The identification of *Staphylococcus aureus* by using a proper antibiogram and the detection of methicillin resistant *Staphylococcus aureus* greatly contribute towards the effective treatment of the patients.

Aims and Objectives: To isolate *Staphylococcus aureus* from the nasal swabs of healthcare workers (HCWs) and to study their antimicrobial susceptibility patterns, which include methicillin resistance.

Materials and Methods: Nasal swabs were collected from the healthcare workers of various clinical departments of the hospital over a period of one year. The isolation of *Staphylococcus aureus* and their antimicrobial susceptibility patterns were carried out by standard bacteriological procedures.

Results: *Staphylococcus aureus* was isolated in 70 cases (22.22%). The prevalence of the *S. aureus* nasal carriage was higher among the male HCWs (54.28%) than among the female HCWs (45.71%). The carriage rate was the highest in the orthopaedics department, followed by those in the surgery and the gynaecology departments. All the *Staphylococcus aureus* isolates were sensitive to vancomycin and linezolid (100%). Penicillin and ampicillin were the most resistant, (90% and 88.6%) respectively. Methicillin resistance was seen in 11.43% of the *S. aureus* isolates, both by the disc diffusion test and by the Oxacillin Resistance Screen Agar (ORSA) test.

Conclusions: The compliance with the sanitary and the antibacterial guidelines of the health professionals is the single most important factor in preventing nosocomial infections. Simple preventive measures like hand washing before and after the patient examination, the use of sterile aprons and masks in the postoperative wards, awareness during the examination of the immunocompromised patients, and avoiding touching one's nose during work, can reduce the disease transmission rate considerably.

Key Words: *Staphylococcus aureus*, Healthcare workers, Nasal carriage

INTRODUCTION

Staphylococcus aureus has long been recognized as an important pathogen in human disease. Staphylococcal infections occur frequently in hospitalized patients and they have severe consequences, despite giving antibiotic therapy. Due to an increasing number of infections which are caused by the methicillin-resistant *S. aureus* (MRSA) strains which are now most often multi-drug-resistant, the therapy has become problematic.

The ecological niches of the *S. aureus* strains are the anterior nares of humans [1]. Three patterns of carriage are known. Approximately 20% of the individuals almost always carry one type of strain and they are called persistent carriers. A large proportion of the population (60%) harbours *S. aureus* intermittently, and the strains change with varying frequencies. Such persons are called intermittent carriers. Finally, a minority of the people (20%) almost never carry *S. aureus* and they are called noncarriers. A persistent carriage is more common in children than in adults, and many people change their pattern of carriage between the

age of 10 and 20 years. The reasons for these differences in the colonization patterns are unknown. A persistent carriage seems to have a protective effect on the acquisition of other strains, at least during the hospitalization of the patients. This barrier to the colonization is reduced when the carriers are treated with antibiotics [2].

Healthcare Workers (HCWs) constitute an important reservoir of *S. aureus*. Several studies have reported that the rate of the nasal carriage of *Staphylococcus aureus* among the HCWs ranges from 16.8%-56.1% [3-6]. The screening of the nasal carriage in HCWs is an important component in the control of MRSA in any health care facility. The identification of the colonized staff members allows the appropriate management of these persons, to prevent the spread to others [7].

AIMS AND OBJECTIVES

To detect the presence of *Staphylococcus aureus* in the anterior nares of the HCWs and also to detect the antimicrobial suscep-

tibility patterns of the isolates, which include methicillin resistance.

MATERIALS AND METHODS

The present study was carried out to study the prevalence of the nasal carriage of *Staphylococcus aureus* among Health Care Workers (HCWs) and their antimicrobial susceptibility patterns. This study was carried out for a period of one year, from August 2009 to July 2010. A total of 315 nasal swabs were collected from the health care workers who were working in various clinical departments of the hospital. A written informed consent was taken from all the study subjects. The HCWs with a history of the use of antibiotics were also included in the study.

Nasal swabs were collected from the anterior nares of both the nostrils with a sterile swab stick which was moistened with saline. The primary inoculations of the collected swabs were done on 10% sheep blood agar medium, MacConkey's agar medium and Mannitol salt agar medium. The plates were incubated aerobically at 37°C for 24 hours and they were examined for growth. The *Staphylococcus aureus* which was isolated from the nasal swab samples was identified by standard methods [8,9] based on the colony morphology, pigment production, gram staining, the catalase test, the slide and tube coagulase test, the modified Hugh and Leifson (O/F) test and the fermentation of mannitol.

The isolates were typed according to the scheme which was described by Coia et al., (1990) [10], which distinguished four groups or biotypes on the basis of the Tween 80 hydrolysis, the urease test, pigmentation and the gentamicin susceptibility.

All the isolated *Staphylococcus aureus* strains were tested against different antimicrobial agents by the modified Kirby Bauer disc diffusion method [11]. Commercially available antibiotic discs were used, which were obtained from HiMedia Laboratories Ltd. The discs which were used were ampicillin (10mcg), amikacin (30mcg), amoxicillin-clavulanic acid (30/10mcg), cefotaxime (30mcg), ciprofloxacin (10mcg), cotrimoxazole (25mcg), erythromycin (5mcg), linezolid (30mcg), penicillin (10units), and vancomycin (30mcg).

MRSA was detected by the disc diffusion method by using cefoxitin (30mcg) and oxacillin (1mcg) discs and also by its growth on Oxacillin Resistant Screen Agar plates (ORSA) [12].

The health care workers who were found to be colonized with *Staphylococcus aureus* were advised to apply mupirocin ointment in their anterior nares and they were re-tested for the nasal carriage of *S.aureus* after 3 months of treatment.

RESULTS

A total of 315 nasal swab samples from various clinical departments were randomly collected and screened during the course of the study. From these, a total of 70 yielded *Staphylococcus aureus* in the culture [Table/Fig-1]. The prevalence of the *S.aureus* nasal carriage was higher among the male HCWs (54.28%) than among the female HCWs (45.71%). The carriage rate was the highest in the orthopaedics department, followed by those in the surgery and gynecology departments. The difference in the nasal carriage of *S.aureus* between doctors and nurses was not statistically significant, while the difference was quite significant between the 3rd and 4th grade workers as compared to that between the doctors or nurses [Table/Fig-2]. The identities of these Staphylococcal isolates were then confirmed by standard biochemical methods.

The isolates were then grouped into biotypes by using accepted phenotypic characters. A majority of the *S. aureus* strains (45.71%) belonged to the biotype B, 28.75% belonged to the biotype D, 21.43% belonged to the biotype C and only 7.14% belonged to the biotype A; 4.3% of the isolates could not be typed. The isolates were then tested to demonstrate their resistances to methicillin by using oxacillin and cefoxitin discs and ORSA and for their sensitivity profile to a battery of 12 antibiotics. The results of the in-vitro antimicrobial sensitivity tests which were carried out on the 70 *Staphylococcus aureus* isolates against 12 antibiotics which included oxacillin and cefoxitin, have been shown in [Table/Fig-3]. The MRSA isolates were resistant to all the antibiotics except vancomycin and linezolid. Their resistance to methicillin was determined by the disc diffusion method by using cefoxitin and oxacillin discs. It was also further confirmed by their growth on the ORSA plates. 11.43% of the *S.aureus* isolates showed methicillin resistance, both by the disc diffusion test and ORSA. The health care workers were en-

Culture results	Isolates	No./percentage
Culture positive	<i>S.aureus</i>	70(22.22%)
	CONS	135(42.86%)
	Others	42(13.33%)
Culture Sterile	-	68(21.58%)
Total	-	315(100%)

[Table/Fig-1]: Culture results of nasal swabs of 315 HCWs.

Category→	Doctors	Nurse	Others	Total
Positive	18(25.71%)	16(22.86%)	36(51.43%)	70(100%)
Negative	108(42.69%)	86(35.10%)	51(20.81%)	245(100%)

[Table/Fig-2]: Nasal carriage of *S.aureus* among different categories of HCWs.

Antibiotics	Sensitive (no. /%)	Resistant (no. / %)
Penicillin	7(10%)	63(90%)
Ampicillin	8(11.43%)	62(88.57%)
Vancomycin	70(100%)	0(0%)
Linezolid	70(100%)	0(0%)
Erythromycin	57(81.43%)	13(18.6%)
Amoxicillin-clavulanic acid	51(72.86%)	19(27.14%)
Amikacin	62(88.57%)	8(11.43%)
Cefotaxime	50(71.43%)	20(28.6%)
Ciprofloxacin	58(82.86%)	12(17.14%)
Cotrimoxazole	48(68.57%)	22(31.43%)
Oxacillin	62(88.57%)	8(11.43%)
Cefoxitin	62(88.57%)	8(11.43%)

[Table/Fig-3]: Sensitivity/ resistance profile of the isolates.

quired about their use of antibiotics within the past 3 months. It was found that all the healthcare workers with MRSA had a history of the use of antibiotics and that this correlation was statistically significant (p value <0.05).

CONS: coagulase negative *Staphylococcus*.

After the application of the mupirocin ointment as per direction, 64 of the HCWs responded to the treatment and were culture negative after the treatment, while 6 of them were either resistant or had a recurrence of the colonization.

DISCUSSION

In our study, we found that 22.22% of the HCWs carried *S.aureus* in their anterior nares and that 11.43% of these were MRSA. Studies with similar and contrast findings have been tabulated in [Table/Fig-4]. It is worth mentioning that all the HCWs who had a history of antibiotic usage during the period of our study, carried MRSA in their anterior nares. This put both the patients and the workers at risk. They might act as potential sources for the nosocomial spread of the infection, especially to those with open wounds who are admitted to a surgical unit. The presence of

Parameters	Present study	Similar findings	Contrast findings
<i>Staphylococcus aureus</i> isolated from anterior nares	22.22%	13% (Vinodhkumaradithyaa A et al., 2009) [13].	Shobha KL et al., (2005) [14] 0%
Biotypes of the isolates	A-4.3 %, B-46%, C-21%, D-28%, untypeable-7.14%	A-7.6%, B-49%, C-0%, D-34%, untypeable-8.8% (Vidhani S et al., 2001) [15].	A-25%, B-15%, C-10%, D-20% (Alli OAT et al., 2007) [16].
Sex differentiation	Males-54%, Females-45.71%	Males-42%, Females-57% (Shakya B et al., 2010) [17].	Males-22.5%, Females-44.6% (Ahmad S et al., 2010) [18].
Department wise cases	Orthopedics - 32.35, Surgery-31, Gynecology - 30.30%	Orthopedics-30%, surgery-35.7% (Apisarthanarak A et al., 2006) [19].	ICU-38.1%, Surgery-26% (Pan A et al., 2006) [20].
Category of HCWS	Doctors-25%, Nurses-22.86%, others-51%	Doctors-22.7%, nurses-19.2% (Vinodhkumaradithyaa A et al 2009) [14].	Doctors-53%, nurses-33.3%, others-18% (Ahmad S et al., 2010) [18].
Methicillin Resistance	11.43%	15.4% (Vinodhkumaradithyaa A et al., 2009) [14].	1% (Mathanraj S et al., 2009) [21].
Reduction in <i>S.aureus</i> isolation after mupirocin	91% reduction	86% reduction (Muller A et al., 2005) [22].	-

[Table/Fig-4]: Comparative analysis of present study with other studies

MRSA may cause problems in the hospital infection control programs. The study shows the need for a periodic screening of all the hospital personnel and measures which are taken to treat the carriers.

CONCLUSION

The single most important factor for preventing nosocomial infections is compliance of the health professionals with the sanitary and the antibacterial guidelines. To achieve this, the health professionals should be informed about the potential consequences of the nosocomial infections, both inside and outside the hospital, and their cooperation should be sought to diminish the carriage of *Staphylococcus aureus*. Simple preventive measures like hand washing before and after the patient examination, the use of sterile aprons and masks in the postoperative wards, aware-

ness during the examination of immunocompromised patients, and avoiding touching one's nose during work, can reduce the disease transmission rate considerably. All the HCWs should be periodically educated and trained about the maintenance of hygiene and infection control and the effects of the use or rather, the misuse of antibiotics.

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