ORIGINAL PAPER

Nasal Staphylococcus Aureus Carriage in Nurses and their Household Members

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Abstract

Background: Staphylococcus aureus colonization is common in normal population and the prevalence is higher in health care staff. Transmission of this organism is possible from the nose to the hands and with the contact of the individual's hands to the nose during the routine work.
Aims: The aim of this study is to investigate the nasal *S.aureus* carriage in nurses working in the crucial departments and in their household members.
Methodology: This study consisted of 50 nurses working in a Medical Faculty Hospital and their 128 family members between January 14th-April 30th 2008. The bacterial strains were identified by conventional method and the antibiotic resistance was carried out by disc diffusion method.
Results: *S.aureus* carriage was 18% (9/50) for nurses and 24.2% (31/128) for household members and methicillin resistance was not determined. There was no significant relationship among the risk factors in the nurses group but a meaningful relationship was observed between the carriage state and chronic sickness and using antibiotics in the nurses' household group.
Conclusions: It is necessary to detect the carriers among the apparently healthy nurses and it could be beneficial to control their family members particularly if they have a chronic disease or use antibiotics.

Keywords; Family, Hospital, Nasal carriage, Nurses, *Staphylococcus aureus*

Introduction

There have been *Staphylococcus* spp. widely in our environment and they are also a member of normal human flora. *Staphylococcus aureus (S.aureus)* can be as a temporary flora member especially in the skin, mucosa and many other body parts (Hizel et al., 2005; Kluytmans, Belkum and Verbrugh, 1997). These bacteria colonize on umbilicus, perineum and skin together with the birth and they especially locate in the nose in the following years (Moreillon, Que and Glauser, 2005). The transmission is mainly possible with the replacement of *S.aureus*, colonizing on the front part of the nostrils. Transmission of the organism is provided from the nose to the hands and with the contact of the individual's hands to the nose during the routine work (Akyol, 2006; Kökoğlu et al., 2003).

In our country, while the colonization rate in general population changes between 10% and 50%, it is informed that the colonization in the health staff can reach to 70% (Gül, Ciragil and Aral, 2004). Cesur investigated 500 hospital staff

and idetified 18% (90/500) nasal carriage of S.*aureus* (Cesur, 2001). Öncül et al found that 15.8% of 495 health care workers were carrier of nasal S.*aureus* at GATA Haydarpasa Training Hospital and the rate was 16.6% between nurses. *S.aureus* carriers are a potential infection source for themselves and the people around them (Öncül et al., 2002). Especially the health staff in whose noses *S.aureus* colonization was an important contamination resource. They generally colonize with the strains from the patients and they can carry the strain to other individuals (Akyol, 2006; Kökoğlu et al., 2003). Most of invasive S.a*ureus* infections are assumed to arise from nasal carriage. In a study done by Ben-David et al to evaluate Methicillin-resistant S.*aureus* (MRSA) transmission in ten trauma intensive care units, strains obtained from the patients and health staff was similar (Ben-David, Mermel and Parenteau, 2008). It was thought that the origin of the epidemia could be the health staff who were not known before as MRSA carriers (Von Eiff et al., 2001). Health care workers who carry S.*aureus* in their nares can cause outbreaks of surgical - site infections (Luzar et al., 1990; Cespedes et al., 2002). Pujol and colleagues searched for bacteraemia source in an intensive care unit and found that most of the S.*aureus* bacteraemias had an intravascular device as a source. Also in this study, carriers of S.*aureus* had a relative risk of 12.4 for the development of S.*aureus* bacteraemia (Pujol et al., 1996). In a study by Wertheim and co-workers determined that more than 50% of the cases of bacteraemia source were device related (Wertheim et al., 2004).

Potential transmission risk is also able to circulate the S.*aureus* from the hospital into other settings, including the home - and back again. The major routes of spread are via hands, hand and body contact surfaces, food contact surfaces, cleaning utensils, clothing and linens, and personal hygiene items such as face cloths and toothbrushes (Bloomfieldet al., 2006). Eveillard et al investigated transmission to households in MRSA-positive healthcare workers' families and reported transmission in four out of ten families (Eveillard et al., 2004).

The colonization prevalence is affected from the factors such as the age, the use of antibiotics and hospitalizing (Gül, Ciragil and Aral, 2004). The use of antibiotic correlates with risk for MRSA colonization and infection was studied in multiple studies and the results show the hospitalized patient's prior antibiotics exposure (of almost any kind) was strongly linked to subsequent infections with MRSA (Eveillard et al., 2004; Treakle et al., 2009; Chapin and Lauderdale, 2007).

This study was aimed to determine the prevalence and risk factors associated with nasal carriage of *S.aureus* colonization among nurses working in surgical departments and their household members.

Material and Methods

Study setting and design

This study was a descriptive and prospective study and conducted in nurses and their families at Eskisehir Osmangazi University Hospital between January 14th and April 30th 2008.

Ethical considerations

Ethical approvals were received from the Ethics Committee of Eskişehir Osmangazi University, Medical Faculty. Information about the study was given to all nurses and an informed consent was obtained from the participants.

Participants

This study included 50 nurses working in the surgical depatments, intensive care units, operating room and their household members (n=128).

Data collection and instruments

Individual Definition Form

In data collection, the individual definition form was used. The form was prepared to have information about the individuals' general characteristics (age, gender, working unit), their family informations and the risk factors affecting the prevalence of *S.aureus* carriage.

Procedure

The nasal samples were taken by turning the sterile cotton swabs, included in Stuart transport system, four or five times around 1/3 anterior vestibulum of both noses. After the samples were taken, they were sent to the laboratory within 24 hours. All nasal specimens were cultured onto 5% sheep blood agar and the plaques were incubated an overnight at 35 $^{\circ}$C in aerobic conditions. In the presence of Gram positive coccus with Gram staining method, the catalase test was performed. Catalase positive two-three

colonies were taken with a loop to make tube coagulase test from pure culture and suspended in 0.5 cc rabbit plasma. The tubes were incubated at 35 °C for the first four hours and at room temperature for the next twenty hours, and they were evaluated in terms of coagulation at fourth, eighth and twenty-fourth hours (Chapin & Lauderdale 2007). Catalase and coagulase positive colonies were accepted as *S.aureus*.

Methicillin resistance was determined by Kirby-Bauer disk diffusion method. Briefly, the suspensions at a turbidity of 0.5 Mc Farland standards were prepared with 0.85% sterile saline from pure *S.aureus* colonies. These bacterial suspensions were inoculated to Mueller-Hinton agar surface including 4% NaCl with a sterile cotton swab and standard antibiotic disks consisted of 30 µg cefoxitin, 1 µg oxacillin, 5 µg mupirocin (Oxoid, UK) were placed onto the agar surface. In order to prevent false results about methicillin resistance, both cefoxitin and oxacillin disks were used. After overnight incubation at 35° C, the inhibition zones were evaluated in accordance with Clinical and Laboratory Standards Institute (CLSI) M2-A9 recommendations (NCCLS, 2006). All microbiological procedures were done in the Bacteriology Laboratory of Microbiology Department of Eskisehir Osmangazi University Medical Faculty.

Data analysis

The research data were evaluated with SPSS 13.0. The data were analysed statistically with Mann-Whitney U Test since they were not applicable for normal distribution. While comparing categorical data, $\chi 2$ ve Fisher's $\chi 2$ tests were used. In the study, the descriptive prevalances were given as average and standard deviation. As the significance level, $p<0.05$ was accepted.

Results

General results:

The average age of the carrier nurses was 30.6±3.4 and non-carrier nurses' was 29.9±5.32. It was found that the average age of the carriers in their household members was 25.14±17.53 and and non-carriers' was 30.09±17.86. There was no significant difference between each group's ages and nasal carriage status ($p>0.05$).

In this study, the rate of nasal S.*aureus* carriage was found 18% (9/50) in nurses and any methicillin resistance was determined. The rate of nasal *S.aureus* carriage was determined 24.2% in 31 of the 128 people forming the nurses' family and methicillin resistance was not determined. Any significant result was found between nurses' and their household members' nasal carriage rates ($p>0.05$). Nasal carriage status of nurses and their family household groups were summarized in Table 1.

In the statistical evaluation about the units nurses worked, the significant difference was found in the operating room ($p<0.05$). The rates of nasal carriage according to their working units were summarized in Table 2.

The results about risk factors: Nasal S.*aureus* carriers and non-carriers in each group were compared about hospitalizing in the last six months, using antibiotics in the last three weeks, surgical intervention in the last six months, smoking habit, chronic sickness, skin problems and using medicine except antibiotics. There was no significant relationship among the risk factors in the nurses group. In the nurses' families group, a meaningful relationship was observed between the carriage state and chronic sickness and using antibiotics ($p<0.05$). The risk factors in nurses and nurses' family group were summarized in Table 3.

Table 1. Nasal carriage status of nurses and their family household groups

Groups	Nasal S.*aureus* Carriage			Total	*p*
	MSSA n (%)	MRSA n (%)	Negative n (%)		
Nurses	9 (18%)	-	41 (82%)	50	0.130
Nurses' Household Members	31 (24.2%)	-	97 (75.8%)	128	

Table 2: The rates of nasal carriage according to nurses' working units

Working Units	***Staphylococcus aureus***		
	Positive No. (%)	**Negative No. (%)**	***p***
Surgical Departments	2 (22.2)	23 (56.1)	0.138
Intensive Care Units	2 (22.2)	14 (34.1)	0.699
Operating Rooms	**5 (55.6)**	**4 (9.8)**	**0.005**
Total	9 (18)	41 (82)	

Table 3. The risk factors in nurses and their family household group

Risk Factors	**Nurses** ***S. aureus***			**Nurses' Family Household** ***S. aureus***		
	Positive No. (%)	**Negative No. (%)**	***p***	**Positive No. (%)**	**Negative No. (%)**	***p***
Hospitalizing-last 6 m	1 (11.1)	-	-	4 (12.9)	7 (7.2)	0.460
Antibiotics-last 3 w	1 (11.1)	8 (19.5)	1.000	**10 (32.3)**	**14 (14.4)**	**0.036**
Surgery-last 6 m	1 (11.1)	3 (7.3)	0.560	5 (16.1)	9 (9.3)	0.325
Smoking habit	4 (44.4)	19 (46.3)	1.000	8 (25.8)	26 (26.8)	0.913
Chronic sickness	3 (33.3)	6 (14.6)	0.334	**8 (25.8)**	**10 (10.3)**	**0.040**
Skin problems	3 (33.3)	5 (12.2)	0.144	2 (6.5)	1 (1.0)	0.145
Medicine except antibiotics	1 (11.1)	7 (17.1)	1.000	5 (16.1)	14 (14.4)	0.778

Discussion

In this study which we aimed to determine the prevalence and risk factors associated with nasal carriage of *S.aureus* colonization among nurses working in surgical departments and their household members, nasal *S.aureus* carriage rate was found 18% in nurses. The colonization prevalence shows variability according to the studied society and between healthcare workers the rate is higher. Literaturely, studies showed that the prevalence of nasal carriage in nurses was changed between 14-32.4% in Turkey (Bozkurt et al., 2007; Gül, Çıragil and Aral, 2004; Öncül et al., 2002; Kocazeybek et al., 2003; Hızel et al., 2005; Kökoğlu et al., 2003). The comparison of the result obtained in this study with results from other studies, carriage rate among nurses was slightly less but also this result shows the importance of nurses as possible agents of transmission in the hospital environment.

Some departments such as intensive care units and operation rooms have higher risks in staphylococcal infections. Naz et al detemined that the highest rate of nasal S.*aureus* carriage was in operation rooms (20.8 %) (Naz, Çevik and Aykın, 2006). In a study made by Rhbar et al, the carriage rate was the highest in the orthopaedics department, followed by those in the surgery and the gynaecology departments (Rahbar and Yaghoobi, 2006). In this study, it was stated that five of the nine nurses determined as nasal *S.aureus* carriers were the staff of the operating room. In the statistical evaluation about the

relationship between the colonization and the units, the difference in the nurses working in operating rooms was significant ($p<0.05$).

It was shown in different studies that the people with whom the carrier health-care staff were in touch (sharing the same flat) had also risk (Allen et al., 1997; Mitsuda et al., 1997). Choi et al evaluating nasal *S.aureus* colonization among healthy adult individuals found the 23.4% colonization rate (Choi et al., 2006). Therefore, it was reported that colonization and infection could also develop without any risk factors. Studies introduced that MRSA transmission was possible in the individuals who are not health staff and have any risk factors in the community (Kazaz et al., 2000; Saxena, Singh and Talwar, 2003). Kenner et al determined that asymptomatic *S.aureus* colonization was possible in the healthy society outside hospitals and the prevalence of MSSA (Methicillin-Sensitive S.*aureus*) colonization was 38% and MRSA was 2% (Kenner et al., 2003). In our study, also we determined that there were carrier individuals synchronously in the families of six of the nine carrier nurses. When all individuals were evaluated in terms of risk factors, it was seen that some carriers had not any risk factors. In our study, colonization without any risk factors was determined in the family household of nurses. This finding evoked that there could be a probable transmission of the colonized strains intrafamilial transmission. In the genotyping studies done with the health staff and showing the transmission in the family, having the similar findings strengthened this probability much more (Allen et al., 1997; Mitsuda et al., 1997; Shopsin et al., 2000).

This barrier to colonization is reduced when carriers are treated with antibiotics (Kluytmans, Belkum and Verbrugh, 1997). In this study, presence of antibiotic usage within the last three weeks was found as a risk factor for MSSA carriage in nurses' family member group. This factor was described as a risk factor for carriage with previous studies (Hoefnagels-Schauermans, Niclaes and Buntinx, 2002; Karabay et al., 2006). This study has shown compatibility with previously reported studies.

People with significantly increased carriage rates include those with insulin-dependent diabetes mellitus (DM), those on hemodialysis and the common factor seems to be repeated or long-term puncture of the skin by needles and going to hospitals for any treatment or control (Kluytmans, Belkum and Verbrugh, 1997). Poyraz et al. studied the nasal carriage of S.*aureus* in patients having chronic disease and detemined that carriage was significantly higher in patients with chronic disease (Poyraz, Öztop and Özyazıcı, 2000). Similarly Abu-Rabie determined that there was a significant association between S.*aureus* nasal carriage and having a chronic disease (Ab-Rabie, 2010). In this study, there was a meaningful relationship between the carriage state and chronic sickness (DM, hearth disease, rheumatoid arthritis and tyroid function diseases) in the nurses' household members group. The reason of this relationship may be associated with going hospital more than healthy people.

Limitations of the study: This was a master thesis study in department of Surgery Nursing and had some limitations. This study needed the phenotypic identification of S. aureus isolates. But this needed a further examination and financial support. When the conditions become more efficient, following these strains by studying genetically is highly important epidemiologically. This is the prospective side of this study to achieve the detection of the isolates which we kept under the heat -70^{o}C.

Conclusion

In the present study, nasal carriage rate among nurses was found slightly lower according to literature without any meaningful risk factors. We also observed that usage of antibiotics and having any chronic disease were risk factors for nasal S.*aureus* carriage in the group of nurses' household members. Based on these findings, it is necessary to detect the carriers among the apparently healthy nurses and it could be beneficial to control their family members particularly if they have a chronic disease or use antibiotics. We also recommend that unnecessary usage of antibiotics should be avoided for elimination of nasal carriage of S.*aureus* in our environment.

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