

Health Care Practice, *Staphylococcus Aureus* in Toxicological ICU, Loghman Hakim Hospital, Tehran, Iran

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Abstract

Objective: One of the prominent microorganisms in several reports of nosocomial infections is *Staphylococcus aureus* (*S. aureus*) which is carried by several health care workers (HCW) many times throughout the day. The present investigation was conducted to assess the nasal and hand carriage rate of *S. aureus* amongst medical personnel of Loghman Hakim Hospital's Toxicological Intensive Care Unit (TICU).

Patients and Methods: All health care workers of TICU (n= 70) were recruited to this study. A questionnaire with demographic information, work category, duration of working in the (TICU) and history of infection by *S. aureus* was completed by one trained nurse of the ward. A total of 140 swabs (nasal=70, hand=70) were collected from personnel in TICU. Isolates with both inhibition zone diameter ≤ 13 mm around oxacillin disc and ≤ 21 mm around cefoxitin disc were considered MRSA strains. Also, we used KOH preparation technique to identify hyphae from the samples.

Result: Eighteen (25.7%) persons were *S. aureus* carriers while methicillin-resistant *staphylococcus aureus* (MRSA) was found in 6 (8.6%) subjects. There was no significant difference between the sexes (p = 0.075), age (p = 0.080), work category (p=0.100), and duration of working in the TICU (≤ 5 and >5 years) (p = 0.875) with regard to nasal and hand carriage of *S. aureus*.

Conclusion: Transmission of *S. aureus* by HCWs has to be concerned, however more studies are required to examine the relationship between nasal or hand colonization of MRSA in HCWs and subsequent MRSA infection in patients.

Key words: Health care workers, Toxicological Intensive Care Unit, *S. aureus*, MRSA.

Introduction

According to previous investigations, there have been increasing reports of nosocomial infection following community or hospital exposures of health care workers (HCWs) (1). *Staphylococcus aureus* (*S. aureus*) was the endemic microorganism in several reports of nosocomial infections which induced high mortality and morbidity (2). This microorganism is a virulent bacterium that can cause serious infections including skin and soft tissue infections, wound infection, bacteremia, pneumonia, and endocarditis (3).

It is estimated that *S. aureus* has developed the ability to acquire resistance to all classes of antimicrobial agents (4) and methicillin-resistant *S. aureus* (MRSA) has become a major problem in many hospitals worldwide (2).

While MRSA was originally considered first and foremost as a nosocomial pathogen, over approximately the last 15 years, many countries reported a growing problem with MRSA in the community (5).

The prevalence rate of MRSA amongst hospital patients and staff in New Zealand was almost 0.17% in 2005 (6). MRSA carriers are colonized with the organism in the nares (nose), sputum, urine, an open wound, in the stool or on the skin and have critical roles in transmission of this pathogen (7).

As an outcome of this increasing rate of MRSA carriage in patients discharged from hospitals, MRSA carriage or infection is now commonly explained in patients readmitted or even newly admitted to hospitals (8, 9).

However, in the world where MRSA is endemic, transfer of patients between hospitals and readmissions are major contributors to the extension of MRSA (10, 11).

Healthcare givers who are at the interface between the hospital and the community may serve as agents of cross-transmission of hospital acquired- and community-acquired MRSA (12).

In Iran, the prevalence of nasal carriage of *S. aureus* among hospital personnel varies between 28.2% and 44.5% in different studies (13).

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The necessity of mass screening of health care givers for MRSA has been extensively debated with regards to advantages, disadvantages and ethical issues (14).

Based on our previous studies among patients with ventilator-associated pneumonia (VAP) and aspiration pneumonia (AP) in the TICU, the most frequent isolated microorganism was *S. aureus* (58.7%). This organism was predominant among drug and opioid users as well (15, 16).

According to the previous investigations, we found that HCWs also could be considered as a source of this pathogen, so we have made our decision that this study would be focused on the prevalence of nasal and hand carriage of MRSA among healthcare givers in TICU in Loghman-Hakim Hospital, Tehran, Iran.

Patients and Methods

This cross-sectional study was conducted at Toxicological Intensive Care Unit (TICU) of Loghman-Hakim Hospital Poison Center (LHHPC), during 7 months from January 2011 to August 2011.

The hospital is a unique care, teaching and referral poison treatment center in Tehran with nearly an annual average of 20000 admissions and out-patient hospital visits.

The study protocol with code number of 94- 23. 1. 2011 was reviewed and approved by Ethics Review Committee in Research Deputy Department of Shahid Beheshti University of Medical Sciences, Tehran, Iran.

All health care workers of TICU (n= 70) were recruited to this study.

A questionnaire with demographic information, work category, duration of working in TICU and history of infection by *S. aureus* was completed by a trained nurse of the ward.

A total of 140 swabs (nasal=70, hand=70) were collected from personnel in TICU to screen for hand and nasal *S. aureus* colonization.

The nasal samples were obtained from the anterior nares by using a sterile cotton swab moistened with normal saline. The swab was inserted into each nostril in turn, to a depth of approximately 1 cm, and rotated five times. Similarly, swabs of web space and fingertips of the dominant hand were also obtained at least 30 min after the last hand wash.

The swabs were transported in Tween 80 to the microbiology laboratory ward and incubated over night at 35°C.

Specimens were plotted on manitol salt agar (MSA) plates and were then incubated at 35 °C for 18-24 hours.

According to the standard techniques, the catalase, coagulase and DNase testing was performed on Gram positive cocci isolates for identification of *Staphylococcus aureus*.

Screening for MRSA was undertaken by the Kirby-Bauer disc diffusion method using oxacillin (1 µg) and cefoxitin (30 µg) discs on Mueller-Hinton Agar (MHA). (17)

The MHA on which oxacillin disc was placed was supplemented with 2% sodium chloride and incubated aerobically for 24 h at 30°C. The plate on which cefoxitin

disc was placed was incubated aerobically for 18h at 35°C.

Isolates with both inhibition zone diameters of ≤ 13 mm around oxacillin disc and ≤ 21 mm around cefoxitin disc were considered MRSA strains.

Also, we used KOH preparation technique to identify hyphae from the samples.

Each sample was transferred to a microscopic slide. One drop of a 10 to 20% solution of KOH was then placed over that. A cover slip was added and the preparation was examined.

The statistical analysis was performed with SPSS version 16. Data of the participants were analyzed through appropriate statistical test, Chi-square Tests. The alpha level of significance was set at 0.05.

MRSA colonization in HCW carriers were decolonized with oral rifampin, 600 mg daily, for 14 days. Because of poor availability of mupirocin ointment in our drug market, we used rifampin only. They were followed up for three months and no further positive MRSA was detected.

Results

This cross-sectional study included 70 HCWs, with age range of 20 to 60 years (mean = 34.2, SD = ± 7.6).

There were 34 (48.6%) males and 36 (51.4%) females. The demographic and medical data of the subjects were shown in table 1. Table 2 showed the distribution of *S. aureus* carriage across occupation/ cadre. There was no positive history of infection by *S. aureus* among the subjects. Among 140 samples of the nose and hand, 18 (25.7%) were positive for *S. aureus*.

Five (7.1%) of the samples showed presence of yeasts. Nasal *S. aureus* carriage rate of the subjects was significantly high (24.3%). Only one subject had positive hand *S. aureus* colonization and no dual (nose and hand) carriage among personnel was detected.

Out of 18 *S. aureus* carriers, 33.3% (n=6) were MRSA carriers whose samples were obtained from nasal swabs. In the present study, among the 6 MRSA carriers, 3 cases were auxiliary nurses and the others were nurse, administrative staff and porter in order.

Four MRSA positive samples were observed in the age group 30-39 years, followed by group 20-29 (n=2). (P value>0.05)

Based on the data analyses, there were no significant differences between the socioeconomic classes (P value=0.119) and work categories (P value=0.050) with regard to MRSA and methicillin-sensitive *Staphylococcus aureus* (MSSA) groups.

There was no significant difference between the sexes (p = 0.075), age (p = 0.080), work categories (p=0.100), and duration of working in the TICU (≤ 5 and >5 years) (p = 0.875) with regard to the positive and negative carriage of *S. aureus* (nasal and hand).

Among the HCWs, just 1.4 percent (n=1) had positive KOH test for nasal fungus but 5.7% (n=4) for nail fungus.

Table 1: Characteristics of TICU's health care workers

Characteristic	Description
Age(years)	N (%)
20-29	17(24.3)
30-39	40(57.1)
40-49	11(15.7)
50-59	1(1.4)
60-69	1(1.4)
Sex distribution	
Males	34(48.6)
Females	36(51.4)
Number of years in TICU	
≤5	30(42.9)
>5	40(57.1)
Socioeconomic class*	
Upper	12(17.1)
Middle	46(65.7)
Lower	12(17.1)
Category of work	
Doctors	7(10)
Nurses	23(32.9)
Auxiliary nurse	17(24.3)
Students	5(7.1)
Radiology Technicians	3(4.3)
Physiotherapy technicians	2(2.9)
Porters	8(11.4)
Administrative staff	5(7.1)

* Socioeconomic class based on the characteristic of personality and their salary

Table 2: occupation/ cadre related distribution of *S. aureus* carriage.

Cadre	Number of sampled (%)	Number of positive (%)
Doctors	7(10)	4(22.2)
Nurses	23(32.9)	2(11.1)
Auxiliary nurses	17(24.3)	3(16.7)
Students	5(7.1)	2(11.1)
Radiology Technicians	3(4.3)	1(5.6)
Physiotherapy technicians	2(2.9)	0(0)
Porters	8(11.4)	4(22.2)
Administrative staffs	5(7.1)	2(11.1)
Total	70(100)	18(100)

* Among the 6 MRSA carriers, 3 cases were auxiliary nurses and the others were nurse, administrative staff and porter in order.

Discussion

S. aureus was one the predominant microorganisms of nosocomial infections in several reports; also it has been shown that HCWs are the most important sources of this pathogen. (18) Presence of carriers among HCWs led to increased infection outbreaks in critical units such as burn wards, nurseries and ICUs (19, 20).

According to our previous finding, *S. aureus* was the most frequently isolated microorganism among poisoned patients with VAP and AP in TICU.

Our TICU comprises 18 beds for intubated and under mechanical ventilation poisoned patients most of whom had drug overdose.

S. aureus was dominant in drug and opioid users for their skin colonization as discussed in different references. (15, 16, 21)

Comparing to their counterparts in general ICU, TICU health care workers seemed to get more involved in patient manipulation e.g. chest physiotherapy, daily chest X-ray administered for new patients and more frequent secretion suctioning due to bronchial hyper activity. (15)

This may indicate that close contact between patients and personnel increased the risk for cross-transmission of the microorganisms.

In the present study, we observed a nasal *S. aureus* carriage rate of 24.3% (17/70). Likewise, in other reports, almost 25% of hospital HCWs were stable nasal *S. aureus* carriers, and 30% to 50% of them also possessed the bacteria on their hands. (22-23)

But only one subject had positive hand *S. aureus* colonization in our study.

It has been reported in two other studies that approximately 20 to 30% of HCWs carried *S. aureus* and could transmit it. (24, 25)

Moreover and having compared the results of our study with other studies in Iran, we found that the estimated prevalence in this study was remarkably lower than the other studies reported by Mosavi, Khodami, Mansuri and Khalegi, Rahbar et al, Ghasemian et al and Rashidian et al, separately.(13,26- 30)

We found that MRSA carriage rate among the HCWs (8.5 %) was higher than Fadheel et al report (4.0%) at North Shore Hospital in New Zealand and 1.8% in Southern India.(31- 32)

In contrast, there was a high MRSA carriage rate (52.5%) among HCWs of Ilorin Teaching Hospital in Nigeria. (33) In different investigations, the MRSA carriage rate of the medical personnel varies widely from 1 to 60 percent, which is due in part to differences in sample size and its quality, method of MRSA identification and type of ward or hospital.

Opal et al noted HCWs exposed to an environment with a high rate of endemic MRSA infection had a high incidence of either hand or nasal colonization with MRSA. (34)

Askarian et al had annotated *S. aureus* as the susceptible pathogen to linezolid, mupirocin, fusidic acid and rifampin (100%), possibly because in Iran the uses of these antibiotics were limited .There were high resistance rates of MRSA to gentamicin, clindamycin, tetracycline, and ciprofloxacin and they reported that empirical therapy in their hospital with these antibiotics may not be effective. (35)

Antibiotics should be preserved for the future. Their appropriate use could retard or prevent the emergence and spread of resistant bacteria. (36)

In this study we did not evaluate the antimicrobial susceptibility of *S. aureus* by E-Test method, but based on our previous finding, *S. aureus* was shown as sensitive to amikacin and ciprofloxacin (96.3%), teicoplanin (92.3%), cefepime (as fourth generation cephalosporin) (59.3%) and in others like vancomycin, ceftriaxone, cefotaxim and clindamycin (sensitivity= 89%). (15)

Fadeyi et al found that doctors (22.7%) and nurses (16.7%) were the most colonized staff. On the contrary, in the present study the result was different as among the 6 MRSA carriers, 3 cases were auxiliary nurses. (33)

Also in the present study, there was no significant difference regarding sex, age, work category, and duration of working in the TICU (≤ 5 and >5 years) between nasal carriage of MRSA and MSSA. Likewise Askarian et al survey, no significant difference between the carriage of MSSA and MRSA was reported however only in the univariate analysis, a statistically significant difference was found regarding occupation. (35)

According to Askarian et al findings, local therapy with mupirocin ointment has been shown to eliminate MRSA nasal colonization. In present study, we used rifampin, 600 mg daily for eradicating carriage of *S. aureus* among the HCWs because rifampin seems to be of similar efficacy like mupirocin. (35)

Conclusion

Transmission of *S. aureus* in HCWs should be concerned, however more studies are required to examine the relationship between MRSA nasal or hand colonization of HCWs and subsequent MRSA infection in patients.

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