

Original Article



Prevalence of methicillin-resistant *Staphylococcus aureus* colonization in the emergency department health care workers

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Abstract

Introduction: The aim of this study was to evaluate the prevalence of methicillin-resistant *Staphylococcus aureus* (MRSA) colonization in the health care workers of emergency department of Imam Reza hospital, Tabriz, Iran

Methods: In a total of 63 physicians and nurses in the emergency department of Imam Reza hospital, after obtaining written consent and completing a checklist, a sample of nasal mucosa was collected for microbiological examination and isolation of *Staphylococcus aureus* (SA) strain. Determination of resistance patterns (by diffusion method) was performed according to the standard methods of methicillin.

Results: Out of 63 participants, 8 subjects (12.7%) had colonization of *S. aureus*; 4 of them were physicians (17.3% of the participated physicians) and 4 were nurses (10% of the participated nurses). Out of 8 isolated SA, 2 cases (25%) and overall 3.1% were methicillin-resistant. In our study, there was a significant relationship between co-employment in other hospitals and patient care at home with SA colonization, but there was not a significant relationship with specialty, work experience, sinusitis, history of antibiotic use, history of skin disease, hand washing habits and use of personal protective equipment.

Conclusion: Prevalence of MRSA was not high among health workers of emergency department.

Introduction

Staphylococcus aureus (SA) is one of the major pathogens in nosocomial and community-acquired infections. It can cause infection in the persons when the origin of infection is in the patient's own body or exogenous when the origin of infection is external.^{1,2} Staphylococcal infections begin with the entrance of microorganisms from skin or mucosal defects and can cause localized involvement or spread to distant areas or organs and lead to life-threatening infections. SA mostly affects the skin and soft tissues and can cause a wide range of infections in humans, including bacteremia, pneumonia and osteomyelitis. Clinical manifestations of localized infections with this microorganism include folliculitis, carbuncles, furuncles, impetigo, and mastitis and wound infections.³

Clinical findings have shown that infections caused by SA have rapidly become resistant to a wide range of antibiotics, because of the capabilities of this microorganism.⁴ Although SA is naturally sensitive to antibiotics, it has been resistant to the types of antibiotics used in practice over the years. Ten years after the discovery of penicillin in the middle of the last century, many hospital-colonized staphylococci began resistance

to this antibiotic by acquiring the penicillinase gene.⁵

After the production of beta-lactamase penicillins due to the production of beta-lactamase-resistant semi-synthetic substances by this microorganism⁶ Scientists produced a new type of antibiotic called methicillin, but very soon after methicillin production, resistant strains of SA were also reported to be called methicillin-resistant *Staphylococcus aureus* (MRSA).⁷ This drug resistance has limited treatment options to antibiotics such as vancomycin. At the same time, due to overuse of vancomycin, the susceptibility to this type of antibiotics has also decreased.^{8,9} The aim of this study is to determine the prevalence of MRSA among physicians and nurses in the emergency department of Imam Reza hospital.

Methods

This cross-sectional study assessed the prevalence of nasal carriage of SA and MRSA among hospital workers in tertiary center, Imam Reza hospital, emergency department, Tabriz University of Medical Sciences, Iran. This study recruited all hospital workers including physicians and nurses working for more than 3 months in emergency department. Selection of participants was

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non-randomized and informed consent was obtained from all participants. A total of 63 samples was included in this study. Each participant completed a questionnaire of demographic characteristics including age, sex, level of education, specialty (physician or nurse), work experience, co-working in other hospitals, patient care at home, history of chronic skin disease such as eczema and psoriasis, history of sinusitis, adherence to the principles of hand washing and use of personal protective equipment during examination of patients. Exclusion criteria included antibiotic use within the last three months, recent rhinoplasty, working for less than 3 months in the emergency ward, and lack of consent to participate in the study. Samples were taken with sterile cotton swab to the depth of one centimeters from each participant's nasal cavity by rotating 3 to 4 times. The swabs were immediately streaked on the blood agar and immediately sent to microbiology Laboratory. Thereafter, the samples were incubated for 24 to 48 hours at 30-34°C and then white and yellow colonies were stained and the presence of gram-positive cocci was confirmed. Catalase test was performed on gram-positive cocci to differentiate SA from *Streptococcus*. In the next step, coagulase tests were performed on catalase positive samples for differentiation of staphylococcal positive coagulase (SA) from negative coagulase (*S. epidermidis*). Isolated colonies were then placed on mannitol salt agar and examined for fermentation of mannitol. SA isolation was confirmed by DNAase tests. Suspensions of 0.5 McFarland were obtained from SA colonies and mounted on Müller-Hinton agar plates. Cefoxitin and vancomycin disks were placed on Müller Hinton agar plates and susceptibility was determined according to the Clinical and Laboratory Standard Institute (CLSI) guidelines.¹⁰ According to previous studies, sensitivity to cefoxitin by disk diffusion method has negative predictive value, and its sensitivity and specificity are similar to polymerase chain reaction (PCR) method in differentiation of methicillin-resistant staphylococci. The prevalence of MRSA among hospital samples in June to mid-September, 2019 was also determined based on laboratory data determined and compared with the prevalence among physicians and nurses in the emergency department of Imam Reza hospital. Data were analyzed using descriptive statistics (mean, standard deviation and percentage frequency) and chi-square test or fisher exact test using SPSS 15.0 software.

Results

Sixty-three health care workers including 40 nurses and 23 physicians participated in our study. Thirty-seven (58.7%) were women and 26 (41.3%) were men. There was no significant relationship between sex and SA colonization ($P=0.056$). The age of participants ranged from 23 to 49 years old. Eight (12.7%) had colonization of SA, 4 of them were physicians (17.3% of the participated physicians)

and 4 were nurses (10% of the participated nurses). Out of all 8 isolated SA positive cases, 2 (25%) and overall 3.1% were methicillin resistance (MRSA) and none of them were resistance to vancomycin. There was no significant relationship between specialty (physician or nurse) and SA colonization ($P=0.448$). The work experience among health care workers was between 1 to 23 years and mean was 6.24 ± 8.48 years. Out of 63 participants in the study, 52 (82.5%) had work experience for less than 15 years and 11 participants (17.5%) had work experience for more than 15 years. In our study, there was no significant relationship between work experience and SA colonization ($P=0.331$). Sixteen (25.4%) was employed simultaneously in other hospitals, six (26.08%) of them were in the physician group and 10 (25%) in the nursing group. In our study, there was a significant relationship between co-employment in other hospitals and SA colonization ($P=0.021$). Two participations (3.1%) simultaneously cared patients at home, both of them (5%) were in the nursery group. There was a significant relationship between patient care at home and SA colonization ($P=0.014$). Five (7.9%) had skin disorders; four of which (17.39%) were in the physicians group and one (2.5%) was in the nursing group. There was no significant relationship between skin disorders and SA colonization ($P=0.117$). Twenty-two (34.9%) had a history of sinusitis; nine (39.13%) were in physicians and 13 (23.5%) were nursing group. There was no significant relationship between history of sinusitis and SA colonization ($P=0.702$). Forty participants (63.49%) washed their hands regularly after examining the patients; 13 (56.52%) in the physician group and 27 (67.5%) in the nursing group. In our study, there was no significant relationship between regular hand washing and SA colonization ($P=1.000$).

Forty-three participants (68.25%) regularly used personal protective equipment such as glasses, gloves, and etc. during the examination of patients; 13 of them (56.52%) were in the physician group and 30 (75%) were in the nursing group. In our study, there was no significant relationship between regular use of personal protective equipment and SA colonization ($P=0.251$). Among the 1000 positive cultures reported in the microbiology department of Imam Reza hospital from June to mid-September 2019, 98 cases (9.3%) were SA. SA samples were reported to be 76.1% sensitive to methicillin and 23.9% resistant. There was no significant difference about methicillin resistance between hospital samples and emergency department staffs colonies ($P=1.000$).

Discussion

SA may be colonized in the anterior part of the nasal mucosa of healthy individuals without any clinical symptoms, whereas individuals with an impaired organ function are at high risk of infection with this microorganism. Thus, colonization of the nasal mucosa of hospital staff, students, and patients' care givers who are

in direct contact with these patients may potentially be responsible for the transmission of the infection.^{11,12}

In Iran, the rate of nasal carriage of MRSA in health care workers is between 3% to 10.8%^{13,14} and its prevalence has been reported to be 73% in Saudi Arabia,¹⁵ 15.1% in Oman,¹⁶ 8.4% in Ethiopia,¹⁷ 2.4% in Ecuador,¹⁸ 0% in Thailand,¹⁹ 9.3% in Pakistan²⁰ and 6.3% in Argentina.²¹ In our study, the range of nasal carriage of MRSA among health care providers was 3.1% and the prevalence was low in our hospital.

In the study of Nasiri et al in 2009, prevalence of SA nasal carriage in Madani hospital of Tabriz, Iran was 26.5% and incidence of colonization of SA in nasal cavity was more in men than women.²² In our study, there was no significant relationship between sex and SA colonization ($P=0.056$).

In the study of Khalili et al,²³ there was no significant relationship between age, sex and work experience with prevalence of MRSA carriage, but there was a significant relationship between specialty and prevalence of MRSA in nose and nails. In our study, there was a significant relationship between co-employment in other hospitals, patient care in home and SA colonization.

Salman et al²⁰ reported that there was no significant relationship between different health care workers and SA colonization. In our study, prevalence of SA was more in physicians than nurses; however, there was no a significant relationship between specialty and SA colonization.

Physicians, nurses, and students are in constant contact with patients, and they can play an important role in the transmission of SA, which is important in subjects such as dialysis patients and infants. Contact with different patients and prolonged hospital stay make it possible to colonize antibiotic-resistant bacteria, making it difficult to treat infectious diseases. As the MRSA can be a serious problem in nosocomial infections, it is better to periodically evaluate hospital staffs for nasal carriage of MRSA.

Conclusion

Prevalence of MRSA was not high among health workers of emergency department, Imam Reza hospital in Tabriz. However, eliminating the carriers can reduce antibiotic resistance in future.

Conflict of Interest

Authors declare no conflict of interest in this study.

Ethical Approval

Ethics committee approval was received for this study from the ethics committee of Tabriz University of Medical Sciences (IR.TBZMED.REC.1398.595).

Authors' Contribution

Study design, PP; Study conduct, PP; writing, PN; Analysis, HSK; Critic and article search, KSH; data gathering, PN.

Study Highlights

What is current knowledge?

- The prevalence of MRSA is low among health workers of emergency department

What is new here?

- This study is a starting point for further studies in other departments of hospital.

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