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# Prevalence and Resistance Profiles of Methicillin-Resistant Staphylococcus aureus Colonized in the Nostrils of Cancer Patients in Namazi Teaching Hospital, Shiraz, Iran

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## Abstract

**Background:** Methicillin-resistant (MRSA) *Staphylococcus aureus* (*S. aureus*) are responsible for a vast number of nosocomial infections especially in immunocompromised subjects such as cancer patients. The presence of comorbidities including malignancies has been associated with *S. aureus* bacteremia mortality. Thus, detection of MRSA in these patients and antibiotic susceptibility pattern of the isolates eases selection of first-line medications and prevention from further complications in cancer patients. The aim of this study was to determine the prevalence of MRSA infection and antibiotic susceptibility patterns of isolates in pre and post-chemotherapy course in cancer patients.**Materials and Methods:** From May 2011 to July 2012, 200 nostril samples of cancerous patients were obtained and cultured on blood agar plates. After isolation and confirmation of *S. aureus*, antibiotic resistance pattern of isolates was determined pre-chemotherapy and post chemotherapy against Vancomycin, Tigecycline, Linezolid, Chloramphenicol, and Oxacillin using disk diffusion test following CLSI guidelines. Chi-square test was used for data analysis.**Results:** Among a total number of 200 various cancer patients (64.5% females), 42 (21%) cases were positive for S. *aureus* and 7 (3.5 %) were MRSA carriers. Mean ages of MSSA and MRSA infected patients were 50.97±15.94 and 53.57±18.28 years old, respectively. In vitro susceptibility pattern of MRSA and MSSA isolates to 4 tested agents did not differ significantly after chemotherapy in contrast with pre-chemotherapy state. **Conclusions:** This study showed that chemotherapy did not change the susceptibility pattern of MRSA species to antibiotics of choice in cancer patients. However, the importance of controlling Methicillin resistant staphylococcal infections in critical cases, specifically cancer cases, necessitates the early detection and further investigations on more effective medications. **[GMJ. 2015;4(1):21-25]**

**Keywords:** MRSA; Shiraz; Iran; Healthcare-Associated Infections; Cancer

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## Introduction

Methicillin-resistant *Staphylococcus aureus* (*S. aureus*) have attracted the concern of clinicians regarding their increasing frequency of infection worldwide [1, 2]. With the emergence of new clones, management of Methicillin-resistant *S. aureus* (MRSA) infections gets more difficult, necessitating up-to-date medical protocols to ensure an acceptable success rate in control and treatment of this major public health problem [1, 3]. MRSA is not only considered as a healthcare-associated infection (HCAI), [4] but also may originate from patients themselves, who are already colonized [5]. This may bring about serious nosocomial outbreaks in hospitals [6], either due to *S. aureus* infections or other secondary infections related to MRSA comorbidities, which are not much common among Methicillin-susceptible *S. aureus* (MSSA) colonized or non-colonized patients [5]. Previously, MRSA infections were limited to hospital wards and medical facilities; however, with the established trend of its prevalence, it is gradually becoming community acquired [6]. Immunocompromised patients like cancer patients undergoing chemotherapy or ICU patients can be highly affected by such infections, as it can make them susceptible to complications like pneumonia, one of the major causes of morbidity and mortality [5, 7]. Precautionary measures have been developed to minimize the spread of these infections, among which contact hygiene, hand washing, detection and isolation of infected patients can be mentioned. Furthermore, eradication of MRSA nasal colonization in infected patients and healthcare staff has been undertaken showing variable success rates [8]. Proper surveillance programs with the purpose of determination of prevalence of MRSA, regional patterns, and its antiobiotic susceptible profiles in a region are helpful to design guidelines for the control and prevention of MRSA infections. This will aid physicians to decide their first choice medications better. So, the purpose of this study was to observe cancer patients referring to Namazi Teaching Hospital, Shiraz, Iran to determine the prevalence of MRSA infection and antibiotic susceptibility patterns of isolates in pre and post-chemotherapy. Detection of colonized patients allows their treatment prior to occurrence of severe infections.

## Materials and Methods

In this cross-sectional study, conducted in Namazi Teaching Hospital, Shiraz, Iran 200 cases with various cancer types, for the period 0f 14 months from May 2011 to July 2012, who were randomly selected among patients referred for outpatient chemotherapy and also those hospitalized in oncology wards were included. Namazi Teaching Hospital is the main health care center and one of the top referral centers in Shiraz, Southwest Iran. Demographic and medical data such as age, gender, type of cancer, antibiotics used prior to initiation of the study, ward and duration of hospitalization were recorded.Patients were required to fill out an informed written consent and all processes of this research were approved by Ethics Committee of Shiraz University of Medical Sciences. All patients who received medications out of our protocols, refused to cooperate during the study, and those who did not fill consent forms were excluded. After obtaining a nostril sample from each patient using cotton swabs, nutrient Broth media containing 6gr/L NaCl were used to safely deliver samples to the bacteriology section of the Microbiology laboratory of Namazi Teaching Hospital. A culture growth was then provided on blood agar plates, after 24 hours of incubation at 37°C. Subsequently, *S. aureus* species were identified and isolated by the use of standard biochemical tests including colony morphology, Gram staining, catalase test, coagulase slide and tube test, mannitol salt agar and DNase test agar.

For culture-positive cases, antibiotic resistance profile of sample-derived *S. aureus* were determined by using agar disk diffusion test following Clinical and Laboratory Standards Institute (CLSI) standards [9]. Diameter of this clear area is considered as an index for bacterial susceptibility to a specific compound. Briefly after providing 0.5 McFarland standard suspensions of microorganisms and accomplishing a full distribution on Müller-Hinton agar, antibiotic discs such as Linezolid (30µg), Tigecycline (15µg),

Oxacillin (1 µg), Vancomycin (30µg), and Chloramphenicol (10µg) (Hi-media, India) were set on agar media with appropriate distances. Methicillin resistance was evaluated on Muller Hinton agar (Hi-media, India) by Oxacillin disk. Succeeding a 24 hours-long incubation at 37°C, the diameter of growth inhibition zone was measured and recorded for each disc. Sampling was done twice, before and after chemotherapy (400 specimens were collected). Data were analyzed by SPSS software version 15.0 using Chi-square analytical test for comparing groups.

## Results

This cross-sectional study was conducted on a total number of 200 various cancer patients, consisting of 129 females (64.5%) and 71 males (35.5%) with the age range of 1 to 84 years old, who were selected among patients of oncology ward or those referred for outpatient chemotherapy in Namazi Teaching Hospital. Methicillin resistance of positive cultures was assessed by 1 -µg Oxacillin disk, before and also after chemotherapy. Before chemotherapy, 158 cases (79%) had negative *S. aureus* cultures; of the remaining 42 (21%) cases had positive cultures and 7 (3.5%) were MRSA carriers. Mean ages of MSSA and MRSA infected patients were 50.97±15.94 and 53.57±18.28 years old, respectively (P>0.05). Six carriers were among 100 breast cancer patients and the other one was from 5 cases of lung cancer. After chemotherapy, 2 other cases presented with positive *S. aureus* cultures and one of them, MRSA carrier who was a case of breast cancer.

After determination of MRSA frequency, assessment of antibiotic susceptibly to four agents was done. Results of pre- and post-chemotherapy susceptibility of nasal samples are demonstrated in table 1. Susceptibility pattern of the microorganism to 4 tested antibacterial agents did not differ significantly after chemotherapy course (P>0.05).

## Discussion

Our study shows a 21% rate of *S. aureus* carriers among cancer patients referring for chemotherapy to Namazi Teaching Hospital with one sixth being carriers of MRSA. Susceptibility pattern of MRSA and MSSA to 4 tested antibacterial agents did not alter significantly after chemotherapy in contrast with pre-chemotherapy state. The highest rate of sensitivity of MRSA was to Linezolid (50%). Results of a study conducted in Kerman, Iran evaluating the prevalence of various types of MRSA and their resistance to antimicrobial agents, indicated that MRSA was best susceptible to

**Table 1.** Antibiotic susceptibility pattern (susceptible, S; resistant, R; intermediate, I) of the studied MSSA and MRSA isolates to Vancomycin, Tigecycline, Linezolid, Chloramphenicol and Oxacillin (Methicillin) before and after chemotherapy course in cancer patients.

| Antibiotic Agent | | Before Chemotherapy | | After Chemotherapy | |
|---|---|---|---|---|---|
| | | MSSA | MRSA | MSSA | MRSA |
| Vancomycin | S | 14 (40%) | 1 (14.3%) | 15 (41.7%) | 1 (12.5%) |
| | I | 21 (60%) | 6 (85.7%) | 21 (58.3%) | 7 (87.5%) |
| | R | 0 | 0 | 0 | 0 |
| Tigecycline | S | 1 | 0 | 1 (2.8%) | 0 |
| | I | 0 | 0 | 0 | 0 |
| | R | 34 (97.1%) | 7 (100%) | 35 (97.2%) | 8 (100%) |
| Chloramphenicol | S | 5 (14.3%) | 0 | 6 (16.7%) | 0 |
| | I | 0 | 0 | 0 | 0 |
| | R | 30 (85.7%) | 7 (100%) | 30 (83.3%) | 8 (100%) |
| Linezolid | S | 21 (60%) | 3 (42.9%) | 22 (61.1%) | 4 (50%) |
| | I | 4 (11.4%) | 1 (14.3%) | 4 (11.1%) | 1 (12.5%) |
| | R | 10 (28.6%) | 3 (42.9%) | 10 (27.8%) | 3 (37.5%) |

Vancomycin and Linezolid, also showed that staphylococcal cassette chromosome mec (SCCmec) type III is the most prevalent strain in that area [2]. Assessment of *S. aureus* nasal colonization among 173 nurses in an Iranian teaching hospital revealed a rate of 4.6% (8 cases) of MRSA carriers, 6 of which were Oxacillin resistant and mecA-positive, and 2 were Oxacillin-susceptible mecA-positive (OS-MRSA) strains [4]. In a study conducted by Javidnia *et al.* in Teheran hospitals in Iran, it was shown that dominant MRSA clones in environment and in patients were the same. Antimicrobial assay of these isolates revealed that the highest resistance, which was for more than 98% of isolates, was against Penicillin, Ciprofloxacin, and Tetracycline [6]. A review and meta-analysis studying previous data on epidemiology of mecA-MRSA strains in multiple cities of Iran showed an average positive rate of 52.7%±4.7% with a wide variable range of relative frequency from 20.48% to 90% in Isfahan and Tehran, respectively. This study concluded that with regard to high rate of relative frequency of MRSA in Iran, suitable measures are essential to minimize the transmission of strains [1].

As it was shown in our study, 3.5% of cancer patients were carriers of MRSA, which may require specific antibiotic therapy in case of active infections. The cost and morbidity of MRSA infection in head and neck cancer patients undergoing surgery, as evaluated in a study by Watters et al, revealed that it would lead to a high waste of financial and health care resources as well as the burden imposed on patients for longer hospital stay and requirement of other interventions like surgery [10]. As for patients undergoing surgery, risk factors of development MRSA infection in cancer patients include longer duration of operation, larger hemorrhages, and using Cephalosporins or Imipenem [11]. There is a more probability to detect gram positive bacteria, especially with a high proportion of MRSA in blood culture when immunosuppressed patients develop febrile neutropenia [12]. Comparison of genetic variation and virulence of MRSA isolates among cancer and non-cancer patients in Saudi Arabia showed no statistically significant difference regarding adhesion genes, contrary to higher presence of toxin genes in isolated strains from cancer patients [13]. A study investigating the relationship between Methicillin resistance and virulence in *S. aureus* bacteremia in cancer patient showed no significant association [14]. Since one of the risk factors of developing infections in cancer patients is receiving prior antibiotic therapy, it seems rather plausible to avoid empirical antibiotic therapy in order to diminish emergence of new resistant MRSA clones and poor outcome [15]. Intranasal application of Mupirocin ointment has been one of the most effective methods of MRSA eradication, except for cases with colonization in other body sites [3,8,16]. It has also been suggested that oncology ward personnel should be decolonized with nasal application of Mupirocin [17]. Transmission through contact with healthcare staff, as one of primary routs of spread, also emphasizes hand hygienic practices. For MRSA infected patients, Vancomycin is currently the drug of choice [8]. This study emphasizes early detection and treatment of MRSA carriers in cancer patients, which should be placed in the guidelines of infection control committee of our hospitals.

## Conclusion

This study showed that chemotherapy did not change the susceptibility pattern of MRSA species to antibiotics of choice in cancer patients. However, the importance of controlling Methicillin resistant staphylococcal infections in critical cases, specifically cancer cases, necessitates early detection and further investigations on more effective medications.

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## Conflicts of Interest

None declared.

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