

# Methicillin-resistant *Staphylococcus aureus* (MRSA) an important microorganism: determination of its prevalence and evaluation of its associated factors in hospitalized dermatologic patients

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**Background:** Methicillin-resistant *Staphylococcus aureus* (MRSA) has recently emerged as a worldwide major nosocomial pathogen that causes significant morbidity and mortality. MRSA is frequently colonized on the skin. The aim of this study was to determine the MRSA colonization/infection prevalence and to evaluate the potential risk factors for its development in the hospitalized patients in a referral dermatology ward.

**Method:** In this cross sectional study, 203 patients with cutaneous lesions who were admitted to the dermatology ward of a tertiary teaching hospital from 2008 to 2010 were recruited. Samples were collected during the first 48 hours of admission. *S. aureus* was identified using gram staining, catalase, and coagulase tests. The disk diffusion method was used for testing the sensitivity of different bacteria to antibiotics. Mueller-Hinton agar was the culture medium used for MRSA susceptibility testing.

**Result:** *S. aureus* was the most common pathogen that grew in 56.2% (114/203) of isolates. MRSA was found in 35.5% (82/203) of isolates. The duration of the cutaneous lesions, age group, positive history of antibiotic use in past 12 months, and underlying diseases were statistically different between the patients with colonization of MRSA and methicillin-sensitive *Staphylococcus aureus* (MSSA) ( $P < 0.05$ ). Using binomial multivariable logistic regression, it was determined that recent antibiotic therapy and presence of underlying diseases were the risk factors for MRSA colonization.

**Conclusion:** This study showed that MRSA colonization is an important problem in dermatology wards. This finding should be noted for proper selection of antibiotics to treat the patients.

**Keywords:** antibiotic, drug resistance, hospital-based dermatology, methicillin-resistant *Staphylococcus aureus* (MRSA)

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## INTRODUCTION

*Staphylococcus aureus*, a gram-positive coccus, is the most common cause of skin and soft tissue infections <sup>1,2</sup>. Carriers are an important source of

infection. It was shown that treatment of carriers can reduce hospital- (nosocomially-) acquired infection. Unfortunately, due to the emergence of antibiotic-resistant strains of *S. aureus*, the number of the antibiotics available to treat these infections

is decreasing rapidly<sup>3</sup>.

Methicillin-resistant *Staphylococcus aureus* (MRSA) has been recently emerged as a major nosocomial pathogen worldwide with a significant morbidity and mortality. Prolonged hospitalization, use of antimicrobial agents, surgical procedures, and close contact with a patient with MRSA colonization or infection are considered the risk factors for hospital-acquired (HA) MRSA. It seems that MRSA infected or colonized patients are the major carriers of MRSA and recent hospitalization is the most common risk factor<sup>4,5</sup>. Recently, community-acquired MRSA infections have been found in healthy individuals although underlying diseases such as diabetes mellitus, chronic skin diseases, intravenous drug use, and recent antibiotic use are the known risk factors<sup>6</sup>. After discharge from the hospitals, patients with HA-MRSA colonization spread the bacteria to their family members and other individuals who have contact with them. Therefore, effective prevention of the dissemination of MRSA throughout the communities requires effective control of HA-MRSA transmission<sup>7</sup>.

The high endemicity of MRSA poses a problem for antibiotic therapy because of the possible development of resistance to glycopeptides, which could lead to untreatable infections. In addition, MRSA imposes economic burdens on the health care system. As this organism can spread easily from a person to another individual, MRSA is introduced into the hospitals by the admission of a patient with MRSA colonization/infections who serves as a reservoir. Particularly in the high-risk wards, the control of MRSA requires implementation of infection control measures including rapid detection of MRSA by screening every patient at risk at the time of admission, identifying the microorganism carriers using specific labeling, rigorous hand washing by the staff, and isolation of patients with MRSA colonization/infections<sup>8,9</sup>. In addition, corticosteroids are one of the mainstays of anti-inflammatory therapy in many dermatologic diseases. Colonization/infection by *S. aureus* in patients with corticosteroid resistance can play a superantigen role<sup>10</sup>. Studies have revealed MRSA colonization rates from 3.6% to 84% in the different hospital wards<sup>4,5,8,11-14</sup>.

This study was conducted to determine the MRSA colonization/infection prevalence and to evaluate the potential risk factors for its development in

hospitalized patients with cutaneous lesions in a referral dermatology ward in Northern Iran.

## PATIENTS AND METHODS

### Study Setting

Razi Hospital is a tertiary-level care teaching hospital that is affiliated with Guilan University of Medical Sciences, Rasht, Iran. It has 280 beds and 72,200 patient-days per year. The dermatology ward has 22 beds with more than 4,300 patient-days each year. This ward is essentially used for the hospitalization of the referral patients with severe or chronic dermatologic conditions.

### Study Population

In this cross sectional study, 203 patients with cutaneous lesions who were admitted to the dermatology ward of Rasht Razi Hospital from 2008 to 2010 were recruited. The study population neither used systematic antibiotics during the past 72 hours nor did they receive any local anesthesia or antiseptic solution before taking a swab.

### Microbiological Methods

First, cutaneous lesions were washed with saline. Then, excess serum was dried with sterile gauze. The cotton tipped swabs were used to collect samples by rolling across an area with a diameter of one centimeter for 5 seconds. The samples were immediately sent to the central hospital laboratory and were cultured on manitol salt agar and blood agar<sup>8</sup>. The samples with mixed flora were cultured on mannitol salt agar with 7.5% NaCl. *S. aureus* was identified using gram staining, catalase, and coagulase tests. The disk diffusion method was used for antibiotic susceptibility testing. Mueller-Hinton agar was used for MRSA susceptibility testing<sup>15-18</sup>.

MRSA colonization was defined as a positive culture from the cutaneous lesions of a hospitalized patient within the first 48 hours.

### Statistical Methods

Mean  $\pm$  standard deviation (SD) was used to statistically describe the distribution of continuous variables, and proportions were presented as

the relative frequency (percentage) for nominal/ordinal data. Tables were used to describe the data summaries.

Statistical analysis was done using PASW Statistics (IBM Corp., Armonk, USA) version 18. The collected data was statistically analyzed using *t*, chi-square, Fisher's exact, and Mann-Whitney tests, as well as a multivariable logistic regression model. The statistical significance level was considered 0.05.

### Ethical Issues

This study was conducted in accordance with the Helsinki Declaration.

### RESULTS

In this study, 203 patients with a mean age of  $47.3 \pm 14.4$  years (range: 13-78 years) were studied. Ninety-six patients (47.3%) were female and 107 patients were male. Immunobullous diseases were the most common causes of hospital admission in this study with 82 cases (40.4%) (Table 1).

Of 203 patients, 114 (56.2 %) were colonized/infected by *S. aureus*, of which 71.9% (82/114) was MRSA. The mean duration of the cutaneous

**Table 1.** The frequency of demographic and dermatologic diseases in the recruited patients

Variable	N (%)
Gender	
Male	107 (53.7)
Female	96 (47.3)
Age groups (Years)	
<30	25 (12.3)
30-39	42 (20.7)
40-49	52 (25.6)
50-59	37 (18.2)
≥60	47 (23.1)
Dermatologic diseases	
Immunobullous diseases	82 (40.4)
Leg ulcer	32 (15.8)
Psoriasis	15 (7.4)
Dermatitis	14 (6.9)
Drug reactions	10 (4.9)
Collagen-vascular diseases	9 (4.4)
Lymphoma	5 (2.5)
BCC* or SCC**	5 (2.5)
Behcet disease	3 (1.5)
Vasculitis	3 (1.5)
Pyoderma gangrosoma	3 (1.5)
Others	22 (10.8)

\*Basal cell carcinoma

\*\*Squamous cell carcinoma

lesions was  $14.2 \pm 4.2$  weeks in MRSA patients in comparison to  $3.4 \pm 0.8$  weeks in patients with MSSA ( $P=0.03$ ). There was no statistically significant

**Table 2.** Comparison of patients with MRSA and MSSA colonization/infection in a referral dermatology ward

Variables	Culture results		P-value
	MSSA N (%)	MSRA N (%)	
Gender			
Male	19 (31.7)	41 (68.3)	NS
Female	13 (24.1)	41 (75.9)	
Age group (years)			
<40	11 (33.3)	12 (66.6)	0.001
40-49	7 (23.3)	23 (76.7)	
50-59	8 (34.8)	15 (65.2)	
≥60	3 (7.9)	35 (92.1)	
Usage of systemic antibiotic			
Yes	12 (16.9)	59 (83.1)	0.03
No	13 (34.2)	25 (65.8)	
Recent hospitalization			
Yes	1 (1.9)	50 (98.1)	0.001
No	25 (51.9)	27 (48.1)	
Presence of underlying diseases			
Yes	1 (2.7)	36 (97.3)	0.001
No	21 (30.4)	48 (69.6)	
Recent ambulatory care			
Yes	22 (23.2)	73 (76.8)	NS
No	4 (36.4)	7 (63.6)	
Duration of the cutaneous lesion (Mean ± SD) (weeks)	$3.4 \pm 0.8$	$14.2 \pm 4.2$	0.03

**Table 3.** Comparison of patients with MRSA and MSSA colonization/infection according to the dermatologic diseases

Disease	Culture results ( <i>S. aureus</i> )			P-value <sup>†</sup>
	Positive		Negative* N (%)	
	MSSA N (%)	MRSA N (%)		
Immunobullous diseases	13 (24.5)	40 (75.5)	29 (35.4)	
Leg ulcer**	4 (14.8)	23 (85.2)	5 (15.6)	<0.001
Others	15 (44.1)	19 (55.9)	55 (61.8)	

\*Sum of patients with colonization of gram negative and negative culture.

\*\*Prevalence of *S. aureus* colonization/infection was significantly higher in patients with leg ulcers in comparison with other microorganisms.

†There was no statistically significant association between the MRSA or MSSA and the underlying conditions ( $P = 0.2$ ).

association between colonization/infection with MRSA or MSSA and gender and history of recent ambulatory care, while significant differences in age groups, positive history of systemic antibiotic use during the past year, and underlying disorders were detected between the two groups ( $P=0.001$ ) (Table 2). Although the distribution of *S. aureus* isolates was different according to the dermatologic disorders, the distribution of MRSA isolates was not statistically different (Table 3). No patient had a history of intravenous treatment. Using a binomial multivariable logistic regression model, recent antibiotic therapy and underlying diseases were determined as the risk factors for MRSA colonization/infection.

## DISCUSSION

The main reservoirs of MRSA in institutions are infected or colonized patients. MRSA colonization increases the risk of infection by this strain significantly. MRSA is more pathogenic than MSSA. A delay in the initiation of effective MRSA therapy is a significant mortality risk factor, especially in the immunosuppressed patients, the elderly, and the patients who receive corticosteroids such as those with some chronic skin diseases. Therefore, assessment of MRSA colonization in high risk wards of the hospitals such as dermatology wards is very important<sup>4</sup>.

In this study, MRSA colonization was detected in 40.4% (82/203) of cutaneous lesions isolates. The prevalence of MRSA colonization varies in different geographic areas and even at different times. It has been reported as low as 2% in Netherlands to as high as 70% in Japan and Hong Kong. Comparison of the findings of our study with other studies shows dermatology wards are high-risk areas for the patients to become colonized by MRSA<sup>2,3,5-8,12-14</sup>. High rates of colonization in dermatology units

may be justified with risk factors such as recurrent hospitalization, presence of underlying diseases, corticosteroid and other immunosuppressive drugs administration, and frequent use of antibiotics. In the present study, *S. aureus* colonization was significantly higher in leg ulcers and grew in 84.4% of the patients with leg ulcer, of which 84% was MRSA. These findings are similar to the results of a study conducted in a dermatology inpatient department in Florida by Valencia et al<sup>11</sup>.

Old age has been known as a risk factor for MRSA colonization and this organism has been found to be significantly more in the elderly patients. In the aging process, a decline in the regular functions of the skin including cell replacement capacity, barrier function, chemical clearance capacity, sensory perception, mechanical protection, wound healing, immune responsiveness, thermoregulation, sweat production, sebum production, vitamin D production, and DNA repair capacity are observed<sup>19</sup>. In our study, the mean duration of the cutaneous lesions was significantly longer in the MRSA group in comparison with the MSSA group. However, the findings of other studies were different<sup>6,12</sup>.

According to the findings of our study, recent antibiotic therapy and presence of underlying diseases were risk factors for MRSA colonization/infection. Several other studies have also reported these variables as risk factors<sup>5,6,12,13</sup>. Frequent use of antibiotics might result from self-treatment of the patients, antibiotic prescribing habits of the general physicians who refer the patients to the dermatology centers, or the nature of the underlying diseases.

The present study had some limitations. We could not evaluate MRSA colonization in the patients after 48 hours because of the different conditions of the patients at the time of admission. In addition, *mecA* gene was not determined due to technical problems

at Rasht Razi Hospital laboratory. In conclusion, we observed high rates of *S aureus* colonization/infection in patients hospitalized for dermatologic disorders. We also found a marked increase in MRSA colonization/infection, especially among the patients with leg ulcers. To improve the situation, expanded control programs including laboratory-based surveillance programs, isolating patients with MRSA infections, using barrier precautions such as gloves and gowns, hand washing, careful environmental cleaning of the patients' rooms, and appropriate use of broad-spectrum antibiotics are recommended.

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