

Original Article

Investigation of Colonization with Methicillin-Resistant and Methicillin-Susceptible *Staphylococcus aureus* in an Outpatient Population in Turkey

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SUMMARY: Methicillin-resistant *Staphylococcus aureus* (MRSA), known as a nosocomial pathogen, has been isolated from community-acquired infections since the 1980s. It has been reported that there are carriers of MRSA in the community although the rate of carriers is low and the most important risk factor of community-acquired carriage is hospitalization or referral to healthcare facilities. We attempted to investigate methicillin-resistant and methicillin-susceptible *S. aureus* colonization, respectively, in nasal and axillary swabs obtained from 500 patients without a history of hospitalization who were admitted to outpatient clinics and from 102 healthcare workers chosen as a control group. Of the patients, 9.4% had nasal *S. aureus* colonization without methicillin-resistant strains. Of the health care workers, 8.8% had *S. aureus* colonization without methicillin-resistant strains and only one worker had MRSA. The nasal carriage ratio of *S. aureus* in children was found to be 19.1% (22 of 115), and that in adults was 6.5% (25 of 385). The difference between the two age groups was determined as statistically significant ($P = 0.006$).

INTRODUCTION

Methicillin-resistant *Staphylococcus aureus* (MRSA) was first reported from England soon after the advent of methicillin in 1961, and caused problems first in Europe and subsequently throughout the world (1). At present, MRSA frequently causes hospital infections and leads to a considerable increase in morbidity and mortality. According to data from the National Nosocomial Infection Surveillance System (NNIS) of the Centers for Disease Control and Prevention, the rate of infections with MRSA in intensive care units (ICU) in the US has approached 50% (2). In our hospital in İzmir, Turkey, MRSA accounts for approximately 60% of staphylococci isolated from hospital infections in ICU, and the average ratio of MRSA infections in the ICU and other hospital wards were found to be 25.3 and 19.2%, respectively, during the study period (unpublished data from the Infection Control Committee of Dokuz Eylül University Hospital).

Community-acquired MRSA colonization was first reported in drug addicts, after which there was an increase in the ratio of MRSA causing not only hospital infections but also community-acquired infections (3). Although such risk factors as recent hospitalization or recent referral to a healthcare center, staying in long-term care units, IV drug addiction, long-term antibiotic treatment, surgical interventions, and chronic underlying diseases have been reported, the prevalence of community-acquired MRSA is reported to be between 1.3 - 3% (2-6). An increase in the number of cases of MRSA infections and colonization in the community will influence the precautions to be taken against infections and

the recommended empirical treatment. In fact, MRSA prevalence in the community should be determined so that infections such as those of skin and soft tissue known to be caused by staphylococci can be treated empirically.

We attempted to investigate MRSA colonization in children and adults without a history of hospitalization presenting with various complaints over the past year to outpatient clinics of Dokuz Eylül University Hospital. The aim of this study was to investigate the presence of risk factors other than hospitalization for acquiring MRSA.

MATERIALS AND METHODS

This surveillance was conducted in a 720-bed tertiary care teaching hospital in İzmir, one of the most developed cities in Turkey, situated in the western region, and the patients admitted to this hospital generally represent the medium to high socio-economical class.

Subjects: The study included 500 adults and children admitted to outpatient clinics of Infectious Diseases and Clinical Microbiology and Internal Medicine, Dokuz Eylül University Hospital, İzmir, Turkey, from January 1 to December 31, 2000. For the purpose of comparing the carriage ratio of MRSA in the study group to that of a control group, 102 volunteer healthcare personnel with the exception of medical doctors working in close contact with the patients in the Internal Medicine Ward were used as the control. Data on age, sex, underlying chronic diseases, hospitalization history, long-term care facility residence, drug addiction, HIV infection, and antibiotic therapy in the last 6 months were recorded, and patients with a history of hospitalization in the preceding year and those suspected of having soft tissue infections by staphylococci were not included in the study. In the selection of the control group, nonexistence of risk factors such as chronic diseases, HIV infection, antibiotic usage, and IV drug abuse were taken into consideration.

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Laboratory procedures: The swabs were obtained from the nares and axillae, cultured in 5% sheep blood agar (Difco Laboratories, Sparks, Mo., USA) and incubated at 35°C aerobically for 16-18 h. Catalase and tube coagulase testing were used for identification of *S. aureus*. Mueller-Hinton agar (Oxoid Ltd., Hampshire, England) containing 4% sodium chloride and 6 µg/ml of oxacillin were used to determine sensitivity to methicillin according to the National Committee for Clinical Laboratory Standards (NCCLS) (7). *S. aureus* ATCC 29213 (sensitive) and 27R MRSA (resistant) were used as control strains.

Statistical analysis: Chi-square tests were used to compare colonization rates where available. $P < 0.05$ was considered significant.

RESULTS

In the study group, 265 (53%) of the patients were female and 235 (47%) were male, and 67 (65.6%) of the healthcare workers were female, 35 (34.4%) male. The subjects' ages ranged between 1-85 years with a mean of 32.53 years (± 17.59). In the study group, 115 subjects (23%) were 1-16 years old, 341 (68.2%) were 17-60 years old, and 44 (8.8%) were over 61 years. All subjects in the control group were 20-56 years old.

In the study group, 55 of 500 (11%) patients were found to be colonized with *S. aureus*. In 42 of these patients, *S. aureus* was isolated from nasal swab cultures, and in eight from axillary swab cultures. *S. aureus* was isolated from both anterior nares and axillary region cultures in the remaining five patients. None of the isolated strains were resistant to methicillin. Nasal carriage ratio of *S. aureus* in children was found to be 19.1% (22 of 115), that in adults 6.5% (25 of 385). The difference between the two age groups was determined as statistically significant ($P = 0.006$). These results are shown in Table 1.

Among 102 volunteer healthcare workers, 10 (9.8%) were found to be colonized with *S. aureus*. Of these, 9 (8.8%) had *S. aureus* in the nares, one in the axillary region. Only one

S. aureus strain obtained from nasal swabs of healthcare workers was found to be resistant to methicillin.

There was no statistically significant difference in the carriage ratio of *S. aureus* between the study and control groups ($P = 0.520$).

Data on risk factors such as underlying existing chronic diseases, long-term care facility residence, drug addiction, HIV infection, and antibiotic therapy in the last 6 months are given in Table 2. Among the *S. aureus* carriers, no significant risk factors were observed. Only three of the carriers were diabetic patients, and five of them had used β -lactam antibiotics in the last 6 months.

DISCUSSION

MRSA, formerly considered only as a nosocomial pathogen, has been isolated in community-acquired infections since the early 1980s (8). Soon after the introduction of penicillin in the beginning of the 1940s, *S. aureus* became resistant to penicillin, and the resistant strains remained as causative agents of nosocomial infections. When the ratio of nosocomial infections caused by penicillin-resistant *S. aureus* strains reached 50%, these strains began to be detected in the community. At present, it is known that more than 50% of staphylococcus strains isolated from patients having nosocomial infections in ICU's are resistant to methicillin and the prevalence of community-acquired MRSA infections has begun to increase (2,9-11). Extrapolating from data on dissemination of penicillin- and MRSA strains from hospitals to the community, it can be speculated that vancomycin-resistant *S. aureus* may be a cause of community-acquired infections in the future (3).

As in nosocomial infections, MRSA colonization of the skin and soft tissues is important in cases of community-acquired infections. Nasal carriage of *S. aureus* has been demonstrated to be a significant risk factor for nosocomial and community-acquired infections (12). A clearly distinct problem is the emergence of new multidrug sensitive but virulent community-acquired MRSA strains (11,13,14). However, as yet there has been no evidence of these virulent strains in Turkey. In order to prevent the dissemination of MRSA and to take appropriate infection control measures, the prevalence of colonization should be detected in the community.

Carriage of MRSA and methicillin-susceptible *S. aureus* (MSSA) strains in patients referred to outpatient clinics of Dokuz Eylül University Hospital were investigated in the study presented here. None of the patients admitted to the outpatient clinics were found to be carriers of MRSA, and only one healthcare worker in the control group showed nasal MRSA colonization. In addition, 9.4 and 2.6% of the study group were found to be carriers of nasal and axillary MSSA, respectively. Eight healthcare workers were found to be carriers of nasal MSSA and one to be a carrier of axillary MSSA. However, no statistically significant difference in MSSA carriage ratio was found between the study and control groups.

In our country, the ratio of MRSA causing hospital infections is not low. Topeli et al. (15) found that the rate of methicillin resistance among *S. aureus* strains causing bacteremia in ICU patients was 37.7% in a Turkish hospital. Öncül et al. (16) reported that MRSA strains were isolated from 25% of the infections in a burn unit located in Turkey. In another study, the ratio of MRSA in hospital infections in

Table 1. Culture results of nasal and axillary swab specimens from study group

	MSSA (%)	
	Children <i>n</i> = 115	Adults <i>n</i> = 385
Anterior nares	22 (19.1)	25 (6.5)
Axillae	3 (2.6)	10 (2.6)

MSSA: Methicillin-susceptible *Staphylococcus aureus*.

Table 2. Risk factors observed in the study subjects

Risk factor	Colonized group (%) <i>n</i> = 55 ¹⁾	Non-colonized group (%) <i>n</i> = 445
Diabetes mellitus	3 (5.5)	27 (6.1)
β -lactam antibiotic use	5 (9.1)	43 (9.7)
Malignancy	0	2
HIV infection	0	0
Drug addiction	0	0
Long-term care facility residence	0	0

¹⁾ *S. aureus* was isolated from both anterior nares and axillary region cultures in five patients.

ICU was reported as 22.2% (17). On the other hand, there is insufficient data on community-acquired MRSA infections and the ratio of colonization of MRSA in the community. Cesur and Cokca (18) determined the colonization ratio of MRSA as 2.6 and 6% in community members and in healthcare workers, respectively. To our knowledge, there are no other studies showing data from our country extent in the literature.

It has been noted that the ratio of nasal MRSA carriage is 0.2-3% in the community in several countries, and some risk factors for the acquisition of MRSA have been identified (2-6, 8-10). Jernigan et al. (3) investigated the ratio of MRSA colonization in 974 patients at the time of hospital admission, in 2.7% of whom MRSA was isolated. However, the authors realized that those patients had a history of hospitalization or had been admitted to a nursing home in the preceding year or had at least one serious underlying disease. Given that a history of hospitalization is the most important facilitative factor for colonization of MRSA, we excluded patients with a history of hospitalization in the preceding year from our study. When referrals to healthcare centers are not taken into consideration, the rate of MRSA may only reach 0.2% (2). The other risk factors are stays in long-term care units, IV drug addiction, HIV infection, crowded living conditions, long-term antibiotic treatment, surgical interventions, and chronic underlying diseases (2,3,5,11). Among risk factors other than hospitalization, rate of HIV infection is relatively very low (by 2000, the reported cases numbered only 1141) and injecting drug users are relatively rare in our country (19) (Full text was available on web site at <http://www.saglik.gov.tr/sb/default.asp?sayfa=ozelistatistik&id=118&kelime=&page=>, as of 22 March 2004). The patients admitted to our hospital generally represent the medium to high socio-economic class, and none of the participants in the study group was homeless. In a study that attempted to investigate the community prevalence of MRSA in the urban poor of San Francisco, Charlebois et al. (4) found that the prevalence of *S. aureus* and MRSA were 22.8 and 2.8%, respectively. The authors concluded that the urban poor and homeless were often subjected to crowded living conditions and poor access to sanitation facilities. The ratio of carriage among this population might be higher than that among the general population. The risk factors determined in our study were not significant enough to be taken into consideration, which might explain the absence of MRSA colonization in the study group.

The ratios of *S. aureus* colonization in outpatients have been reported in various studies to be between 21-38% (4-6, 8). In our patients, the colonization ratio of *S. aureus* was lower than that in those studies due to the rarity of risk factors among our subjects.

Kenner et al. (6) reported that the rates of MRSA and MSSA colonization in the community were 2 and 38%, respectively, and emphasized that the rate of MSSA carriage was considerably higher in people under 18 years old, whereas, inversely the rate of MRSA colonization was higher in the population aged over 18, though this difference was statistically insignificant. In our study, MSSA carriage ratio in children was also found to be significantly higher than that in adults.

In our study, only one MRSA strain was found among the nasal swab specimens of the control group. In some studies, a ratio of nasal carriage of MRSA among healthcare workers of 0-3.3% was found, and the authors observed that the carriage was usually transient (20-22). The Internal Medicine and Infectious Diseases and Clinical Microbiology Units,

where the study was conducted, were moved to a newly constructed building in our hospital, and the healthcare workers included were employed in the study year. There has been a well-arranged infection control program in our hospital for more than 10 years, and we control or test the compliance of health care workers to infection control precautions periodically, such as hand washing. It is thought this program might explain the lower colonization ratio of MRSA found among the health care workers in our facility.

It is claimed that the rates of MRSA colonization may vary according to both risk factors and geographical region (8). Surveillance studies should be carried out in every geographical region to detect the prevalence of MRSA strains, and appropriate infection control measures should be taken to prevent infection with these strains.

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