RESEARCH NOTE

The point prevalence and associated factors of nasal methicillin-resistant *Staphylococcus aureus* colonisation in eight geriatric hospitals in Korea

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ABSTRACT

The prevalence and associated factors of nasal methicillin-resistant *Staphylococcus aureus* (MRSA) colonisation were investigated among patients in geriatric hospitals in Korea. *S. aureus* was isolated from 317 (50.2%) of 632 patients. The nasal MRSA colonisation prevalence was 36.1%. In bivariate analysis, stay in an intensive care unit, decreased functional status, recent use of antibiotics, use of urinary catheters and the existence of skin breaks were associated with nasal MRSA colonisation ($p < 0.05$). Of these factors, only decreased functional status and recent use of systemic antibiotics were associated independently with nasal MRSA colonisation following logistic regression analysis.

Keywords Carriage, geriatric hospitals, long-term care facility, methicillin-resistant *Staphylococcus aureus*, nasal colonisation, risk factors

Original Submission: 1 September 2004; **Revised Submission:** 14 February 2005; **Accepted:** 1 July 2005

Clin Microbiol Infect 2006; 12: 81–83
10.1111/j.1469-0691.2005.01313.x

As populations age in developed countries, increasing numbers of older individuals reside in long-term care facilities (LTCFs). In Korea, *c.* 8% of the population was aged >65 years in 2002, and this proportion is increasing rapidly. As antimicrobial resistance rates in Korea are higher than in other industrialised countries [1], it seems inevitable that resistance rates in Korean LTCFs will also be high. Methicillin-resistant *Staphylococcus aureus* (MRSA) has emerged as the most important infection control problem, and MRSA accounts for >70% of *S. aureus* isolates from tertiary hospitals in Korea [2]. However, little is known about antimicrobial resistance in LTCFs in Korea. The present study was performed to assess the prevalence of nasal MRSA colonisation in geriatric hospitals, and to determine the factors associated with such colonisation.

The study was performed in July–August 2002 in eight provincial geriatric hospitals that were founded or supported by local government. Each hospital cares for patients who are suffering from various chronic diseases, mainly dementia or stroke. The study was approved by the National Health Institute, Korea. Oral informed consent was obtained from each patient sampled. The anterior nares were sampled for *S. aureus* by swabbing both nares with sterile cotton swabs and placing each swab into Amies transport medium (KOMED, Seoul, South Korea). Samples were also collected from skin lesions, such as bedsores or wounds, if present. Swabs were inoculated into tryptic soya broth (Dalynn Biologicals, Calgary, Canada) and incubated for 24 h at 35°C. Mannitol salt agar (Becton Dickinson, Franklin Lakes, NJ, USA) and mannitol salt agar containing oxacillin (Sigma-Aldrich, St Louis, LA, USA) 6 mg/L were used for the isolation of *S. aureus* and MRSA, respectively. Isolates were tested for coagulase activity with Staphaurex Plus (Remel, Lenexa, KS, USA), and subsequently tested for catalase activity. Susceptibility to oxacillin was determined by disk-diffusion according to NCCLS guidelines [3]. Molecular typing was performed by pulsed-field gel electrophoresis (PFGE) using *Sma*I-digested chromosomal DNA, with banding patterns classified as described previously [4].

Medical charts were reviewed for all enrolled patients, and data were obtained from their nurses or attendants regarding factors associated with MRSA colonisation. Patients were stratified by functional status [5,6]. An MRSA carrier was defined by at least one positive MRSA nasal culture. Statistical analyses were performed using the SAS program (SAS Institute, Cary, NC, USA). Bivariate analyses for the evaluation of relation-

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ships between MRSA colonisation and each associated factor were performed with the chi-squared test. As the use of significance levels of 0.05 or 0.10 might fail to identify variables known to be important, the analysis included any independent variables whose bivariate test had a p value <0.25 in multiple logistic regression analysis.

The mean number of occupied beds in the eight hospitals was 135 (range 76–259); three had a bed capacity <100. Of 1000 hospitalised patients, 632 were included in this study. Samples were not obtained from 368 patients because of their serious medical condition, absence of consent or unavailability. The participant numbers at each LTCF ranged from 50 to 163. The study population consisted of 162 men and 470 women, with a mean age of 75 years. Neurological disease, such as dementia and stroke, had been diagnosed in two-thirds of patients; 139 had received systemic antimicrobial therapy within the previous month; 84 had chronic skin lesions.

In total, 317 (50.2%) of the 632 patients carried *S. aureus* in their nares, and MRSA was isolated from 228 (36.1%). The prevalence of nasal *S. aureus* and MRSA colonisation in each hospital varied from 36.0% to 55.3%, and from 16.0% to 47.2%, respectively. In addition to nasal swabs, 24 swabs of skin lesions from 84 patients yielded MRSA. Studies in other countries have reported a wide range of MRSA colonisation rates in LTCFs (8–53% in the USA [7], 4.7% in the UK [8], 1.1% in Germany [9], and 3–14.0% in Japan [10]). Hori *et al.* [11] reported that the prevalence of MRSA among the elderly in a UK university hospital was 15.8%. Although the populations involved in the present study were patients in geriatric hospitals, the MRSA colonisation rate seemed to be much higher than those in Europe and Japan.

Analysis of the DNA banding patterns of 180 of the MRSA isolates revealed 21 different PFGE clusters with $>85\%$ relatedness by the Dice coefficient and UPGMA methods. Two major PFGE patterns (comprising nearly 60% of isolates) indicated probable transfer of MRSA among patients in the hospital. One of the major patterns was found in 68 isolates from six hospitals, and the other was found in 37 isolates from four hospitals. Bivariate analyses of potential risk-factors for nasal MRSA colonisation showed significant ($p < 0.05$) associations with intensive care unit stay, poor functional status, use of antibiotics within the previous 4 weeks, use of urinary catheters, and the presence of skin breaks. In addition to these factors, an age >75 years, neurological disease, surgery conducted during the previous year, and the use of nasogastric feeding tubes were included in the multivariate analysis. Of the nine variables, poor functional status and the use of antibiotics within the previous 4 weeks showed a significant association (Table 1).

Many studies have investigated risk-factors for MRSA colonisation; these include diminished functional status, presence of foreign bodies, wounds, antibiotic therapy and previous colonisation with MRSA [12]. Of these, only diminished functional status and antibiotic therapy were statistically significant by multivariate analysis in the present study. The association between MRSA colonisation and underlying disease has been investigated previously [13,14]. In the present study, neurological disease seemed to be related to MRSA colonisation, and these patients also tended to have poor functional status (p 0.004). Therefore, patients with poor functional status, who required more intensive nursing care, carried MRSA frequently. Patients in intensive

Table 1. Characteristics of patients colonised and non-colonised with MRSA

Characteristic	Colonised patients (%) *n* = 228	Non-colonised patients (%) *n* = 404	p	Adjusted[a] odds ratio (95% CI)
Size of hospital				
≥ 100 beds	159 (69.7)	279 (69.1)	0.859	
< 100 beds	69 (30.3)	125 (30.9)		
Age				
< 75 years	96 (42.1)	197 (48.8)	0.107	1.19 (0.84–1.70)
≥ 75 years	132 (57.9)	207 (51.2)		
Male	57 (25.0)	105 (26.0)	0.784	
ICU stay	46 (20.2)	41 (10.2)	< 0.001	1.58 (0.88–2.83)
Length of hospitalisation				
< 3 months	56 (24.6)	105 (26.0)	0.526	
3–5 months	54 (23.7)	98 (24.3)		
> 6 months	118 (51.7)	201 (49.7)		
Functional status(grade)[b]				
I	36 (15.8)	108 (26.7)	< 0.001	–
II	65 (28.5)	156 (38.6)		1.23 (0.76–2.00)
III	127 (55.7)	140 (34.7)		2.30 (1.39–3.80)
Neurological disease	162 (71.1)	262 (64.9)	0.111	1.80 (0.21–2.69)
Malignancy	7 (3.1)	8 (2.0)	0.387	
Diabetes	58 (25.4)	95 (23.5)	0.588	
Renal disease	9 (4.0)	19 (4.7)	0.658	
Antibiotic therapy	77 (33.8)	62 (15.4)	< 0.001	2.21 (1.45–3.35)
Surgery	25 (11.0)	27 (6.7)	0.060	1.78 (0.96–3.29)
Bed sore or wound	45 (19.7)	39 (9.7)	< 0.001	1.37 (0.81–2.32)
Urinary catheter	32 (14.0)	24 (5.9)	0.001	1.30 (0.66–2.56)
Nasogastric feeding tube	25 (11.0)	29 (7.2)	0.102	0.71 (0.35–1.43)

ICU, intensive care unit.
Data are no. (%) of patients, unless otherwise indicated.
[a]After multivariate analysis.
[b]Group I patients are ambulatory and require minimal assistance in daily activities; group II patients require moderate assistance in daily activities; and group III patients require assistance for most daily activities.

care units also had a higher incidence of MRSA. MRSA is spread to patients by direct contact with the contaminated hands of personnel [15,16], so simple infection control procedures based on careful hand washing are important to prevent spread.

Antibiotic use is very common in LTCFs, and various antibiotic groups have been identified as possible risk-factors for MRSA colonisation [7,17,18]. Previous administration of a fluoroquinolone is associated independently with MRSA persistence [6,19]. In the present study, 140 (22.2%) patients had received systemic antibiotics within the previous 4 weeks. However, no individual class of antibiotics was found to be associated with nasal MRSA colonisation.

As this study was conducted in geriatric hospitals for chronic diseases, the results should not be extrapolated to other types of LTCFs in Korea; indeed, the prevalence of MRSA could be much lower in other types of facilities. In addition, 37% of the patients were not included in this study, and it is possible that this group of patients might have been more debilitated and have an even higher prevalence of MRSA colonisation. The results of the study suggest strongly that effective infection control procedures which reflect the resources available in LTCFs need to be developed, and that similar studies should be repeated in other types of LTCFs.

ACKNOWLEDGEMENTS

This study was supported by a grant from the Ministry of Health and Welfare, Korea, and was presented, in part, at the 14th European Congress of Clinical Microbiology and Infectious Diseases (Prague, 2004). We thank the geriatric hospital personnel for their cooperation, S. W. Lee and H. Y. Kim for assistance with the statistical analyses, and M. H. Yang and J. H. Kim for collection of samples and clinical data.

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