

Nasal Carriage of Methicillin-resistant *Staphylococcus aureus* in Healthcare Workers

Nam Hee Ryoo^{1,4}, M.D., Jung Sook Ha¹, M.D., Seong Yeol Ryu^{2,4}, M.D.,
Chun Soo Kim^{3,4}, M.D., Ki Young Kwon^{2,4}, M.D., Soon Im Choi⁴, R.N.

*Department of Laboratory Medicine¹, Internal Medicine² and Pediatrics³, Keimyung University
School of Medicine, Infection Control Committee⁴, Dongsan Medical Center, Daegu, Korea*

Abstract

Objectives : Methicillin-resistant *Staphylococcus aureus* (MRSA) colonization is considered to be a significant risk factor for MRSA infections in patients. The anterior nares is the most frequent carriage site for *S. aureus*. This study was undertaken to ascertain a point prevalence of MRSA colonization among healthcare workers working in intensive care units (ICUs) of a tertiary teaching hospital.

Materials and Methods : A total of 270 ICU staffs (145 doctors and 125 nurses) working in 6 different ICUs were included, and swabs of the anterior nares were taken from the staffs for culture. Mannitol-salt agar, catalase and coagulase tests were used to identify *S. aureus* and cefoxitin disk was used to detect methicillin resistance. All procedures were followed as directed in CLSI guidelines.

Results : The colonization of *S. aureus* was found in 58 of 270 staffs (21.5%). Thirteen of 58 isolates of *S. aureus* were methicillin resistant, so the prevalence of MRSA carriage among ICU healthcare workers was 4.8%: 2.1% (3/145) for doctors and 8% (10/125) for nurses. The highest rate of nasal carriage of MRSA was seen in cardiovascular care unit whereas chest surgery ICU had no prevalence of MRSA at all.

Discussion : The annual prevalence of MRSA infection was about 78% in ICU of our hospital, but the nasal carriage of MRSA among healthcare workers in ICU was 4.8%. The prevalence of MRSA colonization was rather higher in nurses than doctors which could be due to the frequent contact and close relation with the patients. Therefore, more attention and annual follow-up surveillance together with molecular studies will be needed to have infection-control, to minimize MRSA prevalence and to clarify the endemic clonality if an outbreak of MRSA infection occurs within the hospital.

Corresponding Author: Nam Hee Ryoo, M.D., Department of Laboratory Medicine, Keimyung University School of Medicine, Dongsan Medical Center, 216, Dalseongno, Jung-gu, Daegu, 700-712 Korea
Tel: +82-53-250-7950 E-mail: nhryoo@dsmc.or.kr

Key Words : ICU, Korea, medical staffs, MRSA, nasal carriage, prevalence

Introduction

Methicillin-resistant *Staphylococcus aureus* (MRSA) is one of the most important multiple antibiotic-resistant pathogens in many hospitals worldwide [1–4]. Infections caused by MRSA are still the major concern in nosocomial settings, especially within intensive care units (ICUs) [4–6]. There have been many studies emphasizing that hand and nasal MRSA carriages played important roles in the transmission of infection [4,5]. Therefore the surveillance cultures of nares with or without hands were performed in most hospitals to determine the prevalence of MRSA carriers among healthcare workers and patients and to evaluate the cost-effectiveness of such surveillance culture [2,7].

In Korea, the mean rate of MRSA prevalence among the clinical isolates is around 70% in majority of tertiary hospitals [8]. From 1999 through 2002, we observed increased rates of MRSA among clinical isolates ranged from 73% to 78% in our 900-bed tertiary teaching hospital. At the time of strict adherence to hand antiseptics provided bed-side of each patient or at the wall of each admission room starting from 2002, the prevalence abruptly decreased to 72% in 2003. However, the MRSA prevalence exceeded again over 73% afterward. Therefore we decided to determine the prevalence of nasal carriage of MRSA among the healthcare workers working in ICUs and investigate any relations between MRSA prevalence and nasal carriage of MRSA in

healthcare workers.

Materials and Methods

The study was conducted in a 900-bed tertiary-care university hospital in Daegu, Korea. A total of 270 staffs working in 6 different intensive care units (ICU), neurosurgery (NSICU), surgery (SICU), cardiovascular (CCU), medical (MICU), chest surgery (CSICU) and pediatric (PICU), was participated in this evaluation. They were 145 doctors, 68 professors and 77 residents and 125 nurses, 105 registered and 20 aid nurses. Nasal swabs were taken from the right anterior nares of the staffs with a cotton swab soaked with sterile normal saline. The swabs were then directly inoculated to mannitol salt agar. Then the agar plates were soon delivered to microbiology laboratory and incubated at 35°C for 24 – 48 hours.

All colonies that had yellow color on mannitol salt agar were selected for the further evaluation. Identification of *S. aureus* was made by the conventional methods including gram stain, catalase and coagulase positivities and mannitol salt test and VITEK identification with GPI card (bioMerieux, Marcy, l'Etoile, France). Antimicrobial susceptibility test was performed by disk diffusion method according to CLSI guidelines. Single well-separated colony was selected and suspended in Mueller-Hinton broth. The suspension was adjusted to 0.5 MacFarland turbidity standard and then inoculated with a sterile swab on Mueller-Hinton agar. After

several minutes of drying, 4 antibiotic disks, namely oxacillin, cefoxitin, vancomycin and teicoplanin, were applied. The plates were then incubated at 35°C for overnight. The statistical comparisons were performed with Chi-squared test using Statistical Package for the Social Sciences (SPSS) for Windows (Version 12.0; SPSS, Chicago, IL, USA) software. The findings were presented with 95% confidence interval (CI) and corresponding *p* value with the significance at 0.05.

Results

Out of 286 working healthcare workers in 6 different ICUs, 270 staffs were participated for the surveillance of MRSA nasal carriage. They were 145 doctors and 125 nurses. The overall nasal carriage of *S. aureus* was 21.5% in our healthcare workers (Table 1). These comprised 32 doctors and 26 nurses with carriage rate of 22.1% and 20.8%, respectively ($P>0.05$). Ten professors (14.7%) had *S. aureus* in nares out of 68 professor participants whereas 22 residents

(28.6%) out of 77 participants ($P\leq 0.05$). None of the professors were colonized with MRSA, but 3 of the residents (2.1% among doctors) were discovered with MRSA in their nares. Among nurses, 20 registered nurses (19%) and 6 aid nurses (30%) out of 105 and 20 participants, respectively, were colonized with *S. aureus* in their nares ($P\leq 0.05$). MRSA was noted only in 10 registered nurses (8% among nurses). Thus, the overall nasal carriage rate of MRSA in ICUs of our hospital was 4.8% (13/270).

The nasal carriage of *S. aureus* varied from 16.7% to 28.6% among six different ICUs. CCU showed the highest carriage rate whereas NSICU had the lowest (Table 2). MRSA carriage rate between 6 different ICUs were ranged from 0 to 9.5%. CCU had the highest rate of all and CSICU had the lowest that no MRSA carrier had been found even though *S. aureus* was found in 23.8% of the staffs.

Discussion

MRSA is the most prevalent multiple

Table 1. The prevalence of nasal MRSA carriage among 270 healthcare workers

Staff (No)		Carriage rate	
		<i>S. aureus</i>	MRSA
Doctors (145)	Professors (68)	10 (14.7%)*	0
	Residents (77)	22 (28.6%)	3 (2.1%)
Nurses (125)	RN (105)	20 (19.0%) [†]	10 (8.0%)
	AN (20)	6 (30.0%)	0
Total (270)		58 (21.5%)	13 (4.8%)

**P* value ≤ 0.05 , when compared to residents; [†]*P* value ≤ 0.05 , when compared to AN; RN, registered nurse; AN, aid nurse

Table 2. Distributions of MRSA carriage rate between six different intensive care units (ICUs)

ICU (No)	Carriage rate	
	<i>S. aureus</i>	MRSA
Cardiovascular (21)	6 (28.6%)	2 (9.5%)
GS (47)	9 (19.1%)	3 (6.4%)
Pediatrics (54)	14 (25.9%)	3 (5.6%)
NS (42)	7 (16.7%)	2 (4.8%)
Internal medicine (85)	17 (20.0%)	3 (3.5%)
CS (21)	5 (23.8%)	0
Total (270)	58 (21.5%)	13 (4.8%)

GS, general surgery; NS, neurosurgery; CS, chest surgery

antibiotics-resistant pathogen and remains a significant cause of hospital-acquired infection in the world [2-4,9]. Colonized patients are the chief source of *S. aureus* infections in the hospital. Especially when the patient is colonized with MRSA, the relative risk will be much greater [4]. MRSA transmission and infection could occur endogenously and also by transfer between the patients and healthcare worker to patient [5,7]. Although multiple body sites can be colonized, the anterior nares is the most frequent carriage site for *S. aureus* [3]. Therefore, the prevalence of MRSA nasal carriage in patients on admission or in healthcare workers considered carefully for the evaluation of the MRSA infections.

During the surveillance for point prevalence of nasal carriage of MRSA among ICU working staffs, the average MRSA prevalence was remained as usual in about 75%, but slightly high in ICUs ranged up to 78%. There weren't any particular outbreaks of MRSA infection during the surveillance

period. In our study, the nasal carriage rate was much lower compared to the previously reported data in Korea [10,11]. Oh *et al.* described that transient carrier was occurred in 10% whereas permanent carrier in 2.8% [10] at the time of an outbreak. Park *et al.* reported that the prevalence of the nasal carriage among the healthcare workers was significantly increased for 10 years from 5.3% to 18.6% [11].

It was not clear whether the carriers were short or long-term carriers, or persistent sources of MRSA. Decontamination of these carriers was considered the most among other infection control measures to avoid the hospital outbreaks [12,13]. We performed the elimination of nasal carriage of MRSA among 8 out of 13 carrier healthcare workers by the application of mupirocin to their nares. It took an average of one week (5 days to 2 weeks) for complete elimination. It is very cautious to state that the nasal carriage of MRSA in healthcare workers did not affect the mean prevalence of MRSA in our hospital, but we could ascertain that there will be other significant factors that attribute to the high prevalence of MRSA in ICUs of our hospital. Therefore, more attention and annual follow-up surveillance together with molecular studies will be needed to have well-settled infection control, to minimize MRSA prevalence and to clarify the endemic clonality when occurred within the hospital.

Summary

The objective of this study was to ascertain a point prevalence of MRSA colonization among healthcare workers

working in intensive care units (ICUs) of a tertiary teaching hospital. A total of 270 ICU staffs working in ICUs were included, and swabs of the anterior nares were taken from the staffs for culture. Identification of *S. aureus* and methicillin resistance tests were performed following the CLSI guidelines. The colonization of *S. aureus* was found in 58 of 270 staffs (21.5%). Thirteen of 58 isolates of *S. aureus* were methicillin resistant, so the point prevalence of MRSA carriage among ICU healthcare workers was 4.8%: 2.1% (3/145) for doctors and 8% (10/125) for nurses. The highest rate of nasal carriage of MRSA was seen in cardiovascular ICU whereas chest surgery ICU had no prevalence of MRSA at all. The annual prevalence of MRSA infection was about 78% in ICU of our hospital, but the nasal carriage of MRSA among healthcare workers in ICU was 4.8%. The prevalence of MRSA colonization was rather higher in nurses than doctors which could be due to the frequent contact and close relation with the patients. Therefore, more attention and annual follow-up surveillance together with molecular studies will be needed to have infection-control, to minimize MRSA prevalence and to clarify the endemic clonality if an outbreak of MRSA infection occurs within the hospital.

References

1. MacKenzie FM, Bruce J, Struelens MJ, Goossens H, Mollison J, Gould IM, *et al.* Antimicrobial drug use and infection control practices associated with the prevalence of methicillin-resistant *Staphylococcus aureus* in European hospitals. *Clin Microbiol Infect* 2007;**13**:269-76.
2. Cesur S, Cokca F. Nasal carriage of methicillin-resistant *Staphylococcus aureus* among hospital staff and outpatients. *Infect Control Hosp Epidemiol* 2004;**25**:169-71.
3. Chen CB, Chang HC, Huang YC. Nasal methicillin-resistant *Staphylococcus aureus* carriage among intensive care unit hospitalized adult patients in a Taiwanese medical centre: one time-point prevalence, molecular characteristics and risk factors for carriage. *J Hosp Infect* 2010;**74**:238-44.
4. Lucet JC, Chevret S, Durand-Zaleski I, Chastang C, Regnier B, Multicenter Study Group. Prevalence and risk factors for carriage of methicillin-resistant *Staphylococcus aureus* at admission to the intensive care unit: results of a multicenter study. *Arch Intern Med* 2003;**163**:181-8.
5. Porter R, Subramani K, Thomas AN, Chadwick P. Nasal carriage of *Staphylococcus aureus* on admission to intensive care: incidence and prognostic significance. *Intensive Care Med* 2003;**29**:655-8.
6. Corbella X, Dominguez MA, Pujol M, Ayats J, Sendra M, Pallares R, *et al.* *Staphylococcus aureus* nasal carriage as a marker for subsequent staphylococcal infections in intensive care unit patients. *Eur J Clin Microbiol Infect Dis* 1997;**16**:351-7.
7. Eveillard M, Martin Y, Hidri N, Boussougant Y, Joly-Guillou ML. Carriage of methicillin-resistant *Staphylococcus aureus* among hospital employees: prevalence, duration and transmission to households. *Infect Control Hosp Epidemiol* 2004;**25**:114-20.
8. Lee H, Kim CK, Lee J, Lee SH, Ahn JY, Hong SG, *et al.* Antimicrobial resistance of clinically important bacteria isolated from 12 hospitals in Korea in 2005 and 2006. *Korean J Clin Microbiol* 2007;**10**:59-69.
9. Ibarra M, Flatt T, van Maele D, Ahmed A, Fergie J, Purcell K. Prevalence of methicillin-resistant *Staphylococcus aureus* nasal carriage in healthcare workers. *Pediatr Infect Dis J* 2008;**27**:1109-11.
10. Oh HS, Lee SE, Kim EC, Lee HJ, Oh MD, Choe

- KW. Health care workers' nasal carriage and outbreak control of epidemic methicillin-resistant *Staphylococcus aureus*. *Korean J Infect Dis* 2001;**33**:194-201.
11. Park GB, Lee MK. Nasal carriage of methicillin-resistant *Staphylococcus aureus* among healthcare workers and community students in 1997 and 2006. *Korean J Nosocomial Infect Control* 2007;**12**:85-90.
12. Hardy K, Price C, Szczepura A, Gossain S, Davies R, Stallard N, *et al*. Reduction in the rate of methicillin-resistant *Staphylococcus aureus* acquisition in surgical wards by rapid screening for colonization: a prospective, cross-over study. *Clin Microbiol Infect* 2010;**16**:333-9.
13. Ammerlaan HS, Kluytmans JA, Wertheim HF, Nouwen JL, Bonten MJ. Eradication of methicillin-resistant *Staphylococcus aureus* carriage: a systematic review. *Clin Infect Dis* 2009;**48**:922-30.