Comparison of Protocols for Surveillance of Methicillin-resistant Staphylococcus aureus (MRSA): Medical Staff vs ICU Patients

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Abstract. To compare the sensitivity of various protocols for methicillin-resistant Staphylococcus aureus (MRSA) surveillance, active surveillance for detecting MRSA nasal colonization was performed on 97 members of the medical staff and 218 patients in the Intensive Care Unit (ICU) of a university hospital. Duplicate nasal swabs were collected from each participant. One was plated directly on a blood agar plate (D-BAP) and observed at 24 and 48 hr. Another was incubated overnight in tryptic soy broth (TSB) with 6.5% NaCl, and subcultured on both BAP (B-BAP) and mannitol salt agar with 4 mg/L of oxacillin (B-MSAOXA). The MRSA colonization rate was similar in the medical staff and patient samples (16.5% vs 11.9%, p = 0.285). Among the medical staff members, the sensitivity of MRSA detection was the same (93.8%) in D-BAP and B-BAP. In the ICU patients, which are a high-risk group, the sensitivity of MRSA detection was improved by adding a pre-enrichment step (73.1% on D-BAP vs 96.2% on B-BAP). The simple direct plating protocol was sufficiently sensitive for the medical staff members, but pre-enrichment was an essential step to increase detection of MRSA in the ICU patients.

Keywords: Staphylococcus aureus, methicillin-resistance, MRSA surveillance, pre-enrichment media

Introduction

Methicillin-resistant Staphylococcus aureus (MRSA) is one of the most common nosocomial pathogens. Its prevalence is quite variable geographically, from <1% in northern Europe to >40% in southern and western Europe, while averaging 40-50% in USA hospitals [1,2]. In Korea, the methicillin resistance rate is very high (64-68% of all S. aureus infections in hospitals) [3,4]. Rapid screening and identification of MRSA carriers among high-risk patients, followed by isolation using contact precautions, are essential steps in MRSA control [5]. In addition, since direct contact with medical staff members who are colonized with MRSA is a main route of transmission, the surveillance of the medical staff is also important. However, to our knowledge, few surveillance studies on medical staff personnel have been performed. The American Society for Microbiology recommends use of salt-containing enrichment broth in conjunction with a blood agar plate and mannitol salt agar containing 4 to 6 mg/L of oxacillin to increase sensitivity [6]. It should be noted that the broth-containing protocol is 2- to 2.5-fold more expensive than the simple direct protocol [7]. In the present study, we undertook active surveillance to evaluate the MRSA detection rate according to the use of different culture media for nasal samples from medical staff members and ICU patients.
Methods and Materials

This study was performed prospectively from April to May 2006. A total of 112 specimens (97 initial and 15 follow-up specimens) from 97 medical staff members (25 doctors, 49 nurses, 14 student nurses, and 9 others) and 265 specimens (218 initial and 47 follow-up specimens) from 218 ICU patients were screened consecutively. For medical staff members, the screening for MRSA was re-examined at one week after treatment if it was initially positive. For newly admitted ICU patients, the screening for MRSA was carried out within the first 48 hr in the ICU and was repeated weekly in case of prolonged hospitalization. For already hospitalized patients in the ICU at the beginning of this study, screening was performed initially and repeated weekly.

Duplicate nasal swab specimens were transported in Amie’s medium (Micromedia Co., Korea) and were processed within 2 hr of collection in the following manner: one swab was streaked directly on sheep blood agar plate (D-BAP) (Asan Medical Co., Korea), incubated at 35°C, and examined at 24 and 48 hr; the other swab was inoculated into tryptic soy broth (TSB) (BBL, Cockeysville, MD, USA) containing 6.5% NaCl and, after 24 hr, subcultured in both BAP (B-BAP) and mannitol salt agar containing 4 mg/L of oxacillin (B-MSAOXA) (Shinyang Chemical Co., Korea). The subcultures were examined at 24 hr. Suspicious colonies were identified as \textit{S. aureus} by catalase production, positive clumping test, or positive tube coagulase test. MRSA was confirmed by cefoxitin disk diffusion susceptibility testing according to CLSI guidelines [8].

For the MRSA-positive medical staff members, mupirocin treatment of the nares was applied for 5-7 days, followed by surveillance for MRSA as mentioned above [5]. For the MRSA-positive patients, decolonization including mupirocin ointment application to the nares combined with chlorhexidine bathing (Avagard Antiseptic Hand Rub with 0.5% chlorhexidine gluconate, 3M Co., Australia) daily, with or without medication, was performed for 5 days, and MRSA surveillance was repeated. The total MRSA detection rate was calculated as the number of MRSA growth from at least one medium from one specimen divided by the total number of specimens.

Statistical analyses were carried out using the Chi-square test (SPSS 9.0 for Windows, SPSS Inc., Chicago, IL, USA). A p value of <0.05 was considered to be significant.

Results

The initial MRSA colonizing rate was similar in the medical staff and ICU patient samples (16.5% vs 11.9%, p = 0.285). In medical staff members, compared with the total result (16/97), the sensitivity of direct plating was the same (93.8%) for D-BAP after 24 hr (D-BAP 24 hr), for D-BAP after 48 hr (D-BAP 48 hr), and for TSB pre-enrichment before plating on BAP (B-BAP) (Table 1). However, the sensitivity of TSB pre-enrichment before plating on MSAOXA (B-MSAOXA) was significantly lower (50.0%, p = 0.008). In ICU patients, compared with the total result (26/218), sensitivity was higher in broth-containing protocols: 73.1% in both D-BAP (24 hr) and D-BAP (48 hr), vs 96.2% in both B-BAP and B-MSAOXA. The B-BAP method showed the lowest specificity in both groups (50.6% in medical staff members, 82.4% in ICU patients).

Follow-up screening for 15 of 16 medical staff members who were initially positive was performed after a week of treatment, and all became negative for MRSA. Of the 32 initially positive ICU patients, follow-up screening was performed for 11 patients after treatment, and all but one became negative. Follow-up screening was also performed for 25 patients hospitalized for prolonged periods. Six of
17 patients who were initially MRSA-negative became positive.

Discussion

The MRSA colonizing rate was similarly elevated in the medical staff members and the hospitalized ICU patients. This finding emphasizes the need for active surveillance of MRSA in medical staffs as well as in patients. Based on this study, improved sensitivity of enrichment was remarkable only in the high-risk group of patients in the ICU. This finding corroborates previous reports that enrichment of screening swabs is more sensitive than direct plating and may be particularly useful for screening high-risk groups of patients and monitoring the clearance of MRSA colonization [7,9].

It is likely that other organisms are more abundant on the swabs from patients and this would obscure the growth of *S. aureus* on direct plating. In addition, there may be fewer MRSA in some patients and these bacteria can be detected by a more sensitive method including broth enrichment. The D-BAP method showed good performance, because of the characteristics of staphylococcal beta-hemolysis, for screening of MRSA in medical staff members. Prolonged incubation (48 hr) was not helpful. Single use of MSAOXA seems less useful because its sensitivity can be influenced by mannitol-fermenting coagulase-negative staphylococci or other mannitol-fermenting bacteria in specimens, and it was difficult to detect MRSA in case of staphylococcal colonies that slowly turned yellow on MSAOXA media. In addition, 6 (35%) of 17 initially negative patients acquired MRSA during prolonged hospitalization. This finding supports the recommendation of Coia et al [10] that regular (eg, weekly or monthly, according to local prevalence) screening of all patients in a high-risk group should be performed routinely. The high acquisition rate in our study may be related to the fact that our ICU is a colonized area; more intensive intervention should be considered to prevent spread of MRSA.

In conclusion, given the high colonizing rate of MRSA in the endemic area, regular surveillance for MRSA is needed both in medical staff members and hospitalized ICU patients. A simple D-BAP protocol is sensitive enough for the medical staff, but considering the high acquisition rate in the ICU patients in this study, pre-enrichment is essential to increase the sensitivity of MRSA detection in high-risk groups.

References