Staphylococcus aureus Contamination on the Surface of Working Tables in Ward Staff Centers and Its Preventive Methods

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We investigated *Staphylococcus aureus* (*S. aureus*) contamination on the surface of working tables in ward staff centers and the effects of disinfection by wiping with 80% (v/v) ethyl alcohol on this contamination. When working tables were not regularly disinfected or washed, *S. aureus* [methicillin-sensitive *S. aureus* (MSSA) and/or methicillin-resistant *S. aureus* (MRSA)] was detected in 29 (51.8%) of 56 tables in 6 wards investigated. MRSA was detected in 17 (30.4%) of 56 tables and in all investigated wards. The *S. aureus* contamination density on the entire surface of the *S. aureus*-contaminated tables was 2081 ± 8915 (mean $\pm$ S.D.) colony-forming units (cfu) ($n=29$, range, 10 – 4.8×10^4 cfu), and the MRSA contamination density on the entire surface of the MRSA-contaminated tables was 158 ± 200 cfu ($n=17$, range, 10 – 7.4×10^2 cfu). The second investigation was performed immediately after working tables not regularly disinfected or washed were disinfected by wiping once with 80% (v/v) ethyl alcohol, and MRSA was detected in 5 (8.9%) of 56 tables. The contamination density on the entire surface of the MRSA-contaminated tables was 36 ± 30 cfu ($n=5$, range, 10 – 80 cfu). The third investigation was performed immediately after working tables not regularly disinfected or washed were disinfected by wiping with 80% (v/v) ethyl alcohol twice with a 1-min interval, and no *S. aureus* contamination was observed in any of 56 tables. These results suggest that disinfection by wiping once with 80% (v/v) ethyl alcohol could not completely eliminate MRSA in particulates. For the disinfection of the MRSA-contaminated surface of working tables and the removal of particulates, regular disinfection by wiping with 80% (v/v) ethyl alcohol is necessary.

Key words methicillin-resistant *Staphylococcus aureus* (MRSA); contamination; working table; alcohol; disinfection

The primary transmission route of methicillin-resistant *Staphylococcus aureus* (MRSA) is direct contact.¹⁾ Important measures for the prevention of nosocomial MRSA transmission include correct handwashing²⁾ and disinfection of environmental surfaces as potential reservoirs of MRSA. Among environmental surfaces, those that frequently come into contact with the fingers are particularly important. Previous studies on surfaces have evaluated the MRSA contamination states of various items such as doctors' and nurses' pens,³⁾ tourniquets,⁴⁾ mattresses,⁵⁾ television sets,⁶⁾ faucet handles,⁷⁾ bedframes,^{5,8)} over-bed tables,⁸⁾ computers,^{7,9)} room door handles,¹⁰⁾ immersion bathtubs, stretchers for an immersion bath, and chairs for the shower.¹¹⁾ However, to our knowledge, there have been no detailed studies on the MRSA contamination status of the surface of working tables, which frequently come into contact with the fingers of medical staff such as physicians and nurses, in ward staff centers. In the establishment of infection, microbial density is important, and therefore, the MRSA contamination density on environmental surfaces may be important; however, there have been few quantitative studies on MRSA contamination on environmental surfaces. Therefore, we examined methicillin-sensitive *S. aureus* (MSSA) and MRSA contamination on the surface of working tables in ward staff centers and the effects of disinfection by wiping with 80% (v/v) ethyl alcohol on this contamination.

MATERIALS AND METHODS

Subjects of Investigation Between March and August, 2005, we investigated contamination by *S. aureus* and total bacterial count on the surface of 28 tables in 6 wards (4–5 tables per ward), excluding the Intensive Care Unit, of a gen-

eral hospital (310 beds). The surface area of the investigated working tables (Fig. 1) was about 8100 cm² or 9000 cm².

Methods of Investigation First, investigation was performed when working tables were not regularly disinfected or washed (before disinfection). During another period, working tables that were not regularly disinfected or washed were disinfected by wiping once with 80% (v/v) ethyl alcohol (Kenei Pharmaceutical Co., Osaka), with investigation after 1 min (immediately after wiping disinfection once). In addition, during another period, working tables not regularly disinfected or washed were disinfected by wiping with 80% (v/v) ethyl alcohol twice with a 1-min interval, and after 1 min, investigation was performed (immediately after wiping disinfection twice). Each investigation was performed twice. For disinfection by wiping, the table surface was

Fig. 1. Investigated Working Tables

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wiped once in one direction with sterile gauze (15 cm × 10 cm) adequately soaked with 80% v/v ethyl alcohol. This disinfectant is used because it has a broad antimicrobial spectrum, dries rapidly and is not sticky, and is widely used.

Investigation Period and Patients from Whom MRSA Was Isolated The investigation periods were March–April, 2005 (before disinfection), May–June, 2005 (immediately after wiping disinfection once), and July–August, 2005 (immediately after wiping disinfection twice). The total number of reported patients from whom MRSA was isolated in each ward on the day of investigation was divided by the number of beds. The obtained value was 0.066 (41/620) before disinfection, 0.055 (34/620) immediately after wiping with disinfectant once, and 0.044 (27/620) immediately after wiping with disinfectant twice. Of the 6 wards investigated, 1 had no MRSA patients during the entire investigation period.

Quantification of MRSA and MSSA, and Total Bacterial Count on Surfaces The entire surface of each table was wiped with sterile gauze (15 cm × 10 cm) moistened with sterile physiological saline, and the gauze was placed in a glass bottle (100 ml) containing 30 ml sterile physiological saline. The glass bottles were manually stirred for about 5 s and ultrasonicated at 36 kHz for 10 min.¹²⁾ The physiological saline in the glass bottles was used as samples, serially diluted 1:10 with sterile physiological saline. The undiluted samples (0.5 ml) were inoculated onto 6 salt egg yolk agar plates (Nissui Pharmaceutical Co., Tokyo) and 1 Trypticase Soy Agar[®] (Nippon Becton Dickinson Co., Tokyo). The 10-fold serial dilution samples (0.5 ml) were inoculated onto 1 salt egg yolk agar plate and 1 Trypticase Soy Agar[®]. These media were cultured at 35 °C for 48 h, and colony-forming units (cfu) were counted. Yellow colonies with pearl-ring formation on the salt egg yolk agar plates were evaluated by Gram-staining, morphological examination, and the coagulase test (Staphylo La Seiken[®]: Denka Seiken Co., Tokyo), and *S. aureus* was identified. The cfu count on the Trypticase Soy Agar[®] was regarded as the total bacterial count.

The methicillin sensitivity of cultured *S. aureus* was determined using MRSA screen agar containing 6 µg/ml oxacillin (Nippon Becton Dickinson Co., Tokyo). When *S. aureus* on the salt egg yolk agar plate exceeded 10 cfu, 10 cfu were randomly selected, and methicillin sensitivity was determined. The MRSA or MSSA count per working table was estimated from the ratio of methicillin-resistant to methicillin-sensitive colonies.

Statistical Analysis Data are expressed as the mean ± S.D.

RESULTS

In the investigation before disinfection, *S. aureus* (MSSA and/or MRSA) was detected in 29 (51.8%) of 56 tables, and MRSA was detected in 17 (30.4%) of 56 tables and in all 6 wards investigated. On the tables contaminated with *S. aureus*, the *S. aureus* contamination density/table was 2081 ± 8915 cfu ($n=29$, range, $10-4.8 \times 10^4$ cfu), and the MRSA contamination density/table was 158 ± 200 cfu ($n=17$, range, $10-7.4 \times 10^2$ cfu). In the investigation immediately after wiping disinfection once, *S. aureus* was detected in 8 (14.3%) of 56 tables, and MRSA was detected in 5 (8.9%) of 56 tables and in 3 of 6 wards. On the *S. aureus*-contaminated tables, the *S. aureus* contamination density/table was 285 ± 695 cfu ($n=8$, range, $10-2.0 \times 10^3$ cfu), and the MRSA contamination density was 36 ± 30 cfu ($n=5$, range, $10-80$ cfu). In the investigation immediately after wiping disinfection twice, no *S. aureus* contamination was observed in any table investigated (Table 1).

The detection rate of 100 cfu or greater total bacterial count was 100% before disinfection, 57.1% immediately after wiping disinfection once, and 19.6% immediately after wiping disinfection twice, the contamination density/contaminated table was 7806 ± 14690 cfu ($n=56$, range, $3.0 \times 10^2-7.4 \times 10^4$ cfu), 1229 ± 3464 cfu ($n=52$, range, $60-2.0 \times 10^4$ cfu), and 86 ± 38 cfu ($n=30$, range, $60-1.8 \times 10^2$ cfu), respectively.

DISCUSSION

Microorganisms are transmitted from environmental surfaces to patients primarily *via* hands that come into contact with these surfaces.¹³⁾ Contact with contaminated environmental surfaces has been shown to cause *S. aureus* transmission to the fingers.¹⁴⁾ Even if medical staff correctly wash their hands,²⁾ contact with contaminated environmental surfaces reduces the cleanliness of the fingers. In this study, we investigated MRSA contamination on the surface of working tables, which frequently come into contact with the fingers of medical staff such as physicians and nurses in ward staff centers. Investigation before disinfection showed MRSA contamination in 17 (30.4%) of 56 evaluated tables and all wards, including one ward where no MRSA patients were isolated during the entire investigation period. Although simple comparison between the results in this study and previous studies is difficult, the MRSA detection rate in this study (30.4%) was higher than that for doctors' and nurses' pens (25%),³⁾ tourniquets (29%),⁴⁾ or mattresses (20%)⁵⁾ in previ-

Table 1. MSSA/MRSA Contamination on the Surface of Working Tables and the Effects of Wiping with 80% (v/v) Ethyl Alcohol

Contaminants	Presence/absence of disinfection	No. of working tables contaminated/No. of working tables examined (%)	No. of working tables contaminated at a density (cfu/working table)				
			<10	10–99	100–999	1000–9999	10000–99999
MSSA and/or MRSA	Before disinfection	29/56 (51.8)	27	12	14	2	1
	Wiping disinfection once	8/56 (14.3)	48	6	1	1	0
	Wiping disinfection twice	0/56 (0)	56	0	0	0	0
MRSA	Before disinfection	17/56 (30.4)	39	9	8	0	0
	Wiping disinfection once	5/56 (8.9)	51	5	0	0	0
	Wiping disinfection twice	0/56 (0)	56	0	0	0	0

Detection limit: 10 cfu/working table. Surface area of the table: 8100 or 9000 cm².

ous studies. Since MRSA can survive for a long period on environmental surfaces,¹⁵⁾ MRSA contamination on the surface of working tables may accumulate. Therefore, appropriate disinfection of the surface of working tables is necessary.

Next, the effects of disinfection by wiping with 80% (v/v) ethyl alcohol on MRSA attached to the surface of working tables were evaluated. Immediately after wiping disinfection once, the mean MRSA contamination density decreased to about 1/5, and the contamination detection rate to about 1/3 of the pre-disinfection value, but MRSA was not eliminated. Immediately after wiping disinfection twice, MRSA was eliminated. The reason why MRSA was not eliminated by wiping disinfection once may be as follows. In the investigation before disinfection, the gauze used for wiping samples mostly showed the attachment of a large amount of particulates. In the investigation immediately after wiping disinfection once, the gauze used for wiping samples also frequently showed particulate attachment. We speculate that MRSA was not completely eliminated due to particulates by wiping disinfection once. The mean contamination density of the total bacterial count also decreased to about 1/6 after wiping disinfection once and about 1/100 of the pre-disinfection density after wiping disinfection twice, which also suggests the marked influence of particulates on the anti-microbial effects of disinfectant.

These results suggest that regular disinfection by wiping with 80% (v/v) ethyl alcohol is necessary for MRSA disinfection and the removal of particulates from the surface of working tables.

An important measure for the prevention of nosocomial

MRSA transmission is the appropriate disinfection of surfaces such as working tables that frequently come into contact with the fingers. Of course, correct handwashing²⁾ before and after contact with patients is also important.

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