Nasal Carriers of *Staphylococcus aureus* among Healthy Individuals

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Abstract

Staphylococcus aureus and *Staphylococcus* spp. were isolated from healthy students and their drug resistance was investigated. *S. aureus* was isolated from 17 of 70 persons (24.3%). Fourteen strains of 22 isolates of *S. aureus* were ampicillin-resistant. Two strains each were cefmetazole-resistant and gentamicin-resistant. None of the strains was found to be methicillin-resistant. Compared with the strains isolated from the hospital ward environment, *S. aureus* in healthy individuals was relatively sensitive to antibiotics.

Introduction

Methicillin-resistant *Staphylococcus aureus* (MRSA) is well recognized as a causative agent of nosocomial infection. Medical staff members sometimes carry *S. aureus* in their anterior nares^{1,2)}. Under these circumstances it is important to determine the carriers of *S. aureus* among healthy individuals and the medical staff. We isolated *S. aureus* and other *Staphylococcus* spp. from healthy students of Tottori University and tested these bacteria for drug susceptibility. Then, the antibiogram was compared with that of the isolates from the hospital ward environment.

Materials and Methods

Specimens were collected from the anterior nares of healthy medical students of Tottori University by using sterilized swabs that were streaked directly on nutrient agar plates. The plates were incubated for 24 hr at 37°C. Species of *Staphylococcus* were identified as described elsewhere³⁾. Antibiotic susceptibility testing was performed by the disk method⁴⁾ using ampicillin (ABPC), methicillin (DMPPC), cephaloridine (CER), cefmetazole (CMZ), tetracycline (TC), erythromycin (EM) and gentamicin (GM) (Showa disc; Showa Yakuhin Kako Co. Ltd., Tokyo). The strains categorized as giving an intermediate or equivocal test result with the methicillin disk method were further tested by the dilution method⁵⁾. Specimens were collected from students in February, March, April and June 1992.

Results

Strains of *Staphylococcus* spp. were isolated from a total of 70 students. *S. aureus* was isolated from the anterior nares of one of the 3 individuals tested in February, 6 of the 19 in March, 5 of the 31 in April and 5 of the 17 in June, as shown in Table 1. In total, *S. aureus* was isolated from 17 persons (24%).

Eighty strains of *Staphylococcus* were isolated and 6 species were identified (Table 2). As we tried exclusively to isolate *S. aureus* in February and March, the isolation rate for *S. aureus* was relatively high (2 strains from 4 students in February and 9 strains from 12 in March). In total, 22 strains of *S.*

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Table 1 Isolation of *Staphylococcus aureus* from the anterior nares of healthy individuals

	Feb. 6	Mar. 13	Apr. 23	Jun. 6	Total
No. of persons tested	3	19	31	17	70
No. of persons keeping <i>S. aureus</i>	1	6	5	5	17
Isolation rate (%)	33.3	31.6	16.1	29.4	24.3

Table 2 Identification of *Staphylococcus* spp.

Species	No. of strains isolated on :				Total(%)
	Feb. 6	Mar. 13	Apr. 23	Jun. 6	
<i>S. aureus</i>	2	9	5	6	22(27.5)
<i>S. epidermidis</i>	1	0	17	20	38(47.5)
<i>S. capitis</i>	0	0	0	1	1 (1.3)
<i>S. warneri</i>	0	1	2	0	3 (3.8)
<i>S. haemolyticus</i>	0	0	0	1	1 (1.3)
<i>S. hominis</i>	1	2	5	7	15(18.8)
Total	4	12	29	35	80(100)

Table 3 Antibiotic susceptibility of 80 isolates from healthy individuals

<i>Staphylococcus</i> spp.	No. of strains	No. of resistant strains to :							Total(ratio)*
		ABPC	DMPPC	CER	CMZ	TC	EM	GM	
<i>S. aureus</i>	(22)	14	0	0	2	0	1	2	19(0.9)
<i>S. epidermidis</i>	(38)	10	0	0	0	0	2	0	12(0.3)
<i>S. capitis</i>	(1)	0	0	0	0	0	0	0	0(0.0)
<i>S. warneri</i>	(3)	0	0	0	0	0	1	1	2(0.7)
<i>S. haemolyticus</i>	(1)	0	0	0	0	0	0	0	0(0.0)
<i>S. hominis</i>	(15)	4	0	0	0	5	2	1	12(0.8)
Total	(80)	28	0	0	2	5	6	4	45(0.6)
Per cent	(100)	35			2.5	6.3	7.5	5.0	8.0

*No. of resistant factors/strain

ABPC: ampicillin, DMPPC: methicillin, CER: cephaloridine, CMZ: cefmetazole, TC: tetracycline, EM: erythromycin, GM: gentamicin

aureus (27.5%) were isolated from 70 persons. Thirty-eight strains of *S. epidermidis* (47.5%) and 15 strains of *S. hominis* (18.8%) were the main isolates.

Table 3 shows the susceptibility of 80 strains to 7 antibiotics. Fourteen strains of *S. aureus* were resistant to ABPC (17.5%), 2 strains each of this species were resistant to CMZ (2.5%) and GM (2.5%), and 1 strain was resistant to EM (1.3%). Nineteen resistance factors were found among 22 strains of *S. aureus*, the average resistance factor being 0.9 for each strain. Twenty-eight strains isolated were resistant to ABPC (35%). The rates of resistance to EM and TC were 7.5% and 6.3%, respectively. In contrast, none of the strains were resistant to DMPPC and CER.

In order to confirm the 22 strains giving equivocal test results, dilution testing was performed using oxacillin (MIPIC) and methicillin (DMPPC). Table 4 shows that all the strains tested were categorized as being susceptible.

Table 4 Dilution susceptibility testing methods for *Staphylococcus*^{a)}

Organisms	No. of strains	Conc. of MIPPC ($\mu\text{g/ml}$)				Conc. of DMPPC ($\mu\text{g/ml}$)		
		≥ 6	4	2	2>	≥ 16	8	8>
<i>S. aureus</i>	18				18			18
<i>S. epidermidis</i>	4				4			4
<i>S. aureus</i> (MRSA) ^{b)}	2	2				2		

a) Twenty-two strains of *Staphylococcus aureus* and *Staphylococcus epidermidis* categorized as an intermediate or equivocal test result by disk method were tested by dilution testing.⁵⁾

b) Two strains of *Staphylococcus aureus*, which were isolated clinically from the patients and identified as MRSA, were kindly given by Dr. A. Ashimoto of Department of Oral and Maxillofacial Surgery in university hospital.

Discussion

S. aureus and other *Staphylococcus* spp. were isolated from healthy students, living away from a hospital, and antibiotic susceptibility testing was performed. The rate of isolation of *S. aureus* from the healthy individuals was 24.3%. The isolation rate for DMPPC-resistant *Staphylococcus* was extremely high in the hospital ward as reported previously³⁾. In the 64 strains of *Staphylococcus* isolated from the ward environment in January 1992, the isolation rates for ABPC- and DMPPC-resistant *Staphylococcus* were

Fig. 1 Comparisons of isolation rates for antibiotic-resistant *Staphylococcus* between the isolates from healthy individuals and those from the hospital ward environment

White column ($\square$) shows healthy individuals and shaded column (■) shows ward environment. *Average rate of drug-resistance. ABPC: ampicillin, DMPPC: methicillin, CER: cephaloridine, CMZ: cefmetazole, TC: tetracycline, EM: erythromycin, GM: gentamicin.

Fig. 2 Number of resistance factors per bacterium in *Staphylococcus* spp. isolated from the healthy individuals and from the hospital ward environment

White column ($\square$) shows healthy individuals and shaded column (■) shows ward environment.

54.7% and 37.5%, respectively (Fig. 1). The average isolation rate for drug-resistant *Staphylococcus* was 25.7%. However, fewer antibiotic-resistant staphylococci were isolated from the healthy individuals than from the ward (Table 3 and Fig. 1).

The resistance factors to 7 antibiotics of *S. aureus*, *S. epidermidis*, *S. haemolyticus* and *S. hominis* isolated from the ward, were 2.6, 1.7, 3.2, and 2.5, respectively (Fig. 2). The average resistance factor for all 64 strains was 1.8. By contrast, the resistance factor in a bacterium isolated from the healthy individuals was less than 1.0. The average resistance factor was 0.6, which is one-third that from the ward environment. Thus, the isolation rate for drug-resistant strains and the average drug-resistance factor in a bacterium was higher in staphylococci from the ward environment than in staphylococci from healthy individuals. These findings have also been reported by others^{6,7)}.

Several reports have described MRSA isolated from healthy individuals^{1,2,8,9,10,11)}. Kawashima studied the nasal carriage of MRSA by medical staff and reported that the rate of isolation of MRSA in the anterior nares was high in patients, nurses and doctors, in this order. However, MRSA was not found in the student nurses or the laboratory staff⁸⁾. There were many nasal carriers of MRSA in the hospital or the ward where the patients were suffering from MRSA infections. Thus, the nasal carriers of MRSA in the hospital have been suggested to be related to nosocomial infection^{1,2,9,10)}. Patients with MRSA should be separated in an isolation room¹¹⁾. In the present study, we found a great difference in the isolation rate for *S. aureus* and MRSA between the isolates from the healthy individuals and those in the ward environment. For prevention of nosocomial infections it is important to comprehend the status of carriers of *S. aureus*, especially MRSA.

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健康人の鼻前庭より *Staphylococcus aureus* の分離

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要 旨

医学部学生から *Staphylococcus aureus* の分離を試み、さらに *Staphylococcus* spp. について薬剤感受性を調べた。検査した 70 人中 17 人の鼻前庭部に *S. aureus* が見出された (24.3%)。 *S. aureus* は全部で 22 株分離できたが、そのうち 14 株が ABPC

耐性、2 株が CMZ 耐性、2 株が GM 耐性、1 株が EM 耐性であった。DMPPC 耐性株は見つからなかった。同時に調査した附属病院の病棟より分離した *S. aureus* および *Staphylococcus* spp. よりも薬剤耐性度ははるかに低かった。