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Antibiotic Susceptibility of *Staphylococcus* spp. Collected from the Entrance Hall of the New Dispensary at Tottori University Hospital

Yoshinori Tanaka, Akiko Adachi, Tomofumi Ogoshi, Yoshiki Ohnishi, Naoto Kobayashi and Yasuhide Fukatsu

Department of Bacteriology, Faculty of Medicine, Tottori University, Yonago 683 Japan

Fifty-three strains of *Staphylococcus* were isolated from the entrance hall of the dispensary at the university hospital. The frequencies of *S. aureus*, MRSA in *S. aureus*, and DMPPC-resistant strains in all the strains of *Staphylococcus* isolated were 17%, 22% and 30%, respectively. In relation to our previous studies, these results fall between those from healthy individuals and those from a hospital ward.

Key words: epidemiology; methicillin-resistant *Staphylococcus aureus* (MRSA); nosocomial infection

Nosocomial infection with *Staphylococcus aureus* has become as troublesome as it used to be in the 1980s. One of the reasons for this is the occurrence of methicillin-resistant *Staphylococcus aureus* (MRSA) and multidrug-resistant strains of coagulase-negative staphylococci (CNS). In 1991 we investigated the occurrence of *Staphylococcus* spp. in the new ward of a university hospital over a 10 month period (Tanaka et al., 1992). Last November, a dispensary was opened at Tottori University Hospital, and we collected bacteria samples from the entrance hall to monitor drug-resistant strains of *Staphylococcus*.

Materials and Methods

Staphylococcus specimens were collected from the entrance hall of Tottori University Hospital on January 11 and February 14, 1996. Sterilized swabs were rubbed on the surface of handrails, doors, the service counter, and on the floor of the hall. These swabs were put directly on to nutrient agar plates and mannitol salt agar plates, which were incubated for 2 days at 37°C. Several colonies were selected at random from each plate and the bacteria were gram-stained, and gram-positive cocci were selected by oxidation-fermentation, and then identified using the N-IDtest·SP-18 (Nissui Seiyaku Co. Ltd., Tokyo, Japan). The *Staphylococcus aureus* identified was finally confirmed to be coagulase-positive.

Antibiotic susceptibility was performed by the disk method using ampicillin (ABPC), methicillin (DMPPC), cefmetazole (CMZ), erythromycin (EM), gentamicin (GM), tetracycline (TC), minocycline (MINO), and lomefloxacin (LFLX) (Showa disc; Showa Yakuhin Kako Co. Ltd., Tokyo). Antibiotic disk breakpoint zone sizes for resistance and susceptibility were set according to the manufacturer's instructions. The strains giving an intermediate or equivocal test result by the methicillin disk method were analyzed further by the dilution method.

Results

Fifty-three strains of *Staphylococcus* were isolated from the entrance hall of the university hospital. Twenty-six strains were isolated on January 11, and 27 strains were isolated on February 14, as shown in Table 1. Pathogenic

Abbreviations: ABPC, ampicillin; CMZ, cefmetazole; CNS, coagulase-negative staphylococci; DMPPC, methicillin; EM, erythromycin; GM, gentamicin; LFLX, lomefloxacin; MRSA, methicillin-resistant *Staphylococcus*; MINO, minocycline; TC, tetracycline.

Table 1. Isolation of *Staphylococcus* from the entrance hall of Tottori University Hospital on January 11 and February 14, 1996

Species	No. of strains isolated on: Jan. 11	Feb. 14	Total (%)
S. aureus	1	8	9 (17.0)
S. capitis	9	2	11 (20.8)
S. caprae	4	0	4 (7.5)
S. epidermidis	0	7	7 (13.2)
S. haemolyticus	8	2	10 (18.9)
S. hominis	0	1	1 (1.9)
S. intermedius	1	0	1 (1.9)
S. kloosii	1	0	1 (1.9)
S. lugdunensis	0	2	2 (3.8)
S. saprophyticus	0	1	1 (1.9)
S. warneri	2	2	4 (7.5)
S. xylosis	0	2	2 (3.8)
Total	26	27	53 (100)

strains of *S. aureus* (17%), opportunistic pathogens of *S. capitis* (21%) and *S. epidermidis* (13%), and nonpathogenic strains of *S. haemolyticus* (19%) were found. These 4 species and *S. hominis*, *S. saprophyticus*, *S. warneri* and *S. xylosis* are known to inhabit humans and are often isolated from clinical specimens (Schleifer and Koos, 1986). *S. caprae*, *S. intermedius*, *S. kloosii* and *S. lugdunensis* do not inhabit humans. These species of *Staphylococcus* are often found in the soil.

The drug susceptibility of isolated staphylococci is shown in Table 2. Forty-five per cent of all the isolates were ABPC-resistant, and 30% were DMPPC-resistant. Six strains of DMPPC-resistant *S. haemolyticus* were the most common strains isolated. *S. haemolyticus* and *S. aureus* had a high frequency of drug resistant factors (0.40 and 0.25, respectively). Only 2 strains were MINO-resistant.

Discussion

According to Bergey's Manual of Determinative Bacteriology, *Staphylococcus* has been classified into 28 species and 4 subspecies (Holt et al.,1994). The N-IDtest·SP-18 system can be used to separate the genus *Staphylococcus* into 26 species, however it cannot identify *S. filis* and *S. saccharolyticus*. In January, many strains of *S. capitis* and *S. haemolyticus* were isolated, and *S. aureus* and *S. epidermidis* were found in February. The reason this segregation occurred is unclear. Among the 12 species isolated, *S. aureus*, *S. capitis*, *S. epidermidis*, *S. haemo-*

Table 2. The susceptibility of the 53 isolates to antibiotics

Species	No. of strain	No. of strains resistant to: ABPC	DMPPC	CMZ	EM	GM	MINO	TC	LFLX	Total*
S. aureus	9	9	2	2	2	2	0	0	1	18 (0.25)
S. capitis	11	1	2	3	2	1	1	1	1	12 (0.14)
S. caprae	4	1	1	1	1	0	1	1	1	7 (0.22)
S. epidermidis	7	2	2	0	1	1	0	2	1	9 (0.16)
S. haemolyticus	10	7	6	2	6	3	0	3	5	32 (0.40)
S. hominis	1	1	0	0	0	0	0	0	0	1 (0.13)
S. intermedius	1	0	0	0	1	0	0	0	0	1 (0.13)
S. kloosii	1	0	0	0	0	0	0	0	0	0 (0)
S. lugdunensis	2	0	2	0	0	0	0	0	1	3 (0.19)
S. saprophyticus	1	0	0	0	0	0	0	0	0	0 (0)
S. warneri	4	2	0	0	0	0	0	0	0	2 (0.06)
S. xylosis	2	1	1	1	0	0	0	0	0	3 (0.19)
Total	53 (100)	24 (45.3)	16 (30.2)	9 (17.0)	13 (24.5)	7 (13.2)	2 (3.8)	7 (13.2)	10 (18.9)	88 (0.21)

*The average number of resistant factors is shown in parenthesis, and was calculated by dividing the total number of resistant factors by the number of strains and number of drugs used.

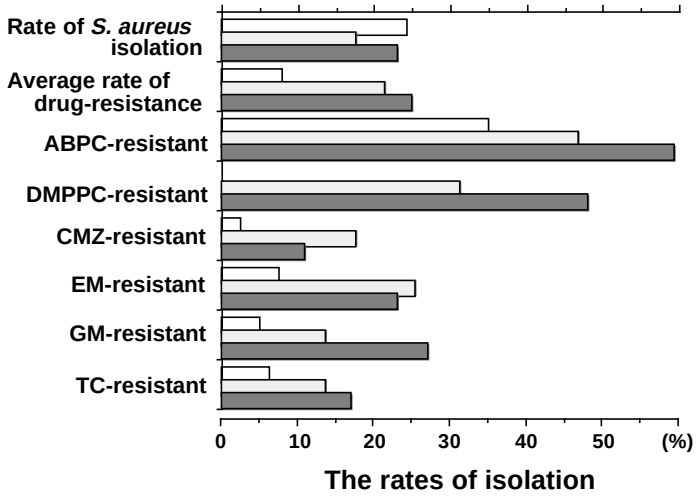

Fig. 1. The isolation of antibiotic-resistant *Staphylococcus aureus* strains from healthy individuals, the entrance hall and from the hospital environment.

The white column (▭) represents the healthy individuals, the dotted column (▭) represents the entrance hall, and the shaded column (▭) represents the ward environment.

lyticus, *S. hominis*, *S. saprophyticus*, *S. warneri* and *S. xylosis* inhabit humans, and are often isolated from clinical specimens (Schleifer and Koos, 1986). At the same time *S. capitis*, *S. epidermidis*, *S. saprophyticus* and *S. xylosis* are opportunistic pathogens to humans.

MRSA are known to be found in the hospital environment (Kusano and Nakasone, 1989; Hedin and Hambraeus, 1991; Ndawula and Brown, 1991; Kjolen and Andersen, 1992; Omori et al., 1992; Hedin, 1993; Richards et al., 1993; Mehtar, 1994; Cox et al., 1995; Layton et al., 1995). The frequency of MRSA in *S. aureus* was 55–80% (Kusano and Nakasone, 1989). We isolated MRSA from a ward environment for a period of a year just after the ward opened, and found that MRSA was isolated at a frequency of 20%, and the frequency of DMPPC-resistant *Staphylococcus* in all of the strains of *Staphylococcus* isolated was 48%. In this study, the frequency of MRSA isolation was 22%, and that of DMPPC-resistant *Staphylococcus* was 30% (Table 2). The frequency with which DMPPC-resistant strains were isolated was not as high as that of *Staphylococcus* in the ward. However, DMPPC-resistant strains of *Staphylococcus* clearly started to inhabit the new entrance hall.

In another of our experiments, *Staphylococcus* was isolated from young healthy students (Tanaka et al.,1993). Drug-resistant strains of *S. aureus* isolated from healthy individuals, the dispensary entrance hall, and a ward of the university hospital are shown in Fig.1. The frequency of isolating *S. aureus* in the genus *Staphylococcus* was almost the same in the 3 groups, but there were a lot of differences in the drug-resistance between the 3 groups of *S. aureus*. Efforts to reduce the number of drug-resistant strains of *Staphylococcus* are required to lower the risk of nosocomial infection.

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