

## Changes in bacteriology of discharging ears

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### Abstract

A bacteriological study on 161 consecutive out-patients presenting with otorrhoea was performed prospectively at a local teaching hospital in Taiwan between August 2000 and June 2001. A total of 177 isolates were recovered. *Staphylococcus aureus* was found in 77 (43.5 per cent) isolates, and non-*Staphylococcus aureus* in 100 (56.5 per cent) isolates. *Pseudomonas* sp was found to be the most common pathogen (28.8 per cent) in the non-*Staphylococcus aureus* group. *Staphylococcus aureus* had become more common than *Pseudomonas aeruginosa* in acute otitis externa, granular myringitis, and chronic otitis media in Taiwan. Methicillin-resistant *Staphylococcus aureus* (MRSA) was also an increasing problem in all three disease entities. The prevalence of community-acquired MRSA infections in discharging ears was found to be 13.7 per cent (22/161). MRSA were highly susceptible to vancomycin, teicoplanin, fusidic acid, and minocycline. More studies should be done to determine the susceptibility of MRSA to ofloxacin in the future.

**Key words:** Ear; Bacteriology; Methicillin Resistance; *Staphylococcus aureus*

### Introduction

*Pseudomonas aeruginosa* (*P aeruginosa*) and *Staphylococcus aureus* (*Staph aureus*) have been identified as the predominant isolates from cases of acute otitis externa<sup>1</sup> and chronic otitis media.<sup>2</sup> Gram negative bacilli, especially *P aeruginosa* and *Proteus* species, are the most commonly cultured organisms of granular myringitis.<sup>3</sup> Improved anaerobic bacteriological techniques in recent years have emphasized the role of anaerobes in both chronic otitis media and acute otitis externa.<sup>4,5</sup> Although the entire spectrum of these organisms that cause such ear infections have been published in various geographical locations, these data are old. With the wide usage of antibiotics and the emergence of many new resistant bacterial strains, it has become necessary to re-evaluate the most recent bacteriology of discharging ears in Taiwan. Therefore, the purpose of this study was to investigate the current bacteriology of ear infections and to compare the results with previous reports from Taiwan.

### Materials and methods

This study was carried out prospectively on 161 consecutive out-patients presenting with otorrhoea between August 2000 and June 2001. Among these patients, 88 were male, 73 were female, and their ages ranged from one to 85 years. The bacteriological culture was obtained as follows: excess dis-

charge was removed from the external auditory canal with a sterile cotton pledget on an ear probe, and the specimens were taken near the tympanic membrane using a sterile cotton swab. It was then inoculated into culture media separately for aerobic and anaerobic culture. The specimens were processed and identified by conventional methods. The susceptibility of the isolated organisms to antimicrobial agents was tested by the Kirby-Bauer method. Only cultures that revealed a moderate to heavy amount of bacterial growth were considered significant and included in this study. Fungi were excluded. At the same time, the status of the tympanic membrane was inspected by the senior otologist to determine the disease entities: acute otitis externa, granular myringitis, or chronic otitis media. The pathogens were categorized into three groups: methicillin-resistant *Staph aureus* (MRSA), methicillin-susceptible *Staph aureus* (MSSA), and non-*Staph aureus* (Non-SA). The results were compared with previous reports from Taiwan.

### Results

A total of 177 isolates were recovered from the 161 cultures. *Staph aureus* was found in 77 (43.5 per cent) isolates, and non-*Staph aureus* in 100 (56.5 per cent) isolates. *Pseudomonas aeruginosa*, which was found in 51 (28.8 per cent) isolates, was the most common pathogen in the non-*Staph aureus* groups. These

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TABLE I  
ORGANISMS ISOLATED FROM DISCHARGING EARS

	Isolates (%)
MSSA	54 (30.5)
MRSA	22 (13.0)
Non SA	
<i>P. aeruginosa</i>	51 (28.8)
Coagulase (-) Staph	13 (7.3)
<i>Enterobacter</i> sp.	6 (3.4)
<i>Proteus</i>	4 (2.3)
Others	23 (12.4)
<i>Clostridium</i>	4 (2.3)
Total	177 (100)

results are shown in Table I. For each individual disease entity, the results are as follows:

*Acute otitis externa*

A total of 47 isolates were recovered from 42 specimens. Anaerobes consist of only 2.4 per cent (one out of 42) of all these specimens. Mixed infection was found in five (11.9 per cent) cultures. Compared with a study by Juan in 1986, slightly increased numbers of Gram positive organisms were noted (Juan, 1986, unpublished data). *Staph aureus* was the most common pathogen in acute otitis externa and MRSA was recovered from four (8.5 per cent) isolates. Figure 1 reveals the changes in the bacterial pattern of acute otitis externa.

*Granular myringitis*

Twenty-one specimens from patients with granular myringitis yielded 24 isolates. Anaerobic bacteria were found in one (4.8 per cent) specimen. Mixed infections were noted in three (14.3 per cent) cultures. The numbers of *Staph aureus* had increased since 1990s. But MRSA had not been seen previously. Again, *Staph aureus* was the most common pathogen in this study. MRSA was recovered in two (8.3 per cent) isolates. Figure 2 shows the bacteriology of GM now and previously.<sup>6,7</sup>

*Chronic otitis media*

A total of 106 isolates were recovered from the 98 specimens from patients with chronic otitis media.

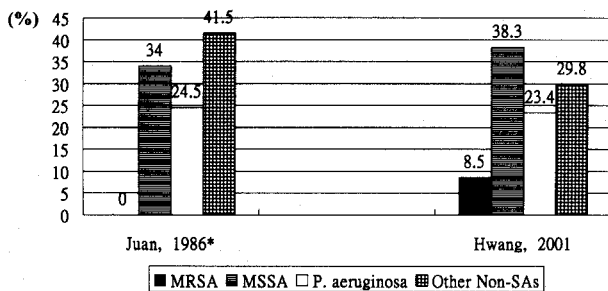


FIG. 1

Comparison of bacteriology in acute otitis externa. (Juan, 1986 unpublished data)

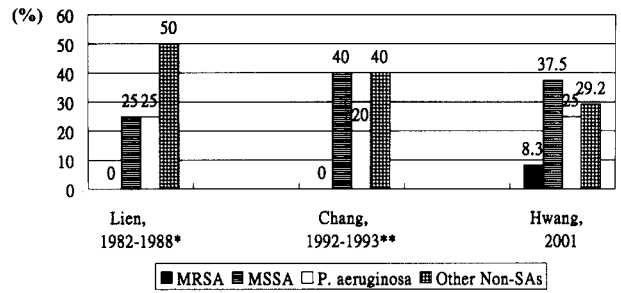


FIG. 2

Comparison of bacteriology in granular myringitis. \* (Lien and Chang, 1996)<sup>6</sup> \*\* (Chang and Lien, 1995)<sup>7</sup>

There was no cholesteatoma in any cases. Anaerobes were isolated in only 2.0 per cent (two out of 98) of these specimens. Mixed infection was found in seven (7.1 per cent) cultures. Compared with previous reports, the number of Gram positive organisms was greatly increased, especially *S. aureus* isolates. Also, *Staph aureus* had replaced *Pseudomonas* to become the most common pathogen in chronic otitis media. MRSAs were recovered in 16 (15.1 per cent) isolates. Figure 3 shows the changes of bacteriology in chronic otitis media.<sup>8</sup>

*MRSA ear infections*

The percentage of MRSA among *Staph aureus* isolates was 28.6 per cent (22/77). The prevalence of community-acquired MRSA infections in the discharging ear was 13.7 per cent (22/161). Mixed infection (two isolates of MRSA and *Pseudomonas aeruginosa*) was recovered in one of 22 cultures. Comparing MRSA with other pathogens, there was no obvious difference in the distribution of sex and age. Community-acquired MRSA infection was more common in chronic otitis media than in acute otitis externa and granular myringitis (16.3 per cent, 9.5 per cent and 9.5 per cent, respectively). Susceptibility of MRSA and MSSA to various antibiotics is shown in Table II. MRSA was highly susceptible to vancomycin, teicoplanin, fusidic acid, and minocycline. But, the sensitivity to gentamicin, clindamycin, and erythromycin was low.

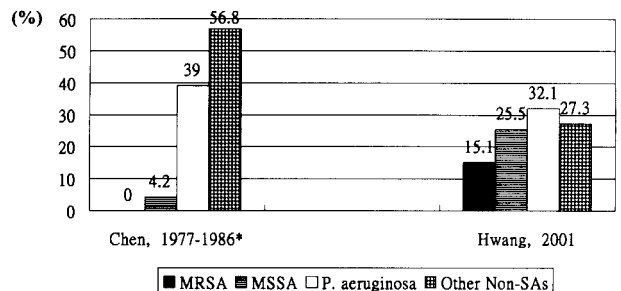


FIG. 3

Comparison of bacteriology in chronic otitis media. \* (Chen et al., 1992)<sup>8</sup>

TABLE II  
SUSCEPTIBILITY OF MRSA AND MSSA ISOLATES TO VARIOUS  
ANTIBIOTICS

	Susceptibility	
	MRSA	MSSA
Vancomycin	22/22 (100%)	54/54 (100%)
Teicoplanin	22/22 (100%)	54/54 (100%)
Minocycline*	21/22 (95.5%)	54/54 (100%)
Fusidic acid*	21/22 (95.5%)	53/54 (98.1%)
Gentamicin	7/22 (31.8%)	53/54 (98.1%)
Clindamycin*	3/22 (13.6%)	32/54 (59.3%)
Erythromycin*	2/22 (9.1%)	28/54 (51.9%)

\*Oral form was available.

## Discussion

In this study, we have found that *Staph aureus* has replaced *P. aeruginosa* as the most common pathogen of chronic otitis media in Taiwan. Vartiainen<sup>9</sup> also discovered this tendency in his series. In Japan, Kato *et al.*<sup>10</sup> also reported that *Staph aureus* had become more common than *P. aeruginosa* between 1989 and 1992. These reports demonstrate that *Staph aureus* caused chronic otitis media had dominated in various geographical locations. *Pseudomonas* and *Proteus* species had previously been the most commonly found pathogens in chronic otitis media. The presence of *Proteus* species was found to be statistically significant in cases with cholesteatoma. In our study, the low percentage of *Proteus* species may be explained partially by the absence of cholesteatoma. Also, the discrepancy may be due to differences in geographical location.

Anaerobes and mixed infections were most frequently detected in ears with extensive cholesteatoma or granulation tissue formation.<sup>8</sup> They can be isolated from up to 50 per cent of cases with chronic otitis media.<sup>11</sup> Although previously *Bacteroides* species were found to be the most common anaerobic pathogens in chronic otitis media and acute otitis externa. Only *Clostridium* species were found in our cases. The absence of cholesteatoma in this series is considered as the main reason for this finding.

*P. aeruginosa* was shown to be the most common isolate from acute otitis externa until 1995 by various authors<sup>1,4</sup> with the exception of Makino's report in 1988.<sup>12</sup> In Taiwan, Juan's and our studies showed that *Staph aureus* was the most common isolate from acute otitis externa since 1986. Increased growth of *Staph aureus* isolates, especially MRSA, was shown in all of these three diseases. These changes may be due to the improvement of public health, the decreased severity of ear diseases, and the use of antimicrobial drug therapy during this time. Simultaneously, the growth of anaerobes increased in acute otitis externa and granular myringitis, but decreased in chronic otitis media in Taiwan. Further studies should be performed to determine whether there have been changes in the pattern of anaerobes in discharging ears.

In 1961, the first strains of MRSA were noted. The percentage of nosocomial MRSA increased from two per cent in 1974 to approximately 50 per cent in

1997.<sup>13,14</sup> A similar trend was also found in Taiwan during the past 10 years. Recently, the prevalence of community-acquired MRSA infections also rose in various fields.<sup>15-17</sup> But, they had rarely been reported in discharging ears. Previous reports of community-acquired MRSA infections were often linked to intravenous drug abuse, cystic fibrosis, chronic diseases, and repeated antimicrobial therapy.<sup>15,18</sup> Recently, the prevalence of community-acquired MRSA infections without identified risk factors in both adults and children also increased.<sup>16-19</sup> Moreover, Moreno *et al.*<sup>15</sup> reported that patients with community MRSA isolates were indistinguishable from those with community MSSA isolates in the case-control study, including age, sex, and risk factors, etc. In the ear, however, our findings showed that irradiated ears had higher percentage of MRSA isolates.

The MRSA strains revealed antibiotic susceptibility and resistance profiles different from typical hospital-acquired MRSA isolates. Nosocomial MRSA tends to exhibit multiple antibiotic-resistance patterns. In contrast, community-acquired MRSA are generally susceptible to more antibiotics.<sup>18</sup> Also, Herold *et al.*<sup>17</sup> demonstrated that community-acquired MRSA isolates obtained from children with identifiable risks were resistant to more drugs than those without identifiable risks. However, high resistance to erythromycin, clindamycin, and gentamicin was noted in our cases with few risk factors. This might be due to antibiotic abuse over the years. In the literature, the susceptibility of MRSA to new quinolone otics is still controversial. Ikeda and Takasaka<sup>20</sup> reported that otic drops containing the fluorinated quinolones, ofloxacin and NY-198, demonstrated high *in vitro* activity against MRSA organisms causing purulent otitis media. However, MRSA organisms still occurred in 34.7 per cent of all post-operative infections despite using ofloxacin-soaked packing as reported by Suh *et al.*<sup>21</sup> Resistance of MRSA to ciprofloxacin has also been reported by several investigators.<sup>22,23</sup> Therefore, whether ofloxacin otics is an effective treatment update for MRSA ear infections is still unclear.

Our results are in agreement with Brumfitt's opinion<sup>24</sup> that vancomycin remained the treatment of choice for MRSA infections. However, the drawbacks of treatment with vancomycin or other intravenous antibiotics include cost, adverse effects, toxic reactions, and inconvenience for out-patients. In this article, we showed very good susceptibility of MRSA to two oral antibiotics: minocycline and fusidic acid. Combined with the ofloxacin otics, all of our patients had complete remission of otorrhoea within two weeks. Intravenous antibiotics were not necessary. So, we suggest that this regimen should be tried first for community-acquired MRSA infections in discharging ears.

More studies should be performed to determine the susceptibility of MRSA to ofloxacin, and to develop a new otological agent in the future. Intervention against the spread of MRSA should be more aggressive and immediate.

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