



Characteristics of community-acquired methicillin-resistant *Staphylococcus aureus* in infants and children without known risk factors

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This retrospective study sought to determine the characteristics of community-acquired methicillin-resistant *Staphylococcus aureus* (CA-MRSA) infections in patients younger than 18 years without known risk factors who were treated at a teaching hospital in central Taiwan. Epidemiological and clinical data were collected from medical charts. Possible risk factors included hospitalization within the past 6 months, transfer from other hospitals or nursing homes, and having underlying illness. A total of 173 isolates of community-acquired *S. aureus* were analyzed. Seventeen (9.8%) of these 173 isolates were methicillin-resistant *S. aureus* collected from patients without risk factors, 31 (17.9%) were methicillin-resistant *S. aureus* from patients with risk factors, and the other 125 (72.3%) were methicillin-susceptible *S. aureus*. Most isolates of community-acquired methicillin-resistant *S. aureus* collected from patients without risk factors (14/17, 82.4%) were obtained from the infected wounds of skin or soft tissues. Only 4 (23.5%) in 17 patients with isolates resistant to methicillin were prescribed antimicrobial therapy with glycopeptides. Nevertheless, all patients recovered without any long-term sequelae. These results highlight the fact that community-acquired methicillin-resistant *S. aureus* infections occur frequently in Taiwan among patients who have no established risk factors for this infection.

Key words: Children, community-acquired, methicillin-resistant *Staphylococcus aureus*

Community-acquired methicillin-resistant *Staphylococcus aureus* (CA-MRSA) infections in both outpatients and inpatients are increasing in prevalence among adults and children [1-7]. Although the majority of these cases occur in individuals with discernible predisposing risk factors, CA-MRSA may also occur in people without known risk factors [1,7-13]. In 1995, 3 research groups reported cases of CA-MRSA infection in pediatric patients without discernible risk factors [8,9,13]. Since then, more and more strains have been isolated and reported in different locations around the world. In Taiwan, several cases of CA-MRSA infection have been reported since December 1999 [14,15]. However, no study have involved patients less than 18 years of age. The purpose of this retrospective study was to determine the characteristics of CA-MRSA in patients younger than 18 years treated at a teaching

hospital in central Taiwan who had no known risk factors.

Materials and Methods

Medical records of patients younger than 18 years treated for CA-MRSA infection from May 1999 through December 2000 at the China Medical College Hospital were reviewed. A case was considered community-acquired if MRSA was isolated from cultures of outpatients or within 72 h after admission, according to the Centers for Disease Control and Prevention criteria [16]. Patients who had been hospitalized within the past 6 months, transferred from other hospitals, or resided in nursing homes or other long-term-care facilities were considered to be at increased risk of MRSA infection [2,17,18]. Isolation of an MRSA organism was classified as either a colonization or an infection depending on the presence of signs or symptoms [19]. Patients considered to have colonization were excluded.

Data were collected from medical records on the age, sex, residency status, travel history, admitting

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service, history of intravenous drug use, family members or close relatives with pyoderma, previous antimicrobial therapy, surgical intervention, site of culture, and antimicrobial susceptibilities. Medical records were also reviewed to collect data on the underlying health conditions, including premature delivery, cerebral palsy, diabetes mellitus, chronic lung disease, skin disease, malignancy, vascular disease, liver disease, and the presence of an indwelling catheter or prosthetic device at admission. Patients with any of the above risk factors were excluded.

Susceptibility of *S. aureus* isolates was evaluated using disc diffusion testing at the microbiology section of the China Medical Collage Hospital (Taichung). Disc diffusion testing was performed as recommended by the National Committee for Clinical Laboratory Standards [20].

Results

A total of 415 *S. aureus* isolates were identified during the period of surveillance (Table 1); 101 (24.3%) were MRSA and 314 (75.8%) were methicillin-susceptible *S. aureus* (MSSA). Among the 101 MRSA isolates, 48 (47.5%) were community-acquired and 53 (52.5%) were hospital-acquired. Among the 48 CA-MRSA isolates, 17 (35.4%) were obtained from patients without predisposing risk factors and 31 (64.6%) were from patients with risk factors. With reference to the total number of CA-SA isolates in this study ($n = 173$), the percentage of CA-MRSA infection in patients without risk factors is 9.8% (17/173).

The mean annual admission number in a pediatric facility was 7812 from 1999 through 2000. The number of patients without risk factors who were hospitalized due to CA-MRSA infection was 14, giving an incidence of 108 per 100 000 admissions per year (Table 1). Similarly, the incidence for patients with risk factors was 184 per 100000 admissions. The incidence of nosocomial MRSA infection was 407 per 100 000

admissions. Among the 314 MSSA isolates, 125 (39.8%) were community-acquired and 189 (60.2%) were hospital-acquired.

The clinical characteristics of the 17 MRSA-infected patients without risk factors are shown in Table 2. Six (35.3%) of these patients were boys and 11 (64.7%) were girls. Children were aged between 6 months and 1 year in 29.4% of cases, from 1 to 3 years in 35.3%, from 3 to 7 years in 11.8%, and older than 7 years in 23.5%. The isolation of MRSA was scattered in time throughout the 20-month study period.

Fourteen (82.4%) patients had various skin or soft-tissue infections (Table 2), including abscess, acute otitis externa, staphylococcal scalded skin syndrome, cellulitis, pustules, and carbuncles. Two patients had osteomyelitis and one had acute otitis media with eardrum perforation. None of the 14 patients admitted to the pediatric facility required transfer to the intensive care unit.

All isolates of CA-MRSA had the same antimicrobial susceptibility test results, which showed resistance to penicillin and sensitivity to vancomycin. Most patients were initially treated with oxacillin or a first-generation cephalosporin, and only 4 patients were prescribed glycopeptides. The reasons for changing antibiotics included severe infection in 2 patients and progressive infection after antimicrobial therapy in 2. The 2 patients with osteomyelitis had temporal motility defect, but were eventually recovered. There were no deaths or serious complications.

Discussion

It is now clear that the problem of CA-MRSA has become widespread as shown by reports from different parts of the United States including Dallas, Minnesota, North Dakota, Hawaii, and Chicago [2-4], as well as in Canada [5] and Australia [6]. Recent studies have also shown that the prevalence of CA-MRSA is increasing [7]. This present results and previous epidemiologic

Table 1. Incidence of *S. aureus* isolates at the China Medical College Hospital, 1999 to 2000

Source of isolate	No. of isolates in admission cases	Rate/100000 admissions	No. of isolates in OPD cases	Total
MRSA				
Community-acquired with no risk factors	14	108	3	17
Community-acquired with risk factors	24	184	7	31
Hospital-acquired	53	407		53
MSSA				
Community-acquired	91	698	34	125
Hospital-acquired	189	1451		189
Total	369	2832	46	415

Abbreviations: OPD = outpatient department; MRSA = methicillin-resistant *S. aureus*; MSSA = methicillin-susceptible *S. aureus*

Table 2. Characteristics of patients with community-acquired methicillin-resistant *S. aureus* infection without risk factors, 1999 to 2000

Patient no.	Age	Sex	Clinical diagnosis	Initial therapy	Final therapy	Admission/ICU/sequela
1	1y3m	F	Abscess; buttock	CEX	Oxa + GM; I/D	+/-/-
2	4y	M	AOE	Amo	Amo/cla	-/-/-
3	8y	F	Osteomyelitis; tibia	Oxa	Teico; op	+/-/+
4	9m	F	SSSS, eczema	Oxa + GM	VCM	+/-/-
5	6y	F	Cellulitis; thigh	Oxa + GM	Oxa + GM	+/-/-
6	1y	F	Pustule; finger	CEX	CEX; I/D	-/-/-
7	3y	M	AOM perforation	Amo/cla	Amo/cla	+/-/-
8	1y3m	F	Carbuncle; temporal	Oxa + GM	Oxa + GM; I/D	+/-/-
9	16y	F	Carbuncle; umbilicus	Oxa	Oxa	+/-/-
10	6m	F	Carbuncle; occipital	Oxa	Oxa	+/-/-
11	2y	F	Cellulitis; buttock	Oxa + GM	VCM	+/-/-
12	8y	M	Abscess; finger	CEX	CEX	-/-/-
13	7m	F	SSSS; impetigo	Oxa + GM	Oxa + GM	+/-/-
14	15m	M	Osteomyelitis; knee	Oxa + GM	VCM; op	+/-/+
15	10m	F	Cellulitis; periorbital	Oxa + GM	Oxa + GM	+/-/-
16	2y	M	Cellulitis; lower leg	Oxa + GM	Oxa + GM	+/-/-
17	8y	M	Abscess; postauricular	CLD + GM	CLD + GM; I/D	+/-/-

Abbreviations: ICU = intensive care unit; CEX = cephalexin; Oxa = oxacillin; GM = gentamicin; I/D = incision and drainage; AOE = acute otitis externa; Amo = amoxicillin; Amo/cla = Amoxicillin/clavulanate; Teico = teicoplanin; op = operation; SSSS = staphylococcal scalded skin syndrome; VCM = vancomycin; AOM = acute otitis media; CLD = clindamycin

observations indicate an important change in the epidemiology of MRSA infections.

This study showed that MRSA infection is no longer limited to pediatric patients at risk for nosocomial infection or those who have other predisposing factors, a finding consistent with several previous studies [1,7-13]. For example, the finding in this series that 35.4% of children with CA-MRSA had no identifiable risk factors is concurred by Herold *et al* [7], despite the differences in the studied populations and methods used in the 2 studies; the latter found that 26 (60%) of 43 community-acquired infections were in children without identified risk. This finding may be related to colonization in the community, schools, or daycare centers [4,11,12]. Although most reported epidemiologic data are from pediatric patients, CA-MRSA infections in adults without risk factors have recently been reported in Hawaii and Australia [2,6], indicating that this problem is no longer confined to the pediatric population.

The predominant sources (82.4% of cases) of the CA-MRSA isolates in this study were skin, wound, abscess, and soft tissues; similarly, the most common diagnoses were cellulites or abscess. This finding corresponds to previous investigations [2,7,13,21-24]. Most patients in this study were less than 3 years old; this high prevalence of CA-MRSA in toddlers (less than 3 years old) is consistent with previous data [7,11]. The isolation of CA-MRSA during the 20-month period of this study was not confined to a few months but was scattered in time, suggesting that the increase did not represent a mini-outbreak.

In spite of the growing rate of CA-MRSA, this study showed that penicillin derivatives can successfully cure CA-MRSA infections with or without the combination of surgical drainage in most cases. Previous studies have also demonstrated that CA-MRSA is more susceptible than nosocomial MRSA isolates to several unrelated antimicrobials, such as clindamycin, gentamicin, and trimethoprim/sulfamethoxazole [1-4,7,11]. This suggests that oxacillin and the other first-line antibiotics mentioned above are still effective empiric antimicrobial agents in most conditions when community-acquired *S. aureus* is highly suspected. Although no vancomycin-resistant *S. aureus* strains were found, the use of glycopeptides as the initial empiric therapy in community-acquired *S. aureus* infections is not justifiable, except when serious or critical conditions necessitate their use. However, if the prevalence of CA-MRSA continues to increase, it may be prudent to consider empirical antimicrobial therapy against community-acquired *S. aureus* infections caused by MRSA, particularly in patients with critical infections.

A limitation of this investigation was its retrospective design based on chart review. Because patients were from different socioeconomic classes, it is possible that some risk factors were not recognized. This study was performed in an inner city hospital in central Taiwan, and therefore the data cannot be extrapolated to the general population in Taiwan. To fully define the extent of the problem of MRSA infections in children without identified risk factors, further population-based studies are required.

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