Epidemiology of *Staphylococcus aureus* Infections and the prevalence of Infection Caused by Community-Acquired Methicillin-Resistant *Staphylococcus aureus* in Hospitalized Patients at Siriraj Hospital

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Background: *The CA-MRSA infections have emerged in many parts of the world over the past decade. To our knowledge, the prevalence of CA-MRSA infections in Thai patients is unknown.*
Objective: *To determine an epidemiology of Staphylococcus aureus (S. aureus) infections in hospitalized patients in Siriraj Hospital and the prevalence of infections caused by community-acquired methicillin-resistant S. aureus (CA-MRSA).*
Material and Method: *The study was carried out at Siriraj Hospital from January to May 2005. The eligible patients were hospitalized patients whom S. aureus were isolated from their clinical specimens submitted to Department of Microbiology. S. aureus isolate was classified into infection or colonization. S. aureus infections were further classified into methicillin-resistant S. aureus (MRSA) or methicillin-sensitive S. aureus (MSSA) infections, and hospital-acquired (HA) or community-acquired (CA) infections. CA-MRSA infection is defined as infection caused by MRSA isolated from the patient within 72-hour of hospitalization and has no features of HA MRSA infections.*
Results: *There were 669 S. aureus isolates from 448 patients. Two hundred and sixty two patients (58.5%) were MSSA whereas 186 (41.5%) were MRSA infections. CA-MRSA was found in three isolates (0.9% of total MRSA) from two patients.*
Conclusion: *The prevalence of CA-MRSA infections in hospitalized patients in Siriraj Hospital was uncommon and these patients could probably be HA MRSA infections.*

Keywords: *Prevalence, Staphylococcus aureus, Methicillin-resistant, Community-acquired, Cross sectional study, Cohort study,Thailand*

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The penicillinase-stable beta-lactams such as cephalosporins, methicillin and nafcillin became available in the late 1950s[1]. Ironically, the first methicillin-resistant *Staphylococcus aureus* (MRSA) was described at about the same time[2, 3]. The prevalence of MRSA progressively increased thereafter[4, 5]. A survey of the National Nosocomial infections Surveillance System reported that the hospital prevalence MRSA increased from 2.1% in 1975 to 35% in 1991[6]. It is currently as high as 70% in certain centers, but great geographic variations exists. The data from the SENTRY Antimicrobial Surveillance Program during 1997 and 1999 revealed that the MRSA prevalence varied as follows: Western Pacific region, 46%; United States, 34.2%; Latin America, 34.9%; Europe, 26.3%; Canada, 5.7%. Moreover, a variation of MRSA varied greatly among countries within a region. In European centers, the percentages of MRSA varied from less than 2% in the Netherlands to 54.4% in Portugal. In Western

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Pacific countries, MRSA ranged from 23.6% (Australia) to more than 70% in Japan and Hong Kong[7]. In Thailand, from a survey of 32 hospitals (1998-2001), the MRSA ranged from 24-36%. MRSA has traditionally been considered a healthcare-associated pathogen in patients with established risk factors[8-10]. MRSA has become a major cause of hospital-acquired (HA) infections over the past decade.[11]

MRSA is an emerging community pathogen. It was first reported in the early 1990s among closed communities of Aborigines in Western Australia[12]. Fatal community-acquired MRSA (CA-MRSA) infections were reported in USA in 1999[13]. Outbreaks of CA-MRSA infections in healthy children, adolescents, and adults were described worldwide[13-25]. CA-MRSA infections tend to occur in younger persons than do hospital-acquired MRSA (HA-MRSA) infections. They often cause sporadic cases of skin and soft tissue infections but cases of necrotizing pneumonia were also reported[26]. CA-MRSA was found to be associated with virulent strains producing Panton-Valentine leucocidin (PVL) and a variety of other exotoxins[27]. It showed resistance to methicillin, which is encoded by the *mecA* gene, mostly found on the type IV staphylococcal cassette chromosome (SCC)[16]. The spread of CA-MRSA strains was not limited to the community and might also be seen in the hospital setting[28]. A recent meta-analysis reported a pooled MRSA colonization prevalence rate of 1.3% in 10 studies testing a total of 8,350 persons in the community, whereas the respective prevalence rate was 0.2% in studies excluding persons exposed to healthcare services[29]. In this meta-analysis, it was also found that MRSA colonization was more frequent among persons in the community from whom cultures were obtained in the healthcare setting compared with those screened outside the healthcare setting[29]. Studies from some states in USA showed an increase in the number of CA-MRSA clinical isolates during the past decade[15, 21, 23], whilst this number remained stable in other states[14]. Factors that might facilitate the spread of CA-MRSA within hospitals included admission of unrecognized carriers from the community, prolonged asymptomatic colonization, inadequate laboratory identification and report, and inadequate adherence to hand hygiene and contact precaution measures.

The CA-MRSA infections have emerged in several parts of the world over the past decade. An emergence of CA-MRSA was reported from Taiwan with relatively high incidence (25-75%)[30, 31] whereas a true CA-MRSA infection was very rare in Singapore[32,33]. To our knowledge, a prevalence of CA-MRSA infections in Thailand is unknown. This study determines an epidemiology of *S. aureus* infections in hospitalized patients in Siriraj Hospital and the prevalence of infections caused by CA-MRSA.

Material and Method

Subjects and Study Procedures

The study was approved by the Ethics Committee on Human Research of Faculty of Medicine Siriraj Hospital. This cross sectional study was carried out from January 1 to May 31, 2005 at Siriraj Hospital, a 2,000-bed tertiary care university hospital in Bangkok, Thailand. The eligible patients were hospitalized patients whom *S. aureus* were isolated from their clinical specimens submitted to Department of Microbiology. *S. aureus* isolates were classified into infection or colonization. *S. aureus* infections were further classified into MRSA or MSSA; and nosocomial, HA or community-acquired (CA) infections. CA is defined as infection caused by MRSA isolated from the patient within 72-hour of hospitalization and has no features of HA MRSA infections, history of hospitalization, surgery, dialysis, or residence in a long-term care facilities within one year of the MRSA culture date or a permanent indwelling catheter or percutaneous medical device (e.g. tracheostomy tube, gastrostomy tube, or urethral catheter) present at the time of cultures, a known positive culture for MRSA prior to the study period or who had been discharged from an acute care hospital within 10 days. Nosocomial infection is the infection occur-

Table 1. Classification of cases with *S. aureus* isolated from their clinical specimens

Classification of cases		No. of cases (%)
MSSA*		262 (100)
	Community-acquired	68 (26.0)
	Nosocomial	117 (44.7)
	Healthcare-associated	77 (29.4)
MRSA**		186 (100)
	Community-acquired	2 (1.1)
	Nosocomial	154 (82.8)
	Healthcare-associated	30 (16.1)
Total		448 (100)

* Methicillin-Sensitive *Staphylococcus aureus*
** Methicillin-Resistant *Staphylococcus aureus*

ring in the patient who has been hospitalized for more than 72-hour or who had been discharged from an acute care hospital within 10 days. The isolates that are neither CA nor nosocomial-acquired therefore, belong to the "healthcare-associated" setting and are classified as HA infections. The medical records of the eligible subjects were reviewed. The relevant information regarding clinical data and microbiological data of each

Table 2. Demographics of 446 cases with *S. aureus* isolated from their clinical specimens

Demographic data		Type of *S. aureus*		
		MSSA (N=262)	MRSA (N=184)	p
Age	Mean (yr.)	44.9	55.3	<0.001
	Standard Deviation(yr.)	27.3	24.0	
	Minimum (d.)	1	7	
	Maximum (yr.)	93.0	95.0	
Gender	Male	129 (49.2%)	99 (53.8%)	0.39
Nationality	Thai	251 (95.8%)	179 (97.3%)	0.57
	Others	11 (4.2%)	5 (2.7%)	
Location of the residence	Central	218 (83.2%)	152 (82.6%)	0.72
	Northeast	17 (6.5%)	12 (6.5%)	
	South	11 (4.2%)	8 (4.3%)	
	North	7 (2.7%)	2 (1.1%)	
	Others	9 (3.5%)	10 (5.5%)	
Occupation	Nursing home	1 (0.4%)	0	NA*
	Government employee	15 (5.7%)	12 (6.5%)	
	Farmer	7 (2.7%)	6 (3.3%)	
	Student	28 (10.7%)	10 (5.4%)	
	Employee	46 (17.6%)	21 (11.4%)	
	Free	13 (5.0%)	16 (8.7%)	
	None	150 (57.2%)	117 (63.5%)	
	Others	2 (0.8%)	2 (1.1%)	
Living arrangement	Private	257 (98.1%)	181 (98.4%)	1.0
	Nursing home	5 (1.9%)	3 (1.6%)	

* Not available

Table 3. Clinical data of 446 patients

Clinical data		Type of *S. aureus*		
		MSSA (N=262)	MRSA (N=184)	p
Ward	Medicine	105 (40.1%)	118 (64.1%)	<0.001
	Surgery	87 (33.3%)	48 (26.1%)	
	OB&GYN	7 (2.7%)	1 (0.5%)	
	Pediatrics	38 (14.5%)	10 (5.4%)	
	EENT	16 (6.1%)	6 (3.2%)	
	Others	9 (3.5%)	1 (0.5%)	
History of healthcare-associated conditions		158 (60.3%)	145 (78.8%)	<0.001
Catheter or device		42 (16.0%)	40 (21.7%)	0.16
Prior presence of MRSA		2 (0.8%)	14 (7.6%)	<0.001
Hospitalization > 72 h*		108 (41.2%)	142 (77.2%)	<0.001
Prior hospitalization		150 (57.3%)	145 (79.2%)	<0.001

*Hospitalization more than 72 hours or who had been discharged from an acute care hospital within 10 days

Table 4. Underlying medical conditions of 446 patients

Underlying diseases / conditions		Type of *S. aureus* MSSA(N=262)	MRSA (N=184)	p
Pulmonary diseases	COPD	4 (1.5%)	14 (7.6%)	0.06
	Bronchial asthma	4 (1.5%)	1 (0.5%)	
	ILD	2 (0.8%)	0	
	Prior pneumonia	1 (0.4%)	0	
	Others	14 (5.3%)	16 (8.7%)	
Neoplastic diseases		57 (21.8%)	45 (24.5%)	0.58
Liver diseases	Cirrhosis	11 (4.2%)	17 (9.2%)	0.07
	Chronic active hepatitis	1 (0.4%)	1 (0.5%)	
	Others	4 (1.5%)	3 (1.6%)	
Heart diseases	CHF	5 (1.9%)	4 (2.2%)	0.13
	CAD	24 (9.2%)	25 (13.6%)	
	Valve replacement	1 (0.4%)	2 (1.1%)	
	Congenital heart diseases	7 (2.7%)	3 (1.6%)	
	Others	8 (3.1%)	9 (4.9%)	
Neurologic diseases	Stroke	22 (8.4%)	19 (10.3%)	0.01
	TIA	1 (0.4%)	0	
	Cerebral palsy	1 (0.4%)	0	
	Bed-ridden status	8 (3.1%)	14 (7.6%)	
	Others	14 (5.3%)	18 (9.8%)	
Renal diseases	Azotemia	7 (2.7%)	14 (7.6%)	0.13
	Chronic kidney disease	15 (5.7%)	10 (5.4%)	
	HD via catheter	15 (5.7%)	9 (4.9%)	
	HD via AVF	9 (3.4%)	7 (3.8%)	
	Peritoneal dialysis	2 (0.8%)	3 (1.6%)	
	Others	2 (0.8%)	4 (2.2%)	
Diabetes mellitus		55 (21.0%)	53 (28.8%)	0.07
High alcohol intake		16 (6.1%)	16 (8.7%)	0.20
Smoking		25 (9.5%)	19 (10.3%)	0.60
Neutropenia		5 (1.9%)	13 (7.1%)	0.01
Splenectomy		1 (0.4%)	1 (0.5%)	1.0
Metabolic disorder		2 (0.8%)	4 (2.2%)	0.24
Recent operation		15 (5.7%)	15 (8.2%)	0.52
Implanted devices	Pacemaker	0	1 (0.5%)	0.03
	Others	13 (5.0%)	19 (10.3%)	
Recent corticosteroid		8 (3.1%)	17 (9.2%)	0.02
Immuno-suppressives		21 (8.0%)	22 (12.0%)	0.28
Others		111 (42.4%)	83 (45.1%)	0.63

subject were retrieved and entered into the structured case record forms.

Data Analysis

Data were expressed as percentage and mean $\pm$ SD for nominal and continuous variables, respectively. Analyses were performed using SPSS 13.0 (SPSS Inc, Chicago, Illinois). Nominal variables were compared by Chi-square test or Fisher's Exact test and continuous variables were compared by two-tailed unpaired t-test or Mann-Whitney U test as appropriate. The statistically significant factors were confirmed by the multivariate analysis using a forward likelihood logistic regression model. A p- value < 0.05 was considered significant.

Results

From January 1 to May 31, 2005, 669 *S. aureus* isolates from 448 patients were enrolled. Two hundred and sixty two patients (58.5%) were MSSA whereas

186 (41.5%) were MRSA. CA-MRSA was found in three isolates (0.9% of total MRSA) from two patients as shown in Table 1.

Description of CA-MRSA patients

Case 1

A 46-year old Thai male presented with a three-month history of fever, malaise, weight loss, and hematemesis. He came to community hospital as an outpatient three times within three weeks. His underlying medical conditions included liver cirrhosis, hepatitis C infection, heavy alcoholic drinking, and smoking. He was admitted to general medical ward with dyspnea. He received endotracheal tube, nasogastric tube, and urethral catheter. Chest radiography revealed bilateral reticulonodular with patchy infiltration. MRSA was isolated from the sputum on the second day of hospitalization. Sputum examination was positive for acid fast bacilli. He was empirically treated with ceftriaxone, amikacin, and ciprofloxacin. He also received anti-tuberculosis drugs. He had clinical improvement and left the hospital six days after admission.

Case 2

A 52-year old female presented with chronic ulcer of her left leg. She had wound dressing at a community clinic everyday for two weeks and she took penicillin V 2 grams per day for two weeks. She was admitted to surgery ward for wound debridement and she was found to have diabetes mellitus. MRSA was isolated from pus and tissue on the first and second day of admission. She received ceftriaxone and clindamycin, wound debridement and diabetic control. She was improved and left the hospital seven days after admission.

MSSA and MRSA patients

The demographics of the patients who had

Table 5. Previous medical history of antibiotics use in 446 patients

Antibiotic	Type of *S. aureus*		
	MSSA (N=262)	MRSA (N=184)	p
Prior antibiotics use	74 (28.2%)	135 (73.4%)	<0.001
Cephalosporins	25 (9.5%)	82 (44.6%)	<0.001
Penicillins	31 (11.8%)	40 (21.7%)	0.07
Aminoglycosides	6 (2.3%)	23 (12.5%)	<0.001
Quinolones	6 (2.3%)	28 (15.2%)	<0.001
Macrolides	2 (0.8%)	3 (1.6%)	0.65
Tetracyclines	0	1 (0.5%)	0.42
Carbapenems	3 (1.1%)	27 (14.7%)	<0.001
Glycopeptides	3 (1.1%)	13 (7.1%)	0.002
Miscellaneous	13 (5.0%)	56 (30.4%)	<0.001

Table 6. Predisposing factors of 446 patients

Risk factors	Type of *S. aureus*		
	MSSA (N=262)	MRSA (N=184)	p
Arterial catheter	11 (4.2%)	6 (3.3%)	0.80
Central venous catheter	16 (6.1%)	30 (16.3%)	<0.001
Double lumen catheter	15 (5.7%)	15 (8.2%)	0.41
Endotracheal tube	62 (23.7%)	75 (40.8%)	<0.001
Tracheostomy	11 (4.2%)	25 (13.6%)	<0.001
Urethral catheter	88 (33.6%)	104 (56.5%)	<0.001
Nasogastric tube	70 (26.7%)	104 (56.5%)	<0.001
Surgical intervention	127 (48.5%)	98 (53.3%)	0.37
Others	33 (12.6%)	32 (17.5%)	0.20

Table 7. Category of infections of 446 patients

Type of infection		Type of *S. aureus*		
		MSSA (N=262)	MRSA (N=184)	p
Infective endocarditis	Native valve	1 (0.4%)	0	1.0
Soft tissue infection	Abscess	50 (19.1%)	10 (5.4%)	<0.001
	Cellulitis	6 (2.3%)	0	
	Necrotizing fasciitis	3 (1.1%)	1 (0.5%)	
	Others	19 (7.3%)	9 (4.9%)	
Orthopedic infection	COM*	7 (2.7%)	2 (1.1%)	0.80
	AOM**	2 (0.8%)	0	
	Surgical site infect	3 (1.1%)	4 (2.2%)	
	Others	2 (0.8%)	2 (1.1%)	
Respiratory tract infection	CAP***	22 (8.4%)	10 (5.4%)	0.03
	HAP****	20 (7.6%)	39 (21.2%)	
	Lung abscess	0	1 (0.5%)	
	Empyema	2 (0.8%)	2 (1.1%)	
	Others	6 (2.3%)	0	
Urinary tract infection		5 (1.9%)	3 (1.6%)	1.0
Primary bacteremia		23 (8.8%)	9 (4.9%)	0.17
Other infections		23 (8.8%)	22 (12.0%)	0.35
Colonization		75 (28.6%)	74 (40.2%)	0.01

* Chronic osteomyelitis
** Acute osteomyelitis
*** Community-acquired pneumonia
**** Hospital-acquired pneumonia

Table 8. Source of clinical specimens containing *S. aureus*

Specimen	Type of *S. aureus*	
	MSSA (N=262)	MRSA (N=184)
Blood	36 (13.7%)	17 (9.2%)
Joint fluid	5 (1.9%)	2 (1.1%)
Pleural fluid	2 (0.8%)	1 (0.5%)
Peritoneal fluid	0	1 (0.5%)
Pus	99 (37.8%)	39 (21.2%)
Sputum	82 (31.3%)	93 (50.5%)
Bronchial fluid	1 (0.4%)	2 (1.1%)
Urine	13 (5.0%)	7 (3.8%)
Others	24 (9.2%)	22 (12.0%)

MRSA infections were not significantly different from those who had MSSA except MRSA patients were older: 55.3 years vs 44.9 years as shown in Table 2. The variables that were significantly different between MRSA and MSSA patients are shown in Table 3 to 12. They were: 1) clinical data on type of wards (p<0.001), history of healthcare-associated factors (p<0.001), prior MRSA culture (p<0.001), hospitalization more than 72 hours or who had been discharged from an acute care hospital within 10 days (p<0.001), prior hospitalization (p<0.001); 2) underlying medical conditions on neurologic diseases (p=0.01), neutropenia (p=0.01), implanted devices (p=0.03), and recent corticosteroids (p=0.02); 3) previous history of prior antibiotic use (p<0.001), cephalosporin use (p<0.001), aminoglycoside use (p<0.001), quinolone use (p<0.001), carbapenem use (p<0.001), glycopeptide use (p=0.002), miscellaneous antibiotics (p<0.001); 4) predisposing factors on central venous catheter, endotracheal tube, tracheostomy, urethral catheter, and nasogastric tube (p<0.001); 5) category of infection on soft tissue infection (p<0.001), respiratory tract infection (p=0.03), and colonization (p=0.01); 6) clinical evaluation of infections on duration of fever (p<0.001), duration of admission (p<0.001), admission to ICU (p=0.04), and duration from hospitalization until death (p=0.03); 7) initial antibiotic regimen on number of initial antibiotics regimen (p<0.001), fourth generation cephalosporin use (p=0.003), penicillins use (p<0.001), quinolones use (p=0.001), carbapenems use (p<0.001), glycopeptides use (p<0.001), and miscellaneous use (p=0.006); 8) outcome on early outcome (p<0.001), complication (p=0.002), overall outcome (p<0.001), and cause of overall death (p<0.001). Six

Table 9. Clinical outcomes of infections

Duration (day)	Type of *S. aureus*		
	MSSA (N=262)	MRSA (N=184)	p
Duration of fever	113 (43.1%)	121 (65.8%)	<0.001
Mean	4.39	6.56	
Standard Deviation	9.26	7.24	
Range	1-90	1-35	
Duration of symptom	230 (87.8%)	161 (87.5%)	0.96
Mean	28.34	9.99	
Standard Deviation	242.72	15.10	
Range	1-3650	1-120	
Duration of hospitalization	262 (58.5%)	184 (41.1%)	<0.001
Mean	28.62	47.82	
Standard Deviation	36.01	52.53	
Range	1-213	1-348	
Admission to ICU	45 (17.2%)	65 (35.3%)	0.04
Mean	13	28	
Standard Deviation	20	45	
Range	1-101	1-348	
Duration from admission to death	50 (19.1%)	77 (41.8%)	0.03
Mean	18.21	18.60	
Standard Deviation	33.20	17.38	
Range	1-211	1-72	

variables associated with mortality were surgical wards, respiratory infections, use of endotracheal tube, category of *S. aureus*, indwelling urethral catheter, and having implanted devices as shown in Table 13.

Discussion

The recent report on *S. aureus* concluded that CA-MRSA in Thailand was extremely rare[34]. There was a report from a hospital in Thailand describing a child who had CA-MRSA infection[35]. He presented with submandibular lymphadenitis and MRSA was isolated from pus collected from incision and drainage of the lymph node on admission day. The molecular type of this isolate of MRSA was unknown. Our data suggests that the prevalence of CA-MRSA infections in hospitalized patients in Siriraj Hospital was uncommon, and both patients who met criteria of CA-MRSA infections could probably be HA MRSA infections since both of them had history of hospital visits just prior to their hospitalizations. Moreover, the antibiotic susceptibility profiles of MRSA isolated from both patients were multi-drug resistant. The universal definition of CA-MRSA has not been established and acceptable. In fact, the previous review revealed that at least eight different definitions have been used to classify MRSA infections as community acquired[29]: 1) isolation of MRSA within 24 h of admission, 2) isolation of MRSA within 24 h of admission, with other exclusions, 3) presence of MRSA at or within 48 h of admission, 4) isolation of MRSA within 48 h of admission, with other exclusions, 5) isolation of MRSA within 48–72 h of admission, 6) isolation of MRSA within 72 h of admission, 7) isolation of MRSA within 72 h of admission, with other exclusions, 8) isolation of MRSA from a patient from a community clinic or facility. An observation of a very low prevalence of CA-MRSA might not be valid since we did not include out-patients who could have minor *S. aureus* infections and these patients might have CA-MRSA infections. A recent outpatient visit within 12 months was found to be the risk factors for MRSA acquisition[29]. Other risk factors were recent hospitalization, recent nursing home admission, chronic illness, injection drug use, and close contact with a person with risk factor(s) for MRSA acquisition.

Table 10. Initial antibiotic regimens of 446 patients

Initial antibiotic regimen		Type of *S. aureus* MSSA (N=262)	MRSA (N=184)	p
Number of initial antibiotic regimens	Monotherapy	147 (56.1%)	76 (41.3%)	<0.001
	Duotherapy	72 (27.5%)	77 (41.8%)	
	Triple therapy	9 (3.4%)	11 (6.0%)	
	> 3 antibiotics	1 (0.4%)	4 (2.2%)	
	No treatment	33 (12.6%)	16 (8.7%)	
First generation cephalosporin		17 (6.5%)	4 (2.2%)	0.06
Second generation cephalosporins		2 (0.8%)	0	0.51
Third generation cephalosporins		90 (34.4%)	62 (33.7%)	0.97
Fourth generation cephalosporins		7 (2.7%)	18 (9.8%)	0.003
Penicillins		84 (32.1%)	27 (14.7%)	<0.001
Aminoglycosides		29 (11.1%)	17 (9.2%)	0.64
Quinolones		14 (5.3%)	27 (14.7%)	0.001
Macrolides		5 (1.9%)	2 (1.1%)	0.70
Tetracyclines		2 (0.8%)	1 (0.5%)	1.0
Carbapenems		7 (2.7%)	38 (20.7%)	<0.001
Glycopeptides		21 (8.0%)	37(20.1%)	<0.001
Miscellaneous		43 (16.4%)	51 (27.7%)	0.006
Susceptible to initial antibiotics	Susceptible to all antibiotics	66 (25.2%)	18 (9.8%)	NA*
	Susceptible to some antibiotics	19 (7.3%)	2 (1.1%)	
	Resistant to all antibiotics	3 (1.1%)	36 (19.6%)	
	Unknown	174 (66.4%)	128 (69.6%)	

* Not available

Table 11. Outcomes of 446 patients

Outcome		Type of *S. aureus* MSSA (N=262)	MRSA (N=184)	p
Early outcome *	Improve	202 (77.1%)	92 (50.0%)	<0.001
	Failure	51 (19.5%)	78 (42.4%)	
	Death	9 (3.4%0	14 (7.6%)	
Cause of early death**	Death	9 (3.4%)	14 (7.5%)	0.21
	Uncontrolled *S. aureus* infection	4 (1.5%)	10 (5.4%)	
	Other	5 (1.9%)	3 (1.6%)	
	Unknown	0	1 (0.5%)	
Complication	Uncontrolled *S. aureus* infection	9 (3.4%)	21 (11.4%)	0.002
	Unrelated to *S. aureus* infection	72 (27.6%)	77 (41.8%)	
Overall outcome	Improve	202 (77.1%)	101 (54.9%)	<0.001
	Failure	46 (17.6%)	75 (40.8%)	
	Undetermine	14 (5.3%)	8 (4.3%)	
Cause of death	Death	50 (19.1%)	77 (41.8%)	<0.001
	Uncontrolled *S. aureus* infection	8 (3.1%)	19 (10.3%)	
	Other	42 (16.0%)	57 (31.0%)	
	Unknown	0	1 (0.5%)	

* Outcome within 3-5 days of treatment
** Death within 72 hours

Table 12. Susceptibility of *S. aureus* to initial antibiotic regimen of 448 cases

Antibiotic	Type of *S. aureus*								
	MSSA (N=262)			MRSA (N=184)			CA-MRSA (N=2)		
	S*	R**	I***	S*	R**	I***	S*	R**	I***
Ampi/amoxy	18.2%	81.8%	0	0	100%	0	0	0	0
Cefazolin	100%	0	0	0	100%	0	0	0	0
Chloramphenicol	96.6%	3.4%	0	92.3%	6.7%	0	0	100%	0
Cotrimoxazole	99.4%	0.6%	0	13.1%	85.9%	1.0%	0	100%	0
Erythromycin	91.4%	7.4%	1.2%	1.1%	98.9%	0	0	100%	0
Gentamicin(10mcg)	98.2%	1.8%	0	8.1%	91.9%	0	0	100%	0
Methicillin	100%	0	0	0	100%	0	0	100%	0
Amoxy/clavulanate	100%	0	0	0	100%	0	0	0	0
Ampi/sulbactam	100%	0	0	0	100%	0	0	0	0
Cefoxitin	100%	0	0	0	100%	0	0	0	0
Ceftazidime	100%	0	0	0	100%	0	0	0	0
Ceftriaxone	100%	0	0	0	100%	0	0	0	0
Netilmycin	100%	0	0	0	100%	0	0	0	0
Ofloxacin	100%	0	0	0	100%	0	0	0	0
Tetracycline	59.7%	40.3%	0	12.9%	87.1%	0	0	100%	0
Ciprofloxacin	80.6%	5.0%	14.4%	1.0%	99.0%	0	0	100%	0
Clindamycin	94.8%	4.5%	0.7%	8.6%	91.4%	0	0	100%	0
Fosfomycin	100%	0	0	87.7%	9.2%	3.1%	100%	0	0
Fusidic acid	100%	0	0	91.8%	6.1%	2.1%	100%	0	0
Vancomycin	100%	0	0	100%	0	0	100%	0	0
Teicoplanin	100%	0	0	100%	0	0	100%	0	0
Linezolid	100%	0	0	100%	0	0	100%	0	0
Rifampicin	100%	0	0	46.2%	53.8%	0	50%	50%	0

* Sensitive, ** Resistant, *** Intermediate

Table 13. Variables associated with mortality by logistic regression

Variable	p	Adjusted OR	95% CI for OR
Ward			
Medicine	0.001	3.4	1.7-6.8
Others	0.40	0.7	0.3-1.7
Respiratory infection	<0.001	3.2	1.8-5.7
Retain endotracheal tube	0.001	2.8	1.5-5.2
Category of *S. aureus*	0.004	2.1	1.3-3.6
Urethral catheter	0.01	2.2	1.2-4.0
Implanted devices	0.21	4.6	1.3-16.9

MRSA colonization can persist for months to years[9,36], and one study reported an estimated half-life of MRSA colonization of 40 months among patients known to be colonized with MRSA who were admitted to a university hospital[36]. The majority of colonized patients remained completely asymptomatic. Therefore, acquisition of MRSA, whether it occurs in the hospital or in the community, frequently goes unrecognized unless clinical infection develops. Given the duration for which colonization with MRSA can persist, an infection may develop in a setting different from that in which the organism was initially acquired. Thus, in the absence of more epidemiological data, such as the results of surveillance cultures documenting time of acquisition, the true site of acquisition of MRSA is rarely known with certainty. The commonly used term "CA-MRSA" implies that it is known that the organism was acquired in the community. It appears, however, that this term is often used to refer to the detection of colonization or infection in the community, rather than to actual acquisition of MRSA in the community. The term "community-onset" MRSA (CO-MRSA), which simply describes the patient's location at the time of identification of MRSA, would be more technically correct than the currently used "CA-MRSA", which implies that the site of MRSA acquisition is known[29]. When a patient with nosocomially acquired MRSA spreads the

organism to multiple members of the patient's household or community, this should not be called "community acquisition".

In this study, we found that the patients who had MRSA isolated from their clinical specimens were significantly associated with health care-associated risk factors, prior antibiotic use, and predisposing factors when compared with those with MSSA. These observations were similar to the previous study[8-10]. MRSA patients were also associated with longer duration of fever, longer duration of hospitalization[9, 37], more frequent admission to ICU[9, 37] and higher mortality than MSSA patients. Most MRSA isolates were susceptible to several antimicrobial classes (including chloramphenicol, fosfomycin, and fusidic acid) and treatment of MRSA infections may not routinely require glycopeptides. CA-MRSA poses important challenges for public health officials. Surveillance data are needed to determine the geographic distribution of cases and to monitor the emergence of this important problem in the community. In addition, local information is needed to direct clinical decisions about treatment. However, public health resources for establishing new surveillance systems are limited. Creative approaches to surveillance, such as tracking infections from sentinel hospitals in areas that serve high-risk communities or performing periodic cross-sectional surveys, should be considered.

Conclusion

The prevalence of CA-MRSA infections in hospitalized patients in Siriraj Hospital was uncommon. These patients could probably be health care-associated MRSA infections. All CA-MRSA should be confirmed by molecular analysis.

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ระบาดวิทยาของการติดเชื้อ Staphylococcus aureus และความชุกของ community-acquired methicillin-resistant Staphylococcus aureus ในผู้ป่วยที่รับไว้รักษาในโรงพยาบาลศิริราช

ศรีเพชรัตน์ เมฆวิวัฒน์วงศ์, สมพร ศรีเฟื่องฟุ้ง, กุลกัญญา โชคไพบูลย์กิจ, ดรินทร์ โล่ห์ศิริวัฒน์, วิษณุ ธรรมลิขิตกุล

ผู้วิจัยศึกษาผู้ป่วยที่รับไว้รักษาในโรงพยาบาลศิริราชที่แยกเชื้อ Staphylococcus aureus จากสิ่งส่งตรวจของผู้ป่วยระหว่างเดือนมกราคมถึงพฤษภาคม พ.ศ. 2548 เพื่อทราบระบาดวิทยาของการติดเชื้อ S. aureus และความชุกของการติดเชื้อ S. aureus ที่เกิดในชุมชน พบว่าจากจำนวนเชื้อ 669 สายพันธุ์ที่แยกได้จากผู้ป่วย 448 คน เชื้อจากผู้ป่วย 262 คน (ร้อยละ 58.5) เป็นเชื้อ MSSA ส่วนเชื้อจากผู้ป่วย 186 คน (ร้อยละ 41.5) เป็นเชื้อ MRSA ความชุกของการติดเชื้อ S. aureus ที่เกิดในชุมชนพบเพียง 3 สายพันธุ์จากผู้ป่วย 2 คนเท่านั้น ผู้ป่วยที่ติดเชื้อ MRSA มีลักษณะที่แตกต่างจากผู้ป่วย MRSA คือ 1) ผู้ติดเชื้อ MRSA มีอายุมากกว่า 2) ผู้ติดเชื้อ MRSA เป็นผู้ป่วย อายุรกรรม เคยรับการรักษาที่สถานพยาบาล เคยมีการติดเชื้อ MRSA เคยอยู่โรงพยาบาลมาก่อน และอยู่ในโรงพยาบาลนานกว่า 72 ชั่วโมง 3) ผู้ติดเชื้อ MRSA มีโรคปอดเรื้อรัง โรคระบบประสาท เม็ดเลือดขาวในเลือดต่ำ มีอุปกรณ์การแพทย์อยู่ในร่างกาย ได้รับคอร์ติโคสเตียรอยด์ และยาต้านจุลชีพ 4) ผู้ติดเชื้อ MRSA มีอุปกรณ์การแพทย์สอดใส่เข้าสู่ร่างกาย 5) ผู้ติดเชื้อ MRSA มีปอดอักเสบ การติดเชื้อที่ผิวหนังและเนื้อเยื่อใต้ผิวหนัง และ colonization 6) ผู้ติดเชื้อ MRSA มีเชื้อ S. aureus ในเสมหะ 7) ผู้ติดเชื้อ MRSA มีไข้นานกว่าอยู่โรงพยาบาลนานกว่า และอยู่ในหออภิบาลนานกว่า 8) ผู้ติดเชื้อ MRSA ได้รับการรักษาด้วยยาต้านจุลชีพหลายขนาน เชื้อ MRSA ทุกสายพันธุ์ไวต่อ vancomycin, teicoplanin และ linezolid ผู้ติดเชื้อ MRSA มีอัตราความล้มเหลวต่อการรักษา และอัตราการตายสูงกว่าผู้ติดเชื้อ MSSA ปัจจัยที่สัมพันธ์กับอัตราตายจากการติดเชื้อ S. aureus คือ ผู้ป่วยอายุรกรรม ปอดอักเสบ มีการติดเชื้อ MRSA และได้รับอุปกรณ์การแพทย์สอดใส่เข้าสู่ร่างกาย