CHAPTER VI

DISCUSSION

In this study, it was found that there were 16 out of 30 burn patients (53.33%) infected with MRSA during the 32 weeks of the study. This prevalence was higher than that obtained in the study done by Danchaivijitr *et al.* who showed that the prevalence of MRSA in burn patients at the same burn unit of the same hospital during August 1990 to July 1991 was 48.3%. Therefore, the result in this study indicated that MRSA could still be commonly found in the burn unit with an increasing rate of recovery.

Almost of the MRSA-positive patients had acquired MRSA after an average of 12 days after the admission in burn unit as shown in Table 5-1. This result was consistent with many previous study which stated that burn unit was the major source of MRSA in the hospital. (11,14-15,41,65-69) In addition, from the demographic table, it was found that there was only one patient (patient L) who was positive for MRSA in his nasal cavity upon his admission into burn unit while the rest of the patients acquired the organisms from this unit. It is also possible that the patient who did not acquire MRSA from burn unit, had acquired the organism from the other hospital where he was transferred from because the isolate from the patient had unique pulsotype (type D) that did not share with the others. However, in order to considers whether there was an outbreak in this burn unit or not, the organism isolated from each unit or hospital must be the same type as the most prevalent type, so the MRSA with pulsotype D was not the outbreak strain.

MRSA was found in both nasal cavities and wounds of 3 MRSA-positive burn patients while the rest of the patients carried the organisms in all sites studied including nasal cavities, hands, and wounds. About the source of MRSA in the patients; it had been clearly shown that patients could be MRSA autoinfection since 7

out of 16 patients carried MRSA in their nasal cavities before they become infected in the wound. On the other hand, the patients could also get wound infection from the other sources since it was found that 3 patients had MRSA infected wounds before the organisms were isolated from their nares and hands, and 6 patients carried MRSA in both nasal cavities and wounds at the same time. The results from this study indicated that the transmission might occur from wound to nasal cavity as well as from nasal cavity to wound. However, not everybody could be the MRSA nasal carriers, it has been mentioned somewhere that the anatomical structure of nose maybe involved in this aspect. In addition, Thompson *et al.* (1982) (11) reported that patient at high risk for acquisition of MRSA infection were those with cutaneous wounds and those receiving antibiotics. They also suggested that the isolation of MRSA from nasal cavity along with from wound seemed to be autoinfection, while exogenous infection presented in wounds. The transmission of MRSA via hand is possible, but it seems to be transient.

Nasal cavity seems to be one of the important habitat of *S. aureus* in human. Sheretz *et al.* (1987) reported that twenty percent to forty percent of general human (non-medical) carried *S. aureus* in their nares, but in medical personnel, *S. aureus* was carried by 50%, 70%, and 90% of physicians, nurses and ward attendants, respectively. (19) Thus, it was inconsistent with the data obtained from this study which show that there were only 25 (46.30%) of 54 Thai medical personnel carried *S. aureus*. Among these subjects, there were only 8 (32.0%) personnel carried MRSA and almost all personnel (24 of 25 personnel, 96%) carried methicillin-sensitive *S. aureus* (MSSA) in their nares. Sheretz *et al.* also showed that coagulase-negative staphylococci constituted 90% to 100% of the staphylococci isolated from nares when *S. aureus* is not present. The results in this study also showed the similar evidence that 96.30% of medical personnel carried coagulase-negative staphylococci in their nasal cavities. However, the organisms other than staphylococci including *Streptococcus* sp., *Proteus* sp., and non-fermentative gram-negative rods were also found.

The prevalence of MRSA in medical personnel in this study was lower than some other previous studies (10,13-15,65-69), which stated that medical personnel were the important reservoir of MRSA. There were only 8 out of 54 personnel (14.81%) carried MRSA in their nares. It has been long known that the burn unit is the important source of MRSA in the hospital, thus the medical staffs in this study might pay attention to their health and were cautious to MRSA. In addition, the burn unit at Siriraj hospital had been closed for a certain period of time and had been recently open just before the start of the specimen collection in this study. Therefore it was shown that the frequency of isolation of MRSA was very low (Table 5-3), and MRSA was not detected in some period. It also indicated that the medical personnel might not be the significant source of MRSA because at the certain period, which MRSA could still be isolated from patient, the organism could not be isolated from medical staff. It was quite agreeable with the result from the study done by Pittet *et al.* (42) who concluded that the transmission should be from patient to patient not from the other source.

However, the prevalence of MRSA in medical staffs in this study was more than that obtained in the study by Linnemann *et al.* (8) which showed that only 9 out of 432 medical staffs (2.1%) carried MRSA. It not necessary that MRSA had to be found only in nasal cavities of medical personnel but it could also be isolated from hands. Boyce *et al.* (1997) (109) suspected that personnel who took care of some MRSA patients may contaminated their hands by touching either the patient or objects in the immediate environment and then failed to wash their hands because they do not appear visibly soiled with blood or body secretions. It had also been suggested that MRSA may be transferred from one patient to another by contaminated medical staffs' uniform (109), but there were no study which provided direct evidence that MRSA was transmitted from one patient to another via the clothing of personnel. Further studies are needed to prove this suggestion. There were many reports that supported that the principal mode of transmission is via hands of medical staffs. Carriage of MRSA by staff is usually transient. (13,42,110) In this study, it had been informed that

every medical staff usually wears individual disposable gloves, thus it was possible that their hands were not directly touch patients but indirectly contact to the environment in the unit.

The isolation of MRSA from inanimate environment in this study was very low. There were only 14 of 510 isolates (2.75%) that were positive for MRSA. Most of MRSA isolates were on the buttons of enteral pumps that located in patients' rooms (8 of 191 isolates, 4.2%). It was possible that medical personnel had touched these medical devices, and the bacteria on their hands were transferred to them, thus the MRSA was transient contaminated these tools. MRSA was also found on bed rails (4 of 191 isolates, 2.1%). The organisms could possibly come from the contaminated hands of burn patients as well as medical staffs. The prevalent rate of MRSA in bath tubs was very low, because the bath tubs were regularly cleaned after use, thus the contaminated MRSA from the patient's skin was eradicated. Therefore, MRSA was isolated from bath tubs at least once in 64 times of specimen collection. The result of this present study was inconsistent with Rutala *et al.* (1983) (13) and Layton *et al.* (1993) (111) who reported that the incidence of MRSA in burn unit was quiet high and MRSA could contaminated in many areas of the burn unit. However, McDonald (1997) (110) reported that the inanimate environment is not significant reservoir for MRSA.

During the specimen collection at the burn unit, there was a report about the frequent recovery of MRSA in the TICU at the same hospital. Thus, the specimen collection was done at this unit once. It was found that only 3 out of 11 patients (27.27%) were positive for MRSA while no medical personnel in the unit was MRSA carrier. This result suggested the prevalence in other ward besides burn unit was lower than in the burn unit. However, all the MRSA isolates were collected for the PFGE typing, and it was found that the isolates from the three TICU patients were in the same pulsotypes as those found in burn patients which were B1 (patient IB2 and IB4) and A (patient IB8)

All MRSA isolates were tested for antimicrobial susceptibility. It was found that all strains were susceptible to vancomycin and teicoplanin. It means that these agants are still effective against MRSA. In addition, netilmicin, fosfomycin, chloramphenicol and clindamycin, which most isolates ($\geq$ 75%) express the susceptibility to them , should be effective in the treatment of this infection. However, the MRSA isolates were also shown to be resisted to multiple antimicrobial agents including gentamicin, co-trimoxazole, and ciprofloxacin. The result of this study was consistent with the report on the antimicrobial susceptibility test from Department of Microbiology, Siriraj Hospital (115), except for the susceptibility to imipenem, co-trimoxazole, and chloramphenicol. In this study, the MRSA isolates were more resistant to imipenem and cotrimoxazole than the MRSA isolates in the previous Siriraj hospital's report, while the isolates in this study were more susceptible to chloramphenicol than the isolates in such report. It was possible that imipenem and co-trimoxazole were commonly used in the burn unit, and these agents might cause the occurrence of the resistant strains. Whereas, the use of chloramphenicol in the burn unit was less frequent than those two agents, so the MRSA isolates from this study were more susceptible to chloramphenicol than the MRSA isolates in the report.

Hershow *et al.* (1992) (112) and Haley *et al.* (1982) (35) were both suggested that burn or trauma patients who received high-dose or broad-spectrum antibiotics were appeared to be at high risk of MRSA infection. This study was consistent with the results from this study which showed that in 14 out of 16 patients who were MRSA positive had received antibiotics administration for at least 3 days prior to the first positive isolation while only 4 out of the 14 MRSA-negative patients (28.36%) were on antibiotic administration.

In addition, cefazolin, ceftriaxone, imipenem, and amoxycillin were most frequently administered in the patients at least 3 days before the first MRSA isolation. It was shown that most of MRSA-positive patients received beta-lactam antibiotics, while MRSA-negative did not. Despite of the fact that cephalosporins were most

frequently administered to the burn patients, MRSA isolates in this study were very resistant to these agents. It was indicated that the use of beta-lactam antibiotics in prophylaxis was not appropriate and it could possibly lead to the occurrence of MRSA.

The results from the study on MRSA prevalence were not enough to conclude the epidemiology of MRSA. Hence, the molecular typing by pulsed-field gel eletrophoresis (PFGE), was done to complete this part of the study. The antimicrobial susceptibility patterns of MRSA isolates (antibiogram) was also included in combination with PFGE in order to obtain the epidemiological data.

PFGE results were shown that there were 5 pulsotypes from MRSA isolated from patients, medical personnel and medical equipment; A, B, C, D, and E, but the predominant pulsotype in this study was pulsotype B. Chromosomal stability make this technique suitable for the long-term follow up of epidemic strains of MRSA. In contrast to the other bacterial species, the polymorphism provided by PFGE is relatively low, because of a high degree of genetic relatedness between MRSA strains (106). MRSA pulsotype B was isolated from the most burn patients, medical personnel and medical equipment along the study. It is possible that this strain might be the epidemic strain of the hospital, because the isolates from the TICU was also shared the same pulsotype with the isolates from the burn unit.

The subtypes of pulsotype as recommended by Tenover *et al.* (1995)(113) who informed that there might be the genetic mutation of chromosomal DNA which caused the difference between bands of the same clone of the organism. The genetic mutation was point mutation which included the gain or lose of the restriction site and the insertion or deletion of a fragment. After identifying the common pattern, the size and number of the fragments in the common pattern were compared with the fragment that make up the patterns of the other isolates. On the basis of pairwise, fragment-to fragment comparisons, each isolate's pattern was then classified for its relatedness to common pattern. Pattern that was distinctly difference from the common pattern by two or three fragments was considered to be subtype of the common pattern which

meaned that the subtype was from the same clone as its type. For each patient, if the fragments were different from common pattern for up to six fragments, Thal *et al.* (1997) (114) are also considered to be subtype. The pulsotype E and E1 were in this case, they differed by 6 fragments.

In this study, it was found that there was the patient who was infected or colonized with more than one strains of MKSA (Patient J). Eventhough, he carried two MRSA strains in his nares (Pulsotype A and B), he was still infected with only MRSA pulsotype A in his wound throughout the time of his admission.

The use of antibiogram to trace the epidemiology of MRSA is not appropriate. Because of the variety of antibiograms due to the instability in this phenotype characteristic. In addition, there was no relationship between antibiogram and pulsotype.

Pulsed-field gel electrophoresis is an effective tool to study and trace the distribution of MRSA in burn unit. This study is the first longitudinal epidemiology of MRSA, but it still could not clearly define the route of transmission of MRSA. This study suggest that the burn unit was still the source of MRSA and the transmission from patient to patient was more likely to happen via temporary contamination on medical personnel's hands as well as medical equipment in the unit.