ORIGINAL ARTICLE

Nasal Carriage of *Staphylococcus aureus* and Its Antibiotic Susceptibility Pattern among Medical and Nursing Students

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Abstract

Background: Nasal carriage of *Staphylococcus aureus* (*S.aureus*) especially methicillin-resistant *S. aureus* (MRSA) among health care personnel poses a risk to the patient. **Objectives:** To determine the prevalence of nasal colonization of *S. aureus* and its antibiotic susceptibility pattern among pre-clinical and clinical medical and nursing students attending Faculty of Medicine and Health Sciences at the Universiti Malaysia Sabah. **Materials and Methods:** Between April and November 2013, nasal swabs were collected from anterior nares of 449 students and inoculated on Mannitol salt agar and Tryptone soya broth. Staphylase coagulase test kit and tube coagulase test were done for identification. Antibiotic susceptibility test was done on seven antibiotics by Kirby–Bauer method. *S. aureus* isolates which showed zone diameter of 22 mm to cefoxitin discs were further tested with Slidex® MRSA detection kit to detect penicillin-binding protein product of MRSA. **Results:** The prevalence of nasal colonization of *S. aureus* was 31.0% and all were methicillin susceptible *S. aureus* (MSSA). Antibiotic susceptibility testing revealed all 139 *S. aureus* isolates were sensitive to oxacillin, trimethoprim/sulfamethoxazole and cefoxitin, whereas 116 (83.5%), 1 (0.7%), 3 (2.2%) and 24 (17.3%) were resistant to penicillin, erythromycin, clindamycin and tetracycline, respectively. **Conclusions:** There was no MRSA among *S. aureus* isolated in this study. *S. aureus* isolates were highly resistance to penicillin, however, no resistant to oxacillin, co-trimoxazole, and cefoxitin.

Key words: Antibiotic susceptibility pattern, nasal carriage, *Staphylococcus aureus*

INTRODUCTION

Staphylococcus aureus can be found as a commensal on the skin and mucosal surfaces of human especially anterior nares, other skin sites, and the perineum.[1] Carriage of *S. aureus* is a risk factor for the occurrence of infections in health-care settings.[1] *S. aureus* is an important pathogen for human. It causes localized infection to disseminated infection such as bacteremia, acute hematogenous osteomyelitis, meningitis, pulmonary infections, and even causes fatal septicemia. Contamination of a surgical site will lead to post-operative wound infection. Spread of infection through contact is an important issue in hospitals, where health-care staff and patients are nasal and skin carrier of antibiotic-resistant staphylococci.[2] Antibiotic resistance is an increasing problem worldwide. Among them methicillin-resistant *S. aureus* (MRSA) is one of the best-studied bacteria. Since the 1980s, the MRSA isolation rate among *S. aureus* has increased to about 70%, 30% and around 40% in Japan and the Republic of Korea, Belgium and the United Kingdom and the United States, respectively.[3] In some parts of the WHO Western Pacific Region as many as 80% of *S. aureus* infections were reported as MRSA, whereas in some areas of the Southeast Asia Region, more than 25% of *S. aureus* infections were reported to be MRSA.[4] This study was conducted to find out the nasal carriage of *S. aureus* and its antibiotic susceptibility pattern

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including MRSA, among medical and nursing students of Faculty of Medicine and Health Sciences, Universiti Malaysia Sabah, Malaysia.

MATERIALS AND METHODS

Ethical approval: The study was approved by the Medical Research and Ethic Committee, Ministry of Health Malaysia (Registration number: NMRR-13-725-16306).

The study was conducted from April 2013 to November 2013. Four hundred and forty nine pre-clinical and clinical medical and nursing students with the age range of 18-25 years, of the Faculty of Medicine and Health Sciences, Universiti Malaysia Sabah were participated in the study. Nasal swabs were collected from both anterior nares using sterile disposable swab with transport medium. The swabs were inoculated to the Mannitol salt agar (MSA) and Tryptone soya broth (TSA) and incubated overnight at 37°C. Subculture was made from TSA to MSA. Mannitol fermented colonies were subjected to Gram stain and coagulase test using Staphylase test kit (Oxoid, Basingstoke, Hampshire, England) and tube coagulase for the identification of *S. aureus*. Antibiotic susceptibility test was performed on Mueller-Hinton agar (Oxoid, Basingstoke, Hampshire, England) by Kirby–Bauer method. Seven antibiotic discs, penicillin (10 U), oxacillin (1 µg), erythromycin (15 µg), clindamycin (2 µg), tetracycline (30 µg), trimethoprim/sulfamethoxazole (TMP-SMX) (1.25/23.75 µg), and cefoxitin (30 µg) were included. Cefoxitin was used as a surrogate for MecA mediated oxacillin resistance.[5] The antibiotic susceptibility pattern was interpreted according to Clinical and Laboratory Standards Institute guideline.[5] Those *S. aureus* which showed zone diameter of 22 mm in cefoxitin (30µg) disc were further tested with Slidex® MRSA Detection kit (bioMérieux® SA) for Penicillin-binding protein 2a (PBP2a) product. *S. aureus* American Type Culture Collection (ATCC® 43300) was used as a positive control.

RESULTS

Out of 449 samples tested [Table 1] *S. aureus* was isolated from 139 (31%) and 310 (69%) were negative [Table 2]. *S. aureus* isolation rate among medical students group was higher than that of nursing students which were 33.2% and 22.7%, respectively [Table 2]. In this study, *S. aureus* nasal carrier rate of preclinical students group is higher than that of clinical group, and there was no association between *S. aureus* nasal carriage and clinical exposure (Pearson Chi-square test, $\chi^2 = 0.702$, df = 1, P = 0.402) [Table 3]. The antibiotic susceptibility pattern of all 139 *S. aureus* isolates was shown in Table 4. Eleven *S. aureus* with the zone diameter of 22 mm in cefoxitin (30 µg) disc were negative for PBP2a. All 139 *S. aureus* isolates were methicillin-susceptible *S. aureus* (MSSA), and none of them was MRSA.

DISCUSSION

Out of 449 students participated, 139 (31.0%) were nasal carriers of *S. aureus* and all isolates were methicillin-susceptible *S. aureus* (MSSA). A study by VasanthaKumari *et al*. (2009) showed that the *S. aureus* carriage rate was 31.5% (51) with no isolation of MRSA.[6] Another

Table 1: Number of students participated in the study

Program	Pre-clinical	Clinical	Total
Medical students	126	226	352
Nursing students	58	39	97
Total	184	265	449

Table 2: Association of *S. aureus* colonization between program attended by the subjects

Program	*S. aureus*		Total (%)
	Isolated (%)	Not isolated (%)	
Medical students	117 (33.2)	235 (66.8)	352 (100.0)
Nursing students	22 (22.7)	75 (77.3)	97 (100.0)
Total	139 (31.0)	310 (69.0)	449 (100.0)

S. aureus: *Staphylococcus aureus*

Table 3: Association of *S. aureus* colonization between preclinical and clinical students

Hospital exposure status	*S. aureus*		Total (%)
	Isolated (%)	Not isolated (%)	
Preclinical	61 (33.2)	123 (66.8)	184 (100.0)
Clinical	78 (29.4)	187 (70.6)	265 (100.0)
Total	139 (31.0)	310 (69.0)	449 (100.0)

S. aureus: *Staphylococcus aureus*

Table 4: Antibiotic susceptibility pattern of 139 *S. aureus* isolates

Antibiotics	Number of isolates (%)		
	Resistant	Intermediate	Susceptible
Penicillin	116 (83.5)	0	23 (16.5)
Erythromycin	1 (0.7)	11 (7.9)	127 (91.4)
Clindamycin	3 (2.2)	5 (3.6)	131 (94.2)
Tetracycline	24 (17.3)	2 (1.4)	113 (81.3)
TMP-SMX	0	0	139 (100.0)
Oxacillin	0	0	139 (100.0)
Cefoxitin	0	0	139 (100.0)

S. aureus: Staphylococcus aureus, TMP-SMX: Trimethroprim/sulfamethaxazole

cross-sectional study detected 10% *S. aureus* nasal carriage rate among preclinical and clinical medical students and all *S. aureus* were found to be MSSA.[7] In a study conducted by Faculty of Health Sciences, UiTM, from 422 Nursing and Medical Laboratory Technology students, *S. aureus* was isolated from 66 samples (16%) and only one (0.5%) MRSA was detected.[8] Another study conducted at UPM, Serdang involving 100 students from the faculty of medicine and health sciences revealed 26% nasal carriage of *S. aureus*. Oxacillin susceptibility and mecA gene detection by polymerase chain reaction revealed that three out of 100 (3%) of samples were positive for MRSA.[9] A cross-sectional study on nasal carriage of *S. aureus* from students, staff, and visitors of Faculty of Medicine and Health Sciences, UPM was 23.4% with only one MRSA isolate.[10]

In the United States, nasal carriage of *S. aureus* and MRSA among students at a Louisiana Medical University was 15.95% and 3.2%, respectively. MRSA positive was two senior medical students and a one graduate medical trainee. The study also showed that *S. aureus* carriage rate was higher in clinical than non-clinical students.[11] However, our study showed that there was no association of *S. aureus* carriage between preclinical and clinical groups. A survey conducted on a 95 college students in Hawaii for the nasal carriage of *S. aureus* revealed 33% positive, out of which 3 (3.15%) were MRSA.[12] A study done in a Brazilian university including 250 medicine, dentistry, nursing and pharmacy students for the nasal colonization of *S. aureus* isolated 102 (40.8%) *S. aureus* and six (2.4%) were community-associated-MRSA.[13]

A study in Rome between March and April 2009 on 106 medical and prevention technician students showed 30 positive for *S. aureus* nasal carriage (28.3%) with no MRSA isolated.[14] Another study on multi-drug resistant bacteria among medical students in Vienna detected 25.3% of nasal swab samples tested were positive for *S. aureus* and none of them were MRSA.[15] *S. aureus* nasal carriage study done on 300 healthy young adults from a Hungarian University revealed that the prevalence rate was 29.3% with 0.67% MRSA.[16]

In Asia, a study conducted in Chang Gung University in Northern Taiwan on 322 preclinical and clinical students showed overall *S. aureus* isolation rate of 17.1% with MRSA carriage 2.2%.[17] A study on 200 healthy university students in Thailand found out that MSSA colonization was 15% and MRSA was 1% and only 2 students were positive for MRSA out of 200 tested.[18] In a study by School of Medicine, University of Sarajevo the *S. aureus* carriage rate was 10.6%, among 387 students tested.[19] Department of Microbiology, Melaka Manipal Medical College, Malaysia conducted research on 157 preclinical medical students, detected 23.7% *S. aureus* nasal colonization with no isolation of MRSA.[20] A follow-up study on medical students at the HRH Princess Maha Chakri Sirindhorn Medical Center, Thailand showed increasing rate of *S. aureus* isolation, of 29.7%, 30.5% and 39.4% after certain period of time in hospital rotation schedule, however no MRSA was detected.[21] A study by Faculty of Medical Sciences, Duhok University, Iraq demonstrated 26 (9.2%) *S. aureus* isolation among 284 students tested, however MRSA isolation was high as compared to other studies done in Asia, which was 13 (4.5%).[22]

In this study, 83.5% of *S. aureus* showed resistance to penicillin. Community studies on *S. aureus* penicillin resistance in Malaysia showed 82.7%,[10] 79.4%[23] and 52.6%.[8] Approximately, over 80% of *S. aureus* isolated from the hospitalized patients in Malaysian Hospitals were resistant to penicillin.[24] However, *S. aureus* penicillin resistance was high in other countries, 92.0% in Brazil,[13] 88.0% in Iran,[25] 87.5% in China,[26] and 96.7% in Thailand.[18]

Erythromycin resistance of *S. aureus*, in this study, was only 0.7%. In Malaysia, erythromycin resistance among healthy community of university students was 8.8%[23] while in other institution the resistance rate was 2.5%,[10] 3.8%,[9] 2.6%[8] and 4.8%.[7] However, the erythromycin resistance of *S. aureus* isolated in Malaysian Hospitals was higher which was 17.7%.[24] The erythromycin resistance pattern conducted in Thailand, Iran, Italy, Tanzania and Bosnia among the healthy students showed 26.7%,[18] 21.4%,[25] 23.3%,[14] 19.7%[27] and 7.3%.[19]

In a current study, *S. aureus* isolates were highly sensitive to clindamycin with only three isolates (2.2%) were resistant to clindamycin. Studies conducted among healthy community in Malaysia found clindamycin resistance of 2.5%[10] to even no resistance at all.[8] Clindamycin resistance of *S. aureus* isolates of patients from Malaysian hospitals in the year 2014 was 10.9%.[24] Clindamycin resistance among healthy university students were 23.3% in Italy,[14] 26.7% in Thailand,[18] 12.5% in China,[26] and 4.8% in Iran.[25] These studies showed higher resistance to clindamycin as compared to ours and Malaysia studies.

Tetracycline resistance of *S. aureus* isolates was 17.3% in this study. Tetracycline resistant of nasal isolates of *S. aureus* among healthy people in Malaysia were 5.9%,[23] 5.4%,[10] and 13.2%.[8] In Malaysian hospitals, tetracycline resistance of *S. aureus* was 20.5%.[24] Studies conducted among healthy community especially university students in other countries detected tetracycline resistance of 3.3% in Sapienza University of Rome, Italy[14] while 9.1% resistance was reported in Tanzanian University.[27] Tetracycline resistant was found to be higher than other earlier studies done in Malaysia which showed that there was increasing trend of *S. aureus* tetracycline resistance among healthy population in Malaysia.

All the *S. aureus* isolates were found to be sensitive to TMP-SMX in our present study. Likewise no TMP-SMX resistance was detected among *S. aureus* from healthy community.[10,23] However, TMP-SMX resistance of *S. aureus* was reported at

7.7% from 39 Malaysian Hospitals.[24] TMP-SMX resistance rate among university students in Bosnia and healthy adults in Iran were 2.4% and 33.3%, respectively.[19,25]

None of the *S. aureus* isolates in our study was resistant to oxacillin. The prevalence of oxacillin resistance or MRSA in the community studies of Malaysia were quite low, from all sensitive[23] to 1.2%,[10] and 3% resistance.[9] In Malaysia, 17.2% of *S. aureus* isolates from hospitals were resistant to oxacillin.[23] A community study conducted in the United States in 2001-2002, showed 0.8% of *S. aureus* were resistant to oxacillin.[28] A study at the Faculty of Medicine and Health Sciences, of the Brazil University detected 5.8% oxacillin resistant by both E-test oxacillin strip and agar dilution.[13] A survey among biomedical students in Rome detected 28.3% *S. aureus* carrier rate and none of them were oxacillin resistant.[14]

CONCLUSIONS

No MRSA was detected among *S. aureus* nasal carrier in this study. There was no association between *S. aureus* nasal carriage and clinical and nonclinical exposure groups of students. *S. aureus* carriage rate was higher in medical than nursing students. Nasal carriage of MRSA among university students was low in Malaysia. Penicillin resistance of isolated *S. aureus* was high in this study however there was no resistance at all to TMP-SMX, oxacillin, and cefoxitin. There was increasing tetracycline resistance of *S. aureus* among healthy population in Malaysia.

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