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Prevalence of Methicillin-Resistant *Staphylococcus aureus* in Nasal Cavity of Medical Students at Shendi University, Sudan

Leila Mohamed A. Abdelgader [a], Ali Mohammed S. Habiballuh [a], Azam Zaher A. Altoum [a], Ghanem Mohammed Mahjaf [a*], Nusaiba Abdelrahman M. Hakim [a], Tibyan Abd Almajed Altaher [b] and Babbiker Mohammed Taher Gorish [c]

[a] Department of Medical Microbiology, Faculty of Medical Laboratory Sciences, Shendi University, Sudan.
[b] Department of Clinical Chemistry, Faculty of Medical Laboratory Sciences, Shendi University, Sudan.
[c] Department of Medical Microbiology, Faculty of Medical Laboratory Sciences, Omdurman Islamic University, Sudan.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Original Research Article

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**Corresponding author: Email: mahjaf.gh@gmail.com;*

ABSTRACT

Background: Methicillin-resistant *Staphylococcus aureus* (MRSA) is becoming ever more prevalent in Sudan, and the proportion of MRSA to methicillin-sensitive *Staphylococcus aureus* (MSSA) seems to be increasing. New strains of MRSA are ever-developing resistance to antibiotic treatment, increasing morbidity and mortality rate.
Objectives: To detect the prevalence of methicillin-resistant *Staphylococcus aureus* in the nasal cavity of medical students at Shendi University and to detect variations of MRSA Colonization between student smokers and non-smoker students.
Methodology: 60 swabs were collected from medical students of Shendi University, culture, and direct gram stain were done, then the plates were examined for any significant bacterial growth. The isolated bacteria were then identified by colonial morphology, indirect gram stain, and biochemical tests.
Results: All data were analyzed using Statistical Package for Social Sciences (SPSS). Of these, 66.7 % (40/60) were males. 33.3% (20/60) were females. The isolated organism was *Staphylococcus aureus* 24 (40%), with no growth 36 (60%). The study showed that the overall resistance of *Staphylococcus aureus* to Methicillin was 21 (35%) and 3 (5%) Sensitive to Methicillin. Methicillin-resistant *Staphylococcus aureus* cases were found in nine (100%) of the students who smoked and twelve (80%) of the students who did not smoke. Of the pupils who did not smoke, three (20%) had *Staphylococcus aureus*. Methicillin Sensitive.
Conclusion: The carriage rate of S. aureus is consistent with similar studies. MRSA carriage in this university study appears high as compared to the general population. Although this study did not confirm a variety of risk factors for the carriage of MRSA previously identified by others, university healthcare personnel should be aware of the changing epidemiology of MRSA and the preventive measures needed to avoid outbreaks.

Keywords: MRSA; staphylococcus aureus; smoker; shendi; Sudan.

1. INTRODUCTION

"Staphylococcus aureus (SA) is a Gram-positive opportunistic bacterium that commonly colonizes the mouth, nasal passages, and skin of healthy individuals. This can lead to a variety of local and invasive problems, ranging from superficial skin infections to life-threatening pneumonia and bacillus infections. *Staphylococcus aureus* infections have been occurring in humans since ancient times. Shortly after penicillin was first used to treat his SA infection in 1940, the first penicillin-resistant SA strains emerged" [1]. "Antibiotic-resistant SA strains are considered a major health problem" [2]. "Meta-analysis of studies of *S. aureus* bacteremia that were published from January 1980 through December 2000 demonstrated significantly increased mortality associated with MRSA infection, compared with infection due to *methicillin-susceptible S. aureus* (MSSA)" [3]. "There is strong evidence that SA is transmitted between patients and dentists through the clinical setting" [4]. "The presence of SA has been demonstrated to be associated with oral mucosal disorders such as angular stomatitis, erythema, swelling, and burning, suggesting a role for SA in oral mucosal disorders. Nasal and oral transport of methicillin-resistant SA (MRSA) serves as a reservoir for recolonization of other body sites and cross-infection between patients and medical staff" [5]. "In addition to genetic differences, infections with community-associated methicillin-resistant *Staphylococcus aureus* (CA-MRSA) are generally different. Although CA pathogens are most commonly associated with skin and soft tissues (abscesses, boils, folliculitis), pathogens acquired in healthcare facilities are associated with respiratory, cardiovascular, urological, and surgical sites more likely to become infected. In addition, CA-MRSA is susceptible to non-lactam antibiotics (clindamycin, trimethoprim-sulfamethoxazole, tetracycline, etc.)" [6]. "MRSA can cause highly invasive, rapidly progressive, life-threatening infections, such as necrotizing pneumonia, severe sepsis, and necrotizing fasciitis" [7,8]. "Individuals with MRSA colonization or carriage (that is, the presence of bacteria that do not cause a detectable host immune response, cellular damage, or clinical signs and symptoms of infection) have an increased risk of subsequent infection and are an important source of person-to-person transmission. Healthcare facilities are environments with high antibiotic selection

pressure (which can contribute to the selection of antimicrobial resistance in bacteria) and frequent human contact, and they host people who are predisposed to infection (for example, due to invasive procedures and/or immune compromise)" [9]. "Most nations are predicted to have an MRSA prevalence of less than 50%, with others claiming a frequency as low as 25%" [10]. While MRSA prevalence has begun to decline in South Africa (from 36% in 2006 [11] to 24% in 2007–2011 [12], statistics from most other countries indicate that it has been rising since the early 2000s. Some of the variance between countries may be explained by variations in the use and availability of antimicrobials, the rate of HIV infection (which is a risk factor for MRSA colonization [13], and infection control procedures. "Hospital outbreaks (health-care-associated MRSA, or HA-MRSA) were caused by MRSA in various regions of the world in the ten years after it was first described" [14]. These conditions have facilitated the epidemic spread of MRSA in hospitals; MRSA is now endemic in many healthcare facilities throughout the world and, as a consequence, it has become a major focus for infection control efforts globally.

2. MATERIALS AND METHODS

A descriptive cross-sectional-based study was conducted to detect the prevalence of methicillin-resistant *Staphylococcus aureus* in the nasal cavity of medical students at Shendi University from July to December 2022. The collected samples were transferred to the Medical Microbiology Lab at the Faculty of Medical Laboratory Sciences at Shendi University, where they were processed and examined. A sixty (60) nasal swab sample was taken from participants. Participants involved in this study were medical students of all ages at Shendi University. A nasal swab sample was taken from each participant to detect *Staphylococcus aureus* and MRSA after culturing, followed by susceptibility testing.

2.1 Sample Collection

Best results were obtained by using a flocked swab in combination with Amies transport medium." Flocked swabs provide better sample collection due to their brush-like tip, which releases higher numbers of target cells and retains more liquid samples than foam swabs. Once a swab and transport medium, like Puritan's Opti-Swab Media Transport System, was selected, the tester should wash their hands and put on clean gloves.

2.2 Susceptibility Testing

Both disk diffusion and MIC methods employed the phenotypic identification of susceptibility. The disk diffusion method (also known as the Kirby-Bauer test) is appropriate for rapidly growing organisms. In this procedure, a standard turbidity (McFarland 0.5) solution was prepared to compare its color with the turbidity of the bacterial suspension by using a sterile loop touch to isolate 3–5 well-isolated colonies of the tested organism in 3–4 ml of saline or nutrient broth. Inoculate a Mueller-Hinton agar plate with a sterilized swab. Apply three different strokes to the media with the swab. By sterile forceps, place antibiotic-impregnated disks on Mueller-Hinton agar plates inoculated with the test organism. After incubation (typically 16 to 18 hours), examine the diameter of the zone of inhibition around each disk. Each organism-antibiotic combination has different diameters.

2.3 Quality Controls

Sterile disposable swabs are used to collect the samples, and nasal swab samples must be cultured. All dishes and slides will be washed before and after use. The quality of staining solutions will be checked before used. During work, all swabs will be closed well to avoid contamination. Contamination also will be avoided during culturing by culture near the flame.

2.4 Data Analysis and Presentation

Data will be computed and analyzed by using Statistical Package for Social Sciences software program; version (21.0). The means will be obtained; other variables, frequencies, and percentages will be calculated and presented in the form of tables. The value will be used to assess the significance of the results.

3. RESULTS

Sixty nasal swabs were obtained from Shendi University medical students.. In this study, 17 (28.3%) samples are aged ranged from17-20 years, 43(71.7%) age ranged from 20-45years, there is no statically significant association between the carrying of *S. aureus* and age (*P. value* = 1.00) (Table 1). 66.7 % (40/60) were

males. 33.3% (20/60) were females, there is no statically significant association between the carrying of *S. aureus* and gender (*P. value* = 0.75) (Table 2). The isolated organism was *S. aureus* growth of 24 (40%), with no growth of 36(60%) (Table 4). The study showed that the overall resistance of S. *aureus* to Methicillin was 21 (35%) and 3 (5%) Sensitive to Methicillin (Table 5). 9(100%) of Smoker students were resistance S. *aureus* to Methicillin .12(80%) of non-Smoker students were resistance S. *aureus* to Methicillin. 3(20%) of non-Smoker students were S. *aureus* Sensitive to Methicillin, and there is no statically significant association between Smokers students and non-smokers on resistance *S. aureus* to Methicillin (*P. value* = 0.75) (Table 6).

4. DISCUSSION

The nasal carriage of *S. aureus* varies depending on the different populations studied. This study was conducted in River Nile State, Shendi University from March 2021 to February 2022. 60 nasal swab samples were collected randomly from healthy students and smoker students of both sexes, where 20 students of them were male non-smokers and 20smoker and the other 20 students were females. 24 samples of students show growth of *S. aureus* on the selective media mannitol salt agar and 36 samples show no growth. Age ranged between (17-20 years) showing 1 sensitive and 7 resistance. Age ranged between (21-24years) showing 2 sensitive and 14 resistance. 14 samples from the male show 12 resistance and 2 sensitive. 10 samples from females show 9 resistances and 1senstive. We found 9 samples from smoker students show resistance and 0 Sensitive. 15 samples from non-smoker students show 12 resistance and 3 sensitive. This study found 40% of the population are carriers of *S. aureus* and 95% are resistant to methicillin. 60 (29.6%) carried *S. aureus. S. aureus* carrier (OR=3.0, 95% CI 1.28-7.03). Of the 60 participants that carried *S. aureus*, 15 were identified as MRSA. This relates to a 7.4% MRSA carriage rate among generally healthy university students. This result is in agreement with the result obtained by Rodney E Rohade at Texas University (2009) [15]. MRSA nasal colonization was found to be low outside of the healthcare environment. Smokers and oral contraceptive users have high nasal carrier rates. Comparison with our result shows smoking increases MRSA colonization. 9(100%) of Smoker students were resistance *S. aureus* to

Table 1. Distribution of study population according to age

Age	Frequency	Percent%
17-20 years	17	28.3%
21-24 years	43	71.7%
Total	60	100.0%

Table 2. Distribution of the study population according to gender

Sex	Frequency	Percent %
Male	40	66.7
Female	20	33.3
Total	60	100.0%

Table 3. Distribution of the study population according to Smoking

Smoking	Frequency	Percent%
Smoker	20	33.3
Non smoker	40	66.7
Total	60	100.0%

Table 4. Distribution of the study population according to *S. aureus* growth

Growth of S. aureus	Frequency	Percent%
Growth	24	40.0
No growth	36	60.0
Total	60	100.0%

Table 5. Distribution of study population according to *S. aureus* Susceptibility to Methicillin

Susceptibility to Methicillin	Frequency	Percent%
Sensitive	3	5.0%
Resistance	21	35.0%
Total	24	40.0%

Table 6. Variation of Susceptibility to Methicillin between smokers and non-smokers

Variable	Sensitive	Resistance	Total
Smokers	0	9	9
Non smokers	3	12	15
Total	3	21	24

Methicillin .12(80%) of non-Smoker students were resistance *S. aureus* to Methicillin. 3(20%) of non-Smoker students were *S. aureus* Sensitive to Methicillin. but the result was not statically significant may be due to the low sample size.

5. CONCLUSION

The carriage rate of S. aureus is comparable with previous research. MRSA carriage appeared to be high in this university study as compared to the general population. Although this study did not confirm a number of previously recognized risk factors for MRSA carriage, university healthcare workers should be aware of the shifting epidemiology of MRSA and the preventive actions required to avoid outbreaks.

CONSENT AND ETHICAL APPROVAL

Ethical approval for the study was obtained from the Board of the Faculty of Medical Laboratory Science at Shendi University. The written informed consent form was obtained from each guardian of the participant as well as from the subject himself before recruitment into the study. All protocols in this study were done according to the Declaration of Helsinki (1964).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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