

COMPARISON OF NASAL CARRIAGE OF MRSA AND ITS ANTIBIOTIC SUSCEPTIBILITY WITH SPECIAL REFERENCE TO MUIPIROCIN AMONG STUDENTS OF HEALTH-CARE SETTINGS AND OTHER STUDENTS

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ABSTRACT

Objectives: One of the potential risk factors for nosocomial staphylococcal and Methicillin-resistant *Staphylococcus aureus* (MRSA) infections is colonization of the anterior nares of HCWs, and from there they may spread to the patients, which may cause a burden on the health-care system. In this context, we made an attempt to compare the Staphylococcal and MRSA nasal carriage and their susceptibility to Mupirocin in students who are exposed to the health-care system and those who are not.

Methods: Nasal swabs were collected from 100 paramedical students as the study group and 100 non-medical students as the control group, all in the age group between 18 and 21 years. 5% sheep blood agar and mannitol salt agar were used to isolate *S. aureus*, and antibiotic sensitivity was done by Kirby Bauer Disc Diffusion Technique. Cefoxitin disc (30 µg) and Vancomycin screen agar were used to detect MRSA and Vancomycin resistance, respectively. A 5 µg disc of Mupirocin was used to test the susceptibility of Mupirocin.

Results: Nasal carriage rate of *S. aureus* and MRSA was 23% and 8% in Paramedical students and 17% and 4% in Nonmedical students respectively. 83% of isolates from paraclinical students and 95% of isolates from non-medical students were susceptible to linezolid. Out of 12 MRSA strains from both groups only one strain showed resistance to Mupirocin.

Conclusions: Nasal carriage of *S. aureus* and MRSA and antibiotic resistance of isolated strains were more common in paramedical students and also in female students. Vancomycin resistance was not observed in MRSA strains from male students. Mupirocin resistance, even in a single case, needs to be addressed.

Keywords: Nasal carriage, Methicillin-resistant *Staphylococcus aureus*, Mannitol salt agar, Disc diffusion technique, Community acquired methicillin resistant *Staphylococcus aureus*, Mupirocin disc.

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INTRODUCTION

Methicillin-resistant *Staphylococcus aureus* (MRSA) strains were initially described in 1961 and emerged in the last decade as one of the most important nosocomial pathogens [1]. One of the potential risk factors for nosocomial staphylococcal and MRSA infections is colonization of the anterior nares of health-care workers (HCWs) with these organisms [2]. MRSA strains, with their nasal colonization, are well known for their high tendency to spread among the HCWs and from them to the patients, which in turn may lead to an increase in the treatment cost burden by prolonging the duration of hospital stays or the administration of expensive medications and spreading in the community [3].

Mupirocin, a topical glycopeptide antibiotic, is now commonly used for nasal decolonization of HCWs as part of routine surveillance to prevent the emergence and transmission of MRSA in health-care facilities and for the treatment of MRSA infections. The use of mupirocin is increasing day by day [4], and the increased pressure of antibiotic use has led to the emergence of mupirocin-resistant *S. aureus* (MupRSA), and the clinicians are left with few alternatives to prevent the spread of MRSA [3].

The prevalence of MRSA nasal carriage, with special reference to Mupirocin susceptibility, among the general public in this area is not available. Hence, we made an attempt to compare MRSA nasal carriage and its susceptibility to Mupirocin in non-medical students who are not exposed to health-care settings and in students in paraclinical courses who are exposed to patients.

Objects

1. To know the nasal carriage rate of MRSA among Diploma in Medical Laboratory Technicians (DMLT) students who are undergoing training at Govt. Medical College, Srikakulam.
2. To compare the nasal carriage rate of MRSA among students in health-care settings and others.
3. To know the susceptibility of isolated MRSA strains to mupirocin.

Inclusion criteria

Students of DMLT branches and non-medical students who have given their consent to collecting nasal swabs.

Exclusion criteria

1. Those who were hospitalized in the last 1 year.
2. Those who were on antibiotics for any reason within the last 3 months.
3. Persons with upper respiratory tract infections, deviated nasal septum, polyps, sinusitis, or any disease related to nasal orifices.

METHODS

Nasal swabs from DMLT students who are undergoing training at Government Medical College, Srikakulam, and students who are attending a degree college were collected after obtaining informed written consent.

Sample collection

Nasal swabs were collected by sterile, dry cotton swabs from the anterior nares of each nostril of a subject, inserting the swab, and

then gently rotating the swab three times [1]. In the case of sneezing, resampling was done. After collecting the sample, swabs were re-inserted into the transport tube, labeled, and transported to the laboratory for processing.

Processing of the sample

All the swabs were inoculated on 5% sheep blood agar and mannitol salt agar and incubated at 37°C for 24 h. The next morning, plates were observed for growth, which was identified on the basis of colony morphology, Gram’s stain, biochemical tests like catalase, oxidase, DNase, and tube coagulase. Plates that showed *S. aureus* growth were subjected to the Kirby–Bauer disc diffusion technique for antibiotic sensitivity, including methicillin. Antibiotic discs of penicillin (10 units), ciprofloxacin (5 µg), clindamycin (2 µg), erythromycin (15 µg), levofloxacin (5 µg), linezolid (30 µg), rifampin (5 µg), tetracycline (30 µg), and cotrimoxazole (1.25/23.75 µg) were used. Zone diameter interpretation for determining sensitive, intermediate, or resistant was done as per CLSI guidelines [3,5].

The detection of MRSA was done by testing with a 30 µg Cefoxitin disc for MRSA screening, and zone size was interpreted according to CLSI guidelines. An inhibition zone diameter of ≤21 mm was reported as MRSA, and ≥22 mm was reported as methicillin-sensitive *S. aureus* (MSSA). Vancomycin resistance was tested by using Vancomycin screen agar (6 µg/ml vancomycin) from Hi Media [6]. 5 µg discs of Mupirocin were used to test the susceptibility of mupirocin and plates were incubated for 24 h at 35°C ± 2°C. The zone diameters were carefully examined with transmitted light for any light growth within the zone of inhibition. Isolates with no zone of inhibition were interpreted as mupirocin-resistant [7].

RESULTS

Nasal swabs were collected from 100 paramedical students as the Study group and 100 non-medical students from Degree College as the control group, all in the age group between 18 and 21 years. More female students have participated, and the female-to-male ratio in both groups was 70:30. *S. aureus* was isolated more in number in paramedical students when compared to non-medical students (23% in paramedical students and 17% in non-medical students). Within paramedical students, the nasal carrier rate was higher in female students than in male students (24% in female students, where it was 20% in male students). The carrier rate of *S. aureus* was double in female students among non-medical ones (20% in female students, where it was 10% in male students), as shown in Table 1.

The nasal carriage rates of *S. aureus* and MRSA were 23% and 8% in paramedical students and 17% and 4% in non-medical students respectively.

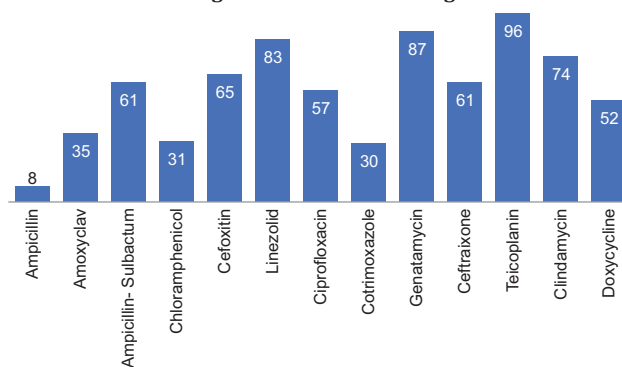
Surprisingly, vancomycin-resistant strains were not reported from male students in both the control and study groups. Whereas in female students, vancomycin-resistant *S. aureus* was isolated from three paraclinical students and from two non-medical students, and their percentages are given in Table 1.

Table 1: Category wise and gender wise number of samples collected and number of *S. aureus* isolates, MRSA strains and Vancomycin resistant strains

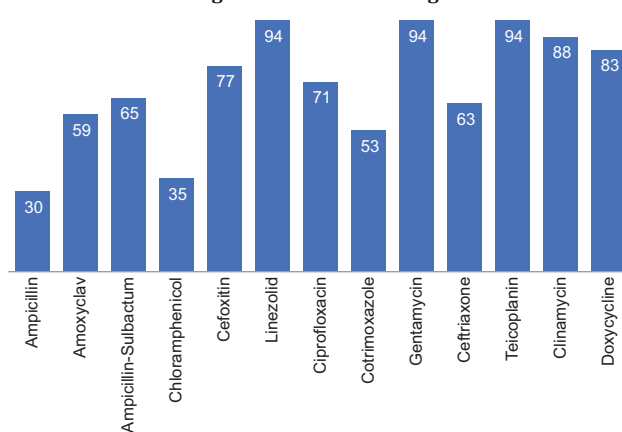
Category	Gender	No. of students	<i>S. aureus</i> isolates (%)	MRSA isolates (%)	% of MRSA in <i>S. aureus</i> isolates (%)	Vancomycin resistant strains (%)	% of vancomycin resistance in <i>S. aureus</i> isolates (%)
Para medical	Male	30	6 (20)	1 (3.33)	16.6	0	-
	Female	70	17 (24)	7 (10)	41.17	3 (4.28)	17.64
Total		100	23 (23)	8 (8)	34.7	3 (3)	13
Non-Medical	Male	30	3 (10)	0	-	0	-
	Female	70	14 (20)	4 (5.7)	28.57	2 (2.85)	14.28
Total		100	17 (17)	4 (4)	23.52	2 (2)	11.76
Grand total		200	40 (20)	12 (6)	30	5 (2.5)	12.5

S. aureus: *Staphylococcus aureus*, MRSA: Methicillin-resistant *Staphylococcus aureus*

The antibiotic sensitivity pattern of *S. aureus* isolated from para-medical students was given below as a bar diagram



Antibiotic sensitivity pattern of *S. aureus* isolated from non-medical students was given below as bar diagram



S. aureus strains isolated from paramedical students showed more resistance to antibiotics when compared to the isolates from non-medical students, as shown in the bar diagrams. Only one case of mupirocin resistance was observed among paramedical students.

DISCUSSION

S. aureus grows harmlessly on the moist skin of the nostrils in about 30% of healthy people, and the perineum is also commonly colonized. Organisms are spread from these sites into the environment by hands, clothing, and dust consisting of skin squames and cloth fibers [8]. Nasal carriage of MRSA is a recognized risk factor and a precursor for invasive infection [9].

At present, two types of MRSA infections are recognized: health-care-associated MRSA (HA- or HCA-MRSA) and community-acquired MRSA (CA-MRSA) infections. HCA-MRSA isolates also tend to be multiresistant [10].

Vancomycin and linezolid are commonly used antibiotics for MRSA infections, whereas mupirocin, a topical antibiotic, is used for the treatment of skin and soft tissue infections as well as the decolonization of carriers [4]. Mupirocin 2% ointment is used either alone or with skin antiseptics as part of a comprehensive MRSA decolonization strategy. Increased mupirocin use, either for decolonization strategy or its use in the treatment of superficial skin and soft-tissue infections, which is approved [11], predisposes to mupirocin resistance, which is significantly associated with persistent MRSA carriage [9].

Two types of resistance to mupirocin have been described: high-level and low-level mupirocin resistance [12].

In the present study, the nasal carriage rate of *S. aureus* and MRSA was higher in paramedical students than in non-medical students. But the p value is not significant between the study group and the control group for staphylococcus nasal carrier rate. But surprisingly, when we compared between genders, irrespective of study or control group, the p value was significant (31 female students carry *S. aureus* in their nasal orifices out of 140, when compared to 9 male students positive for *S. aureus* out of 60). This observation needs further exploration by doing a study involving a larger number of male and female students.

Nasal carriage rates of *S. aureus* and MRSA were 14% and 4% in healthy individuals and 27% and 11% in patients, with a significant p value in the Bharathi *et al.* study, and they also observed that community-associated *S. aureus* and CA-MRSA were more susceptible to antimicrobials than hospital-associated *S. aureus* and HA-MRSA [13]. The nasal carriage rates of *S. aureus* and MRSA were 23% and 8% in paramedical students and 17% and 4% in non-medical students in the present study, and strains from non-medical students were more susceptible to antimicrobials.

11.33% of females and 18.83% of male subjects carried *S. aureus* strains in their noses, and 2.16% of females and 7% of male candidates were detected as MRSA nasal carriers in a study by Pires *et al.* [14]. Nasal carriage was higher in males (15.47%) as compared to females (13.26%), and 19.51% of isolates were MRSA in a study by Anwar *et al.* [15], and MRSA was 30% in our study.

The nasal carriage rate of *S. aureus* and MRSA was more in female students in both study and control groups in our study. The prevalence of *S. aureus* nasal carriage was 23.4% in one study [16], similar to our study in the paraclinical group (23%), and 20% in total.

The *S. aureus* nasal carrier rate was 27.92%, the MRSA carriage rate was 1.83%, and there was no vancomycin resistance in one study. They detected methicillin resistance by the cefoxitin disc diffusion method, confirmed it by the minimum inhibitory concentration (MIC), and did amplification of the *mecA* gene by PCR [17]. In the present study, vancomycin resistance was observed in 2.5% of the total cases. Giri *et al.* studied MRSA colonization among health-care workers and found the highest rates among doctors, whereas we have studied it in paraclinical students [2].

The prevalence of MRSA in the apparently healthy community of East Sikkim was estimated to be 11.1% [1]. In a study by Ahmadi *et al.*, they found that 181 (30.16%) persons were colonized with *S. aureus*, among which 68 (11.33%) and 113 (18.83%) strains were isolated from female and male subjects, respectively, with 2.16% and 7% MRSA nasal carrier rates among female and male candidates, respectively [18].

The nasal carriage of *S. aureus* and MRSA in second-year MBBS students was 52.7% and 11.5%, respectively, in one study. The overall MRSA carriage rate was 6.1% (out of 148 students, 9 strains of MRSA were isolated) [19]. Whereas overall MRSA carriage was 8% and 4% in paraclinical students and non-clinical students, respectively, in this study.

Agarwal *et al.* found the prevalence of *S. aureus* nasal carriage among HCWs is 48% and MRSA nasal carriage is 14% in Barabanki, Uttar Pradesh, and all isolates were susceptible to linezolid [3]. They also observed mupirocin resistance in 7% of MRSA isolates and no mupirocin resistance in MSSA strains. In the present study, only 83% of isolates from paraclinical students and 95% of isolates from non-medical students were susceptible to linezolid. Regarding mupirocin resistance, out of 12 MRSA strains, only one strain showed resistance (8.3%).

In one study, they controlled an outbreak of *S. aureus* by giving immediate treatment to direct care staff and patients with nasal mupirocin [20], whereas all strains were mupirocin susceptible in another study [21]. In the present study, nasal carriage of MRSA was cleared with topical application of 2% mupirocin for 1 week in all students except the one with a mupirocin-resistant strain, and that student was referred to the medicine department for further follow-up. Hence, it is necessary to create awareness among health-care personnel about the strict implementation of universal health precautions, especially hand hygiene while delivering services to treat patients in the health-care system, and the judicious use of antibiotics, including mupirocin topical application, to prevent the development of resistance.

CONCLUSIONS

1. Nasal carriage of *S. aureus* was more common in paramedical students than in non-medical students.
2. *S. aureus* nasal carriage was more common in female students in both groups.
3. Vancomycin resistance was not observed in MRSA strains from male students.
4. Strains isolated from paramedical students showed more antibiotic resistance than strains from non-clinical students
5. Mupirocin resistance, even in a single case, needs to be addressed to prevent its spread among health-care personnel.

AUTHORSHIP

1st Author: The conception and design of the study, analysis and interpretation of data, and drafting of the article.

2nd Author: The conception and design of the study and the acquisition of data.

ETHICS COMMITTEE APPROVAL

Was obtained from the Institutional Ethics Committee.

CONFLICTS OF INTEREST

Nil.

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