

Screening for Nasal Carriage of Mupirocin Resistant *Staphylococcus aureus* among health care workers in a tertiary care hospital

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Abstract

Introduction: The aim is to isolate and to identify *Staphylococcus aureus* from the nasal swabs of the health care workers and screen for the mupirocin resistance among the isolated *Staphylococcus* strains.

Materials and Methods: Present study is a prospective type of study. A total of 100 nasal swabs were collected from health care workers. All the nasal swabs were cultured on MacConkey and Blood agar. Isolated organisms were subjected for antibiotic susceptibility testing by Kirby-Bauer disk diffusion method.

Results: Among the 100 nasal swabs, *Staphylococcus* spp. was isolated in 100 (100%) samples which comprised of 13 (13%) *Staphylococcus aureus* isolates and 87(87%) were Coagulase negative *Staphylococcus*. Of 13 *Staphylococcus aureus* isolates, 7 (53.84%) and 6 (46.15%) were detected as Methicillin Resistant *Staphylococcus aureus* and Methicillin Sensitive *Staphylococcus aureus* respectively. None of *S.aureus* isolates was resistant to mupirocin. Low level mupirocin resistant (MupL) was seen in 10 (30%) of Methicillin Resistant Coagulase negative *Staphylococcus* and 5 (14.7%) in Methicillin Sensitive Coagulase negative *Staphylococcus* isolates, respectively. High level mupirocin resistant (MupH) was seen in 4 (12%) of Methicillin Resistant Coagulase negative *Staphylococcus* and 4 (12%) of MRCoNS and MSCoNS isolates, respectively.

Conclusion: Mupirocin is a potent antibiotic to treat the nasal carriage of *S. aureus*. As resistance to mupirocin both low and high level is on rise, it is a matter of great concern. Policies and guidelines should be framed to create awareness among the health care workers regarding the screening methods for the detection and treatment of nasal carriage.

Keywords: MRSA- Methicillin resistant *Staphylococcus aureus*, MSSA- Methicillin sensitive *Staphylococcus aureus*, Mupirocin resistance.

Introduction

Staphylococcus aureus is a commonly isolated pathogen from the nosocomial infections.¹ Antibiotic resistance in *Staphylococcus aureus* is a worldwide phenomenon. Overuse of antibiotics and negligence to complete a full course of antibiotics once prescribed has resulted in the current scenario of widespread resistance.

Staphylococcus aureus colonization is mainly found in the anterior nares. Other sites of colonization are skin, wounds, tracheostomy sites and sputum of intubated patients. Studies have reported that the rate of nasal carriage of *Staphylococcus aureus* varies from 16.8% to 90%.² The principle mode of transmission is from patient to patient or through the colonized hands of healthcare workers (HCWs) who acquire the infection from patients or by handling the contaminated materials.

Screening for the detection of antibiotic resistance in the organism is the need of the hour to combat the heavy burden and spread of the antibiotic resistance. Most of the Staphylococcal infection results due to the endogenous colonization or through carriers. Eradication and inhibition of Staphylococcal colonization is an important measure to prevent the transmission.³⁻⁵

Methicillin was used to prevent or eradicate the carriers. But due to the development of Methicillin

resistant *Staphylococcus aureus* (MRSA), there is an increase in the number of MRSA carriers among HCWs which cause serious nosocomial infection. The drug of choice for the treatment of serious MRSA infection was Vancomycin till date.⁶ With the emergence of Vancomycin resistant MRSA, treatment option has become more limited.

Mupirocin, is a topical glycopeptide antibiotic commonly used for nasal decolonization of healthcare workers and to prevent emergence and transmission of infection in the health care facilities⁷. The use of Mupirocin in eradicating mupirocin susceptible strains from the nose is documented in various studies, about 85% of nasal carriers could be cleared, and although relapse do occur⁸. But resistance is another hindrance to achieve this target. Hence, our study aims to detect the mupirocin resistance strains of *Staphylococcus aureus* among healthcare workers.

Materials and Methods

Present study was a prospective type of study and it was carried out in Department of Microbiology, for a period of two months from July to August 2016. A total of 100 nasal swabs were collected from HCWs including doctors, postgraduate and undergraduate medical students, staff nurses and lab technicians. Inclusion criteria was swabs showing growth of gram positive cocci in clusters and exclusion criteria was

colonies identified as contaminants or gram negative organisms. After obtaining the Ethical committee clearance from Institutional Ethics committee, informed consent was taken from the health care workers.

The anterior nares swabs were collected with the help of sterile cotton swab moistened in normal saline from HCWs and immediately cultured on Blood and MacConkey agar. Plates were incubated aerobically at 37°C for overnight. Smear was prepared from the grown colonies for direct examination by gram staining. Gram stained identified colonies were subjected for catalase and coagulase test. Coagulase test was performed by both slide and tube coagulase method. Tube coagulase test was considered as the confirmatory test for *Staphylococcus aureus*.

In slide coagulase test, a clean glass slide was taken with drops of saline in the center of the slide and colonies were emulsified well. A drop of undiluted plasma was added to the bacterial suspension and mixed well. Prompt clumping of the organisms shows the presence of the blood coagulase. In tube coagulase test, the isolated colonies were inoculated in the nutrient broth and were incubated at 37°C for 4 hours. After 4 hours, plasma was added in the cultured broth and incubated for overnight at 37°C. The formation of coagulum was taken as tube coagulase positive.

Then, the colonies were cultured [by lawn culture method] on Muller Hinton agar (MHA) for Antibiotic

susceptibility test by Kirby Bauer disk diffusion method. Antibiotic discs like Cefoxitin 30 µg, Mupirocin 5 µg and 200 µg were placed on MHA. Plates were incubated at 37 °C for overnight. The zone of inhibition was measured by using zone scale. The zone of inhibition of ≤ 21 mm was considered as methicillin resistant for cefoxitin and ≥ 22 mm were considered as methicillin sensitive as per CLSI guidelines. For, mupirocin if the zone was formed, it was considered as sensitive and in resistant strains, no zone formation was observed.

Statistical Analysis

The results were recorded and analyzed statistically in Microsoft office Excel Sheet 2010. Simple percentage calculation was used for statistical analysis.

Results

In our present study, 100 Healthcare workers working in our hospital were included in the study. Out of these HCWs, 80 (80%) were females and 20 (20%) were males. The age ranged between 19 and 65 years. Of the 100 nonduplicate nasal swabs processed in the laboratory, *Staphylococcus* spp. was isolated in 100 (100%) samples which comprised of 13 (13%) *S. aureus* isolates and 87(87%) were Coagulase negative *Staphylococcus*. [Table1]

Table 1: Show the distribution of various samples on the basis of the source

Source	Number of samples (n=100)	Number of <i>Staphylococcus aureus</i> (n=13)
Doctors	4 (4%)	-
Nurses	25 (25%)	3 (12%)
Technicians	29 (29%)	6 (20.68%)
Postgraduate students	2 (2%)	-
Undergraduate students	40 (40%)	4 (10%)
Total	100	13

Of 13 *S.aureus* isolates, 7 (53.84%) and 6 (46.15%) were detected as MRSA and MSSA strains respectively.

Table 2: Distribution percentage of MRSA and MSSA as well as MRCoNS & MSCoNS strains in the total specimens received

Source	MRSA	MSSA	MRCoNS	MSCoNS
Doctors	-	-	2 (50%)	2 (50%)
Nurses	1 (4%)	2 (8%)	10 (40%)	12 (48%)
Technicians	3 (10.34%)	3 (10.34%)	7 (24%)	16 (55%)
Postgraduates	-	-	1 (50%)	1 (50%)
Undergraduate	3 (7.5%)	1 (2.5%)	13 (32.5%)	23 (57.5%)
Total	7 (53.84%)	6 (46.15%)	33 (37.9%)	54 (62%)

MRSA- Methicillin resistant *Staphylococcus aureus*, MSSA- Methicillin sensitive *Staphylococcus aureus* MRCoNS - Methicillin resistant Coagulase negative *Staphylococcus aureus*, MSCoNS- Methicillin Sensitive Coagulase negative *Staphylococcus aureus*

None of *S.aureus* isolates was resistant to mupirocin. But some of the MRCoNS and MSCoNS were resistant to mupirocin. MupL was seen in 10 (30%) and 5 (14.7%) of MRCoNS and MSCoNS isolates respectively. MupH was seen in 4 (12%) and 4 (12%) of MRCoNS and MSCoNS isolates respectively.

Table 3: Displays the antibiotic susceptibility pattern of MRSA & MSSA and also for MRCoNS & MSCoNS strains for different group of antibiotics

Antibiotics	MRSA	MSSA	MRCoNS	MSCoNS
Cefoxitin	7 (53.84%)	6 (46.15%)	33 (37.9%)	54 (62%)
MupL	-	-	10 (30%)	5 (9.25%)
MupH	-	-	4 (12%)	4 (7.4%)

MRSA- Methicillin resistant *Staphylococcus aureus*, MSSA- Methicillin sensitive *Staphylococcus aureus* MRCoNS - Methicillin resistant Coagulase negative *Staphylococcus aureus*, MSCoNS- Methicillin Sensitive Coagulase negative *Staphylococcus aureus*, MupH- Mupirocin High level resistant MupL- Mupirocin Low level resistant

Discussion

Nasal carriage of MRSA acts as an important cause for nosocomial infection transmitted by colonized healthcare workers.

The prevalence of *S.aureus* in a nasal carriage of healthcare workers in our study was 13 (13%) compared to the study conducted by Loveleena Agarwal which showed about 96 (48%) of prevalence of *S. aureus* and another study conducted by Dardi Charan Kaur showed prevalence of about 38 (27.14%) of *S.aureus*. Similar findings were reported by Rudrakshi singh which showed 35 (26.16%)¹⁰ and Golia et al showed about (24.84%) of prevalence of *S. aureus*

In our study, prevalence of MRSA and MSSA were 7 (53.84%) and 6 (46.15%) respectively and 33 (37.9%) of MRCoNS and 54 (62%) of MSCoNS were detected. However in the study conducted by Loveleena Agarwal, about 96 (48%) of *S. aureus*³ and another study conducted by Dardi Charan Kaur, about 38 (27.14%) of *S.aureus* were reported.⁹ Similar findings were observed in the studies by Rudrakshi singh where 35 (26.16%)¹⁰ of *S. aureus* and in Golia et al (24.84%) of *S. aureus*⁸ were being reported respectively.

In our study, all *S. aureus* isolates were sensitive to mupirocin, but 14 (42%) MRCoNS and 9 (16.6%) MSCoNS were resistant to mupirocin, respectively.

Prolonged usage and multiple courses of mupirocin are all associated with development of mupirocin resistance.¹⁴ Exposure of CoNS on skin surface during long time or repeated topical application of mupirocin may lead to development of a reservoir of high level resistance determinants in CoNS which may then be transferred to *S.aureus* in patients on mupirocin therapy.

In the presence of mupirocin resistant strains treatment with mupirocin may be ineffective especially with high level mupirocin resistant. Even though low level mupirocin resistant strains can be controlled by normal schedule of mupirocin but few studies suggest that treatment failure may occur after few weeks. This emphasizes the importance of identification of both high and low level resistant strains.¹⁵⁻¹⁷

Conclusion

Mupirocin is a potent antibiotic to treat the nasal carriage among the healthcare workers. As resistance to mupirocin both low and high level is on rise it is a

matter of concern. More such studies have to be done on a larger population and should encourage the judicious use of antibiotics in both the hospital and community level.

Policies and guidelines should be framed to create awareness among the medical students, hospital staffs and doctors regarding the screening methods for the detection and treatment of nasal carriage. Alternative preparations such as chlorhexidine and neomycin cream could be encouraged if colonization persists after two courses of mupirocin or if swabs show mupirocin resistance.

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