

SCREENING OF MUPIROCIN SUSCEPTIBILITY IN CARRIERS OF MRSA AMONG HEALTHCARE WORKERS

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Article

Keywords: S.aureus, MRSA, MRCoNS, HCW, Mupirocin resistance, HAI

Posted Date: April 12th, 2022

DOI: <https://doi.org/10.21203/rs.3.rs-1544588/v1>

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Abstract

Background: Methicillin resistant *Staphylococcus aureus* (MRSA) is a rampant cause of healthcare associated infections(HAI),causing wide range of infections in patients and is mainly spread by asymptomatic nasal carriage in Health care workers(HCWs).The treatment is topical mupirocin which is becoming ineffective owing to acquisition of mupirocin resistance.Therefore their detection in HCWs and the associated mupirocin resistance is necessary. **Aim:** To find the prevalence of MRSA in nasal swabs taken from HCWs **Methods:** A nasal swab was collected from the anterior nares of the consenting HCWs. The swabs were then inoculated on basal media and colonies were identified using standard biochemical methods. All *Staphylococcus aureus* and Coagulase negative *Staphylococcus* (CoNS) were subjected to disc diffusion method using Cefoxitin (30µg) discs to detect MRSA and MRCoNS. The resistant isolates were tested with mupirocin discs to detect mupirocin resistance. **Results:** Of 100 HCWs,S.aureus was isolated in 46 (46%) ,out of which MRSA were 4 (8.69%). CoNS was isolated in 3 (3%) workers, of whom MRCoNS was found in 1 (33.33%). 1 isolate from MRSA(25%) and no MRCoNS showed mupirocin resistance **Conclusion:** Healthcare workers complying with the sanitary guidelines is the single most important factor in preventing HAI. There is a need for stringent HAI control practices as well increasing awareness among HCWs about such practices.

Introduction

Staphylococcus aureus is the most important cause of wound and skin infections^[1]. Methicillin Resistant *Staphylococcus aureus* (MRSA) has become endemic worldwide within the past two decades. There are both the hospital acquired MRSA and the community acquired MRSA strains and infections^[2]. Health-care workers (HCWs) and asymptotically colonized patients are the major sources of MRSA in the hospital environment. They constitute an important source of nosocomial infections and its dissemination both in the hospital and in the community^[3] .

The role of the MRSA carriers in the transmission of this pathogen is critical. Such carriers may transmit the organism to another person through direct contact, usually through colonized hands and aerosolization following sneezing. Therefore, HCWs who are at the interface between the hospital and the community may serve as the agents of the cross transmission of the hospital acquired MRSA and the community acquired MRSA ^[4] .

MRSA is now endemic in many countries including India^[5] .Adding to this woe,a few studies have shown isolation of methicillin resistant Coagulase negative *Staphylococcus* spp.(MRCoNS) in certain patients^[6, 7] .This leads to a potential disastrous Infection Control issue.

Treatment of nasal carriage of *Staphylococcus* is routinely done by nasal Mupirocin ointment, which is also effective in the eradication of MRSA and MRCoNS carriage. It acts by binding specifically to the bacterial isoleucyl-tRNA synthetase (IRS) enzyme and inhibits its protein synthesis. With the increased

use of mupirocin, both low and high level resistance has been reported during treatment with nasal mupirocin^[8].

Low-level resistance (minimal inhibitory concentration [MICs], 8-256 µg/ml) is usually associated with point mutations in the chromosomally encoded ileS gene whereas high-level resistance (MICs, ≥ 512 µg/ml) is generally due to a plasmid-mediated gene, mupA (also referred to as ileS2), which encodes an additional modified IRS^[9]. The mupA gene is typically plasmid mediated, and some of these plasmids are conjugative. MupB is a new high level mupirocin resistance mechanism in *S. aureus*^[10].

Various studies suggest that during mupirocin prophylaxis transfer of mupA gene from normal commensal flora of the skin such as *Staphylococcus epidermidis* to MRSA is responsible for the emergence of mupirocin resistance^[11].

An outbreak of MRSA in a hospital will have a catastrophic effect on the provision of safe healthcare to the patient. It increases morbidity and prolongs hospital stay thereby increasing the economic burden for the patient. Therefore the detection of MRSA in HCWs and the associated mupirocin resistance is necessary. The results of the study will benefit healthcare by knowing the rate of MRSA prevalence and if any mupirocin resistance is present in our hospital. Therefore the detection of MRSA in HCWs and the associated mupirocin resistance is necessary

Methods

It is a cross-sectional study conducted at a tertiary care centre in Hyderabad during the months of June 2018 to December 2018. The necessary Institutional Ethics Committee clearance was obtained. A total of 100 HCWs participated in the study. The HCWs participating in the study were explained about the study in a language they understand and written informed consent was obtained

Inclusion criteria:

- HCWs working in the institution for more than 1 year.
- HCWs who are free of any respiratory symptoms belonging to all ages and genders.
- HCWs who have granted written informed consent to participate in the study.

Exclusion criteria:

- Medical interns (Work duration < 1 year)
- HCWs who are suffering from a Upper Respiratory tract infection
- HCWs who refused to participate in the study.

Methodology:

After obtaining written informed consent, the HCW was seated comfortably. A sterile cotton nasal swab which was pre-wetted with saline was collected from the vestibule of anterior nares of both nostrils. The nasal swabs were transported to the lab immediately and from both nostrils streaked on Blood agar plates. The plates were then incubated for 24hrs at 37°C in an incubator. The isolates were then identified as *S.aureus*, CoNS and others by standard biochemical techniques.

All the confirmed *S.aureus* strains were subsequently tested for methicillin resistance using cefoxitin disc (30 µg) in Modified Kirby Bauer Disc Diffusion method. The isolates were considered methicillin-resistant if the zone of inhibition was less than 21mm. The confirmed CoNS were tested in a similar manner and a zone of less than 24mm was considered as MRCoNS.

The isolates of MSSA(Methicillin sensitive *S.aureus*) ,CoNS,MRSA and MRCoNS were then tested for Mupirocin resistance by Modified Kirby Bauer disk diffusion method using 5 µg and 200 µg Mupirocin discs to determine low and high level resistance respectively. Based on the zone sizes,three different phenotypes of Mupirocin resistance are identified.

Mupirocin susceptible: A zone diameter of ≥ 14 mm for both 5 µg and 200 µg discs.

Low-level resistance: Isolates that showed zone diameters < 14 mm in the 5 µg disc but more than or equal to 14 mm in the 200 µg disc

High-level resistance: Isolates with zone diameters < 14 mm for both 5 µg and 200 µg.

Results

Out of 100 HCWs,*S.aureus* was isolated in 46 (46%) of HCWs ,out of which MRSA and MSSA were **4 (8.69%)** and **42 (91.31%)** respectively.

CoNS was isolated in 3 (3%) workers, of whom MRCoNS was found in **1 (33.33%)** and methicillin-sensitive coagulase negative *Staphylococcus spp.*(MScoNS) **2 (66.67%)** respectively.[Table I].

Of the 110 HCWs, doctors and nurses presented with the lowest prevalence of nasal colonization and the Housekeeping staff with the highest prevalence.[Table II].

Among the 100 health care workers, MSSA and MScoNS isolates were **100% sensitive** to mupirocin but ONE isolate from MRSA(**25%**) and none from MRCoNS showed mupirocin resistance.High-level mupirocin resistance was exhibited by the isolate from a doctor.

Discussion

Methicillin-resistant *S. aureus* has been recognized as an important HAI pathogen worldwide because of the increased rate of multidrug resistance among the hospital acquired MRSA strains.

The present study shows 46% *Staphylococcus aureus* isolated from which 8.69% MRSA isolated from nasal cavity of HCWs of which 25% was resistant to mupirocin. Of the 3% CoNS, 33.33% were MRCoNS and showed no resistance to mupirocin.

The present study shows a prevalence of 8.69% for MRSA which is comparable to a study by Singh et al where the nasal carriage of MRSA among HCWs was found to be 7.5% [12]. Rongpharpi et al stated that Methicillin resistance was seen in 11.43% of the *S. aureus* isolates. [13]

A study by Kaur et al deduced that out of 140 nasal swabs collected from HCWs, *S. aureus* was isolated in 38 (27.14%), and CoNS was isolated in 73 (52.14%). MRSA was isolated in 20 (14.28%) and MRCoNS in 34 (24.29%). MSSA and MScCoNS isolates were 100% sensitive to mupirocin, but two isolates from MRSA (1.43%) and five from MRCoNS (3.57%) were mupirocin resistant. [8]

A study by Tiewsoh et al studied 432 samples, 24 (5.55%) were MRSA and 104 (24.07%) were MRCoNS. Only 4.16% ($n = 1$) showed high-level resistance to mupirocin among the MRSA isolates, while resistance among MRCoNS was higher at 6.7% ($n = 7$) for low-level resistance and 17.30% ($n = 18$) for high-level resistance. [1]

In a study by Shakya et al, MRSA prevalence rate was 10% among health-care personnel. [14]

In relation to the professional category, the lowest prevalence of colonization by the nursing staff (2.85%) followed by doctors (3.33%) and high prevalence was found in Housekeeping staff (5.71%) [Table II]. Agarwal et al reported 6% MRSA in nursing orderlies [15]. Tiewsoh et al reported 2.38% prevalence in Housekeeping Staff, 6.7% in Nurses and 2.38% in Doctors. [1]

Silva *et al.* observe that to develop activities like respiratory therapists or laboratory technicians represent a risk factor for the colonization by *S. aureus*. These individual possesses 4.57 times greater probability of being colonized when compared to doctors. [16]

The high prevalence of MRSA among housekeeping staff is probably due to the lack of knowledge and deficiency in information provided regarding infection control, use of PPE, proper hygiene while handling patients etc.

Mupirocin is the drug of choice for nasal carriers and has been effective for many years. By due to the injudicious use in recent times, resistance has been noted to it.

In our study among the 100 HCW's, MSSA and MScCoNS isolates were 100% sensitive to mupirocin but one isolates from MRSA (25%) and zero from MRCoNS were mupirocin resistance, which is comparable to the findings of Kaur et al showing 1.43% mupirocin resistance in MRSA. [8]

Agarwal *et al.* reported 28 out of 200 HCWs showing nasal carriage of MRSA and mupirocin resistance was seen in four of them, of which three isolates were Mup^H and one was Mup^L [15].

Shakya *et al.* observed 0% resistance to mupirocin in the HCW's^[14] whereas Tiewsoh et al noted 4.16% resistance.^[1]

Conclusion

The prevalence of MRSA and MRCoNS in HCWs and its associated mupirocin resistance is a cause for concern. To ensure maintenance of infection free environment and curtail the spread of HAIs, hospitals must develop stringent hospital infection control policies. At the same time, there is a necessity to create awareness among housekeeping and nursing staff about the same by educating them about steps to prevent infection transmission to eradicate MRSA carriage. As a routine, screening and treatment of HCWs should be done for MRSA status in every hospital.

Due to chances of developing resistance, mupirocin nasal ointment should be reserved for the eradication (in both patients and staff) of nasal carriage of MRSA only.

Healthcare workers complying with the sanitary and the antibacterial guidelines is the single most important factor in preventing HAIs. Simple preventive measures like hand washing before and after the patient examination, the use of sterile gloves and other personal protective equipment in the postoperative wards, awareness during the examination of the immunocompromised patients, and avoiding touching one's nose during work, can reduce the disease transmission rate considerably.

Declarations

AUTHOR CONTRIBUTION: All authors contributed to the study conception and design. The material preparation, data collection and analysis were performed by Dr Naila Fatima. The first draft of the manuscript was written by Dr Naila Fatima. Dr G Jyothi Lakshmi edited and commented on previous versions of the manuscript. Both the authors read and approved the final manuscript before its submission.

DATA AVAILABILITY: The datasets generated during and/or analysed during the current study are not publicly available to guard the privacy of the participants. But they can be made available from the corresponding author on reasonable request.

ADDITIONAL INFORMATION- CONFLICTS OF INTEREST: The authors confirm that there is no conflict of interest whatsoever, in the data submitted

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Tables

Table I: Distribution of organisms isolated from the nasal swabs taken from HCWs

ISOLATES	NUMBER (%)
S.Aureus (n=46)	
MSSA	42 (91.31%)
MRSA	4 (8.69%)
CoNS (n=3)	
MSCoNS	2 (66.67%)
MRCoNS	1 (33.33%)
Other organisms	38 (38%)
Sterile culture	13 (13%)
Total	100

Table II : Distribution of isolates based on the type of HCW.

PROFESSION	TOTAL NO: OF SWABS	S.aureus ISOLATES	MRSA ISOLATES	CoNS ISOLATES	MRCoNS ISOLATES
Doctor	30	9 (30%)	1 (3.33%)	2 (6.66%)	1 (3.33%)
Nursing staff	35	11 (31.42%)	1 (2.85%)	0	0
Housekeeping staff	35	26 (74.28%)	2 (5.71%)	1(2.85%)	0
Total	100	46	4	3	1

Table III: Mupirocin resistance in MRSA and MRCoNS

PROFESSION	MRSA ISOLATES	MUPIROCIN RESISTANCE	MRCoNS ISOLATES	MUPIROCIN RESISTANCE
Doctor	1 (3.33%)	1 (25%)	1 (3.33%)	0
Nursing staff	1 (2.85%)	0	0	0
Housekeeping staff	2 (5.71%)	0	0	0
Total	4	1 (25%)	1	0