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Original Research Paper

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IN VITRO ACTIVITY OF MUPIROCIN ON STAPHYLOCOCCAL NASAL CARRIERS AMONG HEALTH CARE PERSONNEL IN A TERTIARY CARE HOSPITAL, JAIPUR, INDIA.

Dr. Sakshita Agnihotri	PhD Research scholar, Department of Microbiology, Pacific Medical College, Udaipur, Rajasthan.
Eeshita Dhar*	PhD Research scholar, Department of Microbiology, JSS Medical college and Hospital, JSSAHER, Mysore. *Corresponding Author
Dr. Abhishek Shandilya	Associate Professor (Oral and Maxillofacial Surgery Department), Jaipur Dental College, Kukas, Jaipur.

ABSTRACT **Introduction:** Mupirocin (pseudomonic acid A) is an antibacterial agent with topical usage and wonderful antistaphylococcal and antistreptococcal characteristics. The formulation for nasal usage has been permitted by the U.S. Food and Drug Administration to eradicate nasal infections in adults. Healthcare workers possessing S. aureus as healthy carriers can be major origin of infection for the admitted patients. The anterior nares have proved to be the major reservoir for strains of S. aureus in both adult and children masses. **Objective:** To determine the prevalence of mupirocin susceptibility in S. aureus, coagulase-negative staphylococci (CoNS) and MRSA species by disk diffusion. **Materials And Methods:** A total of 100 nasal swabs were collected from health care personnel, aseptically during the study period. All the swab samples were processed immediately and isolated by standard microbiological methods. Antibiotic susceptibility testing was done by Kirby-Bauer disc diffusion method. **Results:** Carriage rate of staphylococci was found to be 51% (including 44% of S. aureus and 7% CoNS), out of 100 nasal swabs collected during the study period. Prevalence rate of MRSA is detected to be 60.7% (31/44) in the health care workers. A total of 13 MSSA were detected in the sample collected from the anterior nares and 5 cases of MRCoNS also observed. The present study shows that all the identified S. aureus isolates were susceptible to low level mupirocin (5μg) as well as high level mupirocin (200μg). **Conclusions:** Nasal carriage of S. aureus is a major threat for public health as they can disseminate the same to the patients as well as to their colleagues. To reduce the prevalence and antimicrobial resistance, emphasis should be given to aseptic precaution, protective measures and topical application of mupirocin for eradication of nasal carriage.

KEYWORDS : MRSA, MSSA, Mupirocin, Nasal carriage, MRCoNS.

INTRODUCTION

Nasal infection with S. aureus serves not only as an endogenous reservoir of clinical infection in colonized individuals, but also as a source of cross-colonization for mass spread in the community.[1]

Many studies have been conducted all around the world and have accounted the nasal spread of *S. aureus* strains in the range of 16.8% to 90%.[2] Causality with S. S. aureus nasal infections and infections are supported by the fact that nasal and infectious strains share the same genotype.[3] In recent years, nosocomial outbreaks of MRSA have become a major infection control problem.

MRSA strains can be easily spread in hospitals from colonized or infected people. Settled employees are generally asymptomatic but are potential carriers of patient-acquired infection. Colonized or infected health care workers (HCWs) may act as reservoirs and spreaders of MRSA to non-colonized susceptible patients in the hospital.[4]

Nasal mupirocin plays a crucial part in elimination of MRSA carriers. It works by specifically adhering to isoleucyl-tRNA synthetase (IRS) which is the enzyme of bacteria and inhibiting the synthesis of protein. Mupirocin he was first introduced in the UK in 1985 for treating staphylococcal and streptococcal wound infections, Staphylococcus aureus, including MRSA. Right after 2 years of introduction, The resistance to mupirocin emerged in the isolates of MRSA in UK. Since then 2% in Ireland, 12.4% in New Zealand, 24% in the US and 44.1% in Trinidad and Tobago.[5,6,7,8,9] Both high and low resistance have been reported while treatment regimen with nasal mupirocin is carried out.[10]

The true degree of mupirocin susceptibility among health care workers in our community is unknown. Therefore, it is necessary to investigate mupirocin susceptibility in isolated staphylococci.

MATERIALS AND METHODS:

A prospective single-centre study was conducted in the microbiology laboratory of a tertiary care hospital. A total of 100 nasal swabs were collected from various health care workers, including medical professionals, doctoral candidates, physicians, nurses, nursing students, and health workers participated in this study.

Sample Collection Procedure: Hands were washed thoroughly with soap and disinfected with alcohol prior to taking swab samples. Nasal samples were obtained using cotton swabs (Himedia) moistened with sterile saline. A cotton swab was inserted into the anterior nostril and rotated 2-3 times. These swab-sticks were then placed in a sterile transport swab tube, which he immediately transported to the microbiology lab within 2 hours of collection. Culture of the swabs and identification of the obtained growth as *S. aureus* or CoNS (Coagulase Negative Staphylococci) was done by using standard methods.

Nasal swabs were inoculated onto blood agar and mannitol salts agar and incubated overnight at 37°C. Isolates were identified from culture growths obtained on blood agar were examined for colony characteristics and hemolysis production. Staphylococci were identified by the following characteristics:

Colonies, 1–3 mm in diameter, smooth, slightly convex, shiny, densely opaque and consistently buttery, on blood agar (e.g. Staphylococcus aureus exhibits -hemolysis depending on the strain). They had greyish, white or off-white pigmentation. Since then, Staphylococcus aureus has tolerated concentrations of sodium chloride that inhibit most other bacteria. Thus, on mannitol salt agar, acidification results in the formation of yellow colonies with a diameter of 1mm

surrounded by a yellow medium. Therefore, colonies exhibiting staphylococcal-like characteristics were stained with the Gram stain method.(Figure: 1a-1d)

S. aureus isolates were sub-cultured onto nutrient agar plates and incubated at 37°C for 18-24 hours for various biochemical assays. S. aureus isolates were then tested for mupirocin resistance. This was performed by the disc diffusion method using 5 μg and 200 μg mupirocin discs to determine low and high resistance, respectively.[11] The criterion for zone diameter cuto-ff for susceptible and resistant isolates was at >14 mm and <13 mm respectively.[12] (Figure 5)

Three different phenotypes are:
Mupirocin susceptible: A zone diameter of ≥14 mm for both 5μg 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.(Figure: 2)

RESULTS:

- Out of 100 HCWs, carriage rate of staphylococci was found to be 51% (including 44% of *S. aureus* and 7% CoNS).
- 8%, 35% and 8% Staphylococcal nasal carriage was observed in age group < 20 yrs, in between 20-40 yrs and above 40 yrs of age respectively.
- The prevalence rate of MRSA is detected to be 60.7% (31/44) in the health care workers. Only 13 MSSA were detected in the sample collected from the anterior nares. 5 cases of MRCONS also observed.
- The highest prevalence of staphylococci was found to be in the nursing staff (MRSA-11%, MSSA- 5% and MRCoNS-3%), followed by receptionists and doctors.
- The present study shows that all the isolated S.aureus strains were susceptible to low level mupirocin (5μg) as well as high level mupirocin (200μg). (Table 1)

DISCUSSION:

Staphylococcus aureus is a common cause of infection in both community and hospital settings. It is also a common cause of local suppurative lesions such as abscesses, boils and carbuncles. Apart from these suppurative lesions, disseminated lesions and toxin-borne diseases are caused by S. aureus. Most of these infections are transmitted to patients by healthcare workers.

S. aureus inhabits the skin and mucous membranes of humans and some animal species. Although several parts of the body can colonize humans, the anterior nares (vestibulum nasi or 'nose pick area') are the most common carrier sites for Staphylococcus aureus.

According to a study by J. Kluytmans et al. The nasal carriage rate of staphylococci in the general population ranges from 20% to 40%, and of these colonized S. aureus, 92% isolates are methicillin-susceptible S. aureus, the remainder being MRSA.[13]

In the current study, the collection of 100 nasal swab samples was done in total from medical personnel such as physicians, residents, nurses, security guards and receptionists. Of these, 78 were male and 22 were female medical staff. This study also determined the distribution of staphylococci associated with occupation. Staphylococcal prevalence was highest among nursing staff (MRSA-11%, MSSA-5%, MRCoNS-3%), followed by receptionists and physicians. A current study of health care workers with S. aureus nasal infections found that the staphylococcal infection rate was 51% (including 44% for S. aureus and 7% for his CoNS). A review of Ramana et al., reported that S. aureus carrier rate was 16% for 392 children aged 5 to 15 years. Staphylococcus aureus, 19% of which were MRSA.[14] In a study by Ashish Pathak et al. In a study conducted in healthy children in Ujjain, India, the prevalence of nasal carriers of Staphylococcus aureus was 6.3%, of whom S. aureus isolates were 16.3% MRSA.[15]

The current study found that her MRSA prevalence in health care workers was 60.7% (31/44) of his. Only 13 MSSAs were detected in samples taken from the anterior nares. His 5 cases of MRCoNS were also observed.

MRSA is a major cause of nosocomial infections and can cause illness in people with weakened immune systems in hospitals and health care facilities. Topical antibiotic treatment with mupirocin ointment is often used to eradicate nasal Staphylococcus aureus along with other antibiotics. Use of mupirocin ointment has been shown to reduce the extent of S. aureus infection in humans who are nasal carriers of S. aureus. It is a topical antibacterial drug used to treat skin and soft tissue infections and to eliminate staphylococcal carriers in health care workers and patients. Several studies have shown that elimination of anterior nasal carriage reduces the incidence of S. Staphylococcus aureus infections in other parts of the body.

In this study, all isolated S aureus strains were sensitive to both low (5 μg) and high (200 μg) concentrations of mupirocin. Similar results (no mupirocin resistance) were reported by Jan A.J.W. Kluytmans et al.,[13] Dardi Charan Kaur et al. A study conducted showed that methicillin-susceptible Staphylococcus aureus (MSSA) and MSCoNS isolates were reported as 100% susceptible to mupirocin, whereas two isolates from MRSA (1.43%) and MRCoNS 5 isolates (3.57%) were mupirocin-resistant.[16] The results of this study showed that elimination of perioperative nasal transport with mupirocin nasal ointment significantly reduced postoperative wound infections in patients undergoing cardiothoracic surgery.[13]

CONCLUSIONS:

This study found a high prevalence of staphylococcal infections among those aged between his 20s and his 40s, the most active group among health care workers. was shown. This explains the spread of staphylococci to patients and other health care workers through contact with fingers and inanimate objects.

Hospitals should develop more rigorous strategies to control nosocomial infections, but also educate households and caregivers to eliminate MRSA transmission.

Mupirocin nasal ointment can be effectively used to eradicate nasal transmission of MRSA (in both patients and staff).

FIGURES AND TABLES:

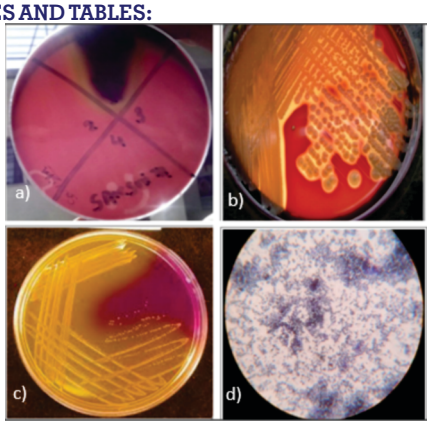

Figure 1: a) Growth on blood agar after overnight

incubation of clinical isolates. b) β-haemolysis on blood agar. c) Mannitol fermentation on MSA by S. aureus. d) Gram positive cocci under microscope, arranged in single, pairs and clusters.

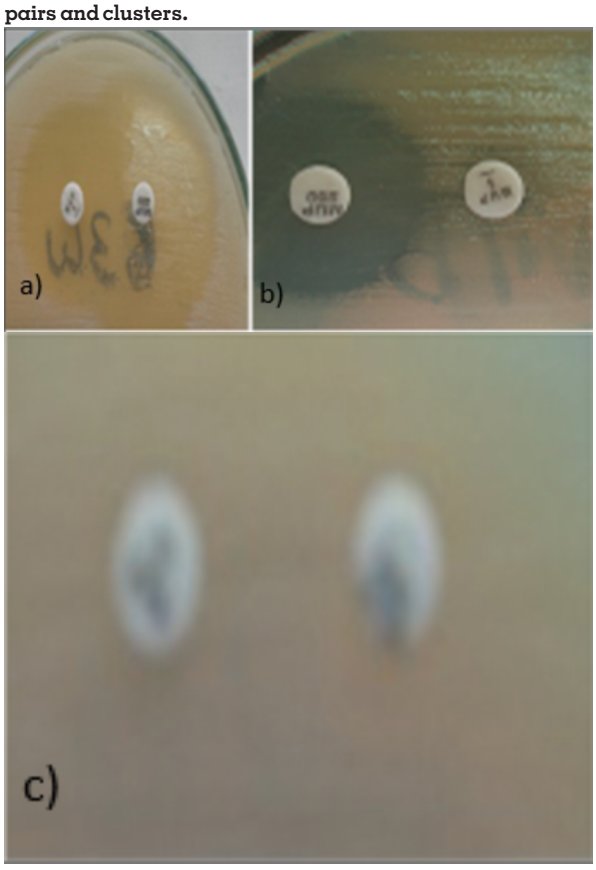

Figure 2: (a) Mupirocin susceptibility (b) low level resistance (c) high level resistance (S. aureus and 7% CoNS)

Table 1: Showing Total Number Of Isolates With Mupirocin Susceptibility Result.

No. of isolates (n)	Mupirocin 200μg	
	Sensitive (n)	Resistant (n)
MRSA (31)	31	0
MSSA(13)	13	0
MRCoNS (5)	5	0
MSCoNS (2)	2	0

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