International Journal of Microbiology and Mycology | IJMM |
pISSN: 2309-4796
http://www.innspub.net
Vol. 7, No. 2, p. 1-7, 2018

Open Access RESEARCH PAPER

Screening for nasal carriage of methicillin resistant *Staphylococcus aureus* among healthcare workers at a Rural Teaching Hospital in Medchal District, Telangana

Jaya Banerjee[1], K. Madhavi[*1], S. Kiranmai[1], R. K. Sureka[2]

[1]*Department of Microbiology, MediCiti Institute of Medical Sciences, Ghanpur Village, Medchal Dist, Telangana state, India*

[2]*Head of the Department, MediCiti Institute of Medical Sciences, Ghanpur Village, Medchal Dist, Telangana state, India*

Keywords: *Staphylococcus aureus,* MRSA, Healthcare worker, Nasal carrier

Publication date: March 30, 2018

Abstract

Staphylococcus aureus is a frequent cause of community and hospital acquired infections. One of the important sources of *Staphylococcus* for nosocomial infection is nasal carriage among hospital personnel. Emergence of drug resistance strains especially Methicillin resistant *Staphylococcus aureus* is a serious problem in hospital environment. This study aimed to determine the nasal carriage rate of *Staphylococcus aureus* with special reference to MRSA among healthcare workers at rural teaching hospital in Medchal, Telangana. We screened 100 healthcare workers of various clinical departments of MediCiti Institute of Medical Sciences. Nasal swabs taken from them were inoculated onto Blood Agar & Mannitol Salt Agar within 1 hour and incubated aerobically at 37°C for 24–48 hours. β-haemolytic colonies & Mannitol fermenting colonies which showed gram positive cocci in clusters in gram staining and produced Catalase & Coagulase were identified as *S. aureus*. Antibiotic susceptibility test was performed by Kirby-Bauer disc diffusion method. Methicillin resistance was detected using Cefoxitin disc diffusion method. Out of 100 healthcare workers, 26 were nasal carriers of *S. aureus* and among them 12 were carriers of MRSA. Overall nasal carriage rate of MRSA was 12%. Highest MRSA nasal carriage was detected among housekeeping personnel. The high rate of nasal MRSA carriage among healthcare workers found in this study necessitates improved infection control measures to be employed to prevent MRSA transmission in our hospital setting through periodic surveillance.

***Corresponding Author:** K. Madhavi ✉ jaya_banerjee2004@yahoo.com

Introduction

Staphylococcus aureus (*S. aureus*) is one of the commonest bacterial pathogen causing community and hospital acquired infections. It is a silent killer pathogen and it has remarkable propensity for development of antibiotic resistance. The community and hospital acquired *S. aureus* infections has been rising, with increasing emergence of drug resistance strains, which are called as Methicillin Resistant *S. aureus* (MRSA) and it has become a serious problem in hospital environment.

MRSA is currently the most commonly identified antibiotic resistant pathogen in the world. Treatment of infection caused by *S. aureus* has become most difficult since the occurrence of MRSA strains are resistant to all β-lactam antibiotics thereby significantly limiting the treatment options. Infections caused by MRSA strains are associated with worse outcomes, in addition to longer hospital stay, prolonged antibiotic administration, higher treatment cost and increased mortality than methicillin-susceptible *Staphylococcus aureus* strains.

One of the important sources of *Staphylococcus* for nosocomial infection is nasal carriage among hospital personnel. Similarly, healthcare providers are also exposed to patients with MRSA infection and are colonized in the course of their work. The ecological niches of *S. aureus* strains are the anterior nares and most of invasive *S. aureus* infections are assumed to arise from nasal carriages. Several studies have reported that the rate of nasal carriage of *S. aureus* among healthcare workers (HCW) ranges from 16.8%-56.1%.

The role of MRSA carriers in the transmission of this pathogen is critical and healthcare workers who are at interface between the hospital and the community may serve as the agents of cross contamination of Hospital acquired and Community acquired MRSA.

Hence the screening of nasal carriage in HCWs is an important component in the control of MRSA in any healthcare facility.

The present study therefore, was aimed to determine the carriage rate of MRSA among the Healthcare Workers at a rural teaching hospital in Medchal district, Telangana.

Materials and methods

Study design

The present study was a cross sectional study conducted at MediCiti Institute of Medical Sciences, Medchal, Telangana, India during the period of October - November 2017.

Sample size

We screened 100 Healthcare Workers of various clinical departments of MediCiti Institute of Medical Sciences, Medchal.

Inclusion criteria

Healthcare Workers such as Nursing staff, Ward boys, Sweepers, O.T staffs and other supporting staffs related to the patient care, were included in the study.

Exclusion criteria

All the Doctors were excluded from the study.

Sample collection

Single nasal swabs from both anterior nares of consenting HCWs were collected by using sterile cotton swabs which were moistened with normal saline. The swab was introduced 2-3 cm in the nasal cavity and rotated 3-4 times both clockwise and anticlockwise. Then the swabs were transported immediately to the microbiology laboratory for bacteriological analysis.

Culture and identification

Swabs were inoculated onto blood agar (BA) & mannitol salt agar (MSA) within 1 hour of collection and incubated aerobically at 37°C for 24-48 hours. β-haemolytic colonies on blood agar and Mannitol fermenting colonies on MSA (yellow or golden yellow coloured) were subjected to

smear microscopy, catalase test and tube coagulase test. Gram positive cocci in clusters on gram staining and produced Catalase & Coagulase were identified as *S. aureus.*

Antimicrobial susceptibility testing: The isolated strains of *S. aureus* were screened for methicillin susceptibility by modified Kirby-Bauer disc diffusion method by using cefoxitin (30µg) discs on Mueller-Hinton agar (MHA) by using an inoculum density which was equivalent to McFarland's 0.5 standard (1.5×108 CFU/ml). Isolates which showed inhibition zone sizes of diameter ≤21mm for cefoxitin discs, were considered as MRSA strains. Antibiotic susceptibility testing for all isolates of *S. aureus* was also done against other antibiotics like ampicillin (10µg), ciprofloxacin (5µg), erythromycin (15µg), clindamycin (2µg), vancomycin (30µg) and linezolid (30µg), by the modified Kirby-Bauer method. Inducible clindamycin resistance was detected by D-zone test. In this study, *S. aureus* ATCC 25923 was used for the control.

Antibiotic sensitivity testing and interpretation of results were done according to CLSI guidelines.

Results

A total of 100 healthcare workers were screened from various clinical departments for MRSA, among them 68% were females and 32% were males. Out of 100 screened healthcare workers, 26 (26%) were positive for nasal carriage of *S. aureus* and among them, 12 were carriers of MRSA. The overall nasal carriage rate of MRSA was 12% which is depicted in Fig.1. The prevalence of MRSA nasal carriage was higher among male HCWs (6.2%) than female HCWs (1.4%) which is shown in table.1.

The distribution of *S. aureus* and MRSA carriage in relation to profession/designation has been presented in table.2. *S. aureus* carriage rate (60%) and MRSA carriage rate (40%) were found among housekeeping personnel. Based on the area of work, the highest rate of MRSA carriers were among HCWs in paediatric (42.8%) and surgery (14.2%) departments (Table.3).

Table 1. Gender wise distribution of *S. aureus* and MRSA carriage rate among HCWs.

Healthcare workers	Total no. of HCWS screened (n=100)	Positive for *S.aureus*	Positive for MRSA
Males	32 (32%)	14 (43.7%)	2 (6.2%)
Females	68 (68%)	12 (17.6%)	10 (1.4%)

Table 2. Profession/designation related distribution of S. aureus and MRSA carriage status among HCWs.

Healthcare workers	No. of samples (n=100)	S.aureus (%)	MRSA (%)
Nursing staff	50	6 (12%)	6 (12%)
Attender	22	10 (45.4%)	2 (9%)
Housekeeping personnel	10	6 (60%)	4 (40%)
O.T staff	8	2 (25%)	0 (0%)
Other supporting staffs	10	2 (20%)	0 (0%)

Table 3. Distribution of S.aureus & MRSA among healthcare workers of different ward.

Departments	Total No. of samples (n=100)	Positive for *S. aureus* (%)	Positive for MRSA (%)
Obs & Gynec	34	8(23.5%)	2(5.88%)
Pediatrics	14	6 (42.8%)	6 (42.8%)
Medical	20	6 (30%)	2 (10%)
Surgical	14	4 (28.5%)	2 (14.2%)
Others	18	2 (11%)	0 (0%)

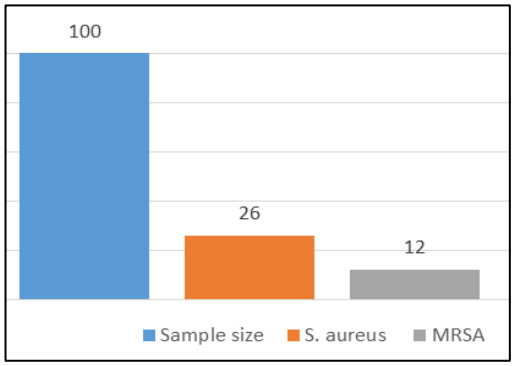

Fig. 1. Nasal carriage rate among 100 healthcare workers.

The antibiotic susceptibility patterns of *S. aureus* and MRSA isolates have been shown in Fig. 2 and Fig. 3. Among all identified *S. aureus* isolates, MRSA isolates were detected by resistance to cefoxitin. All isolates were sensitive to vancomycin and linezolid followed by clindamycin (69.2%) and erythromycin (53.8%) whereas resistance to ampicillin and ciprofloxacin were 53.8%. of the total erythromycin resistant isolates, inducible clindamycin resistance (iMLS$_B$) was seen in 50% (6/12) isolates. Also all MRSA isolates were sensitive to vancomycin, and linezolid followed by clindamycin (66.66%). Among MRSA isolates iMLS$_B$ phenotype was observed in 33.3% of erythromycin resistant isolates.

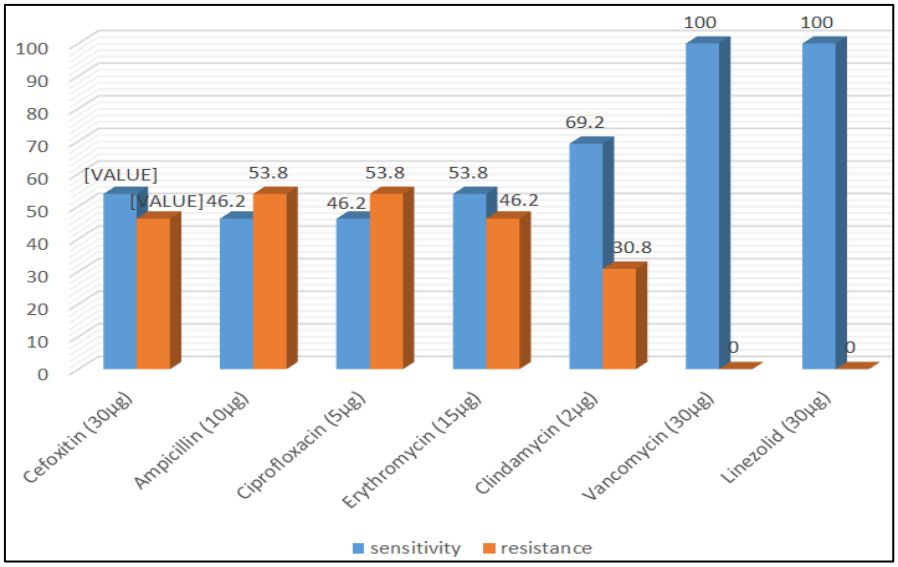

Fig. 2. Antibiotic susceptibility pattern of *S. aureus* isolates.

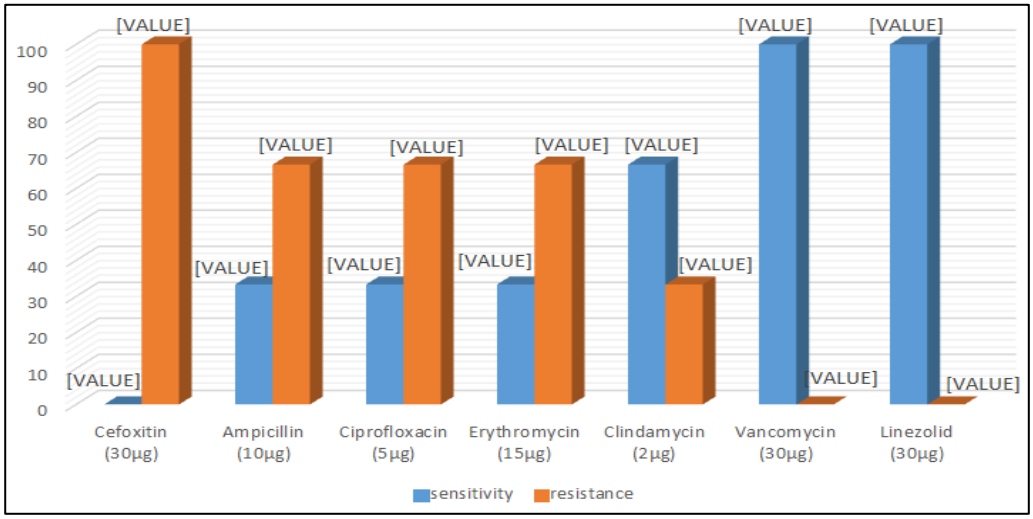

Fig. 3. Antibiotic susceptibility patterns of MRSA isolates.

Discussion

The present study detected a nasal carriage rate of *S. aureus* to be 26% among HCWs which is comparable to the other studies conducted in Assam -22.22% and Gujrat - 22% (Rongpharpi SR *et al*.,2013; Rutvi V *et al*.,2016).

MRSA nasal carriage rate in the present study was detected as 12% which is almost similar to other Indian studies carried out in Assam-11.43% and Bangalore-10% whereas lower than the other studies conducted in West Bengal-18.39% and Kashmir-19.1% (Rongpharpi SR *et al.,* 2013; Malini J. *et al.*, 2012; Himadri Mondal *et al*., 2016; Peer Maroof *et al*., 2016).

On the other hand MRSA carriage recorded is higher in this study as compared to the other Indian studies reported from Mangalore-2.5%, Pondicherry- 1.8%, Madurai- 2% and Delhi-6.6% (Radhakrishna M *et al.,* 2013; S Mathanraj *et al.,* 2009; Vinodhkumaradithyaa A *et al.,* 2009; Goyal R, Das S and Mathur M, 2002). MRSA carriage rate among HCWs is higher in this study indicating the possibility of hospital acquired MRSA colonization among healthcare workers. However outside India, MRSA nasal carriage rate of 7.5% from Nepal, 12.7% from Ethiopia and a very high MRSA nasal carriage rate of 38.9% was reported from Nigeria (Khatri S *et al*., 2017; Shibabaw *et al.*, 2013, Radhakrishna M *et al.,* 2013). However all variations in the prevalence of MRSA between institutions and geographic areas may be explained by microbiological methods (from sample collection technique to culture media), local infection control standards and local prevalence of MRSA.

In the present study, carriage rate of *S. aureus* and MRSA was higher among male HCWs (43.7% and 6.2% respectively) than female HCWs (17.6% and 1.4% respectively). Similar type of findings were reported from the study conducted in Assam where they reported higher nasal carriage rate of *S. aureus* among male HCWs-54.28% than female HCWs- 45.71% (Rongpharpi SR *et al*., 2013). Another study from Pondicherry observed majority of the carriers were males-12.4% (Mathanraj S *et al.,* 2009).

The present study detected highest MRSA carriage rate among the housekeeping personnel (40%). This finding signifies the need to create awareness among housekeeping staffs by educating them, to eradicate MRSA carriage among HCWs. The advantage of eradicating the MRSA carriage by the hospital staff and in the institution with effective hospital control policies, is the prevention of its transmission to the family members of the patients and others in the community.

In this study, HCWs from paediatrics ward and surgical ward accounted for 42.8% and 14.3% of the MRSA carriers respectively. All MRSA isolates were 100% sensitive to Vancomycin and Linezolid. The absence of vancomycin resistance of MRSA, which is compelled by its low toxicity and easy availability, signifies that it can be used in eradication of MRSA carrier state of healthcare workers as well as for the treatment of MRSA outbreaks infection cases.

The susceptibility testing of MRSA to other antibiotics revealed high resistance (66.6%) to ampicillin, ciprofloxacin and erythromycin. Clindamycin resistance was low- 33.3%; however $iMLS_B$ phenotype was seen in 33.3% of erythromycin resistant MRSA isolates. Hence clindamycin can be considered for empirical therapy, but testing for detection of inducible clindamycin resistance should be routinely performed.

Conclusion

It is necessary to detect the MRSA carriers among health care workers (HCWs) in hospitals as they act as a potential source of infection to their patients, causing nosocomial infections and thereby causing extended stays in the hospital.

The high rate of nasal MRSA carriage (12%) among healthcare workers found in this study necessitates improved infection control measures to prevent MRSA transmission. Appropriate measures should include laboratory based periodic surveillance, regular screening of HCWs, giving an early warning in the presence of antimicrobial resistant pathogens, treatment of MRSA-positive HCWs (carriers), isolation of colonized and infected patients and the use of barrier precautions.

The most important factor is to educate the healthcare professionals regarding the potential consequences of the nosocomial infections, to provide them periodic training about the maintenance of hygiene and basic infection control measures and the effects of the use or rather, the misuse of antibiotics.

Ethical clearance

This study has been approved by institutional ethics committee.

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