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International Journal of Current Research
Vol. 6, Issue, 02, pp.5059-5062, February, 2014

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

PREVALENCE OF NASAL COLONIZATION OF METHICILLIN RESISTANT STAPHYLOCOCCUS AUREUS AMONG HEALTHCARE WORKERS, AT A TERTIARY CARE HOSPITAL IN SOUTH INDIA

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ARTICLE INFO

Article History:
Received 18th November, 2013
Received in revised form
10th December, 2013
Accepted 26th January, 2014
Published online 21st February, 2014

Key words:
MRSA,
Nasal carriers,
CLSI guidelines,
Nosocomial infection.

ABSTRACT

Background: Methicillin resistant *Staphylococcus aureus* (MRSA) has emerged as an important nosocomial pathogen. Asymptomatic colonization among healthcare workers is the major source of MRSA in hospital environment. There is paucity of information on carriage of MRSA by healthcare workers in developing nations. Aim of this study was to determine nasal carriage rate of MRSA in healthcare workers and the antibiotic sensitivity of the isolates.

Methods: 300 nasal swabs were collected from doctors and health care workers. All the isolates were identified by standard methods and antibiotic sensitivity was performed by Kirby Bauer disk diffusion method. Methicillin resistance was identified by combined oxacillin and cefoxitin disk diffusion method. Minimum inhibitory concentration (MIC) of the isolates was determined by microbroth dilution method. Results were interpreted as per clinical laboratory standard institute (CLSI) guidelines.

Results: Out of 300 healthcare workers, 32 (10.7%) turned out to be MRSA carriers. The prevalence in doctors was 5.7% and among paramedical personnel was 15.0%. Out of 32 MRSA, only 2 (6.3%) isolates were resistant to vancomycin.

Conclusion: Screening of healthcare workers will better control the incidence of this dangerous pathogen and will provide some measures in control of nosocomial infections. The presence of methicillin resistance may cause problems in hospital infection control programs and may indicate emerging issues. Regular surveillance of hospital acquired infections, monitoring of antimicrobial susceptibility pattern and formulation of a definite antibiotic policy may be helpful.

INTRODUCTION

Staphylococcus aureus is a major pathogen in skin and soft tissue infections. It also causes abscess in deep organs and is responsible for toxin mediated diseases (Naik D, Teclu 2009). *S aureus* has overcome most of the therapeutic agents that have been developed in recent years and hence the antibiotic chemotherapy of this species has always been empirical. The most notable example of this phenomenon was the emergence of MRSA, which was reported just one year after the launch of methicillin (Rajaduraipandi *et al.,* 2006). No antibiotic marker has distinguished a species as much as methicillin has distinguished *S aureus* (Stefani S, Varaldo 2003). Humans are the natural reservoirs of *S aureus* and asymptomatic colonization is far more common than infection (Tiwari *et al*., 2008). Nasal carriage seems to play a key role in the pathogenesis of infection. The ecological niches of *S aureus* are the nares. Elegant studies have shown that nares are the most consistent area from which this organism can be isolated (Klyutmans *et al.*,1997). Because its primary habitat is moist squamous epithelium of the anterior nares, most invasive *S aureus* infections are assumed to arise from nasal carriage (Naisiri *et al.,* 2010). Colonized or infected healthcare workers may serve as reservoir and disseminator of MRSA in hospitals (Goyal *et al.*,2002) Identification of patients and healthcare workers colonized with MRSA, combined with other precautions and taking care of hand hygiene have been helpful in reducing transmission and controlling spread. According to WHO literature, the global financial burden because of MRSA infection has been worked out to be $ 20,000 to $ 114,000 for outbreaks and from $28,000 to $1600,000 for endemic infections per year (Kumari *et al*., 2008). The prevalence of MRSA varies markedly in hospitals in the same country and from one country to another (Vinodhkumaradithya *et al*., 2009). Prevalence of nasal carriers of *S aureus* strains among hospital staff has been estimated to range from 16.8% to 90%.

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Naisiri *et al.*, (2010). Although many studies have been conducted on the prevalence of *S aureus* strains in our country but there is little research in the field associated with nasal carriers. Hence the present study was undertaken to find out the nasal carriage rate of MRSA among healthy hospital staff, as they could pose a potential risk factor for nosocomial transmission leading to MRSA outbreaks.

METHODS

A sterile cotton swab moistened in trypticase soy broth was used to collect sample from the anterior nares of 300 hospital staff. The samples were plated on mannitol salt agar (MSA) and incubated at 37°C for 48 hours. Mannitol fermenting colonies were selected from MSA plates and subcultured on blood agar and incubated at 37°C overnight. The overnight colonies on blood agar plates were identified as *S aureus* by Gram's stain, catalase, slide coagulase and tube coagulase. Methicillin resistance was determined on Mueller Hinton Agar (MHA) by modified Kirby Bauer disk diffusion method using oxacillin 1µg and cefoxitin 30µg disks. The MHA plates on which oxacillin disks were applied was supplemented with 4% NaCl and incubated aerobically for 24 hours at 30°C, while the one on which cefoxitin was placed was not supplemented with NaCl but incubated aerobically at 35°C for 18 hours. Isolates with both inhibition zone diameter ≤13mm and ≤21mm around oxacillin and cefoxitin disks respectively were considered MRSA strains. MIC of the strains was determined by microbroth dilution method. Control strain used was ATCC 25923. Strains showing MIC ≤2µg/ml were interpreted as methicillin sensitive *Staphylococcus aureus* (MSSA) and those showing MIC ≥4µg/ml were interpreted as MRSA. Antibiotic sensitivity of the isolates were tested using disks- Ampicillin 10µg, Erythromycin 15µg, Gentamycin10µg, Netilmycin 30µg, Amikacin 30µg, Tetracycline 3µg, Co-trimoxazole 25µg, Ciprofloxacin 5µg, Rifampicin 5µg and Vancomycin 30µg.

RESULTS

Out of 300 healthcare workers (140 doctors and 160 paramedical staff) screened, 136 (45.33%) isolates were Staphylococci. Of these, 86 (63.23%) were identified as *S aureus* and 50 (36.7%) were coagulase negative Staphylococci. Of the 86 *S aureus* isolates, 32 (37.2%) were MRSA and 54 (62.79%) were MSSA. The overall nasal carriage rate of MRSA among healthcare workers was 10.7% (32 out of 300). Carriage rate of MRSA in males was 12.8% (20 out of 156) and that in females was 8.3% (12 out of 144) (Table 1). Carriage rate was 5.7% (8 out of 140) in doctors and 15.0% (24 out of 160) in paramedical personnel (Table 2). All the carriers belonged to various surgical wards. Out of 32 MRSA carriers- 12 (37.5%) were from surgery ward, 12 (37.5%) were from operation theatre (OT) and 8 (25%) were from orthopedics ward. Antibiotic susceptibility pattern (Table 3) showed that most of MSSA were susceptible to commonly used antimicrobials with sensitivity of 100% for rifampicin and Vancomycin, 90.7% for netilmycin, 85.1% for cotrimoxazole, 83.3% for ciprofloxacin, 70.3% for erythromycin, 68.5 % for amikacin, 48.1% for gentamycin and tetracyclin and 11.1% for ampicillin. MRSA isolates (Table 4) showed 93.7% sensitivity for Vancomycin and Rifampicin, 84.3% for netilmycin, 78.1% for amikacin, 40.6% for ciprofloxacin, 31.2 % for cotrimoxazole, 21.8% for tetracyclin and erythromycin, 12.5 % for gentamycin and 6.2% for ampicillin.

Table 1. Sex- distribution of MRSA carriers

Sex	MRSA		Total
	Positive	Negative	
Male	20 (12.8%)	136 (87.2%)	156 (100%)
Female	12 (8.3%)	132 (91.7%)	144 (100%)
Total	32 (10.7%)	268 (89.3%)	300 (100%)

Table 2. MRSA carriers among healthcare professionals

Profession	MRSA				Total	%
	Positive	%	Negative	%		
Doctor	08	5.7	132	94.3	140	100
Paramedical personnel	24	15.0	136	85.0	160	100
Total	32	10.7	268	89.3	300	100

Table 3. Antibiotic susceptibility pattern of Methicillin sensitive *Staphylococcus aureus*

Antimicrobials	Sensitive	n=54 %
Ampicillin	06	11.1
Erythromycin	38	70.3
Gentamycin	26	48.1
Netilmycin	49	90.7
Amikacin	37	68.5
Tetracycline	26	48.1
Cotrimoxazole	46	85.1
Ciprofloxacin	45	83.3
Rifampicin	54	100.0
Vancomycin	54	100.0

Table 4. Antibiotic susceptibility pattern of Methicillin resistant *Staphylococcus aureus*

Antimicrobials	Sensitive	n=32 %
Ampicillin	02	6.2
Erythromycin	07	21.8
Gentamycin	04	12.5
Netilmycin	27	84.3
Amikacin	25	78.1
Tetracycline	07	21.8
Cotrimoxazole	10	31.2
Ciprofloxacin	13	40.6
Rifampin	30	93.7
Vancomycin	30	93.7

DISCUSSION

Staphylococcal carrier status leads to nosocomial infection. The prevalence of *S aureus* carriers among health care workers in different hospitals varies from 18.6-50%.[9] The burden is further increased when bacteria become resistant to methicillin. In the present study, the rate of nasal colonization of *S aureus* among health care workers was 45.33% (136/300) and that of MRSA was 10.7% (32/300). Data reported in other studies over the world show comparable findings –Mathanraj *et al*. (2009) showing carrier rate to be 8.5%, Khalili *et al.* (2009) (11.38%), Yazgi *et al*. (2003) (9.7%) and Shakya *et al.* (2010) (7.1%). Though statistically not significant, higher nasal carriage of MRSA was seen in males (12.8%) compared to

females (8.3%). This is in agreement with the findings of Nasiri *et al*. (2010) (37% males and 15% females). This can be attributed to the better job conditions & health among women or the possible role of hormones, which needs to be further explored. The prevalence of MRSA carrier rates among doctors was 5.7% and in paramedical personnel was 15%. Similar findings were observed by Cesur *et al.* (2004), in which doctors accounted for 6.1% & paramedical personnel accounted for 11.7%. This should be seen as a great challenge, as the paramedical personnel are the ones with highest frequency of contact with the patients and hence most likely to transmit this dangerous pathogen. All the carriers were from various surgical wards: 12 (37.5%) each from surgery & OT & 8 (25%) from orthopedic ward. No carriers were found from wards like medicine, dermatology, pediatrics & ENT. This is in concordance with a study of Sharma *et al*. (2010) which showed the colonization rate in orthopedics & surgery wards to be 34% & 18% while in medical wards, it was only 1%. The risk of transmission of MRSA is higher in patients of surgical ward due to susceptibility of their open wounds to MRSA, following transmission from health care personnel. Multidrug resistance is common in MRSA when compared to MSSA. In the present study most of MSSA isolates were susceptible to commonly used antimicrobials such as netilmycin -49 (90.7%), cotrimoxazole-46 (85.1%), ciprofloxacin-45 (83.3%) and erythromycin-38 (70.3%). Most of the isolates were resistant to ampicillin-48 (88.9%). Similar pattern of antibiotic sensitivity was reported in a study of Majumder *et al.* (2001) showing 93.3% of MSSA isolates to be susceptible to ciprofloxacin, followed by tetracycline (78.1%), erythromycin (70.5%) and 83.8% of the isolates were resistant to penicillin. In the present study, MRSA isolates showed higher resistance to ampicillin (93.8%), gentamycin (87.5%), tetracycline (78.2%) and erythromycin (78.2%). Only 2 (6.3%) isolates were resistant to vancomycin and rifampicin. Majority of them were sensitive to netilmycin 27 (84.3%) and amikacin 2 (6.2%). This finding is in concordance with the findings of Prakash *et al*. (2007) showing vancomycin resistance to be 6.9%. This finding is alarming, since vancomycin is regarded as drug of choice for treating serious MRSA infections. The present study also indicates that vancomycin resistance is much lower compared to the findings of a study by Adebola *et al*. (2005) stating vancomycin resistance to be 89% in MRSA strains. Emergence of vancomycin resistance leaves us no option, but to use very expensive, reserved, toxic and non readily available drugs like teicoplanin and linezolid. This is going to put additional financial burden for treatment of multi drug resistant MRSA infection.

Conclusion

The prevalence of MRSA carriers among health care workers in our hospital (10.7%) puts both patients and workers at risk. They might act as potential sources for nosocomial spread of infection especially to those with open wounds admitted to surgical wards. Knowledge about MRSA & carrier status needs to be raised among the hospital staff and simple control measures like proper handwashing, improving personal hygiene and sanitary conditions need to be implemented consistently in order to reduce the burden of MRSA infection in hospital environment. Indiscriminate and rampant use of antibiotics for treating MRSA strains must be curtailed as it can lead to emergence of multidrug resistant MRSA, the outcome of which can be devastating for the community.

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