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Research Paper

METHICILLIN RESISTANT *Staphylococcus aureus* – NASAL CARRIAGE AMONG HEALTH CARE WORKERS

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Abstract

Methicillin Resistant *Staphylococcus aureus* (MRSA) infections are major problem in healthcare settings since the management becomes challenging as it leads to failure towards most of the first line antibiotics. Asymptomatic nasal colonisation of MRSA among healthcare professionals (HCWs) remains a major risk factor for the spread of these infections inside the hospital. This study has been taken up to evaluate the nasal carriage of MRSA among healthcare workers in a rural tertiary care hospital. Nasal swabs were obtained from a 100 volunteered HCWs. *Staphylococcus aureus* was isolated from the nasal swabs of 13 HCWs whereas MRSA was isolated from six. In our study, MRSA isolation was found to be more among the non surgical unit staff members rather than surgical unit staff as well as high among the HCWs who are having more years of hospital service. Awareness programmes about universal safety precautions, hand hygiene practices and other simple yet efficacious preventive measures should be disseminated to control the spread and transmission of MRSA infections.

Key words: Nasal carriage, *Staphylococcus aureus,* MRSA, HCWs.

INTRODUCTION

Staphylococcal infections cause significant morbidity and mortality in both community and hospital settings. The infections caused by this organism are considered more serious when they cause life threatening sepsis, endocarditis, osteomyelitis, etc., [1]. Mostly, the strains are penicillin resistant and some have even developed resistance to the newer β-lactamase resistant semisynthetic penicillins including methicillin, oxacillin and nafcillin [2]. The development of methicillin resistance in *S. aureus* (MRSA) poses a serious therapeutic problem to mankind since infections caused by this infectious entity are difficult to treat with first choice of antibiotics and delay in treatment with appropriate antibiotics. The predisposing factors such as selection of broad spectrum antibiotics, indiscriminate use of multiple antibiotics, prolonged hospital stay, intravenous drug abuse, prosthetic devices and lapses in asepsis like hand washing practices increase the risk in the development and spread of MRSA infections [3].

Infections caused by MRSA strains require prolonged antibiotic administration, longer hospital stay and additional cost towards treatment. Asymptomatic nasal colonisers of MRSA are a major risk for the spread of MRSA infection. Within the hospital, colonised health care workers (HCWs) are acting as the reservoir for the spread of MRSA and can readily affect susceptible patients including immunocompromized [4] and patients on dialysis [5].

Identification of health care workers colonised with MRSA at an earlier stage through screening to allow for decolonisation and maintaining hand hygiene are helpful to reduce the transmission and control the spread of infection. Clinical isolates from invasive infections can only focus on the severity of the disease but does not give correct picture of prevalence of carriers among the healthy population. Active surveillance in a non-outbreak situation to identify the reservoirs will indicate the true case load in the health care settings. Moreover studies on MRSA are available from metropolitan and cosmopolitan cities but studies from rural hospitals are very limited. Inspite, the treatment is cumbersome and remains a battle in the clinical scenario for mankind where these organisms extend their resistance to these alternative drugs also [6]. Thus the knowledge of prevalence of MRSA and the antibiotic susceptibility pattern are most important for the treatment of MRSA infections [7,8]. This forms the basis of this study and its significance in screening MRSA among HCWs. Hence this study is useful to find out the carrier state of MRSA among HCWs in a rural tertiary care teaching hospital and to compare the isolate verses wards and also to create awareness about the preventive measures to reduce MRSA associated nosocomial infection.

MATERIALS AND METHODS

A Prospective observational study was undertaken for the period of three months in a tertiary care hospital after getting informed consent and approval by Institutional Ethical committee. A total of 100 Health care/ professionals (54 Doctors, 18 Staff Nurses, 15 FNAs (Female Nursing Assistant), 4 Technicians, 5 Lab attenders and 4 Housekeeping staffs) of a rural teaching hospital who volunteered for this study were enrolled from the surgical and the non-surgical units. The surgical unit staffs were included from the departments of General surgery, Anaesthesiology, Obstetrics and Gynaecology, ENT, Orthopaedics and Dental. The non-surgical unit staffs were included from the departments of General Medicine, Dermatology, Paediatric Medicine, Nephrology and Phlebotomy.

A pretested proforma was used to collect data on age, sex, ward, number of years of health care service, occupation, history of hospitalisation or antibiotic therapy during last 3 months, nasal abnormalities, smoking and history of any chronic illness among the study group. The inclusion criteria was the volunteers working in the hospital for at least a period of 6 months at the time of sample collection were included in the study irrespective of age and sex whereas volunteers with history of recent upper respiratory tract infections, fever, recent nasal surgery, smoking, using snuff, diabetes and other immunocompromised conditions, use of nasal medications or antimicrobial therapy and communicable disease during the last 3 months were excluded.

Specimens were obtained from the anterior nares of both the nostrils with sterile cotton swabs pre moistened with saline. The swab was inserted into the nostril to a depth of approximately 1 cm and rotated 5 times. A separate swab was used for each nostril. The swabs were transported in aseptic conditions in a closed container to the laboratory immediately. The swabs were inoculated into brain heart infusion broth and incubated at 37°C. After 18 - 24 hours, the swabs were inoculated in nutrient agar, blood agar and mannitol salt agar and then incubated at 37°C in ambient air for 18-24 hrs. Golden yellow creamy colonies on nutrient agar, haemolytic colonies on blood agar and yellow colour colonies on mannitol salt agar were processed and confirmed as *S. aureus* by performing gram staining and by a battery of biochemical investigations. Antibiotic sensitivity was performed by Kirby Bauer disc diffusion method.

The presence of MRSA was confirmed further using Oxacillin screen agar. The methodology comprised preparation of Muller Hinton agar plates enriched with 4% NaCl and 6 µg/ml of oxacillin and inoculated with 10µl of 0.5 Mcfarland standard matched suspensions of the *S. aureus* isolate in one quadrant and then incubated at 35ºC. After incubation, confluent growth was observed and considered as oxacillin resistant. The second confirmation was by Cefoxitin

Disc diffusion method where a lawn culture was made using the 0.5 McFarland standard matched suspension of the *S. aureus* isolate on Muller Hinton agar plate and incubated at 37ºC for 18 hours. A zone of inhibition of ≤19 mm was reported as an oxacillin resistant.

RESULTS

The present study included 42 male and 58 females and age ranged from 21 to 68 years. The detailed distribution of age and gender are depicted in Table 1.

Table 1: Age and gender wise distribution of MRSA from subjects

Age	Female (n=58)			Male (n=42)		
	No. of samples screened	No. of *S. aureus* isolates	No. of MRSA isolates	No. of samples screened	No of *S. aureus* isolates	No. of MRSA isolates
21-30	38	4	1	8	0	0
31-40	12	2	0	20	2	1
41-50	3	0	0	2	1	1
51-60	2	0	0	4	0	0
61-70	3	1	1	8	3	1
Total	58	7	1	42	6	3

A total of 100 subjects included in this investigation for the isolation of *S. aureus* and the isolation rate was 13 (13%). Among the 13 isolates, 6 of them were MRSA. Hence, the overall isolation rate of MRSA was 6% among the HCWs and 46.1% (6 out of 13) among the *S. aureus* isolates. The distribution of *S. aureus* and MRSA among HCWs is shown in Table 2.

Table 2: Isolation of MRSA among HCWs

Category of HCWs	No. of persons screened (n=100)	No. of *S. aureus* isolates (n=13)	No. of MRSA isolates (n=6)
Doctors	54	9 (16.7%)	4 (7.4%)
Staff nurses and FNAs	33	4 (12.1%)	2 (6%)
Others*	13	0 (0%)	0 (0%)

*Others include technicians, attenders and housekeepings

Among the 54 doctors screened, 9 showed *S. aureus* and among them 4 were confirmed as MRSA. Out of the 33 samples from staff nurses and FNAs, 4 supported to *S. aureus* and among them 2 were MRSA. *S. aureus* was not isolated from technicians, housekeepings and attenders (Table 2). The p value was considered to be not significant statistically with Chi- square without Yates correction (one-tailed P value equals 0.4111). The number of years of hospital service was correlated with the MRSA isolation as shown in Table 3. It was found that, 6 MRSA isolates from 100 HCWs, among them 2 were from the group of 41-45yrs in hospital settings. But a significant p value was not obtained.

Table 3: MRSA isolation in relation to the duration of hospital service

Years of hospital service	No. of HCWs	No. of *S. aureus isolates*	No. of MRSA isolates
≤5	30	2	1
6-10	25	3	1
11-15	17	1	0
16-20	9	2	1
21-25	2	1	1
26-30	3	0	0
31-35	1	0	0
36-40	3	1	0
41-45	7	2	2
45-50	3	1	0
Total	100	13	6

The isolation of MRSA among the non surgical unit staff was more (12.5%) compared to the isolation from the surgical unit staff (3.9%) and details were depicted in Table 4. The p value was found to be not statistically significant with Chi-square without Yates correction (one tailed p value is 0.0778).

Table 4: Comparison of MRSA isolation in relation to the place of work

Ward of isolation	No. of HCW screened (n=100)	Number of *S. aureus* isolates (n=13)	No. of MRSA isolates (n=6)	Prevalence of MRSA among the *S. aureus* isolates
Surgical unit	76	7 (9.2%)	3 (3.9%)	42.9%
Non surgical unit	24	6 (25%)	3 (12.5%)	50%

The antibiotics susceptibility testing showed variable resistance of the MRSA as well as MSSA isolates to a number of antibiotics as interpreted in Table 5. The antibiotics including co-trimaxazole, doxycycline and linezolid showed sensitive to both MRSA and MSSA.

Table 5: Antibiotic resistance pattern for MRSA and MSSA

Name of the antibiotic	MRSA resistant strains	Number of MSSA resistant
Ampicillin	6 (100)	5 (71.4)
Cloxacillin	6 (100)	5 (71.4)
Erythromycin	1 (16.7)	3 (42.8)
Azithromycin	1 (16.7)	3 (43.8)
Gentamicin	1 (16.7)	1 (14.3)
Amoxyclav	3 (50)	2 (28.6)
Ciprofloxacin	5 (83.3)	2 (28.6)
Levofloxacin	2 (33.3)	0
Cefoxitin	6 (100)	4 (57.1)
Ceftriaxone	4 (66.7)	2 (28.6)
Cefotaxime	4 (66.7)	2 (28.6)
Vancomycin	2 (33.3)	4 (57.1)
Teicoplanin	4 (66.7)	4 (57.1)

(Data in parenthesis denoted percentages)

DISCUSSION

All the six MRSA strains isolated in our study were 100% susceptible to the drugs-doxycycline, co-trimoxazole, and linezolid; 100% resistant to ampicillin, cloxacillin and were variably resistant to the other drugs. Five out of six (83.3%) of the MRSA strains were found to

be resistant to ciprofloxacin. A resistance of 66.6% (4 out of 6) was observed for teicoplanin. About three MRSA isolates were resistant to amoxyclav. A resistance of 33.3% (2 out of 6) was observed for vancomycin and levofloxacin; and 16.6% with erythromycin and azithromycin. All the MRSA isolates were multidrug resistant.

Asymptomatic colonised patients and HCWs are the major reservoirs of MRSA infection in the hospital environment with the latter being more commonly identified as links in the transmission of MRSA [9]. The risk factors such as prolonged use of antibiotics and prolonged hospitalisation [3] make hospitals the ideal place for the spread of MRSA infections. Screening for MRSA carriers is necessary for the prevention and control or such nosocomial infections since MRSA are difficult to eradicate once introduced in the hospital settings [10].

In the present study, the rate of isolation of *S. aureus* is 13% and the prevalence rate of MRSA among the *S. aureus* isolates is 46.2% (6 out of 13). This result is in par with the prevalence rates of MRSA (46%), [7]. Other study highlighted the prevalence rates to be 47.1%, 42.5% and 26.6% from Bangalore, New Delhi and Mumbai respectively [10]. The prevalence rate was found to be 27.2% in Uttar Pradesh [11], 15.4% in a study at Madurai [12].Comparison of these studies indicate that the prevalence rate of MRSA keeps on changing with time, over the last few decades but we cannot assume it to be a raising trend since the increase is not very obvious and there are few ups and downs in the prevalence rates in different studies from different places. Several factors such as efficacy of infection control practices, healthcare facilities, method of isolation and the antibiotic usage (antibiotic stewardship) varying from hospital to hospital may be the cause of such variation.

In other studies involving healthy population, the MRSA prevalence rate was 25% in Texas [13], 24% in East Sikkim [14] and 7.4% in Chandigarh, all showing results much lower than that observed in the present study (46.2%) among the HCWs suggesting that the exposure to hospital environment is a possible risk factor for the acquisition of MRSA colonisation. But the limitation is that this analysis of MRSA prevalence in healthy population was not carried out in our study.

In our study, on comparing the percentage of MRSA among the *S. aureus* isolates, it was found that the incidence of MRSA was greater in the non-surgical unit staff (12.5%) compared to that in the surgical unit staff (3.9%). This reflects on the fact that both surgical and non-surgical staff have equal role in the spread of the disease and abolishes the common blame that surgical unit staffs are put to with regard to the transmission of the infection. In our study, the percentage of multi drug resistant strains among the MRSA was found to be 100%. Multi drug resistance is commonly encountered in MRSA and in one study it was found to be around 30% [15].

All the six MRSA strains isolated in our study were 100% susceptible to the drugs-doxycycline, and linezolid and co-trimoxazole. In the context of resistance to linezolid, some studies highlighted none of the isolates in their study was resistant to linezolid [16]. With reference to co-trimoxazole, similar results were observed where resistance of the MRSA towards co-trimoxazole was found to be less common [2].

In our study, all the MRSA isolates were100% resistant to ampicillin and cloxacilln. Five out of the six MRSA strains were found to be resistant to ciprofloxacin. In the past, ciprofloxacin had been widely used in MRSA infections, but a high level of resistance has developed very quickly after its introduction in general therapy. Majority of the MRSA strains (4 out of 6) showed resistance to teicoplanin and similar results were observed with ceftriaxone and cefotaxime. Three out of the six MRSA showed resistance to amoxyclav.

Interestingly, 2 MRSA isolates showed resistance to vancomycin in our study whereas all the isolates were sensitive to vancomycin [2,6,16]. Nevertheless, there are studies supporting our finding and Vancomycin Resistant *Staphylococcus aureus* (VRSA) strains have been reported from various parts of the country [17]. The risk factors for VRSA a high prevalence of MRSA and indiscriminate glycopeptides use makes the possibility of widespread dissemination and outbreaks by VRSA an indigestible reality [7].

In our study, there is a marked difference in the resistance pattern of MRSA and MSSA found in other study [18]. The MRSA isolates showed an overall greater resistance of 45% to

the antibiotics tested when compared to the 31% resistance seen in MSSA. This is similar to the observations where the MRSA showed a higher resistance to the antibiotics than the MSSA [7,14]. Paradoxically, the resistance for vancomycin showed a greater percentage of 57.1% (4 out of 7) when compared to that seen in MRSA - 33.3% (2 out of 6).

Four MRSA isolates were found to be teicoplanin resistant and 2 of these isolates also showed resistance to vancomycin. This will pose a major problem in therapeutic purposes when infections caused by these strains. This makes linezolid the first drug of choice in the management of MRSA infections. However, recently isolates have known to develop resistance to linezolid during the course of therapy even though cross-resistance has not been noted [17]. These alarming results only suggest to us that the use of glycopeptides must be kept in reserve for life threatening infections with multi drug resistant MRSA and not be used indiscriminately. The limitations found in this study are single centre study, sample size was small and proportionate amount of samples were not taken from each category of HCWs.

CONCLUSION

Further study in this field should be carried out in patients along with the HCWs to find the significance of nasal colonisation in HCWs as the potential source of infection in patients. Surveillance methods and outcome calculation must be standardised for appropriate comparison with other studies. Although this study did not confirm a variety of risk factors, it created awareness among the HCWs about the changing incidence of MRSA, its severity in causing infections and the preventive measures needed to avoid outbreaks. Awareness programmes were conducted for HCWs regarding the importance of universal safety precautions, hand hygiene practices and other simple yet efficacious preventive measures to control the spread and transmission of MRSA infections.

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