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Original Article

Microbiology Section

MRSA Colonisation in Health Care Professionals with Varying Degrees of Exposure to the Hospital Environment

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ABSTRACT

Introduction: To detect Methicillin Resistant Staphylococcus Aureus colonisation in health care professionals with different levels of exposure to the hospital environment and those with no exposure to the same.

Materials and Methods: Swabs were collected from the anterior nares, finger web-spaces and posterior pharyngeal wall of 100 health care professionals and 100 first year medical students. The swabs were cultured on Oxacillin resistance screen agar for 48 hours in ambient air at 35 degree Celsius. The plates were examined at 24 and 48 hours for the presence of blue coloured colonies.

Results: The MRSA colonisation rate was 16% among the health care professionals and 4% among the first year medical students (p=0.005).

Conclusion: More number of the heath care professionals exposed to the hospital environment were colonised with MRSA compared to those who were not exposed. It was also noted that increased exposure to the hospital environment, increased the rate of MRSA colonisation.

Keywords: MRSA, MR-CONS, Hospital environment, Health care professionals, Medical students

INTRODUCTION

MRSA is Methicillin Resistant Staphylococcus aureus. Currently, it is one the most dangerous pathogens colonising in the hospital environment. The infections caused by this organism are increasing day by day. It occurs due to an alteration in the PBP2a protein, making the organism resistant to beta lactam antibiotics.

Methicillin resistance is usually acquired during exposure to hospitals and other health care facilities. The mean isolation rate is 20-40% in India [1]. Despite the technological advancement and the introduction of various new classes of drugs, these infections are difficult to diagnose and treat [2].

A total of 1-3% of the total population is colonised with MRSA and in these cases, treatment is mostly not required as it does not lead to harmful infections in immuno-competent individuals [3]. However, in immuno-suppressed individuals, it can cause severe to fatal infections. Over the recent years, it has also spread to the community.

Infections caused by MRSA have been associated with disastrous outcomes and prolonged hospital stays, higher costs of treatment and increased mortality [4]. It has become a global problem. It is increasingly being recognised in health care settings. Health care professionals are exposed to patients with MRSA infection and are colonised during their course of work. The ecological niches of S. aureus strains are the anterior nostrils [5]. Nasal carriages are responsible for most of the invasive infections. Carriage rates of MRSA have been reported to be between 0.8% to 3% in the community and 6% to 17.8% in health care settings among adults [6, 7]. The necessity of mass screening of health care workers for MRSA has been debated regarding the advantages, disadvantages and ethical issues involved [8]. However, the transmission of MRSA from health care professionals to patients is much greater than previously assumed [9]. Thus screening and identifying MRSA carriers in the hospital exposed environment is the first step towards infection control in health care settings and its spread to the community.

Coagulase negative staphylococci, once dismissed as culture contaminants are now considered as opportunistic pathogens in debilitated or compromised patients. They account for 9% of hospital acquired infections [10].

The present study is aimed at establishing the carriage rate of MRSA and MR-CONS (Methicillin Resistant Coagulase Negative Staphylococcus) among health care professionals in various clinical departments in the hospital and comparing with those not exposed to the hospital environment.

MATERIALS AND METHODS:

It is a prospective cohort study conducted between June 2016 and July 2016 at the department of microbiology, JSS Medical College, Mysore, Karnataka under ICMR's Short

term studentship program. 100 health care professionals i.e., doctors and the nursing staff working in the OPD, wards, and ICU, (exposed to the hospital environment) were included in the study group and 100 persons not exposed to the hospital environment i.e., first year medical student were taken for comparison. Persons with prior MRSA colonisation were excluded from the study. The study protocol was approved by the institutional ethical committee. As it was a short term project funded by ICMR, we used the method of convenient sampling to calculate the sample size. The samples were collected after obtaining a written consent from all the participants.

The specimen was collected from both right and left nares with a dry, un-moistened swab. The tip of the collection swab was inserted approximately 1 inch into the nares and rolled five times in each nostril. The swabs from the study group were also collected from all finger web spaces and posterior pharyngeal wall.

Each specimen was cultured on an Oxacillin Resistance Screen Agar (ORSA) and incubated for 48 hours in ambient air at 35°C. The plates were examined at 24 and 48 hrs for the presence of blue coloured MRSA colonies. Aniline blue present in the medium helped in the identification of Staphylococcus aureus by mannitol fermentation. The antibiotic supplement was 6.0 µg of oxacillin per ml and the presence of 5.5% NaCl has the potential to reduce the growth of non staphylococcal organisms and select the medium for the growth of MRSA [11].

RESULTS

The collected data was entered into MS Excel followed by analysis using SPSS version 22 (licensed to JSS Medical College, Mysore). The demographic characteristics were represented using percentages. The possible associations were found using chi square test. The Yates correction of chi square test was used wherever necessary. Fisher's exact test was also used where expected values were less than 5. p values of ≤0.05 has been considered statistically significant.

The study group consisted of 47(47%) women and 53(53%) men. The control group consisted of 61 (61%) female subjects and 39 (39%) male subjects.

Out of the 100 health care professionals who were screened, 67 (67%) of them were doctors and 33 (33%) were nursing staff.

Of the study population, 14 (14%) subjects screened positive for MRSA, 40 (40%) screened positive for MR-CONS and 2 (2%) subjects screened positive for both MRSA and MR-CONS. Of the control population, 3 (3%) subjects screened positive for MRSA, 7 (7%) for MR-CONS and 1 (1%) for both MRSA and MR-CONS [Table/Fig-1].

Out of the 67 doctors, 11 (16.42%) were positive for MRSA colonisation, 24 (35.82%) for MR-CONS colonisation and 1 (1.49%) had both MRSA and MR-CONS colonisation and of the 33 nursing staff, 5 (15.16%) screened positive for MRSA colonisation, 18 (54.54%) for MR-CONS colonisation and 1 (3.03%) for both MRSA and MR-CONS colonisation. (p= 0.691, from Fisher's exact test). The association was not found to be statistically significant [Table/Fig-2].

	MRSA colonisation only		MR-CONS colonisation only		Both MRSA and MR-CONS colonization	
	No.	%	No.	%	No.	%
Study group (n=100)	14	14	40	40	2	2
Control group (n=100)	3	3	7	7	1	1

[Table/Fig-1]: MRSA and MR-CONS colonisation between the study and control groups.
(p=0.005, from Fisher's exact test).

Study Group	MRSA colonisation only		MR-CONS colonisation only		Both MRSA and MR-CONS colonization	
	No.	%	No.	%	No.	%
Doctors (n=67)	11	16.42	24	35.82	1	1.49
Nursing Staff (n=33)	5	15.16	18	54.54	1	3.03
Total	14	14	40	40	2	2

[Table/Fig-2]: MRSA and MR-CONS colonisation between the doctors and nursing staff.

Among the 67 doctors who were screened, the maximum rate of MRSA colonisation i.e., 6 (21.43%) and MR-CONS colonisation i.e., 12 (42.86%) was found in doctors who had around 5 to 10 years of exposure followed by 2 (11.10%) with MRSA colonization and 5 (27.78%) with MR-CONS colonisation among doctors with 1-5 years of exposure to the hospital environment. 21 doctors with more than 10 years of exposure were screened and of them, 2 (9.5%) had MRSA colonisation and 6 (28.57%) had MR-CONS colonisation. This was not found to be statistically significant [Table/Fig-3].

Out of the 33 nursing staff who were screened for MRSA, maximum colonisation was found in those with more than 10 years of exposure wherein, 2(6.06%) had MRSA colonisation and 8 (24.24%) had MR-CONS colonisation. This is not found to be statistically significant [Table/Fig-4].

DISCUSSION

Strains of MRSA colonize single or multiple body sites, transiently or permanently. MRSA colonization increases the risk of infection with MRSA both immediately after, and in long-term carriers, of whom 23% develop MRSA Infections the following year [12]. Rising colonization is leading to increased infection rates in the community and in hospitals. This, in turn results in prolonged hospital stays and increased health care expenditure [13]. Patient risks include significantly higher mortality and morbidity rates with invasive MRSA infection [14].

Hospital environment exposure (in years)	MRSA colonisation only		MRCONS colonisation only		Both MRSA & MRCONS colonisation		No colonisation		Total study population	
	No.	%	No.	%	No.	%	No.	%	No.	%
0-1 (n=0)	0	0	0	0	0	0	0	0	0	0
1-5 (n=18)	2	11.1	5	27.78	1	5.55	10	55.55	18	26.86
5-10 (n=28)	6	21.43	12	42.86	0	0	10	35.71	28	41.80
>10 (n=21)	2	9.5	6	28.57	0	0	13	61.90	21	31.34
Total									67	100

[Table/Fig-3]: MRSA and MRCONS colonisation in doctors based on years of exposure to the hospital environment. The chi square test p value = 0.632 (with Yates correction)

Hospital environment exposure (in years)	MRSA colonisation only (n=33)		MR-CONS colonisation only (n=33)		MRSA and MR-CONS colonisation (n=33)		No colonisation (n=33)		Total study population	
	No.	%	No.	%	No.	%	No.	%	No.	%
0-1	0	0	1	3.03	0	0	1	3.03	2	6.06
1-5	1	3.03	4	12.12	0	0	4	12.12	9	27.27
5-10	1	3.03	4	12.12	1	3.03	1	3.03	7	21.21
>10	2	6.06	8	24.24	0	0	5	15.15	15	45.45
Total									33	100

[Table/Fig-4]: MRSA and MR-CONS colonisation in nursing staff based on years of exposure to the hospital environment. p=0.951, from chi square test, with Yates correction

In the present study, an attempt was made to calculate the rate of MRSA and MR-CONS colonisation among health care workers exposed to various degrees to the hospital environment and those not exposed to the same. The male: female ratio in our study group was 1.13:1 and in the control group was 0.64:1. A total of 67 doctors and 33 nursing staff were screened. No significant difference in colonization rates was found between the sexes (p=0.670).

MRSA colonisation rate in the study population was 14% and MR-CONS colonisation rate was 40% and both MRSA and MR-CONS colonisation was 2%. In the control group, MRSA colonisation rate was 3% and MR-CONS colonisation rate was 7 % and MRSA and MR-CONS colonisation was 1%. 3 out of 4 students at the control group who screened positive for MRSA, gave history of recent hospital visits. In a study by Lakshmi et al., at Bijapur, India, MRSA carriage rate among clinical and nursing staff was found to be 12.1% [15]. This carriage rate of MRSA is similar to our study. A study by Mathanraj et al. in an Indian hospital reported that 1.8% of healthcare workers had colonization of MRSA in the anterior nares and they are of the opinion that with strict infection control Measures, MRSA colonisation at their hospital could be brought down further [16]. A study by Naeem Akthar, reported an MRSA colonisation rate of 2.10% and MR-CONS colonisation rate was 2.1% [17].

A very high rate of MRSA colonisation has been reported by Archana Iyer et al., in Saudi Arabia, who found an MRSA colonisation of 76% in the hospital staff and 0% colonisation among university students not exposed to the hospital environment [18]. [Table/Fig-5] shows the comparative rates of MRSA colonisation among health care professionals from various studies.

Serial Number	Authors's Names	MRSA colonisation among health care professionals
1	The current study,	16%
2	Lakshmi et al., [15]	12.10%
3	Mathanraj et al., [16]	1.80%
4	Naeem Akthar [17]	2.10%
5	Archana Iyer et al., [18]	76%

[Table/Fig-5]: Comparison of the MRSA Colonisation rates in health care professionals from different studies.

In 2011, study by Kitti et al., 1% of the students of a Thai university, had MRSA colonisation in their nostrils, which corresponds to our study of 4% [19]. The results of our study very clearly indicate that those who have not been exposed to the hospital environment have very low risk of MRSA carriage.

In the present study, MRSA colonisation rate among doctors and nursing staff was found to be 16.42% and 15.16% respectively, indicating no significant difference between the carriage rates of MRSA among doctors and nursing staff. A Nigerian study showed doctors and nurses being equally colonised (65.2% and 64.2% respectively) [20]. In a similar study in 2013 by Agumas Shibabaw et al., MRSA carriage rate among the nursing staff an doctors was 21.2%

and 12.5% respectively [21]. Another similar study by Bidya Shrestha in Nepal, revealed and MRSA colonisation rate of 22.22% among doctors and 21.73% among the nursing staff [22]. The authors opine that, the high rate of MRSA colonisation in their study could be due to high frequency of patient contact. This has been tabulated in [Table/Fig-6].

Serial Number	Authors' Names	MRSA colonisation among doctors	Mrsa colonisation among nursing staff
1.	The current study	16.42%	15.16%
2.	A Nigerian study [20]	65.2%	64.2%
3.	Agumas Shibabaw et al., [21]	12.5%	21.2
4.	Bidya Shrestha in Nepal [22]	22.22%	21.73%

[Table/Fig-6]: Comparison of MRSA colonisation rates between doctors and nursing staff from different studies.

Among the 67 doctors screened, the maximum rate of MRSA colonisation (21.43%) was found in those with 5 to 10 years of exposure to hospital environment when compared to those exposed to the hospital environment for more than 10 years (9.5%). Most of the post graduates fall in this category. The high rate of colonisation in the group could be explained by their active involvement in hospital work, massive workload, continuous patient contact, persistent exposure to the hospital environment and also due to lack of awareness on hand hygiene practices.

Among the nursing staff who were screened, maximum MRSA colonisation was found in the group with more than 10 years of exposure (6.06%). Those with 5-10 years, and less than 5 years of exposure had 3.03%, 3.03% MRSA colonisation respectively. In a study by Askarian M et al, the authors found no significant differences in the colonisation rates between the sexes, age of the individuals and years of health care service [23]. In our study, MR-CONS colonisation rate was 35.82% and 54.54% among doctors and nursing staff respectively. Both MRSA and MR-CONS colonisation was found in 1.49% and 3.03% among doctors and nursing staff respectively. We observed that MR-CONS colonisation was also higher in doctors with 5-10 years of exposure. Among the nursing staff, maximum colonisation rate was found in those with more than 10 years of exposure to the hospital environment. The high rate of MRSA colonisation among health care professionals is a potential risk factor for the patients who receive care from them.

As this study was conducted under ICMR's STS program, our sample size was confined to 200 participants. This was the limitation of our study. An increase in sample size could have yielded statistically significant results.

CONCLUSION

The MRSA colonisation rate not only depends on prolonged exposure to the hospital environment, but also on the active involvement in patient care and hand hygiene practices. The colonisation rate can be decreased by increasing the awareness of hospital infection control practices among the health care professionals, who are the backbone of health care system.

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