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Original Research Article

Prevalence of nasal colonization of MRSA in a teaching hospital

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Abstract: Background: MRSA is one of the leading causes of infections among hospitalized patients. The present study was conducted to know the prevalence of nasal colonization of MRSA in hospitalized patients.
Methodology:
Study design: A cross sectional study.
Study setting: Department of Microbiology, MIMS, Mandya, and
Source of data: Inpatients of MIMS teaching hospital, Mandya irrespective of any departments.
Method of collection of data: A proforma was used to record information on the Socio Demographic factors of the subjects including age, sex, presence of chronic disease, hospitalization within the previous year, use of antibiotics prior to a month of the sample collection, pattern of routine hygienic practices of the subjects. A total of 300 subjects were screened for MRSA after obtaining informed written consent from the subjects.
Results: Out of 300 Inpatients, 148(49.3%) were culture positive for Staphylococcus aureus,52 (17.3%) were MRSA carriers, Out of 52 MRSA isolates from Inpatients, all the 52(100%) isolates were sensitive to Vancomycin and Linezolid. 34(65.3%) were sensitive to Gentamicin, 24(46.1%) to Tetracycline, 23(44.2%) to Ciprofloxacin and 19(36.5%) to Chloramphenicol. All the 52(100%) isolates were resistant to Penicillin followed by 39(75%) resistance to Clindamycin, 38(73.07%) to Erythromycin and 33(63.5%) to Chloramphenicol.

Keywords: Methicillin resistant; Staphylococcus aureus; Colonization.

1. Introduction

Staphylococcus aureus is one of the most prevalent and clinically significant pathogens, causing wide variety of infections ranging from mild skin and soft tissue infections to serious life threatening infections [1]. It has acquired resistance to various antibiotics and is a leading cause of hospital and community acquired infections [2].

Multidrug resistant strains of S aureus have been reported with increasing frequency worldwide, most commonly Methicillin resistant Staphylococcus aureus (MRSA) infections account for 40-60% of all nosocomial infections in many centers across the world.1 Methicillin resistance is caused by the presence of mecA gene, which encodes an additional 78kDa low affinity Penicillin binding protein (PBP)-2a or PBP' which has low affinity for beta lactam antibiotics [3]. MRSA is a serious threat to hospitalized patients globally and also public as community acquired infections [4]. Colonization is the presence, growth and multiplication of the organism in one or more body sites without observable clinical symptoms or immune reaction [5].

Nasal colonization with S. aureus plays pivotal role in the increasing prevalence of MRSA infections worldwide [6]. Colonized patients were considered as a chief source of S. aureus in hospital; approximately 10% to 40% of people on admission have nasal carriage of S. aureus [7]. Recently, cell wall lipoteichoic acid was considered as the core factor for nasal colonization of MRSA. The association of Staphylococcus aureus nasal colonization and staphylococcal infection was first described in the 1930s. Since 1930, the epidemiology of S aureus has changed dramatically, and methicillin-resistant S aureus (MRSA) has reached epidemic levels in both hospitals and community settings. With the changing epidemiology of MRSA, multiple studies have

confirmed nasal colonization as a risk factor for subsequent infection, with most infections caused by the colonizing strain [8]. MRSA is one of the leading causes of infections among hospitalized patients. It causes a wide range of infections such as abscess, impetigo, folliculitis, cellulitis, sinusitis, deep seated pyogenic infections, meningitis, pneumonia, and septicemia. There is a need to screen the Hospital patients for nasal colonization of MRSA and evaluation of the strategies available for decolonization to prevent serious infections and their implications. The present study was conducted to know the prevalence of nasal colonization of MRSA in hospitalized patients.

2. Materials and methods

2.1. Study design

A cross sectional study.

2.2. Study setting

Department of Microbiology, MIMS, Mandya.

2.3. Source of data

Inpatients of MIMS teaching hospital, Mandya irrespective of any departments.

2.4. Study period

April-2015 to March-2016.

2.5. Sample Size

300 from Inpatients.

2.6. Inclusion criteria

Subjects of age above 18 years, both the sexes and all economic groups. Patients with >48 hours of hospital admission.

2.7. Exclusion criteria

Subjects below the age of 18. Patients admitted to the hospital who have a length of stay <48 hours. Those who had Sino nasal symptoms like Rhinitis, Headache, Cough, Post nasal discharge.

2.8. Method of collection of data

A proforma was used to record information on the Socio Demographic factors of the subjects including age, sex, presence of chronic disease, hospitalization within the previous year, use of antibiotics prior to a month of the sample collection, pattern of routine hygienic practices of the subjects.

A total of 300 subjects were screened for MRSA after obtaining informed written consent from the subjects.

Nasal swabs were obtained by using sterile cotton swabs by rolling the swab inside of each nostril with application of an equal pressure [9]. In the hospital, 300 samples were randomly collected from the In-Patients admitted irrespective of Departments and satisfied the inclusion and exclusion criteria. The collected samples were inoculated onto Nutrient agar, Blood agar and Mannitol salt agar and incubated at 37^{o}c for 24-48 hours. Golden yellow colonies in nutrient agar, Beta hemolytic colonies in Blood agar and yellow colonies in Mannitol salt agar were processed further. Golden yellow colonies from Nutrient agar were subjected to Catalase test, Gram's staining and Coagulase test (Slide and tube) with respective controls [10].

Antibiotic susceptibility testing was performed by Kirby- Bauer disk diffusion method as per CLSI Guidelines [11]. Antimicrobial discs used were Penicillin (10 units), Co- trimoxazole (25μg), Linezolid (30μg), Vancomycin (30μg), Chloramphenicol Cefoxitin (30μg), Clindamycin (2μg),Erythromycin (15μg), Tetracycline (30μg), Ciprofloxacin (5μg), Gentamicin (10μg) (Hi media Pvt.Ltd., Mumbai, India). All the isolates whose Zone diameter less than 21mm for Cefoxitin (30 μg) disc were considered as MRSA and zone diameters greater than 21mm were considered as MSSA as per CLSI guidelines [11].

Table 1. Age wise prevalence of MRSA in three study groups

Age groups	Inpatients	
	Number	MRSA Carriers
=29	67 (22.3%)	12 (17.9%)
30-39	57 (19%)	12(21%)
40-49	49 (16.3%)	11 (22.4%)
50-59	48 (16%)	07 (14.6%)
=60	79 (26.3)	10 (12.6)
Total	300	52 (17.3%)

Table 2. Gender wise prevalence of MRSA in the study groups

Gender	Inpatients	
	Number	MRSA Carriers
Male	186 (62%)	36(19.8%)
Female	114 (38%)	16(14.%)
Total	300	52 (17.3%)

2.9. Statistical analysis

Data was entered into Microsoft excel data sheet and was analyzed using SPSS 22 version software. Categorical data was represented in the form of Frequencies and proportions. Chi-square test or Fischer's exact test (for 2x2 tables only) was used as test of significance for qualitative data. P value (Probability that the result is true) of <0.05 was considered as statistically significant after assuming all the rules of statistical tests.

2.10. Statistical software

MS Excel, SPSS version 22 (IBM SPSS Statistics, Somers NY, USA) was used to analyze data.

3. Results

[Table 1] Out of 300 samples from Inpatients, in the age groups of 40-50 & 30-40yrs, a higher MRSA prevalence of 11(22.4%) in 49 & 12(21%) in 57 was seen respectively.

[Table 2] Out of 186 (62%) males and 114 (38%) females screened from 300 samples of Inpatients, 36(19.8%) MRSA carriers were males and 16(14%) were females.

[Table 3] & [Figure 2] Out of 52 MRSA carriers among inpatients, 30 (88.2%) had h/o Chronic diseases like Diabetes, renal disorders. Out of 32 MRSA carriers among HCW's, 13 (10%) had h/o chronic diseases. Out of 15 MRSA carriers among Community, 7(6%) had h/o chronic diseases.

Table 4 shows Antibiogram of MRSA and MSSA isolated from inpatients. Out of 52 MRSA isolates from Inpatients, all the 52(100%) isolates were sensitive to Vancomycin and Linezolid. 34(65.3%) were sensitive to Gentamicin, 24(46.1%) to Tetracycline, 23(44.2%) to Ciprofloxacin and 19(36.5%) to Chloramphenicol. All the 52(100%) isolates were resistant to Penicillin followed by 39(75%) resistance to Clindamycin, 38(73.07%) to Erythromycin and 33(63.5%) to Chloramphenicol. Out of 96 MSSA isolates from Inpatients, all the

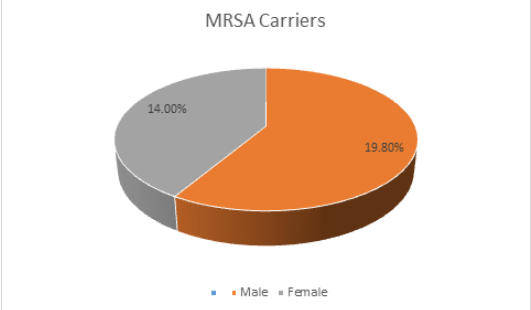

Figure 1. Genderwise distribution of MRSA

Table 3. Prevalence of risk factors in nasal carriers of MRSA

Risk Factors	Inpatients (N*=52) n(%)
H/o Hospitalization within the previous year	38 (26.3%)
H/o Chronic Diseases	30 (88.2%)
H/o Antibiotic usage in the past 1 month	32 (26.4%)

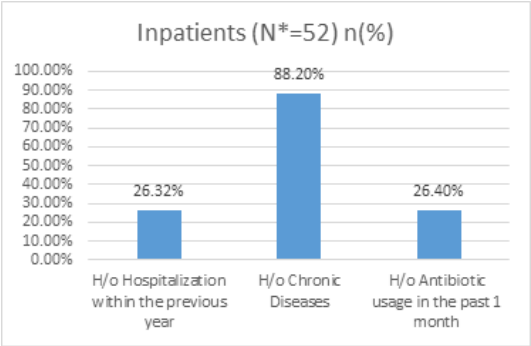

Figure 2. Prevalence of risk factors in nasal carriers of MRSA

Table 4. Antibiogram of MRSA and MSSA isolated from inpatients

Antibiotics	MRSA (n=52)		MSSA (n=96)		P- Value
	Sensitive(%)	Resistant (%)	Sensitive(%)	Resistant (%)	
Penicillin	-	52 (100.0)	19 (19.8)	77 (80.2)	< 0.001
Cotrimoxazole	21 (40.4)	31 (59.6)	62 (64.6)	34 (35.4)	0.004
Tetracycline	24 (46.2)	28 (53.8)	42 (43.7)	54 (56.3)	0.778 *
Vancomycin	52 (100.0)	-	96 (100.0)	-	
Linezolid	52 (100.0)	-	96(100.0)	-	
Gentamicin	34 (65.3)	18 (34.7)	58 (60.4)	38 (39.6)	0.0002
Ciprofloxacin	23 (44.2)	29 (55.8)	62 (64.6)	34 (35.4)	0.016
Erythromycin	14 (26.9)	38 (73.1)	54 (56.3)	42 (43.7)	0.0006
Clindamycin	13 (25.0)	39 (75.0)	53 (55.2)	43 (44.8)	0.0004
Chloramphenicol	19 (36.5)	33 (63.5)	40 ((41.7)	56 58.3)	0.542 *

96(100%) isolates were sensitive to Vancomycin and Linezolid. 62 (64.5%) were sensitive to Cotrimoxazole and Ciprofloxacin each, 58(60.4%) to Gentamicin. 77(80.2%) of MSSA isolates were resistant to Penicillin, 56(58.3%) to Chloramphenicol and 54(56.3%) to Tetracycline.

4. Discussion

Out of 300 samples from Inpatients, a higher MRSA carriage was seen in the age groups of 40-50 (22.4%) followed by 30-40yrs (21%)which is comparable to studies conducted by Rezvan Moniri *et al*.,[12] in which out of 100 subjects, the mean age of nasal carriage of MRSA was 50.24 among inpatients and Shakya *et al*., [13] in their study on 31 inpatients including pediatric age groups, highest prevalence was reported in the age group of <14 years(33.3%) followed by 15-50 yrs (13.2%), which is consistent with our study. In contrary, Rachel J Gorwitz *et al*., [14] reported a higher prevalence of MRSA in the age group of >60 yrs (2.7%) among 18,626 inpatients.

In the Present study, Out of 186 (62%) males and 114 (38%) females screened from 300 samples of Inpatients, 36(19.8%) MRSA carriers were males and 16(14%) were females. We found male preponderance in our study which is in agreement with other study conducted by Jayarani *et al*., [15] who also reported male preponderance (75%). Our study also correlates with other studies conducted in different study groups as mentioned in the following table.

In a study conducted by Aslam N *et al.*, [16] they concluded that nasal colonization rates with MRSA were high among patients suffering from MRSA bacteraemia especially in those undergoing dialysis or surgical procedures. Therefore, screening and nasal decolonization should be practiced in hospitals.

About 25.5% (51 HCPs) were carriers of S aureus and among them 6.5% (13 HCPs) were carriers of MRSA. Among the MRSA carriers, 28.4% were physicians, followed by nursing interns (21.1%), MBBS interns (9%), nurses (5.4%), and others, that is, physiotherapist, housekeeping staff, and helping staff (37.5%). This was observed in a study conducted by Rajshekhar M *et al.*, [17].

Mathanraj *et al*., [18] in his study found that males were more common carriers than the females. They also suggested that further evaluation regarding male preponderance of carriage needs to be done, with the possible roles of hormones. This may also be due to more outdoor activities by males compared to females.

There is a growing concern about the rapid rise in resistance of S. aureus to antimicrobial agents. In India, the importance of MRSA as a problem has been recognized relatively late. The prevalence of MRSA varies in different parts of India and is not uniform.

In the present study, Out of 300 Inpatients, 52 (17.3%) were MRSA carriers.

Javid Bhat *et al*., [19]Parviz *et al*., [20] Mehrdad Askiran [21] *et al*,. who also reported 100% sensitivity to Vancomycin and Linezolid. Out of 52 MRSA carriers among Inpatients, 100% resistance was observed to Penicillin which is in concordance with Javid Bhat [22] *et al*., who also reported 100% resistance to Penicillin. In our study, Gentamicin expressed 34.7% resistance in MRSA isolates, whereas Durgadas *et al*., [23] observed 32%. Groh's *et al*., [24] studied that aminoglycosides particularly Gentamicin are bactericidal agents possessing rapid lethal activity on susceptible MRSA strains both in vitro and in vivo. Erythromycin revealed 73.1% resistance in our study, however Parviz *et al*., [25] reported 89% resistance to Erythromycin in their study. Out of 96 MSSA carriers among inpatients, a higher resistance of 80.2% was observed to Penicillin which was similar to a study conducted by Javid Bhat *et al*., [19] who reported 97.6% which is higher resistance in their study. Our study reported 58.3%resistance to Chloramphenicol, which is in contrast to a study conducted by Parviz *et al*., [20]. followed by Chloramphenicol, Clindamycin resistance of 44.7% was reported in our study which is similar to study conducted by Javid Bhat *et al.*, [22] who reported 41.6% resistance to Clindamycin.

5. Conclusion

The study shows a possibility of an increase in the prevalence of MRSA in hospital. Furthermore, multi-drug resistance was extremely high amongst the MRSA isolates. Based on the findings of this study, we would like to recommend that the infection prevention and control strategies should be strengthened since most of the MRSA isolates were hospital acquired.

No conflicts of interest

Author Contributions: All authors contributed equally to the writing of this paper. All authors read and approved the final manuscript.

Conflicts of Interest: "The authors declare no conflict of interests."

References

[1] Fomda, B. A., Thokar, M. A., Akhan, T. M., Bhat, D., Zahoor, J. A., Bashir, G., ... & Shah, A. (2014). Nasal carriage of Methicillin-resistant Staphylococcus aureus among healthy population of Kashmir, India. *Indian Journal of Medical Microbiology, 32*(1), 39-43.

[2] Mir, B. A., & Srikanth, P. (2013). Prevalence and antimicrobial susceptibility of methicillin resistant staphylococcus aureus and coagulase-negative staphylococci in a tertiary care hospital. *Asian Journal of Pharmaceutical and Clinical Research, 6*(3), 231-234.

[3] Pillai, M., Latha, R., & Sarkar, G. (2012). Detection of Methicillin Resistance in Staphylococcus Aureus by Polymerase Chain Reaction and Conventional Methods: A Comparative Study. *Journal of Laboratory Physicians, 4*(2), 83-88.

[4] Lu, P. L., Chin, C. L., Peng, C. F., Chiang, Y. H., Chen, T. P., Ma, L., ... & Siu, L. K. (2005). Risk factors and molecular analysis of community methicillin resistant Staphylococcus aureus carriage. *Journal of Clinical Microbiology, 43*(1), 132-139.

[5] Maryland Department of Health and Mental Hygiene Epidemiology and Disease Control Program. (2001). Guideline for control of methicillin-resistant Staphylococcus aureus in long term care facilities.

[6] Athak, A., Marothi, Y., Iyer, R. V., Singh, B., Sharma, M., Ericson, B., & Lundborg, C. S. (2010). Nasal carriage and antimicrobial susceptibility of Staphylococcus aureus in healthy preschool children in Ujjain, India. BMC Pediatrics, 10, 100.

[7] Eiff, C. V., Becker, K., Machka, K., Stammer, H., & Peters, G. (2001). Nasal carriage as a source of Staphylococcus aureus bacteremia. *The New England Journal of Medicine, 344*(1), 55-56.

[8] Stenehjem, E., & Rimland, D. (2013). MRSA nasal colonization burden and risk of MRSA infection. *American Journal of Infection Control, 41*(5), 405-410.

[9] Jayarani, K., & Sundarji, S. (2015). Detection of MRSA from nasal carrier among diabetic foot ulcer patients in tertiary care hospital Puducherry. *International Journal of Pharmaceutical and Biological Sciences, 6*(3), 618-623.

[10] Mackie, T. J., & McCartney, J. E. (2014). In Collee JG, Fraser AG, Marmion BP, Simmons A (Eds.), Practical Medical Microbiology (14th ed., pp. 245-258). Philadelphia: Elsevier Churchill Livingstone.

[11] Clinical and Laboratory Standards Institute. (2013). Performance Standards for Antimicrobial Susceptibility Testing: 23rd Informational Supplement M100-S23 (Vol. 30). Wayne, PA: CLSI.

[12] Moniri, R., Musav, G. A., & Fadavi, N. (2009). The prevalence of nasal carriage methicillin-resistant Staphylococcus aureus in hospitalized patients. *Pakistan Journal of Medical Sciences, 25*(4), 656-659.

[13] Shakya, B., Shrestha, S., & Mitra, T. (2010). Nasal carriage rate of methicillin-resistant Staphylococcus aureus among at National Medical College Teaching Hospital, Birgunj, Nepal. *Nepal Medical College Journal, 12*(1), 26-29.

[14] Gorwitz, R. J., & Jernigan, J. A. (2009). Epidemiology of community-associated Staphylococcus aureus infections. In Crossley KB, Jefferson KK, Archer GL, Fowler Jr VG (Eds.), Staphylococci in Human Disease (2nd ed., pp. 272-289). London: Wiley-Blackwell.

[15] Jayarani, K., & Sundarji, S. (2015). Detection of MRSA from nasal carrier among diabetic foot ulcer patients in tertiary care hospital Puducherry. *International Journal of Pharmaceutical and Biological Sciences, 6*(3), 618-623.

[16] Aslam, N., Izhar, M., & Mehdi, N. (2013). Frequency of methicillin-resistant Staphylococcus aureus nasal colonization among patients suffering from methicillin-resistant Staphylococcus aureus bacteremia. *Pakistan Journal of Medical Sciences, 29*(6), 1430-1434.

[17] Rajasekar, M., Ramakrishnan, K., Babu, C. P., & Seetha, K. S. (2015). Detection of MRSA carriers among health-care workers and patients in a tertiary care hospital as an active surveillance measure. *Research Journal of Pharmaceutical, Biological and Chemical Sciences, 6*(5), 632-640.

[18] Mathanraj, S., Sujatha, S., Sivasangeetha, K., & Parija, S. C. (2009). Screening for methicillin-resistant Staphylococcus aureus carriers among patients and health care workers of a tertiary care hospital in South India. *Indian Journal of Medical Microbiology, 27*(1), 62-64.

[19] Bhat, J., & Tenguria, R. (2013). Nasal carriage of MRSA and its antimicrobial susceptibility pattern in healthy individuals and hospitalized patients. *Scholars Journal of Applied Medical Sciences, 1*(4), 304-309.

[20] Mohajeri, P., Izadi, B., Rezaei, M., & Farahani, A. (2013). Frequency distribution of hospital-acquired MRSA nasal carriage among hospitalized patients in west of Iran. *Jundishapur Journal of Microbiology, 6*(6), 9076.

[21] Askarian, M., Zeinalzadeh, A., Japoni, A., Alborzi, A., & Ziad, A. Memish. (2009). Prevalence of nasal carriage of methicillin-resistant Staphylococcus aureus and its antibiotic susceptibility pattern in healthcare workers at Namazi Hospital, Shiraz, Iran. *International Journal of Infectious Diseases, 13*(5), 241-247.

[22] Bhat, J., & Tenguria, R. (2013). Nasal Carriage of MRSA and its antimicrobial susceptibility pattern in Healthy Individuals and Hospitalized Patients. *Sch. J. App. Med. Sci, 1*(4), 304-309.

[23] Durgadas, N., & Alem, T. (2009). A Study on Antimicrobial Susceptibility Pattern in Clinical Isolates of Staphylococcus aureus in Eritrea. *Pan African Medical Journal, 3*(1) , 1-5.

[24] Grohs, P., Kitzis, M. D., & Gutmann, L. (2003). In vitro bactericidal activities of linezolid in combination with vancomycin, gentamicin, ciprofloxacin, fusidic acid, and rifampin against Staphylococcus aureus. *Antimicrobial agents and chemotherapy, 47*(1), 418-420.

[25] Mohajeri, P., Izadi, B., Rezaei, M., & Farahani, A. (2013). Frequency Distribution of Hospital- Acquired MRSA Nasal Carriage among Hospitalized Patients in West of Iran. *Jundishapur Journal of Microbiology, 6*(6), 9076.