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Incidence of Mupirocin Resistant MRSA Carriers amongst Hospital Staff in a Tertiary Care Hospital of India

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Abstract **Original Research Article**

Methicillin resistance rates of *S.aureus* vary considerably between countries. Patients who have had contact with healthcare facilities such as hospital may be colonized in nose with healthcare –associated (HA) MRSA. The hospital reservoir pose a serious challenge. It causes diseases such as bacteraemia and infective endocarditis that tend to be more multiresistant. So cross sectional study was carried out to determine the incidence of nasal carriers of mupirocin sensitive and mupirocin resistant (both low- and high-level resistance) MRSA strains amongst the hospital staff in a tertiary care hospital of Haryana. Out of total 46 subjects, 44 swabs showed a growth of *S.aureus*. and 23 were MRSA carriers.

Keywords: MRSA, mupirocin, Hospital based.

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INTRODUCTION

Staphylococcus aureus is one of the most frequently isolated organisms from both community and hospital acquired infections [1]. Nasal colonisation with *S. aureus* is common and is an important precursor in the pathogenesis of these infections [2, 3]. These infections have now become more serious due to the emergence of resistant strains like MRSA or Methicillin-Resistant *Staphylococcus aureus* which are also harboured in the anterior nares of the carriers. Identification of the hospital reservoir of MRSA carriers is a vital step in the control program of these resistant strains [4]. The hospital reservoir pose a serious challenge in terms of

- Increased treatment failure due to circulation of resistant strains [5] accounting for enhanced morbidity, mortality and cost of treatment
- Association with various infections like surgical site infections, blood stream infections and ventilator-associated pneumonia [6]
- Cross-contamination between hospitalised patients [7]
- Secondary infections in carriers [7]
- Spread of resistant strains to the community [7]

Hospitals staff carrying MRSA in anterior nares is a potentially explosive reservoir that can disseminate these strains with far reaching consequences. Screening of MRSA carriers amongst the hospital staff is imperative for this purpose. It allows for early detection of carriers, early attempts at decolonisation that reduces risk of cross contamination and possibly prevent secondary infection in carriers [8, 9].

Intranasal application of mupirocin is used widely to eliminate *S.aureus* colonisation and prevent health care associated staphylococcal infections [6]. The increased prevalence of MRSA infections amongst patients and its carriage in health staff has led to indiscriminate use and emergence of mupirocin resistance [10]. We sought to describe the incidence of nasal colonisation with mupirocin resistant MRSA strains in hospital staff in our institute where no screening programme for MRSA carriage or decolonisation protocols exist, mupirocin use is uncommon, and no baseline data exists for MRSA carriage.

OBJECTIVES

- To determine the incidence of nasal carriers of MRSA amongst our hospital staff.
- To determine the incidence of high-level mupirocin resistant strains, low-level mupirocin resistant strains and mupirocin sensitive phenotypes amongst these MRSA carriers.
- To determine the incidence of MLS_B resistant phenotypes amongst the MRSA strains isolated.
- To determine the incidence of multidrug resistant MRSA strains amongst the nasal carriers.

METHODOLOGY

Sample Size: All the hospital staff (doctors, nurses, paramedical staff, auxiliary staff working in high risk areas like OT and ICUs) were included in the study.

Type of study: Cross sectional study Study site: Tertiary care hospital of Haryana Duration: July-August 2015 No. of subjects: 46

Inclusion Criteria: All the hospital staff (doctors, nurses, paramedical staff, auxiliary staff working in high risk areas like OT and ICUs).

Exclusion Criteria: Doctors and staff not in direct contact with patients.

History Taking: Informed consent was taken, and case report form was filled by each subject. History was also taken regarding:

- Previous status of carriage of MRSA (if known)
- Previous infection with MRSA strain
- Any previous decolonisation done
- Any prolonged hospitalisation

Specimen collection and identification of bacteria:

Nasal swabs were collected by rotating a sterile cotton swab, moistened with sterile saline, in the vestibule of both anterior nares from the hospital staff. The swabs were immediately transported to the microbiology laboratory at room temperature [11].

Isolation and identification of S.aureus

The swabs were processed as per routine procedure for isolation and identification of *Staphylococcus aureus*. The swabs were inoculated on 5% sheep blood agar and MacConkey agar, incubated at 37ºC aerobically. The growth was identified as *Staphylococcus aureus* by conventional methods e.g. colonial morphology, Gram staining, production of catalase, tube coagulase method using rabbit plasma [12].

Detection of MRSA

Screening for MRSA was done by Kirby-Bauer disc diffusion test, according to the guidelines by Clinical laboratory standards institute (CLSI). Disc diffusion test was done for mupirocin resistance [13]. Epsilometer test (E-test) was done for determination of minimum inhibitory concentration for mupirocin.

RESULTS

Out of 46 nasal swab samples taken, MRSA was found in 23 of the isolates (Table 2). Out of these 23 isolates, high level mupirocin resistance was observed in 12(52.1%) and low-level mupirocin resistance was found in 5(21.7%) isolates by determining MIC using Epsilometer test and agar dilution.

Mupirocin resistant MRSA isolates showed higher resistance to macrolide-lincosamide-streptogamin B (MLS_B phenotype). $cMLS_B$ phenotype was found in 6(35.29%) and $iMLS_B$ was found in 5(29.4%) isolates.

Table-1: Percentage of nasal swabs growing *Staphylococcus aureus*

	No. of Samples	Percentage (%)
Staphylococcus aureus	44	95.65
No growth of *S. aureus*	2	4.34

Table-2: Out of 44 isolates of *S.aureus* isolated from nasal swabs

	No. of samples	Percentage%
MRSA carriers	23	52.2
MSSA carriers	21	47.7

Table-3: Mupirocin resistant *Staphylococcus aureus* among MRSA isolates

	Low level mupirocin resistance		High level mupirocin resistance	
	n	%	n	%
Disc diffusion testing	05	21.7	11	47.8
E test and agar dilution	05	21.7*	12	52.1**

Footnote: Reference values for MIC.

E-Test MIC range	Agar dilution MIC range
<4µg/ml	<4µg/ml
8-256µg/ml*	8-256µg/ml*
>512µg/ml**	>512µg/ml**

*low level mupirocin resistant MRSA, **high-level mupirocin resistant MRSA

Table-4: Out of 17 (73.9%) total mupirocin resistant MRSA isolates, strains with low- and high-levemupirocin resistance

	n	%
Low MupR	05	29.4
High MupR	12	70.5

Table-5: Out of 7 MRSA mupirocin sensitive isolates, those with MLS_B resistance

	No. of samples	Percentage%
c MLS_B	2	28.5
i MLS_B	2	28.5

Table-6: Antimicrobial resistance pattern of MRSA and mupirocin-resistant MRSA isolates

Antibiotics	MRSA (%)	Mupirocin resistant MRSA (%)
Penicillin	56.5	58.8
Linezolid	0	0
Co-trimoxazole	39.1	41.1
Cefuroxime	52.1	68.8
Ciprofloxacin	78.2	88.2

Table-7: Both mupirocin resistance (high/low) and MLS_B phenotype

	No. of samples	Percentage %
c MLS_B +Mupirocin resistant MRSA strains	6	35.29
iMLSB +Mupirocin resistant MRSA strains	5	29.4

DISCUSSION

MRSA is one of the leading cause of infections among health care staff and hospitalized patients. Prevalence of MRSA infections may further increase because of improper hand hygiene and handling of MRSA carrier patients. Mupirocin is a commonly used antibiotic for decolonization of MRSA in carriers and for treatment of skin and soft tissue infections caused by MRSA [10]. With increasing pressure to prevent MRSA infection, there has been a rampant increase in the use of mupirocin for nasal decolonization of MRSA [14].

Out of the 46 nasal swabs collected, 44 showed the growth of *S.aureus* with 23(52.2%) of these being methicillin resistant. A similar incidence of MRSA nasal carriers has been reported in various studies [15, 16] conducted in different parts of the country. Though some studies like that conducted by Chaturvedi *et al.*, [17] have reported a lower prevalence (22.7%) of MRSA isolate, they attribute it to lesser exposure to antibiotics due to low level of health care facilities in their region. In our region the indiscriminate and random prescription of drugs, lack of antibiotic policy and routine surveillance protocol may be an indiscriminating factor.

Among the 23 MRSA isolates, 17(73.9%) strains were mupR. An alarming amount of mupR MRSA strains were isolated in our study. The mupirocin resistance among *S. aureus* isolates has been clearly defined in many parts of the world at different frequencies ranging from 6% to 26.1%. The reason for higher prevalence of mupR in our study can be manifold, specifically health care workers were studied who are exposed to the most resistant strains in the hospital environment, lack of infection control policy in our institute and absence of regular screening and decolonization protocols and the increased use of mupirocin ointment for the skin and soft tissue infections in the region [17].

Low level mupirocin resistance (MuL) and high-level mupirocin resistance (MuH)

Out of the 23 MRSA strains, 5(21.7%) showed low level mupR and 12(52.1%) had high level mupirocin resistance by E test and agar dilution test. Whereas MuL isolates may be treated with normal dosage schedule of mupirocin ointment, but MuH has been found to be associated with treatment and decolonization failure [18-20].

Multidrug Resistance

The proportion of mupR MRSA strains resistant to other antibiotics were significantly higher than MRSA strains: Penicillin (58.8 vs 56.5),

Cotrimoxazole (41.1 vs 39.1), Cefuroxime (68.8 vs 52.1), Ciprofloxacin (88.2 vs 78.2). Though a few studies have reported a variation in antibiotic susceptibility pattern of mupirocin resistant MRSA isolates as compared to with mupirocin susceptible MRSA isolates with mupR isolates being more susceptible to certain antimicrobials like tetracycline and Cotrimoxazole [21].

There is a need for strong decontamination protocols in hospitals as proved by the study conducted.

CONCLUSION

Mupirocin ointment is effective at decreasing colonization with MRSA is an undisputed fact. Our study reveals a high rate of mupirocin resistance amongst MRSA carriers, including high level resistance in the healthcare workers at our institute. Further a high level of multidrug and MLS_B resistance was found among these mupirocin resistant MRSA strains isolated from healthcare workers.

This is a potentially explosive situation. Further this multiple resistance to antibiotics has severely limited therapeutic options available. This highlights the need for baseline testing and subsequent monitoring for mupirocin resistance before implementing infection control strategies primarily based on mupirocin. This will facilitate the early detection of resistance and assist in the control and spread of mupirocin resistant MRSA.

So, each institute needs to develop its own testing protocols for mupirocin resistance best suited to its needs and put a continual surveillance program in place.

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REFERENCES

1. Askarian M, Zeinalzadeh A, Japoni A, Alborzi A, Memish ZA. 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. 2009 Sep 1;13(5):e241-7.
2. Sivaraman K, Venkataraman N, Cole AM. Staphylococcus aureus nasal carriage and its contributing factors. Future microbiology. 2009 Oct;4(8):999-1008.
3. Wertheim HF, Melles DC, Vos MC, van Leeuwen W, van Belkum A, Verbrugh HA, Nouwen JL. The role of nasal carriage in Staphylococcus aureus infections. The Lancet infectious diseases. 2005 Dec 1;5(12):751-62.
4. Mulligan ME, Murray-Leisure KA, Ribner BS, Standiford HC, John JF, Korvick JA, Kauffman CA, Victor LY. Methicillin-resistant Staphylococcus aureus: a consensus review of the microbiology, pathogenesis, and epidemiology with implications for prevention and management. The American journal of medicine. 1993 Mar 1;94(3):313-28.
5. Rayner C, Munckhof WJ. Antibiotics currently used in the treatment of infections caused by Staphylococcus aureus. Internal medicine journal. 2005 Dec;35:S3-16.
6. Jones JC, Rogers TJ, Brookmeyer P, Dunne Jr WM, Storch GA, Coopersmith CM, Fraser VJ, Warren DK. Mupirocin resistance in patients colonized with methicillin-resistant Staphylococcus aureus in a surgical intensive care unit. Clinical Infectious Diseases. 2007 Sep 1;45(5):541-7.
7. Girou E, Pujade G, Legrand P, Cizeau F, Brun-Buisson C. Selective screening of carriers for control of methicillin-resistant Staphylococcus aureus (MRSA) in high-risk hospital areas with a high level of endemic MRSA. Clinical Infectious Diseases. 1998 Sep 1;27(3):543-50.
8. Brun-Buisson C, Legrand P. Can topical and nonabsorbable antimicrobials prevent cross-transmission of resistant strains in ICUs?. Infection Control & Hospital Epidemiology. 1994 Jul;15(7):447-55.
9. Wenzel RP, Nettleman MD, Jones RN, Pfaller MA. Methicillin-resistant Staphylococcus aureus: implications for the 1990s and effective control measures. The American journal of medicine. 1991 Sep 16;91(3):S221-7.
10. Hogue JS, Buttke P, Braun LE, Fairchok MP. Mupirocin resistance related to increasing mupirocin use in clinical isolates of methicillin-resistant Staphylococcus aureus in a pediatric population. Journal of clinical microbiology. 2010 Jul 1;48(7):2599-600.
11. Mohajeri P, Gholamine B, Rezaei M, Khamisabadi Y. Frequency of Mupirocin resistant Staphylococcus aureus strains isolated from nasal carriers in hospital patients in Kermanshah. Jundishapur Journal of Microbiology. 2012 Sep 1;5(4):560-3.
12. Monica C. District Laboratory practise in laboratory medicine, Part 2. Ch-7. 81(1), 157-159. Second edition. Cambridge university press
13. CLSI. Performance Standards for Antimicrobial Susceptibility Testing; Twenty-Third Informational Supplement. CLSI document M100-S23. Vol 33. Wayne: Clinical and Laboratory Standards Institute; 2013, 74-85.

14. Ramsey MA, Bradley SF, Kauffman CA, Morton TM. Identification of chromosomal location of mupA gene, encoding low-level mupirocin resistance in staphylococcal isolates. Antimicrobial Agents and Chemotherapy. 1996 Dec 1;40(12):2820-2823.
15. de Oliveira NE, Cardozo AP, de Andrade Marques E, dos Santos KR, demarval MG. Interpretive criteria to differentiate low-and high-level mupirocin resistance in Staphylococcus aureus. Journal of medical microbiology. 2007 Jul 1;56(7):937-939.
16. Vasquez JE, Walker ES, Franzus BW, Overbay BK, Reagan DR, Sarubbi FA. The epidemiology of mupirocin resistance among methicillin-resistant Staphylococcus aureus at a Veterans' Affairs hospital. Infection Control & Hospital Epidemiology. 2000 Jul;21(7):459-64.
17. Upton A, Lang S, Heffernan H. Mupirocin and Staphylococcus aureus: a recent paradigm of emerging antibiotic resistance. Journal of Antimicrobial Chemotherapy. 2003 Mar 1;51(3):613-7.
18. Simor AE, Stuart TL, Louie L, Watt C, Ofner-Agostini M, Gravel D, Mulvey M, Loeb M, McGeer A, Bryce E, Matlow A. Canadian Nosocomial Infection Surveillance Program Mupirocin-resistant, methicillin-resistant Staphylococcus aureus strains in Canadian hospitals. Antimicrob Agents Chemother. 2007;51(11):3880-3886.
19. India SJ, Ray P, Manchanda V, Bajaj J, Chitnis DS, Gautam V, Goswami P, Gupta V, Harish BN, Kagal A, Kapil A. Methicillin resistant Staphylococcus aureus (MRSA) in India: prevalence & susceptibility pattern. The Indian journal of medical research. 2013 Feb;137(2):363-369.
20. Arora S, Devi P, Arora U, Devi B. Prevalence of methicillin-resistant Staphylococcus aureus (MRSA) in a tertiary care hospital in Northern India. Journal of laboratory physicians. 2010 Jul;2(2):78-81.
21. Hudson IR. The efficacy of intranasal mupirocin in the prevention of staphylococcal infections: a review of recent experience. Journal of Hospital Infection. 1994 Jun 1;27(2):81-98.