Original Research Article

Study of Risk Factors for Nasal Colonization of Methicillin Resistant Staphylococcus Aureus (MRSA) and their Drug Sensitivity Pattern in Admitted Patients

Anurag Ambroz Singh[1], Pooja Singla[2], Rakesh Tank[3*]

[1]Professor, Department of General Medicine, SHKM Government Medical College, Nuh, Haryana, Punjab, India

[2]Associate Professor, Department of Microbiology, SHKM Government Medical College, Nuh, Haryana, Punjab, India

[3]Associate Professor, Department of General Medicine, SHKM Government Medical College, Nuh, Haryana, Punjab, India

Received: 21-08-2021 / Revised: 05-10-2021 / Accepted: 07-11-2021

Abstract

Background: In view of changing epidemiology of MRSA infections and scarcity of literature on risk factors for MRSA infections, a study addressing this knowledge gap was needed. **Aim:** This study was planned to study the prevalence and associated risk factors for MRSA colonisation in hospitalised patients. **Methods:** Study population consisted of 205 patients aged ≥16 years admitted in general medicine ward during the study period. Culture was performed from anterior nares within 48 hours after admission to identify patients colonized with MRSA or MSSA. **Results:** Out of 205 subjects, 24 (11.71%) individuals were infected with MRSA, whereas 16 (7.80%) had MSSA infection. Sterile nasal swab was reported in 63.41%. Use of steroids [OR 5.60 (95%CI 2.83, 22.68)], Chronic kidney disease [OR 4.61 (95%CI 2.85, 22.04)] and alcoholism [OR 2.45 (95%CI 0.52, 3.64)] came out to be three most important risk factors associated with MRSA and MSSA infections among study subjects. Vancomycin & linezolid were found to be sensitive in all twenty four patients of MRSA. Clindamycin & Cotrimoxazole were found to be sensitive in half of the MRSA patients. **Conclusion:** A greater degree of suspicion for MRSA, early detection of MRSA especially among those having risk factors, along with timely intervention with appropriate antibiotics and source control are needed to save these patients.

Key words: MRSA, culture, risk factors, antibiotic use.

Introduction

Methicillin resistant Staphylococcus aureus (MRSA) is an important pathogen worldwide in health care settings. Infections caused by MRSA are difficult to treat and impose great financial burden on health care [1]. Approximately 40% of nosocomial infections in India are caused by MRSA. Almost any site can be infected by MRSA, commonest are blood stream infections, skin and soft tissue infections and pneumonia [2,3].

Hospitalised patients are at increased risk to acquire MRSA colonisation and subsequent infections. In hospital environment patients usually get colonised with MRSA either via unclean hands of health care workers or by contaminated medical equipment and fomites [4]. Certain risk factors in hospitalised patients increase the risk for MRSA colonisation like indwelling catheters, hemodialysis, immunocompromised state etc [5].

Infections with resistant organisms are notorious to impart significant health and economic consequences [6]. In this landscape of changing epidemiology of MRSA infections, a study addressing this knowledge gap was obligatory. Thus this study was planned to study the prevalence and associated risk factors for MRSA colonisation in hospitalised patients.

*Correspondence
Dr. Rakesh Tank
Associate Professor, Department of General Medicine, SHKM Government Medical College, Nuh, Haryana, Punjab, India
E-mail: rakeshtank24@yahoo.com

Material and methods

This was a cross sectional conducted at a rural tertiary care teaching hospital of southern Haryana over a time period of twelve months (April 2019-March 2020). A total of 205 patients admitted in medicine ward were chosen for the study. The sample size was calculated (n=205) considering the prevalence of MRSA from ward inpatients as 15% [7] with confidence level of 95% and 5% absolute error by applying the following formula: $n = (Z^{1-a/2})^2 \times p\,(1-p) / d^2$.

Study population consisted of patients ≥16 years and both sexes admitted in general medicine ward during the study period. Culture was performed from anterior nares within 48 hours after admission to identify patients colonized with MRSA or MSSA. Only those patients who were negative for MRSA colonisation at the time of admission were further taken up for the study. Patients with pre-existing risk factors for MRSA colonisation were not included in the study. All samples were collected under aseptic conditions following recommended procedures. Individuals with cultures growing any other organism simultaneously along with MRSA/MSSA were excluded.The clinical details of each patient were noted on a pre-structured proforma. Patients were enquired about the presence of any associated risk factors like previous hospitalisation (30 days), duration of hospital stay, previous surgery, previous antibiotic use etc. Nasal swabs were collected from both anterior nares with the help of moistened cotton swabs. Swabs were collected at the time of admission and after 48 hrs of admission and transported immediately to Microbiology laboratory for culture and sensitivity. Swabs were processed for gram staining and culture. Culture was put on blood agar plates and were incubated at 37^0C for overnight. Growth was identified by standard biochemical tests. Antimicrobial susceptibility testing was done by Kirby-Bauer disc diffusion method. Cefoxitin

resistant strains were taken as MRSA. Isolation of MRSA from nasal swabs in absence of any systemic signs of infection was considered as colonisation. Before commencement of study ethical clearance was taken from Institutional ethical committee (Letter no. SHKM/CM/2016/903 dated 23.02.2016). Informed consent was taken from each patient. Patients' data were anonymized to maintain confidentiality. Categorical variables were summarized by frequency and percentage. Continuous variables were summarized using mean and SD (for normally distributed variables). Chi-squared test was used as test of association between two categorical variables whereas OR with 95% CI was used to report the strength of association between them. All the data were analysed using SPSS 15 and Stata 13. A P-value <0.05 was considered statistically significant.

Results

Of total 205 subjects, 140 were male and remaining 65 were female. Mean age of study subjects was 38.7 ±12.08 years. Study subjects had a spectrum of pathology/ infections viz. Anemia (15.12%), Cardiac disease (12.19%), Chronic liver disease (10.73%), Diabetes (10.73%) and malaria (10.73%) etc. (Table 1)

Table 1: Characteristics of patients admitted

Characteristic pathology	N (Percentage)
Chronic liver disease	22 (10.73%)
Poisoning	08 (3.90%)
Anemia	31 (15.12%)
Tuberculosis	14 (6.82%)
Diabetes mellitus	22 (10.73%)
CVA	21 (10.24%)
COPD	18 (8.78%)
Chronic kidney disease	12 (5.85%)
Malaria	22 (10.73%)
Cardiac disease	25 (12.19%)
Others	10 (4.88%)
Total	**205 (100%)**

Out of 205 subjects, 24 (11.71%) individuals were infected with MRSA, whereas 16 (7.80%) had MSSA infection. Sterile nasal swab was reported in 130 (63.41%). (Table 2)

Table 2: Outcome of nasal swab culture

Outcome of nasal swab culture		Number (Percentage)
Sterile		130 (63.41%)
Cultre positive (n=75)	MRSA	24 (11.71%)
	MSSA	16 (7.80%)
	Micrococcus	12 (5.85%)
	Coagulase negative staphylococcus	11 (5.36%)
	Gram negative bacteria	08 (3.90%)
	Diphtheroids	04 (1.95%)
Methicillin resistant *Staphylococcus aureus* (MRSA), Methicillin sensitive *Staphylococcus aureus* (MSSA)		

MRSA carriage was common with use of steroids [OR 5.60 (95%CI 2.83, 22.68)], Chronic kidney disease [OR 4.61 (95%CI 2.85, 22.04)] and alcoholism [OR 2.45 (95%CI 0.52, 3.64)]. (Table 3)

Table 3: Risk factors associated with MRSA and MSSA infections

Variables	MRSA (N=24) n (%)	MSSA (N=16) n (%)	Odds Ratio (95%CI)
Use of steroids	6 (25%)	1 (6.25%)	5.60 (2.83, 22.68)
Alcoholism	2 (8.3%)	1 (6.25%)	2.45 (0.52, 3.64)
Diabetes mellitus	3 (12.5%)	2 (12.5%)	1.31 (0.94, 2.08)
Cardiac disease	2 (8.3%)	3 (18.75%)	0.75 (0.38, 1.32)
Chronic kidney disease	4 (16.6%)	1 (6.25%)	4.61 (2.85, 22.04)
CVA	2 (8.3%)	3 (18.75%)	0.84 (0.22, 2.73)
COPD	2 (8.3%)	1 (6.25%)	1.20 (0.36, 5.18)
Skin infection in past 12 months	2 (8.3%)	1 (6.25%)	1.63 (1.30, 2.82)
Anemia	1 (4.16%)	3 (18.75%)	0.79 (0.38, 1.51)

Vancomycin & linezolid were found to be sensitive in all twenty four patients of MRSA. Clindamycin & Cotrimoxazole were found to be sensitive in half of the MRSA patients. (Table 4)

Table 4: Antibiotic susceptibility pattern of MRSA

Antibiotic	Sensitivity (%)
Vancomycin	100 %
Linezolid	100 %
Erythromycin	62.5 %
Clindamycin	50 %
Cotrimoxazole	50 %
Amikacin	75 %

Discussion

This study was conducted among 205 patients to study the prevalence and associated risk factors for MRSA colonisation among hospitalised patients. In this study we observed that out of 205 subjects, 24 (11.71%) individuals were infected with MRSA, whereas 16 (7.80%) had MSSA infection. Sterile nasal swab was reported in 63.41%. Thus in this study prevalence of MRSA infection came to be 11.71%.

The result of this study is in agreement with previous community-based study conducted by Chatterjee et al. He found a slightly higher rate of 52.3% [8]. However, a lower rate of colonization (compared to Chatterjee et al.) was found in the study done by Shetty et al.(25%) and Ramana et al. (16%) [9,10]. However, this is in contrast to a study from South India that had reported a prevalence of 74% of CA-MRSA [11]. This lower prevalence of nasal colonization may be attributed to the difference in geographical distribution (underserved poor) and characteristics of population (muslim predominant) in this study as well as other factors such as sampling technique, its transportation, different culture media, and methods of isolation and identification of S. aureus and MRSA.

In this study, it was observed that MRSA carriage was common with use of steroids, Chronic kidney disease and alcoholism. Infections predominated in both the groups, proportions being <50% for MSSA and >50% for MRSA, in concurrence with other study [12]. However, MRSA was associated with significantly higher odds of Skin infection in past 12 months, COPD and Diabetes mellitus, which reiterate the findings of previous studies [13].

Prior receipt of antibiotics is an established risk factor that selects for drug-resistant MRSA and facilitates colonization and infection. However, we could not assign a particular class of antibiotics; the data could not be ascertained with certainty in all patients as available prescription prior to the hospitalization was uniformly poor in the study setting. A similar finding was recorded by Hanberger H et al. in his study among forteen thousand adult ICU patients, MRSA was associated with cancer and chronic renal failure [14].

In this study, it was observed that Vancomycin & linezolid were found to be sensitive in all twenty four patients of MRSA. Clindamycin & Cotrimoxazole were found to be sensitive in half of the MRSA patients. This is in contrast to the study by Ramana et al [10].and Reta et al [15]. Reta et al. found that 100% resistance to penicillin but only 11.8% resistance to co-trimoxazole. Whereas, Ramana et al. found that 100% isolates were resistance to penicillin but only 14.3% resistance to co-trimoxazole. Ramana et al. also found that gentamicin being the highest susceptibility rate followed by co-trimoxazole, erythromycin, and tetracycline. The lower level of resistance to few antibiotics among the rural population may be attributed to the non-availability of medical practitioners and less use of over-the-counter sale of the drugs attributed to underserved population.

Conclusion

Prevalence of MRSA infection came to be 11.71% among hospitalized patients. Risk factors found to be statistically significant for MRSA were use of steroids, Chronic kidney disease and alcoholism. Every patient is important to us therefore a greater degree of suspicion for MRSA, early detection of MRSA especially among those having risk factors, along with timely intervention with appropriate antibiotics and source control are needed to save these patients.

References

1. Sharma Y, Jain S, Singh H, Govil V. Staphylococcus aureus: Screening for Nasal Carriers in a Community Setting with Special Reference to MRSA. Scientifica (Cairo). 2014;2014:479048.
2. Indian Network for Surveillance of Antimicrobial Resistance (INSAR) Group, India. Methicillin resistant Staphylococcus aureus (MRSA) in India: Prevalence and susceptibility pattern. Indian J Med Res 2013;137:363-9.
3. Patwardhan V, Kumar D, Goel V, Singh S, Sarman S. Changing prevalence and antibiotic drug resistance pattern of pathogens seen in community-acquired pediatric urinary tract infections at a tertiary care hospital of North India. J Lab Physicians. 2017;9(4):264–268.
4. Singh S, Malhotra R, Grover P, et al. Antimicrobial resistance profile of methicillin-resistant Staphylococcus aureus colonizing the anterior nares of health-care workers and outpatients attending the remotely located tertiary care hospital of North India. J Lab Physicians. 2017;9(4):317–321.
5. Patel AK, Patel KK, Patel KR, Shah S, Dileep P. Time trends in the epidemiology of microbial infections at a tertiary care center in west India over last 5 years. J Assoc Physicians India. 2010;58(Suppl): 37–40.
6. Gopalakrishnan R, Sureshkumar D. Changing trends in antimicrobial susceptibility and hospital acquired infections over an 8 year period in a tertiary care hospital in relation to introduction of an infection control programme. J Assoc Physicians India. 2010;58(Suppl):25–31.
7. Indian Network for Surveillance of Antimicrobial Resistance (INSAR) group, India. Methicillin resistant Staphylococcus aureus (MRSA) in India: prevalence & susceptibility pattern. Indian J Med Res. 2013 Feb;137(2):363-9.
8. Chatterjee SS, Ray P, Aggarwal A, Das A, Sharma M. A community-based study on nasal carriage of Staphylococcus aureus. Indian J Med Res 2009;130:742-8.
9. Shetty V, Trumbull K, Hegde A, Shenoy V, Prabhu R, Sumathi K, et al. Prevalence of community-acquired methicillin-resistant Staphylococcus aureus Nasal colonization among children. J Clin Diagn Res 2014;8:DC12-5.
10. Ramana KV, Mohanty SK, Wilson CG. Staphylococcus aureus colonization of anterior nares of school going children. Indian J Pediatr 2009;76:813-6.
11. Eshwara VK, Munim F, Tellapragada C, et al. Staphylococcus aureus bacteremia in an Indian tertiary care hospital: observational study on clinical epidemiology, resistance characteristics, and carriage of the Panton-Valentine leukocidin gene. Int J Infect Dis. 2013;17(11): e1051–e1055.
12. Joshi S, Ray P, Manchanda V, Bajaj J, Chitnis D, Gautam V, Goswami P et al. Methicillin resistant Staphylococcus aureus (MRSA) in India: prevalence & susceptibility pattern. Indian J Med Res. 2013;137(2):363.
13. Singh S, Malhotra R, Grover P, et al. Antimicrobial resistance profile of methicillin-resistant Staphylococcus aureus colonizing the anterior nares of health-care workers and outpatients attending the remotely located tertiary care hospital of North India. J Lab Physicians. 2017;9(4):317–321.
14. Hanberger H, Walther S, Leone M, et al. Increased mortality associated with methicillin-resistant Staphylococcus aureus (MRSA) infection in the intensive care unit: results from the EPIC II study. Int J Antimicrob Agents. 2011;38(4):331–335.
15. Reta A, Gedefaw L, Sewunet T, Beyene G. Nasal carriage, risk factors and antimicrobial susceptibility pattern of methicillin resistant Staphylococcus aureus among school children in Ethiopia. J Med Microbiol Diagn 2015;4:177.

Conflict of Interest: Nil Source of support: Nil