

Original Research Article

Prevalence of Methicillin-resistant *Staphylococcus aureus* (MRSA) infections among patients admitted in critical care units in a tertiary care hospital

Arunkumar V.,^{1*} Prabagaravarathanan R.², Bhaskar M.³

¹Final Year MBBS Student, Government Vellore Medical College and Hospital, Adukkamparai, Vellore District, Tamil Nadu, India

²Senior Assistant Professor, ³Professor and Head, Department of Microbiology, Government Vellore Medical College and Hospital, Adukkamparai, Vellore District, Tamil Nadu, India

Received: 29 April 2017

Accepted: 04 May 2017

*Correspondence:

Dr. Arunkumar V.,

E-mail: arunsept20@gmail.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: The emergence of Methicillin-resistant *Staphylococcus aureus* (MRSA) infections in hospital leads to significant morbidity and mortality. Hence the present study was undertaken to estimate the prevalence of MRSA in critical care units (CCUs) at our centre. The objective of this study was to find the prevalence of MRSA infections in CCUs, to determine their antibiotic profile. And to screen for MRSA in the environment of CCUs in order to find whether they act as a source of infection.

Methods: The present cross-sectional study included 100 patients admitted to various CCUs in our hospital. The clinical specimens (urine, Sputum, pus, blood and CSF) were collected from the admitted patients along with environmental samples from these CCUs. Two samples were collected from each patient and subjected to culture and antibiotic susceptibility testing.

Results: 168 samples from 100 patients were processed. Out of which five pus samples from five different patients admitted in surgical intensive care unit (SICU) were positive for MRSA infection showing 5% prevalence in CCUs. All MRSA strains were sensitive to vancomycin and teicoplanin. Out of 30 environmental swabs, 1 swab taken from paediatric intensive care unit (PICU) showed positivity for MRSA (3%).

Conclusions: CCUs in our hospital have shown 5% prevalence of MRSA among the admitted patients. There was no correlation between environmental MRSA presence and infection in the samples from patient.

Keywords: CCUs, MRSA, PICU, SICU

INTRODUCTION

Staphylococcus aureus is a leading cause of hospital acquired infection (HAI) gives rise to enormous burden to the health care system significantly affecting the patient's morbidity and mortality. Most staphylococci are resistant to penicillin due to the production of β -lactamase. A positive β -lactamase test indicates resistance to penicillin, ampicillin, amoxicillin, azlocillin, carbenicillin, mezlocillin, piperacillin and ticacillin.¹

Resistance to the antistaphylococcal, penicillinase-stable penicillins (methicillin, nafcillin and oxacillin) has been referred to as "methicillin resistance". Most resistance to oxacillin in staphylococci is mediated by the *mecA* gene which directs the production of a supplemental penicillin-binding protein, PBP2a in the cell wall of resistant strains.² MRSA strains are resistant to cephalosporins and other beta-lactam antibiotics make the treatment very difficult. Nowadays Methicillin resistant staphylococcus aureus (MRSA) has been emerging as one of the most

important nosocomial pathogens.³ The incidence of MRSA varies from 25 percent in western part of India to 50 percent in South India.⁴ According to National Nosocomial Infection Surveillance in USA, the occurrence of MRSA causing nosocomial infection has increased from 2% in 1974 to 22% in 1995 and then to 63% in 2004.⁵ A study was conducted among 4,194 patients admitted in Intensive care unit, and the results shows that 238 (5.7%) had screening results positive for MRSA.⁶

Currently, the treatment options for MRSA infections are limited to a very few and expensive drugs like teicoplanin, vancomycin, and linezolid. Thus, control of MRSA is essential to curtail the introduction and spread of infection. The continuing emergence and development of resistance to existing antibacterial agents by bacteria has created the need for new antibacterial compounds that exhibit activity against these resistant strains.⁷ Another alarming sign is that emergence of resistance to vancomycin, although at a low level has been reported.⁸ Glycopeptides and linezolid continue to remain the mainstay of treatment for MRSA.

As the data about the prevalence of MRSA was varying in different regions of our country. The present study was planned to find out prevalence of MRSA infection in our tertiary care centre and their antibiotic profile as the primary objective and to screen for MRSA in the environment of CCUs in order to find whether they act as a source of infection as the second objective.

METHODS

Cross sectional study was conducted in Department of Microbiology, Department of Medicine, Department of Surgery, Department of Paediatrics, in a tertiary care hospital in south India.

Patients admitted in the critical care units (ICCU, NICU, PICU, SICU, IMCU) with illness to whom MRSA prevalence are studied. 100 cases included in the study. The duration of present study was 2 months (From August 2015 to September 2015).

Inclusion criteria

- Patients admitted in intensive care unit with illness.
- 100 patients without any age restrictions.

Exclusion criteria

- Patients who are on antibiotics during admission
- Those who are not giving consent and not interested to participate in study

After obtaining the Institutional Ethical Committee approval, the clinical specimens such as blood, urine, sputum, pus, throat swab and in special situations CSF were collected from the admitted patients after getting

their informed consent along with the environmental samples from Critical care units.

Environmental samples include swabs taken from various places like floor, roof, sidewalls, drug trolley, IV stand, fan, AC, light, apparatuses like respiratory apparatus and suction apparatus, bed and bed cloth present in intensive care units. All the samples were collected under aseptic conditions and in a proper manner were processed immediately and if any delay was anticipated, transport media was used. Selective media like mannitol salt agar was employed for cultivation when specimens were collected from site inhabited by the normal flora.

Clinical samples were then inoculated into blood agar, chocolate agar and Mac Conkey agar and special media in some special situations. Culture plates were then incubated at 37°C in ambient air for overnight.

The organisms which are grown in the form of colonies were processed according to standard procedures for identification of organisms. Standard Kirby - Bauer's Disc Diffusion Method was carried out to identify the methicillin resistance and also to analyse sensitivity pattern of MRSA isolates. Isolates resistant to oxacillin (1µg) and cefoxitin (30 µg) were identified as MRSA and those susceptible as methicillin sensitive *Staphylococcus aureus* (MSSA). Antibiotics discs used were Penicillin (10 unit), Oxacillin (1 µg), Cefoxitin (30 µg), Ciprofloxacin (5 µg), Erythromycin (15 µg), Vancomycin (30 µg), Cotrimoxazole (25 µg), Cefotaxime (30 µg) and others obtained from Himedia.

RESULTS

A total of 100 patients admitted in various critical care units were included in our study. The percentage of patients admitted in critical care units included in our study were shown in Figure 1. Age group distribution in the study group has been shown in Table 1. Equal distribution of male and female patients had been included in the study as shown in Table 2. The patients admitted in critical care units comprised more of the under 5 age group and the elderly above 60 years of age who were more susceptible for infections.

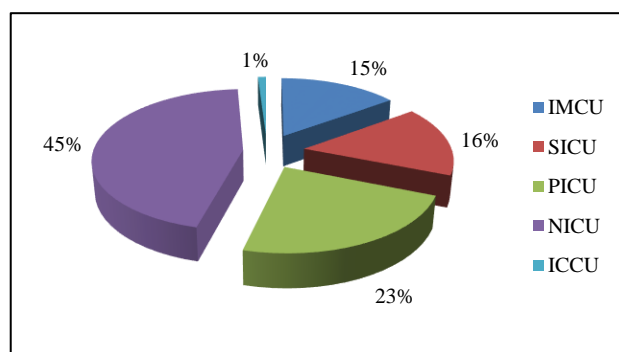


Figure 1: Percentage of patients admitted in various critical care units.

Table 1: Age group distributions included in the study.

Age group	Frequency	Percent
0 - 5	64	64.0
6 - 19	6	6.0
20 - 40	8	8.0
41 - 60	9	9.0
Above 60	13	13.0
Total	100	100.0

Table 2: Distribution of male and female patients included in the study.

Gender	Frequency	Percent
Male	51	51.0
Female	49	49.0
Total	100	100.0

Table 3: Number of clinical samples collected from patients admitted in CCU.

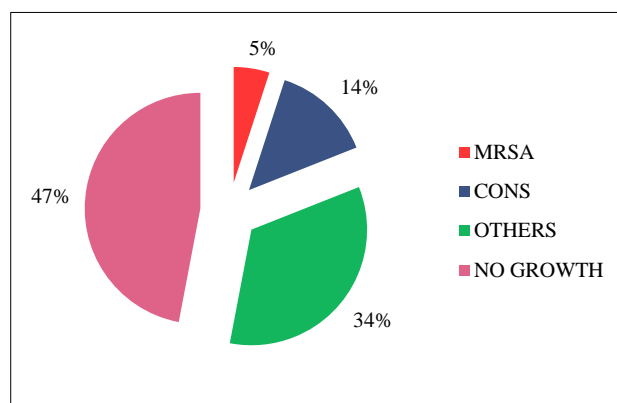
Samples	Frequency	Percentage
Blood only	30	30.0
Blood and urine	25	25.0
Blood and CSF	21	21.0
Blood and pus	16	16.0
Sputum and urine	3	3.0
Throat swab and urine	1	1.0
Sputum and blood	2	2.0
Pus and urine	2	2.0
Total	100	100

Table 4: Susceptibility pattern of MRSA against various antibiotics.

Antibiotic	Resistant	Intermediate	Sensitive
Cefotaxime	5	0	0
Ciprofloxacin	2	0	3
Amoxicillin	2	0	3
Amoxyclav	1	0	4
Erythromycin	1	1	3
Cefoxitin	5	0	0
Vancomycin	0	0	5
Teicoplanin	0	0	5
Cotrimoxazole	2	0	3
Penicillin	5	0	0

From each patient minimum 2 samples like blood and pus, blood and CSF, blood and urine, sputum and urine, throat swab and urine, sputum and blood, pus and urine were collected (Table 3 shows the sample details). In NICU, only blood sample were collected (urine samples from patients admitted in NICU were not collected as it required suprapubic catheterization which may itself induce iatrogenic infection to the babies and since none

of the babies suffered LRTI sputum or gastric aspirate was not collected).

**Figure 2: Organisms isolated in various critical care units.**

From 100 patients, a total of 168 samples have been collected. Of which 94 blood samples, 31 urine samples, 20 CSF samples, 18 pus samples, 4 sputum samples and 1 Throat swab were collected.

In the present study only 5 MRSA isolates were obtained and all the 5 were isolated from pus samples and, all the MRSA were isolated from the patients admitted in SICU. The distribution of the Organisms isolated from the patients admitted in various critical care units shown in Figure 2.

The antibiotic sensitivity patterns were done with various antibiotics shown in the Table 4. And it shows that all 5 MRSA isolates were completely resistant to cefotaxime, cefoxitin and penicillin, moderately resistant to ciprofloxacin, amoxicillin and cotrimoxazole.

All the MRSA strains isolated were found to be sensitive to vancomycin and teicoplanin which can be used as a drug of choice for Methicillin-resistant *Staphylococcus aureus* infections.

Organisms isolated from the various surveillance samples in Critical care units have been shown in Table 5. MRSA was isolated from the side walls of PICU and they were subjected to antibiotic susceptibility. It was noted that the antibiotic susceptibility pattern of MRSA strains isolated from the environment was different from those isolated from patients. These environmental strains were resistant to penicillin and cotrimoxazole and sensitive to gentamicin, erythromycin, vancomycin and teicoplanin. It was also noted that the patients admitted in PICU had not acquired MRSA infection.

On the contrary *Staphylococcus aureus* was isolated from the environmental samples obtained from SICU found to be sensitive to methicillin.

Table 5: Organism isolated from surveillance samples in critical care units.

	Fan, AC, light	Floor, walls and roof	Drug trolley	Respiratory and suction apparatus	IV stand	Bed and Bed cloth	Open plate culture
IMCU	NG	NG	NG	NG	NG	NG	NG
ICCU	NG	NG	NG	NG	NG	NG	CONS
NICU	CONS	NG	NG	CONS	NG	CONS	CONS
SICU	NG	NG	NG	NG	NG	MSSA	CONS
PICU	NG	MRSA	NG	NG	NG	NG	NG

NG - No Growth; MSSA - Methicillin Sensitive Staphylococcus aureus; CONS - Coagulase Negative Staphylococcus aureus; MRSA - Methicillin Resistant Staphylococcus aureus.

DISCUSSION

MRSA is a global phenomenon with a prevalence rate ranging from 2% in Netherland and Switzerland to 70% in Japan and Hong Kong.⁹ In this study the prevalence of MRSA was found to be 5% in a total of 100 patients admitted in critical care units. It has been stated that in patients admitted in ICU, rate of acquisition of bacteria (present in ICU) increase with increase in the time they stay in ICU.¹⁰

In this study, all MRSA isolated were found to be sensitive to vancomycin and teicoplanin and all were resistant to penicillin and cefoxitin. Another study has reported intermediate sensitivity to vancomycin.⁷ Vancomycin seems to be the only antimicrobial agent which showed 100% sensitivity and may be used as the drug of choice for treating multidrug resistant MRSA infections. However, regular monitoring of vancomycin sensitivity and routine testing of other newer glycopeptide like teicoplanin should be carried out.

Among the Surveillance samples from various places in critical care unit's MRSA strains were found only in PICU. Following which proper fumigation was done and repeat swabs were taken from PICU and it shows negativity for MRSA. This study had been a tool for detection of MRSA in our tertiary care centre. It also had underlined the necessity for further regular surveillance of MRSA and other hospital associated infections including monitoring antibiotic sensitivity pattern of MRSA and formulation of definite antibiotic policy that may be helpful for reducing the incidence of MRSA infection. By following universal precautions, the most important one being frequent hand washing with alcohol based soap after each patient care will be useful to curtail the infection.

CONCLUSION

Though this preliminary report has shown a low prevalence of MRSA in our hospital, it has alerted us that regular surveillance of MRSA is mandatory in any tertiary care centre. It has also highlighted that further studies with larger study group and time needs to be conducted to identify any changing antimicrobial profile

of MRSA isolated. This will be of great use for effective control against MRSA infections. Therefore, along with effective screening proper antibiotic policy also must be evolved and adhered. All clinical and Para medical faculties must be trained and educated regarding the control measures in preventing the spread of MRSA. The hospital infection control policy and guidelines that already exists should be strictly implanted and followed so as to enable the clinicians to deliver better and proper health care to the patients.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the Indian Council of Medical Research (ICMR), New Delhi, India, for providing Short Term Research Studentship (STS) to the first author in 2015.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: Not required

REFERENCES

1. Clinical and Laboratory Standard Institute (CLSI). Performance standards for antimicrobial susceptibility testing; 16th informational supplement. USA, Wayne. P.A.2009;29(3):M100-S19.
2. El-Jahl HA, Jallad M, Thwaini AJ. Nasal carriage of methicillin resistance Staphylococcus aureus in individuals exposed and not exposed to hospital environment. *Eu J Sci Res.* 2008;22(4):570-4.
3. Sanjana RK. Prevalence and antimicrobial susceptibility a preliminary report. *J Col Med Sci Nepal.* 2010;6:1.
4. Joshi S, Ray P, Manchanda V, Bajaj J, Chitnis DS, Gautam V, et al. Methicillin resistant Staphylococcus aureus (MRSA) in India: Prevalence and susceptibility pattern. *Indian J Med Res.* 2013;137(2):363-9.
5. Shrestha B, Pokhrel B, Mohapatra T. Study of nosocomial isolates of Staphylococcus aureus with special reference to methicillin resistant S. aureus in a tertiary care hospital in Nepal. *Nepal Med Coll J.* 2009;11(2):123-6.

6. Sim BL, McBryde E, Street AC, Marshall C. Multiple site surveillance cultures as a predictor of methicillin-resistant *Staphylococcus aureus* infections. *Infect Cont Hospital Epidemiol.* 2013;34(8):818-24.
7. Sucilathangam G, Niranjana S, Velvizhi G, Palaniappan N, Anna T. Phenotypic differentiation of BORSA from MRSA: comparison of susceptibility testing methods and MRSA Latex agglutination test. *J Pharm Biomed Sci.* 2013;27(27):592-8.
8. Assadullah S, Kakru DK, Thoker MA, Bhat FA, Hussain N, Shah A. Emergence of low level vancomycin resistance in MRSA. *Indian J Med Microbiol.* 2003;21:196-8.
9. Fluit AC, Wielders CL, verhoef Jf. Epidemiology and susceptibility of 3051 *Staphylococcus aureus* isolates from 25 university hospitals participating in the European SENTRY study. *J Clin Microbiol.* 2001;39:3727-32.
10. Fridkin SK, Gaynes RP. Antimicrobial resistance in intensive care units. *Clin Chest Med.* 1999;20:303-16.

Cite this article as: Arunkumar V, Prabagaravarathanan R, Bhaskar M. Prevalence of Methicillin-resistant *Staphylococcus aureus* (MRSA) infections among patients admitted in critical care units in a tertiary care hospital. *Int J Res Med Sci* 2017;5:2362-6.