Nasal colonisation with MRSA in patients undergoing cardiac surgery

Asha Pai K B, Manjunath R Kamath, Vimal Kumar Karnaker, Gopalakrishnan M

Keywords: cardiac surgery, MRSA, MDR, nasal colonization

Abstract

Introduction: Patients colonised with MRSA are at an increased risk of developing post surgical infections and the implications are greater in vascular and orthopaedic surgeries involving prosthetic implants. Preoperative screening for nasal colonisation and decolonisation reduces the risk for the development of such infections. Aims and objectives: To assess the rate of nasal colonisation with MRSA and their antibiotic susceptibility pattern among patients undergoing cardiac surgery in our centre.

Methods and material: Anterior nasal swabs from 69 patients undergoing cardiac valve replacement surgeries, that were sent to the Department of Microbiology, as part of routine preoperative screening for nasal colonisation by MRSA, were included in the study. Screening for MRSA was done by disc diffusion method using cefoxitin disc. Antibiotic sensitivity testing of the MRSA isolates was done by modified Kirby Bauer disc diffusion method. Vancomycin sensitivity was assessed by macro broth dilution method.

Results: Ten percent of patients were found to harbour MRSA in their anterior nares. Multidrug resistance was observed in 44% of isolates. All the isolates were sensitive to vancomycin. Over 55% of the isolates showed vancomycin MIC in the range of 1-2 µg/mL.

Conclusion: Our study revealed a high rate of MDR among MRSA colonising the anterior nares. This is of great concern, as the infection caused by such isolates is not only difficult to treat but also can increase the morbidity and mortality. We recommend preoperative screening for nasal colonisation by MRSA among all the patients undergoing high risk surgeries.

1. Introduction

Methicillin Resistant Staphylococcus aureus (MRSA) is an important cause of nosocomial as well as community acquired infections [1]. Patients colonised with MRSA are at an increased risk of developing post surgical infections and the implications are greater in vascular and orthopaedic surgeries involving prosthetic implants [2]. The incidence of surgical site infections has been estimated to range from 0.7% to 10%, with mediastinitis rate ranging from 1.4-2.2% [3-6]. Such infections are becoming difficult to treat due to multidrug resistance among these organisms. Colonization with MRSA has also shown to increase the risk of infection in long-term carriers. Individuals who are known to have harboured MRSA for >1 year are at high risk and should be considered to be targets for intervention [7]. Different studies have reported the prevalence of nasal carriage of MRSA ranging from as low as 0.7% to as high as 32%; which varies depending on population studied [8, 9].

Preoperative Screening for nasal carriage and decolonisation can decrease Staphylococcus aureus related surgical site infections [10]. We conducted this study to assess the rate of nasal colonisation with MRSA and their antibiotic susceptibility pattern among patients undergoing cardiac valve replacement surgery.

Material and methods

Specimen collection and processing: Anterior nasal swabs from 69 patients undergoing cardiac valve replacement surgeries, that were sent to the Department of Microbiology, as part of routine preoperative screening for nasal colonisation by MRSA, were included in the study. The samples were inoculated on Blood agar and MacConkey agar and incubated overnight at 37°C. On the subsequent day, if there was growth of bacterial colonies, smears were prepared and stained with Gram stain. All the gram positive cocci were then identified by standard microbiology techniques including catalase test, slide and tube coagulase test and DNase test [11]. The isolates which were identified as Staphylococcus aureus were included in the study.

Detection of MRSA: Staphylococcus aureus isolates were screened for Methicillin resistance by modified Kirby Bauer disc diffusion method using cefoxitin disc (30 µg). Isolates with a zone of inhibition of ≥22 mm were considered as methicillin sensitive and <21 mm as methicillin resistant as per CLSI guidelines [12].

Antibiotic susceptibility testing: Susceptibility of the MRSA isolates to various antibiotics was determined by modified Kirby Bauer Disc Diffusion method as per CLSI guidelines. The following antibiotic discs were used: erythromycin (15 µg), clindamycin (2 µg), ciprofloxacin (5 µg), co-trimoxazole (1.25 µg/23.75 µg), chloramphenicol (30 µg), gentamicin (10 µg), tetracycline (30 µg) and linezolid (30 µg). Staphylococcus aureus ATCC 25923 was used as internal control in each run of the test [12].

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Vancomycin susceptibility: Susceptibility to vancomycin was determined by macro broth dilution method. Stock solution of Vancomycin (final concentration of 10,000 µg/mL) was prepared in sterile distilled water. Five hundred micro liters of two fold dilution of vancomycin, ranging from 0.5 µg/mL - 256 µg/mL was prepared in cation adjusted Mueller Hinton broth. Five hundred micro liters of inoculum containing 10⁵ CFU/mL of MRSA was added to each tube and incubated at 37°C for 24 hours. Growth in the tubes were detected by observing for turbidity. The lowest concentration of vancomycin that inhibited growth of MRSA was taken as the MIC and recorded in microgram/milliliter [13]. The results were interpreted according to CLSI guidelines [12].

RESULTS
Out of the 69 patients screened, anterior nares of 33 patients (47.82%) were found to be colonised with Staphylococcus aureus. Seven patients (10.14%) and 26 patients (37.88%) were found to harbor MRSA and Methicillin Sensitive Staphylococcus aureus (MSSA) respectively. Out of the 7 patients, nasal swabs of 2 patients showed growth of Staphylococcus aureus with two different colony morphologies. Further analysis showed that these isolates had different antibiotic susceptibility pattern, although they were isolated from same sample. Therefore, a total of 9 MRSA isolates were obtained from 7 patients. The antibiotic resistance pattern of MRSA isolates is shown in [Table1].

An isolate was considered to be multidrug resistant (MDR), if it exhibited resistance to at least three different classes of antibiotics tested. MDR was observed in 4 (44.44 %) out of the 9 MRSA isolates. All the 4 MDR isolates were found to be resistant to ciprofloxacin and co-trimoxazole. Three out of the 4 MDR isolates were resistant to erythromycin and tetracycline. Inducible clindamycin resistance was observed in 1 out the 4 MDR isolates. Chloramphenicol, gentamicin, linezolid and vancomycin were found to be effective against 3 out of the 4 MDR isolates. One isolate was resistant to all the tested antibiotics except linezolid and vancomycin.

Vancomycin MIC is shown in [Table 2].

### Table 1: Antibiotic resistance pattern of MRSA

<table>
<thead>
<tr>
<th>Antibiotics (µg)</th>
<th>No. of resistant isolates (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ciprofloxacin</td>
<td>7 (77.78)</td>
</tr>
<tr>
<td>Cotrimoxazole</td>
<td>6 (66.67)</td>
</tr>
<tr>
<td>Tetracycline</td>
<td>4 (44.45)</td>
</tr>
<tr>
<td>Erythromycin</td>
<td>3 (33.33)</td>
</tr>
<tr>
<td>Clindamycin</td>
<td>2 (22.22)</td>
</tr>
<tr>
<td>Gentamicin</td>
<td>1 (11.11)</td>
</tr>
<tr>
<td>Chloramphenicol</td>
<td>1 (11.11)</td>
</tr>
<tr>
<td>Linezolid</td>
<td>0 (0.00)</td>
</tr>
</tbody>
</table>

### Table 2: Distribution of Vancomycin MIC

<table>
<thead>
<tr>
<th>Vancomycin MIC (µg/ml)</th>
<th>No. of isolates (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 0.5</td>
<td>4 (44.45)</td>
</tr>
<tr>
<td>1</td>
<td>4 (44.45)</td>
</tr>
<tr>
<td>2</td>
<td>1 (11.11)</td>
</tr>
</tbody>
</table>

DISCUSSION
Staphylococcus aureus is found as transient normal flora of human skin and mucosal surfaces in 10-90 % of the population [14]. The most common sites for colonisation are the anterior nares, throat, perianal area, groin, umbilicus and axillae [15, 16]. Asymptomatic carriage can persist from months to years [17]. Colonisation of anterior nares by Staphylococcus aureus is an important and increasingly prevalent risk factor for subsequent infection in cardiothoracic and orthopaedic surgery [18]. Staphylococcus aureus colonisation increases the rate of nosocomial surgical site infection after major heart surgeries and patient's endogenous flora is the principal source [19, 20]. Colonisation with MRSA is associated with a fourfold increase in the risk of infection compared with colonisation with MSSA [21]. Preoperative screening for nasal carriage and decolonisation reduces the risk for the development of deep seated infection by 79% and superficial infection by 55% [22].

The rate of colonisation of anterior nares with Staphylococcus aureus ranges between 20-40%, depending upon population studied and geographical area [23]. The result of our study is higher (47.82%) compared to the reports by Munoz P et al from Spain and Price et al from USA [20, 24].

Our study shows that 7 (10.14%) patients were colonised with MRSA which is consistent with the result of a study conducted by Rao AK et al, on 100 patients attending surgical outpatient department in Mysore, India [25]. The rate of MRSA colonisation of anterior nares in our study is higher, as compared to other studies by Mathanraj S et al and Sharma Y et al, from India [26, 27]. Sharma Y et al, have reported that, MRSA colonisation was found in 5% of the outpatients and healthcare workers in New Delhi [27]. A very low prevalence of colonisation of 0.7% has been reported by Munch et al, from Queensland, Australia which is in contrast to a high prevalence of 32% from Egyptian out patients as reported by Abou Shady HM et al [8, 9]. These data suggest that, the rate of MRSA colonisation varies according to the quality of sample collected, techniques of culture, the population studied and the geographical area.

The antibiotic susceptibility pattern of our isolates reveals that, ciprofloxacin was the least effective antibiotic with over 75% of the isolates being resistant, which is consistent with two other studies from India [27, 28]. Over 65% of our isolates were resistant to co-trimoxazole. This is in agreement with another study conducted by Fomda BA et al, among the healthy population in Kashmir [29]. However our report is contradictory to the low rates of resistance to co-trimoxazole, among MRSA recovered from anterior nares, as reported by Chaterjee SS et al [30].

All the isolates were sensitive to vancomycin and linezolid which is in agreement with other studies by Sharma Y et al and Goyal et al [27, 28]. However, the vancomycin MIC of over 55% of our isolates was in the range of 1-2 µg/mL. There is a possibility that these isolates could represent hVISA strains. Sakoulas G et al have shown that, the increasing vancomycin MIC, though within the susceptible range, was associated with a significant risk of vancomycin treatment failure in MRSA bacteremia [31]. Lodise TP et al and Sariano A et al have reported that, a higher clinical failure was associated with vancomycin MIC ≥ 1.5 µg/ml [32, 33]. The high vancomycin MIC values observed in our study are of great concern, as this might have effect on the success of treatment with vancomycin.
Multidrug resistance was observed in 44.44% of isolates, which is slightly higher than other reports from India [25, 27, and 34]. The higher rate of MDR in our study may be due to selection pressure owing to the uncontrolled use of antibiotics in the community. Our patients might have a history of admission to hospital in the past one year and hence may represent the carriage of hospital acquired strains which are usually more resistant to several antibiotics compared to the community acquired MRSA [35].

Our study has several limitations. The relatively small number of cases included in the study is a major drawback. The nasal cultures may underestimate the real prevalence of MRSA colonization, as it can also be found on other parts of the body as well. Lastly, though we screened the patients on admission to our hospital, we have not considered any previous contact with any other health care settings and hence these cases can represent carriage of hospital acquired strains rather than community acquired ones. Further studies are needed to confirm this.

CONCLUSION

Our study revealed a high rate of MDR among MRSA colonizing the anterior nares. This is of great concern, as the infection caused by such isolates is not only difficult to treat but also can increase the morbidity and mortality. We recommend preoperative screening for nasal colonization by MRSA among all the patients undergoing major heart surgeries, so that timely measures can be taken to prevent endogenous postoperative infections and to interrupt the transmission of such isolates to the health care workers as well as to other patients.

REFERENCES


