Original article

Study of nasal carriage of Staphylococcus aureus among health care workers of a rural tertiary health care centre

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Abstract:
Background: Staphylococcus aureus is an important cause of nosocomial infections. Health care workers carrying Staphylococcus aureus can be a potential source of infection to the patients. It has also been considered an important risk factor for infections in carriers

Material and methods: Nasal swabs of Health care workers were collected aseptically and cultured using standard microbiological methods. Antibiotic susceptibility was done by disc diffusion method as per CLSI guidelines.

Results: Out of 192 samples, Staphylococcus aureus was isolated from 28 (14.58%). Of these 24 were MSSA (Methicillin sensitive Staphylococcus aureus) and 4 MRSA (Methicillin resistant Staphylococcus aureus). So MSSA carriage was 12.5% and MRSA carriage was 2.08%. All isolates sensitive to mupirocin (5µg), Rifampicin (5µg) and vancomycin. Penicillin (0%) and tetracycline (35.71%) were least sensitive antibiotics.

Conclusion: Nasal carriage of Staphylococcus aureus among Health care workers is a cause of concern. Continuous surveillance and strategies to interrupt transmission should be implemented.

Keywords: Nasal carriage, MRSA, MSSA, Staphylococcus aureus, Health care workers

Introduction

Staphylococcus aureus is a major nosocomial pathogen that causes a range of diseases, including endocarditis, osteomyelitis, pneumonia, toxic shock syndrome, food poisoning and boils.[1]

In 1940’s penicillin was the drug of choice for staphylococcal infections. But very soon resistance to penicillin was reported from various countries. Methicillin (penicillinase resistant penicillin) was first introduced in 1959 for treatment of infection due to penicillin resistant strains of Staphylococcus aureus. Unfortunately in 1960 there was first report of methicillin resistance in Staphylococcus aureus (MRSA) from Europe[2].

Now MRSA are responsible for majority of Staphylococcus aureus infections with increasing morbidity and mortality globally. The nosocomial MRSA strains (HA-MRSA) is a significant problem in Indian hospitals.[2] In addition to these HA-MRSA now community acquired (CA-MRSA) strains also poses a significant threat to public health. CA-MRSA isolates are more virulent, spread quickly and can cause more severe infections than HA-MRSA.[3,4]

Initially for MRSA infections MLS B (macrolid, lincosamide, streptogramin) family of antimicrobials were used frequently. But widespread use of MLS B family of antimicrobials has led to the emergence of resistance to these.[5]

Some MRSA strains are only sensitive to glycopeptides. But in the past 10 years there are reports of reduced susceptibility to vancomycin or glycopeptides in Staphylococcus aureus (VISA or GISA) and vancomycin resistance in Staphylococcus aureus (VRSA).[4] Staphylococcus aureus can colonize healthy individuals. The anterior nares have been shown to be the main reservoir of Staphylococcus aureus in...
both children and adults. These individuals are at risk of developing infection or can transmit the pathogen to others [5].

Within the hospital colonized health care workers act as a reservoir for the spread of Staphylococcus aureus to uncolonized susceptible patients. The Staphylococcus aureus is transmitted to nares by contaminated hands and from surfaces where it can survive for months. [6,7,8]

Decolonization of nasal and extra nasal sites on hospital admission may reduce this risk. [9]

This study is an attempt to find out the prevalence of nasal carriage of Staphylococcus aureus and its sensitivity pattern particularly methicillin resistance among health care workers of rural tertiary health care centre.

Material and methods

The study was conducted in the Department of Microbiology, JNMC & AVBRH, Sawangi (M) Wardha from Jan 2013 – Mar 2013. Healthy health care workers not suffering from any upper respiratory tract infection and who have not received any antibiotics for the past 30 days were selected for the present study.

This includes 192 Health care workers (nursing staff, attendants, food handlers, laboratory personnel) working in the Acharya Vinoba Bhave Rural Hospital, Sawangi (Megahe).

After explaining the details of the proposed project, letter of informed consent signed by each volunteer was obtained. A proforma including age, sex, health status and relevant data was collected from each volunteer.

Collection of samples-Presterilized swabs moistened with sterile saline were used for sample collection. The swabs were rubbed very well by rotating 5 times over the inner wall of the ala and nasal septum of both nostrils and transported to Microbiology laboratory within 2 hour for processing. All the swabs were processed as per CLSI guidelines.

Processing of samples

The nasal swabs were cultured on Mannitol Salt agar (selective medium for Staphylococcus aureus) within one hour after collection by streaking as per the conventional technique. The culture plates were incubated at 37°C for 24-48 hours in the incubator. The volunteers whose swabs show suspected Staphylococcus aureus colonies (yellow colonies surrounded by yellow medium due to mannitol fermentation) were called again to collect 2nd swab. This time swabs were inoculated on nutrient agar, blood agar and Mannitol Salt agar. The culture plates were incubated at 37°C for 24-48 hours in the incubator. Colonies were identified as per standard microbiological methods. Isolates which were β- haemolytic, mannitol fermenting, golden yellow pigment producing and tube coagulase test positive were subjected to further processing.

Antibiotic susceptibility testing:

All the Staphylococcus aureus isolates were subjected to in vitro antibiotic susceptibility testing method by disc diffusion on Muller-Hinton agar as per CLSI (Clinical and Laboratory Standards Institute) guidelines.

Antibiotic discs and Ezy MIC Strips from Himedia ltd, Mumbai were used.

Interpretation of antibiotic susceptibility was done using Himedia interpretation chart and following CLSI guidelines. [10]

Phenotypic detection of MRSA was done using cefoxitin disc method and oxacillin MIC testing using Ezy MIC Strips. Isolates with Zone ≤ 21 mm for cefoxitin and MIC for Oxacillin ≥ 4 were labelled methicillin resistant and those with Zone ≥ 22 mm for cefoxitin and MIC for Oxacillin ≤ 2 as Methicillin sensitive.
In all the isolates resistant to erythromycin (zone size ≤13mm) clindamycin sensitivity is interpreted by placing Erythromycin (15 μg) disc at a distance of 15mm (edge to edge) from clindamycin (2 μg).

1. MS Phenotype - sensitive to clindamycin (zone size ≥21mm) and giving circular zone of inhibition around clindamycin
2. Inducible MLS\textsubscript{B} Phenotype - sensitive to clindamycin (zone size ≥21mm) and giving D shaped zone of inhibition around clindamycin with flattening towards erythromycin disc.
3. Constitutive MLS\textsubscript{B} Phenotype - clindamycin (zone size ≤14mm) with circular shape of zone of inhibition if any around clindamycin

**Observations**
The nasal MSSA/MRSA carriage was investigated in 192 health care workers. These includes staff form laboratory (30), wards(104), Intensive care units (28), Operation Theatre(25) and food handlers(5).

Among 192 samples studied 28 (14.58%) were positive for Staphylococcus aureus. Highest rate of Staphylococcus aureus carriage was seen among central clinical laboratory staff (30.77%) followed this in orthopaedic ward (23.08%). Table 1 shows staphylococcus aureus carriage among health care workers in study group.

Antibiotic Sensitivity of all 28 isolates was done by disc diffusion testing. Sensitivity pattern is depicted in Table 2.

So in the present study MSSA carriage was 12.5% and MRSA carriage was 2.08%.

Erythromycin resistance was seen in 7(25%) isolates. Among these 6 were clindamycin sensitive (MS Phenotype) and 1 resistant (Inducible MLS\textsubscript{B} Phenotype) Penicillin(0%) and tetracycline(35.71%)were least sensitive antibiotics.

All 28 strains were sensitive to mupirocin(5μg), Rifampicin(5 μg) and vancomycin.

Table No 1: Staphylococcus aureus carriage among health care workers

<table>
<thead>
<tr>
<th>Working area</th>
<th>Position held</th>
<th>No of samples processed</th>
<th>No. Of patients with nasal colonisation of Staphylococcus aureus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microbiology laboratory</td>
<td>Laboratory technicians/attendants</td>
<td>17</td>
<td>1(5.88%)</td>
</tr>
<tr>
<td></td>
<td>Residents</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Laboratory technicians/attendants/ clerks</td>
<td>13</td>
<td>4(30.77%)</td>
</tr>
<tr>
<td>Central clinical laboratory</td>
<td>Laboratory technicians/attendants</td>
<td>28</td>
<td>4(14.29%)</td>
</tr>
<tr>
<td>ICU</td>
<td>Staff nurse/attendants</td>
<td>28</td>
<td>4(14.29%)</td>
</tr>
<tr>
<td>OT</td>
<td>Staff nurse/attendants</td>
<td>25</td>
<td>3(12%)</td>
</tr>
<tr>
<td>Orthopedic ward</td>
<td>Staff nurse/attendants</td>
<td>13</td>
<td>3(23.08%)</td>
</tr>
<tr>
<td>Surgery ward</td>
<td>Staff nurse/attendants</td>
<td>39</td>
<td>5(12.82%)</td>
</tr>
<tr>
<td>Gynaecology ward</td>
<td>Staff nurse/attendants</td>
<td>42</td>
<td>6(14.29%)</td>
</tr>
<tr>
<td>Paeds ward</td>
<td>Staff nurse/brother/mausi</td>
<td>10</td>
<td>2(20%)</td>
</tr>
<tr>
<td>All wards</td>
<td>Food handlers</td>
<td>5</td>
<td>0(0%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>192</td>
<td>28(14.58%)</td>
</tr>
</tbody>
</table>
Table No 2: Sensitivity pattern of Staphylococcus aureus isolates

<table>
<thead>
<tr>
<th>Antibiotics</th>
<th>Penicillin(10U)</th>
<th>Tetracycline(30 µg)</th>
<th>Erythromycin(15µg)</th>
<th>Chloramphenicol(2 µg)</th>
<th>Cotrimoxazole(25 µg)</th>
<th>Ciprofloxacin (5 µg)</th>
<th>Rifampicin(5 µg)</th>
<th>Mupirocin(5 µg)</th>
<th>Vancomycin(30 µg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N=28</td>
<td>0</td>
<td>10</td>
<td>21</td>
<td>27</td>
<td>14</td>
<td>20</td>
<td>28</td>
<td>28</td>
<td>28</td>
</tr>
<tr>
<td>%</td>
<td>0</td>
<td>35.71</td>
<td>75</td>
<td>96.43</td>
<td>50</td>
<td>71.43</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

**Discussion**

Nasal carriers of Staphylococcus aureus among health care workers can propagate these pathogens to other healthy personnel and patients. Our study shows an Staphylococcus aureus prevalence of 14.58%. Prevalence of nasal carriage among different study population ranges from 4.3% to 62.14%.(6-14) Higher carriage rates of 40-65% were quoted among health care workers in Indian hospitals (7,14). In community base studies it was found to be higher in school going children than in preschool children and in adults,(6,9,11) Our study finding correlates with studies in China among health care workers 15.4% and in Turkey among midwifery students 17.03%(13,14). Lower prevalence compared to other Indian teaching rural tertiary care hospitals may be because of strict hospital infection control practices that we are following.

Highest rate of Staphylococcus aureus carriage seen among central clinical laboratory staff in our study might be because of contact with large number of outdoor patients and handling large number of infected samples. High carriage was also observed in nursing staff of orthopaedic ward in the present study might be because of cross infection during patient care as Staphylococcus aureus is the most common cause of wound infections from orthopaedic ward.

The prevalence of MRSA nasal carriage was 2.08% in the present study. MRSA carriage in different study population was reported in the range of 0.16% to 40%. (6-14) the prevalence of nasal MRSA carriage in our study was significantly lower than previously reported from different cities in India including in Aligarh (21.43%) and Bagalkot, Karnataka (40.28%).[7,14] Our results are comparable with that of other countries like turkey (2.96%), China (3%).(13,14)

The overall susceptibility test results showed penicillin and tetracycline to be least effective drugs with sensitivity of 0% and 35.71%. Due to indiscriminate use of penicillin across the globe high resistance has developed in staphylococcus aureus against penicillin thus susceptibility was found very low in various studies like in Serbia it was 3.22% [6] and in china it was 3.5%. [13]

Our study also demonstrated sensitivity of 50% to cotrimixazole, 71.43% to ciprofloxacin and 75% to erythromycin. This finding is in aggrement with another study conducted at community based study at Srinagar and Chandigarh. (11,15). Our finding
contradicts the finding of study at China where sensitivity to cotrimoxazole was 7%.(13)
Our finding of high rate of sensitivity to clindamycin correlates with findings of studies on nasal isolates of Staphylococcus aureus at Srinagar, Ujjain and Chandigarh.(8,11,15)
Susceptibility to rifampicin, mupirocin and vancomycin was found to be 100%. Thus these antibiotics emerge as the best alternatives for the treatment of staphylococcus aureus infections. This result is in agreement with many other studies conducted across India. [11,15]

**Conclusion:**
Nasal carriage of Staphylococcus aureus by health care workers is a major threat for public health. There is need of continuous surveillance programme to reduce Staphylococcus aureus-olonisation in health care centres.
To reduce the prevalence and antimicrobial resistance emphasis should be given on following hospital infection control practices. Antibiotic policy should be strictly followed and antibiotic abuse discouraged.

**Acknowledgment**
We are highly thankful to Department of community medicine for help in collection of samples. We are also thankful to Mr. Swapnil and Mrs. Swati technicians department of microbiology for technical support.

**Figure I:** Screening of nasal swabs using Mannitol salt agar

Sample A- Colonies of Staphylococcus aureus

**Figure II:** MIC Testing for oxacillin and vancomycin using Ezy MIC Strips

**References**


10. Wayne, PA: Clinical and Laboratory Standards Institute (CLSI) guidelines 2012: Performance standards for antimicrobial susceptibility testing; Seventeenth information supplement; M100-S22 January 2012; Vol.32 No. 3.


