Screening of nasal carriage for *Staphylococcus aureus* and their resistance to oxacillin and cefoxitin among medical students in Karbala University

Suhad Hadi Mohammed, Mohammed Neama Hmood, Areej Abbas Abd, Seham Aaid Obaid, Baraa Ahmed Fahad & Fatemah Hadi Kadhem

**Objective**

Carriage of *Staphylococcus aureus*, especially methicillin-resistant *S. aureus* (MRSA) is a problem within healthcare organizations and in the community. The aim of the study was to screen *S. aureus* carriage and their susceptibility to cefoxitin and oxacillin among medical students.

**Methods**

A total of 100 nasal swabs were collected. Isolation and identification of the isolate as *S. aureus* was done using Gram stain, coagulase test and catalase test. *S. aureus* isolates were confirmed as MRSA using cefoxitin (30 μg) disc and oxacillin (30 μg) disc by Kirby-Bauer disc diffusion method on Mueller-Hinton agar. From 100 nasal swabs, 76 were coagulase negative *Staphylococcus* and 20 were coagulase positive *Staphylococcus*.

**Results**

From 100 nasal swabs, 76 were coagulase negative *Staphylococcus* and 20 were coagulase positive *Staphylococcus*. From these, 60% and 40% were oxacillin- and cefoxitin-resistant isolates, respectively. The data obtained from this study revealed that there were carriers of MRSA among the medical students.

**Keywords**

MRSA, coagulase, oxacillin, cefoxitin

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**Introduction**

*Staphylococcus aureus* has long been recognized as an important human pathogen. The anterior nares represent the primary ecological reservoir of *S. aureus* in humans, and nasal carriage is a major risk factor for a variety of infections. Three patterns of nasal carriage are known (persistent carrier, intermittent, and non-carrier). Approximately 20% of the individuals almost always carry one type of strain and they are called persistent carriers. A large proportion of the population (60%) harbours *S. aureus* intermittently, and the strains change with varying frequencies. Such persons are called intermittent carriers. Finally, a minority of the people (20%) almost never carry *S. aureus* and they are called non-carriers. A persistent carriage is more common in children than in adults, and many people change their pattern of carriage between the age of 10 and 20 years. The reasons for these differences in the colonization patterns are unknown.

Healthcare workers (HCWs) constitute an important reservoir of *S. aureus*. Several studies have reported that the rate of the nasal carriage of *S. aureus* among the HCWs ranges from 16.8% to 56.1%. The anterior nasal swabs were taken from 100 healthy students from third and fourth stage whom they had internship programme in hospitals during summer from October 2014 to March 2015. Sterile swab was moistened with sterile normal saline and was rotated at least 5 times in both nares, then placed in the transport media, using standard methods.

Specimen Collections

Anterior nasal swabs were taken from 100 healthy students from third and fourth stage whom they had internship programme in hospitals during summer from October 2014 to March 2015. Sterile swab was moistened with sterile normal saline and was rotated at least 5 times in both nares, then placed in the transport media, using standard methods.

Specimens Processing

All specimens were directly inoculated from transport media into plates of Mannitol salt agar (MSA) and blood agar and incubated at 37°C for 24 h (Fig. 1). All colonies from primary cultures were subcultured onto MSA and incubated at 37°C for 24 h. *S. aureus* were identified depending on the morphological features on culture media (beta-hemolytic on blood agar and mannitol fermentation on MSA) and biochemical tests (catalase positive test and coagulase positive by definition, MRSA strains harbours the *mecA* gene, which encodes the low-affinity penicillin-binding protein (PBP) designated as PBP2a.
Detection of oxacillin and cefoxitin resistance in Staphylococcus aureus

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Results
A total of 100 nasal swab samples were collected and screened during this study. From these, a total of 20 (20%) were identified as coagulase positive S. aureus isolates and 80 (80%) were identified as coagulase negative Staphylococci isolates (Table 1). The coagulase positive isolates were then tested to demonstrate their resistances to methicillin by using oxacillin and cefoxitin discs, 8 (40%) were resistant to cefoxitin and 12 (60%) were resistant to oxacillin. There is positive significant correlation between the two drugs (Table 2).

Distribution of the Resistant Strains Among Sex and Age
The prevalence of S. aureus nasal carriage was higher among the older age group individuals (70%) than the younger age group (30%). Concerning the resistance profile, there were 62.5% (5/8) of cefoxitin-resistant isolates, and 66.6% (8/12) of oxacillin-resistant isolates found among the older than the younger volunteers (Table 3). The current study revealed that 62.5% (5/8) of cefoxitin-resistant isolates and 50% (6/12) of oxacillin-resistant isolates were found in females.

Discussion
The primary reservoir of S. aureus in humans is the anterior nares. Nasal carriage is recognized as a major risk factor for the development of both community-acquired and nosocomial infections. This appears to play a key role in the epidemiology and pathogenesis of infection. The factors that distinguish between a carrier and a non-carrier are still unknown. Enhanced adhesion of S. aureus, to cell associated and cell-free secretions, along with the induction of reduced mucociliary activity, could well explain the nasal colonization by S. aureus. It is imperative that nasal carriage due to S. aureus strains should be prevented in order to stem the rate of infection, and in preventing the transmission of resistant strains of the organism.

Although nasal carriage of S. aureus is harmless in healthy individuals, they can become carriers who could pose the risk of spreading infections to the community at large, and since the section of individuals under this study were medical students, their interaction and exposure to hospital environment could cause major risks in transmitting to patients

Table 1. Culture results of nasal swabs

<table>
<thead>
<tr>
<th>Culture results</th>
<th>Isolates</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Culture positive</td>
<td>S. aureus</td>
<td>20 (%)</td>
</tr>
<tr>
<td></td>
<td>Coagulase negative Staphylococci</td>
<td>76 (%)</td>
</tr>
<tr>
<td>Culture positive</td>
<td>Micrococcus</td>
<td>3</td>
</tr>
<tr>
<td>Other bacteria</td>
<td>Bacillus</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 2. Screening for MRSA

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Resistant N (%)</th>
<th>Sensitive N (%)</th>
<th>Total N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxacillin</td>
<td>12 (60)</td>
<td>8 (40)</td>
<td>20 (100)</td>
</tr>
<tr>
<td>Cefoxitin</td>
<td>8 (40)</td>
<td>12 (60)</td>
<td>20 (100)</td>
</tr>
<tr>
<td>Correlation</td>
<td></td>
<td></td>
<td>r = 0.667 P value = 0.001*</td>
</tr>
</tbody>
</table>

MRSA: methicillin-resistant S. aureus. *Correlation significant at 0.01 level.
and spreading nosocomial infections. Therefore, it is necessary to detect \textit{S. aureus} carriage in medical students.

The current study revealed that out of the 100 samples collected from medical students, 96 were identified as \textit{Staphylococcus} while 4 specimens showed no growth of Staphylococcal colonies, instead they showed growth of \textit{Micrococcus} sp. and \textit{Bacillus}. Twenty samples out of 96 (20.8%) were coagulase positive \textit{S. aureus} isolates and 76 (79.1%) were coagulase negative \textit{Staphylococci}.

The prevalence of \textit{S. aureus} carriage has been reported in healthy populations in several countries; 43.2\% of \textit{S. aureus} in nasal cavity of adults in Iraq, 17.3\% in nasal cavity of Turkish children, 36\% in nares of Japanese adults and 32.4\% in nasal cavity of adults in the United States.\cite{5,6,7,8} Pant and Rai’s (2007)\cite{9} findings revealed higher \textit{S. aureus} nasal colonization rate (43.8\%) in staffs of teaching hospital in Nepal. Also, in Abia state of Nigeria, Chigbu and Ezeronye (2003)\cite{10} reported 50\% nasal colonization in both hospital and nonhospital subjects. Chatterjee et al. (2009)\cite{11} showed that the overall prevalence of \textit{S. aureus} nasal colonization was 52.3\%, Whereas Onanuga and Temedie (2011)\cite{12} showed that 33.3\% \textit{S. aureus} isolates were obtained from 120 nares specimens screened. Whilst, Adesida et al. (2007)\cite{13} reported a much lower (14.0\%) nasal colonization in medical students in Lagos, Nigeria. These variations may be attributed to the characteristics of the population under study. A population that is on antibiotics at the time of sampling may yield a much lower prevalence of \textit{S. aureus} while a population from hospital settings may yield a much higher prevalence because of the high prevalence of infectious patients in that environment. Other factors that can cause variations may be sampling and culture techniques.

Concerning the detection of MRSA, all the 20 \textit{S. aureus} isolates were tested for cefoxitin and oxacillin resistance using a disk diffusion method and 60\% and 40\% were found to be susceptible to oxacillin and cefoxitin, respectively. Higher incidence of MRSA was found in another study in Iraq/Baghdad among HCWs and patients in hospital.\cite{14} In another study, resistant percentage was found to be of 90.9\%.\cite{15} Fey et al. (2003)\cite{16} stated that the resistance to meticillin was 81\%, while Jain et al. (2008)\cite{17} observed about 75.26\% of isolates were methicillin-resistant. These observed differences may due to the variation in the geographic area, sources of clinical specimens, genetic background and the collection site of the isolates.\cite{18}

### Conclusion

The data obtained from this study revealed that there were reservoirs or carriers of MRSA in medical students.

Screening for resistant strains of \textit{Staphylococci} in medical students should be adopted as a protocol in medical colleges, in order to curb the spread of drug-resistant \textit{Staphylococcus} from the hospital to the community. This will also help in monitoring the HCWs population who might pose a risk to patients and hospital personnel and the community, at large.

### References

Detection of oxacillin and cefoxitin resistance in *Staphylococcus aureus*

Research

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28. Al-Geobory HA. Comparative study between methicillin resistant *Staphylococcus aureus* (MRSA) and methicillin sensitive *Staphylococcus aureus* (MSSA), and detect the antimicrobial effects of some plant extracts on them [MSc thesis]. Baghdad, Iraq: College of Science, Baghdad University, 2011.
