Incidence of Methicillin-Resistant \textit{Staphylococcus aureus} Infections in Correctional Facilities-Nigeria

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1. Introduction

Methicillin-resistant \textit{Staphylococcus aureus} (MRSA) is a specific strain of \textit{Staphylococcus aureus} bacteria that is resistant to a class of antibiotics related to penicillin, which includes methicillin, oxacillin, penicillin and amoxicillin. MRSA in both healthcare and community associated has become an enormous public health problem\textsuperscript{1,2}. Recently a shift in the epidemiology of MRSA infections have been documented, where by community associated methicillin-resistant \textit{S. aureus} infections have become more common\textsuperscript{3,13}. MRSA is responsible for about 60 percent of skin and soft tissue infections seen in emergency rooms, and invasive MRSA kills about 18,000 people annually\textsuperscript{1,18,19}. It has also been isolated from urine sample\textsuperscript{4}. MRSA is a type of staph that is resistant to a class of antibiotics related to penicillin, which includes methicillin, oxacillin,
penicillin and amoxicillin. Approximately of 1% of people in general are colonized with MRSA, while people receiving certain types of healthcare, such as those receiving dialysis or living in nursing homes, are at increased risk of being colonized with MRSA. Staphylococcal infections are characterized by intense suppurative inflammation of local tissues with a tendency for the infected area to become encapsulated leading to abscess formation. Deverick, reported in his work that over 1.7% of people in general have bacteria isolation of MRSA from urine sample

MRSA (methicillin resistant *Staphylococcus aureus*) strains isolated are on increasing resistant to multiple non-β-lactam containing antimicrobial drugs. The increasing prevalence of MRSA multi-drug resistant strains which limits the therapeutic options available for the management of MRSA associated infections has become a worrisome issue worldwide. Recent report of vancomycin resistant *S. aureus* shows an area of chemotherapy in which effective bactericidal drugs to treat infections with this organism may not be readily available. This resistance is mediated by the mecA gene, chromosomally located in the staphylococcal cassette chromosome (SCCmec), which codes for a penicillin binding protein (PBP)2a with a low affinity for beta lactams. The pathogenicity of *S. aureus* infections is associated with various bacterial surface components (e.g., capsular polysaccharide and protein A), including those recognizing adhesive matrix molecules (e.g., clumping factor and fibronectin binding protein), and to extracellular proteins (e.g., coagulase, hemolysins, enterotoxins, toxic-shock syndrome (TSS) toxin, exfoliatins, and Panton- Valentine leukocidin and MRSA strains being group of *S. aureus* are likely to have one or more of these pathogenicity traits.

2. Material and Methods

2.1 Specimen Collection: Two hundred samples of Mid-stream urine (MSU) were randomly and aseptically collected using universal sterile bottles from male inmates in Kuje medium prison. Samples were transported to the laboratory for microbiological examination in the Department of Microbiology, National Institute of Pharmaceutical Research and Development (NIPRD) Idu Industrial Area, Abuja Nigeria.

2.2 Processing of samples: Specimen was processed within 2hrs of collection by the standard microbiological technique. The samples were inoculated directly on the Phenol red Mannitol salt agar plate incubated at 37˚C for 18-24 hours in aerobic atmosphere. The Colonies formed were selected on the basis of their yellow mannitol fermentation and subculture to obtain pure culture.

2.3 Biochemical test: The following identification processes were carried out according to the method stated in Cheesbrough, 2006. (Table 1)

<table>
<thead>
<tr>
<th>BIOCHEMICAL TEST</th>
<th>REACTION OF TEST ON ISOLATES</th>
<th>RESULTS OF TEST ON ISOLATES</th>
</tr>
</thead>
<tbody>
<tr>
<td>CATALASE TEST</td>
<td>Rapid and sustained appearance of active bubbles</td>
<td>Positive (presence of <em>Staphylococcus aureus</em>)</td>
</tr>
<tr>
<td>COAGULASE TEST</td>
<td>Presence of clotting</td>
<td><em>S. aureus</em> is present</td>
</tr>
<tr>
<td>SUGAR FERMENTATION</td>
<td>Colour change</td>
<td><em>S. aureus</em> is present</td>
</tr>
</tbody>
</table>

2.4 Microscopic characteristic of isolated colonies: The colour and size of the colonies were recorded for identification purpose.

2.5 Gram staining: Gram staining was done according to the method stated in Cheesbrough, 2006.

2.6 Catalase test: This test is used to differentiate those bacteria that produce the enzyme catalase, such as staphylococci from non-catalase producing bacteria such as streptococci.

2.7 Coagulase test: This test is used to identify *S. aureus* which produces the enzyme coagulate.

2.8 Antibiotic Susceptibility Testing: The antibiotic susceptibility tests were carried out using Kirby-Bauer disc diffusion method. Mueller Hinton agar use used and antibiotics (Cloxacillin (30µg), Gentamycin (1 µg), Penicillin–G(10µg), and Vancomycin (30µg)) used were from oxoid. The zone of inhibition s were measured and recorded. (see table 3)

2.9 Statistical Analysis: Microsoft Excel package was used.

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3. Result

Out of the 200 samples collected, 120(60%) were Staphylococcus species. Out of this 120 Staphylococcus species, 97(80.8%) were Staphylococcus aureus and other S. spp (different from aureus) makes 23(19.2%) (See table 2). When the S. aureus isolates were subjected to oxacillin, 80(82.5%) were methicillin resistant. All the MRSA isolated were susceptible to gentamycin, erythromycin and vancomycin. They were however resistant to pencillin and oxacillin.

<table>
<thead>
<tr>
<th>Isolates</th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>S. aureus</td>
<td>97</td>
<td>80.8</td>
</tr>
<tr>
<td>S. spp (different from aureus)</td>
<td>23</td>
<td>19.2</td>
</tr>
<tr>
<td>Total</td>
<td>120</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 2: Incidence of isolates

When the S. aureus isolates were subjected to oxacillin, 80(82.5%) were methicillin resistant. All the MRSA isolated were susceptible to gentamycin, erythromycin and vancomycin. They were however resistant to pencillin and oxacillin.

Table 3: Antibiotic susceptibility profile of the MRSA isolates.

<table>
<thead>
<tr>
<th>Antibiotics</th>
<th>Status</th>
<th>Size of inhibition zone.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penicillin</td>
<td>Resistant</td>
<td>11mm</td>
</tr>
<tr>
<td>Gentamycin</td>
<td>Susceptible</td>
<td>10mm</td>
</tr>
<tr>
<td>Erythromycin</td>
<td>Susceptible</td>
<td>16.2mm</td>
</tr>
<tr>
<td>Vancomycin</td>
<td>Susceptible</td>
<td>18mm</td>
</tr>
<tr>
<td>Oxacillin</td>
<td>Resistant</td>
<td>12mm</td>
</tr>
</tbody>
</table>

4. Discussions

From the results obtained, the overall prevalence rate of MRSA in Kuje prisons is 82.5% which is higher than the report of Ghamba et al.8 who reported 28.0% and the study in Oshogbo (Olowe et al15), and Kano (Nwankwo et al16), which revealed lower prevalence rates of 47.8%, and 28.6% respectively. A similar research carried out in United State also reported an increase in the prevalence with 1.5% of the population colonized Kottler, et al.17 by MRSA over the 1% reported by CDPH.5 Table 2, shows that S. aureus has the highest prevalence with 80.8% isolates, which further agree with the report of Daniyan et al.11 and Onanuga et al.14 that recoded 79.26% and 69.0% respectively. The pathogenicity of S. aureus infections is associated with various bacterial surface components (e.g., capsular polysaccharide and protein A), including those recognizing adhesive matrix molecules (e.g., clumping factor and fibronectin binding protein), and to extracellular proteins (e.g., coagulase, hemolysins, enterotoxins, toxic-shock syndrome (TSS) toxin, exfoliatins, and Panton-Valentine leukocidin8 and MRSA strains being group of S. aureus are likely to have one or more of these pathogenicity traits.

The higher prevalence in this study can be associated to low of proper hygiene among the inmates in the prison. As the major means of transmission is contact with an infected persons, contaminated object or through air.20, 21. It is thus recommended that more orientation on importance of hand wash and sterilization of clinical equipment should be done.

5. Conclusion

Prevalence of Methicillin-resistance Staphylococcus aureus is high in this study making MRSA to remains a clinically important isolate from virtually any location, including urine.18. Most outbreaks of MRSA involve CA-MRSA rather than HA-MRSA. Thus monitoring the SCCmec type is important in determining the epidemiologic trends of MRSA strains in correctional facilities. In order to eradicate the spread and transmission of these CA-MRSA strains rapid diagnostics test are used to detect virulent strains of MRSA that have to be implemented for successful identification and treatment of these strains in hospital and from communities. The correct implementation of hospital infection procedures need to be taken to prevent the spread and outbreaks of MRSA among inmates.

Reference


