Predominance of Capsular Polysaccharide Type 5 among Oxacillin-Resistant Staphylococcus aureus

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The relationship between capsular polysaccharide types 5 and 8 and resistance of Staphylococcus aureus to oxacillin was studied with a collection of 406 clinical isolates from six French hospitals. Of 175 type 5 isolates, 84 (48%) were resistant to oxacillin. In contrast, only 8 of 160 type 8 isolates (5%) and 5 of 71 nontypeable isolates (7%) were resistant to oxacillin. Therefore, capsular typing of clinical isolates of S. aureus may facilitate the choice of first-line antibiotic therapy.

Capsular polysaccharides (CPs) have been identified in clinical isolates of Staphylococcus aureus, and a method for the serological typing of the CPs with polyclonal rabbit antisera has been proposed (8). Surveys of clinical isolates with polyclonal (1, 11) or monoclonal (6) antibodies have shown the predominance of types 5 and 8.

Methicillin resistance of S. aureus was reported shortly after the introduction of methicillin (3, 7). Staphylococcus aureus isolates that are resistant to semisynthetic penicillins, such as oxacillin and methicillin, became a rapidly emerging clinical and epidemiological problem (2, 5).

In this study we investigated whether a capsular type predominates among oxacillin-resistant clinical isolates of S. aureus.

MATERIALS AND METHODS

Bacteria. From May through September 1986, 406 clinical isolates of S. aureus were collected from six hospitals in Paris, Clamart, and Tours, France. The organisms were isolated either from blood cultures (42 isolates) or from purulent or inflammatory processes (364 isolates). Each isolate was from a single patient, and only coagulase-positive isolates were included.

CP typing. Bacteria were grown overnight at 37°C on Columbia agar (Difco Laboratories, Detroit, Mich.) slants. The bacterial cells were suspended in 2 ml of phosphate-buffered saline (pH 7) and autoclaved at 121°C for 60 min. After centrifugation, the supernatants were retained and stored at −20°C.

CPs were detected in these supernatants by inhibition of an enzyme-linked immunosorbent assay using CPs of types 5 and 8 (4) and the corresponding monoclonal antibodies (6).

Determination of MICs of oxacillin. The MICs of oxacillin were determined by twofold dilution of the drug in Mueller-Hinton agar (Difco). Final concentrations ranged from 0.025 to 256 mg of oxacillin (Bristol Laboratories, Paris, France) per liter. Stationary-phase broth cultures were diluted 1 in 100 in order to deliver ca. 10⁶ organisms to each plate with a Steers replicator (12). The plates were incubated at 30°C and evaluated after 24 and 48 h. S. aureus ATCC 25923 was used as a control strain.

RESULTS

Capsular types of S. aureus from different sources. Among 406 isolates tested, 175 (43%) contained type 5 CP, 160 (39.5%) contained type 8 CP, and 71 (17.5%) were nontypeable with monoclonal antibodies specific for type 5 or type 8 CP. Although variations were observed in the distribution of type 5 and type 8 CPs within the individual hospitals, these variations were not considered significant. The distribution of capsular types among isolates from purulent or inflammatory processes was not essentially different from that among organisms isolated from blood cultures. However, nontypeable strains were less frequent among isolates from blood (7%) than among isolates from purulent or inflammatory processes (19%).

Capsular types and resistance to oxacillin. Among the 406 isolates tested, 309 (76%) were found to be susceptible to oxacillin (MIC <2 mg/liter) and 97 (24%) were resistant (MIC >16 mg/liter). No intermediate MICs were observed.

The capsular types of the S. aureus isolates were analyzed in relation to oxacillin resistance (Table 1). Forty-eight percent of capsular type 5 isolates were resistant to oxacillin, compared with only 5% of capsular type 8 isolates and 7% of nontypeable isolates. Among 97 isolates resistant to oxacillin, 84 (87%) were found to have type 5 CP. There was no apparent difference in distribution that was related to the geographical or clinical origin of the strains (data not shown).

DISCUSSION

The existence of CPs in clinical isolates of S. aureus has been established (1, 6, 11). Eleven serologically distinct CP types have been proposed (8, 11), and type 8 CP has been characterized chemically and immunologically (4). Immuno-electron microscopical visualization of CP types 5 and 8 has been achieved by using the corresponding monoclonal antibodies (6). This study revealed variation in the degree of bacterial encapsulation depending upon the culture conditions, and this observation may explain the controversies...
TABLE 1. Relationship of capsular type to resistance of S. aureus clinical isolates to oxacillin

<table>
<thead>
<tr>
<th>Capsular type</th>
<th>Oxacillin susceptible</th>
<th>Oxacillin resistant</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>91 (52)</td>
<td>84 (48)</td>
</tr>
<tr>
<td>8</td>
<td>152 (95)</td>
<td>8 (5)</td>
</tr>
<tr>
<td>Nontypeable*</td>
<td>66 (93)</td>
<td>5 (7)</td>
</tr>
</tbody>
</table>

* Neither type 5 nor 8.

concerning the existence of true capsules or microcapsules in S. aureus.

Using these monoclonal antibodies, we confirmed the predominance of capsular types 5 and 8 among clinical isolates of S. aureus previously shown in the United States (1) and Europe (6, 11). In contrast to the observation that the distribution of capsular types 5 and 8 among isolates from purulent or inflammatory processes was not essentially different from the distribution among organisms isolated from blood cultures, we found that nontypeable isolates, isolates which either do not elaborate CP or elaborate CP belonging to other types, were less frequent among isolates from blood. This finding is consistent with studies indicating that CPs confer invasive properties to encapsulated bacteria (10).

The susceptibility to oxacillin of 95% of the S. aureus isolates of capsular type 8 and the predominance of capsular type 5 among oxacillin-resistant S. aureus isolates were the most striking findings of this study. The previously published observation that capsular type 5 was more frequent among nosocomial isolates than among isolates from community-acquired infections (1) and more frequent among isolates from hospital staff carriers than among isolates from community carriers (11) could be due to the fact that oxacillin-resistant S. aureus is isolated mainly in hospitals (5). These observations suggest that the predominance of capsular type 5 among oxacillin-resistant S. aureus in this study of isolates from France may be similar to what has been observed in Israel (11) and the United States (1).

The predominance of capsular type 5 among oxacillin-resistant S. aureus might be explained by the clone concept in epidemiology (9), but further characterization of these isolates, e.g., by bacteriophage typing, and epidemiological studies appear necessary to clarify this issue.

Capsular typing was performed in this study by enzyme-linked immunosorbent assay, which is very sensitive but is not a rapid procedure. In preliminary experiments, latex particles sensitized with monoclonal antibodies to CPs allowed us to determine the capsular type from the primary culture plate in a few minutes. This technique together with the observations that capsular type 5 is predominant among oxacillin-resistant S. aureus and that type 8 and nontypeable isolates are much less frequently resistant to oxacillin may facilitate the choice of first-line antibiotic therapy.

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LITERATURE CITED