Clinical validation for oxacillin susceptibility testing of coagulase negative staphylococci

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Coagulase negative staphylococci (CNS) are an uncommon cause of deep seated infection in children; most such infections occur among children in hospital, those with complicated medical disorders, or those with prosthetic devices. The treatment of invasive CNS infections is complicated as these bacteria are often resistant to β-lactamase resistant penicillins. Hence, vancomycin is usually administered before susceptibility testing is available. For one such infection is suspected, and prosthetic devices are often removed or revised in order to secure a good outcome. In addition, it has been recognised that patients who suffer from infections with seemingly susceptible CNS, as assessed by conventional in vitro susceptibility testing methods, may not have good bacteriological or clinical outcomes as such methods do not reliably detect in vivo resistance in the bacterial population.

Although staphylococci may produce β-lactamase enzyme which degrades penicillin, it is not active against antistaphylococcal semisynthetic β-lactam agents. The mechanisms of resistance to the latter antibiotics involve alterations to penicillin binding proteins, which renders the antibiotic unable to interfere with cell wall synthesis. In a population of resistant bacteria, a variable proportion may express such resistance, and hence are “heteroresistant”, posing problems for resistance determination.

In order to encourage appropriate use of β-lactam antibiotics for CNS infections, several approaches have been proposed to improve in vitro susceptibility testing performance. These techniques aim to show heteroresistance by phenotyping or finding resistance genes by molecular techniques. In this report, we illustrate the application of one such technique to the successful treatment of six patients with invasive CNS infections.

METHODS AND RESULTS
Bacterial isolates were obtained from a variety of sources (table 1). Each infection was of an invasive nature which would commonly merit prolonged antibiotic treatment. Bacterial isolates, identified initially only as CNS, were examined for purity before being subjected to susceptibility testing. Subsequent speciation with APISStaph (bioMérieux, France) revealed that all were Staphylococcus epidermidis except for one that was Staphylococcus lugdunensis (patient 6). Initial assessment included critical agar dilution testing with oxacillin (6 mg/l oxacillin in Mueller–Hinton agar with 2% NaCl supplementation and 24 hours incubation). This assessment was undertaken with standard methods and control organisms. All the isolates were susceptible in this assay. For confirmatory testing, the isolates were assessed by Etest (on Mueller–Hinton agar with 2% added NaCl) according to the manufacturer’s instructions (AB BIODISK); minimum inhibitory concentrations (MICs) were determined according to standard criteria as recommended by the manufacturer. Oxacillin MICs ranged from 0.2 to 2.0 mg/l. In order to determine the presence of oxacillin heteroresistance, the zone of bacterial inhibition from Etest was examined carefully at 24 and 48 hours. Any suspect colony was transferred to confirm bacterial growth and then reassessed by Etest. Resistant CNS colonies are scant and usually pin-point; the repeat Etest thereafter can identify whether the isolate has an MIC greater than 6 mg/l.

No such colonies were found after Etest screening of the isolates from these patients, thus reconfirming the susceptibility as initially determined by critical agar dilution.

Table 1 details some characteristics of these six patients and their infections. All patients had serious and invasive infections, and all patients had preceding or existing illnesses which either complicated the treatment course or put them at risk of CNS infection. Given the clinical presentations, these patients all received an initial course of antibiotics, usually as an empirical regimen for presumed infection. Each went on to complete long term treatment with cloxacillin. Patient 1 continued to yield positive cultures for CNS from the external ventricular drain until intravenous cloxacillin was initiated. Patient 3 was treated with intravenous and subsequently oral cloxacillin; oral use was followed by demonstration of peak serum bactericidal activity of 1/256. Patient 4 continued to have positive blood cultures throughout the time that intravenous vancomycin was being administered despite adequate serum peak and trough levels (34–35 mg/l and 10–17 mg/l respectively). Blood cultures became negative only after intravenous cloxacillin was administered. Patient 5 also had consistently positive blood cultures despite receiving intravenous vancomycin, but therapy was complicated by the intermittent dosing required for intermittent haemodialysis and dose adjustment during treatment of active and advanced renal failure. A specific lumen of a multilumen vascular access device was thought to be colonised by and acting as the source of CNS infection. Blood cultures became negative within two days of commencing intravenous cloxacillin treatment despite leaving the central venous catheter in situ throughout the treatment period.

DISCUSSION
The mechanisms of oxacillin resistance in CNS are similar to those in methicillin resistant Staphylococcus aureus (MRSA).

Abbreviations: CNS, coagulase negative staphylococci; MIC, minimal inhibitory concentration; MRSA, methicillin resistant S aureus
Oxacillin susceptibility testing of coagulase-negative staphylococci

Well; no further drainage

IV cloxacillin and gentamicin for 10 days; oral cephalexin for 2 weeks; external drain left in place until drainage subsided

Characteristics of patients and salient features of their infections

Table 1

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age</th>
<th>Gender</th>
<th>Isolate source</th>
<th>Infection</th>
<th>Cofactors</th>
<th>Initial therapy</th>
<th>Completion therapy</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4 y</td>
<td>M</td>
<td>CSF</td>
<td>CSF and extraventricular drain</td>
<td>Previous cranial surgery; recent intracranial bleed; Renal transplant; immunosuppression; SLE; abscess also yielded viridans streptococci</td>
<td>IV cefotaxime and IV vancomycin for 2 days</td>
<td>IV cloxacillin for 6 days; extraventricular drain removed</td>
<td>Well</td>
</tr>
<tr>
<td>2</td>
<td>18 y</td>
<td>F</td>
<td>Renal abscess</td>
<td>Post-surgical abscess (renal transplant)</td>
<td>IV ampicillin and IV cefazolin for 2–3 days</td>
<td>IV cefotaxime for 2 days and IV vancomycin for 10 days</td>
<td>IV cloxacillin for 8 days; oral cephalexin for 2 weeks; external drain left in place until drainage subsided</td>
<td>Well</td>
</tr>
<tr>
<td>3</td>
<td>10 wk</td>
<td>M</td>
<td>Blood and mitral valve</td>
<td>Endocarditis</td>
<td>IV cefotaxime and IV vancomycin for 7 days</td>
<td>IV cefotaxime for 2 days and IV vancomycin for 10 days</td>
<td>IV cloxacillin for 3 weeks</td>
<td>Well</td>
</tr>
<tr>
<td>4</td>
<td>18 y</td>
<td>F</td>
<td>Blood</td>
<td>? Endocarditis and other multiple physical anomalies</td>
<td>IV cefotaxime and IV vancomycin for 7 days</td>
<td>IV cefotaxime for 2 days and IV vancomycin for 10 days</td>
<td>IV cloxacillin for 4 weeks</td>
<td>Well</td>
</tr>
<tr>
<td>5</td>
<td>12 y</td>
<td>M</td>
<td>Blood</td>
<td>Febrile intraventricular infection but unknown focus</td>
<td>IV ampicillin and IV cefotaxime for 2 days</td>
<td>2 doses IV vancomycin</td>
<td>IV cloxacillin for 10 days</td>
<td>Well</td>
</tr>
<tr>
<td>6</td>
<td>6 mth</td>
<td>M</td>
<td>CSF and ventriculoperitoneal shunt</td>
<td>CSF</td>
<td>IV cefotaxime and IV vancomycin for 11 days</td>
<td>IV cefotaxillin and gentamicin for 10 days</td>
<td>IV cloxacillin for 3 weeks; oral cephalexin for 2 weeks; external drain left in place until drainage subsided</td>
<td>Well</td>
</tr>
</tbody>
</table>

CSF, cerebrospinal fluid; IV, intravenous; SLE, systemic lupus erythematosus.
Child protection registers and the accident and emergency department

Several national bodies and government departments have stated that it is important that accident and emergency (A&E) department should have ready access to child protection registers. A survey of UK A&E departments (G Quin and R Evans. Emergency Medicine Journal 2002;19:136–7) has shown considerable variation in the method of access, criteria for checking, and satisfaction with access to the register.

A postal questionnaire was sent to consultants in 254 major A&E departments and 190 questionnaires (75%) were returned. The most common way of accessing the child protection register (48% of departments) was via the duty social worker but this is time consuming and restricts the number of children who can be checked. One third of departments had access to a copy of the register, (computerised in half of them). Eighteen per cent of departments used combined means of access (social worker plus copy or social worker plus police) or other means. Satisfaction with the means of access was expressed by most consultants using computerised or hard copies of the register (82% and 66% respectively) but by only half of those using only the duty social worker or combined methods. Access to a copy of the register provided only local, and often out of date, information.

Thirty per cent of departments checked all children against the register and the rest either checked children with specified risk factors or relied on staff suspicion of child abuse. Departments with their own copy of the register tend to check all children but distributing copies could put confidentiality at risk. Registration is neither sensitive nor specific for current abuse (many children with nonaccidental injury will not be on the register and children on the register may have accidental injuries). On the other hand about 7% of children put on the register in 1982 were reinjured within a year.

Which policy is the best for the protection of children is not known. It is suggested that outcomes should be compared between departments using different methods.