Presumed Endocarditis Caused by BRO β-Lactamase-Producing
Moraxella lacunata in an Infant with Fallot’s Tetradius

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A case of presumed endocarditis caused by Moraxella lacunata in a 15-month-old male infant with Fallot’s tetrad is described. This infection may have occurred as the result of transmission of this organism between the father and his son. This is the first report of BRO β-lactamase-producing M. lacunata causing presumed endocarditis.

CASE REPORT

On 13 January 2001, a 15-month-old male infant was admitted to Funabashi Medical Center, having had a fever of 38 to 39°C for 5 days. There was a history of severe pulmonary stenosis with Fallot’s tetrad and dextrocardia requiring left and right modified Blalock-Taussig shunt operations at 2 and 14 months, respectively. Due to bronchomalacia 2 months after birth, artificial respiration was utilized for approximately 3 months.

Physical examination revealed a 40.5°C temperature, a pulse of 182 beats/min, and a blood pressure of 95/72 mm Hg. A grade II/VI continuous murmur was audible at the left mid-clavicular line of the first posterior intercostal space. Acute phase parameters were high, with a leukocyte count of 13,800/μl and a C-reactive protein level of 7.9 mg/dl (Fig. 1). Two-dimensional echocardiography did not reveal any vegetation, but a mitral valve insufficiency was detected. Intravenous administration of ampicillin (100 mg/kg of body weight/day) was started as an empirical treatment for suspected infective endocarditis.

Upon admission and before antibiotic therapy was started, a set of blood cultures with a Septi-Chek BHI-S aerobic bottle and a Schaedler anaerobic bottle (Becton Dickinson, Sparks, Md.) yielded penicillin-susceptible Streptococcus salivarius and gram-negative rods. However, two subsequent sets of blood cultures taken 12 h later and on day 3 after admission yielded only gram-negative rods. The gram-negative rods, later identified as Moraxella lacunata (CIP 108000), were penicillinase-producing isolates. No notable bacteria were found from other clinical materials. The therapy was then modified to a combination of ampicillin plus ceftriaxone (100 mg/kg/day), which temporarily reduced the patient’s temperature. Since M. lacunata strains were still recovered from blood cultures collected on days 10 and 13, the ampicillin therapy was discontinued and panipenem-betamipron therapy (80 mg/kg/day) was initiated. This treatment was continued until his discharge on day 42; for the initial 10 days of this treatment, panipenem-betamipron was combined with ceftriaxone. During this period (days 14 to 42; Fig. 1) a total of five sets of blood cultures were taken, all with negative results. The patient’s clinical status improved to a normal level and no mitral regurgitation was observed.

The gram-negative rods grew aerobically on Trypticase soy agar with 5% sheep blood and chocolate agar as nonhemolytic flat colonies after a 37°C incubation. The organism was non-motile; positive for oxidase, catalase, and nitrate reduction; and negative for urease and indole. It was identified as M. lacunata or Moraxella nonliquefaciens with profile 5000000 by using the ID Test HN-20 Rapid (Nissui, Tokyo, Japan). Because these species are difficult to differentiate by traditional biochemical methods, a gelatin hydrolysis test was used for discrimination. All of the five isolates showed gelatin hydrolysis capabilities, which could correspond to the description of M. lacunata strains. Partial 16S ribosomal DNA sequencing was performed, and the results showed that the organism had a sequence 99% similar to the type strain sequence of M. lacunata ATCC 17967 (GenBank accession number D64049).

MICs as determined by a broth microdilution method (7) using cation-adjusted Mueller-Hinton broth are shown in Table 1. The penicillin MICs for all M. lacunata strains were high, whereas low MICs of ceftriaxone (1 μg/ml) and panipenem (0.016 μg/ml) were noted.

More than 90% of Moraxella catarrhalis strains (10) and some M. nonliquefaciens strains (5) have been found to produce BRO β-lactamase, but to date BRO β-lactamase production by M. lacunata strains has not been reported. In all our isolates, the BRO genes were detected by PCR using the primers described by du Plessis (4).

Currently, M. lacunata (including strains previously identified as M. liquefaciens strains) is rarely isolated (6, 15), although in the past it was frequently isolated as a cause of human conjunctivitis and keratitis (1). Additional rare diseases, such as septicemia (12) and endocarditis (8, 9, 14), have
Aztreonam .................................................................................. 1  
Panipenem .................................................................................. 0.016  
Meropenem ................................................................................  
Imipenem ...................................................................................  
Flomoxef ....................................................................................  
Cefotetan ....................................................................................  
Cefpodoxime ..............................................................................  
Cefepime..................................................................................... 4  
Cefpirome...................................................................................  
Ceftriaxone ............................................................................... 1  
Ceftazidime ............................................................................... 1  
Cefotaxime................................................................................. 1  
Piperacillin.................................................................................. 8  
Amoxicillin-clavulanic acid...................................................... ≤1/0.5  
Cefoperazone-sulbactam........................................................... ≤4/2  
Cefazolin..................................................................................... 16  
Cefotiam ..................................................................................... 8  
Cefotaxime................................................................................... ≤0.5  
Ceftazidime................................................................................. 1  
Ceftriaxone................................................................................ 1  
Cefpirome................................................................................... ≤8  
Cefepime .................................................................................... 4  
Cefpodoxime............................................................................. ≤0.5  
Cefoxitin .................................................................................... ≤2  
Cefmetazole............................................................................... ≤0.5  
Cefotetan................................................................................... ≤0.5  
Flomoxef ................................................................................... ≤2  
Imipenem................................................................................... ≤1  
Meropenem............................................................................... ≤0.5  
Panipenem ............................................................................... 0.016  
Aztreonam ................................................................................ 1

been reported, and they are always associated with penicillin-susceptible isolates. In these previous endocarditis reports, penicillins were utilized for intravenous therapy in the first two cases (8, 9), whereas ceftriaxone was selected as the conventional treatment in the third case (14). In our case, M. lacunata isolates were not effectively eliminated by ceftriaxone, despite a low MIC.

To avoid recrudescence of infective endocarditis, prolonged parenteral treatment for 4 to 6 weeks with the appropriate antibiotic is recommended for complete eradication of infecting organisms (2). Panipenem-betamipron, a parenteral carbapenem with broad-spectrum coverage including β-lactamase-producing species, has been confirmed to be safe in a pediatric population (13). In addition, a 30-day treatment with panipenem-betamipron has shown effectiveness against infective endocarditis caused by penicillin-resistant Streptococcus pneumoniae in a pediatric patient with a congenital ventricular septal defect (11). In our case, a 4-week panipenem-betamipron therapy resulted in successful eradication of M. lacunata, and recrudescence following therapy did not occur.

Since this report is on a unique case of presumed endocarditis caused by a BRO β-lactamase-producing M. lacunata, we tried to detect this organism in family members, with informed consent, to clarify its possible transmission route. Culturing conjunctival secretions from the father, mother, and brother taken at the time of patient discharge yielded M. lacunata (CIP 108001) only for the specimen from the 28-year-old father. This isolate was identical to the infant’s strain both in biochemical profile and the presence of the BRO gene. To compare five strains from the patient and one strain from the father and to investigate their genetic relationship, ribotyping (3) using the RiboPrinter (Qualicon Inc., Wilmington, Del.) was performed. Figure 2 shows a clustering analysis result obtained with ribotype patterns of a representative M. lacunata strain from the infant isolates, the father strain, and some Moraxellaceae collection strains. The two M. lacunata strains clearly had the same fingerprint pattern and could be considered identical. On the basis of these findings, the presumed endocarditis of this patient due to M. lacunata may have occurred as a result of a transmission of this organism from the father to the infant; alternatively, the organism could have been transferred from the son to the father. Moreover, the possibility of another common source could not be excluded.

![Table 1: Antibiotic susceptibilities of BRO β-lactamase-producing M. lacunata isolated from an infant](image-url)

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>MIC (µg/ml)</th>
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<tbody>
<tr>
<td>Penicillin G</td>
<td>≥4</td>
</tr>
<tr>
<td>Amoxicillin</td>
<td>≥8</td>
</tr>
<tr>
<td>Oxacillin</td>
<td>≥8</td>
</tr>
<tr>
<td>Piperacillin</td>
<td>≥8</td>
</tr>
<tr>
<td>Cefoperazone-sulbactam</td>
<td>≤1/0.5</td>
</tr>
<tr>
<td>Cefazolin</td>
<td>≥16</td>
</tr>
<tr>
<td>Cefotaxime</td>
<td>≤8</td>
</tr>
<tr>
<td>Cefepime</td>
<td>≤4</td>
</tr>
<tr>
<td>Cefpodoxime</td>
<td>≤0.5</td>
</tr>
<tr>
<td>Cefoxitin</td>
<td>≤2</td>
</tr>
<tr>
<td>Cefmetazole</td>
<td>≤0.5</td>
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<tr>
<td>Cefotetan</td>
<td>≤0.5</td>
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<tr>
<td>Flomoxef</td>
<td>≤2</td>
</tr>
<tr>
<td>Imipenem</td>
<td>≤1</td>
</tr>
<tr>
<td>Meropenem</td>
<td>≤0.5</td>
</tr>
<tr>
<td>Panipenem</td>
<td>0.016</td>
</tr>
<tr>
<td>Aztreonam</td>
<td>1</td>
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</table>

FIG. 1. Clinical time course of a patient with Fallot’s tetrad. BT, body temperature; ABPC, ampicillin; CTRX, ceftriaxone; PAPM/BP, panipenem-betamipron; LC, leukocyte count; CRP, C-reactive protein level. ▼, points at which blood cultures were performed.

TABLE 1. Antibiotic susceptibilities of BRO β-lactamase-producing M. lacunata isolated from an infant
This is the first report of BRO β-lactamase-producing M. lacunata strains.

**Nucleotide sequence accession number.** The nucleotide sequence of the 16S rRNA gene from M. lacunata (CIP 108000) obtained in this study was deposited under GenBank accession number AY294281.

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**REFERENCES**