Recurrent *Streptococcus equi* subsp. *zooepidemicus* Bacteremia in an Infant

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CASE REPORT

A male infant was born via spontaneous vaginal delivery to a gravida 1, para 1 female at 32 weeks and 6 days of gestation because of preterm labor with Apgar scores of 7 at 1 min and 8 at 5 min. The mother’s group B streptococcal colonization status was unknown, and she received 2 doses of ampicillin prior to delivery. Artificial rupture of membranes occurred approximately 1 h prior to delivery. Placental pathology was normal. The infant required continuous positive airway pressure for respiratory distress and received 1 dose of surfactant. He was admitted to the neonatal intensive care unit at the delivery hospital and received ampicillin and gentamicin until a blood culture was negative at 48 h. On day of life (DOL) 12, the infant developed apnea, bradycardia, and hypoxemia. Physical examination revealed poor perfusion, poor tone, and skin erythema on the right side of his neck, chest, and abdomen. Neck ultrasound demonstrated parotitis and cellulitis, and blood culture yielded Gram-positive cocci identified by the outside hospital as group C streptococcus (GCS). He received intravenous ampicillin for 10 days with clinical improvement and clearance of bacteremia. He was discharged home on DOL 23.

The infant did well until DOL 28, when his parents noted nasal congestion, poor feeding of expressed human milk and infant formula, and decreased activity. On DOL 29, he developed altered breathing and central cyanosis after a feeding. Transient skin erythema on the right side of his neck was also noted. Review of systems was negative for fever, cough, emesis, and seizures. At the Nationwide Children’s Hospital emergency department, he developed apnea, bradycardia, and hypoxemia requiring intubation and mechanical ventilation. Laboratory studies and cultures were obtained, and empirical ampicillin and cefotaxime administration was initiated. In the pediatric intensive care unit, he required intravenous fluid resuscitation, vasopressors, and stress dose corticosteroids for hypotension and poor perfusion. A complete blood count, hepatic panel, and cerebrospinal fluid analysis were unremarkable. Chest X-ray, echocardiogram, and computed tomography of the head and neck were normal. Rhinovirus was detected in a nasopharyngeal swab by PCR. Peripheral blood cultures were obtained, and the aerobic blood culture was positive for Gram-positive cocci in pairs and chains at 14 h of incubation (Bact/Alert FN; bioMérieux, Durham, NC). Initial subculture revealed colonies that were 1 to 2 mm in diameter with a large zone of beta-hemolysis on sheep blood agar (Fig. 1) and were identified as GCS based on a negative catalase test and a latex agglutination test positive for group C antigen (Streptex; Remel, Lenexa, KS). The initial blood isolate from the outside hospital was also obtained, and the identification of GCS was confirmed by the aforementioned methods. Results of antimicrobial susceptibility testing (1) of both isolates were as follows: susceptible to penicillin (MIC, 0.03 μg/ml, Etest; bioMérieux, Durham, NC), resistant to clindamycin (disk diffusion), and a rifampin MIC of 0.023 μg/ml (Etest). Culture from the endotracheal tube aspirate also yielded rare GCS; urine and cerebrospinal fluid cultures were negative. The infant was extubated on hospital day 6 and demonstrated continued clinical improvement. He had documented clearance of bacteremia within 24 h and received 18 days of intravenous ampicillin. Evaluation for primary immunodeficiency was negative.

Additional history revealed that 48 h prior to the patient’s first episode of GCS sepsis, his mother had developed fever and malaise requiring hospitalization. Her blood and urine cultures were negative, and her symptoms resolved. Days before the patient’s second episode of GCS sepsis, the mother developed pharyngitis. A throat culture yielded GCS, for which she was prescribed azithromycin. Epidemiological history revealed that the family lived on a farm in Ohio where the father cared for approximately 100 horses, none of which were ill.

Throat cultures obtained from both parents during the second hospitalization were negative for GCS carriage. The infant and his parents were treated with a 2-day course of rifampin prior to hospital discharge. At a 6-week follow-up appointment, the infant was clinically well. Throat cultures from the infant and father at
that time were negative. The mother’s throat culture yielded an isolate that was identified as described above as GCS susceptible to penicillin (MIC, 0.03 μg/ml), resistant to clindamycin (disk diffusion), and with a rifampin MIC of 0.023 μg/ml. Concern that maternal GCS pharyngeal colonization could serve as a source of re-exposure of the infant to GCS prompted treatment of the infant with oral penicillin for 10 days combined with rifampin during the final 4 days. At an appointment 3 months following the mother with oral penicillin for 10 days combined with rifampin the infant’s blood isolate on sheep blood agar after 24 h of incubation at 35°C in 5% CO₂. Colonies were 1 to 2 mm in diameter, slightly umbonate, shiny, and gray to clear with entire edges and a large zone of beta-hemolysis. The final identification was S. equi subsp. zooepidemicus.

Further phenotypic characterization was performed with the two blood isolates from the infant and the throat isolate from the mother with oral penicillin for 10 days combined with rifampin during the final 4 days. At an appointment 3 months following the second hospitalization, the infant continued to do well and had negative throat and rectal cultures. Maternal throat culture was also negative at that time. At 16 months of age, the infant has had no further recurrences of GCS bacteremia or sepsis.

Analysis of the isolates by pulse-field gel electrophoresis (PFGE) with Smal revealed that the two blood isolates from the infant were indistinguishable from one another. The PFGE pattern of the isolate from the mother’s throat culture had two bands different from the infant’s blood isolates, a difference that may be explained by a single genetic event (4). The PFGE results indicated that the mother’s isolate was closely related to the infant’s isolates and was probably the same strain.

Additional molecular characterization of the isolates is shown in Table 1. The S. equi subsp. zooepidemicus szm and szp genes were detected and sequenced (5) and were identical in the three isolates. Molecular detection of S. equi subsp. equi genes eqbN and se18.9 was also attempted (6, 7). Absence of eqbN and se18.9 (as found in S. equi subsp. equi), together with the presence of identical szm and szp sequences typical of S. equi subsp. zooepidemicus, in all three isolates confirmed the identification and supported the conclusion that the isolates from the infant and the mother were the same strain of S. equi subsp. zooepidemicus. Multilocus sequence typing (MLST) (5) revealed that all three isolates had the same novel sequence type, 190 (ST190) (http://pubmlst.org/szooe/pidemicus/). As may be seen in S. equi subsp. zooepidemicus, superantigen genes szeN and szeP, but not szeF, were detected by PCR (8).

This report describes, to our knowledge, the first case of recurrent S. equi subsp. zooepidemicus infection in a young infant. Epidemiological history prompted a detailed molecular characterization that identified the bacterial isolates as S. equi subsp.

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TABLE 1 Molecular characterization of S. equi subsp. zooepidemicus clinical isolates from infant and mother

<table>
<thead>
<tr>
<th>Source of bacterial isolate</th>
<th>MLST result</th>
<th>S. equi subsp. zooepidemicus</th>
<th>S. equi subsp. equi</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>SzM proteinα</td>
<td>szP proteinβ</td>
</tr>
<tr>
<td>Infant’s blood</td>
<td>ST190</td>
<td>A3(b), B2 tandem repeats</td>
<td>Absent</td>
</tr>
<tr>
<td>Initial episode</td>
<td></td>
<td>N2HV5, 5PEPK</td>
<td>Absent</td>
</tr>
<tr>
<td>Recurrent episode</td>
<td></td>
<td>N2HV5, 5PEPK</td>
<td>Absent</td>
</tr>
<tr>
<td>Mother’s throat at 6-wk follow-up</td>
<td>ST190</td>
<td>A3(b), B2 tandem repeats</td>
<td>Absent</td>
</tr>
</tbody>
</table>

α Szm, protective protein; SzM, M-like protein; szP, szE, szeN, and szeP, superantigen genes; eqbN, equibactin gene of S. equi subsp. equi; se18.9, gene for factor H binding protein of S. equi subsp. equi; N-terminal N2 and hypervariable 5 sequence motifs; 5PEPK, five carboxy-terminal PEKK repeats.

β The N, HV, and PEKK regions of Szm are variable among isolates of S. equi subsp. zooepidemicus. The genes were completely sequenced and were identical in all three isolates (18).

γ The A and B regions of Szm are variable among isolates of S. equi subsp. zooepidemicus. The genes were completely sequenced and were identical in all three isolates (19).
zooepidemicus (ST190) and elucidated the mother as the potential source. This result provided a risk factor that could be modified to prevent future disease.

S. equi subsp. zooepidemicus and its clonal derivative S. equi subsp. equi share high DNA homology but differ in their pathogenicity (9). S. equi subsp. equi is the causative agent of a highly contagious respiratory tract infection of horses called strangles. S. equi subsp. zooepidemicus, in contrast, is a commensal organism of equine mucosal surfaces that may cause invasive infections in horses during times of viral infection, heat stress, or tissue injury (8, 9).

The production of superantigens may be important in the pathogenesis of S. equi subsp. zooepidemicus infections. Similar to Streptococcus pyogenes, three genes encoding superantigens (szeF, szeN, and szeP) have been described in the S. equi subsp. zooepidemicus genome (8). Of 165 S. equi subsp. zooepidemicus isolates examined by Paillot et al. (8), one or more superantigens were detected in 49%. The three superantigens possess a characteristic amino acid sequence signature, and their amino acid sequences are 34 to 59% identical to those of superantigens produced by S. pyogenes. The presence of szeN and szeP was associated with meningitis, but the presence of szeF was not. In our case, both szeN and szeP, but not szeF, were detected.

Cases of S. equi subsp. zooepidemicus infections in adults with close and continuous contact with horses and dogs have been described previously (10, 11). A search of the MEDLINE database for English-language publications of infections in infants ≤3 months of age with the key words “Group C Strept”, “Streptococcus equi”, and “Streptococcus zooepidemicus” yielded three prior reports that identified S. equi subsp. zooepidemicus causing meningitis and sepsis (12–14). Two of the cases occurred during outbreaks related to the consumption of unpasteurized cow’s milk but without confirmation of infection in family members of the infants (12, 13). Another report of S. equi subsp. zooepidemicus infection described a 14-week-old infant whose family owned a horse (15). In that case, the mother had a lower respiratory tract infection 3 weeks before the infant’s illness, but she was not tested for S. equi subsp. zooepidemicus colonization. In the case of our infant, results of molecular analysis supported mother-to-infant transmission. Although we questioned the possibility of an equine reservoir, we were unable to test the horses to confirm a zoonosis. No cases of recurrent S. equi subsp. zooepidemicus infection during the first 3 months of life were found in the published literature.

Because of concern that the patient’s mother was a chronic pharyngeal carrier of S. equi subsp. zooepidemicus, she was treated with penicillin and rifampin according to guidelines for chronic S. pyogenes carriage (16, 17). We believed this was a necessary intervention given the infant’s recurrent episodes of sepsis, prematurity, and immature immune system. This strategy appeared to be successful at least temporarily, as evidenced by a negative maternal pharyngeal carrier of S. equi subsp. zooepidemicus from a dog to a handler. J Med Microbiol 59:120–123. http://dx.doi.org/10.1099/jmm.0.012930-0.


