**Case Report**

**Correspondence**
Lu Xinxin
luxinxin2009@126.com

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Intrauterine infection and post-partum bacteraemia due to *Streptococcus galolyticus* subsp. *pasteurianus*

Lu Binghuai, Sui Wenjun and Lu Xinxin

Department of Laboratory Medicine, Beijing Tongren Hospital, Capital Medical University, Beijing 100730, PR China

The case is presented of a woman with intrauterine infection and post-partum bacteraemia due to *Streptococcus galolyticus* subsp. *pasteurianus*, who delivered an infant via Caesarean section. Furthermore, we comment on the possibility of vaginal colonization of this organism as a portal of entry in cases of maternal and neonatal infections.

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**Introduction**

*Streptococcus galolyticus* subsp. *pasteurianus* is a Lancefield group D streptococcus, formerly known as *Streptococcus bovis* biotype II/2, or *Streptococcus pasteurianus*. Sporadic cases of invasive diseases due to *S. galolyticus* subsp. *pasteurianus*, mainly bacteraemia and meningitis, have been reported in neonates and adults (Gavin et al., 2003; Onoyama et al., 2009; Sturt et al., 2010). Here, we present a case of intrauterine infection and post-partum bacteraemia caused by *S. galolyticus* subsp. *pasteurianus* in a woman after a Caesarean delivery.

**Case report**

A 30-year-old woman underwent a Caesarean section (C-section) at 40 weeks gestation, for her baby was in a breech position. During birth there was no prolonged rupture of membranes (PROM) or maternal fever. The course of her pregnancy was uneventful with the exception of moderate anaemia. There were no concerns for fetal deceleration. History taking revealed that this was her first birth, and she had not experienced abdominal surgery and C-section before. Coagulation and routine serum biochemical screens, including liver and renal function tests, were normal. During the C-section, she had uterine tenderness and her amniotic fluid was noted to be foul-smelling, therefore, intrauterine infection was suspected and a sample of fetal membrane immersed in amniotic fluid was sent for histopathological examination and microbiological culture. Furthermore, her vaginal swab, as well as the swabs from the ear and throat of her infant, was also collected for both aerobic and anaerobic cultures. Her full-term male infant was in a good state of health, weighed 3120 g (normal range of birth weight 2500–4000 g), and his Apgar scores were 9 at 1 min and 10 at 5 min after delivery.

The mother presented with fever 18 h after Caesarean delivery. Vital signs were a temperature of 39.2 °C, a pulse of 94 beats min⁻¹ and a blood pressure of 85/60 mmHg. The rest of the physical examination was unremarkable. A complete blood count revealed a leukocyte count of 17.5 × 10⁹ l⁻¹ (92.4 % neutrophils and 5.9 % lymphocytes), a haemoglobin of 84 g l⁻¹, a haematocrit of 24.2 %, and a mean cell volume of 74.6 fl. Her C-reactive protein (CRP) level was 312.4 mg l⁻¹ (normal range, 0–3.0 mg l⁻¹). A systemic infection was suspected and immediate blood cultures (two sets each in aerobic and anaerobic bottles; bioMérieux, Bact/Alert) were collected. The empirical intravenous antibiotics levofloxacin (500 mg every 24 h) and metronidazole (250 mg every 12 h) were initiated.

On the second day after birth, the histopathological examination revealed umbilical phlebitis and deciduitis without visible micro-organisms. The culture of the fetal membrane and vaginal swabs, as well as the ear and throat swabs of the infant, yielded growth of Gram-positive cocci, both catalase- and coagulase-negative. The isolates were initially designated *Streptococcus lutetiensis* by matrix-assisted laser desorption ionization–time of flight mass spectrometry (MALDI-TOF MS; Bruker Daltonics), in which the spectra were analysed using MALDI Biotyper 2.0 software (3995 entries in the database). But they were identified as *S. bovis* biotype II by BD Phoenix Automated Microbiology System STREP (SMIC/ID) panel.

At 11.5 and 15.2 h after incubation, the microbial growth was detected in aerobic and anaerobic blood culture bottles, respectively. Direct Gram-stain demonstrated Gram-positive cocci, arranged in chains. Blood specimens were subcultured onto sheep blood agar, eosin–methylene blue agar and chocolate agar plates at 37 °C, under 5.0 %
CO₂ respectively and they were also inoculated onto another blood agar plate and incubated at 37 °C anaerobically. The organism revealed the identical morphological characteristics and identification results to the aforementioned isolates. MALDI-TOF MS and biochemical methods using the Phoenix system demonstrated inconsistent identification; the isolates recovered from different resources were further subspeciated by partial sequencing of 16S rRNA as *S. pasteurianus*, with 99 % similarity for the first best match (GenBank accession no. NR_043660.1, *S. pasteurianus* strain CIP 107122). Afterwards, the strains were identified as *S. galloyticus* subsp. *pasteurianus* (biotype no. 161011364713731) by Vitek 2 (bioMérieux, France), negative to D-mannitol and positive to *S. gallolyticus* 

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Table 1. Identification of the isolate from fetal membrane by different methods

<table>
<thead>
<tr>
<th>Method no.</th>
<th>ID method</th>
<th>Results</th>
<th>ID score or confidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MALDI-TOF MS</td>
<td><em>S. lutetiensis</em></td>
<td>2.32</td>
</tr>
<tr>
<td>2</td>
<td>BD Phoenix automated microbiology system</td>
<td><em>S. bovis</em> biotype II</td>
<td>93 %</td>
</tr>
<tr>
<td>3</td>
<td>Vitek Compact 2 (bioMérieux)</td>
<td><em>S. galloyticus</em> subsp. <em>pasteurianus</em></td>
<td>97 %</td>
</tr>
<tr>
<td>4</td>
<td>16S rRNA sequencing</td>
<td><em>S. pasteurianus</em></td>
<td>99 %</td>
</tr>
</tbody>
</table>

Discussion

*S. bovis* is frequently found as part of the commensal bowel flora in humans. Extensive taxonomic changes have occurred in the *S. bovis* group, and the strains previously recognized as *S. bovis* isolates now represent a series of species involving unique clinical implications. For example, *S. bovis* biotype I (*S. galloyticus* subsp. *galloyticus*) is linked to colonic carcinoma and endocarditis (Romero et al., 2011), biotype II/1 (*Streptococcus infantarius*, intermittently designated *S. lutetiensis*) is associated with non-colonic cancers (Corredoira et al., 2008), and biotype II/2 (*S. galloyticus* subsp. *pasteurianus*) is often associated with neonate or adult meningitis and bacteraemia (Gavin et al., 2003; Sturt et al., 2010). Their specific clinical association makes correct species identification critical. In our case, the biochemical methods gave the accurate identification, but MALDI-TOF MS failed to identify it to subspecies, which was in keeping with the previous study (Romero et al., 2011). This suggests that the traditional biochemical methods are still a reliable method for the differentiation of *S. bovis* species in clinical practice.

*S. galloyticus* subsp. *pasteurianus*, previously designated *S. bovis* biotype II/2, is a group D non-enterococcal streptococcus (Romero et al., 2011). To date, it is an increasingly recognized aetiology of streptococcal infections, particularly in the newborn (Cheung et al., 2000; Floret et al., 2010; Onoyama et al., 2009). To the best of our knowledge, no study has documented evidence of *S. galloyticus* subsp. *pasteurianus* as a pathogen of maternal infection and its association with newborn infection. Herein, we describe a rare case of intrauterine infection due to the organism, complicated by post-partum bacteraemia.

From review of the literature, *S. galloyticus* subsp. *pasteurianus* might act as a causative organism of systemic infections in populations suffering from underlying diseases in adults (Beck et al., 2008; Smith et al., 2010; Sturt et al., 2010). The mother reported here had histopathological evidence of intrauterine infection. She experienced Caesarean delivery. This exposure history could be a potential clue to the aetiology of her bloodstream infection. Additionally, the 16S rRNA sequence, biochemical characteristics and AST profiles of the isolates from mother and infant revealed 100 % identity. Taken together, our case suggests that *S. galloyticus* subsp. *pasteurianus* may be a potential, if rare, cause of maternal bacteraemia and/or neonate infection during delivery. The mechanism and timing of infection acquisition in neonates remain in debate (Floret et al., 2010; Klatte et al., 2012; Smith et al., 2010). Floret et al. suggested the bloodstream infection in a cluster of five
preterm infants in a neonatal unit was caused by environmental contamination followed by transient hand carriage by a staff member (Floret et al., 2010). It has never been seriously under consideration that the invasive infections caused by \textit{S. gallolyticus} subsp. \textit{pasteurianus} are derived from vaginal sources, except in one previous report (Klatte et al., 2012). The present case suggests that \textit{S. gallolyticus} subsp. \textit{pasteurianus} may colonize the female lower genital tract, with the potential for invasive maternal intrauterine infection given the appropriate circumstances [i.e. ascending infection with secondary intrauterine infection, combined with birth trauma (whether spontaneous vaginal delivery or surgically induced via C-section), and/or haematogenous seeding due to these reasons]. We theorize that the combination of intrauterine infection and surgically induced trauma potentiated haematogenous seeding of \textit{S. gallolyticus} subsp. \textit{pasteurianus}, with subsequent maternal bloodstream infection.

The identical strains were found in the ear and throat of the infant, but clinical findings consistent with meningitis or systemic bacteraemia/sepsis were not observed. Potential mechanisms of the infections during the newborn period include a specific virulence trait of the organism, increased host susceptibility, and differences in portal of entry or maternal colonization. As documented, premature infants, particularly those of very low birth weight, are vulnerable to sporadic incidents of infection caused by \textit{S. gallolyticus} subsp. \textit{pasteurianus} (Floret et al., 2010). The infant in our case was delivered at full term with normal weight and in a healthy state, having no PROM. Furthermore, he was born via Caesarean delivery, during which he was potentially exposed to a lower bacterial inoculum, for only a limited number of bacteria ascend to the inner uterus. A baby born vaginally would be exposed to greater bacterial colonization. This might partially explain why there was no serious systemic infection. Penicillin (Gavin et al., 2003), cefotaxime (Onoyama et al., 2009), ampicillin (Klatte et al., 2012) and ceftriaxone (Klatte et al., 2012; Sturt et al., 2010; Smith et al., 2010) are often used for the meningitis and bacteraemia due to \textit{S. gallolyticus} subsp. \textit{pasteurianus}. The AST profiles of our strain are almost consistent with the data reported by Beck et al. (2008). This organism is resistant to levofloxacin, erythromycin and clindamycin. That explains why the original antibiotics were ineffective. Vancomycin was used and our patient responded well thereafter.

In summary, our observations provide evidence of vaginal colonization with \textit{S. gallolyticus} subsp. \textit{pasteurianus}, and suggest a possible portal of entry in cases of maternal and neonatal infections.

**References**


