The first case report of *Enterococcus gallinarum* meningitis in neonate
A literature review

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**Abstract**

**Rationale:** Enterococcus gallinarum meningitis (EGM) is rarely found in normal adults and even rarer in children. To our knowledge, EGM in neonate has not been reported previously.

**Patients concerns:** Here we reported the first case of EGM in neonate. Prolonged fever was the only manifestation for the case after admission.

**Diagnoses:** Cerebrospinal fluid cultures showed that the isolate was *Enterococcus gallinarum* and sensitive to linezolid.

**Interventions:** Ceftriaxone, beta lactam type, and vancomycin were used respectively, but not effective.

**Outcomes:** The temperature went down to normal after linezolid was used and the baby was discharged in good condition in the end.

**Lessons:** This case indicated that EGM could also occur in neonate and fever could be the only obvious manifestation. Thus, the effective antibiotics and adequate duration are very important and linezolid is a potential good choice, especially for vancomycin-resistant patients.

**Abbreviations:** CRP = C-reactive protein, CSF = cerebrospinal fluid, EGM = *Enterococcus gallinarum* meningitis, FDA = Food and Drug Administration, Hgb = hemoglobin, RBC = red blood cell, WBC = white blood cell.

**Keywords:** *Enterococcus gallinarum* meningitis, linezolid, neonate

1. **Introduction**

Enterococci are facultative anaerobic, gram-positive cocci, which are usually found in urinary tract infection, bacterial endocarditis, and diverticulitis. Central nervous system infection of enterococci is rarely found.\(^1,^2\) Enterococcus gallinarum, which belongs to enterococcus, is a dominant bacterium in poultry gastrointestinal tracts. The infections of *Enterococcus gallinarum* and *Enterococcus casseliflavus* uncommonly occur in clinical practice. *Enterococcus gallinarum* meningitis (EGM) occurs occasionally in postneurosurgery and immunocompromised patients. Six EGM cases have been reported around the world so far, but none has been reported in the neonate. We would share the first case of EGM in the neonate.

1.1. **Ethical statement**

Ethics committee approval is not included as it is commonly accepted that case reports do not require such an approval. Because our work did not use the patients’ data that would allow identifying them, informed consent is not necessary.

2. **Case report**

A 2-day-old baby boy, presented with jaundice without fever, was admitted to the First Affiliated Hospital of Xi’an Jiaotong University for 1 day before the hospitalization. Physical examination at the admission showed that the baby with normal axillary temperature was in good condition and the jaundice was extended to the proximal limb. Laboratory examination results were: direct antiglobulin test negative, release test positive, free test weakly positive, red blood cell (RBC) count 3.46 × 10\(^12\)/L, white blood cell (WBC) count 11.7 × 10\(^9\)/L, and hemoglobin 110 g/L with a mild anemia. Then the blue-ray phototherapy was adopted at the day of the admission.

The baby presented fever (axillary temperature of 38.5°C) without nuchal rigidity and mental confusion at the seventh day after admission. WBC count 27.2 × 10\(^9\)/L, neutrophils count 20.3 × 10\(^9\)/L and C-reactive protein (CRP) count 23 mg/L (The normal reference value is <10 mg/L) went up, too. Blood culture was negative at this time. Intravenous ceftriaxone, 75 mg/kg every 24 hours, was used and the fever was reduced but went up
present report 9 days old. M immunocompromised and puncture, and 1 alcoholism patient, [3]
10 12 M Astrocytoma neurosurgery and history of operation and severe basic diseases. He was not immunocompromised and did not have a neonatal EGM. The baby presented fever secondary to hemolytic disease was 12 years old. We reported a case of a 9-day-old baby with abnormality were observed.

Temperature was up to 39.6 °C. Ceftriaxone, 75 mg/kg every 24 hours, was given to the baby for 5 days in another hospital but the fever was still running. The baby was transferred to our hospital then. CSF and blood culture was negative. Intravenous linezolid was used again and the course of treatment was extended to 3 weeks. Fever faded on the third day of the treatment. The baby, who has been followed up for 2 years since then, stayed in good condition and no fever and neurological abnormality were observed.

3. Discussion
EGM is rarely found in normal adults. Enterococcus meningitis, occurring occasionally in postneurosurgery, immunocompromised patients and patients with nervous system defects and trauma, accounts for 0.3% to 4% of meningitis. While the occurrence of E. faecalis meningitis and E. faecium meningitis accounts for about 90% of enterococcus meningitis. Only 6 EGM cases were reported (details shown in Table 1), [2] including 4 cases secondary to neurosurgery, 1 case secondary to lumbar puncture, and 1 alcoholism patient, [3] and the youngest patient was 12 years old. We reported a case of a 9-day-old baby with neonatal EGM. The baby presented fever secondary to hemolytic disease. He was not immunocompromised and did not have a history of operation and severe basic diseases. The features of this case: fever was the typical clinical manifestation and there was no significant abnormality in the nervous system. Enterococcus meningitis usually presents fever, headache, consciousness disturbance, seizures, and meningeval stimulation signs. Some severe cases may even appear shock, coma, focal neurological deficits, and so on. In this case, fever was the only clinical symptom without consciousness disturbance, seizures, and neck stiffness. It indicated that neurological signs might not be typical in neonates. Risk factors: The neonate diagnosed with EGM had hemolytic disease and his immune system was not well developed yet. Thus, both undeveloped immune function and hemolytic disease could be the risk factors of EGM. By now, the baby in this case was the youngest with EGM among the reported cases in the world.

Ampicillin and penicillin, which kill the bacteria by inhibiting the cell wall, are considered to be the standard antibiotics to resist enterococcus infection. In clinical practice, we usually choose ampicillin and aminoglycoside for enterococcus meningitis in adults. Sometimes patients are allergic to penicillin or present drug resistance, and then sugar peptide antibiotic, such as vancomycin, can be used. Recently, the resistant treatment of enterococcus meningitis faces the new challenges with the vancomycin-resistant enterococcus increasing: multidrug-resistant enterococcus strains arise frequently and the drugs cannot achieve effective concentration in the CSF. Vancomycin is commonly found to be resistant to enterococcus in malignant tumor, immunosuppression, renal insufficiency, and a long course treatment of broad-spectrum antibiotics. While E. gallinarum features a natural resistance to sugar peptide. [4,6] The patients in previously reported cases of E. gallinarum were all sensitive to ampicillin, whether resistant to vancomycin or sensitive to vancomycin. CSF cultures and drug-sensitive test in this case of E. gallinarum were different. The baby was resistant to ampicillin but was sensitive to vancomycin. But the vancomycin appeared ineffective when it was given by intravenous drip for 4 days. Recently, the Food and Drug Administration of the United State has put forward that linezolid quinupristin and dalfopristin synercid can be applied to treat enterococcus infection which present resistant to vancomycin. Linezolid is the best antibiotic to treat enterococcus meningitis due to its good CSF permeability. [7] In this case, CSF cultures and drug-sensitive test of this case showed resistance to ampicillin but sensitivity to vancomycin, but

| Reference | Age, year | Sex | Potential predisposing | Clinical presentation | Vancomycin | Treatment | Prognosis |
|-----------|-----------|-----|------------------------|----------------------|------------|-----------|-----------|
| 8         | 53        | M   | Alcohol abuse          | Fever, confusion, and neck stiffness | Resistance | IV Ampicillin combined with gentamicin for 3 weeks | Recovery |
| 9         | 64        | M   | VP shunt               | Fever and lethargy    | Sensitive  | IV Ampicillin combined with gentamicin for 3 weeks | Recovery |
| 10        | 51        | F   | Lumbar drainage of CSF | Fever and headache    | Resistance | IV Ampicillin combined with rifampin for 3 weeks | Recovery |
| 3         | 57        | M   | VP shunt and rheumatoid arthritis | Fever and neck stiffness | Sensitive  | IV Teicoplanin for 4 weeks and interrupt VP shunt | Recovery |
| 10        | 12        | M   | Astrocytoma neurosurgery and VP shunt | Fever and drowsiness  | Sensitive  | IV Ampicillin for 8 weeks | Recovery |
| 4         | 53        | F   | Cerebral hemorrhage and neurosurgery | Fever, headache, neck stiffness, and confusion | Sensitive  | IV Linezolid for 3 weeks | Recovery |
| Present report | 9 days old | M   | Immunocompromised and hemolytic disease | Fever | Sensitive  | IV Linezolid for 3 weeks | Recovery |

CSF = cerebrospinal fluid, EGM = Enterococcus gallinarum meningitis, F = female, IV = intravenous, M = male, VP = ventriculoperitoneal.
vancomycin treatment was not effective, so intravenous linezolid was used instead. Although we were unable to detect drug concentration in CSF, the reaction to linezolid was good. Routine blood test, liver, and kidney functions were normal. The treatment duration in the 6 reported cases of EGM was about 3 weeks, so we thought that the duration of treatment in our case was adequate. The baby was discharged from hospital after 2-week treatment duration, and meningitis relapsed 10 days later. The secondary treatment was extended to 3 weeks. Then the baby was recovered. In conclusion, the treatment duration of EGM would be recommended to be at least 3 weeks.

EGM is relatively rare. Therefore, there is no detailed evaluation about its prognosis at present. The prognosis of the 6 reported patients is optimistic and the clinical symptoms are significantly improved. This case reminds us that EGM may occur in the neonate. Sometimes fever may be the unique typical manifestation, and the effective antibiotics and adequate duration are important. Linezolid is a better choice for treatment, especially for vancomycin-resistant patients.

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