Enterococcus gallinarum meningitis: a case report and literature review

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Abstract

Background: As an opportunistic pathogen, E. gallinarum mainly leads to nosocomial infections, and it’s multi-drug resistance has gained more and more attention. Central nervous system infections caused by E. gallinarum are rare, but have been reported more often in recent years. The previous cases were generally secondary to neurosurgery, especially ventriculoperitoneal shunts. In recent years, the cases largely occurred in patients with impaired immune function. The patient in our report may have had dual risk factors (immune impairment and an invasive surgical procedure).

Case presentation: The patient, a 35-year-old female, was admitted to our hospital for headaches of 3 days duration accompanied by nausea and vomiting for 2 days. The patient had fevers and chills for 3 days before admission; the peak body temperature was 38.5 °C. The patient had a splenectomy in our hospital 2 years earlier for thrombocytopenia and was thought to be immunocompromised. The abnormal findings on physical examination and laboratory testing were as follows: neck stiffness, present; lumbar puncture: pressure, 300 mmH2O; Pandy’s test, positive; white blood cell (WBC) count, 1536 × 10^6/L; monocyte count, 602 × 10^6/L; monocyte percentage, 39.2%; multinucleate cell count, 934 × 10^6/L; multinucleate cell percentage, 60.8%; protein, 1.08 g/L; WBC count, 21.1 × 10^9/L; neutrophil percentage, 85.3%; neutrophil count, 20.55 × 10^9/L; C reactive protein (CRP): 136.4 mg/L; procaltitonin, 6.70 ng/mL. The patient was given meropenem (2.0 g, intravenous infusion, every 8 h) for anti-infection supplemented with other symptomatic support treatments. The patient’s fever and headache had no significant relief.

Conclusions: Central nervous system infections caused by E. gallinarum are rare, but should be suspected, particularly in patients with impaired immune function or ineffective treatment. Avoiding long-term invasive treatment and improving immunity are helpful to reduce the occurrence of E. gallinarum infections. Early detection and diagnosis, as well as rational antibiotic use, are the keys to achieve satisfactory efficacy.

Keywords: Enterococcus gallinarum meningitis, Infections
(WBC) count, 1536 \times 10^6/L; monocyte count, 602 \times 10^6/L; monocyte percentage, 39.2%; multinucleate cell count, 934 \times 10^6/L; multinucleate cell percentage, 60.8%; protein, 1.08 g/L (Table 1); head and chest CT, normal; head contrast MRI + MRA + MRV, normal; WBC count, 21.1 \times 10^9/L; neutrophil percentage, 85.3%; neutrophil count, 20.55 \times 10^9/L; C reactive protein (CRP): 136.4 mg/L; procalcitonin, 6.70 ng/mL; liver and kidney function, normal; and electrolytes, normal. Meropenem (2.0 g intravenous infusion every 8 h) was administered with other symptomatic support treatments, such as reducing intracranial pressure by mannitol. The temperature fluctuated around 38 °C. There was no significant relief from the headaches. A lumbar puncture was repeated 6 days after admission. The cerebrospinal fluid culture and drug sensitivity testing showed an Enterococcus gallinarum infection and sensitivity to linezolid (Table 2), respectively. Thus, an intravenous infusion of linezolid (0.6 g every 12 h) was administered. On the second day of linezolid, the temperature began to decrease. After 3 weeks of anti-E. gallinarum treatment, the temperature returned to normal and the headache resolved. A lumbar puncture was repeated three times. The cerebrospinal fluid was colorless and transparent, the pressure and WBC count were decreased, and the bacterial cultures were negative. The patient was discharged from the hospital when stable and in good condition.

**Discussion and conclusions**

*Enterococcus gallinarum* was first isolated from the gut of a chicken. *Enterococcus gallinarum* is normal flora in human and animal guts [1]. In recent years, with the increasing use of broad-spectrum antibiotics and invasive medical devices, infections caused by *E. gallinarum* have gradually increased, and multi-drug resistance has gained more and more attention. In 2010, among the isolated strains of *Enterococcus* in several Chinese hospitals, *E. gallinarum* accounted for 1.9% of isolates, and second only to *E. faecalis* and *E. faecium* [2]. As an opportunistic pathogen, *E. gallinarum* mainly leads to nosocomial infections, including urinary tract, abdominal, biliary tract, and a small percentage of bloodstream infections. Patients who undergo invasive operations or are immunosuppressed are susceptible [3, 4]. Central nervous system infections caused by *E. gallinarum* are rare, but have been reported more often in recent years.

Symptoms of *E. meningitis* include fevers and headaches, which may be accompanied by a disturbance of consciousness or even convulsions. Some patients may have septic shock, focal neurologic deficits, petechial

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**Table 1** Results of lumbar puncture after admission

| Lumbar puncture | 1st day | 6th day | 14th day | 22nd day | 31st day |
|----------------|--------|--------|----------|----------|---------|
| Pressure mmH2O (80–180) | 300 | 300 | 160 | 110 | 110 |
| Appearance (Colorless and transparent) | Colorless and transparent | Light yellow and transparent | Colorless and transparent | Colorless and transparent | Colorless and transparent |
| Pandy’s test (−) | + | + | Weak positive | Weak positive | − |
| WBC count 10^6/L (0–8) | 1536 | 204 | 107 | 36 | 11 |
| Monocyte count 10^6/L (not available) | 602 | 164 | 106 | 36 | 10 |
| Monocyte percentage % (not available) | 39.2 | 92.1 | 99.1 | 100.0 | 97.9 |
| Multinucleate cell count 10^6/L (not available) | 934 | 40 | 1 | 0 | 1 |
| Multinucleate cell percentage % (not available) | 60.8 | 7.9 | 0.9 | 0 | 2.1 |
| RBC count 10^6/L (0) | 0 | 0 | 0 | 0 | 0 |
| Glucose mmol/L (2.5–4.5) | 3.21 (RBG 6.80) | 2.32 (BG not tested) | 3.33 (FBG 5.71) | 3.03 (BG not tested) | 3.1 (FBG 4.54) |
| Chlorine mmol/L (120–132) | 121.5 | 115 | 120.0 | 118.2 | 119.7 |
| Protein g/L (0.15–0.45) | 1.08 | 0.84 | 0.52 | 0.41 | 0.33 |
| Cryptococcus smear (Ink stain) | − | − | − | − | − |
| Mycobacterium tuberculosis smear (Acid-fast stain) | − | − | − | − | − |
| Bacterial smear (Gram’s stain) | − | − | − | − | − |
| Bacterial culture (Plate cultivation) | − | − | Enterococcus gallinarum | − | − |

BG blood glucose, RBG random blood glucose, FBG fasting blood glucose
Table 2 The susceptibility results of *E. gallinarum*

| Antibiotic name          | Method | Result | Sensitivity | Determination standard |
|--------------------------|--------|--------|-------------|------------------------|
| Penicillin G             | MIC    | 8.0    | S           | 8 ≥16                  |
| Vancomycin               | MIC    | 2.0    | R           | 4 ≥32                  |
| Linezolid                | MIC    | 1.0    | S           | 2 ≥4                   |
| Tetracycline             | MIC    | ≥16.0  | R           | 1 ≥4                   |
| Ciprofloxacin            | MIC    | ≤0.5   | S           | 0 ≥2                   |
| Erythromycin             | MIC    | 8.0    | R           | 4 ≥1                   |
| Levofloxacin             | MIC    | 1.0    | S           | 0 ≥2                   |
| Ampicillin               | MIC    | ≤2.0   | S           | 0 ≥2                   |
| Quinupristin/Dalfopristin| MIC    | 1.0    | R           | 2 ≥1                   |
| Clindamycin              | MIC    | ≥8.0   | R           | 2 ≥1                   |
| Moxifloxacin             | MIC    | ≤0.25  | S           | 0 ≥2                   |
| Tigecycline              | MIC    | ≤0.12  | S           | 0 ≥2                   |
| Gentamicin-High          | MIC    |        | S           |                       |
| Streptomycin-High        | MIC    |        | R           |                       |

MIC minimal inhibitory concentration, R resistance, S sensitive

Table 3 *Enterococcus gallinarum* meningitis reports in the literature

| Reference                      | Country          | Gender | Age  | Symptoms                      | Susceptibility factors                                                                 | Treatment                                    | Outcome     |
|--------------------------------|------------------|--------|------|-------------------------------|----------------------------------------------------------------------------------------|----------------------------------------------|-------------|
| Yoko Takayama, et al. [8] 2003| Japan            | Male   | 57 years | Fever Neck stiffness          | VP shunt for subarachnoid hemorrhage Rheumatoid arthritis with prednisolone and anti-rheumatic drugs | i.v. teicoplanin for 4 weeks VP shunt removal | Cured       |
| Yoko Takayama, et al. [8] 2003| Japan            | Male   | 12 years | Fever Drowsy Limb cramps     | VP shunt for astrocytoma                                                                 | i.v. ampicillin for 8 weeks VP shunt replaced | Cured       |
| Asok Kurup, et al. [9] 2001   | Singapore        | Male   | 64 years | Fever Drowsy                 | VP shunt for multi-loculated hydrocephalus                                               | i.v. ampicillin and gentamicin for 3 weeks   | Cured       |
| Fahmi Yousef Khan, et al. [10]2011| Pakistan        | Female | 53 years | Fever Headache Consciousness disturbance Neck stiffness | Decompression craniotomy for cerebral hemorrhage                                          | i.v. linezolid for 3 weeks                    | Cured       |
| Vicente Sperb Antonello, et al. [11] 2010 | Brazil | Male | 53 years | Mental confusion Fever Ataxia Neck stiffness | Alcohol abuse                                                                            | i.v. ampicillin and gentamicin for 3 weeks   | Cured       |
| B. Roca, et al. [12] 2006     | Spain            | Female | 51 years | Fever Headache                | Cerebrospinal fluid drainage catheter for persistent right nostril rhinorrhea           | i.v. ampicillin and rifampin for 3 weeks Drain removal | Cured       |
| Po-Yi Paul Su, et al. [5] 2016| USA              | Male   | 53 years | Fever Neck stiffness          | Acute lymphoblastic B cell leukemia with chemotherapy Neutropenic Broad-spectrum antibiotics usage Type 2 diabetes mellitus | i.v. ampicillin and ceftriaxone for 4 weeks   | Cured       |
| Quanxiao Li, et al. [13] 2013 | China            | Male   | 2 days | Fever Hypermyotonia          | Neonatal hemolysis                                                                      | i.v. linezolid for 3 weeks                    | Cured       |

VP shunt ventriculoperitoneal shunt, i.v intravenous
rashes, and meningeal irritation [4]. High value of CRP and procalcitonin can be found in patients with *E. gallinarum* meningitis. The diagnosis of *E. gallinarum* meningitis is based on clinical symptoms, cerebrospinal fluid examination, and pathogen culture. PCR is also used for diagnosis, the results of which can be obtained 48 h earlier than routine bacterial cultures [5]. The patient in this report exhibited fevers, headaches, and neck stiffness. The cerebrospinal fluid was purulent and the culture confirmed an infection with *E. gallinarum*. The patient had undergone a splenectomy and her immunoglobulin level was lower than the normal value, suggesting impairment of humoral immune function, which increased her risk for opportunistic infections [6]. The cerebrospinal fluid culture after the first lumbar puncture was negative, and the possibility that the pathogen was introduced by the first lumbar puncture could not be excluded. Moreover, the administration of broad-spectrum antibiotics may have exacerbated the infection.

There have been eight *E. gallinarum* meningitis cases reported worldwide (Table 3). The previous cases were generally secondary to neurosurgery, especially ventriculoperitoneal shunts. In recent years, the cases largely occurred in patients with impaired immune function. The patient in our report may have had dual risk factors (immune impairment and an invasive surgical procedure).

*Enterococcus gallinarum* carries the vanC drug-resistance gene and has a high rate of resistance for vancomycin (82.1%). The pathogen is relatively sensitive to teicoplanin and linezolid [2]. The strains carrying the vanA or vanB resistance genes have been isolated, and are resistant to vancomycin and teicoplanin.[7]. Based on drug sensitivity testing, we chose linezolid at an adequate dose and time to treat the patient. The course of linezolid generally lasts 3 weeks or longer, and the prognosis is good. We recommended a 3-week course of linezolid and obtained satisfactory efficacy. The symptoms, signs, and follow-up results of the cerebrospinal fluid were all remarkably improved after treatment. The patient did not relapse after treatment was completed.

Avoiding long-term invasive treatment and improving immunity are helpful to reduce the occurrence of *E. gallinarum* infections. Early detection and diagnosis, as well as rational antibiotic use, are the keys to achieve satisfactory efficacy.

Authors’ contributions
BZ and MSY collected and analyzed medical data of the patient. BZ and RZ wrote and revised the manuscript. RZ made a critical revision of the manuscript for important intellectual content. All authors read and approved the final manuscript.

Ethics approval and consent to participate
Not Applicable.

Consent for publication
The patient gave a written consent for publication of her potentially identifying information.

Competing interests
The authors declare that they have no competing interests.

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Abbreviations
BG: Blood glucose; CRP: C reactive protein; CT: Computed tomography; FBG: Fasting blood glucose; i.v.: Intravenous; MIC: Minimal inhibitory concentration; MRA: Magnetic Resonance Angiography; MRI: Magnetic Resonance Imaging; MRV: Magnetic Resonance Venography; R: Resistance; RBC: Red Blood Cell; RBG: Random blood glucose; S: Sensitive; VP shunt: Ventriculoperitoneal shunt; WBC: White blood cell

Availability of data and materials
All the data supporting our findings is contained within the manuscript.