Salmonella Typhimurium Brain Abscess in an Immunocompetent Adult with a Spontaneous Intracerebral Hemorrhage: A Case Report

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A brain abscess caused by Salmonella typhimurium (S. typhimurium) in an immunocompetent adult is rare. We report a case of brain abscess caused by S. typhimurium in a 46-year-old male and a brief review of the literature. The patient visited a local hospital because of right hemiparesis. Brain computed tomography and magnetic resonance imaging results showed an acute hematoma in the left basal ganglia. After 3 weeks of conservative therapy, the patient was transferred to our hospital due to uncontrolled fever, aphasia, and aggravated motor weakness. Contrast-enhanced computed tomography showed a rim-enhanced cystic mass with peripheral edema, prompting trephination to drain the cystic fluid. The drained fluid was yellowish-mucoid, similar to a pus. Specimens from the drained fluid and urine S. typhimurium were cultured and microbiologically analyzed. We administered ceftazidime 2,000 mg and vancomycin 2,000 mg/day for 6 weeks intravenously and changed ceftriaxone 2,000 mg/day for an additional 3 weeks due to a drug eruption. The patient recovered with no neurological deficits. Surgical drainage of the intracranial abscess and prolonged sensitive antibiotic therapy is essential to obtain positive results.

Key Words: Brain abscess; Intracerebral hemorrhage; Salmonella typhimurium

INTRODUCTION

Although Salmonella species can cause focal subdural or epidural empyema and brain abscesses in any age group, most reported cases are patients with precipitating factors, such as immunocompromised conditions (e.g., human immunodeficiency virus [HIV] infection, chemotherapy, long-term steroid therapy), blood problems (e.g., sickle cell disease), previous brain surgery or infarcted brain tissue, hepatic or gastrointestinal disease, alcohol abuse, or infancy. Intracerebral infections caused by Salmonella are rare. Here, we present a rare case of an intraparenchymal brain abscess caused by Salmonella typhimurium (S. typhimurium) at the site of a liquefied intracerebral hemorrhage (ICH).

CASE REPORT

A 46-year-old man visited a local hospital because of right-sided weakness. On neurological examination, the patient showed right hemiparesis and mild dysarthria. Brain computed tomography (CT) and magnetic resonance imaging (MRI) showed acute ICH in the left basal ganglia (Fig. 1). The patient was treated with mannitol alone, and his neurological symptoms were not aggravated. On the 23rd day of admission, the patient suffered from malaise and a severe headache. On the 25th day, he was referred to our hospital because of uncontrolled fever, aphasia, and aggravated motor weakness. Contrast-enhanced computed tomography showed a rim-enhanced cystic mass with peripheral edema, prompting trephination to drain the cystic fluid. The drained fluid was yellowish-mucoid, similar to a pus. Specimens from the drained fluid and urine S. typhimurium were cultured and microbiologically analyzed. We administered ceftazidime 2,000 mg and vancomycin 2,000 mg/day for 6 weeks intravenously and changed ceftriaxone 2,000 mg/day for an additional 3 weeks due to a drug eruption. The patient recovered with no neurological deficits. Surgical drainage of the intracranial abscess and prolonged sensitive antibiotic therapy is essential to obtain positive results.

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tein, 31.1 mg/dL, and no growth on culture.

On microbiological analysis, \textit{S. typhimurium} was cultured from the pus and urine (Fig. 3). In the blood culture, there was no growth of bacteria. Microbes were identified as \textit{Salmonella} group using the Vitek 2 XL system (bioMérieux, Nürtingen, Germany), and the serotype was identified as \textit{S. typhimurium} using Salmonella antisera (JoongKyeon, Ansan, Korea). We administered ceftazidime 2,000 mg and vancomycin 2,000 mg/day for 6 weeks via an intravenous route based on the antimicrobial susceptibility test (Table 1) and changed ceftriaxone 2,000 mg/day for an additional 3 weeks due to the occurrence of a drug eruption caused by vancomycin.

The patient recovered normal neurological status, and follow-up ESR/CRP conducted at week 9 of hospitalization was normalized (Fig. 4). Follow-up at one year after MRI showed only focal encephalomalacia in the left basal ganglia and temporal area (Fig. 5).

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**Fig. 1.** Brain computed tomography (CT) and magnetic resonance imaging (MRI) from a local hospital. The brain CT showed a hyperdense lesion on the left basal ganglia (A), and a MRI scan (T2-weighted, diffusion-weighted, axial section) showed hypointensity in the same area (B, C) consistent with an acute hematoma.

**Fig. 2.** Enhanced brain computed tomography (CT) and magnetic resonance imaging (MRI) at our hospital. A rim-enhancing hypodense lesion and perilesional edema were found on enhanced CT (A). The postoperative MRI diffusion-weighted image showed a hyperintense lesion (B) and T1 enhanced image showed ring-enhanced lesion (C) in the same area, suspicious for a brain abscess.

**Fig. 3.** Round, gray colonies on a 5% sheep blood agar plate (A), and colorless colonies on a MacConkey agar plate (B) were observed at 24 hr incubation at 37°C, 5% CO₂ conditions. It produced hydrogen sulfide on a Salmonella-Shigella Agar plate (C) and showed a red slant/yellow bottom (alkali/acid reaction) with hydrogen sulfide in triple sugar iron agar (D). Gram-negative bacilli from a blood agar plate (Gram stain, x1,000 magnification) (E).
DISCUSSION

Intracranial infections (meningitis, subdural or epidural empyema, brain abscess) caused by Salmonella species are very rare. Since the first Salmonella brain abscess was reported by McClintock in an autopsy study in 1902, fewer than 100 cases of intracranial Salmonella infections have been reported. Among intracranial infections, brain abscesses remain the rarest, and, to our knowledge, only 12 cases of brain abscess caused by S. typhimurium have been reported. However, intracranial infections associated with Salmonella species have increased recently because of the number of immunocompromised patients with acquired immunodeficiency syndrome (AIDS), corticosteroid therapy, broad-spectrum antibiotic use, or chemotherapy has been increasing. Although intracranial Salmonella infections can occur at any age, they tend to be more common in infancy because of the immunologically naïve state.

According to Mahapatra and Bhatia, infectious routes for brain abscesses caused by Salmonella can be divided into 3 groups. First, patients develop a brain abscess during a Salmonella infection elsewhere in the body. Second, patients have a history of Salmonella infection. In the third group, patients presented with a brain abscess with no apparent history of salmonellosis. Our patient had no history of Salmonella infection. Although S. typhimurium was cultured from his urine and drained pus, his blood culture was negative. The patient did not suffer from gastrointestinal symptoms and had no risk factors for decreased immunity.

Intracranial Salmonella infections tend to involve diseased tissues, such as hematomas, fractures, and neoplasms. In our case, diseased tissue and liquefied hematoma may have acted as the culture medium. Systemic diseases including malaria, sickle cell anemia, diabetes mellitus, AIDS, systemic lupus erythematosus, hepatic disease, gastrointestinal disease, alcohol abuse, corticosteroid therapy, and chemotherapy are other factors associated with salmonellosis. In addition, focal infections adjacent to the brain, such as otitis, paranasal sinus infection, meningitis, and osteomyelitis of the skull, are other precipitating factors. In the previous literature on S. typhimurium brain abscesses, 3 cases presented with focal infections adjacent...
### Table 2. Clinical features of 13 patients with Salmonella typhimurium brain abscess

| References          | Year  | Age/Sex | Precipitating factors       | Symptoms and signs                                           | Treatment modalities                  | Outcome  |
|---------------------|-------|---------|------------------------------|--------------------------------------------------------------|---------------------------------------|----------|
| Paniker and George20 | 1965  | 30 months/F | Otitis                      | Fever, otorhoe                                               | Surgical drainage + antibiotics       | Died     |
| Ellis et al.10       | 1981  | 65 years/M | Meningitis                  | Fever, headache, confusion, seizure, hemiparesis, vomiting, diarrhea | Antibiotics                           | Died     |
| Iplikçioglu et al.13 | 1991  | 13 months/M | Unknown                     | Fever, seizure, vomiting                                    | Surgical drainage + antibiotics       | Recovered |
| Arentoft et al.3     | 1993  | 59 years/F | Previous stroke             | Seizure, hemiparesis                                        | Antibiotics                           | Died     |
| Gueit et al.12       | 1996  | 34 years/M | AIDS                        | Seizure, hemiparesis                                        | Antibiotics                           | Recovered |
| Smail et al.23       | 1996  | 34 years/M | AIDS                        | Fever, seizure, focal neurologic deficit                    | Antibiotics                           | Recovered |
| Lu et al.14          | 1997  | 6 months/M | Unknown                     | Fever, diarrhea, drowsiness, convulsion                     | Surgical excision + antibiotics       | Recovered |
| Broux et al.6        | 1998  | 56 years/M | Unknown                     | Fever, septic shock, renal failure, acute respiratory distress | Antibiotics                           | Recovered |
| Kumari and Kan15     | 2000  | 59 years/M | Previous brain operation    | Fever, seizure, confusion                                  | Surgical drainage + antibiotics       | Recovered |
| Chadwick et al.7     | 2004  | 54 years/M | Alcoholic liver disease     | Fever, confusion                                            | Antibiotics                           | Died     |
| Mohindra et al.19    | 2014  | 5 months/M | Unknown                     | Fever, altered bowel habits                                 | Surgical drainage + antibiotics       | Recovered |
| Ploton et al.21      | 2017  | 3 months/M | Otitis                      | Fever, vomiting, seizure                                    | Antibiotics                           | Recovered |
| Present case         | 2020  | 46 years/M | Previous ICH                | Fever, hemiparesis, aphasia                                 | Surgical drainage + antibiotics       | Recovered |

F: female; M: male; AIDS: acquired immunodeficiency syndrome; ICH: intracerebral hemorrhage.

To the brain, 4 cases were in infants, 2 cases were in AIDS patients, one case involved alcoholism, 1 case had a previous stroke history, and the present case involved a previous ICH site (Table 2)1,2,3,7,10,12,13,14,15,17,19,21-23.

Several factors contribute to the pathogenesis of salmonellosis: the Salmonella inoculum size, the virulence of the strain, the host immune response, and local protective factors22. Thus, Salmonella infection in humans shows a spectrum of symptoms from asymptomatic carriers to focal localized infections, such as meningitis, brain abscess, gastroenteritis, or cholecystitis, and sometimes even bacteremia22. Likewise, the clinical presentations of Salmonella brain abscesses vary from simple headache or vomiting to altered states of consciousness or focal neurologic deficits.

Salmonella is a facultative intracellular organism, and a cell-mediated immune response depends on macrophage function2,9,24. Increased susceptibility to Salmonella infection is thought to be due to several factors: prolonged exposure to the organism, impairment of the cell-mediated immune response, impairment of phagocytosis, alterations in local protective factors, and the presence of diseased tissue4,8,25.

Determining the location and size of an abscess through CT and/or MRI and identifying the organism involved in pus culture is crucial for an accurate diagnosis and adequate treatment of brain abscess caused by Salmonella. Such abscess could be treated through surgical drainage and combined antibiotic therapy1,13,22. In our review, almost all patients who died from brain abscesses caused by S. typhimurium did not undergo surgical drainage (Table 2). Chloramphenicol, a third-generation cephalosporin, and trimethoprim/sulfamethoxazole are the drugs of choice after pus drainage. Salmonella strains resistant to these antibiotics are uncommon24. In addition, long-term antibiotic therapy—at least 6 weeks—is essential because of the risk of recurrence. In our case, we administered ceftazidime, based on culture sensitivity, and vancomycin to prevent scalp and tract infections.

### CONCLUSION

We report a rare case of an intracranial abscess caused by S. typhimurium at a previous spontaneous ICH site. Surgical drainage of the intracranial abscess and prolonged sensitive antibiotic therapy are essential to obtain positive results. In particular, we emphasize that early surgical drainage reduces mortality, as it prevents the unnecessary use of broad-spectrum antibiotics through pus culture.
CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

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