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*

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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^{1,3,5,7,8,11,13,15}. 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

wed 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, aggravated hemiparesis, and motor aphasia. A follow-up enhanced brain CT scan revealed a rim-enhancing hypodense lesion and massive peri-lesional edema (Fig. 2A). We performed an emergency trephination to drain the cystic mass lesion in the left basal ganglia. The drained fluid was not a chronic liquefied hematoma; instead, it was yellowish-mucoid in nature and gave a characteristic odor when it was an abscess. After the operation, we rechecked the brain MRI and suspected an intracerebral abscess (Fig. 2B, C). The patient had been healthy prior to the occurrence of spontaneous ICH. He did not have gastrointestinal symptoms, meningeal signs, or immunocompromised indications. The results of the blood examination were white blood cell (WBC) 14,300/ μ L, C-reactive protein (CRP) 72.98 mg/L, erythrocyte sedimentation rate (ESR) 73 mm/hr, hemoglobin 13.4 g/dL, platelets 164,000/ μ L, and HIV Ab (-). Evaluation of the cerebrospinal fluid revealed the following values: WBCs, 2/ mm^3 with 0% neutrophils and 0% lymphocytes, red blood cells, 71/ mm^3 , glucose, 75 mg/dL, pro-

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

On microbiological analysis, *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 *Salmonella* group using the Vitek 2 XL system (bioMérieux, Nürtingen, Germany), and the serotype was identified as *S. typhimurium* using Salmonella antisera (JoongKyeom, 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).

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, ×1,000 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^{18,19,22}. 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 (Table 2)^{3,6,7,10-13,16,19,21,23}. 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^{13,22}. Although intracranial *Salmonella* infections can occur at any age, they tend to be more common in infancy because of the immunologically naïve state^{13,16,19}.

According to Mahapatra and Bhatia, infectious routes for brain abscesses caused by *Salmonella* can be divided into 3

groups¹⁷. 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 neoplasms²². 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^{8,11,13}. In addition, focal infections adjacent to the brain, such as otitis, paranasal sinus infection, meningitis, and osteomyelitis of the skull, are other precipitating factors²². In the previous literature on *S. typhimurium* brain abscesses, 3 cases presented with focal infections adjacent

Fig. 4. Follow-up erythrocyte sedimentation rate (ESR), C-reactive protein (CRP).

Table 1. Antibiotics sensitivity test

Antibiotics	Interpretation	MIC (mg/mL)
Ampicillin/Sulbactam	Sensitive	≤2
Amikacin	Resistant	≤2
Cefazolin	Resistant	≤4
Cefepime	Sensitive	≤1
Cefoxitin	Resistant	≤4
Levofloxacin	Sensitive	1
Meropenem	Sensitive	≤0.25
Trimethoprim/Sulfamethoxazole	Sensitive	≤20
Cefotaxime	Sensitive	≤1
Ceftazidime	Sensitive	≤1
Piperacillin/Tazobactam	Sensitive	≤4

MIC, minimum inhibitory concentration.

Fig. 5. Follow-up magnetic resonance imaging showed only focal encephalomalacic change on the left basal ganglia and temporal area (A, diffusion-weighted imaging; B, fluid attenuated inversion recovery; C, T1-enhanced image).

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 George ²⁰⁾	1965	30 months/F	Otitis	Fever, otorrhea	Surgical drainage + antibiotics	Died
Ellis et al. ¹⁰⁾	1981	65 years/M	Meningitis	Fever, headache, confusion, seizure, hemiparesis, vomiting, diarrhea	Antibiotics	Died
Iplikçioğlu 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. ¹⁶⁾	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 Kan ¹⁵⁾	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)^{3,6,7,10-13,16,19,21,23)}.

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 bacteremia^{8,22)}. 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 function^{2,9,24)}. 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 tissue^{4,8,25)}.

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 therapy^{1,13,22)}. 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 uncommon^{14,22)}. 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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