Case Report

Infected subdural haematoma due to *Salmonella enterica* serovar Typhimurium in an adult

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A 65-year-old man with a history of alcoholism and gastrectomy was diagnosed with an infected subdural haematoma due to *Salmonella enterica* serovar Typhimurium. He was successfully treated with surgical drainage and intravenous ceftriaxone. To our knowledge, there has been no detailed case report in English of infected subdural haematoma or subdural empyema due to *Salmonella* Typhimurium in adults.

Introduction

Nontyphoidal salmonellosis most often results in acute gastroenteritis; however, extraintestinal focal infections have been reported. The most common central nervous system manifestation is *Salmonella* meningitis. Subdural empyema and infected subdural haematoma due to nontyphoidal *Salmonella* species have also been reported (Boles *et al.*, 1983; Buchanan *et al.*, 1973; Chiu & Ou, 1999; Dill *et al.*, 1995; Le Roux *et al.*, 2007; Mahapatra *et al.*, 2002; Rodriguez *et al.*, 1986; Sawauchi *et al.*, 1998; Vetrovec & Warner, 1975); these are rare but important forms of infection. Intravenous antibiotics combined with prompt evacuation of the subdural collection is critical.

Salmonella enterica serovar Typhimurium is a common serovar of human foodborne salmonellosis, both in the US (CDC, 2008) and in Japan (Matsushita *et al.*, 2001). Nonetheless, reports of subdural empyema or infected subdural haematoma due to *Salmonella* Typhimurium are very limited and are mostly from the paediatric population (Buchanan *et al.*, 1973; Chiu & Ou, 1999; Dill *et al.*, 1995; Rodriguez *et al.*, 1986). Here, we present a case of an adult with an infected subdural haematoma due to *Salmonella* Typhimurium who was successfully treated with surgical drainage and antibiotics.

Case report

A 65-year-old man was admitted to the Neurosurgery Department complaining of headache and fever. He had

been in his usual state of health until 3 weeks prior to admission, when a headache developed, accompanied by fever. The pain, which he described as stabbing, gradually increased in intensity and was aggravated in the supine position. Over-the-counter analgesics did not relieve the pain. He denied speech disturbance, double vision, dizziness or numbness. He had difficulty in using his right hand. He had no nausea, vomiting, abdominal pain or diarrhoea.

His past medical history was significant for total gastrectomy due to gastric cancer 15 years previously, alcohol abuse of unknown duration, and brain contusion 2 months prior to admission due to a fall while he was drunk; the latter was conservatively managed. He drank 68 ounces of beer per day and smoked a pack of cigarettes per day for 45 years. He did not travel abroad and was not sexually active. He denied any contact with animals and routinely ate meat, poultry, dairy products and eggs.

On admission, the patient's temperature was 37 °C, his blood pressure was 150/86 mmHg and his pulse rate was 87 beats min⁻¹. He was alert and well oriented. His neck was supple and neurological findings were normal, except for a weaker grip in his right hand. There was no cardiac murmur. His abdomen was soft without tenderness, and his skin was normal without rash. His white blood cell count was 5560 mm⁻³, haemoglobin concentration was 11.3 g dl⁻¹ and platelet count was 186 000 mm⁻³. His C-reactive protein level was 14.8 mg dl⁻¹. Liver and renal function tests were within normal limits. A computed tomography (CT) scan of the head obtained on admission suggested a left chronic subdural haematoma (Fig. 1).

After admission, the patient's fever remained at around 38 °C. On the 4th day in hospital, surgical evacuation of

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Abbreviation: CT, computed tomography.

Fig. 1. CT image of the head showing the subdural haematoma prior to surgery.

the subdural haematoma was performed. Fluid from the subdural space was mainly clotted blood and pus and the sample was sent to the laboratory for culture. Before surgery, cefazolin was used to prevent surgical site infection. Fever continued after surgery, and, therefore, ceftriaxone (2 g per day) was started. The patient's temperature returned to normal 4 days after surgery.

The cultures of the evacuated subdural haematoma grew *Salmonella* Typhimurium on the 8th day in hospital. The evacuated subdural haematoma specimen was streaked onto a sheep blood agar plate and a chocolate agar plate. Colonies were further examined by biochemical tests, including growth on triple-sugar iron agar, lysine-indole-motility medium and Simmons' citrate agar. Isolated *Salmonella* was serogrouped by the slide agglutination test with O-antigen antiserum, and serotyped by the tube agglutination test with H-antigen antisera (Denka Seiken). Based on these results, the isolate was finally identified as *Salmonella* Typhimurium (O4:i:1). Susceptibility studies using a commercial broth microdilution method (autoSCAN 4; Siemens Healthcare Diagnostics) demonstrated that the organism was susceptible to ampicillin, the third- and fourth-generation cephalosporins and quinolones. It is known that despite efficient *in vitro* killing of *Salmonella*, the first- and second-generation cephalosporins are ineffective in treating clinical infections (Pegues & Miller, 2009). Therefore, the sensitivities of these cephalosporins were not reported.

The patient's HIV serology was negative. The blood and stool cultures, which were taken after the initiation of antibiotic therapy, turned out to be negative. A transthor-

acic echocardiogram was negative for vegetations and an abdominal CT scan was normal without any biliary abnormalities or gallstones. The colonoscopy showed normal colonic mucosa and haemorrhoids.

We diagnosed this patient as having an infected subdural haematoma. The patient was treated for 5 weeks with intravenous ceftriaxone (2 g per day). After surgery, his head CT showed that the subdural collection had remarkably decreased in size. The weakness in his right hand showed gradual improvement. The patient was discharged on the 40th day.

Discussion

Subdural empyema is a frequent complication of otorhinological infections, especially sinusitis. Other predisposing conditions for subdural empyema include neurosurgical procedures, skull trauma, meningitis and infection of pre-existing subdural haematoma. The most common causative organisms are streptococci. Less commonly, *Staphylococcus aureus*, anaerobes and Gram-negative bacteria may be present (Greenlee, 2003).

There are a limited number of reports that describe nontyphoidal *Salmonella* species as a cause of subdural empyema in both HIV and non-HIV patients; however, a majority of the case reports have been associated with paediatric patients (Aliaga *et al.*, 1997; Boles *et al.*, 1983; Buchanan *et al.*, 1973; Chiu & Ou, 1999; Dill *et al.*, 1995; Le Roux *et al.*, 2007; Mahapatra *et al.*, 2002; Rodriguez *et al.*, 1986; Sawauchi *et al.*, 1998; Vetrovec & Warner, 1975). Most of the reported cases in adults involve patients infected with HIV. Aliaga *et al.* (1997) mentioned seven reported cases of adult *Salmonella* focal cranial infection in HIV-infected patients. They were all advanced AIDS patients with CD4 counts ranging from 18 to 64 and included two cases of brain abscess caused by *Salmonella* Typhimurium and three cases of subdural empyema caused by *Salmonella* Dublin, *Salmonella* Copenhagen and *Salmonella* Enteritidis, respectively (Aliaga *et al.*, 1997). As for the non-HIV adult population, only a few published reports exist on subdural empyema caused by nontyphoidal *Salmonella* species. Rodriguez *et al.* (1986) described 20 patients with *Salmonella* subdural empyema including two caused by *Salmonella* Typhi. Of these 20 patients, three were reported to be infected with *Salmonella* Typhimurium: an 11-month-old male with an unknown precipitating factor, an 18-month-old male with congenital hydrocephalus and a 37-year-old male with a subdural haematoma following trauma (Rodriguez *et al.*, 1986). In another review of 32 cases of subdural empyema at the University of Alabama Hospital, there was only one adult with *Salmonella* Typhimurium subdural empyema, which occurred with concurrent meningitis after infraorbital trauma (Dill *et al.*, 1995). Of note, the two cases reviewed briefly in the reports by Rodriguez and Dill are the only adult cases of subdural empyema or infected subdural haematoma due to *Salmonella* Typhimurium reported in

English that we could identify using a MEDLINE database search.

Our patient had a history of chronic alcohol abuse and his repetitive falls preceded head trauma, which was the most likely cause of the subdural haematoma. Despite a thorough examination, no source of infection was identified. In this case, we believe that haematogenous seeding of *Salmonella* Typhimurium occurred due to a pre-existing chronic subdural haematoma. Sawauchi *et al.* (1998) reviewed 14 reported cases of infected subdural haematoma not occurring as a post-operative complication in their case report. Six cases including that in the report by Sawauchi *et al.* (1998) were caused by *Escherichia coli*; urinary tract infections were the sources of infection in three cases. Nontyphoidal *Salmonella* species were the causes of infection in four cases, including *Salmonella* Suipestifer in a 10-year-old female with meningitis, *Salmonella* Saintpaul in a 13-year-old female with subtotal gastrectomy, *Salmonella* Group D in a 36-year-old male with gastroenteritis and *Salmonella* Group E in a 66-year-old male with an unknown source of infection (Sawauchi *et al.*, 1998). In addition to the cases reviewed by Sawauchi and co-workers, there were two case reports describing a subdural haematoma infected with nontyphoidal *Salmonella* species. Boles *et al.* (1983) reported a 55-year-old alcoholic male with a post-traumatic chronic subdural haematoma infected with *Salmonella* Sandiego. Le Roux *et al.* (2007) reported a 15-month-old male with a subdural haematoma infected by *Salmonella* Virchow, 3 months after an episode of acute gastroenteritis with a positive stool culture for *Salmonella* Virchow.

Gastric acidity represents the initial barrier to *Salmonella* (Giannella *et al.*, 1972; Tennant *et al.*, 2008); our patient's past medical history of gastrectomy probably put him at risk of *Salmonella* infection. As mentioned earlier, some cases of infected subdural haematoma due to nontyphoidal *Salmonella* species have been associated with acute gastroenteritis or post-gastrectomy status (Le Roux *et al.*, 2007; Sawauchi *et al.*, 1998). Importantly, prior to our report, there has been no detailed report describing an infected subdural haematoma due to *Salmonella* Typhimurium under similar conditions associated with post-gastrectomy status.

Along with other non-typhoidal *Salmonella*, *Salmonella* Typhimurium can be acquired from multiple animal reservoirs. There have been reports of an outbreak of *Salmonella* Typhimurium infection associated with various foods, including peanut butter, eggs and ground beef (CDC, 2006, 2009; Dyda *et al.*, 2009). Although our patient did not have any gastrointestinal symptoms, ingested agricultural products may still have been the source of this organism.

The suitable duration of antimicrobial therapy for a *Salmonella*-infected subdural haematoma after surgical evacuation is unknown. In previous case reports of *Salmonella*-infected subdural haematomas, antibiotics were

administered for 4–6 weeks in addition to surgical drainage (Boles *et al.*, 1983; Le Roux *et al.*, 2007; Vetrovec & Warner, 1975). We treated our patient with surgical drainage and intravenous ceftriaxone (2 g per day) for 5 weeks without any recurrence for 18 months.

Infection of a chronic subdural haematoma must be suspected in patients with unexplained fever, particularly in those with suppressed immunity. Ordering culture, timely surgical drainage of the subdural haematoma and adequate antimicrobial therapy are the key therapeutic approaches.

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