Case Report

Subgaleal and brain abscesses due to *Salmonella enteritidis* following craniotomy for giant cell glioblastoma multiforme: A case report and literature review

Ali Akhaddar¹, Walter Hall², Mohammed Boucetta¹

¹Department of Neurosurgery, Avicenne Military Hospital of Marrakech, Marrakech and Mohammed V University, Rabat, Morocco, ²Department of Neurosurgery, State University of New York (SUNY), Upstate Medical University, Syracuse, New York, United States.

E-mail: *Ali Akhaddar - akhaddar@hotmail.fr; Walter Hall - hallw@upstate.edu; Mohammed Boucetta - boucetta.mohamed@hotmail.com*

**ABSTRACT**

**Background:** Cranial surgical site infections due to *Salmonella* species are rarely reported. Only eight cases of *Salmonella enteritidis* infection following intracranial surgery for brain tumor have been reported to date. We describe a unique case of both subgaleal and brain abscesses caused by *S. enteritidis* following craniotomy for a parafalcine giant cell glioblastoma multiforme. A literature review of the previously published cases is also provided.

**Case Description:** A 36-year-old previously healthy man presented with a posterior parietal parafalcine giant cell glioblastoma multiforme. 5 weeks after craniotomy for tumor resection, the patient presented with worsening headache and painful swelling at the cranial operative site. Head computed tomography and magnetic resonance imaging scans revealed both scalp and brain abscesses in the previous surgical site. He was treated with aspiration of the subgaleal abscess and ciprofloxacin antibiotic therapy; he made a full recovery. Cultures of the aspirate identified *S. enteritidis*, although the primary site of infection was not detected.

**Conclusions:** Although postoperative *S. enteritidis* infections are rare, the large numbers of patients with malignant brain tumors who require tumor resections and receive corticosteroids are at great risk. Adequate drainage (if possible), early isolation of the pathogens, and control of the infection by antibiotic therapy guided by antimicrobial susceptibility testing are vital components to prevent this potentially fatal condition.

**Keywords:** Brain abscess, complication, giant cell glioblastoma multiforme, infection, *Salmonella enteritidis*, *Salmonella* infection, scalp abscess, surgical site infection

**INTRODUCTION**

Central nervous system (CNS) infections due to *Salmonella* species are uncommon.⁶,⁹,¹²,¹³ Among them, the occurrence of postoperative complications caused by *Salmonella enteritidis* is particularly rare.¹¹ Only eight cases of *S. enteritidis* infection following intracranial surgery for brain tumor have been reported.
We describe a previously healthy man who developed both scalp and brain abscesses due to *S. enteritidis* after a craniotomy for the resection of a giant cell glioblastoma multiforme. The patient recovered as a result of aspiration of the subgaleal abscess followed by ciprofloxacin antibiotic therapy. A literature review of previously published cases is also presented.

**CASE DESCRIPTION**

A 36-year-old man with no significant medical history, presented to our medical center with headache, nausea, episodic seizures, and personality changes for 1 month. He was afebrile, had no focal neurologic deficits, and had no systemic abnormalities on clinical examination. Magnetic resonance imaging (MRI) of the head revealed a 3-cm diameter right posterior parietal parafalcine, dura based, enhancing lesion, suggesting an extra-axial tumor [Figure 1]. A right posterior interhemispheric approach was performed for tumor resection. At craniotomy, the tumor was found to be intra-axial with adjacent dural invasion. A near total resection of the tumor was performed. Histopathologic examination of the tumor demonstrated a giant cell glioblastoma multiforme. No bacteria were identified on histological analysis. Postoperatively, the patient demonstrated progressive improvement and was given valproic acid and methylprednisolone as antiepileptic and antiedema treatment. He was discharged to home on the 6th day postsurgery. The sutures were removed on the 14th postoperative day with normal appearing wound healing.

5 weeks after surgery, the patient presented with worsening headache and painful swelling at the cranial operative site. Head computed tomography (CT) scan demonstrated a subgaleal extracranial homogenous low-density lesion with rim enhancement following contrast administration. There was also another intracranial ring-enhancing collection at the glioblastoma resection cavity, suggesting a brain abscess [Figure 2a]. There was no contiguous cranial or bone flap osteomyelitis on CT bone window images. The MRI showed both extracranial and parasagittal cystic masses with homogenous, low-intensity signal on T1-weighted images, and high-intensity signal on fluid-attenuated inversion recovery sequences, with significant cerebral edema surrounding the resection cavity and peripheral enhancement after gadolinium injection [Figure 2b-2e]. Clinically, the patient was conscious and afebrile without signs of meningeal irritation or neurologic deficits. His wound was well-healed without purulent discharge. Laboratory studies disclosed a white blood cell count of $16 \times 10^9$/L (66.5% neutrophils and 22.7% lymphocytes) and a C-reactive protein (CRP) level of 36.2 mg/L, but blood cultures remained negative. Percutaneous needle aspiration of the subgaleal collection yielded approximately 80 mL of purulent material. The suppurative material was submitted for aerobic and anaerobic microbiological studies as well as for fungal analysis. Empiric antibiotic therapy was started with ciprofloxacin, gentamicin, and metronidazole. Gram stain of the pus revealed Gram-negative bacilli. Cultures demonstrated the growth of *S. enterica*, serotype *Enteritidis*. Ciprofloxacin was continued based on the culture sensitivities. The patient was discharged after 4 weeks of intravenous antibiotic therapy and was given oral ciprofloxacin.
Table 1: Summary of nine cases (including our case) with *Salmonella enteritidis* infection following cranial tumor surgery reported in the world literature to date.

| First author, year | References | Country | Age/sex | Initial lesion | Location | Initial cranial surgery | Clinical interval | Clinical presentation | Type of infection | Type of surgery | Bacteria isolated from | Antibiotics used/ duration | Outcome/ follow-up |
|-------------------|------------|---------|---------|--------------|----------|-------------------------|-------------------|---------------------|-----------------|----------------|------------------------|--------------------------|-------------------|
| Rodriguez, 1986   | [12]       | USA     | 28 y/M  | Metastatic brain tumor (Testis embryonal carcinoma) | Rt occipital lobe | Resection | 2 w | Fever, gastroenteritis, raised intracranial pressure | Brain abscess | Surgical drainage | Brain, blood | Trimethoprim-sulfamethoxazole and chloramphenicol/6 w | Recovered/6 w |
| Bossi, 1993       | [5]        | France  | 24 y/m  | Glioblastoma | Temporal | Resection | Not mentioned | Fever, sepsis, altered awareness, VI cranial nerve palsy | Brain abscess | Surgical drainage | Brain, CSF, blood | Ceftazidime, amikacin, Ciprofloxacin/NA | Recovered/NA |
| Fiteni *et al*., 1995 | [7]       | Spain   | 49 y/f  | Astrocytoma | Parietal | Resection | Not mentioned | Fever, sepsis, altered awareness | Brain abscess | Surgical drainage | Brain, CSF, blood | Ceftazidime/6 w | Residual hemiparesis/NA |
| Schroder, 2003    | [15]       | Germany | 46 y/f  | Craniopharyngioma | Suprasellar | Resection (subfrontal approach) | 2 w | Headache, hip pain | Subdural empyema, cranial osteomyelitis | Surgical drainage, bone flap removal | Brain, hip, and feces | Ciprofloxacin and Chloramphenicol/NA | Recovered/NA |
| Aïssaoui, 2006    | [1]        | Morocco | 72 y/m  | Anaplastic oligodendroglioma | Lt Frontal | Second resection | 3 d | Altered awareness, hemiplegia, and fever | Meningitis | Surgical drainage | CSF, blood | Ceftriaxone and Ciprofloxacin/8 d | Dead on day 8 |
| Blázquez *et al*., 2009 | [4]       | Spain   | 26 m/F  | Ependymoma | Rt Frontoparital | Resection | 1 w | Gastroenteritis | Epidural empyema and brain abscess | Cranectomy and drainage | Epidural empyema, CSE, and feces | Cefotaxime and Ciprofloxacin/9 w | Good/2 y |
| Sait *et al*., 2012 | [13]      | USA     | 57/m    | Glioblastoma | Rt Temporal | Second resection | 1 m | Headache, scalp wound infection, and meningismus | Epidural, subdural, brain abscesses, and possible ventriculitis | Surgical drainage, ventricular drainage | Intracranial pus, blood | Ceftriaxone/4 w | Recovered/NA |
| Luciani *et al*., 2016 | [10]      | France  | 60 y/f  | Glioblastoma | Rt Temporal | Resection | 1 w | Fever, confusion, and meningismus (headache) | Meningitis then brain abscess | Surgical drainage | CSF, blood | Ceftriaxone and Ciprofloxacin/4.5 m | Recovered/NA |
| Present case, 2018 |             | Morocco | 36 y/m  | Giant cell glioblastoma | Rt parietal parafalcine | Resection | 5 w | Headache and scalp swelling | Subgaleal and brain abscesses | Percutaneous Subgaleal aspiration | Ciprofloxacin/2 m | Good/3 m |

Rt: Right, Lt: Left, CSF: Cerebrospinal fluid, M: Male, F: Female, NA: Not available, d: Days, w: Weeks, m: Months, y: Years
Akhaddar, et al.: Abscesses due to *Salmonella enteritidis*

at home for an additional month of treatment. Follow-up CT revealed a gradual reduction in abscess volume until its complete resolution 10 weeks after starting antibiotic therapy (CRP level was reduced to 5 mg/L). The patient was then sent to an oncologic center for further management.

**DISCUSSION**

Salmonellosis is usually a self-limited disease that generally causes gastrointestinal tract infection in humans through the oral route. Extraintestinal infections are uncommon, especially in the CNS, and may remain undetected due to a lack of fever and gastroenteritis. Until 2000, about 70 cases of focal intracranial salmonellosis were described in the world literature including brain abscesses, subdural empyemas, and epidural abscesses. Few cases were added thereafter. However, infections following neurosurgical procedures are rare. Searches using MEDLINE database were performed and only eight cases of *S. enteritidis* infection following brain tumor resection were identified from 1966 to date. A summary of the eight patients and the one described herein is provided in Table 1. 4 (44.4%) of the nine cases occurred in women. All but one of the nine cases was reported in a child and the average age was 41.5 years (range, 26 months–72 years). All patients were operated on for an intracranial supratentorial tumor: four patients with glioblastoma, one with a metastatic tumor due to embryonal carcinoma, one with ependymoma, one with astrocytoma, one with anaplastic oligodendroglioma, and one with craniopharyngioma. All patients were receiving systemic corticosteroid treatment except for one.

All patients had a cranial surgical site infection (SSI). In addition, two cases also had gastroenteritis and one patient had concomitant infectious arthritis of the hip. The organism was identified from samples of the cranial SSI in all patients and also from samples outside the SSI in eight cases (six from blood cultures and two from stool cultures). The most common predisposing factors to infection were corticosteroid use and malignancy, but no patient was seropositive for HIV infection.

The clinical features of these patients did not differ from those with SSI caused by other bacteria. The most frequent symptoms at presentation were fever (five cases), altered awareness (four cases), and headache (three cases). Focal neurological deficits were observed in two patients. Meningismus was noted in two instances. Scalp swelling and scalp wound infection were observed in one patient each. The duration of symptoms was documented in seven patients and had an average duration of 2.21 weeks (from 3 days to 5 weeks).

Adequate drainage (if possible), early isolation of the pathogens, and control of the infection by antibiotic therapy guided by antimicrobial susceptibility testing are essential to prevent this potentially fatal condition. In our review, all of the nine patients were on antibiotics. Four received treatment with regimens including ceftriaxone and/or ciprofloxacin, in combination with other antimicrobial agents in three patients. Antibiotic regimens lasted between 1 and 4.5 months. Surgical drainage of the suppurative collection was undertaken in seven patients. Percutaneous scalp aspiration and bone flap removal were performed in one patient each. Complete clinical resolution was achieved in seven patients. One case recovered from neurological clinical symptoms but with subsequent sequelae (residual hemiparesis) and one patient who had severe meningitis died 8 days into antibiotic therapy. These relative favorable results reflect the fact that most of these cases received prompt surgical and antimicrobial treatment.

Among the few cases of reported *S. enteritidis* infection following craniotomy in literature, this is the first case of the simultaneous occurrence of brain abscess and extracranial scalp abscess. The ability of these bacteria to produce a cranial SSI remains unexplained. Although the origin of infection was unclear in our previously healthy patient, the course of corticosteroids that he received and the original malignant intracranial tumor could have predisposed him to infection followed by potential hematogenous spread to the cranial surgical site. Furthermore, the absence of underlying systemic disease seems to be crucial for the cure of our patient. Finally, the possibility of postoperative *Salmonella* infection should be considered in patients with malignant brain tumor having surgery.

**Declaration of patient consent**

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

**Financial support and sponsorship**

Nil.

**Conflicts of interest**

There are no conflicts of interest.

**REFERENCES**

1. Aissaoui Y, Azendour H, Balkhi H, Haimeur C, Atmani M. Postoperative meningitis caused by an unusual etiological agent: *Salmonella enteritidis*. Neurochirurgie 2006;52:547-50.
2. Akhaddar A, Zalagh M, Gazzaz M, Boucetta M. Brain abscess as a complication of intranasal ethmoidectomy for sinonasal polyposis. Surg Infect (Larchmt) 2010;11:483-5.
3. Akhaddar A. Surgical site infections in cranial surgery. In: Akhaddar A, editor. Atlas of Infections in Neurosurgery and Spinal Surgery. Switzerland: Springer International Publishing; 2017. p. 191-215.
4. Blázquez D, Muñoz M, Gil C, Ruibal JL, El Knaichi F, Aleo E, *et al.*
Brain abscess and epidural empyema caused by *Salmonella enteritidis* in a child: Successful treatment with ciprofloxacin: A case report. Cases J 2009;2:7131.

5. Bossi P, Mion G, Brinquin L, Bonsignour JP. Postoperative brain abscess caused by *Salmonella enteritidis*. Presse Med 1993;22:130.

6. Diebold P, Humbert J, Djientcheu Vde P, Gudinchet F, Rilliet B, *Salmonella* epidural abscess in sickle cell disease: Failure of the nonsurgical treatment, J Natl Med Assoc, 2003; 95, 1095-1098.

7. Fiteni I, Ruiz FJ, Crusells MJ, Sanjoaquin I, Guillen G. *Salmonella enteritidis* multifocal infection of the central nervous system. Efficacy of new cephalosporins. Presse Med 1995;24:309-11.

8. Hanel RA, Araújo JC, Antoniuk A, da Silva Ditzel LF, Flenik Martins LT, Linhares MN, *et al*. Multiple brain abscesses caused by *Salmonella typhi*: Case report. Surg Neurol 2000;53:86-90.

9. Lloret MD, Escudero JR, Hospedales J, Viver E. Mycotic aneurysm of the carotid artery due to *Salmonella enteritidis* associated with multiple brain abscesses. Eur J Vasc Endovasc Surg 1996;12:250-2.

10. Luciani L, Dubourg G, Graillon T, Honnorat E, Lepidi H, Drancourt M, *et al*. *Salmonella enterica* serovar *enteritidis* brain abscess mimicking meningitis after surgery for glioblastoma multiforme: A case report and review of the literature. J Med Case Rep 2016;10:192.

11. Millward CP, McMullan NK, Vaiude P, da Rosa SP, Riordan A, Burn SC, *et al*. Extradural abscess secondary to *Salmonella enteritidis* in a child following fronto-orbital facial advancement and remodeling surgery. J Craniofac Surg 2014;25:489-91.

12. Noguerado A, Cabanyes J, Vivancos J, Navarro E, Lopez F, Isasia T, *et al*. Abscess caused by *Salmonella enteritidis* within a glioblastoma multiforme. J Infect 1987;15:61-3.

13. Rodriguez RE, Valero V, Watanakunakorn C. Salmonella focal intracranial infections: Review of the world literature (1884-1984) and report of an unusual case. Rev Infect Dis 1986;8:31-41.

14. Sait M, Rahmathulla G, Chen TL, Barnett GH. Rare case of intracranial *Salmonella enteritidis* abscess following glioblastoma resection: Case report and review of the literature. Surg Neurol Int 2011;2:149.

15. Sarria JC, Vidal AM, Kimbrough RC 3rd. *Salmonella enteritidis* brain abscess: Case report and review. Clin Neurol Neurosurg 2000;102:236-9.

16. Schröder J, Palkovic S, Kipp F, Wassmann H. *Salmonella enteritidis* causing brain abscess and coxitis following intracranial surgery. Acta Neurochir (Wien) 2003;145:919-21.

How to cite this article: Akhaddar A, Hall W, Bousceta M. Subgaleal and brain abscesses due to *Salmonella enteritidis* following craniotomy for giant cell glioblastoma multiforme: A case report and literature review. Surg Neurol Int 2019;10:37.