

Case report

First report of salmonella Dublin subdural empyema: A rare presentation of CNS infection

Seif Bugazia^{a,*}, Ahmed Selim^a, Anuradha Sreenivasan^a, Mohammed Rehman^b,
Mohammed Mahmoud^c

^a Department of Internal Medicine, Henry Ford Macomb Hospital, Clinton Township, MI, USA

^b Department of Neurology, Division of Neurocritical care and Neurointervention, Henry Ford Hospital, Detroit, MI, USA

^c Department of Internal Medicine, Division of Pulmonary and Critical Care, Henry Ford Hospital, Detroit, MI, USA

ARTICLE INFO

Keywords:

S. Dublin
Subdural Empyema
Salmonella enterica serovar Dublin
Nontyphoidal Salmonella

ABSTRACT

Subdural empyema can be precipitated by a range of pathogens. Common clinical symptoms include fever, headache, seizures, and changed mental status. Yet, cerebral infections caused by *Salmonella* are relatively uncommon as it is rare for *Salmonella* to invade the central nervous system. We present the first reported case of *Salmonella enterica serovar Dublin* causing subdural empyema in an 83-year-old female, which was successfully managed with surgical burr hole and drainage in addition to prolonged targeted antimicrobial therapy consisting of 2 g of intravenous Ceftriaxone twice daily for a total of 56 days. This report demonstrates the course of her illness and the corresponding treatment plan; which may help guide medical providers when encountering similar cases.

Introduction

Worldwide, one of the most common foodborne illnesses is caused by the salmonella species [1]. Having more than two thousand serotypes, salmonellae are divided into typhoidal salmonellae (mainly Typhi and Paratyphi A) and nontyphoidal salmonellae (NTS) mainly Enteritidis and Typhimurium [2]. Typhoidal serotypes affect primarily human hosts causing invasive disease in immunocompetent individuals [3]. In contrast, NTS can affect other mammalian species besides humans causing self-limited gastroenteritis characterized by acute intestinal inflammation and diarrhea [3]. NTS causes about 93.8 million gastroenteritis patients globally and around 155,000 deaths yearly [4].

Depending on patient immunity and the serotype of the particular strain involved, NTS invades past the gastrointestinal tract in about 5% of the patients causing bacteremia along with other systemic diseases [5]. Consequently, the infection of the central nervous system (CNS) is rare and unusual. CNS infections include encephalitis, meningitis, ventriculitis, brain abscesses, and subdural/epidural empyemas [6]. Subdural empyemas (SDE) form around one-fifth of all CNS infections [7]. Only 11 cases of *Salmonella* group D SDE have been described in literature from 1986 to 2022 [8]. With rising numbers of patients becoming immunocompromised due to primary diseases or aggressive

chemotherapy treatments, the incidence of invasive NTS infections seems to be on the rise [9]. Early diagnosis and prompt medical treatment can be vital due to the high mortality and morbidity associated with SDE. In this report, we describe an atypical presentation of subdural empyema due to disseminated NTS infection by *Salmonella enterica serovar Dublin* (*S. Dublin*). This unique presentation challenges the general notion that *S. Dublin* infection typically causes gastrointestinal symptoms amongst infected individuals.

Case presentation

We report a case of an 83-year-old female who presented to the emergency department with signs of altered mentation of two days duration. The patient, a previous tobacco smoker, has a past medical history of hypertension, hypercholesterolemia, hypothyroidism, and squamous cell lung carcinoma status post lumpectomy and radiation therapy currently in remission. Accompanying family reported patient developing nonspecific signs and symptoms of fatigue, lethargy and cough prior to her acute mentation change without complaints of abdominal symptoms including discomfort or change in bowel habit/pattern, but did endorse the patient falling without head injury 2 weeks prior to her illness. The emergency medical service found the patient to

* Corresponding author.

E-mail address: sbugazil@hfhs.org (S. Bugazia).

<https://doi.org/10.1016/j.idcr.2024.e02111>

Received 11 June 2024; Accepted 2 November 2024

Available online 6 November 2024

2214-2509/© 2024 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

be febrile at 101.7 Fahrenheit.

On admission, patient was febrile with an initial temperature of 101.7 Fahrenheit with clinical examination noting bilateral weakness. She was alert but not verbally responsive and only intermittently following commands. Head computed tomography (CT) obtained showed acute to subacute and acute on chronic subdural hematomas overlying the left and right cerebral convexities measuring up to 2 cm and 0.8 cm in thickness respectively [Fig. 1]. The head CT also showed an associated mass effect on the left cerebral hemisphere with extensive sulcal effacement resulting in a mild 4 mm left-to-right midline shift without brain parenchymal herniation or hydrocephalus [Fig. 1]. A chest X-ray was also done to investigate the reported cough, revealing a pleural effusion with possible infiltrates in addition to a urinalysis that was grossly positive for infection, with IV Ceftriaxone and Azithromycin subsequently initiated for empiric coverage of respiratory and genitourinary sources of infection.

Patient later underwent neurosurgical intervention with frontal burr hole evacuations of the subdural hematomas with drain placement. Intra-operatively, surgical aspirates were noted to be foul smelling, with both cerebral fluid and blood cultures obtained growing *S. Dublin*, proving the intra-cerebral fluid collection to be a subdural empyema. With urine cultures growing *E. Coli* and blood/cerebral fluid cultures growing pan-susceptible *Salmonella enterica* serovar Dublin, antibiotic coverage was transitioned to IV Ceftriaxone monotherapy with a tentative treatment duration of 6 weeks through a peripherally inserted central catheter.

After a prolonged intensive care stay, the patient was ultimately stabilized with discharge from the ICU into the general medical ward and subsequently into rehab where she was noted to have made a full recovery.

Discussion

Subdural empyema (SDE) is an accumulation of pus between the dura mater and the arachnoid space, typically as a result of an existing infection spreading from otitis media, upper respiratory tract, or sinus cavities. Otolaryngologic infections, particularly sinusitis, account for 40–80 % of SDE cases [10]. Additionally, up to 20 % of these infections are a sequela of CNS operations or head injuries [11]. Common symptoms of SDE are fever, headache, seizures, changes in consciousness and mentation, amongst other focal neurological deficits [12,13]. *Staphylococcus aureus*, *Streptococcus pneumoniae*, and *Haemophilus influenzae* are common pathogens associated with SDE [14]. However, this case of invasive CNS infection was caused by the first documented instance of NTS *S. Dublin* causing SDE. Among the rare cases of *Salmonella* SDE previously reported, infants and children were more commonly affected [15,16]. Whereas in adults, there have been only twelve documented cases, some of whom were immunocompromised including individuals with malignancies and acquired immune deficiency syndrome [15].

S. Dublin tends to infect elderly individuals and those with preexisting debilitating conditions [17–19]. In the majority of reported cases, infections affect patients in the extremities of age, with only two prior reports of *S. Dublin* causing invasive CNS infection in the form of

meningitis [19–21]. In this report, the patient is an 83-year-old female with a history of squamous lung carcinoma which may have made her more susceptible to the infection.

Normally, non-typhoidal *Salmonella* infections are contained in the lamina propria and the local lymphatics of the gastrointestinal tract [22]. However, *S. Dublin* is known, as implied in the literature [18,20], to cause a high incidence of invasive disease with extra-intestinal involvement. This occurs due to specific virulence genes that help *S. Dublin* invade and reach the bloodstream causing bacteremia which could easily develop into sepsis in a patient with weakened immunity as in our presented case. Timely identification and prompt medical treatment can be lifesaving because of the high mortality and morbidity of *S. Dublin* sepsis and SDE [23].

This case of SDE had a very unique route of bacterial seeding as the patient did not suffer from typical risk factors of having a nearby infection in the head or neck or an infection from surgery. Additionally, our patient also lacked gastrointestinal symptoms associated with this classically enteric pathogen. In our case, the spread of the infection, we postulate, was hematogenous due to the presence of an existing bacteremia by *S. Dublin* which later on caused septicemia, however the exact source of infection remains unclear.

For subdural empyema patients, several treatment options are considered: conservative drug therapy, craniotomy, and extra-cranial drainage [24]. Early researchers, such as Dill et al. [25], suggested that the type of surgical approach had minimal impact on clinical outcomes if the procedure was performed promptly and the pus was removed thoroughly. However, more recent studies indicate that craniotomy is associated with lower mortality and recurrence rates compared to other drainage methods, leading most experts to recommend craniotomy for treatment [26–28]. Likewise in the case at hand, burr hole with evacuation of her fluid collections were performed and proved sufficient to eliminate the subdural empyemas. With the help of added medical treatment, the patient recovered fully.

The medical treatment of this case along its course also shifted from Cefepime, Ciprofloxacin, and Ceftriaxone to only Ceftriaxone at a high dose of 2 g twice daily. This change of treatment was done prior to the resulting of the organisms antibiotic sensitivity on culture, with Ceftriaxone ultimately chosen due its higher penetration rate of high doses to the blood-brain barrier [29]. Later on, after culture results showed excellent sensitivity of *S. Dublin* to Ceftriaxone, the treatment regimen was continued for a total duration of 56 days with full patient recovery.

Further literature is needed to explore the unusual presentations of NTS *S. Dublin* causing SDE, specifically in the elderly and immunocompromised. NTS should be taken into account as possible culprits of CNS infection even in the absence of gastrointestinal symptoms. Additionally, the presentation and epidemiology of the salmonella species in general causing subdural empyema and other CNS infections should be further studied and observed.

Conclusion

We report this case to shed light on the first documented atypical presentation of a subdural empyema caused by *Salmonella enterica*

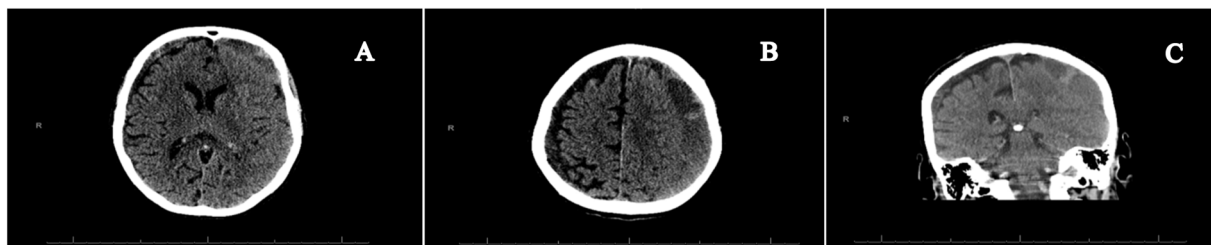


Fig. 1. A and B are coronal sections of patient's brain CT showing subdural hematoma. C shows a sagittal section of brain CT showing right and left subdural hematoma.

serovar Dublin, highlighting an unusual manifestation of a classically enteric pathogen. Prompt identification and targeted antimicrobial therapy, along with surgical intervention, proved crucial in the management of this rare and life-threatening infection. Our case also emphasizes the need for further awareness identifying potential extraintestinal manifestations of Salmonella infections, especially in immunocompromised individuals or those with underlying health conditions. Further research and case documentation are necessary to better understand the pathophysiology, optimal management strategies, and potential preventive measures for rare manifestations of Salmonella infections.

Ethical approval

This case report was conducted in accordance with the Declaration of Helsinki. The collection and evaluation of all protected patient health information was performed in a Health Insurance Probability and Accountability Act (HIPAA) compliant manner.

Author contributions

SB, AS, and AS designed case report layout and drafted the manuscript. MR revised the CT imaging and drafted the radiological legends. MM and MR oversaw manuscript drafting. MM and MR provided care for the patient during their intensive care admission. SB obtained written informed consent from the patient for publication of this clinical vignette manuscript including demonstrated images with a copy readily available for review by the journal's Editor-in-Chief upon their request. All involved authors reviewed the manuscript thoroughly with final consensus on the final submitted version of the manuscript.

Consent

Written informed consent was obtained from the patient for publication of their clinical vignette manuscript including demonstrated images with a copy readily available for review by the journal's Editor-in-Chief upon their request.

Funding

This paper was not funded by any organization or individuals.

CRedit authorship contribution statement

Seif Bugazia: Writing – original draft. **Ahmed Selim:** Conceptualization, Writing – original draft. **Anuradha Sreenivasan:** Supervision, Writing – original draft, Writing – review & editing. **Mohammed Rehman:** Supervision, Validation, Writing – review & editing. **Mohammed Mahmoud:** Supervision, Validation, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

- [1] Popa GL, Papa MI. Salmonella spp. infection - a continuous threat worldwide. *Germes* 2021;11(1):88–96. <https://doi.org/10.18683/germes.2021.1244>.
- [2] Gal-Mor O, Boyle EC, Grassl GA. Same species, different diseases: how and why typhoidal and non-typhoidal Salmonella enterica serovars differ. *Front Microbiol* 2014;5:391. <https://doi.org/10.3389/fmicb.2014.00391>.
- [3] Nicholas AF, Gordon D, Robert AK, Robert SH, Melita AG. Invasive non-typhoidal salmonella disease: an emerging and neglected tropical disease in Africa. *Lancet* 2012;379(9835):2489–99. [https://doi.org/10.1016/S0140-6736\(11\)61752-2](https://doi.org/10.1016/S0140-6736(11)61752-2).
- [4] Gong B, Li H, Feng Y, Zeng S, Zhuo Z, Luo J, et al. Prevalence, serotype distribution and antimicrobial resistance of non-typhoidal salmonella in hospitalized patients in Conghua District of Guangzhou, China. *Front Cell Infect Microbiol* 2022;12:805384. <https://doi.org/10.3389/fcimb.2022.805384>.
- [5] Hohmann EL. Nontyphoidal salmonellosis. *Clin Infect Dis: Publ Infect Dis Soc Am* 2001;32(2):263–9. <https://doi.org/10.1086/318457>.
- [6] IDKD Springer Series. In: Hodler J, Kubik-Huch RA, von Schulthess GK, editors. *Diseases of the Brain, Head and Neck, Spine 2020–2023: Diagnostic Imaging*. Cham (CH): Springer Copyright 2020, The Editor(s) (if applicable) and The Author(s). This book is an open access publication.; 2020.
- [7] Mortazavi MM, Quadri SA, Suriya SS, Fard SA, Hadidchi S, Adl FH, et al. Rare concurrent retroclival and pan-spinal subdural empyema: review of literature with an uncommon illustrative case. *World Neurosurg* 2018;110:326–35. <https://doi.org/10.1016/j.wneu.2017.11.082>.
- [8] Lu HF, Yue CT, Kung WM. Salmonella group d1 subdural empyema mimicking subdural hematoma: a case report. *Infect Drug Resist* 2022;15:6357–63. <https://doi.org/10.2147/idr.s388101>.
- [9] Gordon MA. Salmonella infections in immunocompromised adults. *J Infect* 2008;56(6):413–22. <https://doi.org/10.1016/j.jinf.2008.03.012>.
- [10] Silverberg AL, DiNubile MJ. Subdural empyema and cranial epidural abscess. *Med Clin North Am* 1985;69(2):361–74. [https://doi.org/10.1016/s0025-7125\(16\)31048-3](https://doi.org/10.1016/s0025-7125(16)31048-3).
- [11] Wu TJ, Chiu NC, Huang FY. Subdural empyema in children—20-year experience in a medical center. *J Microbiol, Immunol, Infect = Wei mian yu gan ran za zhi* 2008;41(1):62–7.
- [12] Sellick Jr JA. Epidural abscess and subdural empyema. *J Am Osteopath Assoc* 1989;89(6):806–10.
- [13] Osborn MK, Steinberg JP. Subdural empyema and other suppurative complications of paranasal sinusitis. *Lancet Infect Dis* 2007;7(1):62–7. [https://doi.org/10.1016/s1473-3099\(06\)70688-0](https://doi.org/10.1016/s1473-3099(06)70688-0).
- [14] Suthar R, Sankhyan N. Bacterial infections of the central nervous system. *Indian J Pediatr* 2019;86(1):60–9. <https://doi.org/10.1007/s12098-017-2477-z>.
- [15] Hanel RA, Araújo JC, Antoniuk A, Da Silva Ditzel LF, Flenik Martins LT, Linhares MN. Multiple brain abscesses caused by Salmonella typhi: case report. *Surg Neurol* 2000;53(1):86–90. [https://doi.org/10.1016/s0090-3019\(99\)00161-5](https://doi.org/10.1016/s0090-3019(99)00161-5).
- [16] Chen KM, Lee HF, Chi CS, Huang FL, Chang CY, Hung HC. Obscure manifestations of Salmonella subdural empyema in children: case report and literature review. *Childs Nerv Syst* 2011;27(4):591–5. <https://doi.org/10.1007/s00381-010-1274-z>.
- [17] Zumla A, Mandell, Douglas, and Bennett's principles and practice of infectious diseases. *The Lancet Infectious diseases*. 10. Copyright © 2010 Elsevier Ltd. All rights reserved.; 2010. p. 303–4.
- [18] Kanungo S. *Nelson Textbook of Pediatrics*, 18th edition. Robert M. Kliegman, MD, Hal B. Jenson, MD, Richard E. Behrman, MD, and Bonita F. Stanton, MD. ISBN 978-1-4160-2450-7. Philadelphia, Saunders, 2007, 3147 pp. *Journal of Pediatric and Adolescent Gynecology - J PEDIATR ADOLESC GYNECOL*. 2009;22:67–doi: 10.1016/j.jpjag.2008.01.078.
- [19] Salmonella dublin and raw milk consumption—California. *MMWR Morbidity and mortality weekly report*. 1984;33(14):196–8.
- [20] Diwan N. Salmonella dublin meningitis. Report of a case. *Indian J Pediatr* 1977;44(351):110–1. <https://doi.org/10.1007/bf02862888>.
- [21] Padelt H, Krüger W. [Purulent meningitis with detection of Salmonella dublin and Haemophilus influenzae]. *Kinderarzt Prax* 1968;36(7):305–8.
- [22] Dias M, Antony B, Pinto H, Rekha B. Salmonella enterica serotype Dublin bacteraemia mimicking enteric fever. *Indian J Med Microbiol* 2009;27(4):365–7. <https://doi.org/10.4103/0255-0857.55463>.
- [23] Dhanoa A, Fatt QK. Non-typhoidal Salmonella bacteraemia: epidemiology, clinical characteristics and its' association with severe immunosuppression. *Ann Clin Microbiol Antimicrob* 2009;8:15. <https://doi.org/10.1186/1476-0711-8-15>.
- [24] Bok AP, Peter JC. Subdural empyema: burr holes or craniotomy? a retrospective computerized tomography-era analysis of treatment in 90 cases. *J Neurosurg* 1993;78(4):574–8. <https://doi.org/10.3171/jns.1993.78.4.0574>.
- [25] Dill SR, Cobbs CG, McDonald CK. Subdural empyema: analysis of 32 cases and review. *Clin Infect Dis: Publ Infect Dis Soc Am* 1995;20(2):372–86. <https://doi.org/10.1093/clinids/20.2.372>.
- [26] Kobayashi N, Ishikawa T, Muto T, Kawai H, Hikichi K, Moroi J, et al. Infected organized subdural hematoma after burr hole operation: a case report. *Jpn J Neurosurg* 2009;18(6):464–9.
- [27] French H, Schaefer N, Keijzers G, Barison D, Olson S. Intracranial subdural empyema: a 10-year case series. *Ochsner J* 2014;14(2):188–94.
- [28] Waseem M, Khan S, Bomann S. Subdural empyema complicating sinusitis. *J Emerg Med* 2008;35(3):277–81. <https://doi.org/10.1016/j.jemermed.2007.07.019>.
- [29] Prášil P, Buchta V, Paterová P, Hanovcová I. Penetration of ceftriaxone into the cerebrospinal fluid and its relationship to inflammatory markers during bacterial meningitis. *Klin Mikrobiol a infekční Lek* 2010;16(2):64–72.