JOURNAL OF NEUROSURGERY:
Case Lessons

J Neurosurg Case Lessons 5(4): CASE22458, 2023
DOI: 10.3171/CASE22458

Concomitant brain abscess and spinal cord abscess in an immunocompetent teenage male: illustrative case

Piiamaria S. Virtanen, MD,[1] Med Jimson D. Jimenez, MS,[2] V. Jane Horak, BA,[2] Virendra R. Desai, MD,[1] John J. Manaloor, MD,[3] and Jeffrey S. Raskin, MS, MD[4,5]

[1]Department of Neurological Surgery, Section of Pediatric Neurosurgery, Riley Hospital for Children, Indiana University School of Medicine, Indianapolis, Indiana; [2]Chicago Medical School, Rosalind Franklin University of Medicine and Science, North Chicago, Illinois; [3]Department of Pediatrics, Section of Pediatric Infectious Disease, The Children's Hospital of San Antonio, Baylor College of Medicine, San Antonio, Texas; [4]Division of Pediatric Neurosurgery, Ann and Robert H. Lurie Children's Hospital, Chicago, Illinois; and [5]Department of Neurosurgery, Northwestern University Feinberg School of Medicine, Chicago, Illinois

BACKGROUND Multiple bilateral brain abscesses occur rarely in immunocompetent patients. Hematogenous spread to the central nervous system (CNS) allows suppuration and abscess formation in the privileged immune environment of the CNS; hematogenous spread to the spinal cord is extremely rare and the combination of multifocal brain abscesses and intramedullary abscesses has not been reported. This report presents a rare presentation and diagrams a treatment algorithm involving iterative minimal access surgeries and prolonged medical management.

OBSERVATIONS The authors present a case of an 18-year-old male with numerous multifocal and bilateral intraparenchymal abscesses and a medically resistant C5 intramedullary spinal cord abscess. The symptomatic patient had a left oculomotor palsy and left hemiparesis, ultimately undergoing ultrasound-guided aspiration of abscesses in the left frontal and left cerebral peduncle. Following transient motor improvement, he evolved tetraparesis prompting spinal cord imaging and emergent ultrasound-guided needle aspiration of an occult C5 intramedullary spinal cord abscess. The patient received appropriate medical therapy, completed inpatient rehabilitation, and made a full recovery.

LESSONS Needle- and ultrasound-guided catheter drainage of CNS abscesses should be considered for symptomatic lesions. Following the neurological examination closely is extremely important; if the expected neurological improvement is delayed or regresses, then expanded imaging is warranted.

https://thejns.org/doi/abs/10.3171/CASE22458

KEYWORDS brain abscess; spinal cord; surgical management; brainstem; *S. intermedius*

Multifocal brain abscesses commonly result from hematogenous spread, including cardiopulmonary sources such as cardiac valve disease, although presentations resulting from occult etiologies are also reported.[1] Common infectious agents found in brain abscesses include viridans streptococci, *Staphylococcus aureus*, and anaerobes such as *Peptostreptococcus* and *Fusobacterium*, which tend to be polymicrobial. Fungal organisms such as *Cryptococcus neoformans* and *Histoplasma capsulatum* also occur in immunocompromised individuals. Local dysfunction, global increases in intracranial pressure, and cerebrospinal fluid (CSF) flow dynamic abnormalities are all contributors to the morbidity of this condition. In children with known cyanotic heart disease and right-to-left shunts, brain abscesses were found to be a significant risk factor.[2,3] Moreover, during the last 2 decades, there has been a shift in the case origins of abscesses, with postsurgical trauma surpassing otogenic abscess.[4] Patients with such a complicated infection are treated with a combination of surgical and medical management. There exist no surgical guidelines, and the antimicrobial therapy remains empirical prior to the identification of the causative pathogen.

Widely metastatic abscess formation within the central nervous system (CNS) is rare. There are case reports describing bilateral brain abscesses, but often in patients with concomitant cardiac

ABBREVIATIONS CHSO = total hemolytic, complement 50; CNS = central nervous system; CSF = cerebrospinal fluid; EVD = external ventricular drain; HD = hospital day; Ig = immunoglobulin; MRI = magnetic resonance imaging; PCR = polymerase chain reaction; POD = postoperative day.

INCLUDE WHEN CITING Published January 23, 2023; DOI: 10.3171/CASE22458.
SUBMITTED October 23, 2022. **ACCEPTED** November 29, 2022.

nidus or who have immunocompromised states.[5,6] There is a significant overlap of neurological dysfunction caused by intracerebral and intramedullary abscesses, which could obscure the diagnosis of additional lesions, and specifically, the clinical manifestation of spinal cord pathology could be overlooked. Intramedullary abscesses, although rare, have been described.[1,7–11] These are typically caused by direct extension from congenital lesions rather than from hematogenous spread.

Herein, we describe the presentation and management of the rare combination of a spinal cord abscess in the setting of an evolving care cycle for multifocal brain abscesses found in an immunocompetent adolescent.

Illustrative Case

Presurgical Hospital Course

An 18-year-old left-handed male with a history of histoplasmosis-induced pericarditis 7 years earlier and recent travel to Florida initially presented to a referring institution with fever, cough, altered mental status, left hemiparesis and ophthalmoplegia, and ataxia. Emergent computed tomography of the head without contrast demonstrated numerous lesions suspicious for brain abscesses. CSF was obtained by lumbar puncture, empirical vancomycin and cefepime were given, and he was emergently transferred to our facility.

On arrival, he was afebrile with similar examination findings. Contrast brain magnetic resonance imaging (MRI) demonstrating $>$ 30 ring-enhancing lesions in both cerebral hemispheres and the left cerebral peduncle, with layering in the occipital horn of the left lateral ventricle were consistent with ventriculitis (Fig. 1). A medical workup into the source is summarized in Table 1.

Upon arrival, his empirical antimicrobial coverage was expanded to cover anaerobic and fungal organisms, including vancomycin (1750 mg 3 times/day), ceftriaxone (2000 mg twice/day), metronidazole (500 mg 4 times/day), and liposomal amphotericin B (444.5 mg every day). Vancomycin and metronidazole were discontinued on hospital day 3 and 4, respectively. No improvement in the patient's cranial nerve examination, weakness, or fluctuating encephalopathy, as well as a lack of microorganism growth, prompted cranial surgery.

Cranial Surgery

The goals of surgery included CSF diversion for management of ventriculitis, catheter aspiration of the cerebral peduncle abscess, and specimen acquisition for optimal microbiological diagnosis. A small left frontal frameless stereotactic craniotomy was performed, through which we used ultrasound guidance to (1) drain 2 superficial left frontal abscesses, (2) place an antibiotic-impregnated catheter in the left cerebral peduncle abscess, and (3) place a left lateral ventricle external ventricular drain (EVD).

A total of 15 mL of liquid purulence was evacuated and sent for culture, including 9 mL from the cerebral peduncle catheter. Intrathecal vancomycin and gentamicin were placed through the EVD into the left lateral ventricle. The left lateral ventricle EVD and the midbrain abscess drain were leveled at 20 and 0 cm H_2O above the tragus, respectively.

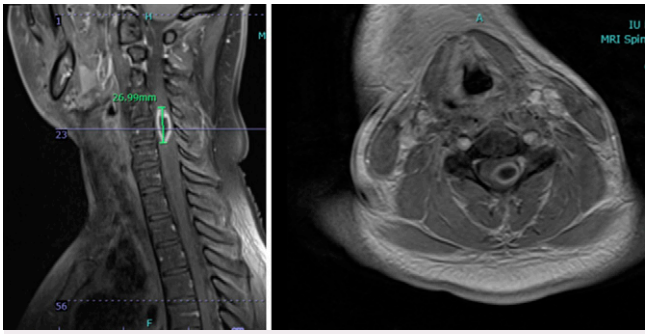

FIG. 1. Sagittal (**left**) and axial (**right**) postcontrast T1-weighted MRI sequences demonstrating the cervical abscess. The axial section was selected at the level where an ultrasound-guided needle was placed orthogonally through the dure into the abscess.

Postoperative Course

The abscess cultures ultimately did not recover any bacteria or fungi; however, few gram-positive cocci were evident on microscopy and vancomycin was restarted. The patient had improved left hemiparesis and the midbrain drain was discontinued due to no output. He continued to have persistent fever spikes and on postoperative day (POD) 3, he developed acutely worsening left-sided weakness and new right upper extremity weakness most notable in the deltoid muscle. Emergent brain MRI demonstrated expected evolution of multifocal brain abscesses; however, MRI of the spine revealed C4–6 intramedullary abscess with associated edema from the obex to T1; this pathology correlated with the decline in neurological examination and we returned to the operating room for drainage.

Spinal Surgery

We performed C5 and C6 laminotomies and ultrasound-guided transdural needle aspiration of an intramedullary spinal cord abscess using a 14-gauge angiocatheter. Intraoperative neuromonitoring using somatosensory evoked potentials and motor evoked potentials were improved following aspiration of 2.5 mL of purulent exudate. Intraoperative neuro-ultrasound showed successful evacuation without residual abscess, which was redemonstrated on postoperative spine MRI (Fig. 2).

Postoperative Course

Universal 16S RNA polymerase chain reaction (PCR) analysis identified, as a sole detectable pathogen, *Streptococcus intermedius*, and allowed for better tailoring of the antimicrobial regimen. The turnaround time for the positive PCR identification was approximately 48 hours. The patient became afebrile following cervical spine abscess drainage on POD 4. The patient had slow improvement in neurological function with persistent weakness and hyperreflexia. The EVD was ultimately weaned without replacement. Flow cytometry was negative for chronic granulomatous disease. CSF and blood cultures remained negative throughout admission. The expected evolution of multifocal CNS abscesses continued with radiographic lag, and dexamethasone (10 mg once followed by 4 mg every 6 hours) was added on hospital day (HD) 16 to his medical regimen, leading to significant improvement in neurological function. He was transferred to acute inpatient rehabilitation on HD 19, improved significantly, and ultimately discharged on HD 48.

Upon completing 80 days of intravenous vancomycin, his antimicrobial therapy was converted to oral linezolid, which he received for an additional 4 weeks. At follow-up 6 months after diagnosis, he had no residual neurological deficits and normal gait and mobility. Neuroimaging demonstrates only minimal persistent enhancement

TABLE 1. Summary of the medical workup

Study	Result
CT chest	Evidence of granulomatous disease and histoplasmosis
CT abdomen and pelvis	Negative for fungal etiology
Transthoracic echocardiogram	Negative for vegetations, thrombus, mass, and effusion
Ophthalmology evaluation	Negative for fungal endophthalmitis
COVID-19	Negative
Respiratory virus profile (RVP)	Negative
Meningitis-encephalitis panel	Negative
Serum histoplasma antigen	Negative IgM and IgG
Urine histoplasma antigen	Negative IgM and IgG
Lumbar puncture CSF	TNC 515, RBC 399, protein 133, glucose 31, positive histoplasma IgG, negative histoplasma IgM
CBC	WBC 19.7, 78% neutrophils
Inflammatory markers	CRP 4.2 mg/L
Coagulopathy panel	PT 17.7 seconds, INR 1.56

CBC = complete blood count; COVID-19 = coronavirus disease 2019; CRP = C-reactive protein; CT = computed tomography; IgM = immunoglobulin M; IgG = immunoglobulin G; INR = international normalized ratio; PT = prothrombin time; RBC = red blood cell count; TNC = total nucleated cells; WBC = white blood cell count.

of spinal cord abscesses and complete resolution of brain abscesses (Fig. 3).

Immunological and Genetic Findings

Upon initial immunological evaluation (HD 11), he was found to have a low complement total (total hemolytic, complement 50 [CH50] level 83, reference range 101–300). This normalized at 2-month follow-up (CH50 level 120). On initial evaluation, he had normal immunoglobulin (Ig) A (IgA; 218 mg/dL; reference range 60–400), IgG (826 mg/dL; reference range 700–1,500), IgM (80 mg/dL; reference range 60–300), IgE (18 kU/L; reference range 2–114), and mannose binding lectin (2574 ng/mL; normal ≥ 51) levels. He had neither neutrophil oxidative burst deficiency nor a T-cell function deficiency. He also

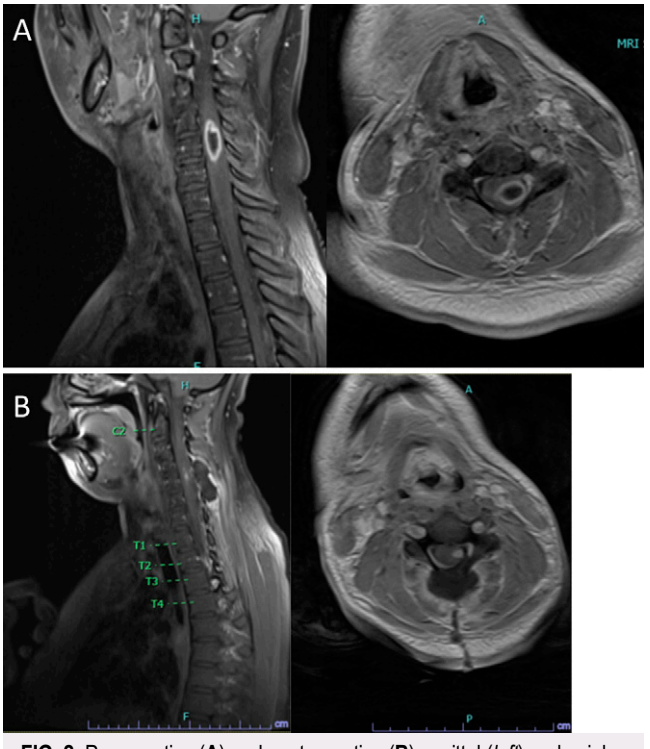

FIG. 2. Preoperative (**A**) and postoperative (**B**) sagittal (*left*) and axial (*right*) postcontrast T1-weighted MRI demonstrating successful drainage of the intramedullary abscess resulting in a small T1 contrast-enhancing lesion.

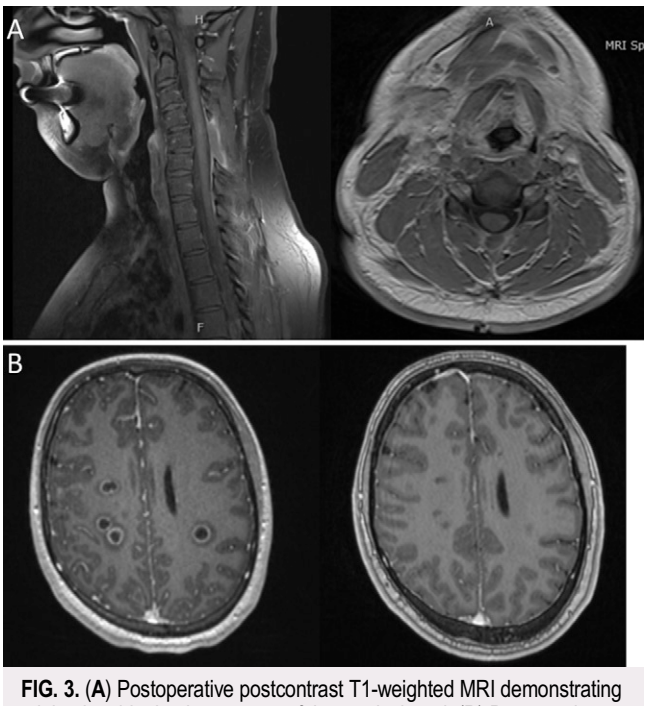

FIG. 3. (**A**) Postoperative postcontrast T1-weighted MRI demonstrating minimal residual enhancement of the cervical cord. (**B**) Preoperative (*left*) and postoperative (*right*) axial postcontrast T1-weighted MRI demonstrating complete resolution of brain abscesses with resultant gliotic scars.

underwent formal genetics evaluation, and no underlying genetic predispositions were found.

Discussion

Observations

Here, we present a rare case of concomitant intramedullary spinal cord and multifocal brain abscess formation. Acute-onset tetraparesis led to identification of a large C4–5 intramedullary abscess. Emergent laminotomy with transdural ultrasound-guided needle drainage was performed with improvement in neurological symptoms.

Intraparenchymal brain and intramedullary spine abscesses generally occur in isolation. There are only a handful of pediatric cases reported with multifocal brain abscesses with coincident intramedullary spinal cord abscess, and these are secondary to brucellosis, tuberculosis, and Bacteroides.[9,12–14]

Dermal sinus tracts represent the most common cause of isolated spinal cord abscess, while hematogenous spread and cardiopulmonary pathology are more common in multifocal lesions.[15] The patient's infectious workup revealed *S. intermedius* exclusively by 16S RNA PCR, supporting his arguably classical imaging findings.[16–19] Universal PCR can screen for a broad range of bacterial, fungal, and mycobacterial targets, and discounted the presence of other pathogens and the possibility of a polymicrobial process. Other published case studies suggest that *S. intermedius* alone can cause severe CNS infections in addition to deep tissue infections, even in otherwise healthy individuals without immunocompromise.[17–19]

Limitations

This single case study adds to the neurosurgical literature but is not the sole evidence for management of concomitant spinal cord and brain abscess. The article highlights the importance of iterative and frequent full neurological examinations and presents the feasibility of this minimal-access neurosurgical treatment approach. It is hoped that this allows others to compare their findings when presented with a similar case and expand the current literature.

Lessons

A detailed neurological examination must be performed in patients presenting with multifocal brain abscesses, and any signs of symptoms unexplained by cranial imaging should warrant strong consideration for complete neuroaxis imaging. In the case of spinal cord or brain stem abscesses, given the small area of highly eloquent tissue, one should consider early drainage given the natural history of these lesions to slightly enlarge as they evolve despite antibiotics.[20,21] In our patient, acute tetraparesis was unexplained by his brain MRI, prompting radiographic evaluation of his spinal cord and subsequent aspiration.

Intraparenchymal and intramedullary abscesses are rarely present simultaneously. In these cases, the neurological examination is complicated by multifactorial etiologies, including perilesional edema, ventriculitis, seizures, and encephalopathy. Alternative surgical strategies involve complete extirpation or open drainage of abscesses; both of these approaches have the potential to cause severe corridor-associated morbidity. This case report demonstrates why unexpected neurological deficits should prompt further imaging and, in this case, led to needle drainage of a spine abscess. Needle- and ultrasound-guided catheter drainage of CNS abscesses should be considered for symptomatic lesions. Testing via 16S RNA broad-range PCR sequencing can increase the potential for pathogen detection and provide an opportunity to tailor medical therapy.

References

1. Chan CT, Gold WL. Intramedullary abscess of the spinal cord in the antibiotic era: clinical features, microbial etiologies, trends in pathogenesis, and outcomes. *Clin Infect Dis.* 1998;27(3):619–626.
2. Takeshita M, Kagawa M, Izawa M, Takakura K. Current treatment strategies and factors influencing outcome in patients with bacterial brain abscess. *Acta Neurochir (Wien).* 1998;140(12):1263–1270.
3. Tekkök İH, Erbengi A. Management of brain abscess in children: review of 130 cases over a period of 21 years. *Childs Nerv Syst.* 1992;8(7):411–416.
4. Carpenter J, Stapleton S, Holliman R. Retrospective analysis of 49 cases of brain abscess and review of the literature. *Eur J Clin Microbiol Infect Dis.* 2007;26(1):1–11.
5. Epstein NE, Hollingsworth R, Black K, Farmer P. Fungal brain abscesses (aspergillosis/mucormycosis) in two immunosuppressed patients. *Surg Neurol.* 1991;35(4):286-289.
6. Pruitt AA, Rubin RH, Karchmer AW, Duncan GW. Neurologic complications of bacterial endocarditis. *Medicine (Baltimore).* 1978;57(4):329–343.
7. Al Barbarawi M, Khriesat W, Qudsieh S, Qudsieh H, Loai AA. Management of intramedullary spinal cord abscess: experience with four cases, pathophysiology and outcomes. *Eur Spine J.* 2009;18(5):710–717.
8. Bunyaratavej K, Desudchit T, Pongpunlert W. Holocord intramedullary abscess due to dermal sinus in a 2-month-old child successfully treated with limited myelotomy and aspiration. Case report. *J Neurosurg.* 2006;104(4)(suppl):269–274.
9. Karaaslan B, Ulkü G, Ucar M, Demirdağ TB, İnan A, Börcek AÖ. Intramedullary dermoid cyst infection mimicking holocord tumor: should radical resection be mandatory? A case report. *Childs Nerv Syst.* 2016;32(11):2249–2253.
10. Martínez-Lage JF, Esteban JA, Poza M, Casas C. Congenital dermal sinus associated with an abscessed intramedullary epidermoid cyst in a child: case report and review of the literature. *Childs Nerv Syst.* 1995;11(5):301–305.
11. Morandi X, Mercier P, Fournier HD, Brassier G. Dermal sinus and intramedullary spinal cord abscess. Report of two cases and review of the literature. *Childs Nerv Syst.* 1999;15(4):202–208.
12. Keihani-Douste Z, Daneshjou K, Ghasemi M. A quadriplegic child with multiple brain abscesses: case report of neurobrucellosis. *Med Sci Monit.* 2006;12(12):CS119-CS122.
13. Liu HW, Tsai MC. Intra-medullary abscess of the spinal cord at the high cervical level. *Formos J Surg.* 2012;45(6):194–197.
14. Fan G, Gu J, He S, Cai X. Case report. Comprehensive management of cervical epidural spinal abscess followed by brain abscesses: a life-threatening and tortuous case. *Int J Clin Exp Med.* 2016;9(8):16867–16872.
15. Bevan R, Leach P. Infected congenital cervical dermal sinuses leading to spinal cord abscess: two case reports and a review of the literature. *Childs Nerv Syst.* 2021;37(1):225–228.
16. Bhatia NS, Farrell JJ, Sampath R, et al. Identification of Streptococcus intermedius central nervous system infection by use of PCR and electrospray ionization mass spectrometry. *J Clin Microbiol.* 2012;50(12):4160–4162.
17. Darlow CA, McGlashan N, Kerr R, et al. Microbial aetiology of brain abscess in a UK cohort: prominent role of Streptococcus intermedius. *J Infect.* 2020;80(6):623–629.
18. Mishra AK, Fournier PE. The role of Streptococcus intermedius in brain abscess. *Eur J Clin Microbiol Infect Dis.* 2013;32(4):477–483.
19. Yamamoto M, Fukushima T, Ohshiro S, et al. Brain abscess caused by Streptococcus intermedius: two case reports. *Surg Neurol.* 1999; 51(2):219–222.
20. Chang KH, Song IC, Kim SH, et al. In vivo single-voxel proton MR spectroscopy in intracranial cystic masses. *AJNR Am J Neuroradiol.* 1998;19(3):401–405.

21. Gelabert-González M, Serramito-García R, García-Allut A, Cutrín-Prieto J. Management of brain abscess in children. *J Paediatr Child Health.* 2008;44(12):731–735.

Disclosures

Dr. Raskin reported personal fees from Medtronic outside the submitted work. No other disclosures were reported.

Author Contributions

Conception and design: Raskin, Virtanen, Desai, Manaloor. Acquisition of data: Raskin, Virtanen, Manaloor. Analysis and interpretation of data: Raskin, Virtanen, Horak, Desai, Manaloor. Drafting of the article: Raskin, Virtanen, Jimenez, Manaloor. Critically revising the article: all authors. Reviewed submitted version of manuscript: Raskin, Virtanen, Jimenez, Desai, Manaloor. Approved the final version of the manuscript on behalf of all authors: Raskin. Statistical analysis: Raskin. Administrative/technical/material support: Raskin, Jimenez, Horak. Study supervision: Raskin, Horak.

Correspondence

Jeffrey S. Raskin: Northwestern University Feinberg School of Medicine, Chicago, IL. jraskin@luriechildrens.org