Brain Abscess of Suspected Otogenic Origin in a Seven-Year-Old Child with Atypical Neurologic Signs

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Abstract

Brain abscesses are a rare life-threatening condition in children. Even though the mortality rate has become relatively low in recent years, incomplete recovery remains a major concern. Clinical sequelae are associated with delayed diagnosis and treatment, often due to variable or subtle symptoms. We present a child with a large brain abscess whose diagnosis was complicated by atypical neurological symptoms. The diagnostic process, treatment and outcome are discussed. Brain abscesses may present with variable neurological signs in children. It remains clear that a high index of suspicion is crucial for making a timely diagnosis.

Introduction

Brain abscesses are a rare but potentially life-threatening condition in children. The incidence has decreased over the last decennia due to global improvements in health care and widespread use of antibiotics. The international incidence rate is 0.3–1.8 per 100,000 persons, and children account for 25% of cases (1, 2). The incidence is higher in developing countries (2, 3). Underlying predisposing conditions include congenital heart disease and immunosuppression (1, 2, 4, 5). Notwithstanding a decrease in mortality over the years, recent data still show mortality rates of 4-12% in children (2, 3, 5). In addition, only 50-70% of children make a full recovery. Factors associated with incomplete recovery and a higher mortality rate are delayed diagnosis, severe neurologic impairment at presentation or rapid neurological deterioration, and development of complications (1, 2, 5, 6). The predominant neurological sequel is epilepsy. Other possible sequelae include motor/visual/hearing deficits, hydrocephalus and language impairment (7, 8).

Brain abscesses are most commonly the result of pathogens spreading to the brain through contiguous sites (middle ear, mastoid or sinus infections) or through a skull discontinuity (head trauma or neurosurgery). Hematologic spread is less frequent and is typically associated with underlying congenital heart disease, pulmonary infection, or pulmonary arteriovenous fistula. Rarely, usually in neonates, brain abscesses are a complication of meningitis. No predisposing factor can be identified In 10-30% of brain abscesses.

The causative pathogens are similar to adult cases, with *Streptococcus* species (including *Streptococcus pneumoniae*) being the most frequent (36-70%), commonly associated with sinusitis, otitis media and endocarditis (*Streptococcus viridans*). *Staphylococcus* species are also common and are related to penetrating head trauma. Less frequent are gram-negative anaerobic bacilli, *Enterobacteriaceae* and fungi (2, 4, 5, 9-12).

In immunocompromised hosts, fungal abscesses (mainly *Aspergillus* and *Candida*), *Toxoplasma*, *Nocardia* species, *Listeria* and *Mycobacterium tuberculosis* can be identified. Identification of *S. viridans*, microaerophilic *Streptococci* and *Haemophilus* species is related to congenital heart defect (2, 4, 9, 10).

In children, the classic symptomatic triad (headaches, fever, and neurologic deficits) occurs in only 15-20% of cases, with headaches (60-70%) being the most common symptom, followed by fever (50-80%). Headaches, vomiting and altered level of consciousness can be associated with increased intracranial pressure. Depending on the location of the abscess, different focal neurologic signs have been described, including seizures, unilateral paresis or motor function deficits, cranial nerve palsies, dysphasia, dyspraxia, ataxia, visual field defects, eye movement abnormalities, spatial neglect, irritability, personality changes and frontal release signs.

The symptoms and the timing of onset are variable and depend on the abscess size and location (2, 4-6, 8, 9, 11). In absence of the diagnostic triad, symptoms and signs can be misunderstood, resulting in delayed diagnosis (1, 7).

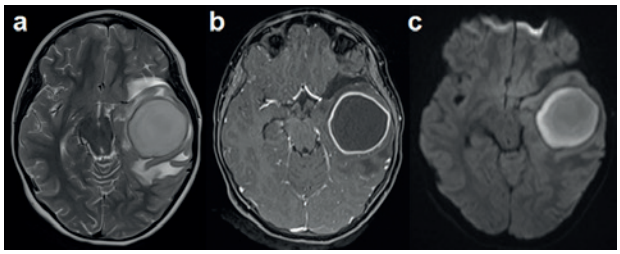
The golden standard for diagnosis is an MRI with and without contrast. If MRI is not available, contrast-enhanced CT is recommended (4, 13, 14). Treatment consists of antibiotic therapy, often combined with surgery. Of course, the underlying causes should be addressed. According to recent guidelines by Bodilsen et al. prompt neurosurgery is recommended whenever feasible. Others suggest antibiotic therapy alone in the case of multiple or small abscesses (<2.5 cm), when the etiology is known, and when patients are in good clinical condition and/or in situations where surgery is risky (12, 14, 15).

The surgical approach is a patient-specific decision. Aspiration seems suitable for deep-seated, small or multiple abscesses, or when general anesthesia is contraindicated. Drainage by craniotomy, craniectomy or excision is common for superficial or posterior fossa abscesses and post-traumatic or postoperative cases (15). Large abscesses (>2.5 cm), behaving as space-occupying processes sometimes require craniotomy and excision (12).

Case report

A fully vaccinated 7-year-old girl, with a history of teeth grinding and chronic otalgia for 2 years, presented to our clinic with acute progressive left-sided otalgia, abdominal pain and retrosternal pain without fever. Clinical examination revealed left-sided myringitis bullosa for which analgesic treatment was prescribed. Two weeks later, she reconsulted with persistent symptoms accompanied by malaise, vomiting and left-sided headaches. Otitis media with effusion of the left ear was noted in association with myalgia and neck stiffness, although she was still afebrile. She was admitted for further investigations. A blood sample

Figure 1. Brain MRI performed at readmission of the patient. Axial T2-weighted image shows a large mass with a T2-hypointense capsule and T2-hyperintense (cystic) content in the left temporal lobe, with surrounding edema (a). The mass has a thin enhancing capsule on contrast-enhanced T1-weighted images, the central content is not enhancing (b). The cystic content has a high signal on diffusion-weighted images (c) with corresponding low signal on the ADC-map (image not shown), compatible with thick viscous fluid. These imaging findings are pathognomonic for cerebral abscess. Due to mass-effect there was subfalcine herniation to the right (images not shown) and a left-sided uncal hernation.



revealed elevated inflammatory markers: white blood cell (WBC) count 29.6x10E9/L [reference value: 4.5-13.5x10E9/L], C-reactive protein (CRP) 82.3 mg/L [reference value: <10 mg/L]. A lumbar puncture was unsuccessful due to the patient's lack of cooperation, but blood and urine cultures were collected before empirically starting intravenous (IV) ceftriaxone. The blood and urine cultures came back negative, and there was a rapid clinical and biochemical improvement with complete resolution of symptoms after 4 days. The patient remained afebrile during hospitalization and she was discharged with a presumptive diagnosis of viral meningitis after 4 days of IV antibiotic treatment.

After discharge, symptoms returned promptly and intermittently. Complaint free episodes were alternated with pain and vomiting. She remained afebrile. Over-the-counter analgesics and antiemetics provided no relief.

After 3 weeks the patient was readmitted because of weight loss (of 1 kg) and inconsistent signs of meningeal irritation (neck myalgia and tenderness on passive neck flexion). Neurological examination on admission showed equal pupils and reactive to light, normal deep tendon reflexes and normal cranial nerve examination, balance and coordination. Except for a slightly elevated CRP (19,6 mg/L), the blood examination was unremarkable. Intravenous fluids, analgesics and antiemetics provided little relief. Papillary edema was urgently ruled out and an otorhinolaryngological examination revealed no middle ear pathology.

At this time, personality changes were noted as well as impaired awareness and increased reaction time. Episodes of irritability and delayed responses emerged, often associated with headache and/or vomiting. However, these symptoms occurred intermittently with asymptomatic periods with normal behavior.

An electroencephalogram (EEG) showed focal slowing over the left hemisphere. Subsequently, an MRI revealed a brain abscess in the left temporal lobe (5,0 cm x 5,4 cm x 5,8 cm) with midline shift, for which the patient underwent urgent neurosurgical abscess drainage. IV ceftriaxone and metronidazole were then empirically started. Cultures were positive for *Streptococcus pneumoniae* type 21, after which ceftriaxone monotherapy was continued according to the sensitivity profile. Within one week, central imaging showed decrease in abscess size, and the neurological examination and EEG normalized. After 3 weeks, the patient was discharged with oral amoxicillin.

Brain MRI after 6 weeks (2,4 x 2,1 x 2,5 cm) and 14 weeks (1,1 cm anteroposterior diameter) showed further volume reduction. Based on imaging and clinical improvement, the antibiotic treatment was discontinued after a total treatment duration of 5 months. One month later, MRI showed cystic and fibrotic tissue transformation.

Considering the unremarkable medical history and the involvement of a *Streptococcus pneumoniae* serotype not currently included in available vaccines, suspicion of an underlying immunodeficiency was limited. However, immunological screening was performed, encompassing analyses of white blood cell subsets, immunoglobulin levels (including subclasses), complement cascade pathways, pneumococcal vaccine antibody response, and splenic function (evaluated by the absence of Howell-Jolly bodies). This work-up revealed a mannose-binding lectin deficiency, a minor immunodeficiency that occurs in a small part of the normal population. Abdominal and cardiac ultrasounds were normal.

Discussion

Brain abscess is a rare but life-threatening condition in children, associated with significant mortality and morbidity. Early detection is crucial because delay in treatment is associated with incomplete recovery and mortality. However, diagnosis can be challenging, especially in absence of the diagnostic triad (headaches, fever, and neurologic deficits). A wide range of neurological symptoms have been described in combination with headaches and vomiting (1, 2, 4, 5, 7, 9).

Our case describes a large temporal lobe abscess in a child, suspected to be of otogenic origin based on the patients' history. Neurological symptoms consisted of impaired awareness with delayed response time and personality changes. However, these signs presented intermittently. In addition, personality changes are atypical for the abscess location, as behavioral disturbances and personality changes are associated with frontal lobe abscesses. In contrast, temporal lobe abscesses usually cause dysphasia or visual field defects (4, 9).

Furthermore, our patient never experienced fever during the disease course, which probably contributed to the delayed diagnosis. In the literature, fever appears to be absent in 20-50% of cases (5, 6, 8, 9).

Empiric antibiotics were started after surgical aspiration. The treatment duration was 5 months and consisted of IV antibiotics for 3 weeks, followed by oral antibiotics for 17 weeks.

Currently, research determining the treatment duration for pediatric brain abscess is lacking. Recent retrospective studies report prolonged antibiotic courses. For instance, a 2019 case series reported a median treatment duration of 92 days (8). However, the current literature recommends antibiotic treatment for 4-6 weeks in surgically treated abscesses and a 6-8 week course for conservative treatment.(3, 13, 15). Notably, Bodilsen et al. recommend treating aspirated abscesses similar to nonsurgically managed abscesses, recommending 6-8 weeks of treatment in both situations (14). Imaging studies should be performed at regular intervals to monitor treatment response (13, 14).

In conservatively treated patients, surgery should be reconsidered in the case of clinical detoration or when there is no clinical and radiological improvement within two weeks. In the case of aspiration, failure to see abscess size regression after four weeks is unusual (2, 15). There is no consensus on the required abscess size for discontinuation of antibiotics (15). In addition, residual contrast enhancement on brain imaging may persist for up to 6 months, making it inappropriate to prolong antibiotic treatment based on radiological findings alone (14).

Furthermore, there is currently insufficient evidence regarding the role of oral antibiotics in the treatment (14, 15). Arlotti et al. propose considering converting to oral treatment when causative pathogens and sensitivity profiles are known, and when the antibiotic agent demonstrates effective central nervous system penetration (15). More research is needed on this subject.

Our case illustrates an atypical presentation of pediatric brain abscess, possibly suggesting less demarcated symptoms related to abscess location. In addition, to our knowledge, an intermittent pattern of neurological symptoms has not yet been described.

Neurological signs such as focal neurological deficit, new-onset seizures or altered mental status along with fever, headaches or other signs of increased intracranial pressure, should prompt central imaging studies. A lumbar puncture is also indicated to rule out intracranial infection. However, if signs of increased intracranial pressure are present, brain imaging should always be performed first due to the potential risk of brain herniation.

In conclusion, a high level of suspicion is crucial for early detection of pediatric brain abscess, particularly in the case of history of acute otorhinolaryngological infections or a skull discontinuity.

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Disclosure of potential conflicts of interest

The authors have no conflict of interest to declare.

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