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Pediatric intracranial abscesses



Christopher M. Bonfield^a, Julia Sharma^a, Simon Dobson^{b,*}

^a Division of Neurosurgery, Department of Surgery, BC Children's Hospital, Vancouver, Canada

^b Division of Infectious Diseases, Department of Pediatrics, BC Children's Hospital, Vancouver, Canada

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Summary Intracranial infections in children are a relatively rare, but potentially severe condition. Because of the potential for rapid deterioration, timely diagnosis and treatment are necessary. These infections are categorized based on their intracranial location: epidural abscess, subdural empyema, and brain abscess. They largely arise from direct extension of adjacent infection, hematogenous seeding, or trauma. Clinical presentations of intracranial infections also vary. However, common signs and symptoms include headache, fever, nausea and vomiting, altered mental status, focal neurologic deficits, and seizures. In general, MRI demonstrates a peripherally enhancing lesion with high signal on diffusion weighted imaging (DWI). Bacterial isolates vary, but most commonly are a single pathogen. Successful treatment requires a multidisciplinary team approach including such modalities as antibiotic therapy and surgical drainage. When possible, open surgical evacuation of the abscess is preferred, however, in cases of deep-seated lesions, or in unstable patients, aspiration has also been performed with good results.

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Introduction

Intracranial infections in children are a relatively rare occurrence. However, these infections can progress rapidly and lead to devastating and permanent neurologic sequelae. This underscores the importance of timely diagnosis and treatment of these conditions. With the advancement of imaging technology, bacterial isolation techniques, newer broad spectrum antibiotics, and improved surgical procedures, mortality has decreased. Nevertheless, intracranial infections remain a major source

of morbidity, both in developing countries, and to a lesser extent, developed ones.

Focal intracranial infections are grouped into 3 main categories based on their location: epidural abscess, subdural empyema, and brain abscess. They arise most frequently from direct extension of infections in surrounding structures (sinusitis, otitis media), but also from hematogenous spread, skull trauma or surgery. Specific infectious pathogens change depending on the etiology of infection, location, age, and underlying medical condition. Clinical presentations of intracranial infections also vary.

* Corresponding author. Tel.: +1 604 875 2345.

E-mail addresses: christopher.bonfield@cw.bc.ca (C.M. Bonfield), sharma.julia@gmail.com (J. Sharma), sdobson@cw.bc.ca (S. Dobson).

However, common signs and symptoms include headache, fever, nausea and vomiting, altered mental status, focal neurologic deficits, and seizure. Successful treatment requires a multimodality approach, consisting of a combination of long-term antibiotic treatment, surgical evacuation, and eradication of the primary infection, if one is identified.

In this article, we will review the major types of focal intracranial infections in children (epidural abscess, subdural empyema, and brain abscess), and the role for surgery in their management.

Epidural abscess

Epidural abscesses are suppurations that occur in the space between the skull and the dura. Historically, they were caused by the spread of infection from mastoids or paranasal sinuses after otitis media and sinusitis, but are now increasingly being seen in the setting of trauma or after craniotomy, paranasal surgery, or skull base surgery.^{1,2} This may reflect an improvement in the treatment of sinusitis with greater accessibility to antibiotics in conjunction with an increase in the number of intracranial surgical procedures performed.² Dental caries and mycobacterial tuberculosis have also been reported to cause epidural empyemas.³

Epidural abscesses are rare and occur in less than 10% of sinus infections and in 0.10–0.43% of craniotomies.^{1,2} Infection within a sinus can spread to the epidural space through osteomyelitic bone forming a “collar button” abscess or can spread through thrombosed emissary veins or nutrient vessels (Breschet’s canals) supplying the dura. In the pediatric population, congenital dermal sinuses may also provide a tract for infection to enter the epidural space. Direct spread from osteomyelitic bone can occur following surgery or trauma.

Presentation can be subtle with fever, headache, neck pain and mental status changes developing over several days. Other findings relate to the primary site of infection and include orbital inflammation, forehead swelling, rhinitis, and otorrhea. Focal deficits and seizures are relatively uncommon.⁴ In the setting of temporal petrositis, patients may present with Gradenigo syndrome: defined by the triad of otorrhea, facial pain and abducens palsy.⁵ Pott’s puffy tumor, the particular finding of soft, well-demarcated, painless swelling of the forehead, is indicative of osteomyelitis of the frontal bone and subperiosteal abscess and is frequently associated with an epidural abscess, which occurs in older children and adolescents.⁶ In the post-operative setting, wound infection is a common presenting sign and is often seen in the absence of fever or headache.⁷ Epidural abscesses appear as lentiform-shaped extradural masses that appear as low density lesions on CT. MRI will show high signal on diffusion weighted imaging (DWI) with a low apparent diffusion coefficient (ADC). These lesions are iso-intense to brain on T1-weighted imaging (T1WI) and hyperintense on T2-weighted imaging (T2WI) and peripherally enhance with contrast (Fig. 1). The dura can also be thickened and may enhance.⁸

Causative organisms depend on the primary site of infection. In post-neurosurgical states after trauma or

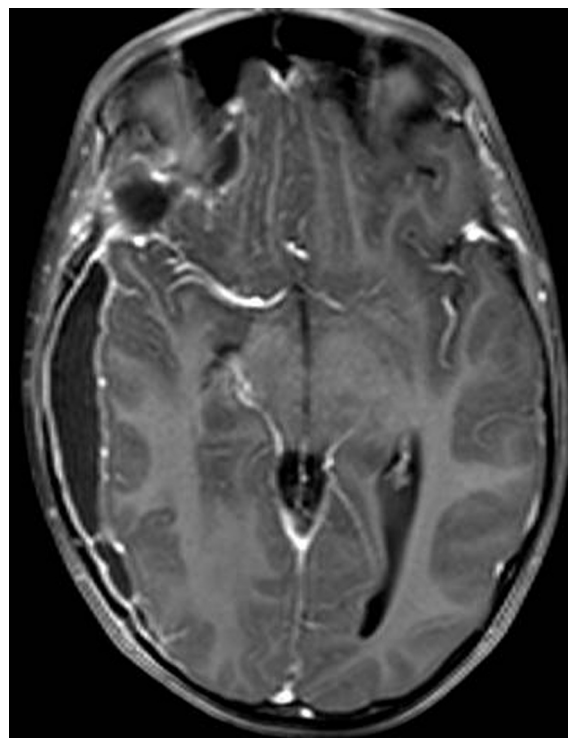


Figure 1 Axial T1-weighted MRI with contrast illustrating a right side peripherally enhancing epidural abscess with mass effect on the temporal lobe.

surgery, the causative pathogens are usually gram-negative bacilli or *Staphylococcus aureus*.¹ Mixed cultures are common and approximately 10% of cultures are sterile. In cases secondary to otitis media, mastoiditis, and sinusitis, isolated organisms include *Streptococcus pneumoniae*, *Proteus mirabilis*, *Pseudomonas aeruginosa*, coagulase negative staphylococcus, and anaerobes.^{1,9}

Treatment for epidural abscesses is aimed at draining pus both in the epidural space and at the primary site of infection with the goal of primary source control, decreasing mass effect, and obtaining a positive culture to direct antibiotic therapy. Recent evidence suggests that when there is minimal mass effect associated with these extradural collections, they can be treated with sinus drainage and antibiotic therapy alone.⁷ There is some controversy as to whether the bone flap should be replaced after craniotomy particularly because it is devascularized and often osteomyelitic. In one series, 75% of patients that had their bone flaps replaced required a second procedure because of the development of intraparenchymal abscesses suggesting that leaving the bone flap off may decrease the risk of repeat surgery.² Empiric intravenous antibiotic therapy should be initiated promptly. Different regimens can be used depending on the presumed cause of infection. In the setting of otitis, sinusitis, or mastoiditis, vancomycin, plus a 3rd or 4th generation cephalosporin (ceftriaxone or cefepime) and metronidazole should be used.¹⁰ If the infection occurs following surgery or trauma, vancomycin with a 3rd or 4th generation cephalosporin (ceftriaxone or cefepime) is recommended. Antibiotics should be continued for at least 4 weeks and as long as 3 months. Mortality rates are

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