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Epidural Abscess Masquerading as Lateral Sinus Thrombosis

ABSTRACT—Controversy regarding the use of anticoagulants, the evacuation of the sinus, or the use of medical treatment alone surrounds the treatment of lateral sinus thrombosis. Treatment of an epidural abscess associated with coalescent mastoiditis is much less controversial—drainage is usually recommended. The differing treatments of these complications mandate accurate diagnosis. The advent of more sophisticated radiological studies has facilitated diagnosis of these complications; however, tests are not infallible. We present three cases in which preoperative imaging demonstrates an epidural abscess mimicking lateral sinus thrombosis by compression of the vessel. A false-positive computed tomography (CT) or magnetic resonance imaging (MRI) study may lead to the wrong diagnosis and, consequently, improper treatment. In light of this possibility, we recommend surgical exploration in all such cases.

Although rarely encountered with today's widespread use of antibiotics, intracranial complications of otologic infection still occur and are associated with significant mortality rates. Early antimicrobial treatment often masks classically described signs and symptoms, obligating physicians to be familiar with their varied presentations in order to make the correct diagnosis. Diagnostic accuracy is mandatory because the unique pathophysiology of each complication requires a different treatment approach. We present three cases in which an epidural abscess presents as lateral sinus thrombosis on preoperative imaging. In light of possible confusion, we recommend surgical exploration to ensure proper management.

CASE STUDIES

Case 1

A.B. was a 13-month-old boy who presented to an outlying hospital with a 3-week history of fever, irritability, and vomiting associated with 1 week of upper respiratory symptoms. Initial physical exam found the patient febrile and lethargic. Subsequent cerebrospinal fluid (CSF) gram stain revealed gram-positive cocci in chains. The patient was treated with intravenous (IV) ceftriaxone sodium (Rocephin®) and dexamethasone and transferred to the pediatric service at Tulane Medical Center. On admission to our facility, van-

comycin was added to the treatment regimen. Physical exam at that time was notable for nuchal rigidity without additional neurological findings. A head CT without contrast was performed and interpreted as within normal limits. Two days later, blood and CSF cultures from the outlying hospital grew penicillin-sensitive pneumococci, prompting a treatment change to IV penicillin.

The patient began improving clinically with antibiotics, and the primary team ordered a brainstem auditory evoked responses (BAER) test to assess any effects of meningitis on the patient's hearing. Bilateral hearing loss, greater on the right, was demonstrated. Subsequent otolaryngology consultation revealed bilateral effusions and retracted tympanic membranes on microscopic otoscopy. A CT of the temporal bone was obtained that revealed soft tissue filling the mastoids bilaterally with coalescence and loss of normal pneumatized air cells bilaterally, a 1.5-cm ring enhancing lesion near the right transverse sinus, and prominent meninges (Fig. 1). The findings were suggestive of bilateral coalescent mastoiditis, concomitant right transverse sinus thrombosis, and meningitis. Preoperative ophthalmology consultation revealed a normal fundoscopic exam. The patient was then taken to the operating room for a right tympanomastoidectomy and bilateral myringotomy with tube insertions. Intraoperatively, the area of questionable sigmoid sinus thrombosis visualized on CT scan was noted to be an epidural abscess. A transtemporal craniotomy for drainage was then performed, and granulation tissue within the abscess cavity was found to be compressing the sigmoid sinus. Normal patency of the sinus returned upon removal of the abscess contents.

The postoperative course was complicated by persistent fever and left postauricular cellulitis noted on postoperative day 2 despite IV antibiotic treatment. Repeat CT of the temporal bones demonstrated persistent opacification in the left mastoid and findings consistent with early epidural abscess. The patient was returned to the operating room, where a left mastoidectomy

was performed. Intraoperative findings included granulation tissue in the left mastoid with a small epidural abscess that had eroded adjacent to the left sigmoid sinus. The patient did well postoperatively and was discharged home to receive a 21-day course of IV vancomycin. The patient was followed for 2 years and suffered repeated episodes of mastoiditis. Subsequent work-up demonstrated a selective pneumococcal antibody deficiency. Since institution of antibody replacement therapy he has been free of any further infections.

Case 2

K.B. was a 5½-year-old girl with a history remarkable only for recurrent otitis media. The patient presented to the emergency department of an outside hospital complaining of left otalgia and otorrhea for 3 days complicated by 1 day of new-onset headaches, back pain, and nightmares. On presentation, the patient was lethargic but arousable, with an oral temperature of 101.5°F. A head CT without contrast demonstrated evidence of left mastoiditis. The patient was admitted for treatment with IV cefotaxime. The next morning, the patient developed emesis, nausea, dizziness, and ataxia with nystagmus. Repeat head CT without contrast showed cerebral swelling. The patient was then started on IV acyclovir and vancomycin and transferred to Tulane Medical Center to rule out meningitis and encephalitis.

A CT of the head and temporal bones with and without contrast was performed on admission to our institution. This revealed soft-tissue attenuation within the left mastoid with bony erosion of the mastoid air cells into the posterior fossa, as well as focal high attenuation in the left sigmoid sinus, suggestive of an acute dural venous sinus thrombosis (Fig. 2). Preoperative ophthalmology consult demonstrated a normal fundoscopic exam. The patient was taken to the operating

Figure 1. Case 1 (A.B.). (A) Bilateral mastoid opacification with coalescence is noted with thinning and erosion of the posterior fossa plate seen bilaterally. (B) The "empty delta" sign is seen on the right.

Figure 2. Case 2 (K.B.). (A) The empty delta sign is seen on the left side with a small intracranial air pocket. (B) Left mastoid opacification with coalescence and air seen just medial to the posterior fossa plate.

room by the otolaryngology service to undergo a left mastoidectomy, bilateral ventilation tube placement, and lumbar puncture. Granulation tissue within the left mastoid, without bony destruction, and a left epidural abscess were found. It was noted intraoperatively that the sigmoid sinus was not actually thrombosed but instead was compressed by the abscess. After draining the abscess via a left retrosigmoid craniotomy, the sigmoid sinus demonstrated free flow of blood by bleeding quite freely with needle puncture. The patient underwent 4 weeks of antibiotic treatment with IV clindamycin, cefotaxime, and otic drops. Her postoperative course was uneventful.

Case 3

M.H. was a 6-year-old boy who presented to the neurology clinic with the chief complaint of headache since being diagnosed with right otitis media 2 weeks previously. Despite antibiotic treatment with amoxicillin, the patient continued to have low-grade fever and headaches associated with intermittent nausea and vomiting. CT of the head without contrast revealed soft tissue opacification of the right mastoid air cells with

increased attenuation along the right cerebellar hemisphere in the area of the transverse sinus. A diagnosis of right mastoiditis was made. Because the CT findings were suspicious for transverse sinus thrombosis, the patient was referred for emergent MRI and MR angiography (MRA). The head MRI showed increased signal in the right mastoid air cells consistent with mastoiditis and abnormal enhancement within the right transverse sinus consistent with thrombosis (Fig. 3). MRA findings revealed decreased flow signal within the right transverse sinus, also consistent with sinus thrombosis (Fig. 4). The patient was admitted by the neurology service and treated with IV heparin, vancomycin, cefotaxime, and metronidazole (Flagyl®).

Examination by the otolaryngology service revealed intact tympanic membranes bilaterally without evidence of retroauricular swelling or point tenderness. Audiogram showed low frequency conductive hearing loss on the right side with excellent bone thresholds. A temporal bone CT, with and without contrast, revealed complete soft tissue opacification of the right mastoid air cells with coalescence, soft tissue density within the attic of the right middle ear cavity, and a low attenuation filling defect within the right transverse sinus. These findings supported the diagnosis of right coalescent

Figure 3. Case 3 (M.H.). (A) CT demonstrates the "empty delta" sign on the right side. (B) MRI demonstrating area of signal enhancement suggestive of sinus thrombosis.

Figure 4. Case 3 (M.H.). MRA and magnetic resonance venography (MRV) demonstrating absence of flow through the right sigmoid sinus (arrows).

mastoiditis, otitis media, and transverse sinus thrombosis. Preoperatively, an ophthalmology consult also noted a normal fundoscopic exam.

The patient was taken to the operating room for planned right mastoidectomy and exploration of the right sigmoid sinus. Operative findings included purulent material with granulation tissue in the right mastoid and a cholesterol granuloma of the right posterior mastoid. Additionally, an epidural abscess with granulation tissue was noted within the right posterior fossa dura anterior to the sigmoid sinus. The abscess was compressing the sigmoid sinus, and the sinus was not actually thrombosed. Needle aspiration of the sinus demonstrated good flow after removal of the epidural abscess. A ventilation tube was also inserted in the right tympanic membrane.

The patient did well until postoperative day 3, when he experienced headaches with nausea and vomiting. A repeat head CT with and without contrast revealed only postsurgical changes and persistent soft tissue opacity consistent with known mastoiditis and recent mastoidectomy. Increased attenuation previously noted in the right sigmoid sinus was no longer identified. The pediatric infectious disease service recommended continuing the IV ceftriazone and metronidazole for 4 weeks. The patient's headaches lessened, and he was discharged home to complete the antibiotic regimen. The child appeared well, without hearing deficit, at the 1-month follow-up exam.

DISCUSSION

Before the ubiquitous use of antibiotics, 2.3% of all patients with acute and chronic suppurative otitis media suffered intracranial complications.¹ Meningitis, abscesses (epidural, subdural, and parenchymal), lateral

sinus thrombosis, and otitic hydrocephalus resulted in mortality rates as high as 76.4% in 1935.² Currently, widespread use of antimicrobial treatment has caused a significant drop in both the incidence and the associated mortality of these cases. Intracranial complications of otitis media and mastoiditis are now rare, with mortality decreased by 90%.²

The unique pathophysiology of each complication mandates different treatment approaches. As a result, understanding their varied presentations remains important to avoid misdiagnosis. An epidural abscess is an inflammatory process located within the potential space between the skull and lateral surface of the dura. A collection of purulence is rare; more often it is dural granulation tissue in direct contact with suppuration of the temporal bone that is noted.

Although an epidural abscess may present with low-grade fever, headache, and otalgia, the patient is usually asymptomatic and lacks focal neurological signs. Discovery may be made incidentally while performing mastoidectomy. Failure to obtain preoperative CT imaging or to explore intraoperatively the underlying dura through thinned mastoid bone can lead to a missed diagnosis.

Treatment of an epidural abscess includes IV antibiotics and surgical drainage. A cortical mastoidectomy is performed with sufficient bone removal to allow direct inspection of the middle and posterior fossa dura. The granulation tissue of the abscess is then evacuated through a transmastoid approach with blunt dissection until normal dura is visualized.

Lateral sinus thrombosis occurs when mastoid infection involves the adjacent lateral and sigmoid sinuses. For this reason, perisinus epidural abscess is usually a concomitant finding. Invasion of the vessel walls occurs via draining emissary veins or by direct extension through erosions or dehiscence in overlying bone. As inflammation progresses from adventitia deeper into intima, a mural thrombus forms that can become infected and create septic emboli. The release of hemolytic streptococcal emboli into the bloodstream creates the classically described spiking "picket-fence" fever pattern.³ Today, the empiric treatment of the antecedent otitis media with antibiotics usually alters this classic pattern into a nondescript low-grade fever.

In addition to fever, lateral sinus thrombosis classically presents with otalgia and otorrhea. Because sinus thrombosis can result in insufficient venous drainage of the intracranial cavity, intracranial pressure may rise and result in a variety of neurological findings. Central nervous system (CNS) findings, such as headache, lethargy, and confusion, may be found, with up to 50% of patients demonstrating papilledema.⁴ Generally, focal neurological signs are absent. Occasionally, *Griesinger's sign*—postauricular swelling and tenderness caused by thrombosis of mastoid emissary veins—will be noted.⁵

In the past, CSF pressure changes were measured with the *Queckenstedt test* to clinically differentiate lateral sinus thrombosis from other intracranial complications with similar presentations. Current literature dissuades use of this test because it risks brain herniation and often produces inconclusive results.⁶

Treatment of lateral sinus thrombosis has been the subject of some controversy. Most authors agree that minimal intervention includes IV antibiotics and mastoidectomy. Surgical exploration is required to uncover the bone ensheathing the sigmoid sinus and to drain any surrounding abscess. It is the subsequent management of the sinus itself, and the use of anticoagulants, which has raised some questions.

Some authors advocate opening the sinus and removing the clot; however, needle aspiration has proved to be an effective method of documenting thrombosis. Additionally, recanalization of the vessel in conjunction with development of collateral circulation usually results in normal CSF pressure after evacuation of the surrounding infection.⁷ As such, clot removal is generally not recommended by most authors.

The need for ligation of the internal jugular vein has also been a subject of contention. Numerous studies have revealed that ligation does not prevent embolization or septicemia. In fact, such treatment is associated with higher rates of morbidity and mortality.³ The result is that internal jugular vein ligation is reserved for cases in which embolization and septicemia persist despite adequate antibiotic and surgical treatment.

Treatment of lateral sinus thrombosis with anticoagulants is generally not recommended. The risk of intracerebral hemorrhage, together with the possibility of inducing embolization, restricts its use.

Unreliable clinical examination has given way to the more accurate radiological diagnosis of intracranial complications. An epidural abscess may often be missed on CT scan unless a large volume of purulent material is present. For this reason, MRI is regarded as the study of choice. Epidural abscess appears as a mildly hyperintense signal separated from brain parenchyma by a hypointense rim that represents dura displaced by the abscess.⁶

Lateral sinus thrombosis may produce a characteristic "empty delta" sign on CT scan by obstructing the flow of contrast within the vessel. Generally, however, subtle findings have not proved CT to be useful in demonstrating thrombosis. So, like epidural abscess, MRI is touted as the study of choice. Methemoglobin within the thrombosed sinus produces a noticeably increased signal intensity on T1-weighted images. This hyperintensity is easily contrasted to the hypointense nature of a normal, nonthrombosed, sinus.⁸

MRI is often supplemented by a more definitive vascular study demonstrating thrombosis of the lateral sinus. Arteriography, retrograde jugulography, and digital-subtraction venography are invasive procedures re-

quiring contrast dye that have been replaced by MRA. MRA has the ability to safely and accurately portray decreased vascular flow within the vessel.

Although more sophisticated radiological studies have facilitated the diagnosis of intracranial extension of otologic infection, they are not infallible. As the three case studies demonstrate, the characteristic radiological findings of both epidural abscess and lateral sinus thrombosis are not universal. Both A.B. and K.B. had CT scans that demonstrated empty delta signs (see Figs. 1 and 2), and M.H. had both an MRI showing increased signal within the sinus (see Fig. 3) and an MRA with absence of flow through the vessel (see Fig. 4). These findings all led to the diagnosis of lateral sinus thrombosis. Only after surgical exploration demonstrated compression of the vessel by epidural abscess, not the presumed thrombosis, was the true diagnosis realized. This possibility leads to our recommendation of surgical exploration in similar cases.

CONCLUSION

With the advent of antibiotics, an intracranial complication of otitis media has become a rare occurrence. As such, physicians are less likely to be familiar with the diagnosis. Recognition of the varied presentations of each complication is important because each distinct pathophysiology dictates a specific treatment plan. Diagnosis has been facilitated by sophisticated radiological studies; however, usually characteristic findings can be misleading. In this article we have presented three patients who had preoperative imaging consistent with lateral sinus thrombosis. At surgical exploration, all three patients were noted to have epidural abscesses that were compressing an otherwise normal lateral sinus. In light of this possibility, we recommend surgical exploration in all such cases.

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