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ORIGINAL RESEARCH–PEDIATRIC OTOLARYNGOLOGY

Pediatric otogenic intracranial abscesses

Brandon Isaacson, MD, Christine Mirabal, MD, J. Walter Kutz, Jr., MD, Kenneth H. Lee, MD, PhD, and **Peter S. Roland, MD,** Dallas, TX

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ABSTRACT

OBJECTIVE: To describe the presentation and management of otogenic intracranial abscesses in a tertiary care pediatric hospital.
STUDY DESIGN: Case series and chart review.
SETTING: Tertiary care pediatric hospital.
SUBJECTS AND METHODS: An inpatient database was queried for the following diagnostic codes from 2000 to 2008: [383.2] petrositis, [383] acute mastoiditis, [386.3] labyrinthitis, [351.0] facial paralysis (Bell's palsy), [351.9] facial nerve disorder unspecified, [351.8] other facial nerve disorders, [383.01] subperiosteal abscess, [383.02] Gradenigo's syndrome, [320] meningitis, [324.9] extradural or subdural abscess, [324.0] intracranial abscess, [325] thrombosis of intracranial venous sinus, and [348.2] otic hydrocephalus. Presenting signs and symptoms, microbiology, length of stay, surgical findings, and outcomes were recorded for each patient.
RESULTS: Forty patients were identified with an otogenic intracranial complication. Thirty patients had evidence of an intraparenchymal, epidural, subdural, or petrous apex suppurative complication of otitis media. Twenty-four of 30 (80%) patients had a canal wall up mastoidectomy, three (10%) patients had a craniotomy without a mastoidectomy, and three (10%) patients were managed with intravenous antibiotics with or without pressure equalization tubes. There were no mortalities in this series of patients.
CONCLUSION: Patients with intracranial abscesses, in selected cases, can be managed with intravenous antibiotics without mastoidectomy. The use of canal wall up mastoidectomy is an acceptable alternative to radical mastoidectomy when surgical intervention is necessary.

In the pre-antibiotic era, intracranial complications of otitis media were a significant source of morbidity and mortality. The introduction of antibiotics has dramatically reduced the incidence, morbidity, and mortality of suppurative complications of otitis media.[1,2] Several studies have indicated that meningitis followed by abscesses are the most common intracranial complications of otitis media.[1,2] A number of authors have confirmed that otitis media is the most common source of intracranial abscesses.[3,4] The objective of this report is to describe the presenting symptoms, location, and management of intracranial abscess secondary to otitis media in the pediatric population.

Methods

A retrospective chart review was performed at a tertiary children's hospital in a major metropolitan area. All inpatient admissions from 2000 to 2008 were queried for the following discharge ICD-9 diagnosis codes: [383.2] petrositis, [383] acute mastoiditis, [386.3] labyrinthitis, [351.0] facial paralysis (Bell's palsy), [351.9] facial nerve disorder unspecified, [351.8] other facial nerve disorders, [383.01] subperiosteal abscess, [383.02] Gradenigos syndrome, [320] meningitis, [324.9] extradural or subdural abscess, [324.0] intracranial abscess, [325] thrombosis of intracranial venous sinus, and [348.2] otic hydrocephalus.

The study population was further subdivided to identify those patients diagnosed with an intracranial abscess including epidural, subdural, intraparenchymal, and petrous apex subsites. Information on the patient's otologic history, presenting symptoms, physical examination, radiological findings, medical and surgical therapy, culture results, length of stay, and treatment outcome were recorded. Exclusion criteria included age older than 18 years and medical records that were incomplete or of questionable accuracy. The study was approved by the institutional review board at University of Texas Southwestern Medical Center.

Results

Complications of otitis media were identified in 151 (19.7%) patients of 768 inpatient encounters over the eight-year study period. Forty patients had an intracranial complication of otitis media. Intracranial abscess formation (75%) was the most common intracranial complication followed by lateral sinus thrombosis (40%), meningitis (27.5%), and otic hydrocephalus (10%). In the remaining 111 patients, 29 (26.1%) had acute mastoiditis without subperiosteal abscess, 67 (60.4%) had acute mastoiditis with subperiosteal abscess, 14 (12.6%) had facial paralysis, and one (0.9%) patient had serous labyrinthitis. Cholesteatoma

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Table 1
Presenting signs and symptoms

	n (%)
Fever	20 (66.7)
Otalgia	17 (56.7)
Headache	11 (36.7)
Otorrhea	10 (33.3)
Postauricular swelling	10 (33.3)
Mental status changes	8 (26.7)
Nausea/vomiting	7 (23.3)
Diplopia	5 (16.7)
Seizures	5 (16.7)
Extremity weakness	2 (6.7)

and chronic otitis media were identified in three (7.5%) of the 40 patients with intracranial complications.

The mean age of patients with an intracranial abscess was six years with a range of eight months to 14 years of age. Eighteen (60%) patients were male, whereas twelve (40%) were female. The left (14) and right sides (16) were nearly equally effected. The presenting signs and symptoms are listed in Table 1. The most common presenting symptoms were fever and otalgia. Diplopia secondary to abducens nerve palsy was identified in three patients with petrous apicitis and two patients with a perisinus epidural abscess. Mental status changes including lethargy, loss of consciousness, or confusion were most commonly seen in patients with empyema or intraparenchymal abscess as opposed to petrous apicitis or an epidural abscess. Seizures or extremity weakness were seen only in patients with an intraparenchymal abscess or empyema. Four patients with intraparenchymal abscesses and one patient with an empyema presented with a seizure. Two patients presented with extremity weakness, one with an intraparenchymal abscess and one with empyema. Postauricular swelling was seen only in patients with epidural abscesses.

Twenty-seven patients had only one intracranial abscess, whereas the remaining three patients had two intracranial abscesses for a total of 33. The most common location for an intracranial abscess was epidural, followed by petrous apex and intraparenchymal. Thirteen of 16 (81.2%) epidural abscesses were adjacent to or in the sigmoid sinus. The remaining three epidural abscesses were located in the middle fossa, one of which was overlying the petrous apex. Five of the seven intraparenchymal abscesses were located in the temporal lobe, whereas two were in the cerebellum.

Three of the 33 (9.1%) abscesses were treated conservatively with intravenous antibiotics with or without pressure equalization tube placement and did not require further surgical intervention. Pressure equalization tubes were placed in the setting of purulent acute otitis media but not in patients with preexisting perforations. Twenty-five of the 33 (75.8%) abscesses underwent incision and drainage, whereas five (15.2%) underwent a mastoidectomy in addition to treatment with antibiotics (Table 2). Mastoidectomy was performed as a primary procedure according to the discretion of the treating physician and the patient's presenting symptoms. No patients required a canal wall down procedure. Three of the 30 (10%) patients had evidence of cholesteatoma at the time of surgery.

The culture results of each subsite are shown in Table 3. Methicillin-resistant *Staphylococcus aureus* was present in two patients, one with petrous apicitis and the other with a perisinus epidural abscess. *Streptococcus pneumoniae* with normal cephalosporin sensitivity but intermediate to full penicillin resistance was present in six patients: five with epidural abscesses and one with empyema. Eight of 30 (26.7%) patients with an intracranial abscess had a bacterial isolate with some evidence of antimicrobial resistance. The mean duration of hospitalization was 14 days (range 4-42 days). There were no mortalities among the 30 patients in this series with an intracranial abscess.

Discussion

Complications of otitis media still occur with some frequency despite the introduction of antibiotics and the increased availability of bacterial immunizations. In an eight-year period, our center managed 40 patients with intracranial complications, 30 of whom had evidence of an intracranial abscess. Consistent with previous reports, an intracranial abscess as opposed to meningitis was the most common intracranial complication of otitis media.[1,2,5-7] A

Table 2
Abscess location and management

	Craniotomy with mastoid	Craniotomy without mastoid	Mastoidectomy with PE tube	PE tube	Antibiotics alone	n (%)
Epidural abscess	1		15			16 (48.5)
Petrous apicitis			5	1	1	7 (21.2)
Brain abscess	3	3	1			7 (21.2)
Empyema	2				1	3 (9.1)
Total	6	3	21	1	2	33

PE, pressure equalization.
All treatment groups received culture-directed or empiric intravenous antibiotic therapy.

Table 3
Microbiology

	GAS	*S aureus*	*S pneumoniae*	Other strep	Gram negative	GPC pairs	*Prevotella*	No growth
Epidural abscess	4	1*	6	1		1	1	2
Petrous apicitis	1	1*	1	1				3
Brain abscess	3	2	1		1			
Empyema			1			1		1
Total	8	4	9	2	1	2	1	6

GAS, group A *streptococci*; *GPC,* gram-positive cocci; *strep, streptococci.*
*Methicillin-resistant *S aureus.*

possible explanation for this finding includes the wide spread use of the *Haemophilus influenzae* vaccine. Acute as opposed to chronic otitis media was more commonly associated with intracranial complications in our series. This is in agreement with other published series from industrialized areas.[2,7] Chronic otitis media with or without cholesteatoma is the more common cause of intracranial complications in areas with poor access to care.[1,8-11] There were no mortalities in our series of intracranial complications, which is in agreement with the lower reported death rates in contemporary reports in developed areas.[6,7,12] The absence of mortality in the present series could be secondary to a number of factors including improved access to care, small sample size, or less pathogenic bacteria.

Ninety percent of patients with intracranial abscesses in our series underwent operative intervention as opposed to conservative management with antibiotics with or without pressure equalization tube placement. Conservative management of complications of otitis media has been utilized successfully in several series.[13-15] Urgent surgical intervention with a mastoidectomy and possible craniotomy is typically performed in patients with an intracranial abscess who present with sepsis, altered levels of consciousness, seizures, or other neurological deficits. Patients who present with altered mental status have more advanced disease and have a higher mortality rate.[16] Incision and drainage or excision of an intracranial abscess may not be necessary in selected cases. Direct incision and drainage were performed on only one of seven patients with petrous apicitis. All seven of these patients eventually recovered including the three patients with an abducens palsy. Two previous reports demonstrated complete resolution of petrous apicitis with abducens nerve paralysis in patients who were treated with culture-directed intravenous antibiotics.[17,18] Six of the seven patients with an intraparenchymal abscess underwent incision and drainage via a craniotomy, whereas the remaining patient had a mastoidectomy. All seven patients eventually recovered without significant neurological deficits. One of three patients with a subdural empyema was treated with only intravenous antibiotics and all three patients recovered. Because of the retrospective nature of this study, it is difficult to surmise the reasons why conservative management was used in some cases, whereas more invasive treatments were used in other patients.

Radical mastoidectomy in the setting of intracranial complications of otitis media, prior to and even after the introduction of antibiotics, was considered the standard of care.[5,9,19,20] No patients in our series had a canal wall down mastoidectomy; however, unlike most series, a majority of our patients had complications that were secondary to acute rather than chronic otitis media. Singh and Maharaj[21] used a canal wall up technique to manage patients with intracranial complications without evidence of cholesteatoma. These authors also successfully managed patients with cholesteatoma using a modified radical as opposed to a radical mastoidectomy. There was no significant change in the mortality or morbidity compared with a series using a radical mastoidectomy.

Conclusion

The frequency, morbidity, and mortality of intracranial complications of otitis media have been dramatically reduced since the introduction of antibiotics. A decrease in the extent and frequency of surgical intervention in patients with intracranial complications has become more prevalent. Our series demonstrates that culture-directed or broad-spectrum intravenous antibiotics may be an alternative treatment option in selected patients. This study supports the use of canal wall up mastoidectomy in patients with intracranial abscesses, even in the setting of chronic otitis media.

Author Information

From the Department of Otolaryngology–Head and Neck Surgery, University of Texas Southwestern Medical Center, Dallas, TX.

Corresponding author: Brandon Isaacson, MD, UT – Southwestern Medical Center, Department of Otolaryngology, 5323 Harry Hines Blvd, Dallas, TX 75287.

E-mail address: Brandon.isaacson@utsouthwestern.edu.

Author Contributions

Brandon Isaacson, study design, writer, manuscript review; **Christine Mirabal,** data collection, writer; **J. Walter Kutz, Jr.,** study design, critical

review; **Kenneth H. Lee,** study design, manuscript review; **Peter S. Roland,** study design, manuscript review.

Disclosures

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