Mastoidectomy for acute otomastoiditis: Our experience

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Abstract
We conducted a retrospective study of 53 mastoidectomies in 51 patients with acute otomastoiditis. In 26 cases (49.1%), surgery had been performed within 48 hours of the development of symptoms. The most common complication of acute otomastoiditis was subperiosteal abscess, which occurred in 37 cases (69.8%). Intracranial complications were seen in 6 cases (11.3%). The most common pathogens isolated from subperiosteal abscesses, the mastoid cavity, and intracranial collections were Streptococcus spp and Staphylococcus aureus. In 14 cases (26.4%), conservative treatment failed to cure acute otomastoiditis; such cases should raise a suspicion of a subperiosteal abscess, an underlying cholesteatoma, or an infection caused by gram-negative bacteria. Upon hospital admission, patients should receive antibiotics that are effective against both gram-positive and gram-negative organisms. Patients with intracranial complications or facial nerve paralysis may require a combination of two or more antibiotics. Long-term follow-up is highly recommended.

Introduction
Extracranial complications of acute otomastoiditis include mastoiditis with bone destruction, subperiosteal abscess, petrositis, facial nerve paralysis, and labyrinthitis; intracranial complications include meningitis, perisinus abscess, brain abscess, subdural abscess, extradural abscess, lateral sinus thrombosis or thrombophlebitis, and otitic hydrocephalus. The infection can spread from the middle ear or mastoid via bone erosion, thrombophlebitis, a preformed pathway, and/or hematogenous dissemination. In addition, the inflammatory process may pass the vascular channels through intact bone by the process of osteothrombophlebitis. The preformed pathway can be a normal opening in the bony wall, such as the oval or round window or the developmental dehiscence of the floor of the hypotympanum, or it can be a corridor created by a skull fracture or previous ear surgery. Extracranial complications are usually a direct result of the infection’s spread, while intracranial complications have a variety of etiologies.

In this article, we describe our study of the treatment of a group of patients who had undergone mastoidectomy for the treatment of acute otomastoiditis over an 18-year period.

Patients and methods
We conducted a retrospective review of the records of all patients who had undergone mastoidectomy for the treatment of acute otomastoiditis at our institution between May 1, 1984, and April 30, 2002. In addition to obtaining demographic data, we reviewed the medical and surgical notes to acquire information on each patient’s history of preadmission middle ear infection, clinical signs at presentation, the status of the contralateral ear, indications for surgery, treatment before and after surgery, and surgical, bacteriologic, and radiologic findings. We also noted the short- and long-term surgical outcomes. We excluded from study consideration any patient who had a history of chronic otitis media or a known cholesteatoma.

A total of 53 cases involving 51 patients met our selection criteria (2 patients had undergone a second surgery for the treatment of a recurrent subperiosteal abscess 8 and 10 months following the initial surgery). The study population was made up of 26 males and 25 females, aged 1 month to 79 years (median: 7.7 yr). The 53 cases involved 11 infants (20.8%), 16 children aged 1 to 2 years (30.2%), 8 children between the ages of 2 and 4 years (15.1%), 12 children between 4 and 11 years of age (22.6%), and 6 adults (11.3%). The mean duration of follow-up was 1.8 years.

Results
Presenting symptoms included retroauricular edema and/or erythema in 41 cases (77.4%), auricular proptosis in 37 cases (69.8%), otalgia in 16 cases (30.2%), headache in 11 cases (20.8%), otorrhea in 11 cases, vomiting in 5 cases (9.4%), meningism in 5 cases, vertigo in 4 cases (7.5%), facial nerve paralysis in 3 cases (5.7%), ataxia in 2 cases (3.8%), and impaired vision, aphasia, and hemiparesis in 1 case each (1.9%). Two patients were comatose upon admission.
Of the 53 cases, the contralateral ear was normal in 27 (50.9%). In the remaining 26 cases, acute otitis media and serous otitis media were diagnosed in 16 (30.2%) and 10 (18.9%) contralateral ears, respectively.

In 13 cases (24.5%), symptoms of acute otomastoiditis had developed within 24 hours prior to hospital admission; in 4 of these cases, patients had been treated with oral antibiotics prior to admission. In another 13 cases, symptoms had appeared between 24 and 48 hours prior to admission, and preadmission oral antibiotics had been administered in 5 of these cases. In 19 cases (35.8%), the onset of symptoms had occurred between 48 hours and 7 days prior to admission, and oral antibiotics had already been initiated in 14 of these cases. Finally, in 8 cases (15.1%), patients had been admitted at some point beyond 7 days after the onset of symptoms, and oral antibiotics had been initiated earlier in 6 of these cases. In all, preadmission oral antibiotics had been administered in 29 of the 53 cases (54.7%). The mean length of hospital stay was 10.2 days.

In 20 of the 53 cases (37.7%), patients had a history of at least one episode of acute otitis media (AOM). In 2 of these cases, patients had experienced an intracranial complication (meningitis and perisinus abscess). Nine patients had experienced a subperiosteal abscess, and 1 other had undergone surgery for the treatment of facial nerve paralysis secondary to a cholesteatoma. Of these 20 cases, 11 had been treated with oral antibiotics prior to admission.

In 33 cases (62.3%), patients had no history of AOM. Among this group, 2 patients had meningitis, 1 was treated for an epidural abscess and cavernous sinus thrombosis, and 1 underwent drainage of a subdural empyema.

In the 29 cases in which preadmission antibiotics had been administered, the duration of treatment ranged from a few hours to 3 weeks. The most commonly prescribed antibiotics were amoxicillin, which was used in 10 cases (34.4%), and amoxicillin/clavulanate, which was used in 8 (27.6%). Other antibiotics included azithromycin, cloxacillin, ofloxacin, cephalaxin, and trimethoprim/sulfamethoxazole.

Preadmission myringotomy had been performed in 7 patients, all of whom underwent mastoidectomy for a subperiosteal abscess.

Of the 53 mastoidectomies, 29 (54.7%) had been performed on patients with a clinical subperiosteal abscess in the mastoid region, 14 (26.4%) on patients who had not responded to conservative treatment, 3 (5.7%) on patients with meningitis, 3 on patients with facial nerve paralysis, 1 (1.9%) on a patient with perisinus abscess, 1 on a patient with subdural empyema, 1 on a patient with an epidural abscess and cavernous sinus thrombosis, and 1 on a patient with suspected sigmoid sinus thrombosis.

Of the 14 mastoidectomies that had been performed because conservative treatment had failed, 4 were performed between 24 and 48 hours after admission; a subperiosteal abscess was found in 3 of these cases, one of which had been underdiagnosed on computed tomography (CT). The other 10 were performed between 48 hours and 26 days after hospitalization. A subperiosteal abscess was found in 5 cases, and a cholesteatoma was removed during 1 of these.

Of the 3 cases of meningitis, 1 mastoidectomy had been performed because of a worsening of symptoms and the appearance of seizures, 1 because of the development of facial nerve paralysis, and 1 because the patient exhibited evidence of bone erosion toward the posterior cranial fossa, which was demonstrated on CT.

In the 3 cases of facial nerve paralysis, CT had suggested a cholesteatoma in 2, and this radiologic diagnosis was confirmed during surgery. In the third case, mastoidectomy had been performed because of the onset of a complete facial nerve paralysis despite intensive antibiotic treatment upon admission. In all 3 cases, facial nerve function was completely restored within a few months of surgery.

CT was available in 45 cases, and it correctly identified 26 of 27 subperiosteal abscesses (96.3%) and 17 of 18 mastoid cortex erosions (94.4%) in patients with subperiosteal abscesses or intracranial complications, including epidural abscess, subdural empyema, and perisinus abscess. CT overdiagnosed sigmoid sinus thrombosis in 1 case and mastoid cortex erosion in 2 cases—one child with a subperiosteal abscess and 1 child with meningitis. In the diagnosis of complicated acute otomastoiditis in our study, the sensitivity of CT was 97% and the positive predictive value was 94%.

The most common intraoperative finding was the combination of pus and granulation, which had been seen in 38 of the 53 cases (71.7%). Purulent discharge alone was seen in 9 of the 53 cases (17.0%) and granulation alone in 6 cases (11.3%). Associated cholesteatoma was removed in 6 cases.

Bacteriologic cultures were obtained in 42 cases. In 6 of the 42 cases (14.3%), the pathogens that were cultured from the middle ear during myringotomy or from the external auditory canal were different from those that were isolated from a subperiosteal abscess, mastoid cavity, or intracranial collection. In 3 of these cases, Staphylococcus pyogenes had been isolated from the aural discharge, but Staphylococcus aureus was found in the subperiosteal abscess. In 1 case, Haemophilus influenzae was found in the ear and S pyogenes in the abscess, and in another mixed flora were found in the ear and Escherichia coli in the abscess. In the final case, different types of S aureus were isolated—coagulase-negative in the abscess and coagulase-positive in the ear.

In 36 of the 53 cases (67.9%), purulent discharge was obtained from a subperiosteal abscess, mastoid cavity, or intracranial collection. Eleven of the 36 specimens (30.6%) did not yield any growth, including 7 that had been obtained
from patients who had received antibiotic treatment prior to admission. With respect to the positive cultures, \textit{S} \textit{aureus} was found in 6 of the 36 cultures (16.7%), \textit{S} \textit{pyogenes} in 6, \textit{Streptococcus pneumoniae} in 4 (11.1%), both \textit{S} \textit{aureus} and \textit{S} \textit{pyogenes} in 2 (5.6%), \textit{Pseudomonas aeruginosa} in 2, \textit{E coli} in 2, \textit{H influenzae} in 1 (2.8%), \textit{Klebsiella pneumoniae} in 1, and \textit{Actinomyces}-like bacteria in 1.

Cultures were obtained in 9 of the 14 cases in which patients had not responded to conservative treatment. Three were negative, 2 grew \textit{P} \textit{aeruginosa}, 2 grew \textit{E coli}, 1 grew \textit{S} \textit{aureus}, and 1 grew both \textit{S} \textit{aureus} and \textit{S} \textit{pyogenes}.

In all, 6 of the 53 mastoidectomies were performed on patients who had an intracranial complication; this group was made up of 3 males and 3 females aged between 1 and 75 years (3 children and 3 adults). These 6 cases included 3 cases of meningitis, 1 case of subdural empyema, 1 case of perisinus abscess, and 1 case of epidural abscess and cavernous sinus thrombosis. The latter 3 patients also underwent drainage of an intracranial collection. Four of the 6 patients had no history of AOM, 1 had been treated for AOM on an outpatient basis for 3 weeks, and the patient with perisinus empyema experienced an episode of AOM 6 weeks prior to admission. One of the 3 patients with meningitis had developed pneumococcal meningitis 6 months prior to admission. Culture specimens were taken from the mastoid cavity of 2 of the 3 patients with meningitis; 1 grew \textit{S} \textit{aureus} and the other was sterile. In the third patient with meningitis, \textit{S} \textit{pneumoniae} was found in blood and cerebrospinal fluid (CSF) cultures. \textit{S} \textit{pneumoniae} was also found in blood and CSF cultures of the patient with subdural empyema, \textit{S} \textit{aureus} was cultured at surgery in the patient with epidural abscess, and \textit{S} \textit{pyogenes} was isolated from the mastoid cavity of the patient with perisinus abscess.

Mastoidectomy with a single antibiotic was effective in all 29 cases of clinical subperiosteal abscess. Cefuroxime was administered in 13 of these cases; following surgery, cefuroxime was switched to ceftriaxone in 2 cases and to amikacin in 1. Intravenous amoxicillin/clavulanate was the initial treatment in 11 cases; postoperatively, it was changed to cefuroxime in 6 cases and to ceftriaxone in 1. In 4 cases, patients were treated with ceftriaxone both before and after surgery. The 1 patient with \textit{P} \textit{aeruginosa} in the abscess cavity and associated cholesteatoma was treated with ceftazidime both before and after mastoidectomy.

Of the 14 mastoidectomies that had been performed because conservative treatment had failed, the initial antibiotic was switched postoperatively in 5. Amoxicillin/clavulanate was switched to cefuroxime in 1 case, to ceftazidime in 1 case, and to ceftriaxone and amikacin in 1 case; cultures of pus taken from the mastoid or abscess cavity in these 3 cases were sterile. In 2 cases, cefuroxime and ceftriaxone monotherapies were changed to ceftazidime; cultures of the mastoid cavity grew \textit{E coli} and \textit{P} \textit{aeruginosa}, respectively.

Two or more antibiotics were used in 8 cases—5 cases of intracranial complications, 2 cases of facial nerve paralysis with a cholesteatoma found at surgery (including 1 case of \textit{P} \textit{aeruginosa} infection), and 1 case of \textit{E coli} cultured from the mastoid.

During follow-up, 9 of the 51 patients (17.6%) experienced one or more episodes of AOM, 3 (5.9%) experienced serous otitis media, and 1 (2.0%) developed chronic otitis media that required a radical mastoidectomy. In addition, 3 patients experienced recurrent mastoiditis several months following surgery. Finally, 3 others experienced a second episode of subperiosteal abscess; 2 of these patients required a repeat operation, and the other had a very small abscess that resolved with conservative treatment.

Cholesteatoma had been found at revision surgery in 4 of the 51 patients (7.8%). In 1 of these patients, the cholesteatoma was seen during the first mastoidectomy and removed during a second-look mastoidectomy 8 months later. In another patient, recurrent subperiosteal abscess developed 10 months postoperatively; that cholesteatoma was discovered during revision surgery to remove the abscess. In the other 2 patients, cholesteatoma was diagnosed on routine observation 1 year postmastoidectomy.

Discussion

Our study focused on (1) patients who had undergone mastoidectomy for the treatment of known or suspected complications of acute otomastoiditis and (2) patients who had failed to respond to conservative treatment, including IV antibiotics and myringotomy. Our case management protocol calls for a myringotomy at the first examination, administration of IV antibiotics, and CT of the temporal bones. We also order contrast-enhanced CT of the brain upon admission in cases of known or suspected complications and in patients who respond poorly to 48 to 72 hours of medical therapy. Of course, antibiotic therapy can be changed on the basis of culture results.

Our finding that 26 of the 53 mastoidectomies (49.1%) had been performed within 48 hours of the onset of symptoms is consistent with results published in other reports.\cite{3,4}

The percentage of bacteria isolated in aural discharge, in the mastoid and abscess cavities, and elsewhere varies among studies.\cite{3,12} In cases of complicated acute otomastoiditis, we believe that the true pathogens can be found only in the subperiosteal abscess, the mastoid cavity, or the intracranial collection. The problem we face is that at the time of surgery, most patients have already been treated with antibiotics, and therefore many of their cultures show no organism growth. In our study, for example, 11 of the 36 specimens (30.6%) obtained intraoperatively were sterile.

Of the 14 mastoidectomies that had been performed because patients had not responded to conservative therapy, a subperiosteal abscess was found in 9 (64.3%),
1 of which was associated with a cholesteatoma. In addition to subperiosteal abscess and cholesteatoma, another cause of treatment failure is infection with gram-negative bacteria.

The bacteriology of intracranial complications of acute otomastoiditis has changed over the years. In 1983, Gower and McGuirt reported that *H influenzae* was the most common cause of meningitis in otomastoiditis (39% of cases), followed by *S pneumoniae* and *P aeruginosa*. By contrast, we found *H influenzae* in only 1 case, that of a patient with a subperiosteal abscess. In fact, our patients with intracranial complications harbored *S aureus*, *S pneumoniae*, and *S pyogenes*. We suggest that patients with *H influenzae* infection respond well to conservative treatment, and therefore they do not require surgery.

In 29 of the 53 cases in our series (54.7%), oral antibiotics were administered prior to admission. It is a well-established fact that acute mastoiditis and other complications were administered prior to admission. It is a well-known treatment, and therefore they do not require surgery.

We accept the supposition that some patients with acute mastoiditis develop a primary infection of the bony framework of the middle ear cleft. Facial nerve paralysis and intracranial complications were seen both in children and adults in our study. Subperiosteal abscess is primarily a children’s disease, and in older children it can be associated with cholesteatoma. Our experience. Int J Pediatr Otorhinolaryngol 1999;50:113-7.

Facial nerve paralysis and intracranial complications were seen both in children and adults in our study. Subperiosteal abscess is primarily a children’s disease, and in older children it can be associated with cholesteatoma. In our series, subperiosteal abscess was found in children between the ages of 5 months and 11 years (5 of them infants); it was found in 1 adult, as well. In addition to subperiosteal abscess, cholesteatoma was seen in 2 11-year-old boys.

All of our patients were successfully treated with IV antibiotics and mastoidectomy (simple, modified radical, or radical) with or without the insertion of a ventilating tube, although some patients with recurrent subperiosteal abscess or cholesteatoma required revision surgery. Intracranial complications were diagnosed in both mastoid surgery. Single-drug therapy with mastoidectomy was effective in all but 8 cases. We obtained good results with the use of cefuroxime and ceftriaxone. Antibiotics that are effective against both gram-positive and gram-negative organisms should be administered upon admission to patients with complicated acute otomastoiditis. Intracranial complications and cases of facial nerve paralysis may require a combination of two or more antibiotics in addition to surgery. Two recent studies have shown that cephalosporins are the most frequently used antibiotics in the management of acute mastoiditis.

In our study, CT of the temporal bones and brain has been extremely helpful, yielding a sensitivity of 97% and a positive predictive value of 94% in the diagnosis of complications of acute otomastoiditis. CT should be performed on all patients prior to mastoid surgery. CT is also recommended for all patients who have known or suspected complications and in those who have not responded to conservative treatment and for whom surgery has not been planned. One study of patients who had undergone mastoidectomy for the treatment of acute mastoiditis revealed a high percentage (33%) of postoperative middle ear infection. In our series, different kinds of middle ear and mastoid infection developed in 19 of the 51 patients (37.3%), and cholesteatoma was found at revision surgery in 4 patients (7.8%). Long-term follow-up for these patients is, therefore, highly recommended.

References