

Conservative Management of Acute Mastoiditis in Children

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Objective: To determine whether treatment of acute mastoiditis in children using antibiotics combined with retroauricular puncture and grommet insertion is effective compared with “standard management” with mastoidectomy.

Design: Retrospective study.

Setting: Tertiary pediatric center.

Patients: We identified 50 patients younger than 14 years with acute mastoiditis (mean age, 32 months). Individuals with subacute mastoiditis and cholesteatoma were excluded from this study. All the children had received antibiotic drug treatment. Before 2002, a subperiosteal abscess (SA) was managed by mastoidectomy. Beginning in 2002, however, conservative management was initially attempted to avoid mastoidectomy.

Main Outcome Measure: The proportion of cured children after conservative management of SA in acute mastoiditis.

Results: Acute mastoiditis occurred in 30 patients al-

ready treated with antibiotics before hospital admission. On examination, 1 child had facial palsy. All the patients except 1 (who had temporozygomatic swelling) had postauricular swelling. Myringotomy or retroauricular puncture isolated bacteria in 38 patients. *Streptococcus pneumoniae* was identified in 28 patients. Computed tomography (43 patients) diagnosed 31 SAs, including 3 cases of sigmoid sinus thrombosis and 1 subdural abscess. All the children were cured without complications regardless of the type of treatment. Comparing the periods before and after 2002, the number of SAs was similar (15 and 16, respectively), but the number of mastoidectomies was reduced (16 and 1, respectively). The hospital length of stay of patients who underwent aspiration was shorter than that of patients who underwent cortical mastoidectomy.

Conclusion: Antibiotic drug use combined with retroauricular puncture and grommet insertion is an effective alternative to mastoidectomy in the treatment of acute mastoiditis with SA in children.

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ACUTE MASTOIDITIS (AM) IS an infectious disease of the temporal bone that can complicate acute otitis media (AOM). The incidence of AM in children younger than 14 years is estimated to be 1.2 to 4.2 per year in developed countries.¹ Despite modern antibiotherapy, AM may develop quickly and become life threatening, with extracranial and intracranial complications. Subperiosteal abscess (SA) is the most frequent complication of AM. In this case, most children undergo mastoidectomy.² The objective of this study was to test the hypothesis that SA, a complication of AM, can be treated equally well by conservative management as by cortical mastoidectomy.

METHODS

POPULATION

We performed a retrospective analysis of medical records and computed tomographs (CTs) of children admitted for AM to our pediatric head and neck surgical department at a tertiary referral medical center (Unité d'ORL pédiatrique, CHRU de Tours, Service de Chirurgie Pédiatrique de la Tête du Cou, Centre Hospitalier Régional Universitaire (CHRU) de Tours) between May 1, 1994, and May 30, 2008. Because the goal was to study AM, the criteria for diagnosis were signs of AOM, protruding ear, postauricular edema combined with tenderness over the mastoid area, and fever. Patients with cholesteatoma, subacute mastoiditis, or postauricular cellulitis secondary to otitis externa were excluded from this study.

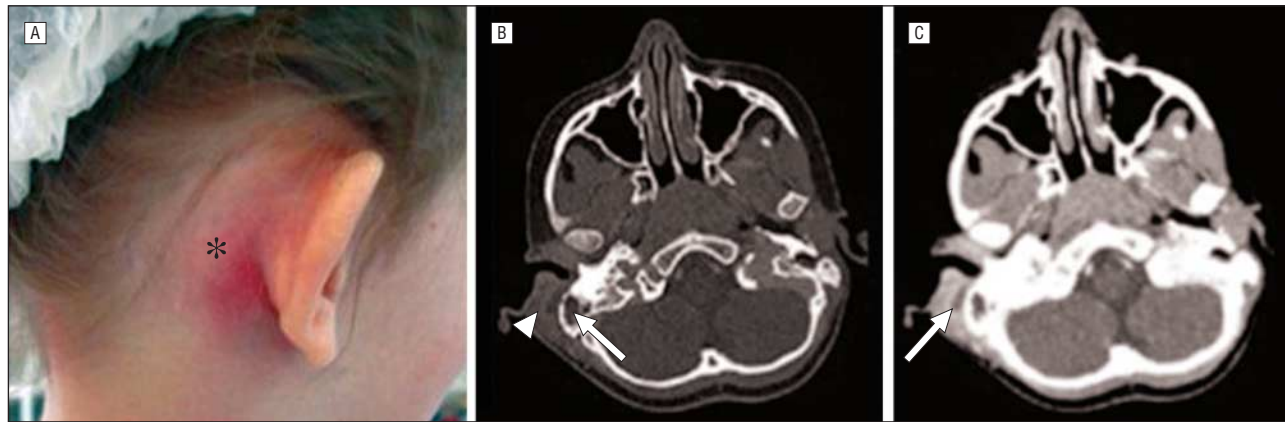


Figure 1. Physical examination and computed tomographic (CT) findings (displayed scan thickness, 5.25 mm) of a right subperiosteal abscess in a 48-month-old girl. A, Clinical aspect of right acute mastoiditis in a 48-month-old girl with tender swelling and erythema over the mastoid (asterisk). B, Axial head CT scan (bone window) showing right mastoid opacification (arrow) with no osseous defects and swelling of soft tissue over the mastoid (arrowhead). C, Axial contrast-enhanced cranial CT scan (soft tissue) showing a right subperiosteal abscess (arrow).

All the patients received broad-spectrum intravenous antibiotic agents targeted at individual culture and sensitivity results. Before antibiotic treatment, ear culture specimens were collected using a sterile suction cannula through the myringotomy or from pus obtained during mastoidectomy and the drainage of the abscess. Specimens were immediately cultured in aerobic and anaerobic culture blood bottles. The 2 culture bottles were sent to the microbiology department without delay. All patients with SA or suspected intracranial complications underwent head CT with intravenous contrast. Pediatric radiologists performed the CT with helical CT acquisitions using a 0.5-, 0.6-, or 0.75-mm section thickness according to the material available, with multiplanar reconstructions. Sections were obtained slightly below the orbitomeatal line to avoid unnecessary irradiation of the eye by using a high-resolution bone algorithm and a low milliampere-seconds value. We performed CT for children with high clinical suspicion of SA or intracranial complications and for patients who did not improve with antibiotic treatment after 48 hours.

In the case of SA, patients treated before 2002 also had a cortical mastoidectomy (operative group), and those treated in 2002 or later did not. The latter had a postauricular puncture or tympanostomy tube placement (conservative group).

OUTCOME MEASUREMENTS

Age, sex, clinical presentation, CT and ear culture findings, management, and outcome were studied to describe the population of children with SA and to compare the operative and conservative groups.

RESULTS

Between May 1, 1994, and May 30, 2008, a total of 50 consecutive children were admitted to the hospital for AM. The ages of these 29 boys and 21 girls with AM ranged from 5 to 163 months (13.5 years), with a mean (SD) age of 32 (35) months and a median age of 19 months. A CT was obtained and reviewed for 43 children. The CTs identified 31 SAs (**Figure 1**). Findings included 3 sigmoid sinus thromboses and 1 subdural empyema (**Figure 2**).

Among the 31 children with SAs, the mean (SD) age was 26 (27) months. All these patients had postauricular swelling. A 35-month-old boy had facial palsy. Com-

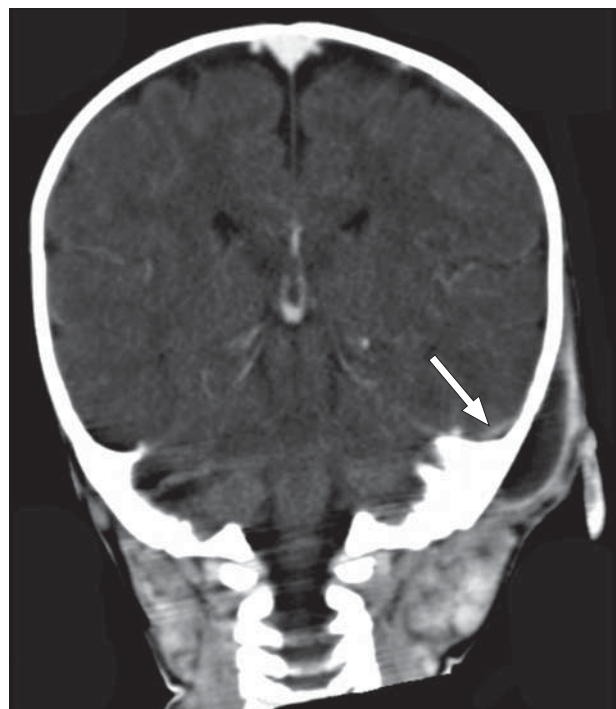


Figure 2. Contrast head computed tomograph with coronal reconstruction of a 9-month-old girl with left acute mastoiditis and a subperiosteal abscess. Left subdural empyema (arrow) was detected. After conservative management, this girl was cured.

paring the 2 groups, the number of SAs was similar: 15 children with SA in the operative group and 16 in the conservative group. Comparing age in the operative and conservative groups using a *t* test, the difference was not significant ($P = .13$).

Table 1 describes pathogen growth in 25 positive ear cultures collected from 31 SAs (81%). Seventeen patients had received antibiotics before hospital admission. *Streptococcus pneumoniae* was the most frequent pathogen, and it was cultured in 19 SAs. Subtypes were not obtained. Rates of antibiotic-resistant *S pneumoniae* were 78% in the operative group and 90% in the conservative group. No significant differences were noted in rates

Table 1. Bacterial Findings Obtained From 31 Children With Subperiosteal Abscess

| Organism | Children, No. | | |
|-----------------------------------|------------------------|---------------------------|--------------|
| | Operative Group (n=15) | Conservative Group (n=16) | Total (N=31) |
| No growth | 3 | 3 | 6 |
| <i>Streptococcus pneumoniae</i> | 9 | 10 | 19 |
| <i>Streptococcus pyogenes</i> | 1 | 3 | 4 |
| <i>Staphylococcus chromogenes</i> | 1 | 0 | 1 |
| <i>Fusobacterium necrophorum</i> | 1 | 0 | 1 |

Table 2. Characteristics of 31 Children With Subperiosteal Abscess Developed After Acute Mastoiditis

| Characteristic | Operative Group (n=15) | Conservative Group (n=16) ^a | P Value |
|-------------------------------|------------------------|--|---------|
| Age, mean (SD), mo | 33 (37) | 17 (16) | .13 |
| Facial palsy, No. | 1 | 0 | NA |
| Sigmoid sinus thromboses, No. | 2 | 1 | NA |
| Subdural empyema, No. | 0 | 1 | NA |
| Mastoidectomy, No. | 15 | 1 | NA |
| Hospital stay, mean (SD), d | 15 (6) | 9 (7) | .02 |

Abbreviation: NA, not applicable.

^aConservative management failed in 1 case, in which cortical mastoidectomy was then performed.

of antibiotic-resistant *S pneumoniae* between the 2 groups (odds ratio, 2.4; $P = .58$) using the Fisher exact test.

The most commonly administered antibiotic during hospitalization in the overall population was ceftriaxone sodium (64%) combined with fosfomycin or metronidazol. The mean duration of antibiotic treatment (intravenous and oral) was 24 days in the operative group and 18 days in the conservative group. **Table 2** compares the operative and conservative groups. In the conservative group, 1 child had a cortical mastoidectomy. This 16-month-old boy had a sigmoid sinus thrombophlebitis complicating an SA and did not improve after 48 hours of conservative management. Results of the ear culture were negative, whereas the blood culture showed *Fusobacterium necrophorum*. All the children were cured after intravenous antibiotic therapy combined with cortical mastoidectomy or conservative management. Comparing the hospital stay in the operative and conservative groups, the difference was significant using a *t* test: 15 days and 9 days, respectively ($P < .02$).

COMMENT

The term *mastoiditis* describes a variety of suppurative complications of AOM. It primarily affects children younger than 2 years.³ Acute mastoiditis is a suppurative infection of the mastoid air cells. With the advent of antibiotic agents, mastoiditis has become a relatively rare complication of AOM, and the incidence rates are less

than 6 cases per 100 000 children younger than 14 years.^{4,5} The reported incidence of mastoiditis complications ranges from 4.0% to 16.6%.⁶⁻⁸ A recent study⁸ demonstrates that a high-grade fever, a high absolute neutrophil count, and a high C-reactive protein level may serve as clinical and laboratory markers of complicated AM. Acute mastoiditis with periostitis is a collection of pus in the mastoid that can result in coalescent mastoiditis, a destructive infection of the mastoid bone and air cell system. This loss of bony architecture may expand and most often results in an SA,⁹ the most frequent complication. Suppurative infection can also spread to the adjacent dura mater of the posterior and middle cranial fossae and to the sigmoid sinus by means of osseous erosion, thrombophlebitis, or anatomical pathways, producing intracranial complications.¹⁰ The present data found 31 SAs in 50 children hospitalized for AM.

Head CT with intravenous contrast is a valid technique for detecting intracranial complications. However, the rise in the use of CT in the pediatric population, entraining with it a rise in pediatric brain irradiation,¹¹ has led to questions about the necessity of using CT for pediatric patients with AM. It is suggested that CT be performed in cases of neurologic signs, deterioration of general state (vomiting and lethargy), suspicion of cholesteatoma, during follow-up in patients with high fever after 48 to 72 hours of therapy, or in cases of local progression of disease.¹² Computed tomography has a sensitivity of 97% and a predictive value of 94% in detecting intracranial complications secondary to AM.^{10,13} In the present study, CTs were available for 43 children and identified 31 SAs, 3 cases of lateral sinus thrombophlebitis, and 1 subdural empyema.

Cranial magnetic resonance imaging (MRI) is an available method of investigation if intracranial complications are suspected.¹⁰ Because of its higher sensitivity in detecting extra-axial fluid collection and associated vascular problems, MRI is performed in children with intracranial neurologic symptoms or CT findings suggestive of intracranial complications.¹⁰ The advantages of MRI include its noninvasiveness and lack of radiation; it also requires no contrast agent.¹⁴ In the present study, cranial MRI was not performed because none of the children showed intracranial neurologic signs on clinical examination. For the child who presented with facial palsy, MRI was impossible during the first day, and facial palsy decreased after 24 hours of treatment. In the future, cranial MRI may be the imaging method of preference for complicated AM, but today in France, the access to MRI in an emergency, the cost, and the need to sedate the children are prohibitive factors in allowing its use.

A systematic use of aerobic and anaerobic culture blood bottles sent to the microbiology department without delay allowed us to increase the rate of pathogenic growth in culture obtained before antibiotic therapy. According to the literature,^{15,16} *S pneumoniae* was the most common pathogen isolated from the ears of the patients. Rates of antibiotic resistance were high but did not modify the management. Because the most documented pathogenic cause of AM is *S pneumoniae*, it will be interesting to see whether introduction of the conjugate vaccine will reduce the complications of AOM.

Table 3. Outcome of Conservative Management for Subperiosteal Abscess

| Source | Conservative Management | Patients, No. | Cured, No. |
|--|-------------------------|---------------|------------|
| Cohen-Kerem et al, ²¹ 1999 | Drainage | 8 | 4 |
| Vera-Cruz et al, ²² 1999 | Drainage | 14 | 14 |
| Taylor and Berkowitz, ²³ 2004 | Drainage | 10 | 10 |
| Taylor and Berkowitz, ²³ 2004 | Needle aspiration | 12 | 12 |
| Khafif et al, ²⁴ 1998 | Needle aspiration | 10 | 9 |
| The present study | Needle aspiration | 16 | 15 |

Subperiosteal abscess is classically considered a surgical disease. Surgery usually involves a mastoidectomy and tympanostomy tube placement, with attendant risks to the dura, sigmoid sinus, and facial nerve, particularly in very young children.¹⁷ This placement allows drainage of the antrum via the middle ear, the external auditory canal, and postauricularly; the drained pus can then be sent for culture, and the osteitic temporal bone can be debrided. This surgical treatment of AM complicated by an SA has changed very little. In the past decade, however, conservative management (ie, intravenous antibiotics combined with tympanostomy tubes and retroauricular puncture) has become an alternative treatment.¹⁸⁻²⁰ The present data confirmed the efficacy of conservative management. Indeed, we did not find significant differences between the group treated with mastoidectomy and antibiotics (operative group) and the group treated with postauricular puncture and antibiotics (conservative group). The main difference was the length of hospital stay, which was shorter in the conservative group than in the operative group. These results are comparable with those of previous studies (Table 3).^{18,19,21-25}

Otogenic intracranial complications can be fatal if not managed appropriately. Some researchers²⁵ recommend that otologic surgery must be performed at the same time as intracranial surgery for patients with mature brain abscesses. However, direct drainage of the intracranial abscess can be avoided if the patient's symptoms, neurologic status, and radiographic findings progress favorably.²⁶ Conservative management is also available in otogenic lateral sinus thrombosis developed after AM²⁷ and otogenic intracranial abscesses.²⁸ Thus, according to these researchers^{27,28} and the present results, surgery is not the criterion standard in complicated AM. For example, in the present study, we cured a child with subdural empyema and an SA after AM with conservative management.

We recommend that conservative management be selected for all children who present an SA secondary to AM. In such cases, otogenic intracranial complications (lateral sinus thrombosis or subdural empyema) require high doses of broad-spectrum intravenous antibiotic agents, which are then targeted at individual culture and sensitivity results. Surgery remains a combined option in cases of neurologic signs or after the failure of conservative management, as in 1 of the present cases caused by *F necrophorum*.

In conclusion, the frequency and morbidity of AM have been reduced since the introduction of antibiotics. Subperiosteal abscess is usually a surgical disease. However, this study demonstrates that conservative management with postauricular puncture or tympanostomy tube placement with antibiotics is an alternative treatment for children with SA. The length of hospital stay is reduced compared with children treated with surgical management. However, when mastoiditis is caused by *F necrophorum*, physicians must be aware that this infection may be more aggressive and more complicated to treat. If conservative management fails, mastoidectomy must be considered.

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