



# Mastoiditis: a disease often overlooked by pediatricians

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Received: May 23, 2000 Revised: June 26, 2000 Accepted: July 7, 2000

Although mastoiditis can be a life threatening disease, clinicians often overlook it because it is uncommon. We reviewed the presentation and management of all children younger than 15 years of age with the discharge diagnosis of mastoiditis in our hospital from January 1994 through December 1999. Nineteen patients that fulfilled the case definition were included. The most common clinical presentation in this series was fever. More specific findings, such as otorrhea, postauricular pain, swelling, and redness of mastoid could be found in less than half of these patients. Only two patients had characteristic physical findings, and mastoiditis was diagnosed in only three patients upon admission. Plain radiographic evidence of mastoiditis was usually not apparent early in the course. In this series, the majority of patients were diagnosed by computed tomography (CT) scans. The present study demonstrates that mastoiditis most commonly presents without a clearly diagnostic set of physical examination and laboratory findings. Mastoiditis should be considered in patients with otitis media or with fever of unknown origin (FUO). The empirical antibiotic treatment should cover organisms commonly found in acute otitis media (AOM), including *Haemophilus influenzae*, *Streptococcus pneumoniae*, and *Moraxella catarrhalis*.

**Key words:** Fever of unknown origin, mastoiditis, otitis media

Mastoiditis, a destructive infection of the mastoid bone and air cell system, is the most common complication of otitis media [1]. As the middle ear and mastoid air space are interconnected, inflammation of the middle ear can lead to mastoiditis in nearly all patients after hyperemia and edema of the mucosa lining of the mastoid air cells and subsequent accumulation of serous and purulent exudates develops [2].

Coincident with the introduction of antibiotics in the early 1940s, the frequency of mastoiditis dramatically decreased. During the early 20th century, about half of patients with otitis media developed mastoiditis. However, by 1959 the incidence had fallen to only 0.4%, and by 1993 less than 0.24% of patients with acute otitis media (AOM) developed mastoiditis [3].

The use of antibiotics has failed to eradicate mastoiditis completely. Significant and even life-threatening complications beyond the tympanomastoid space, including periauricular subperiosteal abscess, facial paralysis, suppurative labyrinthitis, meningitis, epidural and subdural abscess, brain abscess, lateral sinus thrombophlebitis, and even rare fatalities, continue

to occur in the post-antibiotic era [4]. Moreover, only one-third of patients with mastoiditis show pathologic tympanic membrane changes, and since complaints of otalgia, fever, and tenderness are inconsistent [3], the diagnosis is frequently delayed.

The typical clinical presentation and management of mastoiditis are continually evolving. To determine the current status of this disease entity, we reviewed the clinical records of patients recently treated for mastoiditis in our hospital.

## Materials and Methods

### Case definition

Mastoiditis was diagnosed if the patient showed the characteristic physical findings of mastoiditis, including erythema, tenderness, and swelling over the mastoid area. In the absence of typical physical findings, patients with a radiological finding of mastoiditis were also diagnosed. Criteria for radiological diagnosis of mastoiditis includes cloudiness of the mastoid air cells on conventional radiographs, computed tomography (CT) or magnetic resonance (MR) imaging scans.

A retrospective chart review was performed to identify all children younger than 15 years of age with the discharge diagnosis of mastoiditis from January 1994 through December 1999 at Veterans General

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Hospital - Kaohsiung, a tertiary referral medical center with 1200 beds, including 130 beds in the department of pediatrics, serving the population of Kaohsiung and surrounding communities of southern Taiwan. Data including the admission diagnosis, clinical manifestations, laboratory data, bacteriology, radiologic findings, treatment, and outcomes were collected from medical records.

## Results

A total of 19 patients that fulfilled the case definition were included in the study. Two patients had characteristic physical findings, including erythema, tenderness, and swelling over the mastoid area. Seventeen patients had radiological evidence of mastoiditis. The median age of patients was 1-year- and 7-month-old (ranged from 4 months to 14 years). Fourteen patients were male and five were female. Four patients had underlying diseases, two with hypogammaglobulinemia, one with ear canal atresia, and one with mental retardation.

### Admission diagnosis

Mastoiditis was diagnosed in only three of the 19 patients (15.8%) upon admission. AOM was the most common admission diagnosis, recorded in seven (36.8%) patients. Other diagnosis on admission included fever of unknown origin (FUO) in five (26.3%) patients, bronchopneumonia in two (10.5%), cellulitis in one (5.3%), and anorexia nervosa in one (5.3%).

### Clinical presentation

Fever, noted in 14 (73.7%) patients, was the most common clinical presentation. The other clinical presentations included otorrhea in nine (47.4%) patients, otalgia in five (26.3%), postauricle swelling in four (21.1%), postauricle redness in two (10.5%), and headache in one (5.3%).

### Laboratory data

Laboratory studies at admission revealed 15 (78.9%) patients with white blood cell counts of less than 15000/mm<sup>3</sup>, and four (21.1%) patients with counts of more than 15000/mm<sup>3</sup>. Sixteen (84.2%) patients had a neutrophil count of less than 70%, and three (15.8%) patients had a neutrophil count of more than 70%. Fourteen (73.7%) patients had a C-reactive protein (CRP) level of less than or equal to 2 mg/dL, and five (26.3%) patients had a CRP greater than 2 mg/dL.

### Radiology

Nine patients underwent conventional radiography,

three of them had a demonstrable opacification or clouding of the mastoid. CT scan was performed in 14 patients, and MR imaging in one. All CT and MR images showed cloudiness of the labyrinth of the mastoid cells.

### Bacteriology

Cultures were performed of either ear canal swabs, drainage or of aspirated specimens collected from all patients (Table 1). No growth in the culture was reported in seven of the 19 patients (36.8%). Among the 12 patients with positive cultures, six isolates were collected from otorrhea, four from aspiration, and two from ear canal swabs. *Haemophilus influenzae* was the most commonly isolated organism, recovered from four patients, followed by *Streptococcus pneumoniae* (three isolates) and *Moraxella catarrhalis* (two isolates). All three isolates of *S. pneumoniae* in our patients were nonsusceptible to penicillin with minimum inhibitory concentrations (MICs) of 0.19, 0.5, and 4 µg/mL, respectively.

### Treatment

All patients were admitted and treated with antibiotics for a median duration of 35 days (ranged from 14 to 56 days). Six of the nineteen patients were treated with single drug therapy, usually cefuroxime. The remaining 13 (68.4%) patients were treated with combination therapy, usually crystal penicillin plus a third generation cephalosporin. Eight (42.1%) patients underwent ventilation tube placement for decompression, continual drainage and culture. None of the patients required mastoidectomy.

### Outcome

All 19 patients received follow-up with tympanogram and high-resolution CT (HRCT) scans within 2 months

**Table 1.** Bacteriologic isolates of 19 patients less than 15 years of age with mastoiditis treated at Veterans General Hospital-Kaohsiung from January 1994 through December 1999

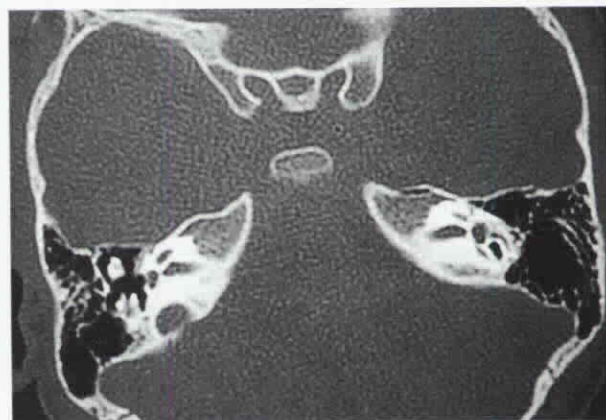
Organism	No. of cases (%)
No growth	7 (36.7)
<i>H. influenzae</i>	4 (21.1)
<i>S. pneumoniae</i>	3 (15.8)
<i>M. catarrhalis</i>	2 (10.5)
MRSA	1 (5.3)
<i>Proteus mirabilis</i> <sup>a</sup>	1 (5.3)
<i>Aspergillus fumigatus</i> <sup>a</sup>	1 (5.3)

Abbreviations: MRSA = methicillin-resistant *Staphylococcus aureus*

<sup>a</sup>Collected from ear canal swabs.



**Fig. 1.** CT scan of the brain showing clouding of the right side mastoid air cells (arrow) without intracranial lesion.



**Fig. 2.** Patient in Fig. 1 received follow-up HRCT 2 months later after antibiotic treatment for 42 days. HRCT shows enhanced fine structure of the middle ear and mastoid in detail.

after discharge. Five patients had an abnormal tympanogram with reduced peak admittance and gradient; three had abnormal HRCT findings, showing clouding of mastoid air cells without bone destruction. None had an intracranial lesion and no clinical sequela was found at follow-up.

## Discussion

During the post-antibiotic era clinicians often overlook mastoiditis, and the diagnosis is frequently delayed because clinical manifestations and laboratory data are often nonspecific as in the present series. The most common clinical presentation in this study was fever. More specific findings, such as otorrhea, postauricular pain, swelling, and redness of mastoid could be found in less than 50% of cases and these findings could not establish the diagnosis. The majority of laboratory findings, including white blood cell counts, neutrophil counts, and CRP were also nonspecific.

Plain radiographic findings of coalescent mastoiditis, suggesting breakdown of the bony trabeculae in the mastoid are usually not apparent early in the course of mastoiditis [4]. The vast majority of our patients did not undergo plain radiography, because most clinicians in our hospital do not consider it valuable in the post-CT era. Fourteen of our patients received CT scanning, and all had positive findings of mastoiditis.

In this series, the majority of our patients were diagnosed by CT scans. Previous studies have reported that CT scan is the most valuable tool for diagnosis of mastoiditis [5-7]. Furthermore, compared with plain film, CT scan provides more information about intracranial spread of infection [6,8]. The results of this

study demonstrate that conventional brain CT is a useful initial examination to screen for mastoiditis, as well as for intra- or extracranial complications (Fig. 1). Although HRCT provides more information about the detailed structure of middle ear and mastoid (Fig. 2) than CT, it cannot provide information about other intracranial lesions. Thus, HRCT is more useful for the purposes of follow-up once the presence of an intracranial lesion has been excluded [5,9].

One contributing factor to a delay in exact diagnosis at admission in this series may have been the higher level of clinical difficulty seen among patients who present at this teaching hospital and tertiary care center. The majority of patients were referred, and most had received antibiotics before the time of admission. Another factor contributing to the delay of diagnosis may be that primary care physicians often overlook possible mastoiditis; this would not be surprising since this disease is infrequently seen today [4]. However, we could not exclude the possibility that in seven patients with otitis media, mastoiditis may have developed during the course of hospitalization.

Our findings that *H. influenzae*, *S. pneumoniae*, and *M. catarrhalis* were the most common isolates are consistent with the hypothesis that since mastoiditis is an extension of infection from the middle ear, it is caused by the same organisms that are responsible for AOM [7,10]. Antimicrobial therapy should be selected on the basis of Gram stain and culture results of the middle ear fluid [10]. However, when such data are not available, our study supports the opinion that initial treatment should cover organisms commonly found in AOM. The recent emergence of high-level antibiotic resistance of *S. pneumoniae* has resulted in a perceived

increase in cases of mastoiditis [5]. All three isolates of *S. pneumoniae* in our patients were non-susceptible to penicillin.

Patients with mastoiditis who initially present with complications or who fail to improve within 24 to 72 h after medical treatment has begun are candidates for mastoidectomy [4]. All of our patients showed clinical improvement within 72 h after antimicrobial therapy, and none required mastoidectomy.

In conclusion, mastoiditis most commonly presents without specific physical examination and laboratory findings. A high index of suspicion of mastoiditis should be maintained in patients presenting with otitis media or FUO. A greater awareness of the clinical variation of manifestations of mastoiditis may assist in the early diagnosis of this illness and a decrease in the rate of serious complications.

### Acknowledgments

We wish to thank Dr. Lawrence C. McDonald and Dr. Hsiu-Jung Lo, of the National Health Research Institutes, Taipei, Taiwan and Dr. Richard H. Michaels of Children's Hospital of Pittsburgh, for their expert discussion and careful review of the manuscript.

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