Original Article

# Acute Mastoiditis in Children: A Tertiary Care Center Experience in 2015–2021

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**Abstract**

**Background:** Acute mastoiditis is a suppurative infection of mastoid air cells and is the most common intratemporal complication of otitis media. **Aim:** This study aimed to evaluate the demographic and clinical characteristics and treatment outcomes of children with acute mastoiditis (AM). **Patients and Methods:** We retrospectively reviewed the medical records of hospitalized pediatric patients aged between 1 month and 18 years with a diagnosis of AM between May 2015 and December 2021. **Results:** A total of 28 hospitalized children with AM were enrolled in this study, of whom 22 (78.6%) were males and 6 (21.4%) were females with a mean ± standard deviation age of 93.5 ± 53.2 months (range = 6 months–16.1 years). The most common clinical symptoms were postauricular erythema (n = 17, 60.7%), tenderness (n = 16, 57.1%), swelling (n = 14, 50%), fever (n = 14, 50%), and auricular protrusion (n = 7, 25%). Mastoiditis complications occurred in 10 (35.7%) children. The most common extracranial complication was subperiosteal abscess (n = 8, 28.6%). The erythrocyte sedimentation rate (ESR) and the rate of antibiotic use before hospitalization were higher in patients with complicated mastoiditis ($P$ = 0.006 and $P$ = 0.039, respectively). Surgery was performed in 12 (42.9%) patients. Statistically, more surgical interventions were performed in patients who developed complications ($P$ = 0.003). **Conclusion:** AM continues as an important disease of childhood. Successful results are obtained with systemic antibiotic therapy and additional surgical intervention as necessary. A careful evaluation of patients with a high ESR and those who received antibiotic therapy before hospitalization is appropriate due to the correlation between these factors and the risk of complication development.

**Keywords:** *Acute mastoiditis, antibiotic therapy, children, surgery*

## Introduction

Mastoiditis is a suppurative infection of the mastoid air cells with three clinical forms, acute, subacute, and chronic. The term acute mastoiditis (AM) is used for cases in which the symptoms last less than month, whereas chronic mastoiditis is defined as the persistence of symptoms for months to years.[1]

The mastoid is part of the temporal bone, which consists of a single cell, called the antrum, and is connected to the middle ear by a channel at birth, which pneumatized over the years, thus forming the interconnected air cells.[2,3] The continuous relationship of the mastoid area, the middle ear, and the eustachian tube is the key point in the pathogenesis of mastoiditis.[1]

AM is the most common complication of acute otitis media (AOM); however, it is a rare condition. Additionally, it is of vital concern for clinicians because it causes a serious disease course, especially in young children. Important risk factors for mastoiditis include high fever, young age, high acute phase

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reactants, recurrent otitis media, and previous antibiotic treatment.[4,5] Common clinical findings of AM include postauricular tenderness, erythema, and swelling and auricular protrusion.[3] *Streptococcus pneumoniae* and *Streptococcus pyogenes* are the most common causative agents of AM; however, non-typeable *Haemophilus influenzae, Staphylococcus aureus* (including methicillin-resistant *S. aureus*), and *Pseudomonas aeruginosa* are also encountered as causative agents.[6,7] The optimal approach in the treatment of mastoiditis is antibiotic therapy and drainage of the infected area. However, the treatment of AM in children has not been investigated in randomized studies; thus, different approaches are practiced between centers.[3]

The incidence of mastoiditis is reported with different results in different countries in the pediatric age group. In light of current literature, mastoiditis varies between 1.2 and 6.1 cases per 100,000 children aged 0–14 years.[8,9] Due to the scarcity of data on pediatric cases of mastoiditis in our country, we aimed to examine the general characteristics, treatment, and complications of pediatric cases with AM.

## Materials and Methods

This retrospective descriptive study was conducted in a 1000-bed tertiary city hospital in Istanbul, Turkey, from May 2015 to December 2021 and included 28 children under 18 years of age with a diagnosis of AM. Neonates who are hospitalized in neonatal intensive care units were excluded from the study.

### Patient data collection and inclusion criteria

Participants were identified through the department's patient files archive (age and sex) physical findings, laboratory findings (white blood cell [WBC], C-reactive protein [CRP], erythrocyte sedimentation rate [ESR]), microbiological findings (blood culture and abscess culture), treatment during the hospital stay, radiological findings (computed tomography [CT] and magnetic resonance imaging [MRI]), surgical intervention, and hospital stay duration.

The inclusion criterion was a diagnosis of AOM in the last 14 days, which was defined based on the American Academy of Pediatrics guidelines, in combination with one or more clinical findings, such as postauricular inflammation (erythema, tenderness, swelling, fluctuance, or mass), auricular protrusion, otalgia, or fever.[1,10]

All patients underwent radiological imaging. CT was preferred, but MRI was performed in patients with suspected intracranial complications.

Intravenous antibiotic therapy was given to all patients, who received a consultation from the otolaryngology department. In addition to systemic antibiotic therapy, surgery was performed on patients when deemed appropriate by the surgeons. Intravenous antibiotic therapy was continued in patients for whom surgery was not recommended. Among patients with poor response to antibiotics or in those with complications, a second review with the otolaryngology team was required to assess the patients for possible surgical intervention.

### Ethical statement

This study was approved by the Medical Research Ethics Committee of our institution. (Report Number: 2022/514/220/5).

### Statistical analysis

Normally distributed quantitative variables were expressed as mean ± standard deviation, whereas non-normally distributed quantitative variables were expressed as median with interquartile ranges. The Chi-square test was used to compare categorical variables. The Mann–Whitney U-test was used to compare non-normally distributed quantitative variables. All analyses were conducted using the Statistical Package for the Social Sciences version 25 software (IBM SPSS Statistics, New York), and *P* values of <0.05 indicated a statistically significant difference.

## Results

The participants included 22 (78.6%) males and 6 (21.4%) females with a mean age of 93.5 ± 53.2 months (range = 6 months–16.1 years; median = 88.5 months) [Table 1].

The most common clinical symptoms in children with AM were postauricular erythema (n = 17, 60.7%), tenderness (n = 16, 57.1%), fever (n = 14, 50%), swelling (n = 14, 50%), and auricular protrusion (n = 7, 25%).

The median WBC count was 11500/mm$^3$ (range = 7825–15350), the median CRP was 42.5 mg/dL (range = 11.0–121), and the median ESR was 55.5 mm/h (range = 22.7–79).

Ten patients (35.7%) developed complications. Subperiosteal abscess (n = 8, 28.6%) was the most common complication followed by sigmoid sinus thrombosis (n = 2, 7.1%). Growth occurred in two (25%) of the eight abscess materials, of which one was *Streptococcus pyogenes* and another was *Pseudomonas aeruginosa.*

All patients were screened by radiological imaging. A total of 22 (78.6%) children underwent CT, and 4 of these patients also underwent MRI. And MRI was performed in a total of 10 (35.7%) patients.

**Table 1: Comparative findings between the patients with AM and those with complicated AM**

| | The patients with AM (*n*=18) | The patients with complicated AM (*n*=10) | *P* |
|---|---|---|---|
| Age (Mean) (months) | 82.8±47.1 | 112.6±60.65 | 0.133 |
| Sex | | | |
| Female | 4 (22.2) | 2 (20) | |
| Male | 14 (77.8) | 8 (80) | 0.891 |
| Clinical findings | | | |
| Postauricular erythema | 10 (55.6) | 7 (70) | 0.453 |
| Tenderness | 9 (50) | 7 (70) | 0.306 |
| Fever | 9 (50) | 5 (50) | 1 |
| Swelling | 7 (38.9) | 7 (70) | 0.115 |
| Protrusion of the auricle | 3 (16.7) | 4 (40) | 0.172 |
| Surgery | 4 (22.2) | 8 (80) | 0.003 |
| Antibiotic use before hospitalization | 12 (54.5) | 10 (100) | 0.039 |
| WBC (Median) (IQR) (/mm$^3$) | 13500 (7100-16100) | 9650 (8350-14050) | 0.464 |
| CRP (Median) (IQR) (mg/dL) | 36 (4.7-90.5) | 60 (38.2-132.7) | 0.146 |
| ESR (Median) (IQR) (mm/h) | 44 (15.7-63) | 77.5 (53-91) | 0.006 |
| Day of antibiotic use (Mean) | 18.44±5.4 | 24.4±9.9 | 0.133 |
| Hospital stay (Mean) (days) | 18.6±5.4 | 24.6±9.8 | 0.146 |

Antibiotic use before hospitalization was detected in 22 (78.6%) patients. Blood cultures were obtained from all patients during admission, and all remained sterile. All patients received intravenous antibiotic treatment during hospitalization. The most common antibiotic combination used in children was vancomycin and cefepime (n = 22, 78.6%). Four patients were initiated on cefepime; however; due to poor response, they were changed to meropenem. In all, 8 (28.6%) received meropenem, while two patients received ceftriaxone. The mean duration of antibiotic use was 20.5 ± 7.7 days (range = 14–44 days; median = 18).

Twelve (42.9%) children underwent surgery. Mastoidectomy was performed in 3 (10.7%) patients, mastoidectomy plus myringotomy was performed in 3 (10.7%), mastoidectomy plus tympanostomy tube placement was performed in 2 (7.1%), mastoidectomy plus myringotomy plus tympanostomy tube placement was performed in 2 (7.1%), myringotomy plus tympanostomy tube placement was performed in 1 (3.6%), and tympanostomy tube placement was performed in 1 (3.6%).

The mean hospitalization duration was 20.7 ± 7.7 days (range = 14–44 days; median = 18.5). None of the patients died, and a clinical cure was achieved in all.

Some of our findings were compared between the patients with AM and those who developed complications due to AM. ESR values and antibiotic use rates before hospitalization were found higher in patients with complicated mastoiditis ($P$ = 0.006 and $P$ = 0.039, respectively). A higher median CRP value was found in patients who developed complications. However, the difference was not statistically significant ($P$ = 0.146). Statistically, more surgical interventions were performed in patients who developed complications ($P$ = 0.003).

Comparative findings between the patients with AM and those with complicated AM are shown in Table 1.

## Discussion

This study examined 28 cases with a diagnosis of AM and revealed favorable clinical outcomes from antibiotic therapy and surgical intervention when necessary. Very few studies examined hospitalized pediatric patients with a diagnosis of AM in our country.[11,12] It is a rare disease, and the literature is limited. Therefore, we think that our study will contribute to the literature.

A comprehensive systematic review that examined 2,109 pediatric patients with AM over 27 years revealed that the most commonly cited findings in clinical diagnosis were postauricular swelling, erythema, tenderness, and auricular protrusion.[13] Our study is consistent with the literature and detected postauricular erythema, tenderness, fever, swelling, and auricular protrusion as the main clinical findings.

Radiological evaluation is usually recommended to confirm the diagnosis in patients without characteristic findings or understand the complication development in patients.[14] However, we think that radiological imaging should be performed on all patients regardless of clinical findings when a mastoiditis diagnosis is considered to detect complications that are not yet clinically evident and plan an appropriate treatment for disease severity. Similar to our study, two different studies in Norway and Lisbon revealed that radiological imaging was preferred at high rates for AM diagnosis and complication observation.[15,16] Van den Aardberg *et al*.,[13] in their systematic review of 65 articles, revealed that the most commonly used radiological imaging method in AM diagnosis in children is CT. Our study performed radiological imaging on all patients, of which CT was most commonly used, consistent with the literature.

Infection markers are also thought to support the diagnosis. The study of van den Aardberg *et al*.[13] determined WBC count as the most-preferred laboratory

test. A study with 135 pediatric patients with AM in Lisbon revealed a significant correlation between increased WBC and CRP values and the rate of complication detection.[15] Additionally, the study by Lautermann *et al*.[17] in 48 pediatric patients with mastoiditis revealed a high ESR in 95% of cases, which was reported as the most valuable laboratory finding. Our study revealed a higher median CRP value in patients who developed complications. However, it was not statistically significant. Moreover, ESR values were higher in patients with complicated mastoiditis ($P = 0.006$). Therefore, we think that patients with a high ESR value should be followed up more carefully in terms of complication development.

AM treatment includes a combination of antibiotic therapy and drainage of the inflamed area from the middle ear and/or mastoid cavity.[5] The study by Geva *et al*., in which 144 pediatric patients with AM were examined, revealed that surgical intervention may not be necessary for all patients and parenteral antibiotic treatment is usually sufficient for most patients.[18] However, the study by Mierzwiński *et al*.,[19] in which they compiled 73 pediatric patients with AM, emphasized the importance of surgical intervention by suggesting that early mastoidectomy prevents serious complications and AM recurrence. The main factors in AM etiology are *Streptococcus pneumoniae* and gram-positive agents, such as *Staphylococcus aureus* and *Streptococcus pyogenes*. Ceftriaxone may currently be the primary drug used to treat these cases, especially considering the frequency of *Streptococcus pneumoniae*, but considering previous antibiotic use and resistance rates in patients, vancomycin may come to the fore in hospitalized patients. However, gram-negative factors, such as *Pseudomonas aeruginosa*, may also be causative in patients with a history of recurrent AOM, and an antibiotic with gram-negative activity, such as cefepime, ceftazidime, or piperacillin-tazobactam, should be added to the treatment.[4,20] In cases, in which patients undergo surgery and the causative agent is isolated in the culture results, causative agent-specific treatment is the most appropriate treatment option. Our study revealed a very low culture rate due to the high percentage of antibiotics used before hospitalization in patients, as stated in some previous articles.[21,22] Additionally, we think that immediate antibiotic treatment initiation after hospitalization without waiting for the operation to prevent complications may be another reason. The most commonly used antibiotic combination in our study was vancomycin and cefepime.

Two types of complications may develop in AM, namely intracranial and extracranial. Different studies have produced different values; however, its frequency varies between 15% and 30%.[8,13] A subperiosteal abscess is one of the most common extracranial complications, but different complications may be encountered, such as hearing loss, facial nerve palsy, Bezold's abscess, and temporomandibular joint (TMJ) ankylosis.[1,8,13,23,24] Intracranial complications include meningitis, venous sinus thrombosis, and temporal or cerebellar abscess. Complications occurred in 10 children (35.7%) in our study, and the most frequently detected was a subperiosteal abscess, consistent with the literature. As expected, surgical intervention was statistically higher in patients who developed complications in our study, and all patients who developed complications had surgery.

Our study revealed a statistically higher rate of complication development in children who used antibiotics before hospitalization due to different reasons. First, the antibiotics used may be inappropriate, and second, these patients may have been more severe from the beginning of the process, and time loss may develop with outpatient antibiotic use. A study by Balsamo *et al*.[25] in Italy for 15 years revealed that patients who used antibiotics previously used intravenous antibiotics for a longer period while they were hospitalized. This result is indirectly related to our data; however, we think that it may have developed for the same reasons.

In conclusion, **s**ystemic antibiotic therapy is the main method of disease management in children with AM; however, in case of complications (such as an abscess), adding surgical treatment is the optimal approach. Our study concluded that ESR is the most important laboratory finding as an indicator, especially in patients who developed complications.

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## Conflicts of interest

There are no conflicts of interest.

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