Biomedicine & Healthcare Research

Biomedicine & Healthcare Research 2025 July;5:36-40

https://doi.org/10.71599/bhr.v5i1.160

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Case series

Management of pediatric acute mastoiditis: A single-center experience over two decades

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Abstract

Introduction: Acute mastoiditis (AM) is a rare but serious complication of acute otitis media. Controversies exist regarding the medical and/or surgical management of this condition. The aim of this study was to evaluate the effectiveness of medical approach of AM among pediatric patients.

Material and methods: We conducted a retrospective study in which we reviewed the medical records of children with AM. We included in this study patients aged less than 16 years with post-auricular inflammation and/or post-auricular tenderness and signs of acute otitis media who were treated in ENT and Pediatric Departments at our institution between 2000 and 2022.

Results: The total number was 68 patients with AM. The mean age of the population was 48 months, ranging from 6 months to 14 years. All children presented with post-auricular inflammation and signs of acute otitis media. Computed tomography (CT) of the temporal bones was performed in 52 (76.5%) children. Nineteen patients had a subperiosteal abscess and 4 children had neurological complications. All patients were immediately treated with intravenous antibiotics. Mastoidectomy was performed in 40 cases (58.8%), including 29 patients (42.6%) with uncomplicated mastoiditis and 5 patients with complicated mastoiditis, i.e. 4 cases of neurological complications, one case of facial palsy and 6 cases of subperiosteal abscess Conservative treatment including intravenous antibiotics, myringotomy and/or drainage of the subperiosteal abscess was used in 28 children (41.2%): 13 cases (46.4%) had abscess drainage combined with antibiotic treatment and the others received antibiotics only. All children recovered completely without any sequelae.

Conclusion: Conservative treatment may be considered as an initial option for uncomplicated cases, with surgery reserved for instances of medical treatment failure or the occurrence of complications. Prospective studies are needed to further substantiate this approach.

Keywords: Mastoiditis; Child; Subperiosteal abscess; Drainage; Mastoidectomy

Received: June 4, 2025; Accepted: July 25, 2025

1. Introduction

Acute mastoiditis (AM) is an infectious disease of the mastoid bone and is the most common intra-temporal complication of acute otitis media (AOM) [1]. It mainly affects the pediatric population.

Since the introduction of antibiotics, the incidence of mastoiditis as a complication of otitis media has decreased. As a result, there is controversy arises about the most effective treatment for this condition [2]. Ear, nose and throat (ENT) surgeons who once operated most cases of AM, now consider non-surgical treatment to be more appropriate [3]. However, there is a lack of consensus regarding the best therapeutic strategies. The aim of our study is to evaluate the effectiveness of non-surgical interventions in AM in children.

2. Patients and Methods

We reviewed the medical records of all patients aged less than 16 years, who were admitted for AM at ENT and Pediatric Department of our institution between 2000 and 2022.

In our study, the diagnosis of AM was based on specific clinical signs and symptoms. The criteria used were signs of AOM on otoscopy, accompanied by signs of retro-auricular inflammation and/or protrusion of the auricle.

Data were collected and analyzed on the children´s age, sex, medical history -particularly history of previous ear disease, clinical signs, previous antibiotic use, laboratory data, radiological findings, surgical or conservative treatment and outcome. Conservative management included intravenous antibiotics treatment, myringotomy and/or drainage of subperiosteal abscess. Patients with chronic otitis media with cholesteatoma or otitis externa were excluded. Recovery was defined by clinical improvement (apyrexia, disappearance of retro-auricular swelling) and biological improvement (improvement of biological inflammatory syndrome).

Data analysis was performed using SPSS for Windows 20.0. Kolmogorov Smirnov test was used to test the distribution of variables. Descriptive statistics were

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expressed as a means for quantitative variables and as number of cases and percentage for qualitative variables.

The Mann-Whitney U test was used to compare medians and Pearson's Chi-square or Fisher's exact tests were used to compare percentages. A p value < 0.05 was considered statistically significant.

3. Results

From 2000 to 2022, sixty-eight pediatric patients with AM were admitted to our ENT and Pediatric departments; 35 (51.4%) were boys. Age ranged from 6 months to 14 years, with a mean age of 48 months.

A history of AOM was reported in 15 (22%) cases; one patient had a history of mastoidectomy on the contralateral side. One patient (1.5%) had recently undergone treatment with chemotherapy for leukemia and 9 patients (20%) were being treated for anemia.

The mean duration of symptoms before admission was 7.2 days (range 0-15 days) and 30 children (44.1%) received antibiotic treatment before admission. Otalgia was present in 50 cases (73.5%). Post-auricular erythema was found in 35 children (51.4%) and 33 children (48.5%) had post-auricular tenderness. All the children had auricular protrusion. Otoscopy revealed pathological tympanic membranes in all cases. In 26 cases (38.2%), otoscopy showed bulging of the tympanic membrane, in 23 cases (33.8%) hyperemia. In the remaining cases there was a perforation of the tympanic membrane. Twenty-one patients (30.8%) had active ipsilateral otorrhea at presentation. Fever, facial palsy and signs of meningitis were seen in 26 (38.2%), 1 (1.4%) and 1 (1.4%) patient respectively.

White blood cell (WBC) counts showed elevated leucocytes counts in 49 cases (72%). High C-reactive protein (CRP) and/or high erythrocyte sedimentation rate (ESR) were found in 50 cases (73.5%).

Bacterial cultures were obtained from otorrhea, subperiosteal abscess, mastoid cavities and after myringotomy in 41 children (67.4%). Bacterial cultures were positive in 14 cases (34.1%) (Table 1).

Table 1. Results of cultures from 41samples, including fluids from ear otorrhea, subperiosteal abscess, mastoid cavity and myringotomy, of children with acute mastoiditis.

Organisms	Results from culture	%
Negative culture	27	66 %
Streptococcus pneumoniae	6	14.6%
Staphylococcus aureus	3	7.3%
Pseudomonas aeruginosa	3	7.3 %
Proteus mirabilis	1	2.4%
Esherichiacoli	1	2.4 %

Streptococcus pneumoniae, Staphylococcus aureus, Pseudomonas aeruginosa, Escherichia coli, Proteus mirabilis were isolated in 6, 3, 3, 1 and 1 cases, respectively. Computed tomography (CT) of the temporal bones was performed in 52 children (76.5%). This was mainly done when the child´s clinical condition raised suspicion of an associated complication.

The CT images allowed a detailed assessment of the extent of the inflammatory process within the middle ear and mastoid, as well as the adjacent intracranial structures. The middle ear and mastoid cavities were opaque in all cases. Imaging findings included erosion of the mastoid cortical. bone with subperiosteal abscess in 19 children (28%) (Fig. 1), sigmoid sinus thrombosis in 2 children (2.9%) and intracranial empyema in 1 case (1.4%).

Fig 1: CT scan of the temporal bones with contrast, axial section, showing swelling of soft tissues over the right mastoid and subperiosteal abscess.

All patients were immediately treated with intravenous antibiotics: 40 patients (58.8%) received combination of cefotaxime (100mg/kg/day) + fosfomycin (100mg/kg/day); 28 patients (41.2%) were treated with amoxicillin-clavulanic acid (100mg/kg/day) alone. In one case where *Escherichia coli* was isolated, the patient was treated with an aminoglycoside plus cefotaxime.

Intravenous antibiotics were given during the hospitalisation. After discharge from hospital, the children were routinely prescribed an oral antibiotic (in most cases amoxicillin-clavulanic acid). The mean total duration of antibiotics was 21 days (range 15 to 45 days). No anticoagulants were given, even in 2 patients with sigmoid sinus thrombosis. Neurosurgical drainage was not performed in the case of empyema.

Mastoidectomy was performed in 40 cases (58.8%) including 29 patients (42.6%) with uncomplicated mastoiditis and 5 patients with complicated mastoiditis, i.e. 4 cases of neurological complications, one case of facial palsy and 6 cases of subperiosteal abscess (Fig. 2).

In the two cases of sigmoid sinus thrombosis, the sinus was surgically managed by evacuation of the thrombus and obliteration of the lumen. Myringotomy was associated with mastoidectomy in 20 children (29.4%).

There were no children treated with myringotomy and/or tympanostomy tube insertion without mastoidectomy. Conservative treatment was performed in 28 children (41.2%): 13 children had subperiosteal abscess drainage combined with antibiotics and 15 children received antibiotics alone (Fig. 2).

In these patients, clinical and biological improvement was observed within 48 hours. The mean hospital stay was 9 days (range 5 to 12 days) and 15 days (range 7 to 16 days) for the nonsurgical and surgical group, respectively. Of 44 patients (64.7%) with uncomplicated AM, 15 had conservative treatment (conservative management group) and 29 underwent mastoidectomy (surgical group). There

were no significant differences in demographic characteristics (age and sex) and biological characteristics (CRP, ESR, WBC) between the two group. When total antibiotic duration and days of hospital stay were compared between the two groups, no significant difference was found (Table 2). Recovery was observed in both groups.

4. Discussion

The management of pediatric AM may vary depending on the presentation, the extent of the disease and the presence of other complications. A systematic review of diagnostic criteria for AM in children found a lack of consensus regarding criteria and strategies for diagnosis [4]. Limitations of our study: the study is retrospective, which induce some difficulties such as selection bias, missing data, and variability in management over the 22-year period. The most used criteria were post-auricular pain, erythema, tenderness, and protrusion of the auricle. AM affects children of all ages but especially those under the age of three. This may be explained by the exposure of most children to upper respiratory tract infections and AOM [1].

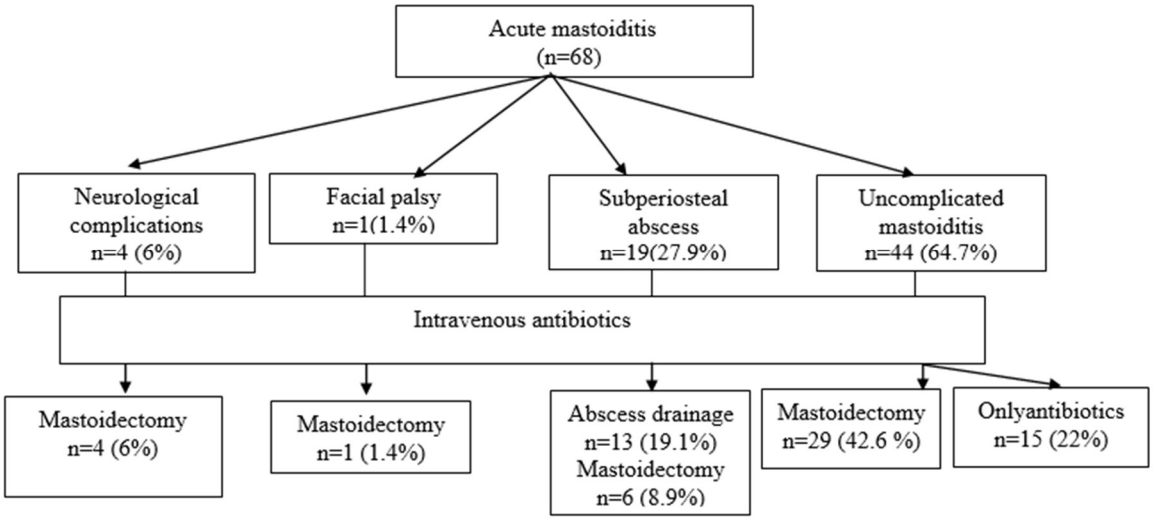

Fig. 2. Therapeutic management in 68 children with AM.

Table 2. Demographic comparison and baseline clinical characteristics

	Conservative management group Median [IQR 25%-75%]*	**Surgical management group Median [IQR 25%-75%]***	***P***
Age (month)	14 [8.5-54]	12 [10-54]	0.741
Total antibiotic duration (day)	14 [13-15]	15 [14-15]	0.101
Hospital stays (days)	4 [3-6]	4 [3-6]	0.898

*IQR: Interquartile Range.

There is still considerable debate about the use of antibiotics in AM [4,5]. In our series, antibiotic treatment with prior hospitalisation occurred in 44.1% of cases. However, according to the literature, patients receiving antibiotics had a significantly higher incidence of sterile culture results [6,7].

The most common pathogens isolated in the literature are *Streptococcus pneumoniae, Streptococcus pyogenes* and *Staphylococcus aureus* [8]. In our series, *Streptococcus pneumoniae* was the most common isolate, as in other case series [9,10]. The microbiology of AOM has changed with the introduction of the heptavalent pneumococcal conjugate vaccine (PCV). Roddy et al. [11] investigated whether a similar change has occurred in pediatric mastoiditis. The bacteriology of mastoiditis pre-PCV (January 1995-December 2000) was compared with that post-PCV (January 2001–April 2005) to guide empirical antimicrobial therapy. There was no reduction in mastoiditis due to *S. pneumoniae* from pre-PCV to post-PCV eras. Of note, Lee et al. [12] reported an increase in atypical pathogens causing AM such as *Actinomyces spp*. and *Mycobacterium tuberculosis* in their hospital.

Computed tomography (CT) has a high sensitivity and predictive value in the diagnosis of AM. However, CT is not systematically performed. In Psarommatis's series [1], only 20% of children underwent a CT scan. Imaging may be valuable in the diagnosis of complications, in the absence of clinical improvement, prior to surgery and in recurrent AM [1]. Taylor [9] suggested the use of CT in cases where a suppurative complication is clinically suspected.

We performed imaging in 52 patients (76.5%), when intracranial complications and subperiosteal abscess were suspected, when there was no clinical improvement and before surgery.

All patients in our series were treated with parenteral antibiotics. Amoxicillin-clavulanate or cefuroxime combined with fosfomycin were the drugs of choice because of their broad-spectrum bactericidal activity against many gram-positive and gram-negative microorganisms [6,7].

Today, there is still an open discussion about the best treatment for patients with AM, and the role of mastoidectomy in AM remains controversial. Some authors have shown that the recovery rate with antibiotics and myringotomy ranges from 60.4% to 87% [1,9]. Taylor et al. [9] concluded that in the absence of clinical suspicion of cholesteatoma or complications, including subperiosteal

abscess, AM can be managed initially without mastoidectomy. Gliklich et al. [13] reviewed the indications for surgical treatment and found that an elevated white blood cell count, a protruding auricle, and fever on admission were indications for surgery.

Psarommatis et al. [1] believe that mastoidectomy plays an important role in the outcome. Mastoidectomy is indicated in cases of complicated AM and in cases of uncomplicated AM with poor response to non-surgical management. In the case of subperiosteal abscess, intravenous antibiotics with postauricular incision and drainage of the abscess with insertion of a tympanostomy is an effective alternative to mastoidectomy and avoids potential complications of mastoidectomy in young children [1,14-16].

However, some authors believe that mastoidectomy should be performed in all cases of AM, including very young children, from 8 months of age [17]. Zanetti et al. [18] reviewed the indications for surgery in AM and the outcomes of this treatment. Their study found that there was no statistically significant difference between conservative management with antibiotics alone and surgical treatment for uncomplicated AM. Children can make full recovery with conservative treatment, but in the absence of clinical and biological improvement, mastoidectomy should be performed within 24-48 hours.

Simple mastoidectomy is warranted for externalization, if the child is older than 30 months or weighs >15 kg. Immediate surgical treatment is indicated for intracranial complications, combined with neurosurgery, if necessary, procedure as needed. Myringotomy is reserved for children with persistent retro auricular swelling and bulging of the tympanic membrane [19,20]. Bakhos et al. [16] showed that mastoiditis complicated by a subperiosteal abscess can be treated conservatively intravenous antibiotics, puncture of the subperiosteal abscess or placement of tympanostomy tube. The length of hospital stay has been reduced compared with children treated with mastoidectomy. If conservative treatment fails, mastoidectomy should be considered.

In our series, mastoidectomy was performed in 40 cases (58.8%) of which 20 cases (29.4%) were associated with myringotomy. Conservative treatment was used in 28 cases, including antibiotics only in 15 cases and subperiosteal abscess drainage in 13 cases. The current treatment protocol did not include immediate myringotomy with or without insertion of a ventilation tube on admission. For uncomplicated AM, there were no significant differences between children treated with conservative treatment and those treated by mastoidectomy in terms of age, total antibiotic duration and days of hospital stay.

5. Conclusion

Acute mastoiditis is a rare but serious complication of acute otitis media. Non-surgical treatment includes intravenous antibiotics and/or myringotomy and/or subperiosteal abscess drainage. This conservative medical treatment may be effective for uncomplicated cases. Surgical approach is indicated when medical management fails or complications occur. Prospective studies are needed to further support these findings, to reaffirm the significance of the findings and their contribution to the ongoing debate on the management of acute mastoiditis.

Ethical considerations

Ethical approval has been obtained from the institutional review board of Farhat Hached University Hospital. Sousse, Tunisia.

Conflict of interest

The authors declare that they have no conflicts of interest.

Funding

None.

Patient consent

Not applicable.

Consent for publication

Not applicable.

Authors' contributions

All authors contributed to the drafting of the article and approved the submitted version.

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Cite this article as: El Omri M, Bellakhdher M, Tej A, Ghammen M, Meherzi A, Kermani W, Boughammoura L. Management of pediatric acute mastoiditis: A single-center experience over two decades. Biomedicine Healthcare Res. 2025;5:36-40. https://doi.org/10.71599/bhr.v5i1.160