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***Treatment of Acute Mastoiditis in Children - A Systematic  
Review***

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**TREATMENT OF ACUTE MASTOIDITIS IN CHILDREN - A SYSTEMATIC REVIEW**  
**TRATAMENTO DA MASTOIDITE AGUDA EM CRIANÇAS - UMA REVISÃO SISTEMÁTICA**

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## INDEX

Abstract.....	4
Resumo.....	5
Introduction .....	6
Materials and methods .....	9
Results .....	10
Discussion.....	13
Conclusion .....	14
References.....	15

## **ABSTRACT**

*Background:* Despite its declining incidence in the post-antibiotic era, acute mastoiditis is a common complication of acute otitis media in children. There is some controversy regarding the management of acute mastoiditis in children, resulting in different approaches according to each center.

*Objectives:* The main goal of our work was to highlight the best management of acute mastoiditis in children according to reported treatment outcomes.

*Method:* A systematic review was conducted using PubMed database.

*Results:* Seven studies were included in this review, with a total of 259 patients. Cure rates with antibiotic treatment and surgery were 93.65% and 97.96%, respectively.

*Conclusion:* Mastoidectomy is the most definitive treatment available. However, this review suggests that a conservative approach (antibiotic therapy or myringotomy) has a success rate of more than 90% as first-line treatment, without the expected complications of surgery, supporting a step-based management of acute mastoiditis.

**Key-words:** mastoiditis, children, acute otitis media, treatment.

## RESUMO

*Contexto:* Apesar do decréscimo na incidência com o aparecimento dos antibióticos, a mastoidite aguda é uma complicação frequente da otite média aguda em crianças. Não há consenso no que diz respeito ao tratamento da mastoidite aguda em crianças, o que resulta em diferenças na sua abordagem de hospital para hospital.

*Objetivos:* O principal objetivo do trabalho foi compreender a melhor abordagem da mastoidite aguda em crianças, de acordo com os resultados da bibliografia disponível.

*Métodos:* Foi feita uma revisão sistemática através da base de dados PubMed.

*Resultados:* Nesta revisão foram incluídos sete estudos, com um total de 259 doentes. As taxas de cura com tratamento antibiótico exclusivo e cirurgia foram de 93.65% e 97.96%, respetivamente.

*Conclusão:* A mastoidectomia é o tratamento definitivo para a patologia em estudo. No entanto, esta revisão sugere que uma abordagem conservadora (tratamento com antibiótico ou miringotomia) tem uma taxa de sucesso superior a 90% como tratamento de primeira linha, sem as complicações expectáveis de uma cirurgia agressiva, apoiando uma abordagem *step-based* da mastoidite aguda.

**Palavras-chave:** mastoidite, criança, otite média aguda, tratamento.

## INTRODUCTION

Acute mastoiditis (AM) is defined by the inflammation of the mastoid air cells of the temporal bone.<sup>1</sup>

### *Epidemiology*

The epidemiology of acute mastoiditis parallels that of acute otitis media (AOM), with higher incidence in children younger than two years old.<sup>2</sup> A history of recurrent AOM is a risk factor for acute mastoiditis.<sup>3</sup>

Despite its decreasing incidence in the post-antibiotic era from 0,4% in 1954 to 0,004% in the 1980s<sup>4,5</sup>, AM remains a common complication of acute otitis media (AOM).<sup>6</sup> Inclusively, some authors report a recent rising of the incidence of AM. They argue that the emergence of antimicrobial resistances and the masking of clinical signs are the main reasons for this new pattern.<sup>3,7</sup> However, other reports describing the incidence of acute mastoiditis during and after the 1990s do not support recent observations.<sup>2,8-10</sup>

### *Signs and symptoms*

AM frequently presents with fever, otalgia, retroauricular tenderness, edema, and anteroinferior displacement of the auricle.<sup>6,11-13</sup>

Acute mastoiditis can be divided in acute mastoiditis with periosteitis (presence of pus in the mastoid cavities) and coalescent mastoiditis (destruction of the bone septae between air cells).<sup>14</sup>

Complications of acute mastoiditis can be extracranial and intracranial. Extracranial complications include: subperiosteal abscess, facial nerve palsy, hearing loss, labyrinthitis, osteomyelitis and Bezold abscess. Subperiosteal abscess occurs when the infection spreads through the lateral cortex of the mastoid. Facial nerve palsy results from compression of this structure along its path, in the petrous portion of the temporal bone. Hearing loss may be transient as a result of the obstruction of the external auditory canal and/or middle ear effusion, or permanent due to damage to the ossicles of the middle ear or suppurative labyrinthitis with cochlear damage. Labyrinthitis result from the inflammation or infection of the bony labyrinth. Clinical features include hearing loss, nausea, vomiting, dizziness, vertigo, and nystagmus. Osteomyelitis of the calvaria occur when the infection spreads posteriorly to the occipital bone. Bezold abscess is an abscess located in the neck, beneath the sternocleidomastoid and digastric muscles.<sup>14,15</sup> Intracranial complications occur when the infection spreads toward the inner cortical bone and include: meningitis, temporal lobe or cerebellar abscess, epidural or subdural abscess and venous sinus thrombosis.<sup>15</sup>

### *Diagnosis*

The diagnosis of acute mastoiditis in pediatric age is often made based on the clinic presentation with characteristic signs and symptoms. Classically, patients present with otalgia, postauricular erythema, tenderness, swelling or mass and protusion of the auricle. <sup>1,2,5,13,16–19</sup>

As AM consists in an infectious process, increased inflammatory parameters (white blood cell count, C-reactive protein and erythrocyte sedimentation rate) suggest the diagnosis.

The diagnosis of AM is best established by computerized tomography (CT), which can also detect the intracranial complications. <sup>15</sup>

### *Etiology*

The pathogen most common implicated in AM is *Streptococcus pneumoniae*, followed by *Streptococcus pyogenes*, *Haemophilus influenzae* and *Staphylococcus epidermidis* but most of the cultures of fluid from the middle ear are negative. <sup>4–7,19–22</sup> Moreover, antibiotic therapy, which may affect the yield of cultures, is frequently administered for AOM before symptoms or signs of mastoiditis are present. <sup>3,20</sup>

### *Treatment*

Antibiotics and drainage of the middle ear and mastoid air cells are the basis of the treatment for acute mastoiditis. However, there are no randomized controlled trials on treatment of AM, and management may vary from one center to the next. <sup>14</sup>

The choice of the antimicrobial for empiric treatment should provide coverage for the most frequent bacterial pathogens. In children with history of recurrent AOM or who have been recently treated with antibiotics, the treatment should also be effective against *P. aeruginosa*. <sup>3,23</sup> Initially, antimicrobial is given intravenously. The administration route can be switched to oral if clinical signs improve or culture and susceptibility results become available. <sup>2,24,25</sup>

The indications for the different procedures vary among centers depending on the pathologic stage and presence and type of complications. <sup>14,26</sup>

Acute mastoiditis often requires drainage of fluid from the middle ear and/or mastoid cavity. Case reports of AM treated without tympanocentesis or myringotomy have been described. <sup>22</sup> Myringotomy, a surgical perforation of the tympanic membrane, with or without placement of tympanostomy tube allows the mastoid cells to drain. Drainage allows the cavity to become decompressed, interrupting the pathological process and, therefore preventing



complications. Aspiration and culture of purulent specimens from middle ear can be important in guiding antimicrobial therapy.<sup>3</sup>

Mastoidectomy (simple or radical) consists in the removal of the mastoid air cells and cortical bone. In simple mastoidectomy the posterior portion of the external auditory canal is preserved; a broad communication is established between the epitympanic space of the tympanic cavity and the mastoid. In radical mastoidectomy, the posterior portion of the external auditory canal is sacrificed; creates a broad communication between the mastoid, tympanic cavity and ear canal lumen – radical cavity. Radical mastoidectomy is almost always combined with a tympanoplasty and the creation of a new tympanic cavity.<sup>14,15</sup>

Mastoidectomy may be warranted if one or more of the following are present: postauricular fluctuance, mass or swelling (suggesting subperiosteal abscess), cervical fluctuance, imaging evidence of fluid collection, cortical bone erosion or intracranial involvement, or neurological signs.<sup>1</sup>

Mastoidectomy is the definitive treatment of acute mastoiditis.<sup>21,27,28</sup> However, as an invasive procedure, the possibility of complications should not be underrated. Recent reports refer post-operative complications such as vertigo and vomiting, facial paralysis, postaural fistula and meatal stenosis.<sup>28,29</sup>

In children, myringotomy and mastoidectomy are surgical procedures performed under general anesthesia. Airway related events are the most common complications in pediatric patients. Complications related with airway management include hypoxemia, laryngospasm, bronchospasm, aspiration and perioperative croup.<sup>30,31</sup>

### *Aim*

Since controlled trials comparing different therapeutic approaches in pediatric AM are lacking, our work was designed to review the outcomes of the various treatment regimens, according to the available evidence in the literature.

## **MATERIALS AND METHODS**

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement was followed in this review.

PubMed database was searched from 1<sup>st</sup> January 2000 to 1<sup>st</sup> February 2019. The search was performed using the keyword “mastoiditis”, in addition to Medical Subjects Headings “mastoiditis” and “analysis” OR “drug therapy” OR “surgery” OR “therapeutic use” OR “therapy”. Language was restricted to English and Portuguese.

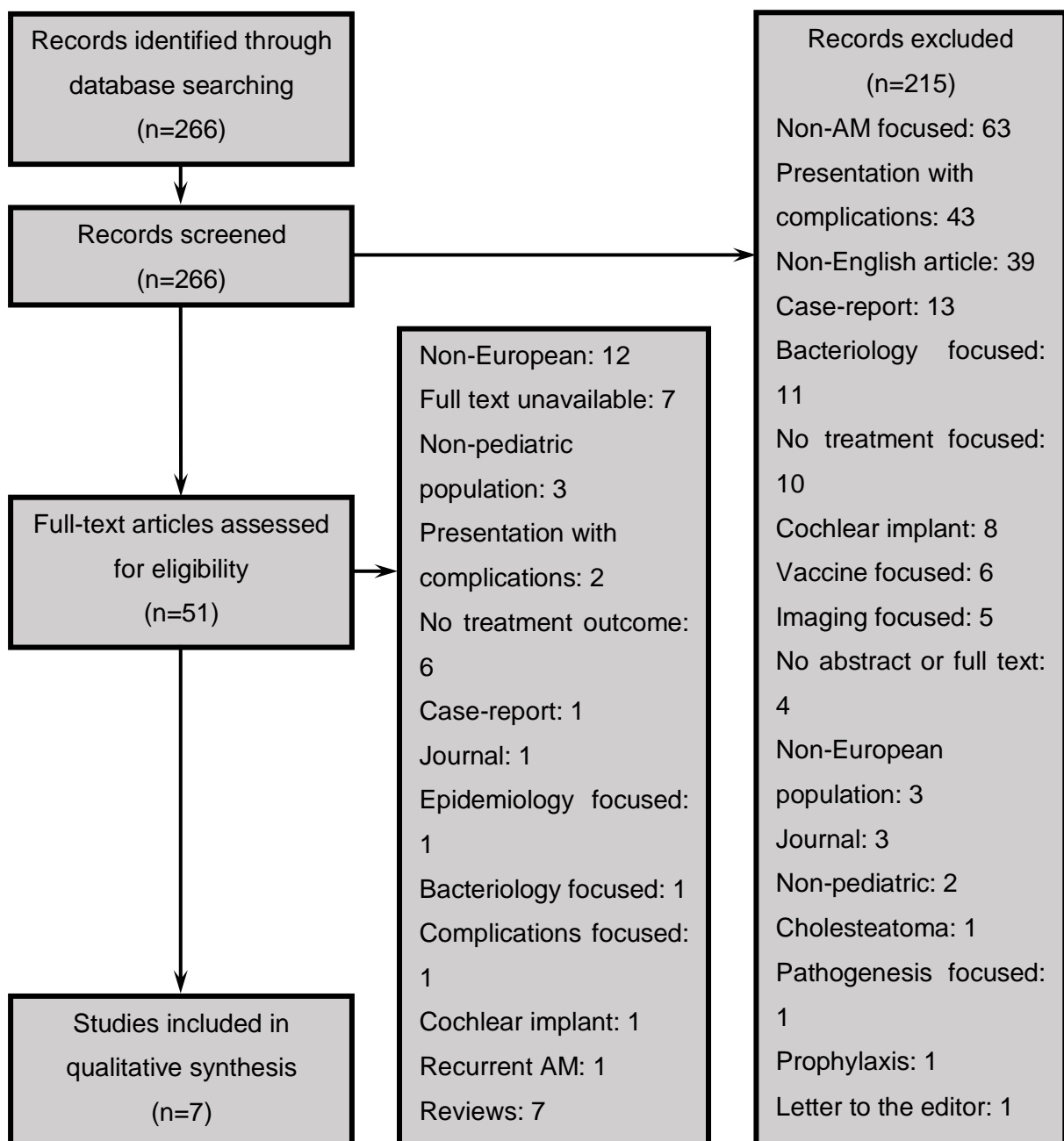
The inclusion criteria were: clinical studies, clinical trials, comparative studies, controlled clinical trials, meta-analysis, multicenter studies, randomized controlled trials and systematic reviews that discussed treatment and treatment outcomes of acute mastoiditis in pediatric patients. Data were collected from articles available in full-text form, from children aged less than 18 years old.

We compared the outcomes from patients who were treated medically only with the ones of who were treated with surgery. Surgical procedures were classified as conservative (myringotomy with or without ventilation tube insertion) or extensive (mastoidectomy).<sup>32</sup>

## RESULTS

A total of 266 studies were identified following a search of electronic databases. Fifty-one articles were selected for full-text assessment after abstract screening. Seven articles were selected for inclusion and data extraction.<sup>13,17,19,21,25,26,33</sup> The PRISMA flow diagram for article inclusion is shown in Figure 1.

Table I shows the characteristics of the included studies. Of the eleven studies included, only one was a case series, while the rest were retrospective studies. Overall, the studies involved a total of 259 patients, with ages between 2 months and 16 years old. The cases presenting with intra or extracranial complications were not included in this review.



**Figure 1.** Flow diagram for article inclusion. AM – Acute mastoiditis

**Table I.** Characteristics of included studies

Study (year, country)	Cases	Age	Presentation	Treatment	Treatment complications	Follow-up duration	Follow-up results
S. De et al. <sup>13</sup> (2002, England)	21	3m – 14y	AM	ATB alone (16)  ATB + Surgery (5)	No improvement, requiring myringotomy (3) Cholesteatoma, requiring mastoidectomy (1)  None reported (12)  None reported	6m	None reported  None reported AOM with ventilation tube (2) AOM with ventilation tube (1)
Tarantino et al. <sup>17</sup> (2002, Italy)	40	6m – 12y	AM	ATB alone (26) ATB + Myringotomy (8) ATB + Mastoidectomy (6)	None reported None reported None reported	Unknown	None reported None reported None reported
Zanetti & Nassif <sup>26</sup> (2005, Italy)	32	2m – 15y	AM	ATB alone (20) ATB + Myringotomy (8) ATB + Mastoidectomy (4)	None reported None reported None reported	1y – 3y1m	None reported None reported None reported
Baljosevic et al. <sup>19</sup> (2006, Serbia and Montenegro)	37	0 - 12 m	AM	ATB + Surgery (37)	None reported	Unknown	None reported
Gorphe et al. <sup>25</sup> (2011, France)	10	0 - 16a	AM	ATB alone (1) ATB + Retroauricular abscess drainage (1) ATB + Myringotomy (8)	None reported None reported None reported	Unknown	None reported None reported None reported
Psarommatis et al. <sup>21</sup> (2012, Greece)	112	2m – 11y	AM	ATB + Myringotomy (112)	No improvement, requiring mastoidectomy (34)	5m	None reported
Lundman et al. <sup>33</sup> (2014, Sweden)	7	1 – 10y	AM	ATB + Mastoidectomy (7)	None reported (5) Radical cavity (1) Incus destruction and radical cavity (1)	2y – 7y6m	Major (1) or minor (2) CHL

m – months; y – years; AM – acute mastoiditis; AOM – acute otitis media; ATB – antibiotic; CHL – conductive hearing loss; SPA – subperiosteal abscess

### *Medical treatment*

All patients have received treatment with intravenous antibiotic before being referred to the hospital or as they were admitted. The initial prescribing was based on epidemiological knowledge and guidelines. Changes made to the initial treatment were based on culture and sensitivity results obtained.

A total of 63 patients were treated with antibiotics alone. Of these, 59 (93.65%) recovered successfully and only 2 needed the placement of ventilation tube for AOM during follow-up period.

### *Surgical treatment*

Surgical procedures were classified as conservative (myringotomy with or without ventilation tube insertion, and drainage of retroauricular abscess) or extensive (mastoidectomy).<sup>32</sup>

Conservative surgery was carried out in 137 patients, only one of those required drainage of a retroauricular abscess. Of the patients who underwent conservative surgery, 34 (24,82%) needed extensive surgery for poor clinical improvement.

Of 17 patients who underwent extensive surgery, 3 reported conductive hearing loss while 14 (82.35%) have no record of sequelae.

### *Clinical outcome and follow-up*

Overall, surgical procedures were performed in 196 patients, of which 3 reported conductive hearing loss and one developed AOM requiring the insertion of a ventilation tube.

In summary, the success rates of antibiotic treatment alone and surgical treatment were 93.65% and 97.96%, respectively.

## DISCUSSION

Conservative approach was preferred to extensive surgery (92.16% *versus* 7.83%), considering a conservative approach either antibiotic alone or its combination with conservative surgery.

Follow-up results show better results, with no sequelae, with a conservative approach, reported in 99.00% of patients *versus* 82.35% of patients treated with an extensive surgery. The extracted data suggests a conservative approach as a first-line treatment in uncomplicated acute mastoiditis.

A conservative therapy is the most frequent option used in the reviewed studies. However, as most of them were retrospective studies, it is impossible to know what influenced physicians' decision when it comes to choosing an approach. The cases managed with extensive surgery may have been more severe on presentation, which might be related with worse follow-up outcomes. In addition, the lack of consensus about the management of AM could have had contributed the different surgical rates between the reviewed studies.<sup>21,34</sup>

Despite the high success rate of surgical treatment (97.96%) when compared with antibiotic treatment alone (93.65%), it is important to note that even conservative surgery in children is performed under general anesthesia, whose risks should not be neglected.

In this review, selected studies provided a low level of evidence (retrospective studies and case series). However, despite possible selection bias, the articles contain valuable data.<sup>35</sup>

Moreover, some studies did not report their outcomes according to the chosen treatment. Those articles were excluded due to the difficulties in comparing data and extrapolating conclusions. Yet, this also means a reduction in potentially valuable data. In addition, considering the exclusion criteria, other sources of data would inevitably have been omitted.

A notable shortcoming of this review may be the exclusion of cases with important and frequent complications (e.g. subperiosteal abscess). This exclusion allowed us to focus on AM but eliminated many AM cases that may present themselves with complications.

Unfortunately, it was not possible to compare single treatments in this review, as all patients were treated with antibiotics prior to or during hospital admission.

Standard criteria for the diagnosis and treatment of acute mastoiditis are still unavailable.<sup>14,32</sup> This is still an area for further research and prospective studies, namely randomized controlled trials, should be conducted for higher evidence level. Future studies could include more detailed reporting of outcomes and the relationship of other variables (e.g. antibiotic regimens) and treatment outcomes.<sup>32</sup>

## **CONCLUSION**

Treatment outcomes of acute mastoiditis in children were favorable in the majority of cases. Mastoidectomy is the most definitive treatment available. Yet, this review suggests that a conservative approach (antimicrobial therapy or myringotomy) is very effective as first-line treatment and may be an appropriate first-line management of acute mastoiditis, without the expected complications of surgery.

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