

Acute Mastoiditis in Children: On the Rise Again?

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Abstract

Introduction: Acute mastoiditis is an otological disease that can lead to serious complications. Recent studies denote an increase in the incidence of mastoiditis. The aim of this study was to evaluate that disease frequency and characteristics in one secondary hospital in the past five years and to compare with previous years.

Methods: Retrospective study of children with acute mastoiditis admitted between 2011 and 2015.

Results: During this period, 105 acute cases of mastoiditis were diagnosed in 98 children (46 more than in the previous five years). The median age was 6 years, with male predominance (58%, $n = 57$). It was presented at least one otorhinolaryngological risk factor in 52% ($n = 55$) and 51% ($n = 54$) used a prior antibiotic. Otagia (92%, $n = 97$) and inflammatory signs of the postauricular region (93%, $n = 98$) were the major clinical findings. Overall, 43% ($n = 45$) presented $> 15 \times 10^9$ white blood cells/L and 35% ($n = 37$) C-reactive protein > 4 mg/dL. Computed tomography and lumbar puncture were performed in those with no improvement ($n = 31$, 30% and $n = 3$, respectively). Complications occurred in 7% ($n = 7$), three extracranial and four intracranial, mostly in children below three years ($p = 0.04$). Headache was more frequent in the group with complications ($p = 0.007$). All of the patients were treated with intravenous antibiotics and 19% ($n = 20$) needed surgical intervention, in which 35% of those were urgent ($n = 7$). Relapse was observed in 10% ($n = 10$).

Discussion: Similar to some studies, we found an increase in the frequency of acute mastoiditis in the last five years. The rate of complications was also analogous to other studies.

Keywords: Acute Disease; Child; Mastoiditis/complications; Mastoiditis/diagnosis; Mastoiditis/epidemiology; Mastoiditis/therapy; Portugal

Introduction

Although less frequent, acute mastoiditis (AM) is the most common infectious complication of acute otitis media (AOM).^{1,2} More rarely, it may arise as the first manifestation of an otologic disease.³ It is more prevalent in infants and children under 3 years old^{4,5} who also have a higher frequency of AM complications.^{1,2} However, the number of cases in children older than 3 years old seems to be increasing.⁵

AM is essentially a clinical diagnosis. Imaging studies, including computed tomography and magnetic resonance imaging, should be reserved for cases in which complications are suspected.^{1,3} These may be intracranial or extracranial, and may result from three mechanisms: hematogenous dissemination, direct extension or clot propagation.

After the antibiotic era, there was a decline in the incidence of acute mastoiditis as a complication of AOM (from about 20/100 to 1.9 to 11.1/100,000). However, in recent years, several studies have reported an increase in its incidence.⁵⁻⁷ Several reasons have been postulated, including increased bacterial resistance,^{4,8} a reduction in the use of antibiotics for AOM,⁸ a substitution phenomenon after the introduction of the pneumococcal vaccine⁵⁻⁷, and an increased and earlier use of nursery schools.^{4,9}

Over time, there was also a change in the therapy strategy, with a progressive increase of conservative treatment through intravenous antibiotic administration, with a reduction of the need for surgery.^{6,8,11} The rate of complications has remained constant, although very variable, with reported rates of 1.9% to 26%.¹⁻¹³

The aim of this study was to evaluate the frequency and characteristics of AM in a level II hospital in the last five years and to compare them with previous years.

Methods

A retrospective, descriptive study based on the collection of data from medical records of computer coded

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cases as acute mastoiditis with or without complications (according to the International Statistical Classification of Diseases, ICD-9) of children under the age of 18 years, admitted to the paediatric inpatient department of a level II hospital, between 1 January 2011 and 31 December 2015 (five years).

The diagnosis was established in the presence of clinical criteria (retroauricular inflammatory signs with auricle protrusion, and one of the following: fever, ear pain or otorrhoea) or of imaging criteria (fluid in the mastoid with bone erosion).

Epidemiological, clinical, laboratory, imaging, therapy and follow-up data were analysed. These data were compared with the data obtained in the previous five years (2006 to 2010) in the same department.

Excel® and Epi Info7® were used for statistical analysis using the chi-square test or Fisher's exact test for categorical variables, and the Student's *t*-test or Mann-Whitney test for continuous variables, with a significance level $p < 0.05$.

Results

During the study period, there were 105 admissions for AM in 98 children, with a median of 23 cases/year (interquartile range, IQR, 9-29 cases/year) (Fig. 1). In the previous five years (2006 to 2010), there were 59 admissions for AM, but in that period, only children up to 13 years old were included. Taking only into account children up to 13 years old in both periods, there were 36 more AM cases in the last five years compared to the previous period. In addition, a reduction in the number of cases in children under the age of 3 years was observed (43% vs 24%, $p = 0.001$). The rate of children with at least one ear, nose and throat (ENT) risk factor

was higher (35% vs 52%, $p = 0.05$), although the pneumococcal vaccination was also more frequent (22% vs 50%, $p = 0.0003$) (Table 1).

There was a seasonal predominance, with 49% of cases occurring in summer; in those months, AM was more frequent in children older than 3 years old (58% vs 13%, $p = 0.0002$).

Of the 98 children with AM, 58% were male. The median age was six years (IQR 2 months to 17 years), and 22% were under the age of 3 years (Fig. 1).

At least one ENT risk factor in 52% of cases: recurrent AOM ($n = 37$), adenotonsillar hypertrophy ($n = 15$), previous ENT surgery ($n = 21$), previous AM ($n = 15$), and sinus disorder ($n = 6$). In three cases, a primary immunodeficiency was also identified.

Fifty percent had no record of pneumococcal vaccination. The vaccinated children had carried out the following complete schedules: 13-valent pneumococcal in 37%, 7-valent pneumococcal in 12%, and 10-valent pneumococcal in one case.

In the 15 days prior to hospitalisation, 51% had been administered antibiotics, particularly amoxicillin/clavulanic acid (43%) and amoxicillin (41%), on average, during 5 ± 3 days, mostly (85%) for AOM.

The main clinical features are listed in Table 2. Ear pain and retroauricular inflammatory signs with auricle protrusion occurred in almost all cases (92% and 93%, respectively). There were no statistically significant clinical differences between age groups, except for otorrhoea, which was more frequent in the above 3 years old group (62% vs 30%, $p = 0.009$).

Blood tests showed that 43% had leucocytosis ($> 15 \times 10^9$ cells/L), and that 35% had C-reactive protein > 4 mg/dL (median 3.2 mg/dL, IQR 0.12-23 mg/dL). Blood cultures were performed in 82% ($n = 86$) of cases, and all were negative. Ear drainage culture was performed in 10

Table 1. Comparison between the data obtained from 2006 to 2010 and the data obtained from 2011 to 2015 in children under 14 years

Acute mastoiditis	2006 to 2010	2011 to 2015	<i>p</i> value
Number of cases	59	95*	-
Seasonality	Not present	Summer	-
Median ages (years)	4	5	-
Age < 3 years (%)	43	24	0.001
Pneumococcal vaccination (%)	22	50	0.0003
≥ one ENT risk factor (%)	35	52	0.05
Prior antibiotic treatment (%)	45	53	0.5
Computed tomography (%)	25	26	0.9
Complications (%)	1.6	6.3	0.24
Surgery (%)	22	19	0.68

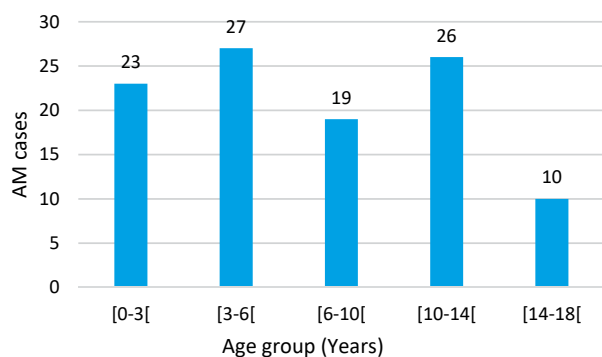
ENT - ear, nose and throat.

*10 cases of patients above 13 years were excluded for comparative purposes.

cases and it was always positive: *Klebsiella pneumoniae* (n = 2), *Pseudomonas aeruginosa* (n = 2), *Enterobacter cloacae* (n = 2), *Streptococcus pyogenes* (n = 1), *Staphylococcus aureus* (n = 1), and *Corynebacterium jeikeium* (n = 1). The isolated microorganisms were sensitive to second and/or third-generation cephalosporins.

Due to suspected complications, a lumbar puncture was performed in three cases, and acute bacterial meningitis was diagnosed in two cases (*Streptococcus pyogenes* and *Streptococcus pneumoniae*).

The ear and mastoids computed tomography was performed in 30%, and showed bilateral mastoiditis in five cases, cholesteatoma in one case, and complications in five cases: retroauricular abscess (n = 2), unilateral sigmoid sinus thrombosis (n = 2), and labyrinthitis (n = 1). Overall, complications were identified in 7%, of which extracranial complications in three patients (two retroauricular abscesses and a labyrinthitis) and intracranial complications in four patients (two acute bacterial meningitis and two sigmoid sinus thrombosis). Of these, four patients were transferred to a level III hospital for



AM - acute mastoiditis.

Figure 1. Distribution of acute mastoiditis cases by age group.

surgical intervention (retroauricular abscesses and sigmoid sinus thrombosis). There was a higher rate of complications in the under 3 years old group (57% vs 19%, $p = 0.04$), with no statistically significant differences in gender, ENT risk factors or prior antibiotic treatment. Headache was the only clinical feature more prevalent in the complications group (43% vs 6%, $p = 0.007$) (Table 3). The consultation by ENT specialists was always requested for diagnosis and treatment of the patients. All the patients were hospitalised, with a median length of stay of four days (IQR 1-29 days), and all the patients received intravenous antibiotic treatment, mainly ceftriaxone alone (85%), for an average of 8 ± 3 days, followed by oral antibiotic treatment, mainly amoxicillin/clavulanic acid (68%) or cefixime (11%), for an average of 11 ± 3 days. In 34% systemic corticotherapy and in 56% topical antibiotic treatment was added. Nineteen per cent of the children underwent ENT interventions: myringotomy (n = 13), tympanomastoidectomy (n = 4), myringotomy with abscess drainage (n = 2), and adenoidectomy (n = 1). The rate of relapse was of 10%, with five children being readmitted, two of them with two readmissions. Of these, four children had recurrent upper airway infections and/or AOM. Therefore, myringotomy was performed in three of these cases and tympanomastoidectomy was performed in another case with secondary retroauricular abscess.

Discussion

As found in other studies,^{4,7} we found that there was an increase in the number of cases AM, especially in children older than 3 years old. That increase occurred

Table 2. Main clinical features by age group (age < 3 years versus ≥ 3 years)

Main clinical features	Total (n = 105)	< 3 years (n = 23)	≥ 3 years (n = 82)	p value
Ear pain	92% (n = 97)	87% (n = 20)	94% (n = 77)	0.37
Fever	56% (n = 59)	74% (n = 17)	51% (n = 42)	0.06
Otorrhoea	55% (n = 58)	30% (n = 7)	62% (n = 51)	0.009
Retroauricular inflammatory signs with auricle protrusion	93% (n = 98)	91% (n = 21)	94% (n = 77)	0.646

Table 3. Comparison of age and clinical features between the group with complications and the group without complications

Characteristics	Complications (n = 7)	Without complications (n = 98)	p value
Age < 3 years	57% (n = 4)	19% (n = 19)	0.04
ENT risk factors	42% (n = 3)	53% (n = 52)	0.7
Ear pain	72% (n = 5)	94% (n = 92)	0.089
Otorrhoea	43% (n = 3)	56% (n = 55)	0.69
Headache	43% (n = 3)	6% (n = 6)	0.007
C-reactive protein (mean)	9.0 mg/dL	4.8 mg/dL	0.033

ENT - ear, nose and throat.

in spite of a higher prevalence of children with pneumococcal vaccination.

The high number of AM observed was similar to some studies.^{5,10,11,14-16}

The increase in the number of cases may be explained by the previously mentioned factors as well as by the extension of the age limit for paediatric care up to 18 years since 2013. On the other hand, the diagnostic criteria of AM are still controversial, which may overestimate diagnosis.^{5,12,15}

The predominance in male children is in line with other studies,^{1,2,6,10,12,15} and the percentage of cases in children under 3 years old (22%) was also similar to some reports.^{3,5} The fact that more than half of the cases had been treated with antibiotics in the 15 days prior to the AM diagnosis is also in line with the literature.⁷⁻¹⁴ The clinical features of AM are also similar to what is expected, except for otorrhoea, which is more frequent than in most studies, and may be related to the existence of more cases of AM in older children, in which otorrhoea is more frequent.¹⁵ The results of ear drainage culture, despite only being performed in a few cases, was similar to some international^{1,3,5} and national^{2,17,18} studies. The rate of complications is within the expected range.¹⁻¹²

Our study, similarly to other studies,⁵⁻⁷ shows that the increase in the pneumococcal vaccination does not seem to decrease the AM rate, although other factors should be considered, and more long-term studies are needed in order to draw definitive conclusions.

As limitations of the study, it is a retrospective study which investigates the clinical medical records with

established AM diagnosis, without a direct observation of each patient.

To conclude whether the incidence of AM is really increasing, the establishment of an initial consensus on the diagnostic criteria and prospective studies on a large scale would be required.

WHAT THIS STUDY ADDS

- It confirms the tendency of an increasing number of cases of acute mastoiditis recently described in several studies, even with a higher prevalence of pneumococcal vaccination.
- It shows that acute mastoiditis was more frequent in children older than three years old, especially in summer.
- It did not show an increase in the rate of complications, despite the described epidemiological changes.

Conflicts of Interest

The authors declare that there were no conflicts of interest in conducting this work.

Funding Sources

There were no external funding sources for the realization of this paper.

Protection of human and animal subjects

The authors declare that the procedures followed were in accordance with the regulations of the relevant clinical research ethics committee and with those of the Code of Ethics of the World Medical Association (Declaration of Helsinki).

Confidentiality of data

The authors declare that they have followed the protocols of their work centre on the publication of patient data.

Awards and presentations

Oral presentation in the 17th Congresso Nacional de Pediatria, November 3, 2016.

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Mastoidites Agudas em Pediatria: A Aumentar Novamente?

Resumo:

Introdução: A mastoidite aguda é uma patologia otológica que pode originar graves complicações. Estudos recentes referem um aumento da sua incidência. Os objetivos deste trabalho foram avaliar a frequência e particularidades das mastoidites agudas num hospital nível II nos últimos cinco anos e comparar com os cinco anos prévios.

Métodos: Análise retrospectiva dos processos clínicos de crianças internadas com mastoidite aguda entre 2011-2015 num hospital nível II.

Resultados: No período em estudo ocorreram 105 internamentos por mastoidite aguda em 98 crianças (mais 46 casos que num estudo relativo aos cinco anos prévios). A mediana de idade foi 6 anos, com predomínio do sexo masculino (58%, n = 57). Identificou-se pelo menos um fator de risco otorrinolaringológico em 52% (n = 55) e realizaram antibioterapia prévia 51% (n = 54). A clínica predominante foi otalgia (92%, n = 97) e presença de sinais inflamatórios retroauriculares (93%, n = 98). Analiticamente, 43% (n =

45) apresentavam leucocitose e 35% (n = 37) proteína C reativa > 4 mg/dL. Efetuou-se tomografia computadorizada em 30% (n = 31) e punção lombar em três casos, por evolução desfavorável. Registaram-se complicações em 7% (n = 7), extracranianas em três casos e intracranianas em quatro, com maior frequência naqueles com idade inferior a 3 anos (p = 0,04). A cefaleia foi mais frequente no grupo com complicações (p = 0,007). Todos realizaram antibioterapia endovenosa e 19% (n = 20) foram submetidos a cirurgia otorrinolaringológica, urgente em 35% (n = 7) destes. Em 10% (n = 10) ocorreu recidiva.

Discussão: Tal como noutros estudos, constatámos aumento da incidência de mastoidite aguda nos últimos cinco anos. A taxa de complicações foi também semelhante à relatada em vários trabalhos.

Palavras-Chave: Criança; Doença Aguda; Mastoidite/complicações; Mastoidite/diagnóstico; Mastoidite/epidemiologia; Mastoidite/terapia; Portugal