Otomastoiditis in children: trends over the last 10 years

Original Article

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Article received on April 24, 2025.
Accepted for publication on June 25, 2025.

Abstract

Objective: To analyze the evolution of otomastoiditis cases in children admitted to a tertiary hospital over the past 10 years.
Study Design: Retrospective longitudinal cohort study.
Material and Methods: Clinical and demographic data were analyzed for all children hospitalized for otomastoiditis between January 2014 and December 2023 in Hospital de Braga.
Results: A total of 100 children were evaluated (63% male; mean age 44.5±39.2 months). The main complications included subperiosteal abscess (28%) and sigmoid sinus thrombosis (7%). Surgical treatment was required in 77% of cases. A significant increase in the number of cases and surgical interventions was observed over the decade; however, the annual average varied between 9.3±3.7 cases/year in the pre-pandemic period, 4.6±1.4 during the pandemic, and 17±1.4 in the post-pandemic period.
Conclusions: Otomastoiditis cases have increased in recent years, with a temporary reduction during the pandemic. Continuous monitoring of the epidemiological evolution is essential to understand the trends in this condition.

Keywords: Otomastoiditis; children; trend; mastoidectomy.

Introduction

Acute otomastoiditis is the most common complication of acute otitis media (AOM), which commonly affects the pediatric population. It can lead to serious complications, such as venous sinus thrombosis, meningitis, facial paralysis, or intracranial abscesses[1]. Despite the advances in diagnostic tools and treatment strategies, acute otomastoiditis remains a clinical challenge, particularly in cases requiring surgical intervention, such as mastoidectomy[1,2]. Following the introduction of the pneumococcal vaccine, several studies have reported a decrease in hospital admissions for otomastoiditis and reduced isolation

of *Streptococcus pneumoniae*[3,4]. However, more recent data indicate that the incidence and severity of otomastoiditis may not have declined as expected and may even be on the rise. This trend is possibly linked to changes in the immune response of the population following the COVID-19 pandemic[5,6]. During the pandemic, containment measures, such as widespread mask use, social distancing, and suspension of in-person school and work activities, led to a significant reduction in respiratory tract infections and consequently, in cases of AOM and otomastoiditis[7-9]. However, following the easing of these restrictions, several countries reported a sharp increase in invasive infections, including a significant rise in acute mastoiditis and subsequent need for mastoidectomy[5,6].

In Portugal, a state of emergency was declared on March 18, 2020, leading to strict lockdown measures that included school closure and a widespread shift to remote work[10]. In the following months, these restrictions were gradually adjusted according to the evolving pandemic situation regarding the number of cases, deaths, and progress of the vaccination campaign. The phased lifting of restrictions began in 2021 and ended on February 17, 2022, with the cessation of the most significant restrictions[11].

In this context and based on the perception of a recent increase in both the incidence and severity of otomastoiditis, this study aimed to evaluate the incidence of pediatric otomastoiditis at a tertiary hospital over the past ten years, with a particular focus on the need for surgical management.

Materials and Methods

This retrospective study included all patients diagnosed with acute otomastoiditis under 18 years of age who were admitted to the Otolaryngology Department of Hospital de Braga from January 2014 to December 2023. The exclusion criterion was the presence of chronic otologic disease known to predispose to recurrent middle ear infections, such as chronic otitis media with cholesteatoma, because the associated higher risk of complications and pathophysiological characteristics may influence the clinical course and prognosis.

Data were collected from the clinical records of all enrolled patients, including the year of diagnosis, demographic characteristics (sex and age at diagnosis, in months), medical history (including the vaccination status), clinical presentation (signs and symptoms), and diagnostic tests and results. Treatment-related data were also analyzed, including the type and duration of antibiotic therapy, length of hospital stay, need for surgical intervention, and type of procedure performed. For analytical purposes, the pandemic period was defined as the interval from March 18, 2020 to February 17, 2022, corresponding to the main period of COVID-19 containment measures in Portugal. Statistical analyses were conducted using the IBM® SPSS® Statistics software , version 22. A p-value < 0.05 was considered statistically significant. In the descriptive analysis, categorical variables were expressed as absolute and relative frequencies, while continuous variables were expressed as means and standard deviations. Categorical variables were compared using the Chi-square test (χ^2) or Fisher's exact test, as appropriate. Continuous variables were analyzed using the Student's t-test for independent samples following verification of a normal distribution. Spearman's rank correlation was used to assess the trends in otomastoiditis cases and treatments over the past decade.

Results

A total of 100 pediatric patients were included in the study, with a mean age of 44.5 ± 39.2 months at diagnosis; 63% were boys (Table 1). Approximately 36% of the patients had a prior diagnosis of AOM and were already undergoing antibiotic treatment at the time of admission for otomastoiditis, with an average treatment duration of 4.9 days. On admission, 55% patients had a fever. The most frequently reported symptoms were otalgia (n = 55), food refusal (n = 9), vomiting (n = 5), and

Table 1
Demographic characteristics of the study sample

Age (mean ± SD, in months)	44,5±39,2
Sex	
Male n (%)	63 (63)
Female n (%)	37 (37)

headache (n = 5). On physical examination, the most common findings were erythema (n = 57), edema (n = 36), and auricular signs such as detachment, bulging, or lateralization of the pinna (n = 62), along with obliteration of the retroauricular sulcus and retroauricular swelling or fluctuation (n = 40), which are typical findings in AOM on otoscopic examination (n = 88). The left ear was more frequently affected (59%), followed by the right ear (40%), with bilateral involvement in 1% of cases. The complications included subperiosteal abscess (n = 28), mastoid empyema (n = 1), intracranial empyema (n = 1), peripheral facial nerve palsy (n = 2), petrositis (n = 1), and sigmoid sinus thrombosis (n = 7). The mean hospital stay duration was 9.63 ± 6.02 days, and the mean duration of intravenous antibiotic therapy was 10.01 ± 5.67 days. The most commonly used intravenous antibiotic was ceftriaxone (n = 90), which was combined with clindamycin in 15 cases. Other regimens included amoxicillin + clavulanate (n = 7), cefotaxime (n = 2), and cefuroxime (n = 1). Treatment was adjusted based on clinical progression (favorable or unfavorable) and when available, microbiological findings and antibiotic susceptibility results. Surgical treatment was required in 77% of cases. Procedures included myringotomy with transtympanic ventilation tube **(TVT)** placement (n = 77), subperiosteal abscess drainage (n = 26), and cortical mastoidectomy (n = 21). In 12 cases, only retroauricular puncture was performed, and pus drainage or incision were not required (Table 2). Microbiological analysis of pus samples collected during myringotomy or abscess drainage, when available, was performed in 47% of the cases (Table 3). In 13 cases, no bacterial growth was identified, while polymicrobial growth was observed in 10 cases. The most frequently isolated organisms were *Streptococcus pneumoniae* (SP) (n = 9) and *Streptococcus pyogenes* (n = 9).

A statistically significant positive correlation was found between the year of diagnosis and number of otomastoiditis cases ($\rho = 0.67$, $p = 0.034$), with an upward trend in the incidence over the past decade (Figure 1). Similar trends were observed in the number of cases requiring surgical intervention ($\rho = 0.729$, $p = 0.017$) (Figure 2) and more specifically, in the number of mastoidectomy procedures ($\rho = 0.665$, $p < 0.036$) (Figure 3).

Subgroup analysis was conducted for children who underwent surgical treatment during the study period. The decision for surgical intervention was based on the severity and progression of otomastoiditis, presence of local or systemic complications, lack of response to initial medical treatment, or clinical deterioration, particularly persistence or worsening of infection despite appropriate antibiotic therapy. In this subgroup, patients were younger (38.29 ± 51.81 months) compared to those treated medically (38.29 ± 32.22 months) ($t = 2.317$, $p = 0.028$). Both the length of hospital stay and duration of intravenous antibiotic therapy were longer in the surgical group (10.47 ± 6.49 and 10.57 ± 6.11 days) compared to the medically treated group (6.96 ± 2.89 and 8.25 ± 3.53 days) ($t = -3.696$, $p < 0.001$ and $t = –1.762$, $p = 0.081$, respectively).

Despite this upward trend, the annual incidence of acute otomastoiditis varied across distinct time periods over the last decade. In the pre-pandemic period, the average was 9.3 ± 3.7 cases per year. During the COVID-19 pandemic (March 18, 2020 to February 17, 2022), there was a marked decrease to 4.6 ± 1.4 cases per year. In the post-pandemic period, there was a significant increase to an annual average of 17 ± 1.4 cases, nearly double the pre-pandemic rate. However, comparative analysis across the three time periods showed no statistically significant differences in the age at diagnosis ($H = 1.483$, $p = 0.476$), need for surgical treatment ($\chi^2 = 4.368$, $p = 0.113$), or mastoidectomy rates ($\chi^2 = 0.456$, $p = 0.796$).

Table 2
Clinical characteristics of the study sample

Prior diagnosis of AOM n (%)	36 (36)
Symptoms on admission	
Fever n (%)	55 (55)
Otalgia n (%)	55 (55)
Food refusal n (%)	9 (9)
Vomiting n (%)	5 (5)
Headache n (%)	5 (5)
Signs on admission	
Retroauricular erythema n (%)	57 (57)
Retroauricular edema n (%)	36 (36)
Pinna displacement, bulging, or lateralization n (%)	62 (62)
Obliteration of retroauricular sulcus, retroauricular swelling or fluctuation n (%)	40 (40)
Typical aom findings on otoscopy* n (%)	88 (88)
Laterality	
Left (%)	59 (59)
Right (%)	40 (40)
Bilateral (%)	1 (1)
Complications	
Subperiosteal abscess (%)	28 (28)
Mastoid empyema (%)	1 (1)
Intracranial empyema (%)	1 (1)
Peripheral facial nerve palsy (%)	2 (2)
Petrositis (%)	1 (1)
Sigmoid sinus thrombosis (%)	7 (7)
Length of hospital stay (mean ± SD)	9,63±6,02
Days of hospital stay (mean ± SD)	10,01±5,67
Treatment	
Surgical (%)	77 (77)
Medical only (%)	23 (23)
Myringotomy with tvt placement (%)	77 (77)
Subperiosteal abscess drainage (%)	26 (26)
Cortical mastoidectomy (%)	21 (21)
Retroauricular puncture (%)	12 (12)

Note: AOM, Acute Otitis Media; TVT, Transtympanic Ventilation Tubes; SD, standard deviation.
* Typical otoscopic signs of AOM include otorrhea, bulging, and/or hyperemia of the tympanic membrane

Table 3
Microbiological findings from analysis of pus samples

Agent	N=
Streptococcus pneumoniae	9
Streptococcus pyogenes	9
Staphylococcus epidermidis	4
Turicella ottidis	4
Staphylococcus auricularis	4
Staphylococcus aureus	3
Pseudomonas aeruginosa	2
Staphylococcus capitis	2
Haemophilus influenzae	2
Acinetobacter guillouiae	1
Corynebacterium amycolatum	1
Chryseobacterium spp	1
Fusobacterium necrophorum	1
Alloiococcus otitidis	1
Serratia marcescens	1
Streptococcus mitis	1

Note: 11 cultures yielded negative results and 10 showed polymicrobial growth

Figure 1
Annual trend in the number of acute otomastoiditis cases (2014–2023). Scatter plot shows a significantly positive correlation between the year of diagnosis and annual number of cases (p = 0.67; p = 0.034).

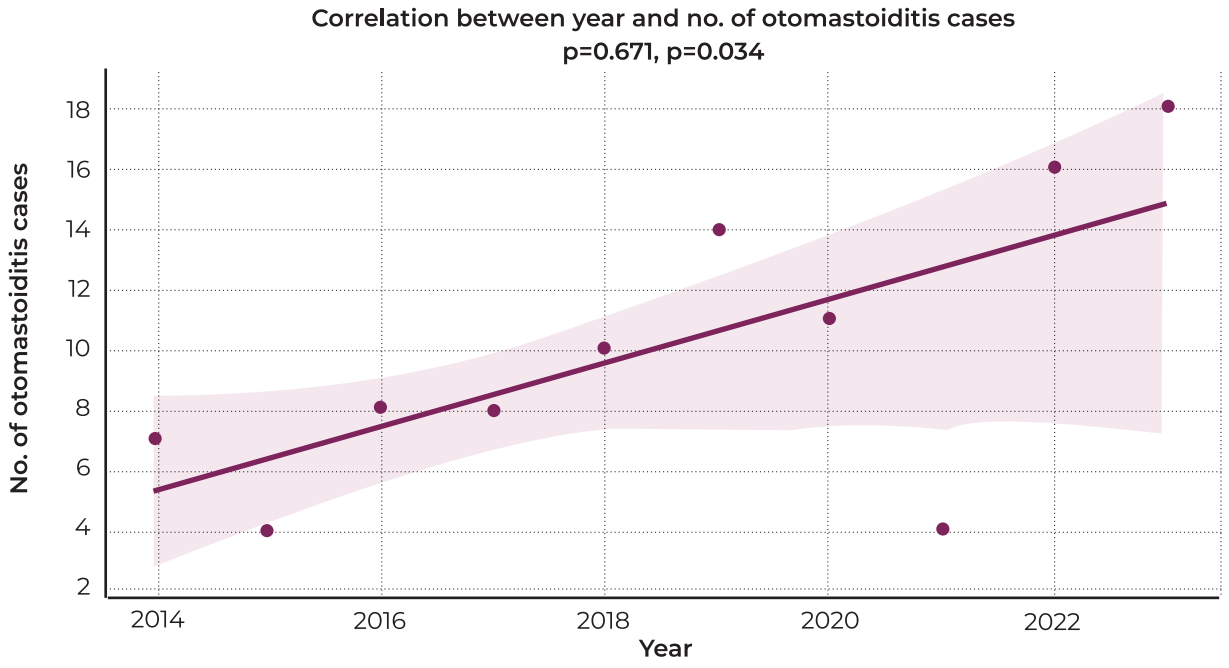


Figure 2
Annual trend in the number of surgical interventions for otomastoiditis (2014–2023). Scatter plot shows a significantly positive correlation between the year of diagnosis and number of cases requiring surgical treatment (p = 0.729, p = 0.017).

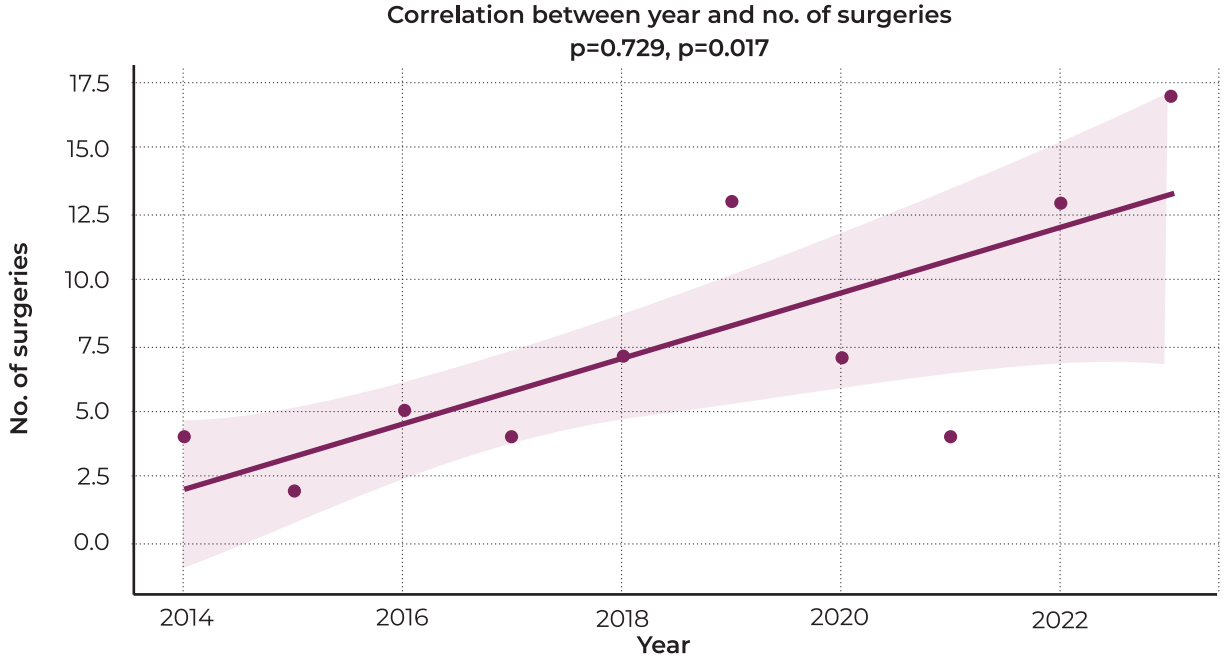
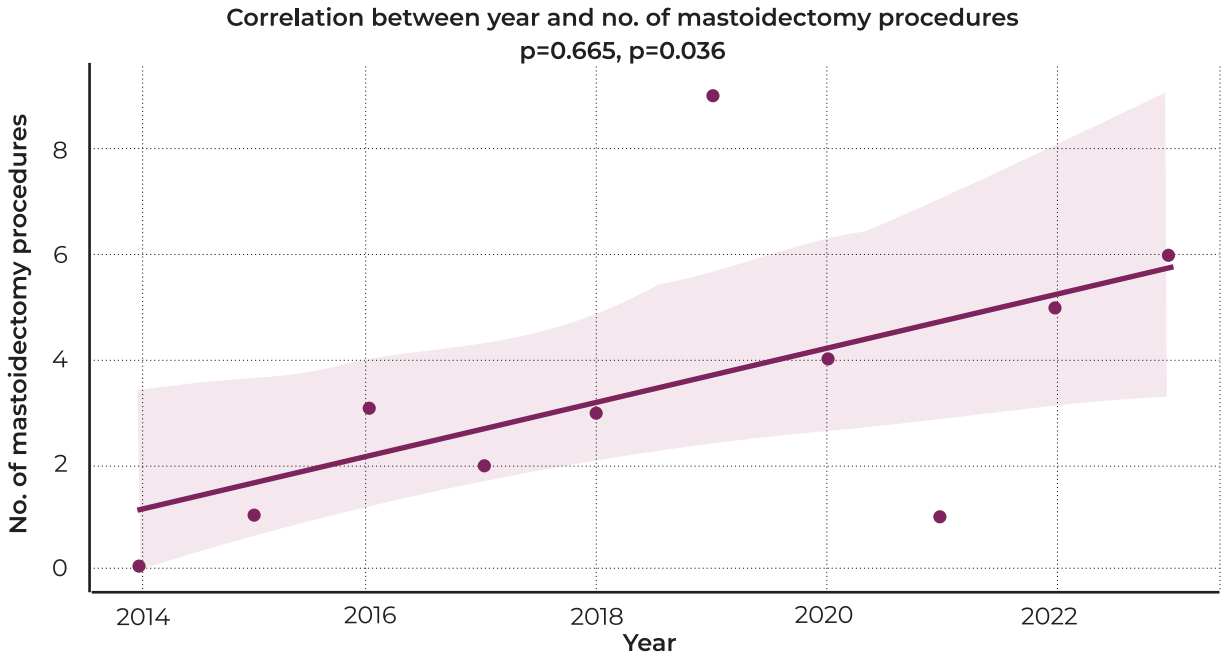


Figure 3
Annual trend in the number of mastoidectomy procedures (2014–2023). The scatter plot shows a strongly positive correlation between the year of diagnosis and number of mastoidectomy procedures ($p = 0.665$; $p < 0.036$).



Discussion

This study found a progressive increase in the number of pediatric otomastoiditis cases over the past decade at a tertiary care hospital. There was also a rise in the number of cases requiring surgical treatment, with a tendency for younger patients to undergo surgery. Despite the marked increase in otomastoiditis cases over the past decade, a decline was observed during the COVID-19 pandemic, particularly during lockdowns and periods of strict respiratory protection measures and social distancing. This pattern suggests the direct impact of pandemic-related containment measures on the incidence of upper respiratory tract infections, including AOM and its complications, consistent with the findings in the literature[7–9].

Following the lifting of restrictions, a significant increase in the annual incidence of otomastoiditis was observed. However, this was not associated with a significant increase in the need for surgery, including mastoidectomy. Hollborn et al. reported a 54% reduction in mastoidectomy procedures in children aged between 0–6 years and 62% in children aged between 7–18 years during the pandemic. After the restrictions were lifted, they observed a sharp increase across all age groups[5]. Similarly, Goldberg-Bockhorn et al. described a decline in otomastoiditis cases from 2020 to 2022, followed by a steep rise, although they did not find a reduction in complicated cases during the pandemic period[6]. As in our study, they reported a significant increase in cases of otomastoiditis caused by *Streptococcus pyogenes*, with annual cases rising from 7–15 in the period of 2011–2018 to 23 in 2019 [6]. Khalifee et al. also reported a substantial post-pandemic increase in pediatric acute mastoiditis, with an annual average of 27.8 cases compared to eight cases annually before the COVID-19 pandemic. They also noted a 4.8-fold increase in the associated complications, particularly intracranial changes, rising from 1.3 to 12 cases per year[12].

Some explanations have been proposed for this increase. Hollborn et al. highlighted the impact of individual protective measures and social distancing; increased public awareness of disease signs and earlier medical appointments; and clinicians' preference for conservative management during the pandemic and avoidance of surgery when possible[5]. Additionally, avoidance of large hospitals due to fear of exposure to SARS-CoV-2 and strain on public services may have led to increased use of private care facilities in Portugal[5]. This may have influenced the perceived reduction in the number of cases in tertiary hospitals during the pandemic.

In contrast, Peyser-Rosenberg et al. observed a reduction in the number of AOM and otomastoiditis cases during the pandemic but noted increased complications and length of hospital stay, possibly due to delayed medical care from fear of SARS-CoV-2 infection[13]. Although our study showed a decrease in the number of otomastoiditis cases during the pandemic, there was no significant difference in the mastoidectomy rates, suggesting a higher proportion of complicated cases during this period.

The post-pandemic increase in infections has been attributed to a temporary immunological deficit due to reduced exposure to pathogens during the lockdown[5,6,12]. This may have contributed to a broader rise in respiratory infections, including AOM and its complications, such as otomastoiditis[5,6,10]. Hollborn et al. suggested the role of other factors, including the emergence of more virulent bacterial strains and fewer adenoidectomies performed during the pandemic[5]. Khalifee et al. noted a shift toward *Streptococcus pyogenes* as the dominant post-pandemic pathogen[10]. In contrast, Peyser-Rosenberg et al. did not find a post-pandemic increase in otomastoiditis, with the incidence remaining similar to pre-pandemic levels[13]. They attributed this to shorter lockdowns implemented in the study population[13] and hypothesized that older children may have developed pre-pandemic immunity, while younger children may have benefited from reduced early-life infection exposure, potentially offering protection against future severe infections or early antibiotic need[13,14].

This study has some limitations, particularly those inherent to its retrospective design and the small sample size in certain subgroups, especially during the pandemic period, which may have influenced the statistical power for comparisons between groups.

Ongoing monitoring of the annual incidence of otomastoiditis is crucial to determine whether the observed increase in cases of otomastoiditis persists long-term. A sustained trend may indicate that the increase is not solely related to the direct impact of the pandemic, while a return to pre-pandemic levels would support the hypothesis of a transient, indirect effect of containment measures.

Furthermore, monitoring microbiological profiles may help in identifying changes in etiological patterns that are potentially driven by the pandemic. Finally, definitions of the pandemic period vary across studies, particularly toward its end, which can hinder direct and uniform comparisons across studies.

Conclusion

This study revealed a significant variation in the incidence of pediatric acute otomastoiditis across the pre-pandemic, pandemic, and post-pandemic periods. A marked reduction was observed during the COVID-19 pandemic, followed by a sharp increase after its end. These findings suggest that containment measures implemented during the pandemic directly influenced the incidence of otologic infections and their complications. However, the upward trend in the post-pandemic period raises the possibility of additional contributing factors, such as immune response changes or shifts in microbial patterns, as suggested by the rise noted in 2019, prior to the pandemic. Continued epidemiological surveillance of otomastoiditis will be essential to better understand the true extent, causes, and duration of these trends.

Conflicts of interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

Data Confidentiality

The authors declare having followed the protocols used at their working center regarding patient data publication.

Protection of humans and animals

The authors declare that the procedures were followed according to the regulations established by the Clinical Research and Ethics Committee and the 2013 Helsinki Declaration of The World Medical Association.

Funding Sources

This work did not receive any contribution, funding, or scholarship.

Availability of scientific data

There are no datasets available, or publicity related to this work.

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