

Subperiosteal abscesses as complications of acute mastoiditis in children: 22 years of experience

Original Article

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Abstract

Objectives: Comparison of the surgical results of patients submitted to Subperiosteal Abscess (SS) drainage compared to those submitted to mastoidectomy.

Study design: Observational and retrospective.

Material and Methods: Review of clinical records of pediatric patients with SA (n=56).

Results: The incidence of AS has remained constant, with an average of 2.5 cases/year. SA drainage with myringotomy was the surgical approach chosen in 43 patients (77%), while 6 underwent mastoidectomy (11%) and 7 underwent drainage and mastoidectomy (13%). The only statistically significant difference between groups was the mean length of hospital stay, which was longer in the mastoidectomy group.

Conclusions: SA drainage combined with intravenous antibiotic therapy is an effective first-line treatment for SA in pediatric age. No higher risk of complications was found in the group of patients treated with drainage compared to the group undergoing mastoidectomy.

Keywords: Acute mastoiditis; Subperiosteal abscess; Complication; Mastoidectomy

Introduction

Acute mastoiditis (AM) is the most prevalent complication of acute otitis media (AOM), with an annual incidence of 1.2–4.2 per 100,000 children¹. The introduction of antibiotic therapy for AOM has decreased the incidence of AM, yet that of intratemporal and intracranial complications has remained high². The proximity of the mastoid bone to the facial nerve, jugular vein, internal carotid artery, sigmoid sinus, meninges, and the brain is the cause of high morbidity associated with such complications. Early diagnosis of AM is therefore essential because delayed diagnosis and treatment could lead to non-negligible rates of mortality.

AM is more frequent in boys than in girls and the incidence peaks between the second and third years of life, like AOM³⁻⁴. Subperiosteal abscesses (SAs) are the most frequent complications of AM, with an incidence of 10%–32%⁵⁻⁸. They classically develop through erosion of the mastoid bone and the discharge of purulent content through the periosteum. Bone erosion is not always evident, indicating that other mechanisms might be involved in the dissemination of infection through the tympanomastoid suture and/or vascular canals in the subperiosteal space⁹.

Intravenous antibiotic therapy is the indisputable therapeutic option for the management of such patients. However, the type of surgical approach remains under debate. Some clinicians prefer more conservative approaches with abscess drainage (retroauricular aspiration puncture and/or incision) with myringotomy (with or without placement of a transtympanic ventilation tube), whereas others favor a lower threshold for canal wall up mastoidectomy¹⁰⁻¹³. The largest multicenter study to date analyzed clinical records of Swedish patients with SAs between 1993 and 2007 concluded that risk of complications is not any higher in patients treated with drainage compared with those treated using mastoidectomy¹⁴. However, results have not been definitive in any of the studies, and further meta-analyses or international recommendations on the topic are needed.

The main objective of the present study was to determine whether surgical outcomes differ between patients treated by SA drainage and those treated by mastoidectomy. We also aimed to clarify variations in demographic data, clinical characteristics, and approaches to patients diagnosed with SA between 2017–2022 and 2000–2016.

Material and Methods

This descriptive, observational, and retrospective study of all pediatric patients (aged < 18 years) admitted to Hospital Dona Estefânia with suspected AM proceeded between January

1, 2000 and December 31, 2021 (n = 340). A diagnosis of AM was considered when patients had AOM and at least one of the following clinical signs: periauricular inflammation such as erythema, redness or edema, loss of the retroauricular fold, or protrusion of the external ear. Patients were subsequently selected (n = 74) based on the findings of SA during mastoidectomy or pus at sites of retroauricular aspiration puncture or incision. Patients with chronic otitis media, cholesteatoma, previous mastoidectomy on the ipsilateral ear, history of fracture of the ipsilateral temporal bone, or incomplete clinical records were excluded. The final sample comprised 56 patients who were evaluated by an otorhinolaryngologist.

We analyzed clinical data, relevant laboratory or imaging findings, complications, therapeutic approaches, and bacteria cultured from aspirates of purulent contents from an SA, from the middle ear after tympanocentesis, or from the mastoid cavity during mastoidectomy.

The patients were assigned to groups according to whether they were treated by SA drainage (needle aspiration and/or incision of the abscess), wall up canal mastoidectomy, or SA drainage and mastoidectomy.

The epidemiological characteristics of the patients diagnosed with SA were compared between the last five years and the preceding 17 years. Categorical and non-categorical variables in univariate analyses were respectively assessed using two-tailed Fisher exact tests, and either t-tests or Mann-Whitney U tests. Values with $p < 0.05$ were considered significantly different. Agreement among the three groups was evaluated using analysis of variance. All data were analyzed using SPSS v. 25, (IBM Corp., Armonk, NY, USA).

Results

Clinical characteristics

Over the 22-year study period, 56 patients met the inclusion criteria. The incidence of SA remained constant and did not significantly decrease over the past five years compared to the preceding 17 years (2.2 vs. 2.6 per year;

p = 0.42265; overall mean, 2.5 per year) (Table 1). The mean age of the patients was 30 (5–180) months, and 84% were aged < 5 years. Mean age did not significantly differ among the groups (Table 2). More (32%) SA episodes occurred during the winter.

Girls (n = 30; 54%) were more affected than boys (n = 26; 46%). Almost half of the patients (43%) had a history of AOM episodes, and this significantly increased over the past five years to 73% (p = 0.0255). The history of AOM episodes (p = 0.664) and chronic illness (Table 2) did not significantly differ among the groups, and no pattern was associated with any specific predisposing disease. The most frequent illness was asthma (n = 3).

The mean hospital stay was 9 days, and decreased by ~1 day during the last five years (p = 0.0001). Patients treated by mastoidectomy remained significantly longer in hospital (p = 0.0136).

Laboratory and microbiology findings

The microbiological findings of cultures obtained by tympanocentesis, from purulent abscess contents, or directly from the mastoid cavity, were available for 18 (32%) of the 56 patients and 9 (50%) were negative. All patients during the last five years underwent microbiological

assessment, which represented a statistically significant increase compared with 2000–2016 (p < 0.00001). *Streptococcus pneumoniae* was the most frequently isolated bacterium (n = 4; 44%), although *Pseudomonas aeruginosa*, *Streptococcus pyogenes*, *Klebsiella pneumoniae*, *Staphylococcus cohnii*, and *Fusobacterium necrophorum* (n = 1 each) were also isolated.

Laboratory findings of C reactive protein and leukocyte counts did not significantly differ among the groups upon admission (Table 2).

Imaging findings and diagnosis

Computed tomography images were acquired from 37 of the 56 patients. The number of patients assessed by CT significantly increased during the past five years compared with 2000–2016 (100% vs. 33%; p = 0.0060). Four patients each were assessed by MRI between 2000–2016, and during the past five years, which represents a significant increase (p = 0.0172). Suspected intracranial complications determined from CT or clinical findings were predominantly assessed by MRI.

Medical approaches

Upon hospital admission, 52% of patients had previously been treated with oral antibiotics

Table 1

Clinical characteristics of pediatric patients with SA according to time frame of diagnosis.

	2000–2016	2017–2021	Total (2000–2021)	p
Patients with SA (n)	45	11	56	—
Patients with SA per year (n)	2.6	2.2	2.5	0.42265
Male/Female	21/24	5/6	26/30	0.9437
Mean age	2 y 7 m	2 y 2 m	2 y 6 m	0.9558
Age < 5 y	38 (84%)	9 (82%)	47 (84%)	0.3722
Previous episodes of AOM	16 (36%)	8 (73%)	24 (43%)	0.0255
CT	26 (58%)	11 (100%)	37 (66%)	0.0060
MRI	4 (9%)	4 (36%)	8 (14%)	0.0172
Microbiological analysis	7 (16%)	11 (100%)	18 (32%)	< 0.00001
Antibiotic therapy before admission	20 (43%)	9 (82%)	29 (52%)	< 0.00001
Total length of hospital stay, days	9.4	7.9	9.1	0.0001
AS recurrence	2 (4%)	2 (18%)	4 (7%)	0.1169

AOM, acute otitis media; AS, subperiosteal abscess; CT, computed tomography; MRI, magnetic resonance imaging

for AOM. This ratio significantly increased to 82% in the last five years ($p < 0.00001$; Table 1). However, the groups did not significantly differ. The most frequently prescribed oral antibiotics were amoxicillin/clavulanate ($n = 13$), amoxicillin ($n = 10$), second-generation cephalosporins ($n = 5$), and azithromycin ($n = 1$). All patients received intravenous antibiotic therapy. Most (73.2%) received a combination of antibiotics and only 26.8% were treated with one. The most common combination therapy was third-generation cephalosporin with meningeal penetration and anaerobic coverage (ceftriaxone and metronidazole or clindamycin). Ceftriaxone was the first choice of monotherapy. Analgesics and antipyretics were administered according to individual symptoms.

Surgical approaches

Drainage of the SA (retroauricular aspiration puncture and/or incision) by myringotomy (with or without placement of transtympanic ventilation tube) was the surgical approach for 43 (77%) patients, whereas 6 (11%) were treated by wall up canal mastoidectomy and 7 (13%) underwent drainage and mastoidectomy. We compared the groups treated with needle aspiration/drainage and mastoidectomy.

The mean elapsed time between admission and myringotomy and needle aspiration/incision procedures was 1.7 (0–4) days (Group 1) and that between admission and mastoidectomy was 2.1 (0–6) and 1.9 (0–6) days (Groups 2 and 3, respectively). Although the mean elapsed time until mastoidectomy was longer, the difference did not reach statistical significance (Table 2).

Clinical course during hospitalization and follow-up

Two complications each of SAs recorded in 2000–2016 and 2017–2022 did not significantly differ ($p = 0.1169$) and SA recurrence did not significantly differ among the groups.

Table 2 shows that the only statistically significant difference among the groups was the mean length of the hospital stay, which was extended after mastoidectomy.

All patients were discharged and were followed-up for at least one year. Audiological evaluation was available for 38 patients (68%) and revealed that four of them had mild unilateral sensorineural hypoacusis.

Discussion

The present findings showed that the incidence of SA has remained stable over the

Table 2

Clinical characteristics of pediatric patients with SA according to type of treatment

	Group 1 (n=43) Drainage of AS	Group 2 (n=6) Mastoidectomy	Group 3 (n=7) Drainage and Mastoidectomy	p
Mean age	2 y 3 m	3 y 4 m	3 y 8 m	0.6104
Previous episodes of AOM	17 (40%)	3 (50%)	4 (57%)	0.664
History of chronic illness	5 (12%)	1 (17%)	2 (29%)	0.443
Microbiological analysis	14 (33%)	2 (33%)	2 (29%)	0.977
Mean CRP upon admission (mg/L)	72.9	83.8	81.8	0.7927
Mean leukocyte count upon admission ($\times 10^3/\mu\text{L}$)	15.4	16.1	15.9	0.4954
Antibiotic therapy before admission	20 (47%)	4 (67%)	5 (71%)	0.364
Hospital stay until surgery (d)	1.7	2.1	1.9	0.6450
Total hospital stay (d)	8.8	10.5	10.7	0.0136
SA recurrence	2 (5%)	1 (17%)	1 (14%)	0.16013

AOM, acute otitis media; AS - subperiosteal abscess; CRP, C reactive protein; d, days; m, months; y, years

past 22 years despite a significant increase in prescribed oral antibiotics for AOM since 2017. Unlike other studies including an analysis of the Portuguese population³, the present study found no significant differences between the sexes. During the 22-year period, 84% of patients were aged < 5 years.

In the present study, samples for microbiological analysis were collected from only 32% patients, which is considerably less than the percentage reported in a previous study¹⁵. *Streptococcus pneumoniae* (n = 4) was the most frequently isolated agent. *Pseudomonas aeruginosa* is among the normal flora of the external ear canal, but some clinicians consider it as a contaminant or simultaneous infection^{4,16}. Significantly more cultures were analyzed at Hospital Dona Estefânia during the past five years, which indicates increasing interest in identifying causative agents and implementing appropriate targeted antibiotic therapy to avoid future resistance. Samples should always be obtained from patients with SA for microbial analysis as soon as possible and before starting intravenous antibiotic therapy to increase the likelihood of identifying causative agents. Samples of SA obtained by puncture or incision can be reliably cultured, without a significant increase in surgical duration¹⁴. One study has found that CT does not alter the course of AM or its management in most pediatric patients with a clinical diagnosis¹⁷, whereas others suggest that anamnesis and objective examinations cannot detect all SAs; therefore, wider complementary exams are needed¹⁸. The number of patients assessed by CT in our department (37 of 56) has significantly increased since 2017 compared with the 17 years before that. Acquiring radiological images from young children requires care because the process requires anesthesia and exposure to radiation, both of which confer risk. Imaging is mostly applied upon suspicion of severe intracranial complications. Evidence of abscesses during the initial stages of SAs might be undetectable by CT. Migirov et al. found that CT did not detect confirmed SA

in five of 39 patients, and Luntz et al. found that SAs were undetectable by CT in 26% of patients upon admission^{6,9}.

Mastoidectomy was the gold standard for treating AM with SA during the 20th century. However, more conservative surgical treatment with retroauricular needle aspiration or incision of the SA have recently been indicated as an alternative to mastoidectomy. Our results indicated that surgery with SA drainage was sufficient for 43 of 56 patients who did not undergo mastoidectomy. These findings support the recent conclusions that mastoidectomy is not an indispensable approach to treating AM, even when SAs are detected. Due to the relatively few patients in Group 1 (n = 43) and the retrospective nature of the present study, we could not conclude whether needle aspiration is sufficient, or when incision is preferable.

Although two children in Group 1 relapsed, the difference was not statistically significant, and the advantages of each of the surgical methods in terms of risk of SA recurrence could not be confirmed. The clinical course did not differ among the treated groups, and the sequelae were mild. The mean hospital stay was 9.1 days, which is longer than that previously reported¹⁴.

The limitations of the present study are its retrospective nature and observations over a period of 22 years. This is because surgical decision-making processes have changed over the years depending on the state of the art in otorhinolaryngology and the availability of complementary diagnostic tests. Thus, retrospectively determining the rationale for some specific decisions is challenging.

Conclusion

The incidence of SA has remained constant since 2017, despite the significantly increased prevalence of treatment with oral antibiotics. Drainage of SA combined with intravenous antibiotic therapy and myringotomy are effective first-line strategies for treating SA resulting from AM in children. Risk of recurrence was not increased after treatment

with drainage compared with treatment using mastoidectomy.

Conflicts of Interest

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

Data Confidentiality

The authors declare having followed the protocols in use at their working center regarding patients' 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 to the 2013 Helsinki Declaration of the World Medical Association.

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Availability of scientific data

There are no datasets available, publicly related to this work.

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