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ORIGINAL ARTICLE

Treatment of acute mastoiditis in children with cochlear implants

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KEYWORDS

Acute mastoiditis; Cochlear implant; Subperiosteal abscess

Abstract

Introduction: Acute mastoiditis (AM) is a paediatric infectious complication that raises a specific problem in case of implanted patients. Objective: To review the cases of AMin a paediatric cochlear implant (CI) programme to study its incidence and associated problems. Materials and methods: A retrospective study was conducted on 248 children aged between 8 months and 14 years who underwent Cl from 1994 to 2009. The demographics, clinical data and their treatment were analyzed. Results: Five patients developed acute mastoiditis (2.01%), three of them with subperiosteal abscess (1.21%). The mean age of implantation was 2 years and 4 months, and the complication presented between 1 and 33 months post-implantation (mean, 11.6 months). Four patients had episodes of serous otitis preimplantation. The mean age of AM patients was of 3 years and 4 months. The Cl type was nucleus in all cases. Conclusions: Conservative management is suggested for AM and subperiosteal abscess in children with cochlear implants. Surgical treatment should be avoided to prevent CI contamination. The first option is intravenous antibiotics and simple puncture of the abscess. If surgical drainage is needed, radiological study should be performed to locate the CI electrodes.

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PALABRAS CLAVE

Mastoiditis aguda; Implante coclear; Absceso subperióstico

Tratamiento de la mastoiditis aguda en niños con implante coclear

Resumen

Introducción: La mastoiditis aguda es una complicación infecciosa otítica que plantea una problemática específica en el caso de pacientes implantados.

Objetivo: Revisar los casos de mastoiditis aguda en el programa de implantes cocleares para valorar su incidencia y los problemas asociados.

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Materiales y métodos: Se realizó un estudio retrospectivo en 248 niños implantados con edades entre los 8 meses y 14 años desde 1994 hasta 2009 en nuestro programa de implantes cocleares. Se analizan los datos demográficos, clínicos y su tratamiento.

Resultados: Cinco pacientes desarrollaron mastoiditis aguda (incidencia de 2,01%), 3 de ellos con absceso subperióstico (incidencia de 1,21%). La edad media de implantación de estos niños fue de 2 años y 4 meses, y la complicación se presentó entre 1-33 meses postimplante (media 11,6 meses). Cuatro pacientes habían presentado episodios de otitis media secretora previos al implante. La edad media de presentación de la mastoiditis fue de 3 años y 4 meses. Todos eran portadores de implante coclear tipo Nucleus, que es el implante más frecuentemente utilizado en niños, en nuestro programa.

Conclusiones: Tendemos a ser más conservadores en el manejo de la mastoiditis aguda y del absceso subperióstico en la población infantil con implante coclear. Consideramos que se debe prescindir del tratamiento quirúrgico mientras sea posible, para evitar la contaminación del implante, extremando el tratamiento intravenoso y utilizando el drenaje simple mediante punción, ya que este procedimiento ha mostrado buenos resultados. En el caso de drenaje quirúrgico, debe realizarse un estudio radiológico para delimitar la situación de los electrodos. © 2009 Esevier España, S L. Todos los derechos reservados.

Introduction

Acute mastoiditis (AM) is an inflammation/infection of the mastoid air cells with mucosal oedema and destructive lesions of bone or osteitis. In acute otitis media (AOM) the mastoid mucosa is affected due to the anatomical and functional continuity existing between the middle ear and the mastoid, but only when there is osteitis is it considered as acute mastoiditis.^{1,2}

It is predominant in males (55%), at ages between 6 months and 3 years, being more common in winter and autumn months.^{3,4} Risk factors include anatomical variations of childhood (smaller size of the mastoid and scarce permeability), previous AOM episodes, secretory otitis media (SOM), immunosuppression and congenital craniofacial malformations.¹⁻³ The aetiology is usually monomicrobial, with the most common being *Staphylococcus* pneumoniae and Haemophilus influenzae, although sterile cultures were found in 35% of cases.⁴ Prior to the advent of antibiotics, mastoiditis was a common complication of AOM with an incidence of 5%10% of cases and a mortality rate of 2 per 100,000 children. It is currently a rare process with a mortality of less than 0.01 per 100,000 children through the use of antibiotics.⁵ According to Rodriguez et al.,⁴ the incidence has increased in recent years, probably due to increased resistance to antibiotics and the inappropriate use of treatments.

According to the AOM national consensus in Spain, mastoiditisshould be managed at hospital. The recommended treatment is to start with intravenous antibiotics with or without myringotomy. In refractory cases, computed tomography (CT) is recommended to rule out complications. If a subperiosteal abscess exists, a simple drainage is performed. Mastoidectomy is recommended if, after a simple drainage, the patient does not evolve favourably, presenting intracranial complications or facial paralysis.⁶

Cochlear implant (CI) is the treatment of choice for severe-profound bilateral sensorineural hearing losses, and it is a safe procedure with few complications.^{7,8} Mastoiditis is a potentially serious complication in patients with a CI because it can facilitate the spread of infection and favour bacterial colonisation in the implant itself; likewise, the surgical procedures for its treatment can damage the electrode guide. $^{2.9}\,$

This is a common complication in this group of patients, with an incidence ranging from 0.9% to 1.7% according to some authors.⁹⁻¹¹ The organisms that most frequently cause mastoiditis in implanted children (*Streptococcus* sp. and *Haemophilus* sp.) originate in the upper respiratory tract and are less aggressive for the implant. Nevertheless, there are others (from the group of *Staphylococcus* sp. and *Pseudomonas* sp.) that can affect the silicone of the implant; this is especially true for germs that produce "slime", an exopolymer that enables them to attach to the CI, as well as to evade the effect of antibiotics.⁹

Mastoiditistreatment in implanted patients is controversial. It is based on antibiotic therapy, isolated or associated to myringotomy or transtympanic drain (TTD). Surgical drainage may be necessary in the event of complications such as subperiosteal abscesses.^{10,11}

Given the potential problems caused by mastoiditis in implanted patients, and the particular relevance of the possible complications, in this study the cases of mastoiditis in our paediatric cochlear implant program were reviewed, studying demographic, clinical and treatment data, among others.

Material and methods

The design was that of a retrospective clinical study of cases of mastoiditis in implanted children included in our cochlear implant program at the ENT service, in the period from 1994 to 2009. The study was conducted with a total of 248 cochlear implanted children, aged between 8 months and 14 years at the time of implantation. All children were vaccinated against *S pneumoniae* and *H. influenzae* to prevent acute otitis media. The surgical technique used consisted of a minimal incision (used since 2004), with cochlear approach through mastoidectomy, posterior tympanostomy and cochleostomy. Perioperative and postoperative prophylaxis was carried out with intravenous ceftriaxone.

Results

From a total of 248 implanted children, 5 patients developed AM (incidence of 2.01%), 3 of them with subperiosteal abscess (incidence of 1.21%). The average age of implantation of these children was 2 years and 4 months and the complication appeared at 1-33 months after implantation (average of 11.6 months). Four patients had presented episodes of secretory otitis media prior to implantation. The average age of mastoiditis was 3 years and 4 months. All were carriers of Nucleus type cochlear implants, which is the implant most commonly used in children in our program (Tables 1-2).

Case 1: Girl with hereditary profound bilateral sensorineural hearing loss, implanted at 2 years and 2 months of age in the left ear, who developed bilateral SOM4 months after implantation. Nine months after implantation, she attended the emergency service for a retroauricular tumour, left otalgia and fever; she was diagnosed with AM complicated by a subperiosteal abscess, which was confirmed by CT. She was initially treated with i.v. antibiotic therapy, surgical drainage and TTD placement. She received i.v. methylprednisolone and ceftriaxone at high doses for 10 days, followed by oral ceftazidime for a further 21 days. In culture, Streptococcus pyogenes were isolated. She did not present any new episodes of AOM or SOM.

Table 1 Clinical cases and symptoms								
Cases	1	2	3	4	5			
Cl age, years. Average 2.3 Age of mastoiditis, years. Average 3.3 years	2.6 3.2	3.25 3.3	1.25 2	2.6 3.2	2.15 4.9			
Time in months of AM after implantation	9	1	8	7	33			
Previous history of SOM Adenoidectomy and TTD pre-Cl	-	+	+	+ +	+			
Fever	+	+	+	+	+			
Petroauricular oedema Retroauricular fluctuation	+ +	+ +	+ +	+	+			

AM indicates acute mastoiditis; CI: cochlear implant; SOM, serous otitis media; TTD, transtympanic drain.

Table 2	Ireatment	and results of	microbiological culture	

Case 2: Boy with a history of bilateral SOM, implanted at 3 years and 6 months of age in the right ear due to profound bilateral sensorineural hearing loss. One month after implantation, he attended consultation for a retroauricular tumour, fluctuant on palpation, right otalgia and fever. CT confirmed the existence of a subperiosteal abscess. He was initially treated with i.v. antibiotics, surgical drainage of the abscess with wicking and TTD placement. He received i.v. methylprednisolone and ceftriaxone at high doses for 10 days, followed by oral ceftazidime for a further 21 days. In culture, S pneumoniae were isolated. He did not present any new episodes of AOM or SOM.

Case 3: Girl implanted at 1 year and 6 months of age, in the right ear. due to hereditary profound bilateral sensorineural hearing loss, with a history of bilateral SOM. Eight months after implantation, she attended the emergency service due to a fluctuating tumour in the right retroauricular region, associated with fever and right otalgia. She was initially treated with i.v. antibiotics, surgical drainage and myringotomy. She received i.v. methylprednisolone and ceftriaxone at high doses for 10 days, followed by oral ceftazidime for a further 21 days. In culture, H. influenzae were isolated. One month after the first episode of AM, she presented a new subperiosteal abscess in the implanted ear. She was treated with puncture/aspiration and i.v. ceftriaxone for 10 days and oral ceft azidime for three months, progressing satisfactorily. In culture, H. influenzae were isolated. At 3 months, the patient presented SOM upon exploration.

Case 4: Boy with bilateral sensorineural hearing loss, implanted at 2 years and 2 months of age, in the right ear, with a history of SOM. Seven months after implantation, he attended the emergency service due to a right mastoid reaction, without fluctuation. AM was confirmed by CT (Figure). He was treated with i.v. methylprednisolone and ceftriaxone at high doses for 6 days and oral ceftazidime for a further 21 days. The patient recovered satisfactorily and did not present any new episodes of SOM or AOM.

Case 5: Boy with a history of bilateral SOM, implanted at 2 years and 6 months of age, in the left ear, due to bilateral sensorineural hearing loss. Four years and 2 months after implantation, he went to the emergency service due to retroauricular otalgia and oedema in the implanted ear, with no fluctuation. He was treated for AM with i.v. methylprednisolone and ceftriaxone at high doses for 5 days, followed by ceftazidime for a further 21 days. The patient recovered satisfactorily and did not present any new episodes of AOM or SOM.

Table 2 Treatment and results of microbiological culture								
Cases	1	2	3	4	5			
Subperiosteal abscess	+	+	+					
Ceftriaxone IV (7-10 d)	+	+	+	+	+			
Oral cefuroxime (15-30 d)	+	+	+	+	+			
Retroauricular drainage	+	+	+					
Myringotomy	+	+	+					
TTD	+	+						
Microorganism	Streptococcus pyogenes	Staphylococcus pneumoniae	Haemophilus influenzae	,				

TTD indicates transtympanic drain.



Figure Coronal section of cranial CT scan. Aright subperiosteal abscess can be observed.

Discussion

AM is an infectious complication that involves risks of serious intra- and extracranial complications.⁵ In the case of cochlear implanted children, it acquires special significance and can pose more medical problems due to the greater ease of labyrinthine and intracranial extension through the cochleostomy. This occurs because the infection can reach the subperiosteal mastoid space by the previously formed surgical pathways, and because the Cl can be colonised by germs and/ or damaged by the surgical manoeuvres performed for treatment.^{7,8} Consequently, our initial attitude is conservative and we try to avoid auditory deprivation, given that childhood is a crucial period for the development of language.¹⁰

In our series, mastoiditis was a common complication after implantation, with an incidence of 2.01% which is slightly higher than that published in other series (1.25% Kempf, 1.7% Migirov, 0.9% Pamos). The history of otitis media prior to implantation and the aetiology were similar to those of mastoiditis in the non-implanted paediatric population.⁴ However, the average age of presentation was higher, with an average of 3 years and 4 months.

All cases of mastoiditis appeared in the period between 2005 and 2009, with post-implantation ages between 1 and 33 months (average of 11.6 months). Since the average age of implantation has gradually decreased, we believe that the increased incidence is attributable to early implantation, because mastoiditis occurs more frequently in young children.⁶ Nevertheless, 3 of our cases had been implanted around the age of 2 years and 3 months.

In our study, AMin children with Cl developed subperiosteal abscesses more rapidly than in non-implanted children. We believe that this is due to the surgery performed for cochlear implantation, because the cochlear approach is performed via mastoidectomy, posterior tympanostomy and cochleostomy, which could facilitate the progression of the infection through the surgically-formed pathway.

ACT should be performed to rule out subperiosteal abscess or evaluate the complications. Conventional radiology in diverse projections is useful in the preoperative evaluation of the location of the receptor and the electrodes, to avoid damaging them during surgery.

In general, the handling of AM and subperiosteal abscess in children tends to be more conservative.⁶ We believe that surgical treatment in implanted children should be avoided whenever possible, utilising intense i.v. treatment and simple drainage by puncture, since the result may be just as satisfactory. In one of our cases, initially treated with surgical drainage, AM recurred after one month; on this second occasion, it was treated conservatively using intravenous antibiotics, associated with puncture and aspiration of the abscess and resulting in a satisfactory outcome.

The use of TTD associated with i.v. antibiotics has been recommended for AM treatment. However, we believe that it could also facilitate infection by germs more aggressive for the Cl, by communicating the external ear with the middle ear.¹⁰ In the case of surgical drainage, a prior radiological study should be performed to outline the location of the electrodes and prevent damaging them. We recommend simple drainage, avoiding wicks or drains that might facilitate external contamination.

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