

Acute mastoiditis in children: presentation and long term consequences

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Abstract

Acute mastoiditis, a destructive bacterial infection of the mastoid bone and air cell system, is relatively uncommon today but remains a potentially serious condition. There is a lack of information in the literature regarding the long term otological problems that children may face following an episode of this condition.

Objectives: Our aim was to examine the presentation, complications and hospital course in this patient population, and to ascertain whether these patients had long term otological problems.

Methods: We retrospectively reviewed the medical records of all patients presenting with acute mastoiditis between January 1990 and December 2005. Patients' parents were contacted by telephone and questioned about further otological problems.

Results: Twenty-nine patients were included in the study, and 27 of these patients' parents were contactable to complete the telephone questionnaire. Sixty-nine per cent of children had no previous history of acute otitis media prior to presentation. Forty-five per cent of patients had received oral antibiotics prior to presentation. Sixty-two per cent of patients developed complications, i.e. a subperiosteal abscess or failure to respond to medical therapy, resulting in the need for surgical intervention (in the form of incision and drainage of periosteal abscess, cortical mastoidectomy, or grommet insertion). Mean follow up of patients was eight years and one month; five (17 per cent) patients had been followed up for less than one year. Two (7 per cent) patients developed a further episode of mastoiditis within six weeks of initial presentation, both of whom required cortical mastoidectomy. Three (10 per cent) patients had further problems with recurrent acute otitis media, requiring tympanostomy tube insertion. One patient required a modified radical mastoidectomy for cholesteatoma (15 years later). Twenty-two patients (91 per cent) had been followed up for longer than one year; these patients had subjectively normal hearing and were asymptomatic at the time of study.

Conclusion: The majority of patients who had suffered an episode of acute mastoiditis had no adverse long term otological sequelae.

Key words: Mastoiditis; Acute Otitis Media; Complications

Introduction

Acute mastoiditis, a destructive bacterial infection of the mastoid bone and air cell system, is relatively uncommon today but remains a potentially serious condition.¹ Significant and even life-threatening complications beyond the tympanomastoid system may occur, including subperiosteal abscess, Bezold's abscess, facial paralysis, suppurative labyrinthitis, meningitis, epidural and subdural abscess, brain abscess, lateral sinus thrombophlebitis, and otitic hydrocephalus.² There is a lack of information in the literature regarding the long term otological sequelae that children may face following an episode of acute mastoiditis. Our aim was to examine the presentation, complications and hospital course in this patient

population, and to ascertain whether these patients had long term otological problems.

Materials and methods

A retrospective medical record review was carried out of paediatric patients (i.e. 15 years or younger) who had been treated for acute mastoiditis between January 1990 and December 2005 at the department of otolaryngology, Children's University Hospital Temple Street, Dublin, Ireland. Patients were identified from our hospital database. The diagnostic criteria for acute mastoiditis were a clinical picture of acute mastoiditis with at least two of the following signs or symptoms: postauricular tenderness,

erythema, swelling, fluctuation of the mastoid area or protrusion of the auricle. All patients in whom the diagnosis of acute mastoiditis was suspected had been examined by both a paediatrician and an otolaryngologist, and had been admitted for intravenous antibiotic therapy.

The medical records of all the patients were reviewed retrospectively, with attention to prior otological infection, presenting signs and symptoms, antibiotic history, radiological investigations, operative management, and clinical outcome. It was initially hoped to recall all patients to the out-patient department in order to obtain an accurate history, audiogram and physical examination. However, almost all parents declined the invitation as their children were well and asymptomatic. Therefore, a telephoned questionnaire was conducted to determine if the patients had: (a) suffered from recurrent otitis media; (b) needed further grommet insertion; (c) suffered any hearing loss; (d) suffered chronic problems or infections; (e) required mastoid surgery; and (f) required an otolaryngology appointment. Post-mastoiditis, all patients had been followed up in our out-patient department for at least one year, and had only been discharged from follow up after obtaining a normal audiogram.

Statistical analysis was carried out using the Statistical Package for the Social Sciences version 11 software for Microsoft Windows (SPSS Inc, Chicago, Illinois, USA). Non-parametric data were analysed using the chi-square test, using a significance level of $p < 0.05$.

Results

Over the 15-year review period, 29 children fulfilled the established inclusion criteria. Thirty-eight per cent were boys (11/29) and 72 per cent (18/29) were girls. The children were aged four months to 11 years (mean 37 months); see Figure 1. Clinical records were available for all 29 children; however, only 27 of the children's parents were contactable and therefore able to participate in the telephone questionnaire. All patients had been hospitalised and treated at the Children's University Hospital

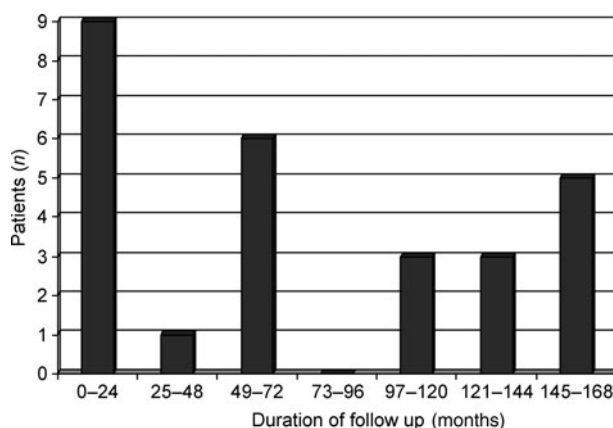


FIG. 1
Duration of patient follow up.

Temple Street, Dublin, Ireland. One patient with an otogenic extradural abscess had been transferred to a paediatric neurosurgical centre.

Sixty-nine per cent (20/29) of the children had no previous history of acute otitis media, and 21 per cent (9/29) had recurrent acute otitis media (i.e. more than three episodes in six months). Four children (14 per cent) had a history of otitis media with effusion which had been treated with tympanostomy tubes and/or adenoidectomy. The duration of ear symptoms before admission ranged from one to 17 days (mean 6.02 days). The duration of ear symptoms (i.e. six days or less compared with more than six days) was not statistically significantly associated with the need for mastoidectomy ($p = 0.07$). Thirteen patients (45 per cent) had received oral antibiotics prior to admission (see Table I), for a time period ranging from one to 14 days (mean 5.3 days). Eight of these patients (62 per cent) developed complications requiring surgical intervention. Sixteen patients had not received oral antibiotics prior to presentation, and nine of these patients (56 per cent) required surgical intervention. The difference between children receiving and not receiving antibiotics pre-admission was not statistically significant ($p = 0.80$).

At clinical presentation, 83 per cent (24/29) of the children had otalgia, 83 per cent (24/29) had evidence of acute otitis media, 79 per cent (23/29) had protrusion of the auricle, 93 per cent (27/29) had retroauricular swelling, 45 per cent (13/29) had an axillary temperature $>38^{\circ}\text{C}$ and 79 per cent (23/29) had leucocytosis (see Table II). Ninety-seven per cent

TABLE I

ORAL ANTIBIOTICS RECEIVED PRIOR TO ADMISSION*		
Antibiotic	Patients (n)	Surgery needed (n)
Co-amoxiclav	4	2
Amoxicillin	5	5
Flucloxacillin	2	0
Cefuroxime	2	1

*n = 13 patients.

TABLE II

CLINICAL AND LABORATORY FINDINGS*		
Finding	Patients	
	n	%
<i>Symptoms</i> [†]		
Otalgia	24	83
Otorrhoea	1	3
URTI	9	31
<i>Signs</i>		
Auricle protrusion	23	79
Post-auricular swelling	27	93
Evidence of AOM	24	83
Fever $>38.3^{\circ}\text{C}$	13	45
<i>Laboratory findings</i>		
Leucocytosis [‡]	23	79

*n = 29 patients; [†]n = 19. [‡]White cell count $>12\ 000/\text{mm}^3$. URTI = upper respiratory tract infection; AOM = acute otitis media

of patients (28/29) did not have spontaneous rupture of the tympanic membrane.

Cultures were obtained from tympanocentesis or during surgery in 16 cases; eight were negative. *Streptococcus pneumoniae* was the most common organism isolated (five isolates), followed by *Staphylococcus aureus* (two) and one mixed culture (see Table III).

Intravenous antibiotics were used in all patients, as monotherapy in 38 per cent of cases, double-agent therapy in 59 per cent, and three or more antibiotics in 3 per cent. Co-amoxiclav was used in 72 per cent of cases, metronidazole in 59 per cent and a third generation cephalosporin in 24 per cent (see Table IV). There was no statistically significant association between the antibiotics used and the subsequent need for surgery.

It was the policy of the hospital that if a child was clinically very well, with no signs of subperiosteal abscess or intracranial complications and responding to medical therapy within 12 hours, a computed tomography (CT) scan of the temporal bones was deferred.

Radiographic evaluation, in the form of CT, was performed in 12 (41 per cent) patients. Eleven of these 12 went on to have drainage of a subperiosteal abscess or a cortical mastoidectomy.

Eighteen patients (62 per cent) developed complications, i.e. a subperiosteal abscess or failed to resolve with conservative management. Ten patients developed retroauricular subperiosteal abscesses which were incised and drained, six underwent cortical mastoidectomy, two required myringotomy plus grommet insertion, and one patient was transferred

to a neurosurgical centre for drainage of an epidural abscess and cortical mastoidectomy (see Table V). Indications for surgery comprised: the presence of a subperiosteal abscess; no response to intravenous antibiotics; or the presence or development of intracranial complications. Surgical treatment (other than abscess drainage) was necessary in eight patients. Six cortical mastoidectomies were carried out, and two patients underwent only ventilation tube insertion.

Seventy-seven per cent (13/17) of patients who had undergone either incision and drainage of a subperiosteal abscess or cortical mastoidectomy had received their surgery within 48 hours of admission; the remaining patients had undergone surgery on either day three or day four. In these latter cases, the reason for delay in operative intervention was the mild clinical picture of the disease.

Patients' length of hospital stay averaged 7.7 days in the operative group, compared with 3.9 days in those who settled with conservative management.

All patients had been followed up at our institution for at least one year post-mastoiditis. Five of our patients had been followed up for less than one year, due to the fact that they had presented to the hospital in the previous year with acute mastoiditis. At the time of study, 22 out of the 27 patients were more than one year post-mastoiditis. Patients' follow up ranged from 12 to 168 months (mean 97 months) see Figure 1.

Two patients suffered a further episode of mastoiditis; both had settled on intravenous antibiotics at their first presentation but re-presented within six weeks. The first patient was initially commenced solely on intravenous co-amoxiclav, with *S pneumoniae* grown on culture. The second patient was treated with a combination of co-amoxiclav and cefotaxime, and the swab culture grew no microorganisms. Both patients then proceeded to cortical mastoidectomy. At the time of study, these patients were four and 12 years post-surgery and had experienced no further problems.

Three patients (14 per cent) had suffered further recurrent acute otitis media and had re-attended at the out-patients clinic. All three required tympanostomy tube placement.

One patient who had undergone a cortical mastoidectomy 14 years ago required a modified radical mastoidectomy for cholesteatoma.

TABLE III

BACTERIOLOGIC FINDINGS AFTER TYMPANOCENTESIS OR SURGICAL DRAINAGE*

Finding	Patients	
	<i>n</i>	%
No growth	8	50
<i>Streptococcus pneumoniae</i>	5	31
<i>Staphylococcus aureus</i>	2	13
Mixed growth	1	6

**n* = 16 patients.

TABLE IV

INTRAVENOUS THERAPY AND DEVELOPMENT OF COMPLICATIONS

Antibiotic	Pts (<i>n</i>)	Pts needing surgery (<i>n</i>)
<i>Monotherapy</i>		
Co-amoxiclav	9	5
Cephadrine	1	1
Ampicillin	1	1
<i>Dual therapy</i>		
Co-amoxiclav + metronidazole	12	5
Cefuroxime + metronidazole	5	4
<i>Triple therapy</i>		
Cefotaxime + gentamicin + ampicillin	1	1

Pts = patients

TABLE V

TREATMENT OUTCOMES*

Treatment	Patients	
	<i>n</i>	%
<i>Medical</i>		
IV antibiotics alone	11	38
<i>Surgical</i>		
I & D subperiosteal abscess + grommet	9	31
I & D subperiosteal abscess only	1	3
Myringotomy + grommet only	2	7
Cortical mastoidectomy	6	2

**n* = 29 patients. IV = intravenous; I & D = incision and drainage

Twenty out of 22 patients (91 per cent) with documented normal audiograms pre-discharge and a mean follow up of 97 months were asymptomatic with subjectively normal hearing.

Two parents of patients who had suffered mastoiditis three and four years previously, and who had both settled on conservative management, agreed to bring their child to our out-patients clinic for audiological assessment. Both children had subjectively normal hearing, and this was confirmed by a normal audiogram.

Five out of the 27 (19 per cent) patients who were less than one year post-mastoiditis (range four to 11 months; mean eight months) were well and asymptomatic.

Discussion

Acute mastoiditis is a serious complication of otitis media. To some extent, mastoiditis occurs in every case of acute otitis media. Middle-ear inflammation and effusion may block the aditus ad antrum, thereby creating pressure within the mastoid system. This pressure is relieved by egress through the cribiform area or the tympanomastoid fissure. This initially results in inflammation and tenderness in the postauricular area. The sulcus is obliterated and the auricle is subsequently pushed down and out. The periosteum in this area is easily separated, and when mucopus extends to this region, a subperiosteal abscess develops.³⁻⁵

The diagnosis of complications of mastoiditis is based on the clinical picture, with support from radiological findings. The clinical findings of acute mastoiditis are well known, but their frequency and clinical significance vary widely in the literature.⁶ Eighty-three per cent of our patients had otalgia or evidence of acute otitis media, 79 per cent had protrusion of the auricle, while 93 per cent had postauricular swelling. Retroauricular fluctuance, indicating a subperiosteal abscess, was the only clinical sign statistically significantly associated with the need for surgical intervention ($p = 0.01$).

There have been recent reports that the incidence of acute mastoiditis is increasing.⁷⁻⁹ In explanation of this, Niv *et al.* showed that the majority of their patients (65 per cent) had not received antibiotics prior to diagnosis, and that a significant percentage of those who had taken antibiotics had done so for less than 48 hours.⁷ In our study, 45 per cent of patients had taken oral antibiotics prior to presentation, and the majority of these patients (62 per cent) required surgical intervention to relieve their symptoms. However, only 56 per cent of patients not taking oral antibiotics prior to presentation required surgical intervention. It is also interesting to note that those patients who had received antibiotics prior to diagnosis and who went on to require surgical intervention had been taking antibiotics for a mean of 5.3 days. In contrast, those patients who had received oral antibiotics prior to presentation and who settled with intravenous antibiotic therapy (that is, who did not require surgery) took oral antibiotics for a mean of three days.

This would suggest that if a child presents with mastoiditis having taken a prolonged course of an oral antibiotic, that child is more likely to require surgical intervention.

The bacteriology of acute otitis media and of its intratemporal and intracranial complications differ markedly. *Streptococcus pneumoniae* is the most frequently cultured bacteria in cases of both acute otitis media and its complications. In contrast, *Pseudomonas aeruginosa*, *Streptococcus pyogenes* and *S aureus* are often found in high proportions in cultures of mastoid effusions from acute mastoiditis, but are rare in acute otitis media.⁹ In our series, a relatively high number of cultures failed to grow microorganisms; the majority of these patients had received oral antibiotics prior to presentation. In addition, no swab culture grew *P aeruginosa*, reflecting the fact that most of our patients had no prior history of recurrent otitis media. Antibiotic resistance was not a problem in our study. There was no significant correlation in our study between the culture of any specific organism and the development of a surgical complication.

- **Acute mastoiditis, a destructive bacterial infection of the mastoid bone and air cell system, is relatively uncommon today but remains a potentially serious condition**
- **This retrospective study investigated possible long term sequelae in patients presenting with acute mastoiditis**
- **The majority of patients who had suffered an episode of acute mastoiditis had no adverse long term otological sequelae**

When attending out-patient appointments, parents frequently ask whether their child will have on-going ear problems, i.e. will their child be more prone to ear infections, and will the mastoiditis affect their hearing? There are few published data to answer these questions. The objective of our study was to contact parents of children we had treated for acute mastoiditis and to determine what subsequent ear problems their child had suffered, if any. We had initially hoped to recall all patients in order to perform re-examinations and audiometry. However, as patients were not discharged from follow up until well and with normal audiometry, and because most patients were still very well, parents felt there was little to gain from re-attending. Five of our 27 patients who had been admitted with mastoiditis in the past year had suffered no further problems (mean follow up eight months). Only three patients (14 per cent) had suffered further problems with recurrent episodes of acute otitis media, warranting tympanostomy tube placement; one of these patients initially settled on intravenous antibiotics, one needed incision and drainage of a subperiosteal abscess, and one underwent cortical mastoidectomy during the acute phase

of their illness. One patient who had undergone cortical mastoidectomy 15 years previously developed a cholesteatoma requiring modified radical mastoidectomy.

Conclusion

In our study, with a mean follow up of eight years and one month, 91 per cent of patients who had suffered an episode of acute mastoiditis experienced no further otological problems and were currently well, with subjectively normal hearing.

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Mr F Glynn takes responsibility for the integrity of the content of the paper.

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