

Acute mastoiditis in children: is surgical treatment necessary?

R. COHEN-KEREM, M.D.*, N. URI, M.D.*, H. RENNERT, M.P.H.†, N. PELED, M.D.‡,
E. GREENBERG, M.D.*, M. EFRAT, M.D.**

Abstract

Acute mastoiditis in children remains an otological problem. Although the widespread use of antibiotics has reduced the need for surgical intervention, surgery is frequently used in the treatment of acute mastoiditis and its complications. The charts of 44 patients hospitalized with signs of acute mastoiditis were reviewed. In 43.2 per cent of all patients, acute mastoiditis was the presenting sign of acute middle-ear infection. Post-auricular erythema and protrusion of the auricle were the most frequent signs at presentation. All four signs (post-auricular erythema, oedema, tenderness, and protrusion of the auricle) were present in 40.9 per cent of patients. No bacterial pathogen was isolated in 45.5 per cent of ear cultures. Complicated acute mastoiditis was diagnosed in 13.7 per cent of the patients. Eighty-seven per cent of patients responded well to intravenous antibiotics and myringotomy, and in 11.4 per cent mastoidectomy or abscess drainage were performed. We conclude that nearly all patients with uncomplicated mastoiditis recover following intravenous antibiotics and myringotomy. Mastoidectomy should be performed in selected cases, such as cases of complicated acute mastoiditis.

Key words: Child; Mastoiditis; Surgery, operative; Antibiotics

Introduction

Acute mastoiditis in children remains a potentially hazardous disease and its complications may cause significant morbidity and mortality. In the pre-antibiotic era, surgery was the mainstay of acute mastoiditis treatment. With the introduction of antibiotics, acute mastoiditis became an infrequent complication of acute otitis media (AOM) (Palva and Pulkkinen, 1959; Palva *et al.*, 1985). Despite this, several studies have shown that acute mastoiditis persists in being a therapeutic problem (Faye-Luanda, 1989; Hoppe *et al.*, 1994; Luntz *et al.*, 1994). Although regular antibiotic treatment of AOM has not eradicated acute mastoiditis, it has reduced the need for surgical intervention. The indications for performing mastoidectomy for the treatment of acute mastoiditis remain unclear (Dew and Shelton, 1998). Some studies suggested that early surgical intervention is frequently required (Hawkins *et al.*, 1983; Luntz *et al.*, 1994; Gliklich *et al.*, 1996), while others have found conservative management sufficient in uncomplicated cases (Myer, 1991; Harley *et al.*, 1997). The objectives of this study were to investigate the background, treatment modalities, and outcome of acute mastoi-

ditis cases in the paediatric population hospitalized in The Carmel Medical Center.

Materials and methods

The study was conducted retrospectively. We reviewed the records of children hospitalized due to acute mastoiditis in either the Department of Pediatrics or the Department of Otolaryngology – Head and Neck Surgery, Carmel Medical Center, Haifa, Israel during the years 1992–1997.

Inclusion criteria were patients with typical signs such as fever, retro-auricular tenderness, redness and protrusion of the auricle. Exclusion criteria were patients with similar signs in which external otitis was suspected or aerated mastoid air cells were demonstrated by radiographical evaluation. Demographic data including age, sex and ethnic origin were collected. The patient's chart was reviewed for a history of acute otitis media, recurrent acute otitis media (rAOM), duration of illness until admission, previous antibacterial treatment, duration of previous therapy, use of ventilation tubes, and the presence of significant past or co-existing illnesses. Signs, symptoms at presentation, laboratory findings

From the Department of Otolaryngology – Head and Neck Surgery*, the Department of Community Medicine and Epidemiology†, the Department of Radiology‡ and the Department of Pediatrics**, Carmel Medical Center, Haifa, Israel.

Accepted for publication: 13 September 1999.

such as blood count, bacterial cultures, and imaging studies were recorded. Complications and treatment modalities were recorded as well.

Statistical analysis was done using statistical software (SPSS, SPSS Inc., Chicago, USA); Chi-squared tests were used to compare categorical variables, and *t*-test for continuous variables. The level of significance for all tests was $p \leq 0.05$.

Results

Forty-four children (24 boys and 20 girls) were hospitalized with the diagnosis of acute mastoiditis during the years 1992–1997. The age distribution was six months to 14 years (median, 25.5 months; mean, 49.2 months). The distribution of patients each year is shown in Figure 1.

History and signs

Other than one patient with hyperimmunoglobulin E (Job's) syndrome, an autosomal recessive immune deficiency disorder, seven patients had underlying medical problems unrelated to their ear disease, while 36 were otherwise healthy. All patients had AOM and in 40.9 per cent it was their first episode of acute middle-ear infection. Four patients (9.1 per cent) had ventilating tubes: three because of rAOM and one due to otitis media with effusion. In 43.2 per cent of all the patients, acute mastoiditis was the presenting sign of acute middle-ear infection. The mean time from the onset of illness until developing signs of acute mastoiditis was 4.3 days. Half of the patients presented with signs of acute mastoiditis in less than three days (range: 1–14 days), while the rest were diagnosed as having AOM for up to 14 days before the evolution of acute mastoiditis. In 56.8 per cent of the cases, no or less than 24 hours of antibiotic treatment had been administered prior to hospitalization. The mean temperature on admission was 38°C, with the highest temperatures measured in younger patients. There was no correlation between temperature and duration of hospitalization.

Signs of acute mastoiditis were post-auricular erythema (93.2 per cent), auricular protrusion (88.6 per cent), post-auricular tenderness (77.3 per cent)

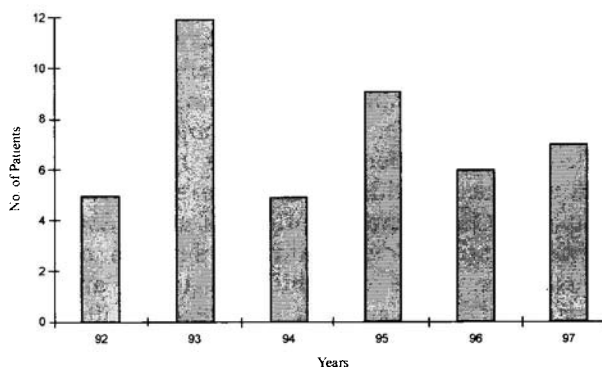


FIG. 1

Number of patients per year.

TABLE I
CULTURE RESULTS IN A GROUP OF 44 CHILDREN WITH ACUTE MASTOIDITIS

Organism	No. of isolates	Frequency (%)
<i>Pseudomonas aeruginosa</i>	11	25.0
<i>Streptococcus pneumoniae</i>	8	18.2
<i>Staphylococcus aureus</i>	1	2.3
Other	4	9.1
No growth	20	45.5
Total	44	100

and post-auricular oedema (63.6 per cent). All four signs were present on admission in 40.9 per cent of patients. Otorrhoea was present in 34.1 per cent.

Laboratory

The mean \pm SD white blood cell count on admission was $16.6 \pm 6.2 \times 10^9/L$. The mean ESR measurement was 70 mm. In all patients, cultures were obtained by either myringotomy (65.1 per cent) or sampling of the external ear canal discharge (34.9 per cent). Culture results are shown in Table I. No growth was reported in 45.5 per cent of cultures. Fourteen of the 20 patients (70 per cent) with sterile cultures had received antibiotics before cultures were obtained. *Pseudomonas aeruginosa* was cultured from 11 patients, eight of these (72.7 per cent) had taken oral antibiotics before cultures were obtained, and in seven patients (63.6 per cent) cultures were obtained from the external canal discharge. *Haemophilus influenzae* and *Moraxella catarrhalis* were not isolated. Radiographical evaluation was performed in 52.3 per cent of the cases and 29.5 per cent of the patients had a computed tomography (CT) scan.

Complications

Six patients presented with complicated acute mastoiditis (Table II) while 38 (86.4 per cent) had no complications.

Treatment

All patients were admitted and treated with intravenous antibiotics. Cefuroxime was given most commonly; patients whose cultures grew *Pseudomonas* sp were treated by mezlocillin or ceftazidime. Microscopic-otoscopy and toilet of the external ear canal were performed daily in 88.6 per cent of all

TABLE II
COMPLICATIONS OF ACUTE MASTOIDITIS IN A GROUP OF 44 CHILDREN

Complication	No. of patients	Frequency (%)
Complicated	6	13.6
Subperiosteal abscess	4	9.1
Facial nerve paralysis	1	2.3
Epidural abscess	1	2.3
Uncomplicated	38	86.4
Total	44	100

patients. The mean time \pm SD from admission until the temperature subsided to 37.5°C was 2.1 ± 1.4 days.

Surgery

Four patients (9.1 per cent) underwent mastoidectomy and one had a subperiosteal abscess drained. Myringotomy without ventilation tubes was performed on 75 per cent of the cases, usually, under mild sedation and local anaesthesia. Of the patients who had either mastoidectomy or abscess drainage, three had subperiosteal abscess, one had acute mastoiditis with cholesteatoma, and one had coalescent mastoiditis and deteriorated clinically within 96 hours of admission. No surgical interventions, except myringotomy, were performed on the child with the epidural abscess, the child with the facial nerve paralysis, or the patients with uncomplicated cases of acute mastoiditis.

Outcome

Complete recovery was observed in all patients. The mean \pm SD duration of hospitalization was 9.97 ± 4.6 days. Patients who had undergone major surgery had longer hospitalizations (mean \pm SD: 13.6 ± 5.3 days, $p = 0.013$).

Discussion

A total of 44 patients presented with acute mastoiditis during a six-year period. As shown in Figure 1, there was no incremental trend in the number of acute mastoiditis patients per year.

The persistence of acute mastoiditis might be explained by the masking effect of the antibiotic therapy. Suppression of the signs and symptoms of mastoiditis provide time for the process to involve the mucoperiosteum and to erode the mastoid's bony septae (Holt and Gates, 1983). Fifty-seven per cent of our patients had not been treated at all or had received antibiotics for less than 24 hours; therefore, other factors, such as drug resistance and bacterial virulence must be considered. In the current series, two groups of patients were delineated: those with signs of AOM before evolution to acute mastoiditis and patients with acute mastoiditis as the first expression of middle-ear disease (43.2 per cent). Previous reports describe acute mastoiditis as the initial presentation of middle-ear disease in 45–54 per cent of cases (Gliklich *et al.*, 1996; Harley *et al.*, 1997). Other authors also showed short periods of AOM before diagnosing acute mastoiditis (Rosen *et al.*, 1986; Luntz *et al.*, 1994; Harley *et al.*, 1997). These figures suggest that acute mastoiditis is not only a complication of long-term, non-resolving AOM, but an acute infection which can develop within 48 hours, shortly after infection begins in the tympanic cavity.

The most frequent signs of acute mastoiditis in this study were post-auricular erythema (93.2 per cent) and protrusion of the auricle (88.6 per cent). Post-auricular tenderness and oedema were seen quite

frequently too, otorrhoea was infrequent. However, all four signs were seen in only 40.9 per cent of the patients.

Sagging of the canal's posterior wall is reported in 80 per cent of patients (Rosen *et al.*, 1986; Gliklich *et al.*, 1996), unfortunately, this finding was not documented in the charts we reviewed. Pain and fever were found to be important symptoms if they persisted despite appropriate conservative management (Gliklich *et al.*, 1996; Harley *et al.*, 1997), while in 95 per cent the fever dropped to below 37.5°C within 3.5 days.

Bacteriological results from this and other studies of acute mastoiditis are discrepant with culture results from the middle ear in AOM (Rosen *et al.*, 1986; Luntz *et al.*, 1994; Bitar *et al.*, 1996; Gliklich *et al.*, 1996). Unexpectedly, in the current study *Pseudomonas aeruginosa* was found to be the predominant bacteria in the positive cultures (25 per cent). These findings do not coincide with those cited in the literature. Most studies of acute mastoiditis found *Streptococcus pneumoniae* to be the predominant Gram positive bacterium and *Pseudomonas* sp. was predominant in mastoiditis resulting from chronic otitis media (Bitar *et al.*, 1996). Sixty-four per cent of the cultures positive for *Pseudomonas*, however, were taken from external ear canal discharge, while in four cases (36.4 per cent) we found *Pseudomonas* sp. in cultures taken after myringotomy. Other authors also found an unexpectedly high rate of Gram negative bacteria in acute mastoiditis (Gliklich *et al.*, 1996). *Haemophilus influenzae* seems to play a minor role in the pathogenesis of acute mastoiditis (Luntz *et al.*, 1994). Anaerobic bacteria may also play a significant role in the pathogenesis of mastoiditis (80.0 per cent of obtained cultures) (Maharaj *et al.*, 1987), but in the current study, no anaerobes grew. The high rate of 'no growth' in cultures (45.5 per cent) might be explained in part by the large number of patients taking oral antibiotics before cultures were obtained, or by undetected anaerobic bacteria in the cultures.

Imaging, especially CT scan, in this potentially hazardous disease plays an important role (Bitar *et al.*, 1996). In the current series, management was based primarily on clinical parameters and only patients who deteriorated or who had suspected complications were evaluated by CT (29.5 per cent). CT scan is imperative if there is no improvement in clinical signs or temperature, or if a probability of intracranial complication exists.

Almost all children responded to the combination of intravenous antibiotic treatment, myringotomy without ventilation tubes, and daily toilet of ear drainage. In two cases of uncomplicated acute mastoiditis, mastoidectomy was performed: one for refractory mastoiditis, which did not respond to treatment within 96 hours, and one with cholesteatoma. The complication rate was quite low (13.6 per cent) compared with the 27 per cent reported by Gliklich (Gliklich *et al.*, 1996). The only intracranial complication involved a seven-month-old boy who had signs of acute mastoiditis after three weeks of



(a)



(c)



(b)



(d)

FIG. 2

(a) CT of the head at the level of the petrous bone shows complete opacification of the antrum and middle ear and sub-cutaneous soft tissue swelling. (b) CT of the head at the level of the clinoids shows a small epidural collection (arrowhead). (c) CT of the head at the same level six days later, shows an epidural collection (arrowhead), erosion of the temporal bone and soft tissue swelling. (d) CT of the same level 11 days, brain and bone windows shows complete resolution of the epidural collection and residual bone destruction (arrow).

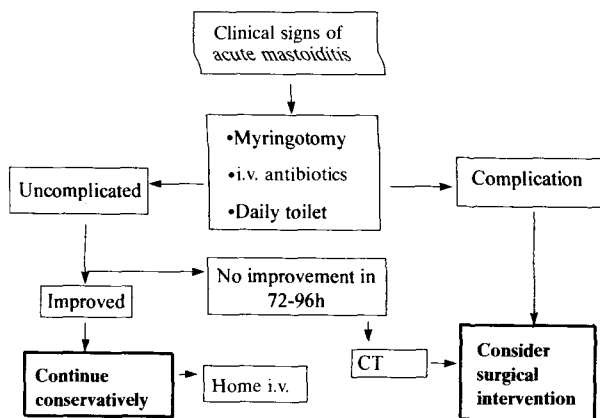


FIG. 3

Flow chart for the management of acute mastoiditis

unresolved AOM. CT revealed a very small epidural abscess. Because of the abscess size, the lack of focal meningeal symptoms or signs, and the child's good general condition, he was conservatively managed, and in a follow-up CT scan the collection disappeared (Figure 2).

The average hospital stay was 10 days, a period which can be shortened if the option of home-i.v. and community-based otolaryngologist follow-up are available.

Conclusion

We believe that most children with acute mastoiditis will respond to intravenous antibiotic treatment and myringotomy without ventilation tubes, and that the surgical option be considered only for cases with non-response or complications. When complications such as subperiosteal abscess or intracranial extension occur, surgical intervention is usually but not universally required. In uncomplicated cases, if no improvement in fever or pain is observed within 72–96 hours, surgical intervention, i.e. mastoidectomy should be considered.

We propose an algorithm for the management of acute mastoiditis, with or without complications (Figure 3).

References

- Bitar, C. N., Kluka, E. A., Steele, R. W. (1996) Mastoiditis in children. *Clinical Pediatrics* **35**: 391–395.
- Dew, L. A., Shelton, C. (1998) Complications of temporal bone infections. In *Otolaryngology Head and Neck Surgery* 3rd Edition. (Cummings, C. W., Fredrickson, J. M., Harker, L. A., Krause, C. J., Richardson, M. A., Schuller, D. E., eds.) Mosby-Year Book, Inc., St Louis, Missouri, pp 3055–3056.
- Faye-Luanda, H. (1989) Acute and latent mastoiditis. *Journal of Laryngology and Otolaryngology* **103**: 1158–1160.
- Gliklich, R. E., Eavey, R. D., Lannuzzi, R. A., Camacho, R. A. E. (1996) A contemporary analysis of acute mastoiditis. *Archives of Otolaryngology – Head and Neck Surgery* **122**: 135–139.
- Harley, E. H., Sdralis, T., Berkowitz, R. G. (1997) Acute mastoiditis in children: A retrospective study. *Otolaryngology – Head and Neck Surgery* **116**: 26–30.
- Hawkins, D. B., Dru, D., House, J. W., Clark, R. W. (1983) Acute mastoiditis in children: A review of 54 cases. *Laryngoscope* **93**: 568–572.
- Holt, G. R., Gates, G. A. (1983) Masked mastoiditis. *Laryngoscope* **93**: 1034–1037.
- Hoppe, J. E., Koster, S., Bootz, F., Niethammer, D. (1994) Acute mastoiditis – relevant once again. *Infection* **22**: 178–182.
- Luntz, M., Keren, G., Nusem, S., Kronenberg, J. (1994) Acute mastoiditis – revisited. *Ear, Nose and Throat Journal* **73**: 648–654.
- Maharaj, D., Jadwat, A., Fernandes, C. M. C., Williams, B. (1987) Bacteriology in acute mastoiditis. *Archives of Otolaryngology – Head and Neck Surgery* **113**: 514–515.
- Myer, C. M. (1991) The diagnosis and management of mastoiditis in children. *Pediatric Annals* **20**: 622–626.
- Palva, T., Pulkkinen, K. (1959) Mastoiditis. *Journal of Laryngology and Otolaryngology* **73**: 573–588.
- Palva, T., Virtanen, H., Makinen, J. (1985) Acute and latent mastoiditis in children. *Journal of Laryngology and Otolaryngology* **99**: 127–136.
- Rosen, A., Ophir, D., Marshak, G. (1986) Acute mastoiditis: A review of 69 cases. *Annals of Otolaryngology, Rhinology and Laryngology* **95**: 222–224.

Address for correspondence:

R. Cohen-Kerem, M.D.,
Department of Otolaryngology – Head and Neck Surgery,
Carmel Medical Center,
7 Michal Street,
34362 Haifa,
Israel.

Fax: +972-4-8250683

E-mail: nrkerem@netvision.net.il