



Original Article

Acute Mastoiditis in Children as Persisting Problem

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OBJECTIVE: Acute mastoiditis is serious otological condition which may cause difficult, sometimes fatal complications. The aim of the study is to present our experiences in diagnosis and treatment of acute mastoiditis in children.

MATERIALS and METHODS: Medical records of 52 children with diagnosis of acute mastoiditis were reviewed retrospectively. Data on clinical presentation, laboratory tests, microbiological and radiological features, prehospital treatment and delay in making the diagnosis, hospital treatment and outcome were analyzed. A relationship between white blood cell count or level of C-reactive protein and therapeutic protocols was investigated.

RESULTS: All children were admitted as emergency patients and were treated with intravenous antibiotics. Almost 15% of patients were not examined by a doctor prior to hospitalization. The conservative treatment was successfully conducted in 15% of patients. One-third of the patients were recovered after myringotomy. Almost a half of the patients underwent surgical procedure such as antrotomy, mastoidectomy or tympanomastoidectomy. Computed tomography (CT) scan was done in patients with signs of developing complications and those with no improvement after the beginning of treatment.

CONCLUSION: Acute mastoiditis is still persisting problem in our health care system. An early diagnosis and adequate treatment of acute mastoiditis is essential in order to prevent serious complications.

KEY WORDS: mastoiditis, otitis media, children, complications

INTRODUCTION

Acute mastoiditis is defined as an inflammation of air cells within the mastoid process^[1,2]. It is a serious complication of acute otitis media (AOM) that most commonly occurs in younger children^[3]. Occasionally, it is the first sign of an ear disease. Early diagnosis and adequate treatment of this condition is essential due to the possibility of infection spreading which in some cases causes fatal complications^[4].

Acute mastoiditis may be staged as follows: 1) acute mastoiditis, 2) acute mastoiditis with periosteitis and 3) acute mastoid osteitis or coalescent mastoiditis. Acute mastoiditis may appear as a consequence of a pathological process during (AOM) and as such should not be always interpreted as a complication. Infection within the mastoid may spread to the periosteum through the emissary veins, causing periosteitis. Acute mastoiditis with periosteitis is suspected based on clinical evidence of AOM and sagging of the postero-superior wall of the auditory canal. Other signs of the disease are the protrusion of the pinna, retroauricular edema, erythema and tenderness. Acute coalescent mastoiditis is characterized by the presence of osteitis that leads to the destruction of bony trabeculae separating the mastoid cells. A subperiosteal abscess may occur in acute coalescent mastoiditis, which is not the case with the acute mastoiditis with periosteitis.

Incidence of acute mastoiditis varies in different parts of the world and among different authors. Several epidemiological studies in North America and the United Kingdom showed that incidences of acute mastoiditis are below 2 per 100,000 children per year^[5]. This rate is little higher in the Scandinavian studies^[6]. In 2007, Kvaerner et al. reported incidence of 4.3-7.1 per 100,000 children aged 2-16 years^[7]. In the countries of South East Europe, there are several studies on mastoiditis based on small number of patients, but there are no official epidemiological results^[8].

The etiopathogenesis of an inflammatory process in mastoid is well understood. However, some aspects of mastoiditis are still controversial. There are many variations in the management of acute mastoiditis in different medical centre. The rates of mastoidectomy in treatment of acute mastoiditis vary greatly in the range between 9 and 88%, as is reported in literature^[9]. Numerous patients with uncomplicated mastoiditis respond well to conservative treatment. Unfortunately, we are still not able to predict which patient will have a poor response or which will develop severe complications. The aim of this study was to present our experiences in diagnosis and treatment of acute mastoiditis in children.

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MATERIALS and METHODS

This retrospective study included 52 pediatric patients with acute mastoiditis hospitalized at our Clinic from 2004 to 2011. Parameters found in the medical records of these children which have been analyzed include the following: demographic information, patient's history and duration of ear discharge, previous treatment and delay in making diagnosis, as well as the beginning of treatment, data concerning clinical signs and symptoms, laboratory tests, radiological and microbiological findings, treatment after admittance to hospital and the outcome.

The diagnosis of acute mastoiditis was based on the medical history, laboratory parameters, clinical and otomicroscopic examinations. The criteria for diagnosis of acute mastoiditis were the signs of undergoing acute otitis media in addition to two or more signs of retroauricular inflammation. The absence of sagging of posterior auditory canal wall was not considered as an exclusion criterion. All patients with middle ear cholesteatoma found on CT scan or during surgery were excluded from the study. The Ethics Committee of the Clinic for Otorhinolaryngology and Maxillofacial Surgery approved this study.

The laboratory values of white blood cell (WBC) count, differential WBC, erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) level were measured daily and used as indicators of disease progression. The microbiological findings were based on swab samples of pus taken from the external ear canal after spontaneous perforation of tympanic membrane or after myringotomy. In cases when mastoidectomy was performed, swabs of pus taken from the mastoid cavities were used.

Patients with signs of developing complications and those with no improvement after the beginning of treatment underwent a CT scan. The CT features of interest were the pneumatization of the mastoid, content of the middle ear cavities, possible osseous destruction or spreading of infection beyond temporal bone. In certain emergency cases when CT was not available, the mastoid was examined by means of an X-ray.

In order to investigate a possible connection between the WBC count and CRP level on one hand and the choice of hospital treatment on the other, patients were assigned to one of three groups, based on used algorithms:

1. Patients treated with antibiotics only
2. Patients treated with antibiotics and myringotomy
1. Patients treated with antibiotics, myringotomy, mastoidectomy or tympanomastoidectomy (partial or radical).

Statistical Analysis

Statistical analysis was performed using SPSS version 18. The Kruskal-Wallis test was used to evaluate the continuous variables. A two-tailed p value lower than 0.05 was considered to be statistically significant.

RESULTS

Medical records of 52 pediatric patients with acute mastoiditis were reviewed in this study. The average age was 5 years and 25 percent

of patients were under the age of two. The youngest patient was only 3 months and 7 days old at hospital admittance, whereas the oldest patient was 14 years old. Acute mastoiditis was found dominantly in boys (63.5%).

All of the children were admitted to hospital as emergency patients. Clinical presentation of the patients is given in Table 1.

All patients had pain behind their ears, hyperemia or retroauricular edema. For the majority of them, the key sign that led them to visit the medical doctor (MD) was protruding ear. One-third of the children had acute rhinitis prior to developing mastoiditis. Vomiting was found in 3 cases of acute mastoiditis. In this study, there were no cases of bilateral mastoiditis or residual mastoiditis.

Twenty-seven patients (52%) were diagnosed with mastoiditis as their initial diagnosis and the remaining 25 patients (48%) had a previous history of acute otitis media. During prehospital treatment, antibiotics were prescribed to 71.1% of patients. Some of the patients did not have any therapy prescribed before hospital admittance because a physician did not examine them at all. The list of MDs that initially examined patients is given in Table 2.

Table 1. Clinical signs and symptoms in patients with acute mastoiditis at hospital admission

Symptoms	Patients
Otalgia	48 (92.3%)
Fever	31 (59.6%)
Otorrhea	18 (34.6%)
Upper respiratory tract infection	17 (32.7%)
Hearing loss	7 (13.5%)
Vomiting/diarrhea	3 (5.8%)
SIGNS	
Pinna protrusion	47 (90.4%)
Retroauricular edema	47 (90.4%)
Retroauricular hyperemia	46 (88.5%)
Retroauricular abscess	6 (11.5%)
Tympanic membrane hyperemia	38 (73.1%)
Tympanic membrane bulging	29 (55.8%)
Tympanic membrane perforation	5 (9.6%)
Posterior wall of auditory canal sagging	4 (7.7%)
Nasal discharge	18 (34.6%)
Cervical adenopathy	4 (7.7%)

Table 2. MDs that examined patients prior to hospital admission

Specialist that examined patient	Number of patients
ENT	27 (51.9%)
Pediatrician	12 (23.1%)
Dermatologist	1 (1.9%)
Infectologist	4 (7.7%)
Not examined by MD	8 (15.4%)

ENT: ear nose throat; MD: doctor of medicine

Bacterial culture was sterile in 16 patients. Previous antibiotic therapy was prescribed to 81% of them. *Streptococcus pneumoniae* was the most common pathogen isolated from mastoid cavity, found in 10 cases. *Pseudomonas aeruginosa* was isolated in 9 cases with one case of *Staphylococcus aureus* coinfection. *Streptococcus beta-haemolyticus*, as a significant disease causing microorganism, was observed in 2 cases of acute mastoiditis. *Enterococcus*, *Streptococcus pyogenes* and *Staphylococcus aureus* were isolated in one case each.

Computed tomography scan of the temporal bone and the brain was performed in 29 cases of acute mastoiditis and different pathological changes in sections of the middle ear and mastoid process were found. It showed fluid in the middle ear in 19 cases and granulation tissue in 7 cases. Pathological content in middle ear was not observed in the remaining three cases. Signs of osseous destruction were evident on CT scan in 5 patients. Four patients underwent the mastoid X-ray in order to make an early diagnosis.

All patients were treated with intravenous antibiotics. In all cases, the third generation cephalosporins were used (ceftriaxone, ceftazidime) as monotherapy or in combination with metronidazole or clindamycin.

Fifteen percent of patients recovered without a need for any surgical intervention. Myringotomy and ventilation tube placement were performed in 36.5% of patients. In 15.7% of them, no secretion was found after incision in the tympanic membrane. Surgical treatment of the middle ear, which included antrotomy, mastoidectomy or tympanomastoidectomy, along with myringotomy, was performed in 48.1% of cases. In half of them, purulent discharge was found after myringotomy. Active granulation tissue in the mastoid cavity was found in 16 patients and in the tympanic cavity in 11 patients. One-fifth of the children had signs of osseous destruction found during surgery.

Subperiosteal abscess, as a complication of acute mastoiditis was found in 6 cases. Erosion of the mastoid cortex was present in 83.3% of them, other had preserved mastoid cortex. The middle ear cholesteatoma was not found in any of these patients.

A significant difference of average values of WBC counts or CRP levels between 3 therapeutic groups of patients with acute mastoiditis was not found.

DISCUSSION

Acute mastoiditis is potentially serious condition which may cause fatal complications ^[10]. Although etiopathogenesis, clinical, diagnostic and therapeutic aspects have been described, mastoiditis continues to be a problem.

There are many reports demonstrating that in the majority of cases, mastoiditis appears as a complication of acute inflammation of the middle ear ^[9]. Acute infection of mastoid cells may be overlooked leading to the therapeutic protocol to be implemented incorrectly. In our experience, treatment is often based on treating general symptoms such as fever, pain, diarrhea or decreased appetite, without the identification of otological condition. Therefore, when general symptoms are noticed in young children, it is necessary for the ENT specialist to perform an examination and to follow the accepted diagnostic and treatment algorithms for inflammatory diseases of middle ear and their complications ^[11].

Otomicroscopic examination is a very powerful tool in making early diagnosis of acute mastoiditis and is quite sufficient for initiation of an adequate therapeutic procedure. The diagnosis is sometimes made only after myringotomy which indicates to the appearance of mucosa and the content of the middle ear.

Our experience confirmed that in some cases acute mastoiditis may be the first clinical sign of middle ear infection, as reported by numerous authors ^[12, 13]. This is more often found in young children, especially those younger than two years of age ^[14]. The explanation could be the fact that their immune system is not always able to provide adequate response to very potent infectious agents. In addition, the possibility of hematogenous spread of infection without an underlying otitis media was described in literature ^[15]. In such cases, acute mastoiditis is a primary infection of the bone and not a complication of acute otitis media. Since most antibiotics do not penetrate the bony tissue as good as soft tissue, the routine use of antibiotics for otitis media is not a safeguard against the development of acute mastoiditis ^[1].

The incidence of acute mastoiditis was significantly decreased by introduction of routine antibiotic treatment in patients with otitis media ^[16]. However, use of broad-spectrum antibiotics may cause suppression of the symptoms and the signs of acute mastoiditis, making the middle ear infection misinterpreted as cured or being in phase of resolution ^[17]. In these cases, generally known as "masked mastoiditis", early myringotomy is recommended, since intracranial complications such as meningitis or brain abscess may occur ^[18]. Failure to isolate bacteria is probably due to previous inadequate antimicrobial therapy. Strict follow-up of patients may prevent late diagnosis of these complications. In our study, there were no cases of masked mastoiditis or intracranial complications.

Patients with acute mastoiditis should be treated in hospital conditions, if possible. In our study, the choice of treatment protocol was based on clinical, laboratory and radiological findings.

Since the most common bacteria which cause acute mastoiditis are *Streptococcus pneumoniae* and *Pseudomonas aeruginosa*, initial antibiotic therapy should be effective against both gram-positive and gram-negative microorganisms. High-doses of intravenous third generation cephalosporin are quite sufficient in some cases. However, a combination of antibiotics is recommended by majority of authors ^[2]. In our experience, the administration of ceftriaxone in combination with clindamycin or metronidazole has proven to be successful in treatment of acute mastoiditis. If conservative therapy shows no results, a cholesteatoma in the middle ear or gram-negative infection should be considered.

Whether the CT scans should be performed still remains a question that needs to be addressed. If possible, CT scans should be used in order to detect pathological changes in the cavities of the middle ear and the mastoid process, possible osseous destruction or presence of other otological complication such as subdural or epidural abscess ^[19]. In the absence of a favorable response to initial therapy, brain and temporal bone CT scans are required ^[20]. In such cases, middle ear cholesteatoma may be frequently found. CT scan is very efficient in preoperative diagnostic evaluation of cholesteatoma, with positive predictive value of 75% ^[21]. The clinical presentation of acute mast-

oiditis in patients with evident middle ear cholesteatoma on CT scan should not be considered as acute mastoiditis itself, since it is caused by a chronic disease of the middle ear or a congenital malformation. Magnetic resonance imaging and magnetic resonance venography are diagnostic methods of choice in cases of suspected complications such as cerebral venous sinus thrombosis ^[22].

Blood tests are also useful in making the diagnosis of acute mastoiditis. It is well known that leucocytosis, elevated ESR and CRP level usually accompany the inflammation ^[23]. However, levels of these parameters are not specific for the infection in the middle ear. Therefore, blood examination should be considered together with other diagnostic methods, especially in the presence of an infection in other body region. Although WBC, ESR and CRP values may provide information about the progression of the disease or the effectiveness of treatment, they are not prognostic parameters for the disease outcome.

In conclusion, common causes of mastoiditis are found in inadequate diagnosis and treatment of acute otitis media. Otomicroscopic examination is an essential part of the diagnostic protocol and it must be performed in each case of acute otitis with poor response to prescribed therapy.

Patients with acute mastoiditis should be considered as emergency patients and treated in hospital conditions. Intensive antibiotic therapy is sometimes quite sufficient, although myringotomy is considered to be the gold standard in treating acute mastoiditis. Depending on the intensity of the pathological process, further surgical intervention might be necessary in order to achieve the best outcome for the patient.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Clinic for Otorhinolaryngology and Maxillofacial Surgery, Clinical Centre of Serbia (14/2012).

Informed Consent: Written informed consent was obtained from parents of the patients who participated in this study.

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REFERENCES

1. Luntz M, Brodsky A, Nusem S, Kronenberg J, Keren G, Migirov L, et al. Acute mastoiditis-the antibiotic era: a multicenter study. *Int J Pediatr Otorhinolaryngol* 2001; 57: 1-9. [\[CrossRef\]](#)
2. Bakhos D, Trijolet JP, Morinière S, Pondaven S, Al Zahrani M, Lescanne E. Conservative management of acute mastoiditis in children. *Arch Otolaryngol Head Neck Surg* 2011; 137: 346-50. [\[CrossRef\]](#)
3. Groth A, Enoksson F, Hultcrantz M, Stalfors J, Stenfeldt K, Hermansson A. Acute mastoiditis in children aged 0-16 years-a national study of 678 cases in Sweden comparing different age groups. *Int J Pediatr Otorhinolaryngol* 2012; 76: 1494-500. [\[CrossRef\]](#)
4. Ghosh PS, Ghosh D, Goldfarb J, Sabella C. Lateral sinus thrombosis associated with mastoiditis and otitis media in children: a retrospective chart review and review of the literature. *J Child Neurol* 2011; 26: 1000-4. [\[CrossRef\]](#)
5. Van Zuijlen DA, Schilder AG, Van Balen FA, Hoes AW. National differences in incidence of acute mastoiditis: relationship to prescribing patterns of antibiotics for acute otitis media. *Pediatr Infect Dis J* 2001; 20: 140-4. [\[CrossRef\]](#)
6. Groth A, Enoksson F, Hermansson A, Hultcrantz M, Stalfors J, Stenfeldt K. Acute mastoiditis in children in Sweden 1993-2007-no increase after new guidelines. *Int J Pediatr Otorhinolaryngol* 2011; 75: 1496-501. [\[CrossRef\]](#)
7. Kvaerner KJ, Bentsdal Y, Karevold G. Acute mastoiditis in Norway: no evidence for an increase. *Int J Pediatr Otorhinolaryngol* 2007; 71: 1579-83. [\[CrossRef\]](#)
8. Baljosevic I, Mircetic N, Subarevic V, Markovic G. Acute mastoiditis in infants. *Eur Arch otorhinolaryngol* 2006; 263: 906-9. [\[CrossRef\]](#)
9. Psarommatis IM, Voudouris C, Douros K, Giannakopoulos P, Bairamis T, Carabinos C. Algorithmic management of pediatric acute mastoiditis. *Int J Pediatr Otorhinolaryngol* 2012; 76: 791-6. [\[CrossRef\]](#)
10. Djerić DR, Schachern PA, Paparella MM, Jaramillo M, Haruna S, Bassioni M. Otitis media (silent): a potential cause of childhood meningitis. *Laryngoscope* 1994; 104: 1453-60.
11. Lin HW, Shargorodsky J, Gopen Q. Clinical strategies for the management of acute mastoiditis in the pediatric population. *Clin Pediatr (Phila)* 2010; 49: 110-5. [\[CrossRef\]](#)
12. Pang LH, Barakate MS, Havas TE. Mastoiditis in a pediatric population: a review of 11 years experience in management. *Int J Pediatr Otorhinolaryngol* 2009; 73: 1520. [\[CrossRef\]](#)
13. Zanetti D, Nassif N. Indications for surgery in acute mastoiditis and their complications in children. *Int J Pediatr Otorhinolaryngol* 2006; 70: 1175-82. [\[CrossRef\]](#)
14. Benito MB, Gorricho BP. Acute mastoiditis: increase in the incidence and complications. *Int J Pediatr Otorhinolaryngol* 2007; 71: 1007-11. [\[CrossRef\]](#)
15. L. Migirov, A. Yakirevitch, J. Kronenberg. Mastoid subperiosteal abscess: a review of 51 cases. *Int J Pediatr Otorhinolaryngol* 2005; 69: 1529-33. [\[CrossRef\]](#)
16. R. Rudberg. Acute otitis media: Comparative therapeutic results of sulphonomamide and penicillin administered in various forms. *Acta Otolaryngol* 1954; 113: 1-79. [\[CrossRef\]](#)
17. Holt GR, Gates GA. Masked mastoiditis. *Laryngoscope* 1983; 93: 1034-37.
18. Martin-Hirsch DP, Habashi S, Page R Hinton AE, et al. Latent mastoiditis: no room for complacency. *J Laryngol Otol* 1991; 105: 767-8. [\[CrossRef\]](#)
19. Luntz M, Bartal K, Brodsky A, Shihada R. Acute mastoiditis: the role of imaging for identifying intracranial complication. *Laryngoscope* 2012; 122: 2813-7. [\[CrossRef\]](#)
20. Rocha JL, Kondo W, Gracia CM, Baptista MI, Büchele G, da Cunha CA, et al. Central venous sinus thrombosis following mastoiditis: report of 4 cases and literature review. *Braz J Infect Dis*. 2000; 4: 307-12.
21. Plouin-Gaudon I, Bossard D, Fuchsmann C, Ayari-Khalfallah S, Froehlich P. Diffusion-weighted MR imaging for evaluation of pediatric recurrent cholesteatomas. *Int J Pediatr Otorhinolaryngol* 2010; 74: 22-6. [\[CrossRef\]](#)
22. Huseyin Dere, Gokce Saygi, Ozgur Akdogan, Adin Selcuk, Gokhan Gokturk. Disseminated Lateral Sinus Thrombosis. *Int Adv Otol* 2010; 6: 102-4.
23. Bilavsky E, Yarden-Bilavsky H, Samra Z, Amir J, Nussinovitch M, et al. Clinical, laboratory, and microbiological differences between children with simple or complicated mastoiditis. *Int J Pediatr Otorhinolaryngol* 2009; 73: 1270-3. [\[CrossRef\]](#)