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ORIGINAL ARTICLE

Acute mastoiditis in children population

Ostre zapalenie wyrostka sutkowatego u dzieci

Authors' Contribution:
A – Study Design
B – Data Collection
C – Statistical Analysis
D – Manuscript Preparation
E – Literature Search
F – Funds Collection

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ABSTRACT:

Aim: The aim of the study was to perform a retrospective analysis of the medical documentation of patients treated for acute mastoiditis (AM) at the Department of Pediatric Otolaryngology in Bialystok and to review the available literature on this subject so as to determine optimum AM management principles.

Material and methods: A retrospective analysis of 40 patients treated for AM in 2001-2017 was performed. Patient enrollment was based on the AM diagnostic criteria established by Anthonsen et al [15].

Results: The mean age of the subjects was 46 months, with 37% of children being less than 2 years old. No previous episodes of acute otitis media (AOM) had been reported in 2/3 of cases. Prior to hospital admission, antibiotics had been administered to 69% of patients. In laboratory investigations, 95% of patients presented with elevated inflammation markers (CRP, leukocytosis), with the values of these markers being higher in patients qualified for surgery. Indications for computed tomography (CT) scans included lack of improvement following 48 hours of conservative treatment or the presence of symptoms of subperiosteal abscesses. CT scans were performed in 35% of patients. Conservative treatment alone was administered to 24 patients (60%); this included myringotomy with/without ventilation tube insertion and intravenous antibiotic therapy. Ceftriaxone was the most commonly used antibiotic, being administered to 75% of patients. Mastoidectomy was required in 16 patients. The most common indication (30%) for mastoidectomy consisted in the presence of subperiosteal abscess.

Conclusion: In non-complicated cases of AM, there is no need for routine performance of CT scans; myringotomy with or without insertion of ventilation drains should be performed and empirical intravenous antibiotic therapy should be started. In the presence of a subperiosteal abscess, a contrast-enhanced CT scan and mastoidectomy are recommended. Deterioration of patient's condition or lack of improvement after 48 hours of conservative treatment requires a CT scan being performed and the decision on potential mastoidectomy being made on the basis of the scan.

KEYWORDS: acute mastoiditis, children, acute otitis media, treatment

STRESZCZENIE:

Cel: Celem pracy była analiza retrospektywna dokumentacji chorych leczonych z powodu ostrego zapalenia wyrostka sutkowatego (OZWS) w Klinice Otolaryngologii Dziecięcej w Białymstoku, jak również dostępnego piśmiennictwa na ten temat, w celu określenia optymalnych zasad postępowania w OZWS.

Materiał i metody: Analiza retrospektywna 40 pacjentów leczonych z powodu OZWS w latach 2001-2017. Kryteria włączenia pacjentów przyjęto za Anthonsen i wsp.[15].

Wyniki: Średni wiek badanych wynosił 46 miesięcy, 37% dzieci miało mniej niż 2 lata. 2/3 przypadków nie było poprzedzonych wcześniejszymi epizodami OMA. 69% chorych otrzymywało antybiotyk przed przyjęciem do szpitala. W badaniach laboratoryjnych u 95% chorych stwierdzono podwyższone wykładniki stanu zapalnego (CRP, leukocytoza), ich wartość była wyższa wśród chorych zakwalifikowanych do leczenia operacyjnego. Wskazaniami do tomografii komputerowej (TK) był brak poprawy po leczeniu zachowawczym przez 48 godzin lub objawy obecności ropnia podokostnowego. Badanie to wykonano u 35% chorych. 24 pacjentów (60%) leczono wyłącznie zachowawczo: myringotomia bez/z założeniem drenu wentylacyjnego oraz antybiotykoterapię dożylną. Najczęściej stosowanym antybiotykiem był ceftriakson – 75% chorych. 16 (40%) chorych wymagało wykonania mastoidektomii, w jednym przypadku obustronnie. Najczęstszym wskazaniem (30%) do mastoidektomii była obecność ropnia podokostnowego.

Wnioski: W niepowikłanych przypadkach OZWS TK nie musi być rutynowo wykonywana, należy wykonać myringotomię z lub bez założenia drenów i rozpocząć empiryczną antybiotykoterapię dożylną. W przypadku obecności ropnia podokostnowego wskazane jest wykonanie TK z kontrastem i mastoidektomią. Przy braku poprawy lub pogorszeniu stanu pacjenta po 48 godzinach leczenia zachowawczego należy wykonać TK z kontrastem i na jej podstawie podjąć decyzję o mastoidektomii.

SŁOWA KLUCZOWE: ostre zapalenie wyrostka sutkowatego, dzieci, ostre zapalenie ucha środkowego, postępowanie

INTRODUCTION

Acute mastoiditis (AM) is the most common complication of acute otitis media (AOM). As a result of antibiotic therapy, the incidence of this disorder was reduced to about 1.2-4.8/100,000 children aged ≤14 years/year [1, 6, 15, 17]. Conflicting data are reported with respect to the impact of reduced use of antibiotic therapy and pneumococcal vaccinations on the incidence of AM. Since a precise definition of AM is lacking, data reported in the literature may be incomparable. Opinions on the necessity of radiological imaging being performed in AM rage from complete negation of any need to recommendations that it should be acquired in all cases [2, 16, 22]. Conservative treatment is recommended in an increasing percentage of patients; however, a consensus position is also lacking in this case.

Therefore, the aim of this study was to perform a retrospective analysis of the medical documentation of patients treated for AM at the Department of Pediatric Otolaryngology in Bialystok and to review the available literature on this subject so as to determine optimum AM management principles.

MATERIAL AND METHODS

A retrospective analysis of 40 patients treated for AM in 2001-2017 was performed. Patient enrollment was based on the AM diagnostic criteria established by Anthonsen et al. [15]:

A) clinical signs and symptoms of recent (within 2 weeeks) acute otitis media;

B) at least 3 of the following 4 symptoms: 1) protrusion of the pinna; 2) retroauricular redness; 3) retroauricular pain upon palpation; 4) retroauricular swelling with/without fluctuations (subperiosteal abscess); and/or

C) and/or operative findings of acute mastoiditis.

Subjects with mastoiditis in the course of chronic otitis media were excluded from the study.

The analyzed parameters included local and otoscopic symptoms, general symptoms, laboratory investigation results (CRP, leukocytosis), bacteriological assay results, radiological diagnostic modalities being used, presence of other complications, and conservative and surgical treatment modalities.

The study was approved by the Ethics Committee of the Medical University of Bialystok, decision no. RI002/301/2018.

RESULTS

The mean age of subjects was 46 months (range: 7 months-15 years, median 32 months), with 37% of children being less than 2 years old. Male patients accounted for 65% of the study population. Left ear and right ear were affected by AM in 22 and 17 cases, respectively, with one case of bilateral involvement. The history of previous acute otitis media was reported in about 1/4 of subjects. For most patients, however, this was the first episode of the disease. Prior to hospital admission, antibiotics had been administered to 69% of patients for an average of 3 days (median of 2 days). Most commonly used antibiotics included amoxicillin/clavulanic acid, cefuroxime and amoxicillin

Predominant otoscopic observations included symptoms of acute inflammation present in 90% of patients, discharge from the ear in 20% of patients, and ear canal stenosis due to posterior wall sagging in 13% of patients. Changes within the mastoid process region such as protrusion of the auricule, retroauricular redness and swelling, and pain upon palpation in the mastoid region were observed in all patients. One half of children presented with body temperature of more than 38°C upon the admission.

In laboratory investigations, 95% of patients presented with elevated CRP levels. The mean level was 73 mg/L (range: 2.7-393, median 51). CRP levels were slightly higher in patients who required surgical treatment: 81 mg/L vs. 68 mg/L in patients not undergoing surgery. The mean level of leukocytosis was 13.6×103 (range 6.7-21×103) with the values also being slightly higher in patients qualified for surgery. Indications for computed tomography (CT) scans included lack of improvement following 48 hours of conservative treatment or the presence of symptoms of subperiosteal abscesses (fluctuationsCT scans were performed in 35% of patients.

Conservative treatment alone was administered to 24 patients (60%); this included myringotomy with/without ventilation tube insertion and intravenous antibiotic therapy. Ceftriaxone was the most commonly used antibiotic, being administered to 75% of patients. A single antibiotic drug was used throughout the treatment in 70% of patients. In 17%, of patients, the treatment was supplemented with metronidazole as an antibiotic against anaerobic bacteria. Antibiotic drug was switched in the course of the treatment in 6 cases.

Mastoidectomy was required in 16 (40%) patients; in one case, bilateral procedure was required. The most common indication (30%) for mastoidectomy resulted from the presence of subperiosteal abscess. Intracranial complications consisting of epidural abscess within the sigmoid sinus region and posterior cranial fossa were observed in 3 patients (7.5%). One patient in this group suffered from concomitant sigmoid sinus thrombophlebitis. Only in 39% of patients, a pathogen was isolated from the middle ear or mastoid process material collected for microbial assays. In most cases, the pathogen was S. pneumoniae (19%); half of its strains were found to be penicillin-resistant.

Mean duration of hospitalization was 9.3 days (range 4-21 days, median 9 days).

DISCUSSION

The incidence of AM in various countries was assessed in 2001 by van Zuijlen et al. [1]. In countries with restricted use of antibio-

tics in the treatment of acute otitis media, the incidence of AM was 3.8/100,000 children aged ≤14/year. In all countries with antibiotic therapy being widely used in the treatment of AOM, the incidence of AM was 1.2-2/100,000 children aged ≤14/year. As shown by these data, restriction of antibiotic treatment may impact the incidence of AM. Some authors observed an increase in AM incidence after restrictions had been implemented [40, 41]. However, no changes in the incidence of AM could be confirmed in other studies [6, 15, 28].

The effects of antibiotic treatment of AOM was analyzed by Thompson et al. [28]. The risk of AM following AOM was 1.8/10,000 incidents treated with antibiotics and 3.8/10,000 incidents not treated with antibiotics. Thus, administration of antibiotics reduced the risk by one half; however, the NNTT value (the number of children with AOM needed to treat to prevent 1 case of AM) is as high as 4831. Antibiotic therapy of acute otitis media does not protect patients from AM. As many as 69% of our AM patients had received antibiotics upon the onset of ear-related symptoms. In the literature reports, the percentage of patients treated with antibiotic before the onset of AM ranges from 30 to 68% [11, 15, 17, 18, 19, 21, 22, 26, 31].

Attention has also been drawn to the influence of pneumococcal vaccinations on the incidence of AM. After introduction of these vaccinations, the incidence of AM was reduced by about 20-45% [8, 9]. Halgrimson et al. [29] observed a drop in the incidence of AM after the introduction of PSV7; however, this drop was only observed in patients below the age of 2, with the incidence rate returning to pre-vaccination baseline after this age. A reduction was observed in the percentage of AM episodes caused by S. pneumoniae with simultaneous increase in the incidence of cases caused by S. pyogenes [9]. In US-based studies, a reduction in the incidence of AM was observed only after the 13-valent vaccine had been introduced [30]. Vaccinations had no effect on the incidence of mastoiditis complications such as subperiosteal abscess, extradural abscess, or sigmoid sinus thrombophlebitis as well as on the percentage of patients who required antromastoidectomy [8].

Numerous publications contain contradicting data on AM. This is partially due to the lack of clearly established definition and diagnostic criteria. Quite frequently, cases of mastoiditis in the course of chronic otitis media or cases of mastoiditis latens are presented along with AM cases. In the review of AM-related literature published by van der Aardweg et al. [24], diagnostic criteria were presented in only 26 out of 65 studies; moreover, the presented criteria differed significantly between individual studies.

The following criteria for the diagnosis of acute mastoiditis were proposed by Groth et al. [17]: 1. mastoidectomy performed with purulent discharge or acute infection in the mastoid process or or clinical signs of acute otitis media (ongoing or within the 14 days prior to inclusion), and two or more retroauricular signs of infection and/or sagging of the ear canal. Criteria adopted by Anthonsen et al. [15] are similar with the exception of at least three mastoid process-related symptoms being required for diagnosis. In our study, the diagnostic criteria were consistent with those proposed by the later authors.

Subperiosteal abscess is a frequent complication of AM. In our study group, it was observed in 30% of patients. The most common incidence rate as reported in the literature is about 20% [12, 17, 18, 31]. Intracranial complications were observed in 7.5% of patient population which was consistent with data most frequently encountered in the literature [12, 18, 20, 31]. All cases of intracranial complications were observed in patients who also presented with subperiosteal abscesses. Concomitant intracranial complications were observed in 25% of patients with subperiosteal abscess.

In the presented study, radiological examinations were performed in 35% of patients. In all cases, these included high resolution contrast-enhanced computed tomography (CT) which facilitates the assessment of both bone lesions as well as potential intracranial complications and soft tissue lesions [32]. Indications for CT scans included the presence or suspicion of a subperiosteal abscess, lack of improvement following conservative treatment, and suspicion of intracranial complications. CT is estimated to have a 50% positive predictive value and a 100% negative predictive value in the diagnosis of confluent AM. Contrast-enhanced CT is estimated to have an 80% positive predictive value and a 90% negative predictive value in the diagnosis of intracranial complications [27]. Different opinions are presented with regard to indications to CT scans; as a result, the percentage of patients in whom CT scans were performed ranges from 0.5 to 86% [11, 12, 17, 18, 20, 22, 23, 33]. In a Danish study in a population of 214 patients, CT scan was performed in only one case [15]. However, it should be highlighted that no cases of intracranial complications were identified in the study group. The authors believed this approach to be justified as no evidence had been presented for CT scans to have any significant impact on treatment outcomes [15]. On the other hand, Luntz et al. [16] believe that since clinical symptoms and laboratory parameters are insufficient to rule out intracranial complications, imaging examinations should be offered in all AM cases. Chesney et al. [34] believe this position to be controversial due to the X-ray exposure and the requirement of general anesthesia being delivered to small children. They believe imaging scans should be limited to patients with neurological symptoms, suspected chronic otitis with cholesteatoma, severe or deteriorating general condition, lack of improvement or exacerbation of symptoms despite conservative treatment, or suspected intracranial complications. Marom et al. [12] consider the presence of subperiosteal abscess to also be an indication for a CT scan, which is consistent with the approach used at our center. In our study material, intracranial complications accompanied subperiosteal abscesses. Luntz et al. [16] had also observed intracranial complications in 50% of patients with subperiosteal abscess and in as little as 3% of patients in whom this complication was not identified. Vassbotn et al. [35] concluded that only one half of subperiosteal abscesses detected upon mastoidectomy had been diagnosed previously in clinical examination, and therefore believe that CT scans should be performed in patients in whom conservative treatment is being attempted.

The widely established management of non-complicated AM, which is also practiced at our site, consists of myringotomy with or without ventilation tube placement and intravenous antibiotic therapy [13]. Patients who fail to improve after 48 hours of this management require radiological diagnostic examinations and an-

tromastoidectomy. Extra- or intracranial complications are also indications for surgical intervention. In our study group, surgical treatment was required in 40% of AM patients; in 30%, indication consisted in the presence of subperiosteal abscess. In most studies, the percentage of surgeries was somewhat lower, ranging from 25 to 35% [15, 17, 21, 23]. The higher percentage observed at our site may be due to its higher reference level and more severe cases being treated. In the study by Gorphe et al. [19] mastoidectomy was performed in 67% of patients, all of whom had subperiosteal abscesses.

Recently, articles have been published which suggest that mastoidectomy may not be necessary even in the case of subperiosteal abscesses. According to the authors of these publications, puncture or incision of the abscess combined with intravenous antibiotic therapy are sufficient to ensure resolution in most patients [10, 13, 20, 21, 22, 42]. However, the analysis performed by Anne et al. [4] suggested that mastoidectomy was still required in 12.5% of patients treated in this manner. Some authors go as far as negating the necessity to perform myringotomy [26, 36].

In our study material, a pathogen was isolated from the collected material in as little as 39% of patients. This is probably due to the widespread use of antibiotic therapy prior to hospital admission as well as to the fact that bacteriological examinations were performed outside of the hospital. A similar percentage of positive cultures, amounting to 30%, was reported by Marom et al. [12] and Geva et al. [26]. In most studies, this percentage was somewhat markedly higher and exceeded 60% [17, 22, 23, 31]. Like reported by other authors, the most common pathogenic isolate was S. pneumoniae [5, 14, 15, 17, 19, 23, 35, 37].

Considering the fact that the two most common pathogens associated with AM are S. pneumoniae and S. pyogenes, empirical antibiotic therapy should target both of these species. Due to the high penicillin resistance of S. pneumoniae strains in Poland, ceftriaxone was the most frequent antibiotic drug used in our study group. Penicillin and second-generation cephalosporins are still in use in Scandinavian countries [15, 17]. Amoxicillin with clavulanic acid is also recommended [21, 22, 26]; however, the drug is characterized by low half-life following intravenous administration, which may result in administration regimen of three times per day being insufficient [3]. Some authors think due to the risk of infection with F. necrophorum, it is necessary to include an antibiotic active against anaerobic bacteria [18, 20].

This anaerobic species has been recently the object of much interest as a pathogen responsible for severe course of AM [7, 25, 38]. Out of 43 children with AM caused by this bacterial species, as many as 93% required surgical intervention i.e. mastoidectomy compared to 9% in children with AM caused by other pathogens [39]. Stergiopoulou et al. [38] published an overview of 20 literature reports pertaining to otogenic infections caused by F. necrophorum in children below the age of 2. Further complications were observed in all children; 83% of them had an epi- or intradural abscess and all of them required mastoidectomy. In the study by Gelbart et al. [7] F. necrophorum was detected (in cultures as well as using PCR, mainly using PCR) in 13% of AM cases. Out of all AM cases with further complications, 41% were caused by this pathogen.

The increased frequency of F. necrophorum infections has not been elucidated to date. Potential causes include restrictions in antibiotic therapy, changes in pathogenic virulence, state-of-the-art pathogen identification methods, common use of pneumococcal vaccines leading to microfloral changes and F. necrophorum carrier status being more common, and the increased penicillin resistance of F. necrophorum strains [7, 38].

CONCLUSION

Following recommendations may be proposed on the basis of the study material analysis and literature review:

1. In non-complicated cases of AM, there is no need for routine performance of CT scans; myringotomy with or without insertion of ventilation tubs should be performed and empirical intravenous antibiotic therapy should be started.

2. In the presence of a subperiosteal abscess, a contrast-enhanced CT scan and mastoidectomy are recommended.

3. Deterioration of patient's condition or lack of improvement after 48 hours of conservative treatment requires a CT scan being performed and the decision on potential mastoidectomy being made on the basis of the scan.

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