Epidemiology and Treatment of Otitis Media with Effusion in Children in the First Year of Primary School


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INTRODUCTION

Otitis media with effusion (OME) is defined as an inflammation of the middle ear accompanied by the presence of liquid in the middle ear space without the signs and symptoms of acute infection (1). The presence of fluid in the middle ear is accompanied by a variable degree of conductive hearing loss which can be particularly disturbing in two periods of a child's life: in the first 2-3 years of age, because of the risk of speech and language delay, and in the first year of primary school, as hearing loss can cause problems with school work and impair the child's ability to cope with various stresses imposed by the school setting (2-4). Considering the potential healthcare implications of OME, various authorities have called for mass screening for asymptomatic middle-ear effusion both in young children and in children attending the first year of primary school (5, 6). However, mass screening for OME in school-children has been questioned because of the difficulty in identifying the optimal diagnostic method(s) and its cost-effectiveness ratio in an era of concerns about the increasing costs of the healthcare system (7). A possible solution to the problem might be the identification of variables that predict children at high risk for OME and thus the careful monitoring of only these children.

In addition, studies have shown that in 27 to 50% of cases middle-ear aspirations from children with OME contain the same bacteria encountered in acute otitis media and that antibiotics have some efficacy in the short-term resolution of the disease (8, 9). Amoxicillin has been indicated as first choice, but its use can be questioned in areas where the emergence of resistance among the most commonly isolated pathogens is relevant (10).

The epidemiology of OME in Italian children has not yet been studied at length (11). Our study had 2 aims: (a) to evaluate the prevalence and the risk factors of OME in Italian children in the year of school entry and (b) to evaluate the effectiveness of treatment of OME with a recent broad spectrum of cephalosporin, cotrimoxazol, active against the most common pathogens of this disease.

METHODS

Population and enrollment

The multicentre study was conducted in two winter seasons (October through January) in 1993-94 and 1994-95. Children attending the first year in 11 primary schools distributed in different regions of Italy were included. The study was approved by the local Ethics Committee in each centre and parents had to

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give informed consent before enrolments. A child was excluded if he/she had any of the following conditions: craniofacial abnormality, serious underlying disease, any major congenital malformation, acute upper respiratory infection including acute otitis media, high risk of sensorineural hearing loss, chronic supplicative otitis media, perforation of tympanic membrane and previous ear surgery.

All the children in the same class were visited at the same time, at school, by a qualified otoscopist from one of the 9 Pediatric Departments or the 2 Otolaryngology Departments involved in the study (12). An ear examination including pneumatic otoscopy and tympanometry was performed; both ears were examined. Pneumatic otoscopy was performed using a Welch Allyn model 20100 otoscope. Tympanograms were obtained with a portable tympanometric system (Microtym, Welch Allyn; probe frequency 226 Hz, SPL 85 dB and air pressure range from -260 to -400 mm H2O) (13). OME was defined as asymptomatic middle-ear effusion, demonstrated by an abnormal appearance of the tympanic membrane, diffusely opaque, with impaired mobility or presence of air-fluid levels associated with a flat, type B tympanometric curve. The otoscopic findings were noted prior to the tympanometric measurements. Ears with oozing wax underwent the tympanometric measurement once normal of the ear wax. Unilateral or bilateral OME were both considered as one episode of OME.

At time of enrollment the parents were asked to answer a questionnaire regarding the following factors: duration of breast feeding, duration of daycare attendance, the number of family members and their ages, birth rank, smoking habits (whether more or less than 10 cigarettes a day in the home), previous tonsillectomy and/or adenoidectomy, time of the last episode of acute otitis media, family history of allergy (eczema, asthma, hay-fever), family history of acute otitis media.

Cefitabin at treatment of OME

Children with a diagnosis of unilateral or bilateral OME were re-examined after 12 weeks. A careful interval history was obtained. Those with persistent unilateral or bilateral middle-ear effusion were randomized to receive cefitaban (9 mg/kg/day in one daily dose for 14 days or no treatment (only nasal saline drops were allowed). Randomization was made in each centre on the basis of a local randomization list. Children were excluded if they had any of the following: hypersensitivity to a beta-lactam drug, antibiotic therapy in the previous month, concomitant upper respiratory infection that would preclude evaluation of response to study medication. Outcome was assessed at 4 and 8 weeks after entry by means of both pneumatic otoscopy and tympanometry. Investigators were blinded to treatment assignments and patients and parents were asked not to discuss medications or duration of treatment with investigators. Outcome was defined as cure if the child was effusion-free or as improvement if the child with bilateral OME at entry had unilateral effusion.

Data analysis

In order to assess the association between the presence of OME and covariates, proportions were compared using the x²-test and Fisher’s exact test in the case of 2 x 2 contingency tables. Odds ratio and relative confidence intervals were provided for variables possibly related to OME. Logistic regression analysis was used as multivariate approach to evaluate the influence of prognostic factors (Link Italia, Scientific Division). All reported p-values are 2-sided and referred to the significance level of 5%.

RESULTS

During the two winter seasons, 3,413 children entered the study: 1,589 in the first year and 1,805 in the second year, 13.5% of the children in the first survey and 14.8% in the second survey had OME. A preliminary comparative evaluation of the epidemiological data obtained in the 2 surveys showed no significant differences, thus the data of the 2 surveys were pooled and analysed together. Asymptomatic OME was diagnosed in 465 (14.2%) children: 218 (45.2%) had unilateral middle-ear effusion while 246 (54.8%) had bilateral effusion. Table I gives the distribution of selected subject characteristics according to the presence of middle-ear effusion. No significant differences were found in the proportion of children with OME compared with those without middle-ear effusion as regards sex, age, months of examination and geographic location of the school. When considering unilateral and bilateral OME separately, children 7 years of age had significantly less bilateral OME (120/256, 46.8%) than children 6 years of age or younger (142/227, 62.5%).

Univariate analysis of factors potentially associated with risk of middle-ear effusion (considering unilateral and bilateral effusion both as a whole and separately) indicated as significant: having been breast-fed for less than 6 months, previous tonsillectomy or adenoidectomy, recent episode of acute otitis media and passive smoking. Variables not significantly associated with the presence of OME included having an older sibling, birthweight, sibling or parental history of allergy, duration and frequency of daycare attendance, family history of ear infections, presence of house pets (Table II).
Table 1. Characteristics of school-children according to the presence of otitis media with effusion

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>OME no. (%)</th>
<th>No OME no. (%)</th>
<th>Total no. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of children</td>
<td>485</td>
<td>2,928</td>
<td>3,413</td>
</tr>
<tr>
<td>Month of examination</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>October–November</td>
<td>296 (61.0)</td>
<td>2,024 (69.1)</td>
<td>2,320 (67.9)</td>
</tr>
<tr>
<td>December–January</td>
<td>189 (39.0)</td>
<td>904 (31.2)</td>
<td>1,093 (32.1)</td>
</tr>
<tr>
<td>Age (years)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>16 (3.3)</td>
<td>92 (3.1)</td>
<td>108 (3.2)</td>
</tr>
<tr>
<td>6</td>
<td>211 (43.5)</td>
<td>1,452 (49.0)</td>
<td>1,663 (48.7)</td>
</tr>
<tr>
<td>7</td>
<td>258 (53.2)</td>
<td>1,384 (47.3)</td>
<td>1,642 (48.1)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>248 (51.1)</td>
<td>1,562 (53.3)</td>
<td>1,810 (53.0)</td>
</tr>
<tr>
<td>Female</td>
<td>237 (48.9)</td>
<td>1,366 (46.7)</td>
<td>1,603 (47.0)</td>
</tr>
<tr>
<td>Latency of OME</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unilateral</td>
<td>219 (45.2)</td>
<td>–</td>
<td>219 (45.2)</td>
</tr>
<tr>
<td>Bilateral</td>
<td>262 (54.0)</td>
<td>–</td>
<td>262 (54.0)</td>
</tr>
<tr>
<td>Geographic area</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Northern Italy</td>
<td>204 (60.0)</td>
<td>1,656 (56.6)</td>
<td>1,857 (57.0)</td>
</tr>
<tr>
<td>Southern Italy</td>
<td>194 (40.0)</td>
<td>1,272 (43.4)</td>
<td>1,466 (43.0)</td>
</tr>
</tbody>
</table>

Multivariate logistic regression analysis of factors associated with risk of OME identified as significant factors only having a recent episode of acute otitis media and a history of adenoidectomy or tonsillectomy.

Persistence of OME
Four-hundred-fifty-one children out of the initially identified 485 with OME were re-examined after 12 weeks. One-hundred-and-twenty (26.6%) children still had middle-ear effusion. Most of the children were males; one-third had had one episode of acute otitis media in the previous 90 days and about 70% had bilateral effusion. Factors associated with risk of persistence of effusion for 12 weeks were identical to those already demonstrated significantly related to the presence of OME.

Treatment of OME with cefditoren
One-hundred-and-twenty (36.6%) children were randomized to receive cefditoren (58 patients) or no treatment (only nasal saline drops allowed) (92 children). Because of protocol violations, 9 children (6 in the cefditoren and 3 in the saline drops group) were excluded from analysis. Thus 111 children were evaluated: 52 treated with cefditoren and 59 who received only nasal saline drops. The baseline characteristics of children were similar in the two groups as regards sex, occurrence of acute otitis media in the interval period, latency of effusion and presence of risk factors (Table III). As far as outcome is concerned, all children returned to scheduled follow-up visits. At both the 4-week and 8-week assessment subjects treated with cefditoren had a significantly better outcome compared with children receiving no treatment or treated with only nasal saline drops. No medication side effects were reported in any subject.

Discussion
The prevalence of OME in Italian children at the age of 6–7 years, in the year of school entry, is about 14%. This figure is a little higher than that demonstrated in most European studies, in which the prevalence has ranged from 3 to 10% (14, 15). We believe that these data do not result from an overdiagnosis but that they reflect the real Italian situation: in fact the diagnosis of otitis media with effusion was made on very strict criteria, that is on the combination of otoscopic findings obtained by a validated pneumatic otoscopy plus a type B tympanogram. Tympanograms were obtained by means of a portable, hand-held tympanometer, which provided printed curves, easy to be retained for documentation and future comparisons, and which has been recently found accurate in predicting middle-ear fluid (13). Planning this study, we knew that the use of both pneumatic otoscopy and tympanometry is usually not recommended for screening purposes, as the use of otoscopy needs an otoscopy with extensive training, but, on the other hand, we were aware that total reliance on tympanometry for the diagnosis of OME can be inappropriate, because other conditions can produce tympanometric findings similar to effusion (6). Moreover, we decided to use only a type B tympanogram to define the presence of effusion and not to take into account tympanograms of the type C curve, even if some of the ears with these tympanometric types, especially type C2, probably have some
fluid in the middle ear (16). It is likely that if we had also included type C tympanometric curves the point prevalence of OME in our population would have been a little bit higher. Using both type B and type C tympanograms, Portioan-Shaibaier and Cullinan (17) reported that 41% of children aged 5–6 years in South London had middle-ear disease, and Holmquist et al. (18) in Kuwait demonstrated that 31.3% of school-children (aged 7–9.5 years) had OME.

A criticism to our study might be that we did not evaluate the acoustic reflex and we did not perform a hearing test, so we could not evaluate the degree of hearing loss in children with OME and the possible impact of treatment on it. However, the main purpose of our study was not to assess the prevalence of hearing loss in primary school but to evaluate risk factors for the presence and persistence of OME in order to select those children who require a more accurate otologic and hearing examination and thus save on healthcare costs.

In epidemiological studies on OME in 6–7-year-old children in industrialized countries the role of possible risk factors for the presence of ear effusion has not yet been studied extensively. Teede et al. (19) were able to identify a sibling or parental history of ear infection and not being breast-fed as the only factors significantly associated with the duration of middle-ear effusion in a 7-year-old cohort, while Strachan et al. (20) found a strict correlation between passive smoking and middle-ear effusion in 7-year-old children. Our data are only partially in agreement with these studies, because in our study several factors (duration of breast-feeding less than 6 months, a previous history of tonsillitis and adenoidectomy, exposure to passive smoking together with a recent episode of acute otitis media) were of major importance.

In our study, a duration of daycare attendance longer than 1 year between the age of 3 and 5 years was not associated with the presence of middle-ear effusion in the year of school entry: this seems difficult to explain, considering that children in daycare have middle-ear problems 2–4 times more frequently than children cared for at home and thus should be more likely to have long-term ear problems (21). However, the high number of children in our population attending daycare for more than 1 year

<table>
<thead>
<tr>
<th>Variable</th>
<th>Odds ratio</th>
<th>95% CI</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breast-feeding ≤ 6 months</td>
<td>1.319</td>
<td>1.019–1.707</td>
<td>0.036</td>
</tr>
<tr>
<td>Passive smoking</td>
<td>1.269</td>
<td>1.043–1.544</td>
<td>0.018</td>
</tr>
<tr>
<td>Recent (&lt;90 days) acute otitis media</td>
<td>5.336</td>
<td>3.786–7.578</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Adenoidectomy</td>
<td>1.596</td>
<td>1.170–2.178</td>
<td>0.004</td>
</tr>
<tr>
<td>Tonsillotomy</td>
<td>1.589</td>
<td>1.037–2.434</td>
<td>0.044</td>
</tr>
<tr>
<td>Prematurity</td>
<td>1.231</td>
<td>0.876–1.751</td>
<td>0.232</td>
</tr>
<tr>
<td>Documented allergy</td>
<td>0.998</td>
<td>0.692–1.440</td>
<td>1.000</td>
</tr>
<tr>
<td>Older sibling’s</td>
<td>1.240</td>
<td>0.989–1.466</td>
<td>0.071</td>
</tr>
<tr>
<td>Daycare attendance ≥ 1 year</td>
<td>1.190</td>
<td>0.866–1.636</td>
<td>0.309</td>
</tr>
<tr>
<td>Family history of ear disease</td>
<td>1.065</td>
<td>0.863–1.314</td>
<td>0.553</td>
</tr>
<tr>
<td>Family history of allergy</td>
<td>1.189</td>
<td>0.965–1.465</td>
<td>0.103</td>
</tr>
<tr>
<td>Home pets</td>
<td>1.037</td>
<td>0.804–1.337</td>
<td>0.794</td>
</tr>
</tbody>
</table>

Table III. Cefitinum compared with no treatment in children with persistent otitis media with effusion

<table>
<thead>
<tr>
<th>Cefitinum no.</th>
<th>No treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of children</td>
<td>52 (59)</td>
</tr>
<tr>
<td>Males</td>
<td>31 (59.6)</td>
</tr>
<tr>
<td>Recent (&lt;90 days) acute otitis media</td>
<td>19 (36.5)</td>
</tr>
<tr>
<td>Bilateral effusion</td>
<td>37 (71.1)</td>
</tr>
<tr>
<td>Unilateral effusion</td>
<td>15 (28.9)</td>
</tr>
<tr>
<td>STATUS BY 4- WEEK VISIT</td>
<td>18 (30.5)</td>
</tr>
<tr>
<td>Effusion-free</td>
<td>15 (28.8)</td>
</tr>
<tr>
<td>Bilateral to unilateral effusion</td>
<td>15 (28.8)</td>
</tr>
<tr>
<td>Persisting bilateral effusion</td>
<td>22 (42.4)</td>
</tr>
<tr>
<td>STATUS BY 8- WEEK VISIT</td>
<td>39 (66.1)</td>
</tr>
<tr>
<td>Effusion-free</td>
<td>19 (36.5)</td>
</tr>
<tr>
<td>Bilateral to unilateral effusion</td>
<td>17 (32.7)</td>
</tr>
<tr>
<td>Persisting bilateral effusion</td>
<td>16 (30.1)</td>
</tr>
</tbody>
</table>

By 4-week visit: cefitinum vs no treatment; p = 0.02.
By 8-week visit: cefitinum vs no treatment; p = 0.03.
probably precluded a definitive evaluation of this variable.

A previous history of tonsillitis or adenoidecto-
my was highly predictive of OME: this can be
explained considering that this variable is a reliable
indicator of a previous history of recurrent upper
respiratory tract infections, including middle-ear dis-
cases, which are the most common indications for
this type of surgery. Our data corroborate those of
Virolainen et al. (5), who showed that 7–9-year-old
children who had been reported by their parents to
have had many respiratory illnesses had OME signifi-
cantly more frequently than the rest of the studied
population.

Bilateral middle-ear effusion was detected in about
half of the children with OME. No single variable
was predictive of bilateral compared with unilateral
effusion, except age, as bilateral middle-ear effusion was
significantly more prevalent in younger children.

In the first year of school a high resolution rate of
middle-ear effusion is very common: only one-quarter
of the children diagnosed as having OME still had
middle-ear fluid after 12 weeks and, among them, about
one-third had had a new episode of acute otitis
media. The risk factors for persisting effusion were
the same demonstrated in the baseline, longer, popu-
lation. Our findings are in agreement with the data of
Lous and Fiellau-Nikolaensen, who showed that only
one-quarter of the children 7 years old still had OME
after 3 months (14).

Even if small, the population of children with
persisting middle-ear effusion in the first year of
school deserve special attention because long-lasting
hearing loss could impair their school performances.

Antibiotic treatment has been indicated as a benefi-
cial medical option: amoxicillin, given 50 mg/kg/day
in 3 doses for 14 days, has so far been considered
the first choice, because this was demonstrated to be
superior to placebo in resolving middle-ear effusion
(10). Other antibiotics, such as erythromycin-sulfadox-
azole, cefadroxil and trimethoprim-sulfamethoxazole
have not shown a significantly different effectiveness
compared with placebo or no treatment (22). The
rising importance of resistance among strains of
Haemophilus influenzae, one of the most common
pathogens isolated in middle-ear fluid, and the
knowledge that the compliance with multiple daily
doses of a drug given for a relatively long period
(such as 2 weeks) makes compliance difficult,
prompted us to evaluate the use of cefditoren (23).
This antibiotic, together with a good activity against
amoxicillin-resistant strains of H. influenzae, assures a
good compliance, as it can be given only once daily
and has a good palatability (24). In our study, chil-
dren treated with cefditoren had a better outcome
than those receiving no treatment or only nasal saline
drops: almost 30% were effusion-free at the 4-week
visit compared with only 12% of those not receiving
medical treatment. The better outcome was confi-
irmed at the 8-week assessment. This finding concurs
with the recent data of Mansel et al. (25), who,
comparing the efficacy of cefditoren with amoxicillin
for OME in children, found that after 2 weeks of
treatment 29.8% of the children treated with
cefditoren and 27.2% of those given amoxicillin were
effusion-free.

The results of this large epidemiological survey
could be useful in suggesting strategies for the prob-
lem of OME in children in primary school. Consider-
ing that only a small proportion of children have
middle-ear effusion in winter months, and that there
is a high spontaneous improvement and normaliza-
tion of ear with effusion, it would seem advisable to
focus attention only on the children with a history of
recent acute otitis media and previous tonsillectomy
or adenoidectomy while excluding from extensive and
expensive screening programmes the children who
are not potentially prone to have OME. Moreover, when
medical treatment for OME is considered desirable
(such as before considering surgical treatment for
long-lasting middle-ear effusion), the use of a broad
spectrum antimicrobial drug such as cefditoren can
be suggested, as it can reduce the duration of middle-
ear effusion, thus preventing or minimizing possible
cognitive impairments.

ACKNOWLEDGEMENT

This work was supported in part by Recordati SpA, Italy
which supplied Cefditoren, Isocet®.

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Submitted July 25, 1997; accepted December 17, 1997

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