

## ORIGINAL STUDY

# Acute middle ear pathology in children with upper respiratory tract infections

Vlad Postelnicu<sup>1</sup>, Oana Iosif<sup>1,2</sup>, Raluca Bidiga<sup>3</sup>, Viorel Rosu<sup>4</sup>, Gabriela Oproiu<sup>5</sup>

<sup>1</sup>ENT Department, MEDLIFE Baneasa Bucharest, Romania

<sup>2</sup>“Carol Davila” University of Medicine and Pharmacy, Bucharest, Romania

<sup>3</sup>MEDLIFE Pediatrics Hospital, Bucharest, Romania

<sup>4</sup>Radiology Department, MEDLIFE Grivita Bucharest, Romania

<sup>5</sup>Institute for Mother and Child Care “Prof. Dr. A. Rusescu”, Bucharest, Romania

## ABSTRACT

**BACKGROUND.** Acute inflammation of the middle ear is frequently diagnosed in children. Acute upper respiratory infections (URI) represent the leading cause of the onset or worsening of an otologic disease in children.

**OBJECTIVE.** This study evaluates the frequency of acute middle ear inflammation and infections associated to acute URI in a selected lot of children presented or referred to ENT specialist examination over a specific period of the winter season.

**MATERIAL AND METHODS.** The study was performed on 92 (71.3%) children with otologic symptoms or disease, from a lot of 129 consecutive children, in the age range 6 to 60 months, who presented at the Medlife Baneasa ENT Department with acute URI, over 1 month period in the winter season.

**RESULTS.** Ear afflictions were present in 88.9% of children aged 6 to 12 months, in 52.9% aged 1 year, in 59.4% aged two years, in 72.3% aged three years and in 81.5% aged four years. Bilateral ear disease was identified in 78.3% (72) cases. The highest incidence of ear disease was found in 3 years old patients – 36.6% (34) of the selected lot; the mean age – 38.2 months; sex ratio boys/girls - 1.2:1. The distribution of the acute ear pathology identified was: otitis media with effusion – 39.1% (72 ears), acute purulent/suppurative otitis media – 25.5% (47 ears), Eustachian tube dysfunction – 13.6% (25 ears), congestive otitis media – 10.3% (19); healthy ears – 11.4% (21). 3.3% of children presented spontaneous perforation of the eardrum.

**CONCLUSION.** Acute ear disease in children is a very common complaint during acute URI. The most frequent acute afflictions of the middle ear identified in acute URI in children up to five years old referred to an ENT specialist were acute otitis media with effusion, followed by acute purulent/suppurative otitis media. Nasal obstruction secondary to the adenoids' hypertrophy and acute inflammation represents the primary cause of acute middle ear diseases in acute URI among pediatric population, since it produces Eustachian tube dysfunction of different grades.

**KEYWORDS:** acute otitis media, otitis media with effusion, upper respiratory infection

## INTRODUCTION

“Otitis media is so common that it may be called an ‘occupational hazard’ of early childhood. Babies and children in daycare centers have a lot of otitis media”<sup>1</sup>.

Acute otitis media (AOM) is the most common inflammation in early childhood and one of the most frequent diseases in the children under 5 years old and has major medical, social and economic effects<sup>2,8</sup>.

The acute inflammation of the middle ear mucosa is usually caused by viruses or bacteria reaching the ear via the Eustachian tube. Acute or recurrent upper respiratory infections (URI - most commonly viral - rhinoviruses, followed by *influenza A* or respiratory syncytial virus) are presuppositions for the development of acute otitis media in children<sup>2</sup>. Acute inflammation of the middle ear is most common in little children and preschool kids. Upper respiratory tract infections (URI) represent the leading cause of the

onset or worsening of an otological disease in children. More than 60% of the children under the age of 6 experience one or more episodes of acute otitis media<sup>2</sup>. In children, otitis usually follows the flu or a common cold<sup>9</sup>.

Otitis media with effusion (OME) represent an accumulation of non-purulent fluid of various viscosities within the middle ear cavity and is a non-specific inflammation<sup>2,10</sup>.

Maximum neural plasticity in speech acquisition and learning is considered to be between 2 to 4 years old. Fluctuant hearing loss in children, present during the episodes of acute otitis media, leads to delays in language, often described by parents as late or incorrect pronunciation and spelling of letters and words<sup>4,11</sup>. Parents often present the infant or the small child to the doctor accusing breathing difficulties with or without cough, although the majority of them have already hearing problems. This hearing impairment is a consequence of the accumulation of fluid, of various viscosities, within the middle ear cavity, due to the Eustachian tube malfunction. Functional disturbance of the Eustachian tube is secondary to URI with nasal congestion and blockage, enlarged lymphoid tissue in the nasopharynx (adenoids) or chronic nasal obstruction<sup>11-13</sup>. Hearing loss of conductive nature is always present in acute otitis media and adults may report tinnitus sensation<sup>2</sup>.

The risk of complications of AOM differs with age; children below the age of one year are immunologically immature and at six months maternal antibodies run out; thus, these children are all vulnerable<sup>14</sup>. A correct diagnosis is very important - since AOM is a disease with many different courses depending on the bacterial agent and the host.

URI should always be investigated and correctly treated in infants, taking into consideration the complications that may occur<sup>15</sup>.

## MATERIAL AND METHODS

In this retrospective study we want to evaluate the acute ear diseases associated with acute URI in a lot of 92 children (from a lot of 129 consecutive children) who presented at Medlife Baneasa ENT Department, over 1 month in the winter season, for acute URI associated with otologic symptoms or disease.

Study inclusion criteria:

- Presence of otological symptoms, acute phase;

Study exclusion criteria:

- Absence of otological symptoms;
- Chronic medical problems or anatomical defects of the ear or nasopharynx.

The diagnosis protocol included:

- Clinical ENT examination;

- Nasal endoscopy, using a flexible 2.5 mm fiberscope - in those cases where the visualization of the rhinopharynx was impaired;
- Ear endoscopy, using a 0-degree, 2.7 mm rigid telescope;
- Tympanogram and stapedia reflex - in those cases with absence of fluid in the middle ear;
- Pure tone or behavioral audiogram - where possible, depending on patient's age;
- Subjective appreciation by parents of nasal obstruction, hearing level, snoring, quality of sleep;
- Radiological examination was performed in certain cases with acute suppurative otitis media, spontaneous perforation of the tympanic membrane - Schüller's incidence X-ray, CT/MRI.

The reassessment of our patients was first performed at 3 and 10 days after the first visit and then after 1 and 3 months.

## RESULTS

In the study were included 92 pediatric patients with acute URI associated with otologic symptoms or disease (from a lot of 129 consecutive children presented for acute URI). The rest of 37 patients presented normal findings at the clinical examination and normal tympanogram on both ears and were excluded from the study (Figure 1). The age range was 6 to 60 months. The boys were found to be more frequently affected than the girls - 54.3% (sex ratio boys/girls - 1.2:1); almost the same percentage was found in the whole lot of 129 patients with acute URI.

In the studied lot, almost all children aged 6 to 12 months were found to have uni- or bilateral ear disease - 88.9% (8 patients); the children aged 13 to 24 months presented ear disease in 52.9% (9 patients) of the cases. In the 25-36 months age group, 59.4% (19) of children presented ear diseases; 72.3% (34) in the 37-48 months age group and 81.5% (22) in the 49-60 months age group (Figure 2).

The highest incidence of ear disease - 36.6% (34) - was found in the age group of 37-48 months (three years old), followed by the four-year-old group (49-60

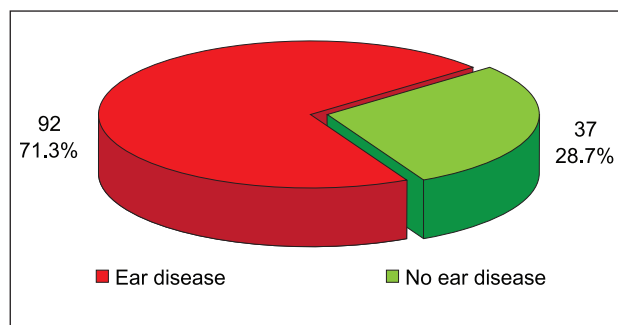
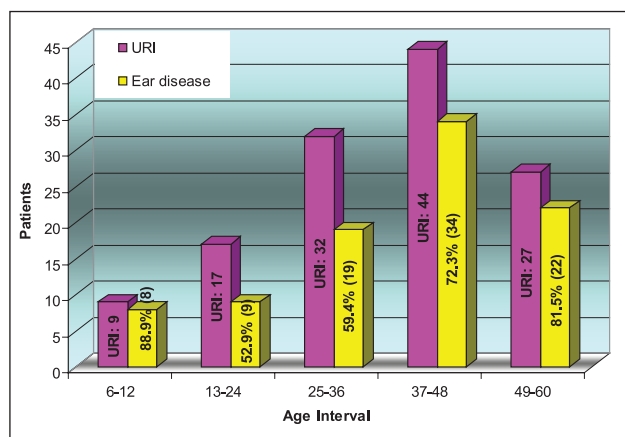
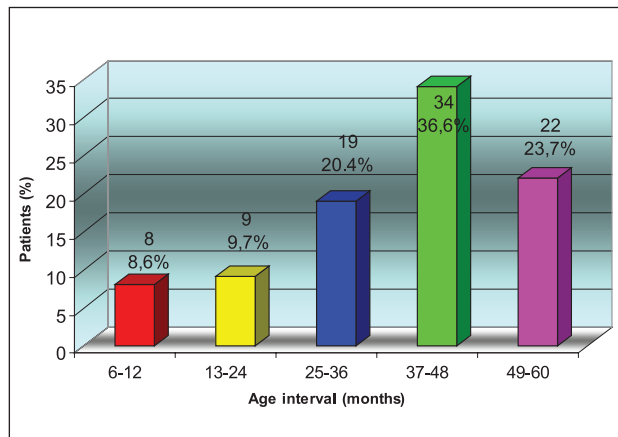


Figure 1 Ear disease in pediatric patients with acute URI first visit, n=129



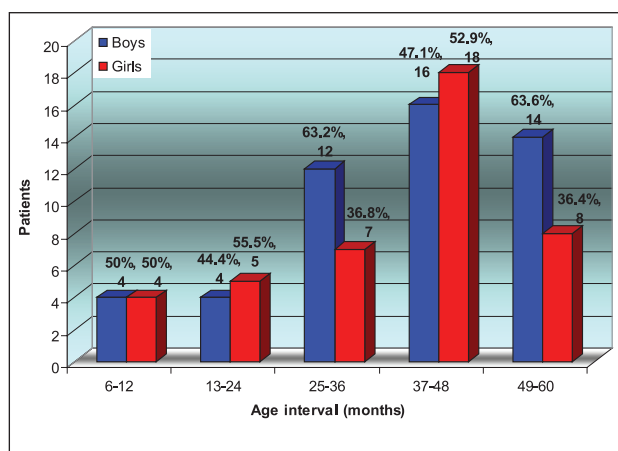
**Figure 2** Ear disease percentage in pediatric patients with acute URI first visit, on specific age intervals, n=129



**Figure 3** Age distribution of children with acute middle ear diseases in acute URI, n=92

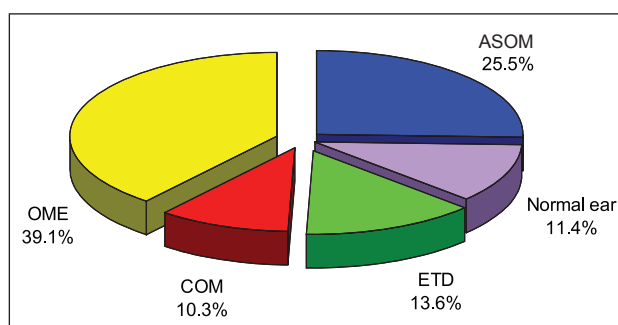
months) - 23.7% (22 patients), the two-year-old group - 20.4% (19) of the patients, one-year-old group - 9.7% (9) and the group under one year old - 8.6% (8) of the patients; the mean age was 38.2 months (Figure 3).

Regarding the sex distribution, until 24 months of age the boys were found to be affected in almost the same percentages as the girls. At the 2 years old group and the 4 years old group years old the boys were found to be significantly more affected than the girls - almost 63% boys versus 37% girls (12 boys versus 7 girls in the 25-36 months group and 14 boys versus 8 girls in the 49-60 months age group). At 3 years old (37-48 months age group) the girls were found to be slightly more affected than the boys - 52.9% (18) girls versus 47.1% (16) boys (Figure 4).



**Figure 4** Gender distribution by age groups of acute middle ear pathology, n=92

The most frequent acute ear pathology (each ear taken separately) identified in the selected lot of 92 children was otitis media with effusion (OME) - 39.1% (72) ears, followed by acute suppurate otitis media (ASOM) - 25.5% (47), Eustachian tube dysfunction (ETD) - 13.6% (25) and congestive otitis media (COM) - 10.3% (19); healthy, normal ears - 11.4% (21) ears (Figure 5). Spontaneous perforation of the tympanic membrane was present in 3 (3.3%) patients. No acute mastoiditis was registered in the selected lot.



**Figure 5** Distribution of acute middle ear pathology in children with acute URI and ear disease, n=92

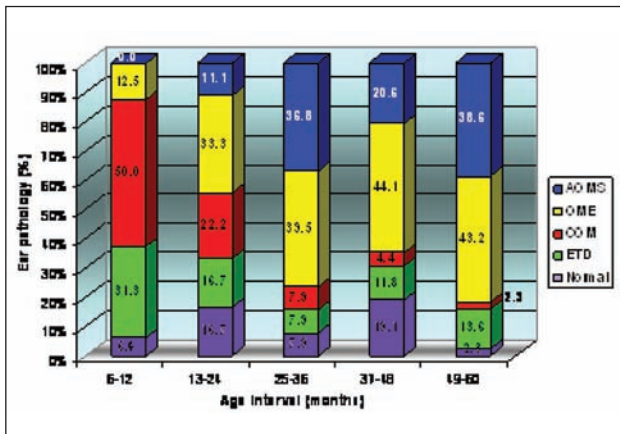
The distribution of ear diseases registered on specific age groups was (Figure 6):

- 6-12 months: COM - 50% (8), ETD - 31.3% (5), OME - 12.5% (2); normal ears - 6.4% (1);
- 13-24 months: OME - 33.3% (6), COM - 22.2% (4), ETD - 16.7% (3), ASOM - 11.1% (2); normal ears - 16.7% (3);
- 25-36 months: OME - 39.5% (15), ASOM - 36.8% (14); COM - 7.9% (3), ETD - 7.9% (3); normal ears - 7.9% (3);
- 37-48 months: OME - 44.1% (30), ASOM - 20.6% (14); ETD - 11.8% (8), COM - 4.4% (3), normal ears - 19.1% (13);

- 49-60 months: OME - 43.2% (19), ASOM - 38.6% (17); ETD - 13.6% (6), COM - 2.3% (1), normal ears - 2.3% (1).

Bilateral ear disease in children with acute URI was found in 78.3% (72) patients (Figure 7).

The distribution of ear pathology in the 21.7% (20) children with unilateral ear disease was as fol-



**Figure 6** Distribution of acute middle ear pathology depending on age in children with acute URI, n=92

lows: OME - 50% (10), COM - 20% (4), ETD - 20% (4), ASOM - 10% (2 cases) (Figure 8). Thus, middle ear discharge was present in 60% (12) of the children with unilateral ear disease. 1 patient (5% of children with unilateral ear disease, 1.4% of the whole lot of children with ear diseases) presented

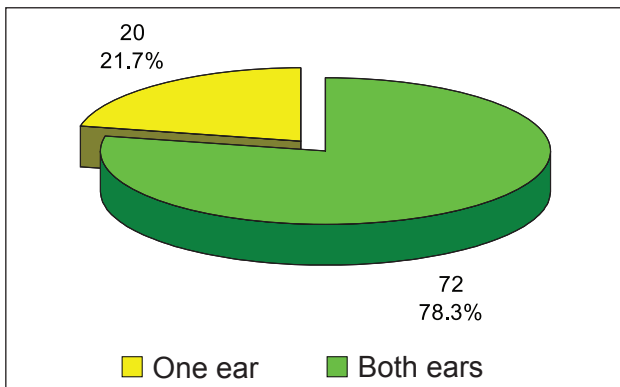
spontaneous perforation of the eardrum at the time of presentation.

The pathology distribution on each ear in patients with bilateral ear disease – 78.3% (72) children of the selected lot – was as follows: OME - 42.4% (61), ASOM - 30.6% (44), ETD - 16.7% (24) and COM - 10.3% (15) ears (Figure 9). In this lot, 2.8% (2) children had spontaneous perforation of the eardrum at the time of presentation (unilateral perforation).

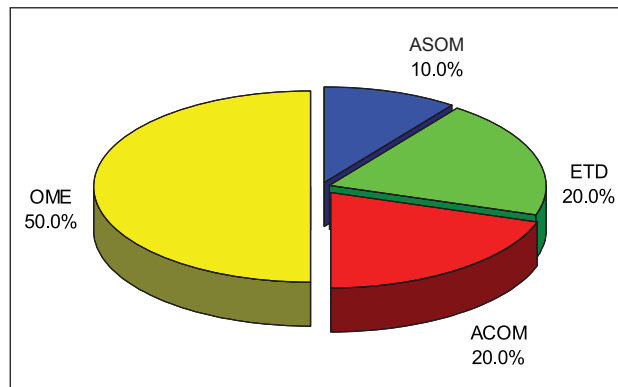
51.8% (47%) children with bilateral ear disease presented ear discharge on both ears (OME, ASOM, OME+ASOM). Middle ear discharge on at least one ear was present in 80.6% (58) children with bilateral ear disease of the selected lot (OME, ASOM, OME+ASOM etc.) (Figure 10).

The most common bilateral finding in patients with ear disease was bilateral OME - 30.6% cases. The clinical findings at ear endoscopy in patients with bilateral ear disease are presented in Table 1.

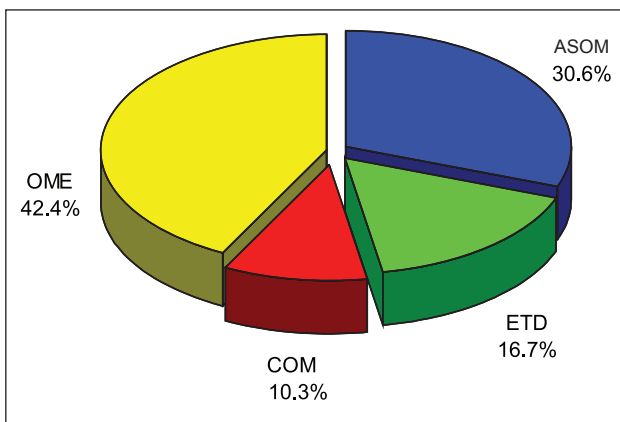
The majority of children - 97.8% (90 cases) - with acute URI and ear disease presented nasal symptoms of disease (nasal blockage, rhinorrhea, coughing during sleep due to posterior drainage of abundant nasal secre-



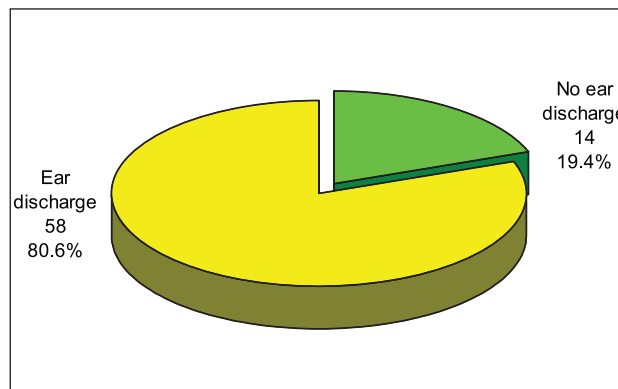
**Figure 7** Bilateral middle ear disease in children with acute URI, n=92



**Figure 8** Distribution of ear pathology in patients with unilateral acute middle ear disease, n=20



**Figure 9** Distribution of ear pathology in patients with bilateral middle ear disease, n=72



**Figure 10** Ear discharge present at least in one ear in children with acute bilateral middle ear disease, n=72

**Table 1**  
**Distribution of pathology in patients with acute bilateral middle ear disease, n=72**

Type	Cases	Percentage (%)
ETD Bilateral	9	12.5
COM Bilateral	4	5.6
<b>OME Bilateral</b>	<b>22</b>	<b>30.6</b>
AOMS Bilateral	15	20.8
COM+ETD	1	1.4
OME+ETD	3	4.2
OME+COM	4	5.6
OME+AOMS	10	13.9
AOMS+ETD	2	2.8
AOMS+COM	2	2.8

tions): acute rhinoadenoiditis - 58.7% (54 cases) (adenoids with signs of acute inflammation: congestive mucosa, covered by purulent secretions mucosa, little hemorrhagic areas and deleted inter-lobar ditches; rhinorrhea, nasal blockage) and acute rhinitis - 39.1% (36 children) (rhinorrhea, nasal blockage, non-suppurative rhinitis). Acute pharyngitis was present in 26.1% patients, tonsillitis - 4.3% (4 cases), with GABHS (Group A beta Hemolytic Streptococcus); laryngitis in 2.2% (2) children; tracheitis - 4.3% (4); bronchitis - 3.3% (3). 2.2% (2) of the patients presented signs of acute purulent conjunctivitis (Figure 11)<sup>16,17</sup>.

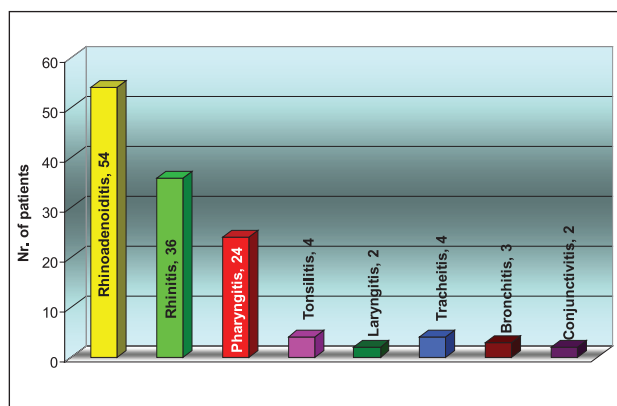
#### Endoscopy aspects

Ear endoscopic examination revealed typical aspects for acute congestive otitis media, otitis media with effusion or acute suppurative media (Figure 12).

**Acute rhinoadenoiditis.** 58.7% of the children presented clinical and endoscopic findings of acute rhinoadenoiditis: adenoids with signs of acute inflammation - congestive mucosa, covered by purulent secretions, deleted inter-lobar ditches and little hemorrhagic areas; rhinorrhea, nasal blockage (Figure 13).

## DISCUSSIONS

Otitis media with effusion is one of the most frequent diseases of childhood; some studies indicate that at least 80% of children experience one or more episodes of otitis media with effusion till the age of four<sup>10</sup>; 30% of children experience three or more episodes of otitis media with effusion until the age of six, with a peak incidence in the first two years of life<sup>1,4,5,19</sup>.



**Figure 11** URI manifestations as primary or secondary symptoms in patients with ear symptoms or disease, n=92

The most important element in acute otitis media is making the correct diagnosis, as early as possible<sup>1</sup>.

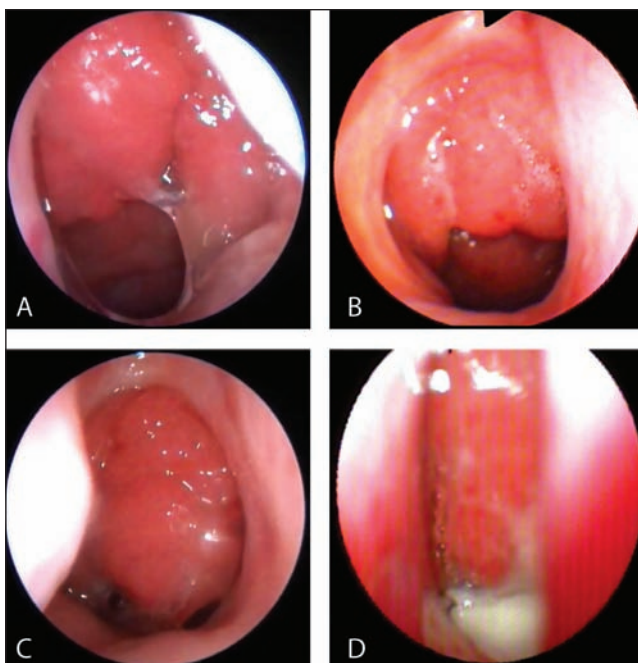
The most frequent middle ear pathology identified in our study was acute otitis media with effusion (39.1%), results that are correlated to those found in the literature. The most frequent pathologies, after otitis media with effusion, identified in our study were: acute purulent otitis media (25.5%), Eustachian tube dysfunction (13.6%) and congestive otitis media (10.6%).

Acute ear infection causes fever, indisposition and prostration in a large number of children. Sometimes, however, there may be otitis and no fever. It is important to remember that small children, especially those under one year of age, may have infections and no fever. In these cases the infant may present increased irritability and alterations in feeding patterns (crying





**Figure 12** A) Normal tympanic membrane; B) Acute congestive otitis media - congestion in Schrapnell and along the handle of the hammer; acute erythematous lesion of the external auditory canal covered by white inhomogeneous squamiae; C) Otitis media with effusion - through the semi-transparence of a relatively aspirated tympanum can be seen in the middle ear air bubbles captive in a clear sero-citrine liquid; D) Otitis media with effusion - serous-opalescent liquid filling the whole middle ear; E) Acute suppurative otitis media - in the acute phase the gross tumefaction of the posterior hemi-tympanum can be observed and appears to occur due to the accumulation of purulent exudates visible through the semi-transparence given by the pushing and thinning of the supra-adjacent tissues (A, C, D - personal library, Dr. Vlad Postelnicu; B, E - reproduced, with permission, from: Sarafoleanu C, Manea C, Neagu A, Postelnicu V. Atlas of Endoscopy in Otolaryngology. Romanian Academy Publishing House, Bucharest, 2009, 121-122<sup>18)</sup>



**Figure 13** A) Small adenoids, left nostril, covered by abundant, sticky secretions which also block the left torus tubarius; B) Medium volume adenoids (right nostril) with the surface and especially the ditches covered by aerated serous secretions; C) Large volume adenoids (left nostril) with almost total obstruction of the left nostril and blocking the Eustachian tube; D) Acute suppurative adenoiditis (left nostril) - circumscribed bulky package (the lower pole extending down the middle part of the inter-choanal septum) with deleted inter-lobar ditches, congestive mucosa and little hemorrhagic areas covered by purulent secretions, indicating acute inflammatory condition (A, C - personal library, Dr Vlad Postelnicu; B, D - reproduced, with permission, from Sarafoleanu C, Manea C, Neagu A, Postelnicu V. Atlas of Endoscopy in Otolaryngology. Romanian Academy Publishing House, Bucharest, 2009, 62-65<sup>18)</sup>

when sucking or refusing to eat)<sup>9</sup>. Eustachian tube dysfunction is the starting point for the most acute and chronic inflammatory diseases and their complications of the middle ear<sup>20</sup>.

One of the causes leading to a malfunction of the auditory tube is nasal pathology; the most important mechanism of nasal obstruction is inflammation, between these two symptoms being a direct connection; the severity of nasal airway resistance can influence the grade of Eustachian tube dysfunction<sup>20,21</sup>. The Eustachian tube dysfunction can appear due to obstructive factors or an alteration of its permeability; the obstruction can be caused by adenoids, their hypertrophy and inflammation leading to an auditory tube dysfunction with reduction of the ventilation of the middle ear and accumulation of liquid. The hypertrophy of the adenoids represents the primary cause of otitis media with effusion among pediatric population<sup>19,22</sup>. Respiratory infections affect the size of adenoids<sup>23</sup>. In the acute phase of inflammation, the acute enlargement of the adenoids may cause ear disease, especially in those ears with a low degree of pneumatization of the mastoid air cells, due to the blocking of the Eustachian tube.

In our study, the main symptoms of acute URI accused by parents in children aged up to two years were: rhinorrhea, agitation, fever, restless sleep, cough and, in particular cases, some older children put the hand more frequently on the affected ear; most parents came to the ENT specialist for symptoms of URI related to nose, pharynx or general, not for ear diseases. Many children aged two years and most of those aged three and four years accused ear pain (in congestive otitis media, acute purulent/suppurative otitis media and the onset of otitis media with effusion). Only few children complained of symptoms of Eustachian tube dysfunction (older ones). 58.7% (54 patients) of the children with ear disease from our study presented acute inflammation of the adenoids and 39.1% (36 patients) acute rhinitis. 97.8% (90 children) of the patients had both acute nasal manifestations of URI and ear disease.

Discharges in the ear - the child may have an episode of severe earache, crying intensely during night; then, in the morning, there may be some discharge from the ear. Usually there is some relief of pain when there is discharge<sup>9</sup>. In our study, complications of untreated local intense ear pain - perforation of the eardrum (acute otitis media, pre-perforative stages) came after long periods of intense crying during night, restless sleep, with loss of appetite and, in two of the three cases, with acute laryngitis.

Schüller's incidence X-ray was performed in certain cases with acute unilateral suppurative otitis media, or bilateral otitis media associated with a small volume of adenoids and mild symptoms of URI, or in cases with spontaneous perforation of the tympanic membrane

and unilateral ear disease. The more severe pathology on one ear was correlated with a poor pneumatization with cloudiness of the projection area of the mastoid air cells or absence of pneumatization of the mastoid air cells at Schüller's incidence X-ray<sup>24-28</sup>. Thus, in acute URI, the less pneumatized mastoids are more likely to develop middle ear effusion because of the acute lack of ventilation through the Eustachian tube.

Some children may have delays in language, often seen by parents as late or wrong pronunciation of letters, then words, as the maximum plasticity of the brain for speech learning is considered to be between 2 to 4 years old<sup>4,11</sup>.

Many factors such as adenoids volume, duration of acute infection or inflammation, bacteriological contamination, degree of pneumatization of the mastoid air cells, age and ability to clean the nose can influence the severity and duration of disease.

In our study, the acute URI and middle ear diseases were found to be more frequent in boys, with a ratio 1.2:1. Almost all children aged 6-12 months who presented for ENT consultation with acute URI - 88.9% (8 of 9) had middle ear diseases, although the parents did not suspect any ear disease of the kids; a high percentage of middle ear diseases was noticed in all age groups: 52.9% in the 13-24 months age group, 59.4% in the 25-36 months age group, 72.3% in the 37-48 months age group and 81.5% in the 49-60 months age group. A possible explanation for the high percentages registered at the ages above 25 months, compared to those aged 13-24 months, is that the majority of the first ones were enrolled in daycare/kindergarten.

The middle ear discharge on at least one ear was present in 80.6% children with bilateral ear disease of the selected lot; 51.8% children presented ear discharge on both ears; only 20.5% children presented ear afflictions without ear discharge on both ears.

We found important to assess the children's health during a correct and complete interdisciplinary consultation between ENT, pediatrician and, when necessary, radiologist.

## CONCLUSIONS

Acute ear disease in children is a very common complaint during acute URI. The most frequent acute afflictions of the middle ear identified in acute URI in children up to five years old referred to ENT specialist were acute otitis media with effusion, followed by acute purulent/suppurative (pre-perforative stage) otitis media.

The most important factor for onset of an acute middle ear disease in children is nasal pathology. Nasal obstruction secondary to the hypertrophy of

adenoids and acute inflammation represents the primary cause of acute middle ear diseases in acute URI among pediatric population, since it produces Eustachian tube dysfunction of different grades.

URI and otic pathology should always be correctly investigated and treated in infants, taking into account the complications that may occur.

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