

ORIGINAL STUDY

Ear ventilation tubes in children with otitis media with effusion and adenoid hypertrophy

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ABSTRACT

BACKGROUND. Acute otitis media is one of the most frequent diseases of children under 5 years, and most of the cases require sustained medical therapy due to possible complications and the total period of hearing impairment. Early detection of the otitis media with effusion (OME) in children is important for normal speech development.

OBJECTIVE. The aim of the study is to evaluate the efficacy of adenoidectomy versus adenoidectomy with ear tubes fixation at the same time of surgery, in a selected lot of patients diagnosed with adenoid hypertrophy, OME and a history of recurrent OME.

MATERIAL AND METHODS. The study was carried out on 40 selected children in the age range 2-7 years, diagnosed with adenoid hypertrophy accompanied by uni/bilateral recurrent OME. All patients underwent adenoidectomy; tympanotomy with ear tube fixation was performed in 35% cases.

RESULTS. Bilateral conductive hearing loss (CHL) was found in 80% of the patients. In those patients with OME at the time of surgery, who underwent adenoidectomy as single procedure, complete remission of the CHL level was achieved up to 1 month. Immediate remission of CHL was achieved in all patients who underwent tympanotomy and ear tube fixation; remission maintained also at 14 and 30 days. Recurrence of OME and CHL was present in 42.3% patients who underwent adenoidectomy alone; the remission of the recurrences was achieved with medical treatment up to 21 days in most patients. Recurrence of ear discharge on blocked ear tubes was noted in 21.4%; the duration of the ear discharge and CHL until remission was up to 7 days. All recurrences were secondary to acute upper respiratory tract infections (URI).

CONCLUSIONS. Adenoidectomy provides a faster remission of OME and is effective in preventing its recurrences. The recurrences of OME have a much smaller healing period after adenoidectomy. Ear tubes fixation ensures the opportunity of a faster recovery of the ear, immediately reducing the CHL secondary to OME. The duration of CHL is much shorter in recurrences of ear discharge on blocked ear tubes than in patients without ear tubes. Early drainage of the middle ear effusion ensures improvement of the quality of life, both immediately after surgery and on a long term basis, supporting the ventilation of the mastoid air cells, essential for the normal functioning of the ear.

KEYWORDS: otitis media, ear tubes, adenoidectomy

INTRODUCTION

Acute otitis media (AOM) represents one of the most frequent diseases of children under 5 years old, and most of them require sustained medical therapy

due to its possible complications and the total period of hearing impairment on the individual. Early diagnosis of otitis media in children has a crucial role in normal speech development, as the most important period to acquire it is between two and four years old^{1,4}.

Otitis media with effusion (OME) represents an accumulation of non-purulent fluid of various viscosities within the middle ear cavity and is a nonspecific inflammation^{2,5}. The inflammation of the middle ear results in metaplasia of the middle ear mucosa, with the proliferation of mucus glands and goblet cells⁶. Pathophysiology of otitis media with effusion usually involves inflammatory conditions of the nasopharynx, any mechanism that causes dysfunction of the Eustachian tube reducing the pressure or aeration of the middle ear. This mechanism causes negative pressure in the middle ear, leading to formation of serous effusion and metaplastic transformation of the mucosa in time. Mucous effusion is mostly seen in children, while in adults we mostly find the serous effusion⁷⁻¹⁰. The study performed on children forced us from the beginning to pay attention to the complications that the middle ear diseases may cause: chronic otitis, recurrent acute otitis, inflammation of the mastoid tissue (acute or chronic mastoiditis), retraction pockets and adhesive complication, tympanic membrane perforation, tympanosclerosis, cholesteatoma, toxic labyrinthitis, delay in speech and language development due to the total period of hearing loss¹⁻¹⁵.

Literature reminds about the adenoids role in producing IgA, as one of the first mechanisms of protection against invasion of microorganisms and foreign molecules. Adenoid hypertrophy involves abnormal growth of adenoid tissue in the nasopharynx that can entirely block the nasal air flow; 5 is considered the maximum age when middle ear complications accompanying adenoids can occur¹⁶⁻¹⁹.

MATERIAL AND METHODS

We admitted in this study 40 children diagnosed with adenoid hypertrophy and otitis media with effusion at the time of surgery. The patients presented in our ENT department between April 2010 and February 2011 and were aged between 1 year 11 months and 6 years 11 months at the time of surgery. The mean interval between first visit and surgery was 71 days.

We will comment upon several aspects regarding otitis media with effusion in children with adenoid hypertrophy:

- the opportunity of ear tubes fixation;
- the total period of the conductive hearing loss which accompanies the otitis media with effusion;
- attempt to make a correlation between the presence of adenoids and repeated otitis media with effusion and conductive hearing loss in children.

Study admission criteria:

- Presence of adenoid hypertrophy;
- Presence of otitis media with effusion at the time of surgery;

- History of recurrent otitis media with effusion.

Study exclusion criteria:

- Absence of adenoid hypertrophy;
- History of previous adenoidectomy or ear surgery;

Preoperative diagnosis:

- All patients included in the study benefited from:

- ✓ Nasal endoscopy, using a flexible 2.5mm fiberoptic;
- ✓ Ear endoscopy, using a 0-degree, 3 mm rigid telescope;
- ✓ Tympanogram and stapedial reflex;
- ✓ 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, quality of life;

- Radiological examination was performed in certain cases with repetitive acute otitis media, otitis media with effusion unresponsive to treatment, repeated acute suppurative otitis media, spontaneous perforation of the tympanic membrane - Schüller's incidence X-ray, CT/MRI.

Postoperative follow-up:

- Control after 3, 10 days and 1, 3 and 6 months and every time the parents considered it necessary (upper respiratory tract infections, subjective increase of the hearing impairment etc.);
- The same diagnostic procedures as in preoperative diagnosis.

Treatment.

a. Preoperative treatment. All the children underwent nasal lavage with isotonic saline nasal sprays at least twice a day at home, from the first visit; those patients with moderate and severe nasal obstruction received topical nasal decongestants for 7-14 days; some patients, especially those who had a history of allergic rhinitis, received nasal corticosteroids once a day after toileting the nose with saline nasal sprays. In acute inflammatory diseases of the ear - acute congestive otitis media, acute suppurative otitis media - the patients received intra-auricular anti-inflammatory therapy for pain relief for a period of 1 to 5 days; in certain patients with acute suppurative otitis media, oral antibiotics were recommended.

b. Surgery. All patients underwent adenoidectomy with/without tympanotomy and ear ventilation tube fixation in the same conditions involving surgery; the operation was performed under general anesthesia, with resection of the adenoids in the head-extended position ("hanging position")²⁰ under endoscopic surveillance^{20,21,22}. The resected specimens (adenoids) were sent for anatomico-pathological examination. The biopsy samples were formalin-fixed, paraffin-embedded and histopathologically examined; the routine

stain used was Haematoxylin and Eosin for the assessment of the histopathological aspects²³. Tympanotomy was done under optical microscopy in the same operatory sequence as secondary stage. Tympanotomy was followed by the suction of the middle ear discharge and lavage of the middle ear with Dexamethasone 21-phosphate in all the cases^{24,25,26}. The secretions collected from middle ear mucosa were sent for bacteriological examination.

c. Postoperative treatment. In the post-surgery surveillance period, the children continued nasal cleaning with saline solution and decreased the use of nose drops with vasoconstriction effect only for the periods of acute upper respiratory tract infections. In those cases with recurrence of ear discharge on blocked ear tubes, we performed lavage of the ear tubes with Dexamethasone and active drainage of the effusion through the ear tube; these patients received local antibiotic ear solutions for up to 5 days.

RESULTS

The highest incidence of adenoid hypertrophy accompanied by otitis media with effusion was found in 3 year-old children (Figure 1). At the time of surgery, 72.5%²⁹ of all children included in this study presented bilateral otitis media with effusion (acute, in remission or chronic otitis media with effusion), 7.5%³ otitis media with effusion and Eustachian tube dysfunction (ETD) and only 20%⁸ unilateral otitis media with effusion. Implicitly, 80% of children had bilateral conduc-

tive hearing loss of different degrees at the time of surgery (Figure 2).

The 40 patients included in this study were divided into 2 lots:

- first lot: 26 patients (65%) - treated surgical, only adenoidectomy;
- second lot: 14 patients (35%) - treated also surgical, adenoidectomy and uni- or bilateral tympanotomy with ear ventilation tube fixation.

In the first lot of patients we performed **adenoidectomy** as a single procedure - on 65%²⁶ of the children included in this study that presented at the time of surgery:

- otitis media with effusion acute or in a remission phase, and
- a large package of adenoids in the rhinopharynx (Figure 3).

Bilateral ear disease (bilateral otitis media with effusion, otitis media with effusion and Eustachian tube dysfunction) and, implicitly, bilateral conductive hearing loss, were found in 76.9%²⁰ of the children from the first lot. Taking into consideration the average period of 71 days between the first visit and surgery, we make a special remark on the duration of the conductive hearing loss of different degrees, but in remission, present in these cases (Figure 4).

Remission of the symptoms of recurrent otitis media with effusion and of the conductive hearing loss in patients who suffered adenoidectomy as single procedure was acquired up to 1 month after surgery.

In the second lot of patients we performed **adenoidectomy and tympanotomy with ear ventilation**

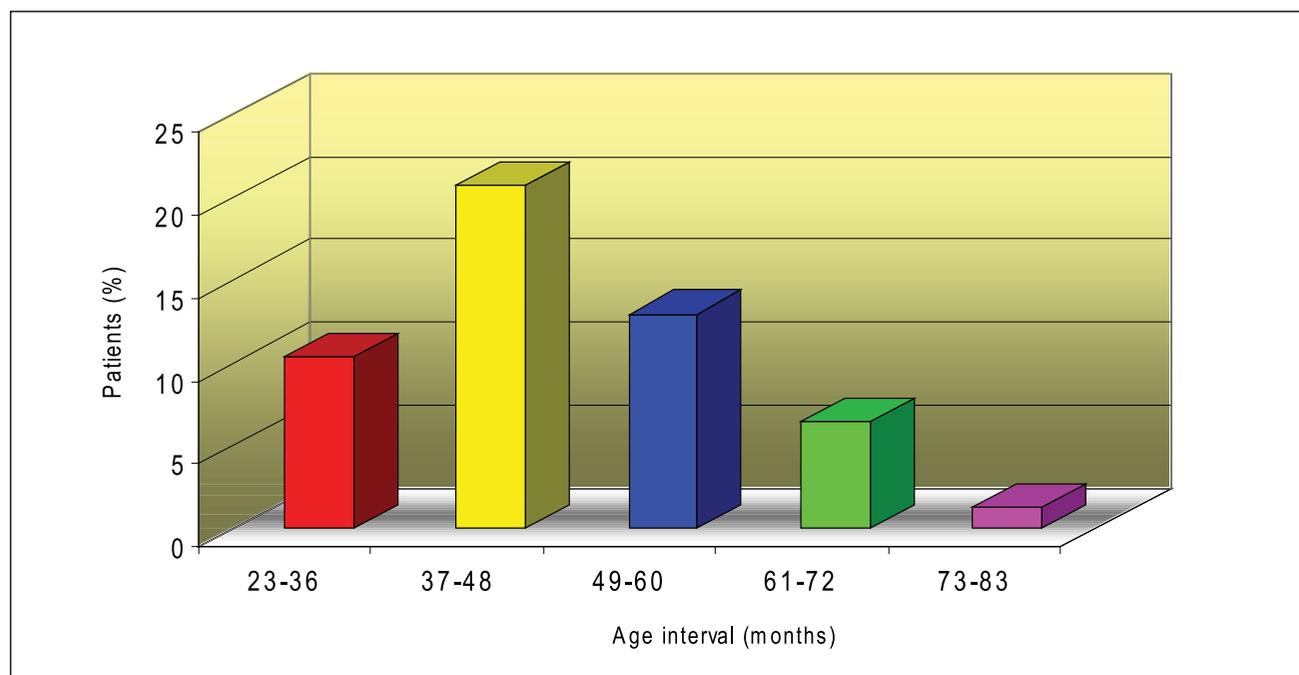


Figure 1 Age distribution, n=40

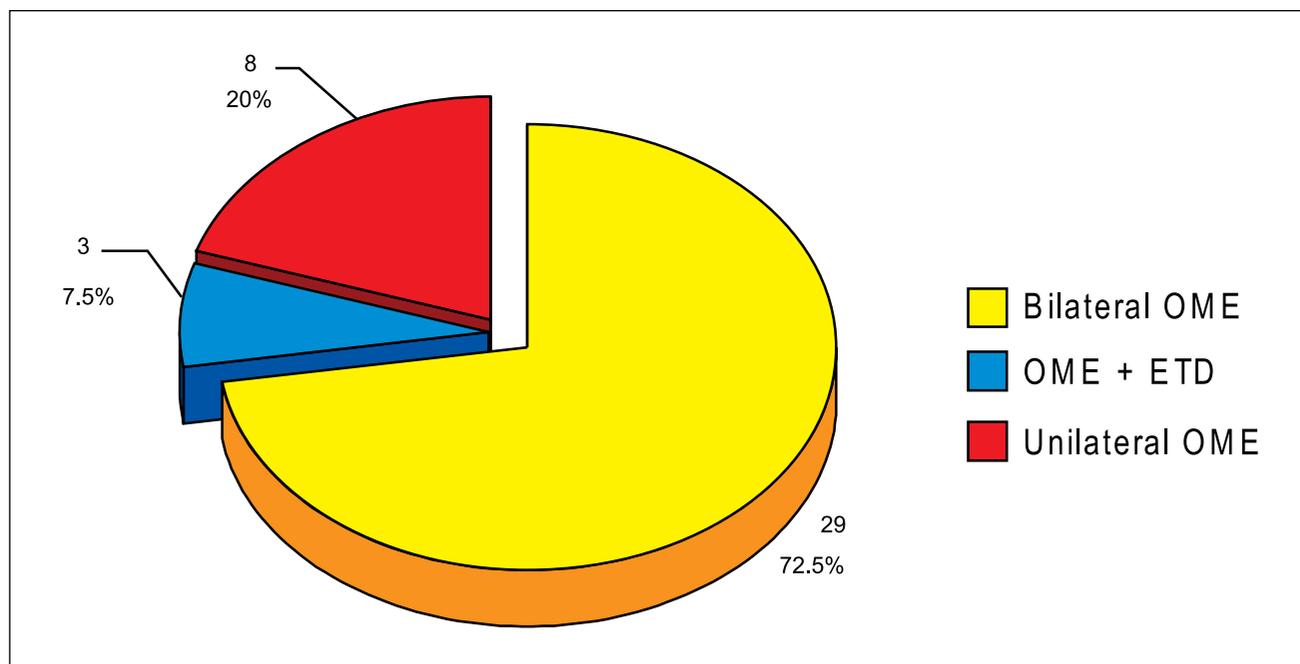


Figure 2 Ear disease and CHL at the time of surgery, n=40



Figure 3 a) Enlarged adenoids covered by abundant secretions, obstructing the nasal flow and the Eustachian ostium, left nostril; b) Medium size adenoid hypertrophy, with partial obstruction of the air flow and no obstruction of the Eustachian ostium, right nostril; c) Acute otitis media with effusion, remission phase, left ear - through the semitransparency of a relatively aspirated tympanum can be seen air bubbles captive in the clear sero-citrine liquid from the cavum tympani; d) Chronic otitis media with effusion, right ear - through the transparency of the relatively aspirated tympanic membrane can be seen a brown-yellowish liquid with a meniscus-like aspect (personal library⁽²⁷⁾)

tubes fixation - on 35%¹⁴ of the children included in this study. Ear tubes fixation was performed only in those children where the additional diagnostic tests (ear endoscopy/microscopy, nasal fibroscopy, tympanometry and stapedian reflex, pure-tone audiometry, radiological examination) revealed both the presence of fluid in the middle ear and a poor response to therapy. The criteria of selection were one or more of the followings:

- chronic otitis media with effusion or acute otitis media with effusion with slow/no response to medical treatment;
- recurrent otitis media with effusion;
- history of repeated acute otitis media with spontaneous perforation of the tympanic membrane;

- unilateral ear disease or a more severe pathology on one ear;
- a medium (non obstructive) rather than a large adenoid hypertrophy.

Ear ventilation tube fixation was performed at both ears on 78.6%¹¹ patients and at one ear on 21.4%³ children (Figure 5).

Remission of the symptoms of otitis media with effusion and of the conductive hearing loss (recurrent or irresponsive to medical treatment) in patients who suffered **adenoidectomy and ear tubes** was noticed immediately after surgery; remission maintained also after 14 and 30 days on most patients with ear tubes.

Bacteriological examination of the middle ear secretions taken during tympanotomy showed in 71.4%¹⁰

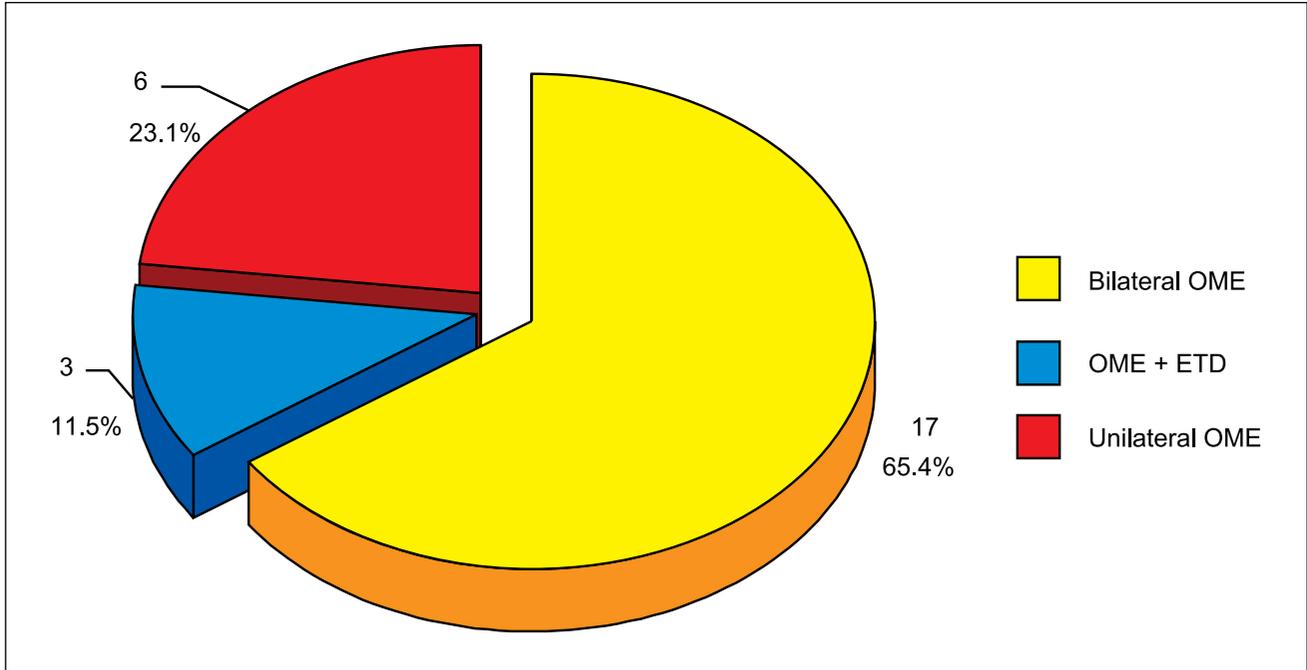


Figure 4 Ear disease and CHL in children who underwent adenoidectomy, n=26

growth of bacterial colonies on the mediums seeded: 28.6%⁴ *Streptococcus pneumoniae*, 21.4%³ *Staphylococcus epidermidis* and, with the same frequency, 7.1%¹ *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Streptococcus viridans*. No growth of any bacterial colonies was registered in 28.6%⁴ cases (Figure 6).

Figure 6

Recurrences. 42.3%¹¹ of the patients who underwent **adenoidectomy** as the only surgical procedure presented recurrences of acute otitis media and otitis

media with effusion at an average of 74 days after surgery; the symptoms and the conductive hearing loss fully recovered under medical treatment up to 21 days. In most patients, the recurrences were present due to secondary to acute upper respiratory tract infections in the winter/spring seasons of 2010/2011 (November-April) (Figure 7).

Blocked ear tubes with recurrence of effusion/ear discharge were noticed in 21.4%³ cases, secondary to acute upper respiratory tract infections, in the winter/

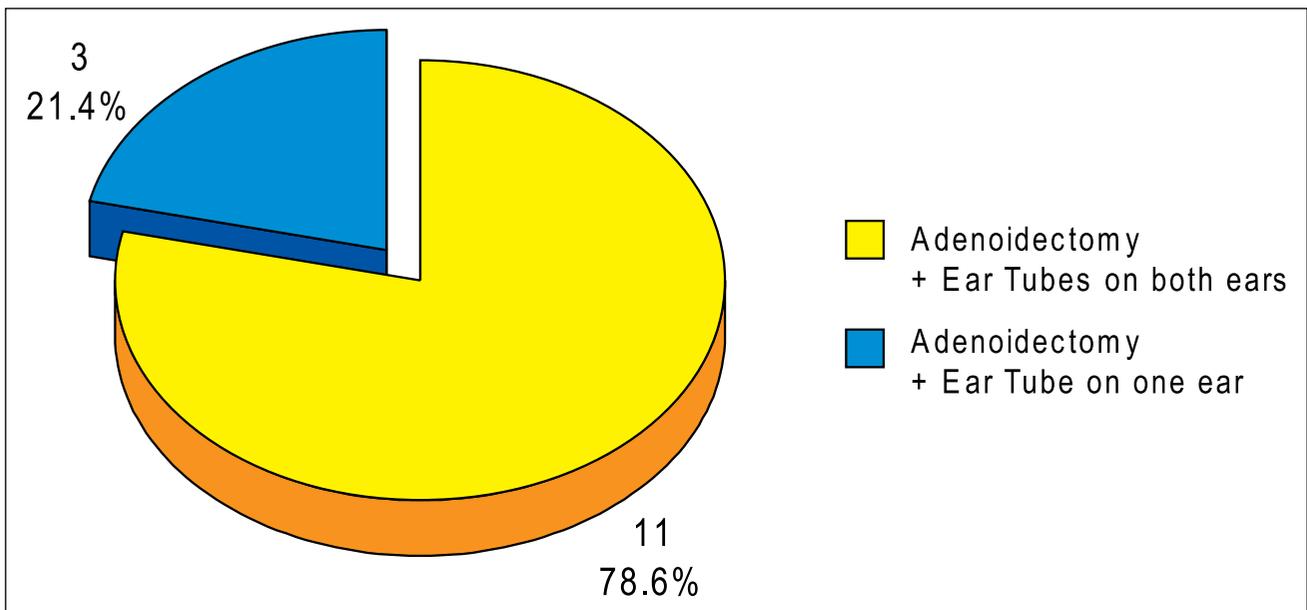


Figure 5 Ear disease and CHL in children who underwent adenoidectomy and ear ventilation tubes fixation, n=14

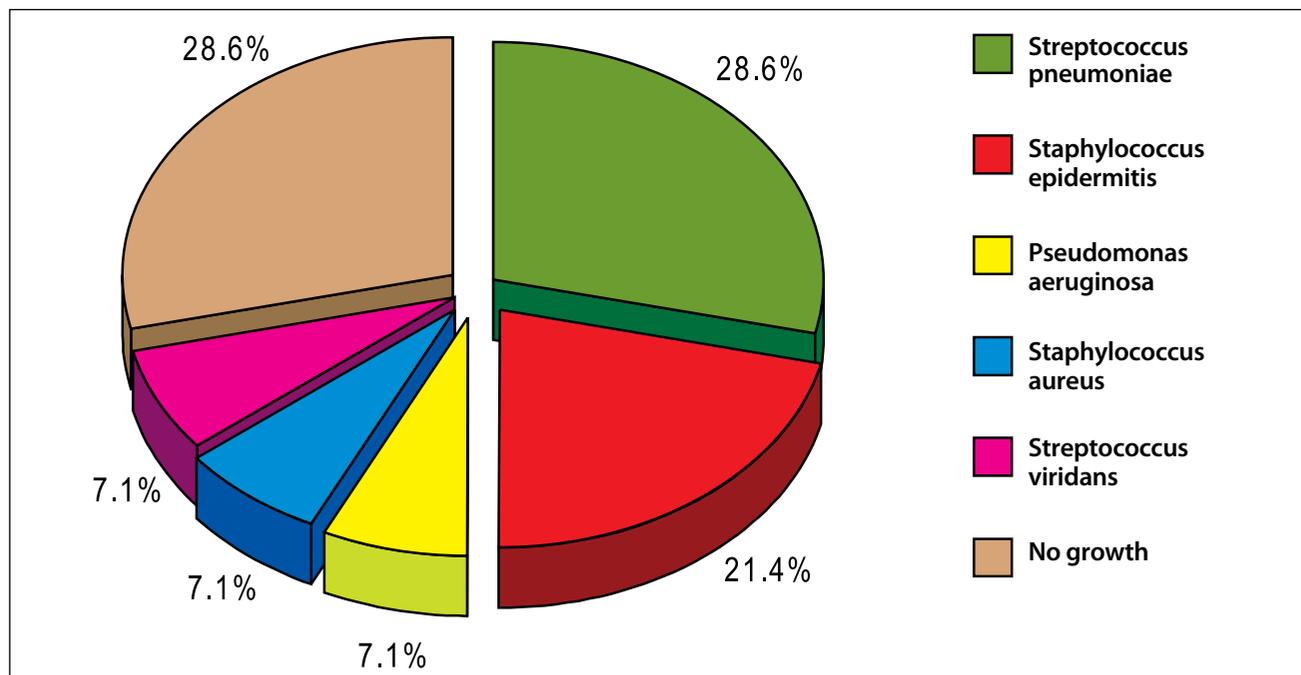


Figure 6 Result of the bacteriological examination of the ear discharge taken during tympanotomy, n=14

spring seasons of 2010/2011 (November-April): 2 of them bilateral and 1 unilateral; the average period of recurrence of ear discharge was at 62 days from surgery (Figure 7). In these cases, the total duration of conductive hearing loss was much shorter than in previous episodes with otitis media with effusion without ear tubes - the dryness of the ear was obtained up to 7

days under local treatment. In Figure 8 we present the evolution of a left ear of a 5 year-old patient with ear tubes and acute ear discharge on blocked ear tube after 60 days from surgery.

45.5%⁵ patients with bilateral ear tubes developed acute upper respiratory tract infections at more than 1 month from surgery but without any affection of the

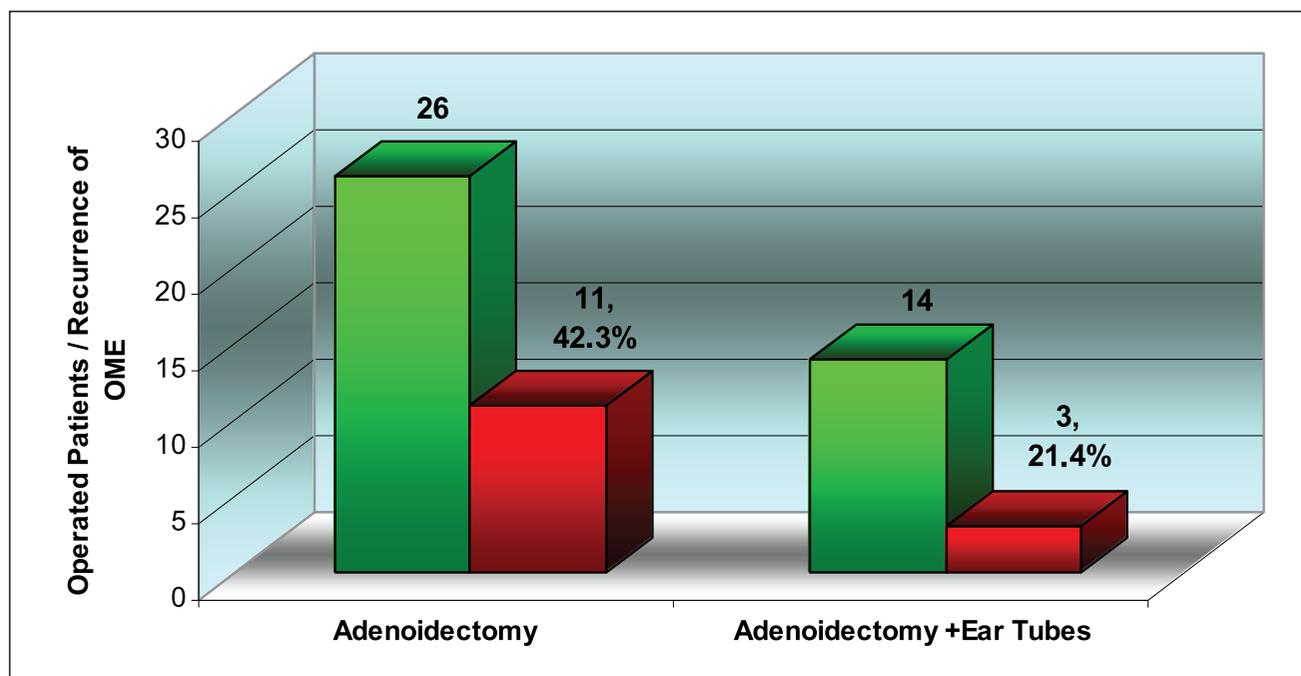


Figure 7 Recurrence of ear effusion in patients with adenoidectomy +/- ear tube fixation (green-patients who underwent the specified procedure, red-recurrence), n=40

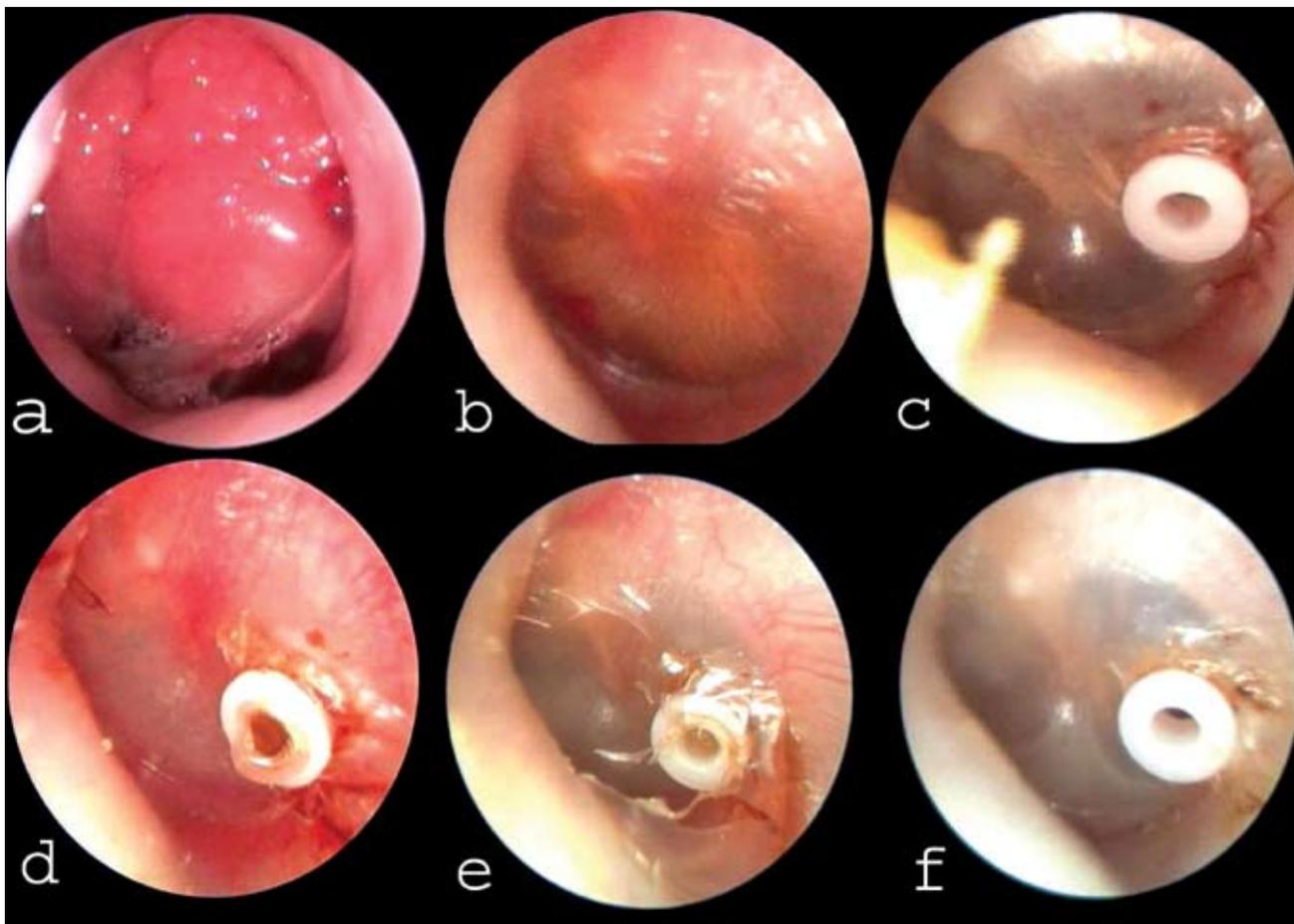


Figure 8 Evolution of a left OME on a 5 years old patient, endoscopic images: a) Enlarged adenoids covered by abundant secretions, obstructing the nasal flow and the Eustachian ostium, right nostril, at the first visit; b) OME, left ear - through the transparency of the tympanum can be seen air bubbles captive in a sero-citrine liquid, first visit; c) Ear ventilation tube, 4 days after surgery - normal tympanic membrane with no secretions in cavum tympani; d) AOM after an URI - ear ventilation tube blocked by thick, sticky secretions; through the semi-transparency of the tympanum can be seen a purulent discharge which is expanding, pushing and thinning the healthy tissues - 60 days from surgery; e) Abortive evolution of the AOM under local treatment - ear tube blocked by dried yellow gummy secretions; through the transparency of the tympanum serous secretions filling the whole cavum tympani can be seen; dried yellow gummy secretions in the external auditory canal - 66 days from surgery; f) Abortive evolution of the AOM - ear tube permeable, through which the serous secretion from the middle ear drains into the external auditory canal - 69 days from surgery (personal library⁽²⁷⁾)

ears (as their major common complaint was before surgery), due to the presence of the ventilation tubes.

14.3%² children developed otitis media with effusion secondary to an acute upper respiratory tract infection; after 1 month the ear tubes were spontaneously eliminated; remission of otitis media with effusion was obtained after 1 month of medical treatment.

Two children who suffered adenoidectomy and unilateral ear tube fixation developed at more than 3 months after surgery acute otitis media in the healthy ear (the ear with normal pneumatization of the mastoid air cells on Schüller's X-ray), secondary to an acute upper respiratory tract infection. The ear with ventilation tube (the one with absence of pneumatization of the mastoid air cells on Schüller's X-ray) remained unaffected in the acute inflammatory state

due to the presence of the ventilation tube, thus the hearing level of the children through the healing period remained almost normal on the operated ear. Remission of the acute otitis media with effusion, secondary to acute upper respiratory tract infections of the non-operated ear, was obtained up to 14 days after medical therapy (nasal decongestants) in both patients (Figure 9).

DISCUSSIONS

Significant improvement of the quality of life (nasal breathing, snoring, sleep apnea, proficiency in school) was reported by parents after surgery. Complete remission of the hearing loss in patients with otitis media with effusion, who suffered only adenoidectomy, was registered up to 1 month after surgery. Significant im-

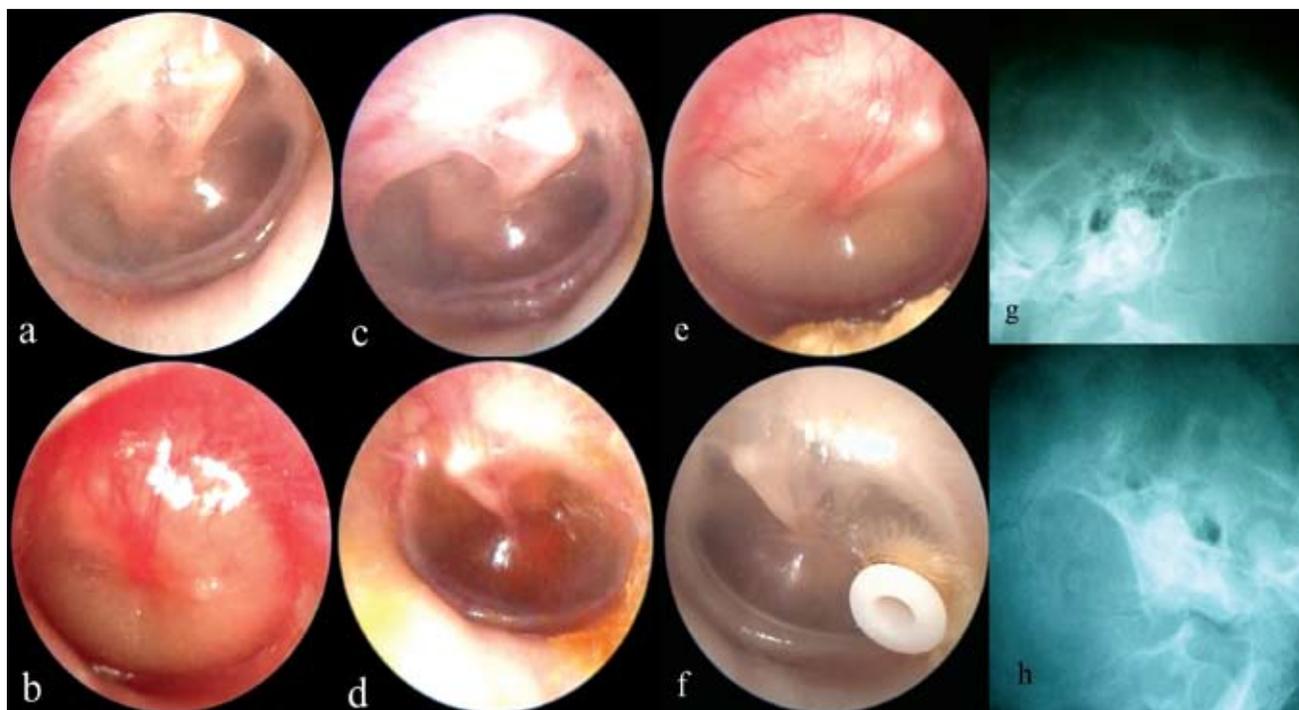


Figure 9 Evolution of a 4y2m child diagnosed with adenoid hypertrophy, with left acute suppurative otitis media and history of repeated otitis media with effusion of the left ear who underwent adenoidectomy and tympanotomy with ear ventilation tube fixation on the left ear. First visit (Figures a-b): a) Right ear-normal tympanic membrane, b) Left ear - acute otitis media, pre-perforative stage. After 1 month (preoperative, figures c-d): c) Right ear-normal tympanic membrane, d) Left ear - otitis media with effusion - through the transparency of the relatively aspired tympanic membrane can be seen a brown-yellowish liquid that fills the whole cavum tympani. 3 months after adenoidectomy and ear ventilation tube fixation on the left ear, in an acute URI (Figures e-f): e) Right ear - acute otitis media with effusion - through the transparency of the tympanic membrane can be seen a serous liquid that fills the whole cavum tympani with a tendency to become purulent, f) Left ear - normal tympanic membrane with ear ventilation tube efficient in the postero-inferior quadrant; no secretion are visible through the transparency of the tympanic membrane nor in the external auditory canal; Figures g-h - Schüller's incidence X-ray of the mastoid bones made at the first visit (equivalent of figures a-b) : g) Right ear - moderate pneumatization of the mastoid air cells, h) Left ear - poor pneumatization and cloudiness of the mastoid air cells (personal library⁽²⁷⁾)

provement of the hearing level was reported postoperatively in those children who underwent tympanotomy with ear ventilation tubes fixation. The total period of hearing loss was smaller in patients with ear tubes.

Recurrences of acute otitis media and otitis media with effusion found in patients who suffered only adenoidectomy were much higher (42.3%) than the recurrences of the ear discharge on blocked ear tubes in patients who suffered adenoidectomy with ear tube fixation (21.4%). Most of the recurrences were secondary to acute upper respiratory tract infections. After adenoidectomy, the ear complications during recurrences were fewer and complete recovery was faster than in the previous episodes of otitis media with effusion acquired before adenoidectomy (up to 21 days, in children who suffered only adenoidectomy). The duration of conductive hearing loss in recurrences of ear discharge on blocked ear tubes was up to 7 days, significantly shorter than in recurrences of the non operated ears.

The efficiency of the ear aeration provided by the ear tube in children with predisposal to ear affections

is demonstrated on a short time basis by the evolution of both the healthy ear and also the operated ear, in acute upper respiratory tract infections as shown above: the healthy ear evolved through an acute otitis media with effusion and the impaired, but operated ear, remained unaffected.

For the middle ear lavage during tympanotomy, we preferred using Dexamethasone for its anti-inflammatory effect on the middle ear mucosa and also for a proper grooming of the middle ear with effusion, thus lowering the risk of developing adhesive and atelectatic postoperative complications (as described in literature)^{24,25,26}.

In most children, further daily cleaning of the nose with saline solutions after surgery provided a normal balance of the nasopharyngeal function, lowering the recurrences and minimizing the complications of the disease.

During this study, we observed after surgery a decrease in volume of the palatine tonsils in those patients diagnosed at the first visit with hypertrophy of the palatine tonsils. A possible cause for this situation may be the removal of the inflammatory/infectious

vicinity inflammation and improvement of the respiratory function.

Useful diagnostic procedures in otitis media with effusion are nasal fibroscopy, ear endoscopy or microscropy, tympanometry and stapedian reflex, hearing examination (tuning fork and pure-tone audiometry - when possible taking into consideration the age), microbiology of the nasal cultures and ear discharge (in otitis media with effusion - effusion taken during tympanostomy), Schüller's X-ray or CT/MRI (acute otitis media with spontaneous perforation of the tympanum, history of repeated acute otitis media/otitis media with effusion especially on one side, otitis media with effusion unresponsive to treatment, chronic otitis media with effusion, mastoiditis).

Most patients with otitis media with effusion at the time of surgery or exacerbations of middle ear diseases after surgery presented a poor pneumatization with cloudiness of the projection area of the mastoid air cells or absence of pneumatization of the mastoid air cells on Schüller's X-ray. The radiological aspect of the mastoid, found on those patients with poor response to medical therapy, guided us during the clinical surveillance, in taking the decision of performing tympanotomy with or without tube fixation. We consider the mastoid bone the key organ responsible for the functioning of the middle ear.

Also, at this time, there is no strong evidence to support the surgical management of unilateral otitis media with effusion⁶, in specific cases where additional diagnostic tests demonstrated a significant more severe pathology on one ear (for example, great difference of pneumatization between the two mastoids at Schüller's incidence X-ray), we performed in the same sequence with adenoidectomy unilateral tympanotomy with ear ventilation tube fixation on the affected ear, with good results.

We make a special remark for total periods of bilateral conductive hearing loss, especially in recurrent otitis media with effusion - each episode of otitis media with effusion lasts at least 14 days until full recovery. At this age range (2 to 4 years), the plasticity of the brain for speech learning is maximum. Limitation of auditory information will lead to delays in language, often seen by parents as late or wrong pronunciation of letters, then words. Parents often present the child to the doctor, accusing breathing difficulties, although at the first consult most of them have hearing problems, as a consequence of otitis media with effusion due to Eustachian tube dysfunction secondary to a large adenoid hypertrophy. In our study we found important to assess the children health during a correct and complete interdisciplinary consultation between ENT specialist, pediatrician and, when necessary, radiologist.

CONCLUSIONS

The adenoid hypertrophy plays an important role in the onset and recurrence of the otitis media with effusion in children. Adenoidectomy provides a faster remission of otitis media with effusion and is effective in preventing its recurrences. After adenoidectomy, the recurrences of otitis media with effusion have a smaller incidence, healing period and gravity. The frequency, gravity and poor response to medical therapy of otitis media with effusion are higher in those patients who have a poor or no pneumatization of the mastoid bone.

The total period of conductive hearing loss is significantly smaller in those children with otitis media with effusion who underwent adenoidectomy with ear ventilation tubes fixation. The duration of conductive hearing loss is also shorter in recurrences of ear discharge on blocked ear tubes than in patients without ear tubes. Taking into consideration the total period of the hearing loss - during the remission period of otitis media with effusion after surgery, during the recurrences and the number of recurrences - the total period of hearing loss is significantly higher in those patients who underwent adenoidectomy without ear tubes. Ear tubes ensure the opportunity of a faster recovery of the ear, immediately reducing the conductive hearing loss secondary to otitis media with effusion, preventing its recurrences. Unilateral surgical management of otitis media with effusion is to be considered in those cases where additional diagnostic tests demonstrated a significantly more severe pathology on one ear.

Early drainage of the middle ear effusion ensures improvement of the quality of life, both immediately after surgery and on a long term basis, supporting the ventilation of the mastoid air cells, essential for the normal functioning of the ear.

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