

OTOLOGY

Alternative treatment for otitis media with effusion: eustachian tube rehabilitation

Un trattamento alternativo dell'otite media effusiva: la riabilitazione tubarica

L. D'ALATRI, P.M. PICCIOTTI, M.R. MARCHESE, A. FIORITA

Institute of Otorhinolaryngology, Policlinico "A. Gemelli", Università Cattolica del Sacro Cuore, Roma, Italy

SUMMARY

In this study, we evaluated the effectiveness of eustachian tube rehabilitation (ETR) as treatment for otitis media with effusion (OME). Thirty-five children with persistent OME were enrolled. Patients were divided into three groups: group I (isolated OME); group II (OME and atypical swallowing); group III (OME, habitual mouth breathing and atypical swallowing). All children underwent ETR. Otomicroscopy and tympanograms were performed before treatment, and at one and three months following ETR. Considering the overall patient population after ETR (one and three months later), the prevalence of type A tympanogram increased significantly compared to before therapy ($p < 0.005$), while the prevalence of type B tympanogram decreased significantly ($p < 0.005$). We found significant differences between pre- and both post-therapy control in groups I and II. However, children in group III experienced significant improvement of middle ear conditions only three months after the end of therapy ($p < 0.005$). On the basis of the physiopathologic knowledge of OME and the underlying principles of ETR, we conclude that ETR can be considered a useful therapy in management of OME.

KEY WORDS: Otitis media with effusion • Eustachian tube • Eustachian tube rehabilitation • Swallowing • Habitual mouth breathing

RIASSUNTO

Scopo di questo studio è stato quello di valutare i risultati della terapia riabilitativa tubarica in pazienti affetti da otite media secretiva (OME). Sono stati trattati 35 bambini affetti da OME suddivisi in 3 gruppi: gruppo I (OME isolata); gruppo II (OME e deglutizione atipica); gruppo III (OME, respirazione orale abituale e deglutizione atipica). Prima della terapia ed a distanza di 1 mese e 3 mesi dalla fine del trattamento, tutti i casi sono stati sottoposti ad otomicroscopia timpanometria. Fra tutti i pazienti, sia a distanza di un mese che di tre mesi dalla fine del trattamento, la prevalenza del timpanogramma tipo A aumentava significativamente ($p < 0,005$) mentre si riduceva in modo statisticamente significativo quella del timpanogramma tipo B. I pazienti del gruppo I e II mostravano un significativo miglioramento sia al primo controllo che a distanza di tre mesi mentre i bambini del gruppo III solo tre mesi dopo la terapia ($p < 0,005$). Sulla base delle conoscenze fisiopatologiche dell'OME e dei principi di rieducazione tubarica, possiamo sostenere che la riabilitazione tubarica potrebbe essere considerata un trattamento utile ed efficace per la terapia delle otiti medie secretive.

PAROLE CHIAVE: Otite media effusiva • Tuba di Eustachio • Riabilitazione tubarica • Deglutizione • Respirazione orale abituale

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Introduction

Otitis media with effusion (OME) can be defined as a non-purulent effusion of the middle ear that may be either mucoid or serous, without sign and symptoms of acute infection¹. Although the lack of acute symptoms makes the prevalence of OME difficult to assess, epidemiologic studies estimate that at least 80% of preschool children have one or more episodes of OME¹, and that the point prevalence of OME on screening tests is about 20%². OME may resolve spontaneously within 3 months, but about 30% to 40% of children have recurrent OME, and 5% to 10% of episodes last 1 year or longer^{3,4}. Moreover, middle ear diseases occurring later in life, such as chronic otitis media and cholesteatoma, can be attributable to OME in childhood⁵.

Many events are advocated in the pathogenesis of OME: inflammation⁶, adenoid hypertrophy⁷, atypical swallowing⁸, craniofacial growth abnormalities caused by nasal obstruction^{9,10} and a reduction of local and/or systemic immune response associated with inadequate ET function^{11,12}.

Owing to the large variability of the spontaneous course of OME, it is common policy to observe the child and postpone treatment until the condition has been persisted for at least 3 months. Medical therapies, including antihistamines, decongestants, antimicrobials and corticosteroids, are not recommended because of the short-term and relatively small magnitude in benefits¹³. Surgical treatment is recommended when OME lasts 4 months or longer and causes persistent hearing loss¹³. Furthermore, a surgical

approach is advocated in the presence of structural damage to the tympanic membrane and in children at risk for speech, language or learning problems. Tympanostomy tube insertion is the preferred initial surgical procedure, while adenoidectomy plus myringotomy, with or without tube insertion, is recommended only when a child needs to repeat surgery for OME¹³.

“Eustachian tube rehabilitation” (ETR) was developed in France 20 years ago¹⁴⁻¹⁶. This is a treatment designed to help ET opening by using a combination of methods including improved nasal hygiene and breathing, muscle strengthening exercises and auto-insufflation. Young children are prone to OME because their Eustachian tubes are short, floppy, horizontal and functionally poor¹⁷. In addition, some negative behaviours may play an important role in the development of OME. Sniffing causes negative pressure in the middle ear which leads to retraction of the tympanic membrane¹⁸. Naso-diaphragmatic breathing exercises should be performed to achieve synchrony between nasal and diaphragmatic breathing, while trough nasal valve exercises help children acquire awareness of nostril dilatation. The ET is normally closed at rest. During swallowing and yawning, the ET physiologically opens because of the activity of tensor and levator veli palatini muscles. Swallowing and yawning exercises increase the chances of tubal opening. The goal of ETR is to allow the activity of the velopharyngeal sphincter. This is obtained by play activities in which movements of the tongue, soft palate and jaws, isolated or associated, are performed. Valsava and Misurya manoeuvres constitute components of ETR. Nevertheless, these passive auto-insufflation manoeuvres have only transient effects when used alone. Finally, as a part of therapy, the regular use of chewing gum should be encouraged. Indeed, chewing activates jaw movements, increases salivary flow, the rate of swallowing and the rate of activations of paratubal muscles and tubal opening^{19,20}.

Although rehabilitation exercises and their underlying principles have been described in detail¹⁴⁻¹⁶, few studies have been conducted to clarify the efficacy in ETR^{21,22}.

The aim of this study is to evaluate the effectiveness of ETR as treatment for persistent OME in children.

Materials and methods

We studied 35 children, 15 males and 20 females, aged between 6 and 11 years [mean = 7.53 years; standard deviation (SD) \pm 2.89]. The clinical protocol was approved by institutional review board committee of the Università Cattolica and informed consent was obtained from parents of patients. The inclusion criteria were: mono- or bilateral OME persistent for at least 3 months at the moment of the enrolment, as verified by type B tympanogram and otomicroscopy analysis; previous adenoidectomy, medical and Politzer's treatments without resolution of OME;

absence of nasal obstruction, as supported by anterior basal rhinomanometry (Ryno Zig® Equipment – Menfis Biomedica, Italy), and acute inflammation of nasal-rhinopharyngeal district. Finally, audiometric tests were performed in all cases before and after treatment, but for the purposes of this study these data were not considered.

All children were submitted to evaluation by a speech pathologist. Assessment of oral habits showed that in 13/35 patients (37.14%) OME was isolated, while in 22/35 patients (62.86%) OME was associated with atypical swallowing and/or habitual mouth breathing. The latter was a dysfunctional habit in the absence of obstructive pathologies of the nasopharynx. According to the absence or the different coexistence of oral dysfunctions, children were divided into three groups: group I – 13/35 children with isolated OME; group II – 7/35 children with OME and atypical swallowing; group III – 15/35 children with OME, habitual mouth breathing and atypical swallowing. After evaluation, the speech pathologist performed ETR to restore or improve the ventilatory function of the ET by a hygienic approach and by training specific voluntary motor activities and correcting deviant mouth habits. Children performed specific tubaric rehabilitation based on lingual, velar and mandibular exercises, nasal respiratory exercises monolateral or bilateral, swallowing exercises and Valsalva's and Misurya's manoeuvres.

The total number of therapy sessions was 12; mean duration of therapy was 3 months. The first eight sessions of ETR were given twice a week, while the last four were planned at a distance of 15 days. Each session lasted 30 minutes. Parents were involved in treatment; they were asked to repeat daily the exercises with their child and to control adherence to hygiene advice.

The results of ETR tympanometry were monitored before, and at one and three months after the end of treatment. During the behavioural treatment and for the following three months, none of the patients received medical therapy. Finally, all patients were instructed to perform the exercises daily for at least one month after the end of treatment.

Statistical analyses were performed with the software package SPSS (version 10.0 for Windows®-SPSS Inc., Chicago, IL, USA). The chi-square test was used for categorical variables. Statistical significance was set at $p < 0.005$.

Results

Tympanogram analysis before ETR showed a type C in 17 ears (24.28%) and a type B in 53 ears (75.71%). One month after the end of treatment, type A, C and B tympanograms were detected in 32 (45.71%), 20 (28.57%) and 18 (25.71%) ears, respectively. Three months later we observed type A in 32 (45.71%) ears, while types C and B were found in 23 (32.86%) and in 15 (21.43%) ears,

Table I. Tympanometric results of the overall group of ears (70/70) before ETR (pre) and at each post-treatment assessment (post 1 = one month after ETR; post 2 = three months after ETR).

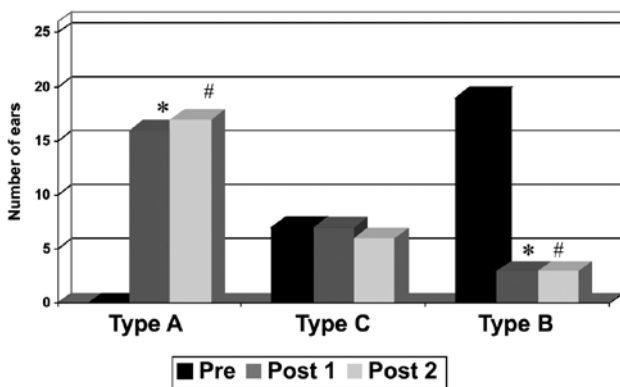
Tympanogram	Pre No. of ears (%)	Post 1 No. of ears (%)	Post 2 No. of ears (%)
Type A	0 (0%)	32 (45.71%) *	32 (45.71%) #
Type C	17 (24.28%)	20 (28.57%)	23 (32.86%)
Type B	53 (75.71%)	18 (25.71%) *	15 (21.43%) #

* = $p < 0.005$ Pre vs Post 1
= $p < 0.005$ Pre vs Post 2

respectively. One month after ETR 13 (76.47%) type C and 19 (35.84%) type B switched to a type A, while 16 (30.18%) type B converted to a type C. Three months after ETR, an additional 3 ears switched from a type B to a type C tympanograms.

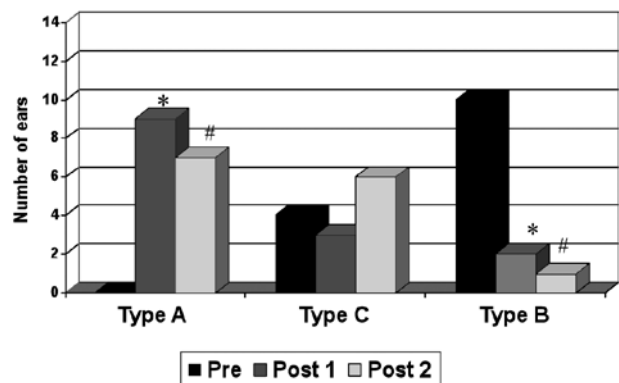
After ETR (one and three months later), the prevalence of type A tympanogram was significantly higher than before therapy ($p < 0.005$), while the prevalence of type B tympanogram was significantly lower ($p < 0.005$). Furthermore, prevalence of type C tympanograms was decreased (or increased) without statistical difference before and after ETR (one and three months after) ($p > 0.005$). Finally, no statistically significant differences were found in tympanometric findings between the two follow-up evaluations ($p > 0.005$) (Table I).

Figures 1, 2 and 3 show the tympanometric results in the three groups of patients before ETR and at the two post-therapy assessments. In groups I and II, comparison between pre-therapy tympanometric findings and both post-treatment evaluations showed a statistically significant increase of the number of type A tympanograms and a statistically significant decrease of the number of type B tympanograms ($p < 0.005$). Moreover, no significant differences were found between early and late post-treatment follow-up ($p > 0.005$) (Figs. 1, 2). In group



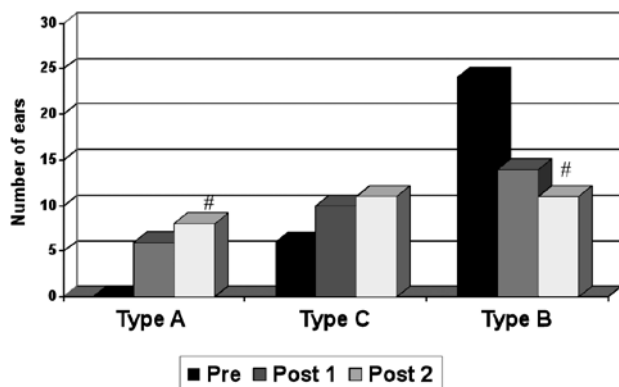
* = $p < 0.005$ Pre vs Post 1
= $p < 0.005$ Pre vs Post 2

Fig. 1. Tympanometric results of group I (26/70 ears) before ETR (pre) and at each post-treatment assessment (post 1 = one month after ETR; post 2 = three months after ETR).



* = $p < 0.005$ Pre vs Post 1
= $p < 0.005$ Pre vs Post 2

Fig. 2. Tympanometric results of group II (14/70 ears) before ETR (pre) and at each post-treatment assessment (post 1 = one month after ETR; post 2 = three months after ETR).



= $p < 0.005$ Pre vs Post 2

Fig. 3. Tympanometric results of group III (30/70 ears) before ETR (pre) and at each post-treatment assessment (post 1 = one month after ETR; post 2 = three months after ETR).

III, comparison between pre-therapy and early post-treatment and the two post-treatment evaluations showed no statistically significant differences in tympanometric findings ($p > 0.005$). In this group, a significantly higher number of type A tympanograms ($p < 0.005$) and a significantly lower number of type B tympanograms ($p < 0.005$) was observed only three months after the end of ETR (Fig. 3).

Discussion

In this study, we treated 35 children with mono- or bilateral persistent OME with a functional approach. The overall results showed a significant improvement of middle ear conditions, as reflected by the tympanometric findings, one month after the end of the ETR. Additionally, the last follow-up visit demonstrated the stability of these results. Evaluating the results in three groups, we found that children with isolated OME and children with OME associated with atypical swallowing (groups I and II) had similar outcomes. However, children with OME associated with habitual mouth breathing and atypical swallowing (group III) experienced a significant improvement of middle ear ventilation only three months after the end of ETR.

Mouth breathing has been found significantly associated with the prevalence of OME²³. In mouth breathers, the altered position of the tongue and oral mucosa dryness contribute to qualitative and quantitative abnormalities in swallowing. Because the ET opens with every swallow, habitual mouth breathing negatively interferes with the ventilatory and pressure equilibration functions of the ET. Various experimental studies conducted on animal models have shown a strict correlation between nasal obstruction, craniofacial growth, OME and ET muscular dysfunction^{9 10 24-26}. Orofacial functional and structural changes related to oral breath might explain the late improvement of middle ear conditions that we observed in children with habitual mouth breathing.

OME is a matter of discussion between otolaryngologists and paediatricians for significant practice variations in management²⁷. Indeed, none of the drugs used for OME treatment has been demonstrated to be effective¹³. On the other hand, tympanostomy tubes seem to be associated with complications in at least 80% of operated ears such as purulent otorrhea, myringosclerosis, segmental atrophy, atrophic scars, retraction pockets, membrane perforation and granulation tissue²⁸. Nevertheless, the indication to insert tubes is still controversial. Many reviews conclude that there is only a small benefit of conventional ventilation tubes²⁹⁻³¹. Indeed, tympanostomy tubes are inserted to ameliorate middle ear ventilation, but have no effects on ET dysfunction³².

Considering the physiopathologic knowledge of OME and the underlying principles of ETR, this functional approach seems to be a valid alternative to invasive treatments for OME. Nevertheless, ETR has received little attention in clinical practice and in the literature. In a clinical study with four non-randomized groups of children with OME, Deggouj et al.²¹ reported a recovery rate of 40% with ETR, 28% with medication and 60% when ETR was associated with medication, while no improvement was observed in the group of children who did not receive any treatment. In a prospective, randomized, pilot study in a small number of subjects, Kouwen et al.²² reported

only marginally significant recovery in children who underwent functional treatment compared to the watchful waiting group.

The reasons for the limited interest in ETR warrant discussion. ETR is a long-term treatment that requires time in learning and carrying out exercises, good compliance of children and daily training. Because of the long time required for therapy, one risk is that patients may lose motivation. Based on our experience, we believe that involvement of children using playing activities and active participation of parents to treatment are two essential factors for the success of ETR.

Conclusions

ETR may be a useful treatment tool in the management of OME and may improve middle ear ventilation, avoiding the need for surgery and exposure to surgical complications. However, the effectiveness of this therapy deserves to be investigated in broader trials, evaluating outcomes obtained in patients treated with ETR and those obtained with more conventional treatments and watchful waiting.

References

- Zielhuis GA, Rach GH, Van den Broek P. *The occurrence of otitis media with effusion in Dutch pre-school children*. Clin Otolaryngol 1990;15:147-53.
- Casselbrant ML, Mandel EM. *Epidemiology*. In: Rosenfeld RM, Bluestone CD, editors. *Evidence Based Otitis Media*. Hamilton, Ont: Becker BC; 1999. p. 117-36.
- Tos M. *Epidemiology and natural history of secretory otitis*. Am J Otol. 1984;5:459-62.
- Williamson IG, Dunleavy J, Baine J, et al. *The natural history of otitis media with effusion – a three-year study of the incidence and prevalence of abnormal tympanograms in four South West Hampshire infant and first schools*. J Laryngol Otol 1994;108:930-4.
- Tos M. *Upon the relationship between secretory otitis in childhood and chronic otitis and its sequelae in adults*. J Laryngol Otol 1981;95:1011-22.
- Hamada E, Iwano T, Ushiro K, et al. *Animal model of otitis media with effusion*. Acta Otolaryngol Suppl 1993;500:70-4.
- Gates GA, Avery CA, Cooper JC Jr, et al. *Chronic secretory otitis media: effects of surgical management*. Ann Otol Rhinol Laryngol Suppl 1989;138:2-32.
- Jonas I, Mann W, Munker G, et al. *Relationship between tubal function, craniofacial morphology and disorder of deglutition*. Arch Otorhinolaryngol 1978;30:151-62.
- Maurizi M, Scarano E, Frusoni F, et al. *Clinical-morphological correlation of nasal obstruction with skull base development and otitis media. An experimental study*. ORL J Otorhinolaryngol Relat Spec 1998;60:92-7.
- Scarano E, Fetoni AR, Picciotti P, et al. *Can chronic nasal obstruction cause dysfunction of the paratubal muscles and otitis media? An experimental study in developing Wistar rats*. Acta Otolaryngol 2003;123:288-91.

- ¹¹ Straetemans M, van Heerbeek N, Tonnaer E, et al. *A comprehensive model for the aetiology of otitis media with effusion*. Med Hypotheses 2001;57:784-91.
- ¹² Rezes S, Késmárki K, Sipka S, et al. *Characterization of otitis media with effusion based on the ratio of albumin and immunoglobulin G concentrations in the effusion*. Otol Neurotol. 2007;28:663-7.
- ¹³ Rosenfeld RM, Culpepper L, Doyle KJ, et al. *American Academy of Pediatrics Subcommittee on otitis media with effusion; American Academy of Family Physicians; American Academy of Otolaryngology – Head and Neck Surgery. Clinical practice guideline: Otitis media with effusion*. Otolaryngol Head Neck Surg 2004;130:S95-S118.
- ¹⁴ Gersdorff M, Cambier C, Huysbrechts-Forester V. *La logothérapie tubaire*. Les Cahiers d'ORL 1986;21:676-82.
- ¹⁵ Lederlè E, Kremer JM. *La rééducation tubaire*. Isbergues: Ortho-Edition; 1989.
- ¹⁶ Daully A, Beauvillain de Montreuil C. *Rééducation tubaire*. Paris: Masson; 1992.
- ¹⁷ Bluestone CD. *Eustachian tube function and dysfunction*. In: Rosenfeld RM, Bluestone CD, editors. *Evidence-based Otitis Media*. Toronto: BC Decker; 1999. p. 137-56.
- ¹⁸ Falk B, Magnuson B. *Evacuation of the middle ear by sniffing: a cause of high negative pressure and development of middle ear disease*. Otolaryngol Head Neck Surg 1984;92:312-8.
- ¹⁹ Kapila YV, Dodds WJ, Helm JF, et al. *Relationship between swallow rate and salivary flow*. Dig Dis Sci 1984;29:528-33.
- ²⁰ Kouwen HB, Dejonckere PH. *Prevalence of OME is reduced in young children using chewing gum*. Ear Hear 2007;28:451-5.
- ²¹ Deggouj N, Dejong-Estienne F. *Tubal rehabilitation: modalities, evaluation and prospects*. Rev Laryngol Otol Rhinol 1991;112:381-8.
- ²² Kouwen H, van Balen FA, Dejonckere PH. *Functional tubal therapy for persistent otitis media with effusion in children: myth or evidence?* Int J Pediatr Otorhinolaryngol 2005;69:943-51.
- ²³ Engel J, Anleunis L, Volovics A, et al. *Risk factors of otitis media with effusion during infancy*. Int J Pediatr Otorhinolaryngol 1999;48:239-49.
- ²⁴ Paludetti G, Almadori G, Scarano E, et al. *Nasal obstruction and skull base development: experimental study in the rat*. Rhinol 1995;33:171-3.
- ²⁵ Scarano E, Paludetti G, Frusoni F, et al. *Morphological distribution of middle-ear epithelium in the Wistar rat: a functional hypothesis*. ORL J Otorhinolaryngol Relat Spec 1997;59:166-9.
- ²⁶ Scarano E, Ottaviani F, Di Girolamo S, et al. *Relationship between chronic nasal obstruction and craniofacial growth: an experimental model*. Int J Pediatr Otorhinolaryngol 1998;45:125-31.
- ²⁷ Coyte PC, Croxford R, Asche CV, et al. *Physician and population determinants of rates of middle-ear surgery in Ontario*. JAMA 2001;286:2128-35.
- ²⁸ Vlastarakos PV, Nikolopoulos TP, Korres S, et al. *Grommets in otitis media with effusion: the most frequent operation in children. But is it associated with significant complications?* Eur J Pediatr 2007;66:385-91.
- ²⁹ Kubba H, Pearson JP, Birchall JP. *The aetiology of otitis media with effusion: a review*. Clin Otolaryngol Allied Sci 2000;25:181-94.
- ³⁰ Rovers MM, Black N, Browning GG, et al. *Grommets in otitis media with effusion: an individual patient data meta-analysis*. Arch Dis Child 2005;90:480-5.
- ³¹ Lous J, Burton MJ, Felding JU, et al. *Grommets (ventilation tubes) for hearing loss associated with otitis media with effusion in children*. Cochrane Database Syst Rev 2005;1:CD001801.
- ³² van Heerbeek N, Ingels KJAO, Rijkers GT, et al. *Therapeutic improvement of Eustachian tube function: a review*. Clin Otolaryngol 2002;57:50-6.

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Address for correspondence: Pasqualina M. Picciotti MD PhD, Policlinico Universitario "A. Gemelli", Università Cattolica del Sacro Cuore, largo A. Gemelli 8, 00168 Roma, Italy. Tel. +39 06 30154439. Fax +39 06 3051194. E-mail: pmpicciotti@rm.unicatt.it