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Total remission of pediatric tinnitus: reporting the results of a non-drug approach to tubal dysfunction

Remissão total do zumbido pediátrico: relato dos resultados de uma abordagem não medicamentosa da disfunção tubária

Remisión total del acufeno pediátrico: informe de los resultados de un enfoque no farmacológico a la disfunción tubárica

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Abstract

Introduction: Tinnitus is a growing symptom in the pediatric population and its etiological multifactorial demands extensive investigations to use appropriate interventions. **Objective:** report the effects of a non-medicated approach of a case of total remission of pediatric tinnitus from tube dysfunction. **Methods:** This article presents a seven-year-old female patient with a complaint of chronic tinnitus associated with tubal dysfunction, considered rare in the literature. Besides that, this study describes the medical evaluations (neurological and otorhinolaryngological), the audiological and psychoacoustic evaluations of the tinnitus, the diagnostic process and the speech-language intervention performed. It was used a non-medication approach that included orofacial myofunctional exercises, Valsalva maneuver and nasal cleaning. **Results:** After a month of intervention, with the daily practice of exercises, the studied

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VCM, RSB, SJO: delineation, colection and data analysis and revision.
BP, DDD: revision.
MVG: delineation, colection and data analysis, revision and supervision.

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subject reported the absence of perception of the symptom and other auditory complaints. This result was also verified in the audiological evaluations. **Conclusion:** The non-medication approach to tubal dysfunction has shown good results in relation to the management of chronic tinnitus for the present case.

Keywords: Tinnitus; Auditory tube; Pediatrics; Hearing.

Resumo

Introdução: Zumbido é um sintoma crescente na população pediátrica e sua multifatoriedade etiológica demanda amplas investigações para utilizar-se adequadas intervenções. **Objetivos:** relatar os efeitos de uma abordagem não medicamentosa em um caso de remissão total do zumbido pediátrico oriundo da disfunção tubária. **Método:** Este artigo apresenta um indivíduo com sete anos, do sexo feminino e com queixa de zumbido crônico associado a disfunção tubária, considerado escasso na literatura. Além disso, este estudo descreve as avaliações médicas (neurológica e otorrinolaringológica), a avaliação audiológica e psicoacústica do zumbido, o processo diagnóstico e a intervenção fonoaudiológica realizada. Utilizou-se uma abordagem não medicamentosa que contemplou exercícios miofuncionais orofaciais, Manobra de Valsalva e limpeza nasal. **Resultados:** Após um mês de intervenção, com a prática diária dos exercícios, o indivíduo estudado referiu ausência da percepção do sintoma e das demais queixas auditivas. Este resultado também foi constatado nas avaliações audiológicas. **Conclusão:** A abordagem não medicamentosa da disfunção tubária demonstrou bons resultados frente ao manejo do zumbido crônico, para o presente caso.

Palavras-chave: Zumbido; Tuba auditiva; Pediatria; Audição.

Resumen

Introducción: Acufeno es un síntoma creciente en la población pediátrica y su multifatoriedad etiológica demanda amplias investigaciones para utilizar adecuadas intervenciones. **Objetivos:** Informar los efectos de un enfoque no farmacológico de un caso de remisión total del acufeno pediátrico oriundo de la disfunción tubárica. **Metodos:** Este artículo presenta un sujeto con siete años, del sexo femenino y con queja de acufeno crónico asociado a disfunción tubárica, considerado escaso en la literatura. Además, este estudio describe las evaluaciones médicas (neurológica y otorrinolaringológica), la evaluación audiológica y psicoacústica del zumbido, el proceso diagnóstico y la intervención fonoaudiológica realizada. Se utilizó un abordaje no medicamentoso que contempló ejercicios miofuncionales orofaciales, Maniobra de Valsalva y limpieza nasal. **Resultados:** Después de un mes de intervención, con la práctica diaria de los ejercicios, el sujeto estudiado refirió ausencia de la percepción del síntoma y de las demás quejas auditivas. Este resultado también se constató en las evaluaciones audiológicas. **Conclusión:** El abordaje no medicamentoso de la disfunción tubárica demostró buenos resultados frente al manejo del acufeno crónico, para el presente caso.

Palabras clave: Acufeno; Tubo auditivo; Pediatría; Audición.

Introduction

Tinnitus is a symptom in which there is the perception of a sound (in the ears or in the head) without the existence of an external sound source. In recent years, the literature has been demonstrating the presence of this symptom in the pediatric population, with its incidence ranging from 4.7% to 46% in general and in children with normal hearing thresholds, and from 23.5% to 62.2% in children with hearing loss[1].

A survey, seeking to characterize tinnitus in the child population[2], observed that the causes of the symptom varied, may be associated with hearing loss, previous orthodontic treatment, acoustic trauma, muscle aspects in the neck region, skull base fracture, as well as alterations in the middle ear and its ventilation. In this sense, Eustachian tube dysfunction is an impairment that deserves attention, considering its importance in middle ear ventilation[2].

In the literature, studies that address the relationship between tinnitus and Eustachian tube dysfunction are scarce, as well as the possibilities of intervention in cases. The treatment of tinnitus originating from Eustachian tube dysfunctions can be performed with the use of medications[3]. However, a previous study[4], performed in children with a history of recurrent otitis media, demonstrated the effectiveness of a non-drug approach in the treatment of this type of dysfunction. The aforementioned approach was performed through blowing and suction exercises associated with nasal cleaning and the Valsalva Maneuver.

The specialized literature already points to the Valsalva Maneuver as a form of treatment for Eustachian tube dysfunctions, when performed repeatedly. This fact occurs due to the ability of this maneuver to modify the middle ear pressure pattern[5,6]. Therefore, it is believed that the non-drug approach described above[4] may also have an effect on the perception of tinnitus, when the etiological hypothesis for the symptom is related to Eustachian tube dysfunction.

It is emphasized that the clinical practice related to the tinnitus intervention process still needs more evidence, especially with regard to the total remission of the symptom. In that regard, the in-depth analysis of cases of total remission can be useful and assist in directing future research[7]. Given the above, the objective of the present study was to report the results of the intervention, through speech therapy, in a case of remission of chronic tinnitus in childhood, originating from Eustachian tube dysfunction.

Materials and Methods

Ethical Aspects

The individual in this study was treated at an ambulatory to support patients with tinnitus, which is part of a project approved by the Research Ethics Committee of the institution of origin (under number 25933514.1.0000.5346). The study complied with all the norms and guidelines established in Resolution 466/12 of the National Health Council of Brazil. The individual involved and their legal guardian agreed to participate in this research, signing the Free and Informed Assent Term and the Free and Informed Consent Term.

Clinical history and procedures

The research participant (G.M.) was seven years old, female and accompanied by her maternal grandmother. The referral for speech therapy care was carried out by the Otorhinolaryngologist and they attended the Ambulatory in July 2018 (07/13/2018). By consulting the medical records, it was verified that in addition to the Otorhinolaryngological evaluation, the patient was previously evaluated by a neuropediatrician. Below, the results of the aforementioned medical evaluations are clarified.

Neurological evaluation

The neurological evaluation was carried out in June 2018 and, at the time, no signs or symptoms of neurological impairment or developmental syndromes and disorders that could be associated with the perception of tinnitus were observed, discarding, then, such possible etiologies.

Otorhinolaryngological and audiological evaluation

The otorhinolaryngological evaluation was carried out in June 2018 and found, through the previous history of G.M. and the medical evaluation, that she had been presenting otitis media in both ears, but at the time she was no longer using medication. In total, eight episodes of otitis media were reported in the last two years, all of which were treated by a pediatrician with drug therapy.

The tinnitus, according to G.M.'s report, was of the "wheezing" type, low-pitched, subjective, in both ears, constant and continuous for approximately eight months (since the last diagnosis of otitis). In addition, she reported that in recent months she had had problems concentrating in the classroom, sleeping and that the perception of the symptom was significantly worse in silence.

In addition to the perception of tinnitus, the patient constantly reported the feeling of bilateral ear fullness, as well as a sign of improvement in the condition when swallowing and opening the mouth. In addition, through videotoscopy, it was observed mild retraction of the tympanic membrane in both ears. After the medical evaluation, the patient underwent an audiological evaluation with a professional speech therapist on the same day. This evaluation included: a) Chronic Tinnitus Investigation Anamnesis, b) Visual Inspection of the External Acoustic Meatus, c) Visual Analog Scale, d) Research of Transient Otoacoustic Emissions, e) Pure Tone Threshold Audiometry and Logoaudiometry, f) Imitanciometry, g) Tubal Function Test and h) Acuphenometry.

a) Chronic Tinnitus Investigation Anamnesis: It was carried out with the aim of verifying the aspects related to tinnitus, the possible etiological causes and the associated factors.
b) Visual Inspection of the External Acoustic Meatus (EAM): To investigate the presence of physical impediments and other alterations in the EAM.
c) Visual Analog Scale (VAS): applied in order to quantify tinnitus discomfort. When presenting the VAS, the following instruction was given to the patient: "Look at this scale, think about how much your tinnitus bothers you and rate it from zero to 10, with zero bothering you at all and 10 bothering you a lot". Considering in this way, the level of discomfort of the patient facing the symptom.
d) Research on Transient Otoacoustic Emissions: procedure performed with the SmartEP equipment from the Intelligent Hearing Systems® brand, using the click stimulus with an intensity of 80dBNPS. The adopted signal-to-noise ratio was 6dB and the pass criterion was the presence of response in at least three frequencies tested, and the research was performed at 1000 Hz, 2000 Hz, 3000 Hz and 4000 Hz.
e) Pure Tone Threshold Audiometry (PTA) and Logoaudiometry: procedures performed to analyze the presence of peripheral hearing disorders. Both procedures were performed in an audiometric booth, with an Otometrics® audiometer, model Madsen Itera II, which had annual acoustic measurements. For PTA, air conduction thresholds were investigated using the Warble stimulus. As for Logoaudiometry, the Speech Recognition Threshold (SRT) and the Speech Recognition Percentage Index (SRI) were evaluated, both using live voice stimuli.
f) Acoustic Immittance Measurements (AIM's): the tympanometric curves of both ears were surveyed, as well as the contralateral stapedial acoustic reflexes at frequencies of 500, 1000, 2000 and 4000Hz. The purpose of the procedure was to verify the integrity of the middle ear and the reflex arc. The equipment used was the Interacoustics® AZ26. Imitanciometry was performed before the Tubal Function Test.
g) Tubal Function Test: the procedure was performed in the Interacoustics® AZ26 equipment. The tympanometric curve was performed in order to verify the basal pressure of each middle ear. After obtaining the patient›s tympanometric curve, a Valsalva maneuver[6] was requested and, finally, water swallowing. After each task, a curve was generated in the equipment. The test was considered normal if any increase in middle ear pressure was observed after the Valsalva maneuver[8] and a return to baseline pressure after deglutition.
h) Acuphenometry: sought to measure the patient's tinnitus in frequency and intensity. The procedure was performed in Otometrics® equipment, model Madsen Itera II (with annual acoustic measurement) and in an audiometric booth. The researched frequencies ranged from 125 Hz to 8000 Hz and the stimulus used was the one most similar to the perception of the patient's tinnitus. In the present case, white noise was used, considering the wheezing type of tinnitus. Initially, stimuli at different frequencies were presented and G.M. should indicate which one was closest to your frequency perception of tinnitus (pitch). Soon after, she needed to indicate which stimulus would be closer to her perception of loudness (loudness). Such intensity was researched every 1dB, as well as the threshold in the frequency of symptom perception. The threshold value was

subtracted from the tinnitus value, to arrive at the final result[9]. Both ears were tested.

In PTA, all air conduction thresholds were within normal limits (in 5 dB). Likewise, the quadritonal mean was within normal limits, according to the classification suggested by the World Health Organization (2014)[10]. In logoaudiometry, the SRT result was 5 dBNA and the SRI was 100% in both ears. The MIA's presented contralateral stapedial acoustic reflexes and type "A" tympanometric curves in both ears[11].

On the VAS, the patient's initial score for tinnitus discomfort was eight. The Tubal Function Test, for both ears, did not show an increase in middle ear pressure after the Valsalva Maneuver, remaining the same baseline pressure value (+50 daBP for the right ear and +45 daPA for the left ear). Likewise, when asked to swallow water, there was no change in the recording of middle ear pressure (Figure 1). In acuphenometry, the patient's perception was similar to white noise at a frequency of 500 Hz bilaterally. The tinnitus intensity was 8 dB for both ears.

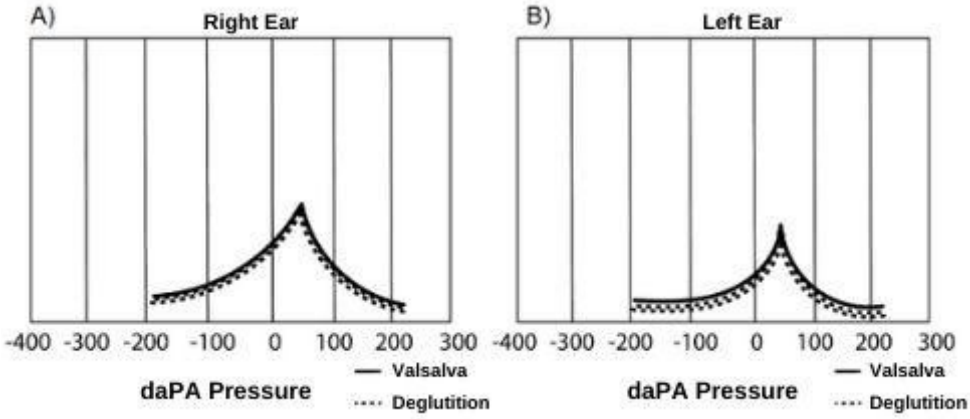

Figure 1. Graphic representation of the tympanometric curves of the right (A) and left (B) ear before the intervention.

Based on the evaluations carried out, the otorhinolaryngologist made the diagnosis of tubal dysfunction and pointed out the condition as the etiological hypothesis of tinnitus perception. This fact occurred because the medical professional performed a comprehensive evaluation of the patient, seeking to investigate all possible etiological factors of the symptom. In this sense, the other auditory and/or para-auditory causes were discarded. It should be noted that the cases of otitis media were no longer present. Finally, the referral of G.M. for the speech therapy intervention process of chronic tinnitus, not prescribing the use of medication.

Management and speech therapy intervention

Case management was focused on the etiological hypothesis (auditory tube dysfunction), so the speech therapy intervention was based on a non-drug approach, described in a previous study[4]. When attending the first consultation, the patient and companion were instructed about tinnitus and its etiological hypothesis. Likewise, they were informed about the management to be carried out and received material, so that the approach procedures could be performed at home. The material consisted of balloons, blowouts and a plastic straw, which were used as follows:

1) Nasal cleaning with saline solution before performing the other exercises;
2) Balloon blowing through the mouth and blowout in each nostril, alternately;
3) Water suction with straw and Valsalva maneuver. The maneuver was performed by occluding the nostrils and inflating the cheeks with air, remaining for about five seconds.

All exercises were demonstrated and performed with G.M. during the first consultation. The instruction was that the exercises should be performed three times a day, every day, and the person responsible for the patient was instructed to record in a notepad the days and times that the exercises were performed. The frequency of balloon blowing and blowouts exercises, as well as water suction with a straw and the Valsalva maneuver were not described in the previous study[4]. Thus, three series were prescribed with 10 repetitions of each one, based on the training performed with G.M. during the first consultation.

Nasal cleaning with saline solution was performed once in each nostril and aimed to fluidize secretions and improve nasal aeration. This, in an attempt to prevent the secretion from being displaced to the ear during the performance of the other exercises. The other proposed exercises were applied with the purpose of mobilizing the muscles responsible for the mobility of the Eustachian tube[4].

Results

G.M. performed the prescribed procedures for a month and returned to the ambulatory clinic in August (08/10/2018). The patient's report was that, at the end of the first week, she began to notice that the tinnitus had decreased in intensity in both ears, as well as the sensation of ear fullness and autophony. During the second week, G.M. started no longer noticing the symptoms in either ear. In addition, there was a report of improved sleep quality and concentration. It should be noted that, during the intervention period, G.M. did not change her other lifestyle habits and did not start any other treatment. The AIM's, the Tubal Function Test, the VAS and the Acuphenometry were performed again during the patient's return in order to measure the improvement of the condition.

During the reassessment of G.M. (08/10/2018), after the intervention, the tympanometric curves remained type "A" bilaterally, as well as the contralateral stapedial acoustic reflexes were present in both ears. In the Tubal Function Test, an increase in middle ear pressure was observed after the Valsalva maneuver and a return to baseline pressure after swallowing water. For the right ear, +55 daPa and +22 daPa were observed for the Valsalva maneuver and swallowing water, respectively. As for the left ear, the values were +45 daPa for the maneuver and +26 daPa for deglutition (Figure 2). These findings suggested adequate functioning of the Eustachian tube. The VAS score reported by G.M in the reassessment was zero, indicating no discomfort with the symptom. Also, in Acuphenometry, there was no perception of tinnitus (0 dB), which is in line with the patient's report. The intensity values obtained in Acuphenometry in the pre and post-intervention moments can be seen in Figure 3.

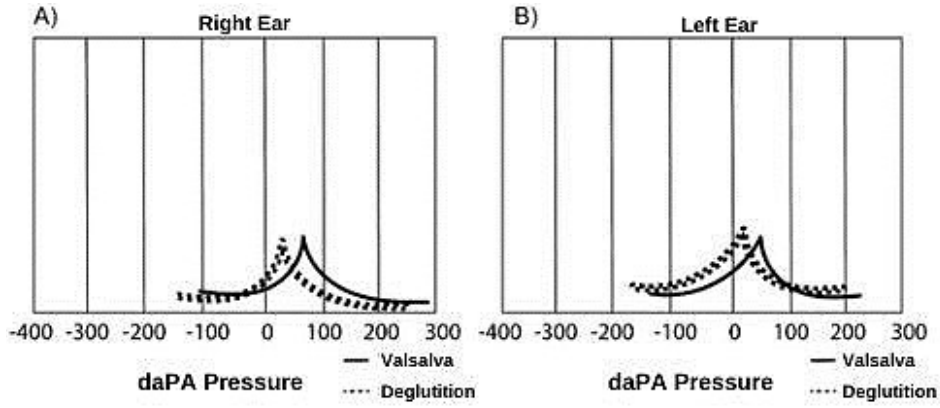

Figure 2. Graphical representation of the tympanometric curves of the right (A) and left (B) ear after the intervention.

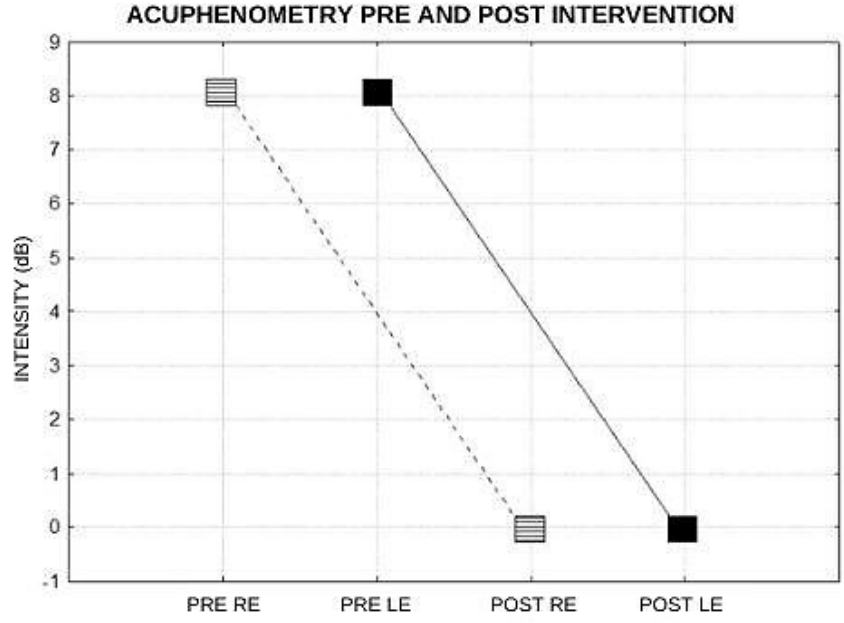

Figure 3. Graphical representation of the result obtained in Acuphenometry pre and post intervention.

Discussion

In this study, the reported individual had Eustachian Tube dysfunction (ET) as an etiological factor for tinnitus, diagnosed through consultation with an otorhinolaryngologist and findings in the audiological evaluation. Tinnitus, ear fullness and autophony described by the patient are symptoms already reported in the literature involving Eustachian tube dysfunction[12].

Also, G.M. presented a mild retraction of the tympanic membrane, associated with a type "A" tympanometric curve in both ears. It is known that tympanic membrane retraction is a diagnostic criterion for Eustachian tube dysfunction, as well as the "C" type tympanometric curve is more frequently observed in these cases[12], which disagrees with the findings of this study. However, in view of mild tympanic membrane retraction, a previous study reported the presence of type "A" tympanometric curve for individuals with mild tympanic membrane retraction[6], as in the case of G.M.

It is known that auditory thresholds within the normal range and the presence of Transient Evoked Otoacoustic Emissions (TEOAE) observed in the case are not common findings in the face of Eustachian Tube dysfunction. However, the specialized literature indicates that in this type of dysfunction, TEOAE tends to present only attenuation at low frequencies and not necessarily the absence of response[13], justifying the findings of this study.

The management of Eustachian tube dysfunction was performed through orofacial myofunctional exercises aimed at mobilizing the structure, as well as the Valsalva maneuver and nasal cleaning. The results of Figures 1 and 2 demonstrate that, for the present case, the chosen approach was effective for the treatment of tubal dysfunction. This finding is in line with the hypothesis of this study, elaborated in view of the results previously described by other authors[4].

Figure 3 shows the total remission of the patient's tinnitus. This finding suggests that the management of the etiological hypothesis of the symptom (in this case, Eustachian tube dysfunction) led to therapeutic success. Another current study[7] also used an approach to tinnitus under the etiological hypothesis, with successful results. At the time, the authors studied a 38-year-old adult individual who presented total remission of the symptom in a period of time similar to that observed in the present study, despite the etiological hypothesis of tinnitus differing from the case presented here.

It should be noted that the Eustachian tube, although little studied in relation to chronic tinnitus, has a unique function for the auditory system, meaning that its dysfunction may result in insufficient ventilation of the middle ear, as in the present study. This picture, once installed, favored the perception of low-pitched tinnitus[3] and ear fullness[14] of the patient, as well as it may have contributed to the cases of otitis media.

The success story of G.M. deserves some considerations regarding management, because, despite the scarce literature on the subject, it is currently known that there are different types of Eustachian tube dysfunction, generating different symptoms and, consequently, different approaches. In this sense, although the specific diagnosis was not made, it is believed that the G.M. may have been of the dilatory type, considering that this condition appears after an episode of upper airway infection and/or otitis media. In addition, individuals with this type of dysfunction often complain of tinnitus[12].

Thus, it is emphasized that the therapeutic success observed in this case will not necessarily be observed in other forms of Eustachian Tube dysfunction. For this reason, in view of this case report, it is suggested that future research seek to carry out studies with larger samples, deeply investigating the relationship between tinnitus and different types of dysfunction and providing the population application of techniques, diagnostic and therapeutic tools.

Conclusion

For this case, the non-drug approach (speech therapy) in the case of chronic tinnitus in childhood, associated with Eustachian tube dysfunction, showed good results, considering that total remission of the symptom was observed.

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