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Intratympanic corticotherapy and tinnitus control after sudden hearing loss

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Abstract

Introduction: Sudden deafness is characterized by an abrupt onset, often idiopathic and tinnitus is present, and becomes the main complaint in up to 80% of patients. **Objective:** To review carefully all studies of the past 10 years on sudden deafness and tinnitus and analyze the effectiveness of oral and intratympanic steroids for tinnitus control in eight patients with sudden deafness and severe disabling tinnitus. **Method**: An analytical prospective in which 64 patients after sudden deafness with tinnitus were monitored and 08 of these suffering with severe disabling tinnitus underwent hearing evaluation and application of the Tinnitus Handicap Inventory and Visual Analogue Scale before, during and after sudden deafness treated with oral and intratympanic steroids. It was made a systematic review of publications on the topic in the library of PubMed/MedLine, keywords: Sudden deafness and tinnitus. **Results:** Eleven scientific studies were analyzed. Eight patients treated with intratympanic and oral corticosteroids were selected, just two patients showed improvement over the hearing but seven of them showed big improvement in their tinnitus, which was demonstrated by an improvement in the values of the degrees of severity of tinnitus. **Conclusion:** Patients with sudden deafness and severe disabling tinnitus, and underwent intratympanic and oral corticosteroids showed, in this study, significant reduction and/or remission of tinnitus.

Keywords: hearing loss, sudden, hearing loss, tinnitus.

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INTRODUCTION

Sudden sensorineural hearing loss (SSHL) was first described by De Kleyn in 1944 and defined as a hearing loss of at least 30 dB in three sequential frequencies in the standard pure-tone audiogram over 3 days or less[1].

It maybe characterized as an impairment of the inner ear and/or central auditory pathways, with intensity and frequency variable, ranging from mild ear feeling clogged to total loss of hearing[2,3].

Population studies of SSHL show a wide distribution, ranging from 5 to 30 cases per 100.000 per year, with an average of 50-60 years and no sex preference. In most cases, there is a unilateral hearing loss, with bilateral involvement reported en less than 5%[1].

Hypotheses are proposed to explain the pathogenesis of sudden hearing loss as the vascular, the viral, the autoimmune and the rupture of membranes one. However, the current trend is to consider the sudden deafness as a disease of multifactorial etiology[2]. In many cases, the etiology remains unknown and constitutes a major challenge, even after complete otologic evaluation, and these cases are classified as idiopathic sudden deafness[3].

The treatment of sudden deafness is based on its etiology. In idiopathic cases, the oral corticosteroids are widely used, although the supporting evidence is weak. Intratympanic dexamethasone has been trialled in patients with sudden sensorineural hearing loss, because it provides a high concentration of steroids in the labyrinth in animal models[1], although its evidence are conflicting. In addition, there are several advantages of intratympanic treatment (see Frame 1). The procedure is well tolerated and relatively easy to perform as outpatient procedure performed under local anesthesia (topical), general anesthesia can be avoided, most patients understand the concept of intratympanic therapy and easily accepts the proposed therapy.

SSHL is often accompained by tinnitus, a debilitating condition not completely understood. However, there are few theories trying to explain its mechanism, one of than associates this symptom with a maladaptive attempts of a cortical reorganization process due to peripheral deafferentation[4].

Patients with tinnitus and SSHL are very frustrated by residual tinnitus even after accomplishment of the treatment for SSHNL. The majority ask doctors about the prognosis of residual tinnitus at the final day of medical treatment for SSNHL.

Attending to the high prevalence of tinnitus (about 80%) in sudden deafness cases and the controversy about the most effective therapeutic options in reduction and/or remission of symptoms of hearing loss and tinnitus, we aimed to assess 8 cases of patients with sudden deafness and tinnitus treated by corticosteroid intratympanic and review studies of 2003-2013 on sudden deafness and tinnitus.

Frame 1
Transtympanic Methylprednisolone For The Treatment Of Sudden Hearing Loss
Advantages
Outpatient procedure
Easily administered
Administered soon after the diagnosis
Relatively painless
Possible use in patients in which corticosteroids are contraindicated (e.g.: immune suppression, HIV, tuberculosis, diabetes)
High drug concentration when administered directly on the affected ear
Adverse effects are rare
Disadvantages/complications
Tympanic membrane perforation
Pain
Otitis media
Vertigo (generally temporary)
Hearing loss

MATERIALS AND METHODS

This is an analytical and prospective study. From June 2011 to July 2013, 64 patients with a diagnosis of sudden sensorineural hearing loss were seen at the otorhinolaryngology outpatient and emergency unit of our Center, Eight was suffering from severe disabling tinnitus. This study was approved by the institutional review board of the Medical School and the University Hospital in which it was carried out.

All patients received information about the risks and expectations of therapy and signed a free informed consent form. A detailed clinical history was taken, followed by an otoneurological examination, and an initial audiological assessment by tonal and vocal audiometry, impedance testing, speech recognition rate (SRR), laboratory tests, and an image exam (magnetic resonance imaging with contrast of the inner auditory canal).

All patients were treated with systemic therapy according to the local protocol (1 mg/kg/day prednisolone for 10 days, followed by decreasing doses thereafter). No patient was given acyclovir antiviral therapy.

Next, salvage therapy with intratympanic methyl-prednisolone was offered to XX patients with a diagnosis of SHL, after systemic therapy failed and no improvements were demonstrated audiometrically. Eight

patients suffering from severe disabling tinnitus agreed to undergo rescue therapy and signed the free informed consent form to be included in this study. Below are the details of inclusion criteria, the audiometric assessment, application technique, analysis of The Tinnitus Handicap Inventory and Analogue Visual Scale for Tinnitus and outcome of recovery of Hearing Loss and Tinnitus.

Inclusion Criteria

There were eight patients included from an original group of 64 candidate patients with sudden sensorineural hearing loss; the 8 patients did not benefit from oral prednisolone (1 mg/kg/day) for the treatment of sudden sensorineural hearing loss, that is, they did not improve as shown below under the item analysis of recovery, and presented in the questionnaires as suffering from severe disabling tinnitus.

Patients that did not meet the inclusion criteria described in Frame 2 were excluded from the study; these were patients with incomplete clinical data or follow-up, inadequate audiometry, or that had undergone more than three injections or that were given different concentrations from those standardized in this study (40 mg/ml) or presented no tinnitus or mild and moderate tinnitus were excluded. All patients with fluctuating hearing loss or suspected Ménière's disease were also excluded from this study.

Frame 2
Inclusion Criteria
• Sudden sensorineural hearing loss of at least 30 dB in three frequencies within three days
• No benefits from oral 1 mg/kg/day prednisolone therapy during 10 days (unilateral) or 30 days (bilateral)
• At least one audiometric test before and after oral therapy and another before and after intratympanic treatment
• Undergoing three intratympanic 40 mg/ml methylprednisolone injections on alternate days
• No previous otological surgery
• No history of Ménière's disease or fluctuating hearing before or after treatments (oral or intratympanic)
• No signs of acute or chronic otitis media
• Severe disabling tinnitus

Audiometric Analysis

All patients underwent tonal and vocal audiometry and speech recognition rate analysis done by audiologists before and after treatment. The tritonal mean was calculated based on pure tone audiometry (PTA) at 0.5, 1.0 and 2.0 KHz. The speech recognition rate (SRR) was based on the percentage of correct answers for monosyllables.

Technique

Prior to any procedure, patients were oriented as to the risks and expectations about the procedure and signed a free informed consent form. EMLA cream (AstraZeneca, Wilmington DE) was applied for topical anesthesia. EMLA cream was placed in the outer ear canal and the tympanic membrane and left for 30 to 45 minutes, after which it was removed. Next, the patient's head was placed at 45° towards the unaffected ear. A 40 mg/mL methylprednisolone solution was warmed to body temperature in a water bath. About 0.3 to 0.5 mL of the solution was injected into the middle ear; two orifices were made with the drug application needle (Gelco N.22), one immediately below the umbus (where the drug will be administered) and another on the postero-superior region (vent hole). No ventilation tubes were needed.

After intratympanic application of the steroid, the patient remained in the supine position and cervical rotation at 45° for 30 minutes to maximize exposure of the round window membrane to the solution. A second injection was done if there was any possibility that the first injection was not adequate. Patients were asked to avoid water in the treated ear for at least two weeks.

Definition of Improvement (analysis of recovery)

The criteria for defining successful recovery after therapy vary in the literature on intratympanic therapy. A 20 dB improvement at 0.5, 1 and 2KHz, or a 20% improvement in discrimination was enough to consider the intervention as successful. Failure of oral prednisolone therapy was absence of improvement, as just described, after 14 days of treatment.

All patients underwent Questionnaire Tinnitus Handicap Inventory (THI)[5] and the Visual Analogue Scale (VAS) to assess quantitatively and qualitatively the therapeutic response in relation to tinnitus. In the Visual Analogue Scale (VAS) score ranges from 1 to 10, where 10 represents the highest degree of tinnitus severity. Scores are requested regarding the intensity and discomfort of tinnitus. Were considered to improve the reduction of two points[6].

Literature Review

The search strategy employed in the literature review was guided by the combination of two descriptors indexed in MeSH (Medical Subject Headings): sudden deafness and tinnitus. Therefore, we performed a systematic review in the libraries of PubMed/MedLine, and analyzed all articles published in the period 2003-2013. The last manual search conducted in electronic databases occurred in July/2013.

RESULTS

The sample consisted of 8 patients, 6 (75%) female and 2 (25%) were male. The age ranged from 26-73 years with an average of 39.5 years. The most affected ear was the left (62.5%). All patients had tinnitus (100%) associated with sudden deafness. Regarding the THI scores, it ranged from 58 to 96, prior to initiation of therapy, 8-82 and 30 days after. Only 1 patient had worsening of tinnitus, referring to 16 points on the scale. We obtained an average difference of 38.6 points among patients who reported an improvement in tinnitus before and after the course of oral steroids and intratympanic. Referring to EVA, there was a change from 7 to 10 points before therapy and from 1 to 8 points after it, in relation to intensity. In relation to the nuisance, there was a change from 7 to 10 points before and 0-08 points after therapy. Of these, only 2 patients showed no improvement according to the scale. None reported worsening of symptoms. Among patients who reported improvement, there was a difference in mean score of 4.7 and 5.5 in intensity, according to the nuisance (Table 1 and Figure 1).

Most of the patients had vertigo associated with sudden deafness, being classified as mild in 75% of cases and severe in 12.5%. Only 1 patient showed no associated vertigo. In relation to the mean-tone, obtained as a result of the following classifications: mild (25%), moderate (25%), severe (25%) and deep (25%). Only 2 patients had improvement of hearing (from severe to normal, mild to normal), keeping unchanged all other results and no worsening (Table 2 and Figure 2).

We performed a literature search with the following aliases: sudden hearing loss and tinnitus. It was found 11 items, as summarized in Frame 3.

DISCUSSION

Tinnitus was present in 100% (n = 8) of the sample, with scores equal to or above 7 on the Visual Analogue Scale (VAS), being considered as severe tinnitus and/or disabling. The sudden hearing loss may be accompanied by tinnitus in approximately 80% of cases[2,3].

Their ages ranged from 26-73 years with a mean of 39,5 years and the ear most affected was the left ear (n = 5). Were followed 6 men and 2 women. Sudden hearing loss can occur mainly in the age group 43-53 years[7], with equal gender distribution. In this study, there was a higher occurrence in male subjects.

Despite less prevalent, sudden deafness is a terrible experience for the patient who perceives it in an abrupt silence, and may be accompanied by tinnitus and/or vertigo, representing not only the loss of inner ear function, but also the commitment of psychological state of the patient[8]. Only one patient did not show vertigo (Table 2).

Currently, in addition to therapeutic approaches such as oral steroids and/or intratympanic methylprednisolone[9] and vasodilators for sudden deafness, which are most commonly used options due mainly prescription is easily associated with the low cost, there are still therapeutic approaches such as the use hyperbaric oxygen therapy (HOT)[2] and cochlear implant[10]. However, corticosteroids seem to have universal acceptance and are the ones with proven effectiveness.

Treatments such as diuretics and antiviral drugs may also be included. Such treatments aim to improve inner ear oxygenation and include vasodilators, plasma expanders, steroids and anticoagulants[11].

In this study, we chose to intratympanic corticosteroid associated with oral corticosteroids and showed that this association was particularly effective in relation to tinnitus, from the eight cases analyzed, seven of these showed a significant improvement verified by THI and EVA. In the EVA, it is observed that 100% of patients had a score greater than or equal to 7 and a significant reduction in scores of patients 1, 2, 3, 4, 7 and 8, in order to reduce at least two points on score and the same was observed in the degree of severity in THI (Table 1).

Several factors may affect the prognosis of the PANSS (eg, hearing loss severity, symptoms duration

Table 1. Characterization of the Tinnitus (THI and VAS).

Patients	Age (years)	Affected Ear	Gender	THI Pre-therapy		THI Post-therapy		VAS Pre-therapy		VAS Post-therapy	
					Classification		Degree	Intensity	Annoying	Intensity	Annoying
1	26	R	M	70	(4) Severe	40	(3) Moderate	8	8	5	5
2	26	L	M	64	(4) Severe	26	(2) Mild	8	8	3	2
3	37	L	M	96	(5) Catastrophic	60	(4) Severe	10	10	7	7
4	42	R	F	76	(4) Severe	8	(1) Slight	8	8	1	0
5	43	L	F	66	(4) Severe	82	(5) Catastrophic	8	8	8	8
6	43	L	M	58	(4) Severe	36	(2) Mild	7	7	7	7
7	27	R	M	72	(4) Severe	30	(2) Mild	7	9	3	3
8	73	L	M	96	(5) Catastrophic	34	(2) Mild	10	10	3	3

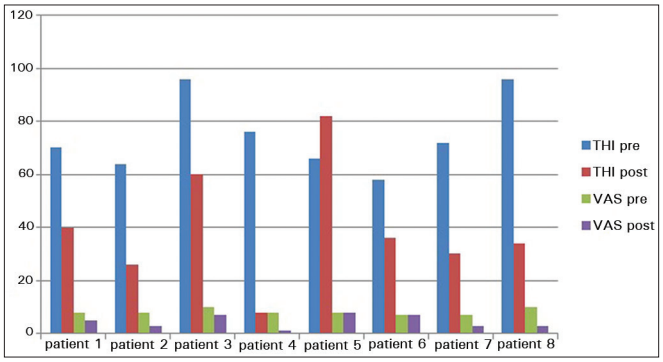

Figure 1. THI and VAS pre and post therapy - intratympanic and oral.

before treatment, vertigo, type of audiogram, and the patients ages).

Regarding hearing improvement, only two patients had good responses to therapeutic intervention. Patient 2, despite their age, presents a clinical STD (sexually transmitted disease) that could prevent or reduce the effectiveness of the proposed treatment. Already Patient 4 also showed no change in auditory thresholds, showed a significant change in their tinnitus. Patient 8, 73 years, has hypertension and diabetes, as well as probable hearing loss due to presbycusis before the episode of sudden deafness. Such comorbidities could not justify the improvement in hearing thresholds after the proposed therapy. However, it should be emphasized again that in relation to complaints of tinnitus, it has undergone a significant change, in which catastrophic change of the degree to mild (Table 1).

Given the results, we note that in addition to the proposed intervention, especially those cases where there were no improvement or even where there were worsening of symptoms over time, there are other recommended therapies such as cognitive-behavioral and Tinnitus Retraining Therapy.

Some therapies for tinnitus tend to focus on the impact of noise on the quality of life and humor, and include antidepressants, anticonvulsants and benzodiazepines, or attempt to mask their own noise with white noise generators. Habituation programs and psychotherapy are almost always recommended[12].

We found 11 articles in PubMed/MedLine with the keywords sudden deafness and tinnitus during the period between 2003 and 2013.

In 2005, a review of published randomized clinical trials addressing the correlation between sudden sensorineural hearing loss and tinnitus and treatment by hyperbaric oxygen therapy (HBOT). The administration of hyperbaric oxygen is based on the argument that both the hearing loss and the tinnitus may result from a hypoxic event in the cochlea, and that hyperbaric oxygen therapy may be able to reverse the oxygen deficit. Significant increase of 25% was found in the hearing threshold of patients undergoing this type of therapy, but in relation to tinnitus, the study was not conclusive[13].

The sudden sensorineural hearing loss (SSHL) is a considerable diagnostic challenge because it can be caused by many different diseases and there is still no definitive treatment for PANSS universally accepted.

In search of a therapeutic approach, the efficacy of enoxaparin sodium associated with venous hemofiltration was studied. 20 patients with SSHL and tinnitus. Seven patients (70%) treated with enoxaparin sodium and venous hemofiltration (group A) had reduced subjective tinnitus and four patients (40%) showed a complete hearing recovery after the first procedure. In group B, eight patients (80%) treated with conventional therapy showed a reduction of subjective tinnitus and hearing score also improved in eight patients (80%) - the hearing remained unchanged in two

Table 2. Characterization of the sample in relation to general data.

Patient	Age (Years)	Affected Ear	Gender	Pre-therapy hearing loss (0,5; 1; 2KHz)	Hearing loss Post-Therapy (degree)	Dizziness	Comorbidities	Onset of symptoms (day/month/year)	Beginning intratympanic therapy (day/month/year)
1	26	R	M	Mild	Normal	Mild	No	30/06/2012	23/07/2012
2	26	L	M	Profound	Profound	Mild	HIV, HEP, VDRL	02/11/2012	18/11/2012
3	37	L	M	Profound	Profound	Mild	No	25/09/2012	12/10/2012
4	42	R	F	Mild	Mild	Mild	No	14/03/2013	08/04/2013
5	43	L	F	Moderate	Moderate	No	Depression, Autoimmune disease, Migraine	05/07/2013	24/07/2013
6	43	L	M	Severe	Normal	Severe	Obesity	10/05/2013	24/05/2013
7	27	R	M	Moderate	Moderate	Mild	No	11/06/2011	27/06/2011
8	73	L	M	Severe	Severe	Severe	High Blood Pressure, DM	03/04/2013	19/04/2013

HEP: Hepatitis; VDRL: Sifilis; DM: Diabetes.

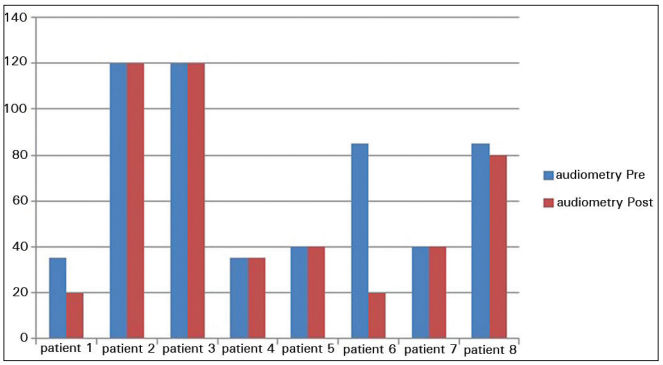

Figure 2. Pure tone audiometry pre and post intratympanic and oral therapy.

patients (20%). None of the patients experienced side effects from this treatment, and the authors concluded that this option can be beneficial as adjuvant therapy for hearing improvement in patients with PANSS, but cost factors are the main obstacles to the use of this therapy[14].

In 2008, Ishida et al.[15] investigated how the symptoms of ear fullness, tinnitus and otoacoustic emissions (OAE) varied over the course of recovery thresholds in pure tone audiometry in SSHL. Eight patients were followed with improvement in SSHL auditory thresholds (Group A) and eight patients with poor hearing improvement (Group B), to elucidate the behavior of these symptoms in your ongoing recovery. Follow-up was performed until there was no change in hearing thresholds over a week. All patients in both groups had ear fullness and tinnitus in association with the onset of the SSHL. However, these symptoms improved only in Group A, showing a significant relationship between recovery of hearing thresholds and improvement of aural fullness. None of the patients (Group A or B) had OAE responses on their first exam. In group A, the OAE responses appeared simultaneously with the improvement in hearing levels in five patients (63%). It was concluded that patients with hearing improvement PANSS (Group A) tend to have OAE responses and sensations of fullness in the ear and tinnitus improved almost simultaneously with the hearing improvement. The improvement was mainly on thresholds in low and mid frequencies. The authors

Frame 3. Studies with the keywords: Sudden deafness and tinnitus.

Authorand Origin	Journal	Sample (n)	Study Design	Subject
Bennett MH, Kertesz T, Yeung P 2005 Australia	The Journal of Laryngology & Otology	304	Review of clinical trials, randomized, controlled	Hyperbaric oxygen therapy for idiopathic sudden sensorineural hearing loss and tinnitus: a systematic review of randomized controlled trials
Bennett MH, Kertesz T, Yeung P. 2005 Australia	Cochrane Database Syst Rev	254	Review	Hyperbaric oxygen for idiopathic sudden sensorineural hearing loss and tinnitus
Mora R, Dellepiane M, Mora F, Jankowska B. 2006 Italy	International Tinnitus Journal	20	Clinical trials, randomized, controlled	Sodium enoxaparin and venovenous hemofiltration in treating sudden sensorineural hearing loss and tinnitus
Bennett MH, Kertesz T, Yeung P. 2007 Australia	Cochrane Database Syst Rev	308	Review	Hyperbaric oxygen for idiopathic sudden sensorineural hearing loss and tinnitus
Ishida IM, Sugiura M, Teranishi M, Katayama N et al. 2008 Japan	Auris Nasus Larynx	8	Prospective study	Otoacoustic emissions, ear fullness and tinnitus in the recovery course of sudden deafness
Kleinjung T, Steffens T, Strutz J, Langguth B 2009 Germany	Cases Journal	1	Case Study	Curing tinnitus with a cochlear implant in a patient with unilateral sudden deafness: a case report
Hikita-Watanabe N, Kitahara T, Horii A, Kawashima T et al. 2010 Japan	Acta Oto-Laryngologica	15	Prospective study	Tinnitus as a prognostic factor of sudden deafness
Fioretti A, Peri G, Eibenstein A 2012 Italy	Case Reports in Otolaryngology	1	Case Study	Suppression of Tinnitus in a Patient with Unilateral Sudden Hearing Loss: A Case Report
Bennett MH, Kertesz T, Perleth M, Yeung P et al. 2012 Australia	Cochrane Database Syst Rev	392	Review	Hyperbaric oxygen for idiopathic sudden sensorineural hearing loss and tinnitus
Ramos A, Polo R, Masgoret E, Artiles O et al. 2012 Spain	Acta Otorrinolaringol Esp	10	Prospective study	Cochlear implant in patients with sudden sensorineural hearing loss and associated tinnitus
Michiba T, Kitahara T, Hikita-Watanabe N, Fukushima M et al. 2013 Japan	Auris Nasus Larynx	44	Prospective study	Residual tinnitus after the medical treatment of sudden deafness

concluded that patients with poor hearing improvement tend to have absent OAE and ear fullness and tinnitus persisted.

Kleinjung et al.[16], in 2009, described the case of a man of 55 years who suffered from tinnitus in the right ear as a result of a SSHL. Several therapeutic efforts including intravenous steroids and graft in the round window showed no positive responses. Given the failure of the rapies performed, it was suggested the cochlear implant that, according to the authors, is a routine procedure for patients with profound bilateral sensorineural hearing loss, and succeeded, some reports showed a suppression of tinnitus as a side effect after implantation. One year after the onset of symptoms on the right side, the cochlear implant was performed, and resulted in a complete suppression of tinnitus after activating the implant. Clinical improvement was also reflected by a decrease in the scores of questionnaires THI and VAS. Given this, the authors suggested the use of cochlear implants as a possible therapy for tinnitus persisted after sudden deafness.

Hikita-Watanabe et al.[17], in 2010, in an article entitled "Tinnitus as a prognostic factor of sudden deafness", rebound that in the group "buzzing rare" there was a worst prognosis to hear than in the group "buzz often". All subjects had SSHL, although the group "short" had a better prognosis than the group "longer duration" when restricted to SSHL accompanied by tinnitus. This indicates that the tinnitus by itself cannot be a problem sign in the prognosis of hearing, but may be an essential sound for the early recovery of the damaged auditory system. The 50 patients were treated with systemic administration of steroids. The hearing recovery was determined by comparing the hearing levels before and after treatment and tinnitus was subjectively evaluated by using a questionnaire.

In 2012, Fioretti et al.[18] described the case of a 67 years-old women with severe and disabling tinnitus in the right ear, hyperacusis and mild headache. Tinnitus has been associated with sudden hearing loss and vertigo on the right side. Shortly after the standard fitting procedure, the patient reported a reduction of tinnitus, hyperacusis, and the headache disappeared completely in the follow-up of 3, 6 and 12 months.

In 2012, a research was also conducted by Ramos et al.[10], in which the authors assessed the effectiveness of cochlear implants in patients with SSHL and disabling tinnitus. Ten patients with sudden hearing loss and severe-profound unilateral tinnitus associates were implanted with a mean age of 42.7 years deployment.

The tinnitus severity was assessed using the Tinnitus Handicap Inventory (THI) and the Visual Analogue Scale (VAS) before and after deployment. Suppression of the tinnitus was observed in two patients. Seven patients experienced an improvement inTHI in different degrees and in only one patient there was no change.

Given the results, it can be concluded that the reduction of tinnitus after cochlear implantation may be due to several mechanisms such as habituation, acoustic masking, direct stimulation of the cochlear nerve and reorganization of cortical areas.

Michiba et al.[19], in 2013, highlighted the fact that many patients are frustrated with the SSHL residual buzz, even after complete SSHL treatment. It was conducted a prospective study that analyzed gender, laterality and age of patients, along with changes in the level of hearing and tinnitus, after scoring early SSHL to determine the prognostic factors of residual tinnitus after the last day of treatment for SSHL. 44 patients with SSHL were followed, all treated with systemic steroids administration for 2 weeks and oral ingestion of vasoactive drugs and B12 vitamin for 6 months.

The hearing improvement rate was determined by comparing the thresholds before and 6 months after initiation of treatment. The tinnitus was assessed subjectively by a questionnaire before, 6 and 24 months after initiation of treatment.

The improvement of hearing thresholds were significantly correlated with improvement in the score of tinnitus 6 months after initiation of treatment compared with before treatment. The scores of tinnitus in all three items were significantly better 6 months after initiation of treatment comparing with the last treatment. Among the comparison between 6 and 24 months after initiation of treatment, there was no significant change. It was concluded that, according to the survey of tinnitus, the time factor is the most reliable item for subjective tinnitus.

Generally, subjective feelings for the ringing residual 6 months after initiation of SSHL treatment are almost the same as 24 months after treatment. Especially younger patients with hearing improvement achieve an improvement of tinnitus in the period between 6 and 24 months after initiation of treatment.

Considering that the research was conducted with a small group of subjects with sudden deafness and tinnitus, it is noted that further studies with larger samples and control group are needed to investigate the efficacy of oral and intratympanic steroids in reducing and/or remission of tinnitus in sudden deafness.

CONCLUSION

Patients that carriers sudden deafness and severe disabling tinnitus, and underwent intratympanic and oral corticosteroids showed, in this study, significant reduction or remission of tinnitus.

REFERENCES

1. Schreiber BE, Agrup C, Haskard DO, Luxon LM. Sudden sensorineural hearing loss. Lancet. 2010;375(9721):1203-11. PMID: 20362815 DOI: http://dx.doi.org/10.1016/S0140-6736(09)62071-7
2. Maia RA, Cahali S. Surdez súbita. Rev Bras Otorrinolaringol. 2004;70(2):238-48. DOI: http://dx.doi.org/10.1590/S0034-72992004000200015
3. Penido Nde O, Ramos HV, Barros FA, Cruz OL, Toledo RN. Clinical, etiological and progression factors of hearing in sudden deafness. Braz J Otorhinolaryngol. 2005;71(5):633-8. PMID: 16612525
4. Rauch SD, Halpin CF, Antonelli PJ, Babu S, Carey JP, Gantz BJ, et al. Oral vs intratympanic corticosteroid therapy for idiopathic sudden sensorineural hearing loss: a randomized trial. JAMA. 2011;305(20):2071-9. PMID: 21610239 DOI: http://dx.doi.org/10.1001/jama.2011.679
5. Paula Erika Alves F, Cunha F, Onishi ET, Branco-Barreiro FC, Ganança FF. Tinnitus Handicap Inventory: cross-cultural adaptation to Brazilian Portuguese. Pro Fono. 2005;17(3):303-10.
6. Araújo MF, Oliveira CA, Bahmad FM Jr. Intratympanic dexamethasone injections as a treatment for severe, disabling tinnitus: does it work? Arch Otolaryngol Head Neck Surg. 2005;131(2):113-7. PMID: 15723941 DOI: http://dx.doi.org/10.1001/archotol.131.2.113
7. Rauch SD. Clinical practice. Idiopathic sudden sensorineural hearing loss. N Engl J Med. 2008;359(8):833-40. PMID: 18716300 DOI: http://dx.doi.org/10.1056/NEJMcp0802129
8. Lazarini PR, Camargo AC. Idiopathic sudden sensorineural hearing loss: etiopathogenic aspects. Braz J Otorhinolaryngol. 2006;72(4):554-61. PMID: 17143437
9. Raymundo IT, Bahmad F Jr, Barros Filho J, Pinheiro TG, Maia NA, Oliveira CA. Intratympanic methylprednisolone as rescue therapy in sudden sensorineural hearing loss. Braz J Otorhinolaryngol. 2010;76(4):499-509. DOI: http://dx.doi.org/10.1590/S1808-86942010000400015
10. Ramos Á, Polo R, Masgoret E, Artiles O, Lisner I, Zaballos ML, et al. Cochlear implant in patients with sudden unilateral sensorineural hearing loss and associated tinnitus. Acta Otorrinolaringol Esp. 2012;63(1):15-20.
11. Liang CY, Gong Y, Li J, Tian AM. Vasodilator agents for sudden sensorineural hearing loss (Protocol). Cochrane Database Syst Rev. 2002;CD003422.
12. Noell CA, Meyerhoff WL. Tinnitus. Diagnosis and treatment of this elusive symptom. Geriatrics. 2003;58(2):28-34. PMID: 12596495
13. Bennett M, Kertesz T, Yeung P. Hyperbaric oxygen therapy for idiopathic sudden sensorineural hearing loss and tinnitus: a systematic review of randomized controlled trials. J Laryngol Otol. 2005;119(10):791-8. PMID: 16259656 DOI: http://dx.doi.org/10.1258/002221505774481246
14. Mora R, Dellepiane M, Mora F, Jankowska B. Sodium enoxaparin and venovenous hemofiltration in treating sudden sensorineural hearing loss and tinnitus. Int Tinnitus J. 2006;12(1):83-6.
15. Ishida IM, Sugiura M, Teranishi M, Katayama N, Nakashima T. Otoacoustic emissions, ear fullness and tinnitus in the recovery course of sudden deafness. Auris Nasus Larynx. 2008;35(1):41-6. PMID: 17904320 DOI: http://dx.doi.org/10.1016/j.anl.2007.04.003
16. Kleinjung T, Steffens T, Strutz J, Langguth B. Curing tinnitus with a Cochlear Implant in a patient with unilateral sudden deafness: a case report. Cases J. 2009;2:7462. DOI: http://dx.doi.org/10.1186/1757-1626-2-7462
17. Hikita-Watanabe N, Kitahara T, Horii A, Kawashima T, Doi K, Okumura S. Tinnitus as a prognostic factor of sudden deafness. Acta Otolaryngol. 2010;130(1):79-83. DOI: http://dx.doi.org/10.3109/00016480902897715
18. Fioretti A, Peri G, Eibenstein A. Suppression of tinnitus in a patient with unilateral sudden hearing loss: a case report. Case Rep Otolaryngol. 2012;2012:210707.
19. Michiba T, Kitahara T, Hikita-Watanabe N, Fukushima M, Ozono Y, Imai R, et al. Residual tinnitus after the medical treatment of sudden deafness. Auris Nasus Larynx. 2013;40(2):162-6. DOI: http://dx.doi.org/10.1016/j.anl.2012.06.007