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Cochlear implant in the treatment of incapacitating unilateral tinnitus: case report

Rita de Cassia Cassou Guimarães Mendes[1]
Angela Ribas[2]
Izabella Pedriali de Macedo[3]
Mauricio Buschle[1]
André Luiz Ataíde[4]
Rodrigo Pereira[4]
Ana Paula Kochen[5]

Abstract

Several studies have shown that cochlear implants may reduce or even eliminate tinnitus in patients with bilateral profound hearing loss. However, there are not consistent references regarding ipsilateral tinnitus compared to unilateral profound hearing loss. The aim of this paper is to describe audiological results of a patient with asymmetrical hearing loss with incapacitating ipsilateral tinnitus in the ear subjected to cochlear implant surgery. Audiological exams and responses to perception protocols for tinnitus before and after surgery were analyzed. The tests showed improvements in the hearing threshold on the side with the implant, improvements in speech perception and a significant reduction in tinnitus perception, which consequently led to an improvement in the patient's quality of life.

Keywords: cochlear implants, deafness, language and hearing sciences, speech, speech perception, tinnitus.

[1] Department of Otolaryngology - Universidade Federal do Paraná - Curitiba - PR - Brasil. E-mail: ritaguimaraescwb@gmail.com.
E-mail: mauriciobuschle@hospitaliguacu.com.br
[2] Speech, Language and Hearing Sciences - Universidade Tuiuti do Paraná - Curitiba - PR - Brasil. E-mail: angela.ribas@utp.br
[3] Speech, Language and Hearing Sciences - Hospital Iguaçu - Curitiba - PR - Brasil. E-mail: ipmacedo@uol.com.br
[4] Department of Otolaryngology - Hospital Infantil Pequeno Príncipe - Curitiba - PR - Brasil. E-mail: andre.ataide@yahoo.com.br. E-mail: rodrigoper@hotmail.com
[5] Speech, Language and Hearing Sciences - Hospital Infantil Pequeno Principe - Curitiba - PR - Brasil. E-mail: anapaulakochen@hotmail.com
Institution: Universidade Tuiuti do Paraná.
Send correspondence to:
Angela Ribas.
Rua José Isidoro Biazetto 845, ap 501, CEP 81200240, Curitiba, PR. E-mail: angela.ribas@utp.br
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INTRODUCTION

Tinnitus means perceiving a sound that is not being generated in the environment at that time. It is a very frequent symptom, which may affect around 17% of the population in some countries. We do not know its prevalence in Brazil, but if we extrapolate the data from our international population, it is possible that some 28 million Brazilians have already had some form of tinnitus[1].

Considered one of the most common symptoms of profound sensorineural hearing loss, tinnitus can significantly affect the quality of life of individuals[2]. Several studies claim that the cochlear implant (CI) can diminish or even eliminate the perception of tinnitus in patients with bilateral profound hearing loss and that, although a risk of tinnitus perception that increases after implantation exists, it is very small[3-6].

The latest international publications[7,8] suggest that patients with unilateral hearing loss, or even severe hearing loss, presenting ipsilateral tinnitus with hearing loss, unresponsive to several treatments, may also benefit from electrical stimulation of the auditory nerve through the CI.

The beneficial effect of a CI on tinnitus can be explained by acoustic masking, by electrical stimulation directly to the auditory nerve, and especially by the reorganization of the central auditory system and associative brain areas that occurs after activation of the implant. With the support of these findings researchers suggest that tinnitus should be a selection criterion in choosing which ear to implant and that patients with severe unilateral hearing loss associated with severe tinnitus can be considered CI candidates[9-11].

The aim of this study was to describe the audiological results of a patient with asymmetric hearing loss with ipsilateral disabling tinnitus, who was underwent the CI procedure.

CASE REPORT

This paper was submitted to the Institutional Ethics Committee and approved under number 047/2009. The subject investigated signed a consent form authorizing the release of data.

This is the case report of a male patient, 49 years old, diagnosed with Meniere's Disease.

He had severe sensorineural hearing loss in the left ear and deep loss on the right, and complained of ipsilateral disabling tinnitus to profound hearing loss, i.e., the right ear.

Throughout the ENT care, various treatments were performed without success, for the reduction or remission of tinnitus, which led the patient at the time to have suicidal thoughts.

The patient underwent cochlear implant surgery to the right ear in an attempt to improve auditory acuity, but mainly as a last resort in tinnitus treatment.

The preoperative and postoperative tests are reported below. The comparison between the responses obtained before and after the CI verify the benefits achieved with this therapy.

Audiometric assessment

Pure tone audiometry and free field audiometry. The tests were conducted in a soundproof booth, with the Madsen Itera - GN Otometrics audiometer.

Before the CI, results were compatible with profound hearing loss to the right ear and severe loss to the left.

After the CI, thresholds compatible with normal hearing on the right ear were observed, as shown in Figure 1.

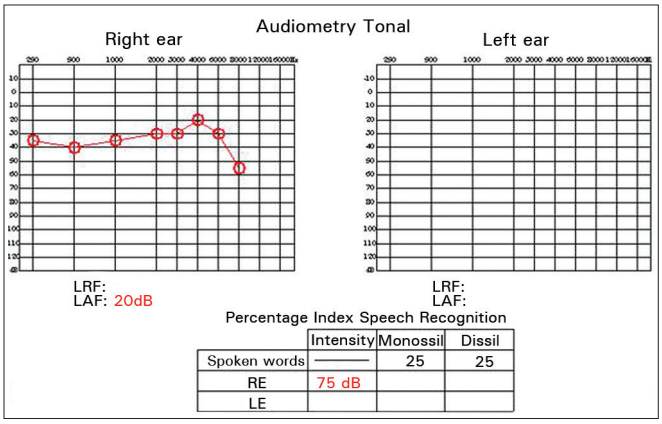

Figure 1.

Assessment of speech perception

We used the Glendonald Auditory Screening Procedure (GASP test)[12] which classifies the category of hearing on a scale of zero to six, where zero means no detection of speech sounds and six means open-set speech recognition. The test was applied prior to the CI, five months later, eight months later, and finally, after a year. Chart 1 shows the comparison between the results where it can be verified that the patient progressed from category zero to six in the 12-month study.

Assessment of tinnitus

The protocol consisted of the tinnitus assessment tests listed below, and Chart 2 shows the intention of each test:

Tinnitus Handicap Inventory (THI)[13] - version adapted to Portuguese, functional, emotional and catastrophic sub indices;

Iowa Tinnitus Activities Questionnaire (TAQ)[14], aspects related to concentration, emotion and hearing;

Chart 1. Results of the test of speech perception (GASP).

Hearing abilities (GASP)	Without hearing aid Pre-CI	With CI 5 months post-op	With CI 8 months post-op	With CI 1 year post-op
Detection of Ling sounds	0 %	100%	100%	100%
Name called out	--	100%	100%	100%
Vowel Discrimination	--	100%	100%	100%
Vocabulary Range	--	100%	100%	100%
Sentence Range	--	100%	100%	100%
Sentence Identification	--	100%	100%	100%
Open-set Recognition	--	100%	100%	100%
Bisyballic List	--	88%	92%	92%
Monosyballic List	--	68%	68%	78%
Nonsense Syllables	--	63%	73%	68%
Hearing Category	0	6	6	6

Chart 2. Description of the tests used in the assessment of tinnitus.

TEST	SUB INDICES	OBJECTIVES	VALUE SCALE
THI	Functional Catastrophic Emotional	Questionnaire to assess consequences of tinnitus, quantification of psycho-emotional and functional deficits caused.	Zero = when the tinnitus does not interfere with the patient's life up to 100 = when the level of discomfort is severe.
TAQ	Concentration Emotion Hearing	Questionnaire which assesses the emotional aspect of tinnitus, as well as problems that are associated with concentration, hearing and sleep.	Zero = when the tinnitus does not interfere with the patient's life up to 100 = when the level of discomfort is severe.
THQ	Social Emotional Behavioral Hearing Life Perspectives	Questionnaire which assesses the physical, emotional and social consequences brought about by tinnitus, in addition to the hearing ability of the patient.	Zero = when the tinnitus does not interfere with the patient's life up to 100 = when the level of discomfort is severe.
VAS	----	Consists of a tool that assists in measuring the intensity of a symptom reported by a patient. Often used to verify the patient's progress during treatment.	Zero = no symptoms up to 10 = maximum intensity of symptom

Iowa Tinnitus Handicap Questionnaire (THQ)[15], factor 1 = social, emotional and behavioral; factor 2 = hearing; factor 3 = life prospects.

Visual Analogue Scale (VAS)[16];

The protocol for assessing tinnitus was applied at the following times: before surgery, 45 days after surgery (activation of CI), two months later, six months later and one year after CI surgery. Tables 1, 2 and 3 present the results recorded in THI, TAQ and THQ. Preoperatively, the tinnitus intensity was classified as severe by VAS.

Table 1. THI Results.

THI	Functional	Catastrophic	Emotional	Total
Pre IC	48	18	32	94
On Activation	2	0	4	6
60 days after activation	2	0	0	2
180 days after activation	0	0	0	0
1 year after activation	0	0	0	0

Table 2. Results of TAQ.

TAQ	Concentration	Emotional	Hearing	Sleep	Total
Pre IC	66	100	96	26	72
On activation	0	20	20	0	10
60 days after activation	0	0	0	0	0
180 days after activation	0	0	0	0	0
1 year after activation	0	0	0	0	0

Table 3. Results of THQ.

THQ	Factor 1	Factor 2	Factor 3	Total
Pre IC	92%	97%	100%	94,8%
On activation	13%	50%	50%	29.6%
60 days after activation	0	6,6%	25%	7.4%
180 days after activation	0	12,5%	75%	14,8%
1 year after activation	20%	12.5%	25%	18,5%

DISCUSSION

The literature[11] states that the CI is configured as an alternative treatment of deafness and constitutes a multifactorial process with proven effectiveness. This fact was borne out in this case report, where the pre and postsurgical audiometric tests showed improvement in tone thresholds with CI use.

The Brazilian study[17] indicates that the hearing assessment obtained six months after the first implant programming demonstrates that English-speaking patients get excellent results in tests of recognizing words and sentences in open presentation, regaining useful hearing. In this case report, the speech perception test also showed significant improvement. The patient went from category zero to six, where there is open-set recognition of words and phrases together. Without a personal sound amplification device (PSAP) during the application of the GASP, the patient reported that he felt only a slight vibration in the right ear to the presented sound stimuli. Shortly after activation of the CI he began to recognize open-set word and auditory performance, improving at each evaluation. This fact is justified, since the patient has post-lingual hearing loss, i.e., he was a listener until recently and possessed auditory memory for speech sounds.

Despite these satisfactory and known findings by physicians and audiologists, the primary complaint by the subject, which is the focus of this study, was the tinnitus. In the four protocols applied, discomfort indexes were intense: VAS rated tinnitus intensity as severe; THI rated at catastrophic; TAQ had a total index of 72% indicating strong interference of tinnitus, especially in the emotional and hearing spheres for the patient, and THQ also showed catastrophic impact. The degree of discomfort, intolerance or failure often are not related to the intensity of tinnitus, says a consulted study[1], but mood disorders (depression, dysthymia) and anxiety often present, exerting strong influences on the worsening of the tinnitus. In our study, the patient reported he had considered suicide due to the discomfort caused by tinnitus.

Di Nardo et al.[6] reported that the CI provides effective results in reducing the perception of tinnitus intensity. In this study, by applying the VAS, we observed a significant reduction in the intensity of tinnitus perception, and that after activation of the CI, the rating went from four to one after 60 days of using the device. After 180 days of use, the patient did not perceive any ringing with the CI turned on and noticed only mild tinnitus with the CI off.

Statistically significant reduction in THI overall indices and sub-indices, pre and post CI, were demonstrated in scientific studies[8,11] showing lower levels of discomfort and a decrease in the intensity of tinnitus as a result of direct electrical stimulation of the auditory nerve and reorganization of the central auditory pathways and cortical association areas, leading to the use of tinnitus as a criterion for choosing the ear to be implanted. In our study, after activation of the CI, there was a reduction in the THI total index (six) and sub-indices (functional 2, catastrophic 0, and emotional 4) to a score of one. The disadvantage that was rated as severe before, now was recorded as mild.

The results related to the concentration (66%), emotional (100%), sleep (26%) and hearing (96%) obtained by preoperative TAQ converged at a rate of 72% indicating strong interference of tinnitus, especially in the emotional and hearing states of the patient. A total reduction of assessed scores on aspects of sleep and concentration with a reduction of greater than 20%, significant data regarding the emotional and hearing aspects, was observed after activation of the CI. After 60 days of CI use the total score was zero.

Regarding THQ, the result for the three preoperative factors analyzed was of catastrophic impact: factor 1 (social, emotional and behavioral) 92%, factor 2 (hearing) 97.5%, and factor 3 (life prospects) 100%, with a total score 94.8%, confirming the severe impairment of quality of life of the patient regarding the perception and discomfort of tinnitus.

Upon activation of the CI there was a reduction in factor 1 to 13.3%, after 2 months of using CI it fell to 6.6%, after 6 months it was zero, and after 1 year of CI use the total reduction was 20%, which is considered a significant result in reduction.

For factor 2, after CI activation the score was 50%, zero after two months, 12.5% after six months, and after one year remained at 12.5%.

Factor 3, life prospects, went from a preoperative score of 100% to 50% after activation of the CI, 25% after two months of use, 75% after six months and reduction to 25% after 1 year of CI use.

The consulted study[11] shows that the CI generates maximum benefit in remission buzz around seven months after the performed procedure. In our study there was a significant reduction in the percentage of THQ (Table 3) after activation of the CI and the subsequent evaluations (two and six months of CI use) mainly in factors 1 and 2.

The reduction in the intensity and degree of tinnitus annoyance confirms the improvement in the quality of life of individuals, a fact that must be considered in preoperative counseling of patients with tinnitus as candidates for cochlear implants.

FINAL COMMENTS

CI as a treatment for post-lingual profound hearing loss is highly effective, there is improvement seen in hearing thresholds in performance and perception of speech sounds, as in the case presented. In addition, it can be seen that the CI was critical to the reduction of tinnitus perception.

Although the literature describes the indication of CI for patients with tinnitus, the initiative is still not being widely accepted by physicians and speech-language pathologists, especially when hearing loss is unilateral or asymmetric.

The improvement in quality of life provided by the CI, especially for the remission of tinnitus in our case, leads us to reflect on the need to study this as a new criterion for CI, i.e., cases of patients with asymmetric bilateral hearing loss accompanied by ipsilateral disabling tinnitus hearing loss in the worst ear and unresponsive to many other treatments.

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