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The Medical Audiological Evaluation of Tinnitus Patients

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Abstract: We outline our routine approach to tinnitus patients, highlighting the different aspects of our examination: the clinical history, objective ear, nose, and throat and general examination, and audiovestibular testing. We emphasize the interest in testing not only the cochlear but the vestibular function of the inner ear. In our view, this testing is of paramount importance, for the cochleovestibular system is a unit, acting as a whole. All these data are stored in a database bank. Then we present our preliminary results. Currently, we have 83 patients suffering from tinnitus, and their results are statistically presented. We characterize the population in terms of its gender distribution and mean age. The localization and characteristics of tinnitus and the associated symptoms also are noted. The results of the audiovestibulometric examinations—pure-tone audiometry, vocal audiometry, and brain evoked response audiometry craniocorpography and electronystagmography are discussed. We concluded that many tinnitus patients, even those who had no vestibular symptoms, showed some disturbances in the vestibular tests. This fact highlights the need for a complete cochleovestibular investigation in all patients complaining of tinnitus.

Tinnitus is a very common complaint among the Portuguese population. Many ear, nose, and throat (ENT) doctors still think this is a very frustrating symptom that they are unable to control. This is not true; nowadays, even when the cure is not possible, we can still help many affected tinnitus patients, relieving and controlling their tinnitus. For this purpose, many investigators have contributed with their work, among whom is Dr. Shulman, indeed one of the most important.

To establish a strategy for treatment or control of tinnitus, we must make a precise diagnosis in terms of its significance, the site of the lesion, and its probable etiology. One concept we must always keep in mind is the fact that the inner ear is a whole—the cochleovestibular unit—with cochlear and vestibular parts acting in concert. This is a continuum so, to evaluate the state of the inner ear, we must study both cochlear and vestibular functions.

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For the evaluation of tinnitus patients in the ear, nose, and throat (ENT) department of Gaia Hospital, we follow a routine systematic protocol; clinical history, an ENT general examination, and complete audiovestibulometric testing. We discuss each of them briefly.

With these data, we try to establish the clinical type of tinnitus, its topodiagnosis, and its probable etiology, thereby creating a strategy for the control of the tinnitus. We are storing all these data in a computer databank, so as to have an approach to our statistics. We started this work in 1994, but it had to be discontinued in 1995. From this work, a communication was engendered at the Twenty-third Meeting of the Neurootological and Equilibriometric Society and an article appeared in the *International Tinnitus Journal* (volume 1, number 2). Recently, we resumed work.

MEDICAL-AUDIOLOGICAL EVALUATION

Clinical History

The clinical history is very important in the study and diagnosis of tinnitus patients. We attach the upmost importance to having a questionnaire to submit to all patients, so as to assess the impairment, disability, and annoyance caused by the tinnitus to affected patients.

We classify tinnitus in terms of its localization—whether the symptom is felt in the ears (right, left, or both) or in the head—and its duration from the onset to the time of the first consultation. We also note whether it is pulsatile or constant, intermittent or fluctuant, and single or multiple. When multiple, we try to characterize each of the sounds that are heard. The tinnitus intensity and annoyance for the patient's daily life are evaluated on a 0–7 scale (as we learned from Shulman), and the type of sound that is heard also is noted. Variously, it is described as a motor, a ringing, an ocean, a siren, and as many other sounds. The patient also is asked for any situation that is known to relieve or enhance the tinnitus.

We also look for any associated symptoms, mainly hearing loss, vertigo or unsteadiness, and ear blockage, alone or in combination, and establish whether any relation exists between them. We consider this extremely important for the determination of an accurate diagnosis. We search the patient's history and family, focusing on the cardiovascular system and on metabolic disturbances, such as diabetes and hypercholesterolemia.

ENT General Examination

A complete general ENT examination is required. We want only to highlight the importance of the pneumatoscopy, determination of the mobility of the tympanic membrane and how this affects tinnitus, and the auscultation of the neck, over the ears and the head.

Audiovestibulometric Testing

As stated, we consider the inner ear as a cochleovestibular unit, so we routinely investigate not only the auditory system but also vestibular function. We routinely perform various tests in tinnitus patients: Audiometry (tonal, vocal, and suprathreshold), SISI test, and tone decay; tinnitus match for pitch and loudness and Feldman masking curves (performed only in recent patients); impedancimetry (tympanogram, ipsilateral and contralateral reflexes, and reflex decay); brain evoked response audiometry (BERA); craniocorpography (CCG); and electronystagmography (ENG; spontaneous and fixation nystagmus, caloric tests, and rotatory tests, when available).

RESULTS

As stated, we are attempting to build a databank for patients from the ENT department of our hospital. This work is not yet complete, so definitive statements are not possible; nevertheless, we can show some of our preliminary results. For the moment, we have data concerning 83 patients with a gender distribution of 40% men and 60% women and a mean age of 54 years (standard deviation, 21.8).

History

The frequency of tinnitus symptom localization in the ears (both and right or left) and in the head was a follows: bilatera, 44%; unilateral, 52%; right, 24%; left, 28%; and head, 22%. The prevalence of associated symptom complains, such as hearing loss and equilibrium disturbances, was 85% hearing loss and 55% unsteadiness.

Audiometric Evaluations

Pure-tone Audiometry

Hearing loss is classified for the purpose of this study into five types: 1, normal; 2, flat neurosensory hearing loss; 3, high-frequency hearing loss; 4, conductive hearing loss; and 5, miscellaneous. The relative frequencies are shown in Table 1.

We also search for recruitment and abnormal adaptive audition, using the SISI test, Metz, tone decay, and reflex decay. These tests are not routinely used together.

We found that 36% of the patients in our sample had a normal auditory level (considering normal a hearing level that is equal to or better than 20 dB hearing level (HL) for all frequencies). The main changes were found to be a deterioration in the high-frequency range (>2 kHz) and a flat neurosensory hearing loss (see Table 1).

Vocal Audiometry

Vocal audiometry is extremely important, and we always search for the speech reception threshold (SRT) and a discrimination score of 30 dB HL over the SRT. Recently, we began searching for tinnitus match of loudness and pitch, using pure tones and broad and narrow band noises, and the masking curves of Feldman. Because to date we have investigated few patients for these parameters, we do not show any results related to these tests.

Brain Evoked Response Audiometry

We record the BERA using a click or increasing intensities of 60, 80, 100, and 120 dB SPL, sometimes with

Table 1. Pure-Tone Audiometry: The Audiometric Pattern

Hearing Loss	Frequency (%)
Normal	36
Flat neurosensory hearing loss	20
High-frequency hearing loss	38
Conductive	5
Miscellaneous	3

contralateral masking. For this study, we considered only the measurements made with the higher intensity (120 dB SPL). We mainly look for the morphology of graphic elements; latencies of waves I, III, V; interpeak latencies of I–III, III–V, and I–V; and interpeak ratio of I:V. We also look for recruitment of the latency of wave V.

Basically, we found the values for latencies of the different waves to be normal, except in cases of acoustic neurinoma (three cases of acoustic neurinoma in this sample). However, considering the morphology of the graphic elements and particularly the interpeak ratio between the amplitude of waves I and V, we found some abnormalities in our cases.

Vestibulometric Evaluations

Craniocorpography

We routinely perform CCG with the standing and the stepping test, according to Claussen's technique [1–4] (as described). The standing (Romberg) test showed two cases of discrete to moderate ataxia, all the others being normal. For the evaluation of the stepping (Unterberger-Fukuda) test, we use mainly two parameters: lateral sway, which is the lateral displacement of the shoulders and head between steps and is measured in centimeters, and angular deviation, which is the angle between the initial and final position of the patient and is measured in degrees. Lateral sway is assumed to be related to central disorders and angular deviation to peripheral lesions.

With these two parameters, we define, basically, four types of CCG assumed to be related to a specific site of lesion. This provides a very important clue for the topographical diagnosis, as follows: type 1, normal; type 2, peripheral lesion (an enhanced angular deviation with normal lateral sway); type 3, central lesion (an enhanced lateral sway and normal angular deviation); and type 4, combined, central plus peripheral lesion (an enhancement of the lateral deviation and the lateral sway). This test was normal in 55% of cases. The angular deviation was pathologically enhanced in 34% of cases, thus defining a type 2 pattern of CCG, and the lateral sway was the only disturbed parameter in 10% of cases, depicting a central (type 3) pattern of CCG. Table 2 shows the results of these tests.

Table 2. Craniocorpography Results of Tests

Test	Percentage of Cases (%)
Standing test	
Normal	85
Stepping test	
Type 1 (normal)	56
Type 2 (peripheral)	37
Type 3 (central)	7
Type 4 (combined)	0

Electronystagmography

As stated, after calibrating the eye movements, we perform the ENG in looking for spontaneous nystagmus and fixation nystagmus and for abnormalities in the smooth-pursuit test. We found that 30% of our patients showed a spontaneous nystagmus.

For statistical purposes the caloric response is quantified using the central frequency of the nystagmus, defined as the number of nystagmus beats during the period of 30 seconds of maximal response. The data are registered using the Claussen's butterfly [2,3]. For this study, we classified the type of caloric response in three groups, as follows: group 1, normal; group 2, inhibited pattern; and group 3, disinhibited. The pattern of response results were normal, 23%; inhibited, 61%; and desinhibited, 17%. We found that only 23% of the caloric tests were completely normal. All the others had at least one abnormal response. We found a pathological unilateral weakness in 45% of cases and a pathological directional preponderance in 20% of cases.

We had some problems with our rotatory chair, which has been out of order for several years. Consequently, many of our patients did not have this test performed.

DISCUSSION

The most frequent symptom associated with tinnitus is hearing loss. The hearing loss is mainly neurosensory and is characterized by a greater loss in the high-frequency range (>2 kHz) or a flat loss (or both).

The supraliminal audiometry is, in our opinion, extremely important in the study of these patients. We search for recruitment (SISI test and Metz test) as a sign of cochlear lesion and for abnormal auditory adaptation (tone decay and reflex decay) as a sign of retrocochlear lesion, thus helping us with the topographical diagnosis. (The results of these tests are not considered in this work). Vocal audiometry also is of great value in the diagnosis of disorders in these patients. We have found that an unexpectedly low discrimination score is highly suspicious of a retrocochlear lesion, namely an acoustic neurinoma. In fact, we have in our sample three cases of neurinomas that presented with tinnitus as the first (and sometimes only) symptom.

Regarding the BERA, we can state that basically the wave latencies and interpeak latencies are normal ex-

cept in the acoustic neurinoma cases. However, the graphic elements—the Interpeak ratio of the amplitude of waves I–V—are abnormal more often. These abnormalities in the graphic elements are very important and always should be sought very carefully. The interpeak ratio of amplitude I–V is thought to be present in central lesions, particularly some lesions of the pons [5].

Although in our sample 45% of the patients had no symptoms related to their equilibrium, we found that fewer than 20% had completely normal vestibulometric tests. These findings show that the vestibular function in tinnitus patients can be damaged even if they do not refer to any equilibrium-related symptom.

Our data support Shulman's concept that tinnitus might be the initial symptom of secondary endolymphatic hydrops. If this proves to be true, we should expect these patients progressively to develop other symptoms of endolymphatic hydrops, such as sensorineural hearing loss and clinical vestibular dysfunction. We emphasize the fact that we found abnormal vestibular tests in tinnitus patients with no vestibular complaints. This highlights the need for a complete neurootological evaluation of these patients.

As our final conclusion, we state our deep conviction that all tinnitus patients, whether or not they have any vestibular symptoms, must be evaluated completely in terms of auditory and vestibular functions. Indeed, the cochleovestibular system always must be considered as a whole and studied as such.

REFERENCES

1. Claussen CF, Tato JM: Equilibriometria Practica, Hasenclever & Cia, Buenos Aires, 1973.
2. Claussen CF, DeSa JV: Clinical Study of Human Equilibrium by Electronystagmography and Allied Tests. Popular Prakashan, Bombay, 1978.
3. Claussen CF, Bergmaan de Bertoro JM, Bertora GO: Otoneurooftalmologia; Ed. Springer Verlag; Berlin Heidelberg, 1988.
4. Claussen CF, Seabra R, Hahn A, Helms J: A Cranio-Corpo-Grafia e os testes caloricos nos doentes com neurinoma do estato-acústico; *Rev. Port. de ORL e Cir. Cerv. Facial* XXXI-1 (55–61) 1993.
5. Guerit J-M, Mayer M: L'enregistrement et l'interpretation des potentiels evoques.