THE MEDICAL AUDIOLOGIC EVALUATION OF THE TINNITUS PATIENT

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Abstract: *We outline our routine approach to tinnitus patients underlying the different aspects of our examination, namely the clinical history, objective E.N.T. and general examination, and audiovestibular testing. We highlight the interest in testing not only the cochlear, but also the vestibular function of the inner ear. This is in our point of vu of a paramount importance for the cochleovestibular system is a unit, acting as a whole. All these data are stored in a data base bank. Then we show our preliminary results. We have, for the moment, 83 patients suffering from tinnitus, and their results are statistically presented. We characterise the population in terms of its sex distribution and mean age. The localisation and characteristics of tinnitus as well as the associated symptoms are also noted. The results of the audiovestibulometric examinations - pure tone audiometry, vocal audiometry, and Brain Evoked Response Audiometry, C.C.G. and E.N.G. - 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 about tinnitus.*

1 - INTRODUCTION

Tinnitus is a very common complaint amongst Portuguese population. Although, many of E.N.T. doctors still think this is a very frustrating symptom which they are not able to control. This is not true. Nowadays, even when the cure is not possible, we can still help many of these patients reliving and controlling their tinnitus.

For this purpose many investigators had contributed with their work, and amongst them all, Prof. Shulman is indeed one of the most important.

In order to establish a strategy for treatment or control of the tinnitus we must make a precise diagnosis in terms of its significance, site of lesion and probable aetiology.

One concept we must always keep in our minds, is the fact that the inner ear is a whole - the cochleovestibular unit - with cochlear and vestibular parts acting as a single unit. This is a continuum. So, to evaluate the state of inner ear we must study both, cochlear and vestibular functions.

For the evaluation of the tinnitus patient in the ENT Department of Gaia Hospital, we follow a routine systematic protocol, which comprises: 1 - Clinical history; 2 - E.N.T. general examination; 3 - A complete audiovestibulometric testing.

We will discuss each of them briefly.

With this data we try to establish the clinical type of tinnitus, its topodiagnosis, and probable aetiology therefore creating a strategy for the control of the tinnitus.

We are storing all this data in a computer data bank, in order to have an approach of our statistics. We started this work in 1994 but it has to be discontinued in 1995. From this work a communication was born in the 23 Meeting of the N.E.S., and a paper came out in the International Tinnitus Journal, volume 1 Number 2. Recently, we resume work.

2 - MEDICAL AUDIOLOGIC EVALUATION

2.1 - CLINICAL HISTORY

The clinical history is very important in the study and diagnosis of tinnitus patient.

We think it is of the upmost importance to have a questionnaire to submit to all patients, in order to assess the impairment, disability and annoyance caused by the tinnitus to the patient.

We classify tinnitus in terms of its **localisation** - if the symptom is felt in the ears, right, left or both, or in the head - and **duration** from the onset to the time of the first consultation. We also note if it is **pulsatille or constant**, **intermittent or fluctuant**, if **single or multiple**. When multiple we try to characterise each one of the sounds that are heard. The tinnitus **intensity** and **annoyance** for the patient's daily life, is evaluated in a 0 to 7 scale as we learn from Shulman, and the **type of sound** that is heard is also noted. Sometimes it is described as a motor, ring, ocean, siren and many others. The patient is also asked for any situation that is known to relieve or enhance tinnitus.

We also look for any associated symptoms, mainly **hearing loss, vertigo or unsteadiness**, and **ear blockage**, alone or in combination, and establish if there is any relation between them. We consider this extremely important for the build up of an accurate diagnosis

We search the patient's past history and family focusing in the cardiovascular system, and metabolic disturbances such as diabetes and hypercolesterolemia.

2.2 - E.N.T. GENERAL EXAMINATION

A complete general E.N.T. examination is required. I only wanted to highlight the importance of the **pneumatoscopy**, to determine the mobility of the tympanic membrane and how this affects tinnitus and the **auscultation** of the neck, over the ears and the head.

2.3. - AUDIOVESTIBULOMETRIC TESTING

As already stated we consider the inner ear as a cochleovestibular unit, and so we routinely investigate not only the auditory system but also the vestibular function.

We routinely perform the following tests in the tinnitus patients:

- **Audiometry**: **Tonal**, **vocal** and **supraliminal** - S.I.S.I. test, and tone decay.
- **Tinnitus match for pitch and loudness**, and **Feldman masking curves** (this is done only in the recent patients)
- **Impedancimetry**: **Tympanogram**, **reflexes** ipsi and contra, and **reflex decay**.
- **B.E.R.A.**
- **C.C.G.**
- **E.N.G.** - **Spontaneous** and **fixation** nystagmus, **caloric tests**, and **rotatory tests** (when available).

3 - RESULTS

As previously stated we are trying to build a data bank with our patients from the ENT Department of our Hospital.

This work is not complete yet, so definitive statements are not possible, but nevertheless we will quickly show some of our preliminary results.

For the moment we have data concerning to 83 patients with a sex distribution of 40% men and 60% women, and a mean age of 54 years (standard deviation = 21,8).

3.1 – HISTORY

The frequence of tinnitus localisation in the ears, both, right or left, and in the head, is shown in Table 1.

TINNITUS	
Bilateral	**44%**
Unilateral	**52%**
Right	**24%**
Left	**28%**
Head	**22%**

Table 1 - Symptoms

The prevalence of associated complaints like hearing loss and equilibrium disturbances is shown in Table 2.

HEARING LOSS	**85%**
UNSTEADINESS	**55%**

Table 2 - Symptoms

3.2 - AUDIOMETRIC EVALUATIONS

Audiometry

-Pure Tone Audiometry

The type of hearing loss, is classified for the purpose of this paper in 5 types, as follows: 1 – Normal; 2 – Flat neurossensorial hearing loss; 3 – High frequency hearing loss; 4 – Conductive hearing loss; 5 – Miscellaneous. Its relative frequencies are shown in Table 3.

We also search for recruitment and abnormal adaptive audition, using the S.I.S.I. , METZ, tone decay and reflex decay. These tests are not routinely used all together.

We found that 36% of the patients in our sample had a normal auditory level (considering normal a hearing level which is equal or better than 20 dB HL for all frequencies). The main changes were found to be a deterioration in the high frequency range (> 2 K Hz) and a flat neurosensorial hearing loss.(Table 3)

PURE TONE AUDIOMETRY	
Normal	**36%**
Flat neurosensorial hearing loss	**20%**
High frequency hearing loss	**38%**
Conductive	**5%**
Miscellaneous	**3%**

Table 2 - Pure Tone Audiometry - The audiometric pattern

-Vocal Audiometry

Vocal audiometry is extremely important, and we always search for Speech Reception Threshold and Discrimination score 30 dBHL over the SRT.

Nowadays, we also search for **tinnitus match of loudness and pitch,** using pure tones and broad and narrow band noises, as well as the **masking curves of Feldman**. For the moment, we still have few patients with these parameters investigated, so we will not show any results related with this tests.

Brain Evoked Response Audiometry

We record the B.E.R.A. using a click of increasing intensities of 60 , 80, 100 and 120 dB SPL sometimes with contralateral masking. For this study we only considered the measurements made with the higher intensity (120 dB SPL).We mainly look for the morphology of graphoelements, latencies of waves I, III, V, interpeak latencies of I-III, III-V, and I-V, and InterPeakRatio I/V. We also look for recruitment of latencie of wave V.

Basically, we found the values for latencies of the different waves to be normal, except in cases of acoustic neurinoma (we have 3 cases of acoustic neurinoma in this sample).

However, considering the morphology of the graphic elements and particularly the Inter Peak Ratio between the amplitude of waves I and V, we found some abnormalities in our cases.

3.3 - VESTIBULOMETRIC EVALUATIONS

Cranio-Corpo-Graphy (C.C.G.)

We routinely perform the C.C.G. with the standing and the stepping test, according to Claussen's technique,[1,3,4,6] as described above.

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 2 parameters, as follows; the lateral sway - which is the lateral displacement of the shoulders and head between steps, and is measured in centimetres - and the angular deviation - which is the angle between the initial and final position of the patient and is measured in degrees. The lateral sway is assumed to be related with central disorders and the angular deviation with peripheral lesions. With these two parameters we define, basically, 4 types of C.C.G. which are assumed to be related with a specific site of lesion, then providing a very

important clue for the topographic diagnosis, as follows: Type 1 - Normal; Type 2 - Peripheral lesion (there is an enhanced angular deviation with normal lateral sway); Type 3 - Central lesion (there is an enhanced lateral sway and the angular deviation is normal); Type 4 - Combined, central plus peripheral lesion (there is 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 C.C.G., and the lateral sway was the only disturbed parameter in 10% of cases depicting for a central - type 3 - pattern of C.C.G..

Table 3 shows the results of these tests.

STANDING TEST	
Normal	**85%**
STEPPING TEST	
TYPE 1 (Normal)	**56%**
TYPE 2 (Peripheral)	**37%**
TYPE 3 (Central)	**7%**
TYPE 4 (Combined)	**0%**

Table 3 - Cranio-Corpo-Graphy - results

Electronystagmography (E.N.G.)

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

Caloric tests

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.[3,4] For this study we classified the type of caloric response in 3 groups, as follows: Group 1 = Normal; Group 2 = Inhibited pattern Group 3 = Desinhibited (Table 4).

PATTERN OF RESPONSE	
Normal	**23%**
Inhibited	**61%**
Desinhibited	**17%**

Table 3 - Electronystagmography- results

We found that only 23% of the calorizations were completely normal. All the others had at least one abnormal response.

We found a pathological unilateral weakness in 45 % of the cases, and a pathological directional preponderance in 20% of cases.

Rotatory tests

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

4. - DISCUSSION

1 - The most frequent symptom associated with tinnitus is the hearing loss.

2 - The hearing loss is mainly neurosensorial, and characterised by a greater loss in the high frequency range (>2 khz) and/or a flat loss .

The supraliminal audiometry is, in our opinion, extremely important in the study of these patients. We search for recruitment (S.I.S.I. 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, thence helping us with the topographic diagnosis. The results of these tests are not considered in this work. The vocal audiometry is also of a great value in the diagnosis of these patients. An unexpectedly low discrimination score is, in our experience, 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.

3 - Regarding the B.E.R.A., we can state that basically the wave latencies and InterPeakLatencies are normal except in the accoustic neurinoma cases. However, the graphic elements, namely the InterPeakRatio of the amplitude of the waves I/V, are abnormal more often. These abnormalities in the graphic elements are very important and should always be looked for very carefully. The I.P.R. of the amplitude I/V is thought to be present in cases of central lesion, namely some lesions of the pons[15].

4 - Although in our sample 45% of the patients had no symptom related with their equilibrium, we found that only less than 20% of them had complete normal vestibulometric tests. These findings show that the vestibular function in tinnitus patients, can be damaged even if they don't refer any equilibrium related symptom.

5 – In our point of view, our data supports Shulman's concept that tinnitus might be the initial symptom of secondary endolymphatic hydrops (S.E.H.). If this proves to be true, we should expect these patients to progressively develop other symptoms of endolymphatic hydrops such as sensorineural hearing loss and clinical vestibular dysfunction. We would like to emphasise the fact that we found abnormal vestibular tests in tinnitus patients with no vestibular complaints. This highlights the need of a complete neurootological evaluation of these patients.

So, as our final conclusion, we would like to state our deep conviction that any tinnitus patient, whether or not he has any vestibular symptoms, must be completely evaluated, in terms of auditory and vestibular functions. Indeed, the cochleovestibular system must always be considered as a whole and studied as such.

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