SEQUENTIAL SOUND THERAPY IN TINNITUS

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ABSTRACT

The sequential sound therapy is a treatment of the tinnitus with white noise that has some own characteristics. They are described the methodology, as well as their differences and similarities with the Tinnitus Retraining Therapy. The sequential sound therapy has been carried out to seventeen patients assisted during the year 2002. 26 generators of sounds adapted, of them, 22 generators of sounds with incorporate earphone. The results of the sequential sound therapy were compared with the results of the treatment with sounds of the tinnitus retraining therapy made to 15 patients assisted during the years 2000 and 2001. The percentage of satisfactory results obtained with the sequential sound therapy has been of 100%, while the therapy with sounds of the Tinnitus Retraining Therapy obtained a 33%. With the sequential sound therapy 6 patients they have disappeared them the tinnitus. With the sequential sound therapy no patient has abandoned the treatment. With the treatment with sounds of the tinnitus retraining therapy abandoned the therapy the 53%.

INTRODUCTION

The treatment with sounds for tinnitus that is done nowadays is the recommended by the tinnitus retraining therapy\textsuperscript{1-6} which consists basically in applying a white noise with an intensity lower than that of tinnitus in order to obtain the habituation and to decrease the tinnitus perception.

Other types of treatments with sounds that have been described above as a therapy for tinnitus are the tinnitus maskers which consist basically in using the white noise with a higher intensity than that of the tinnitus\textsuperscript{7,8}.

The tinnitus retraining therapy is considered as a conceptual methodology that has given consistency to tinnitus treatment and that is being done in all countries. Three pillars make up the fundamentals for the tinnitus retraining therapy: the neurophysiological model, the therapeutic advice and the sound therapy. The neurophysiological model is structured into five interconnected aspects. the generation, detection, emotional aspects, perception and the aversive reaction to tinnitus. Tinnitus generation is in the whole of the auditory pathway, the detection takes place at the sub cortical level and the emotional aspects are released by the limbic system, the perception and the evaluation of tinnitus are performed in cortical areas and the aversive reaction takes place in the autonomous nervous system. The therapeutic advice has four parts, the demystifying, the understanding, the aversive reaction and the treatment of tinnitus. Tinnitus demystifying consists in fundamenting the causes and their mechanisms, the understanding of it means that the patient has to understand all physiology involved, the control of the aversive reaction of tinnitus and the whole treatment for it. Sound therapy uses noises that come from three sources such as natural or environmental noises from the patient’s surroundings, the amplification of hearing aids and the generators of white noise with the characteristic of using white noise of a lower intensity of that of the patient's tinnitus.

The SST uses the sources mentioned before with tinnitus sounds, adds an intermediate step to join them and can adapt to each individual patient as well as to a public health system.

MATERIAL AND METHODS

Sequential sound therapy (SST)

The treatment with sounds is carried out in three steps: starts with a pure or total masking (white noise more intense than that of tinnitus), followed by a limited masking (equal intensity to that of tinnitus) and latterly a partial masking (less intense than that of tinnitus). Going from one to another type of masking depends of the results obtained and the patient’s opinion with which we can adapt conveniently the therapy to the white noise.

Patients

We managed 17 patients diagnosed of tinnitus and having obtained the adequate consent of all of them. Of these, there were 14 women with a mean age of 65 and 3 men with a mean age of 60. Predominant pathology was arterial hypertension in 5 patients, diabetes in three, obesity in two, one cerebro vascular accident and one acoustic trauma. They all began treatment using sound generators according to the 2002 SST. Control group was made up of 15 patients, 11 women with a mean age of 66 and 4 men with a mean age of 63 and diagnosed of tinnitus. Predominant pathology was arterial hypertension in 4 patients, diabetes in two and obesity in one. Control group began treatment using sound generators according to the 2000-2001 TRT.

Complementary tests

As well as obtaining a clinical history centered in compiling information regarding the tinnitus\textsuperscript{10}, complementary tests were performed to all patients and these included: otoscopy, tonal audiometry (air and bone conducted thresholds, discomfort and pain thresholds), logoaudiometry (thresholds for voice detection, word detection, perception, comprehension and discomfort) and tinnitus measurement. All these thresholds are useful whilst adapting the sound generators to the hearing-aids.

Sound generators

Patients treated both by SST and TRT have
used sound generators model TCI as well as sound generators with hearing-aid model TCI COMBI both of Siemens. The technology of the sound generator and of the hearing-aid is digital.

Sound generators are programmed in four levels:
- Level 1: White noise less intense than that of tinnitus (-3dB)
- Level 2: White noise same intensity than that of tinnitus (0dB)
- Level 3: White noise more intense than that of tinnitus (+3dB)
- Level 4: White noise more intense than that of tinnitus (+6dB)

The numbers that appear in brackets are the decibels above (+) or below (-) the intensity of tinnitus.

Adaptation and follow-up

These are personalized to each individual case. Adaptation of sound generators and hearing-aids are carried out considering the intrinsic characteristics of the patients in regards to the tinnitus and depending if there is or not hearing loss. In patients with tinnitus and not hearing loss we adapt sound generators. In patients with tinnitus and hearing loss a sound generator with an hearing-aid is adapted.

1) First month of adaptation: Patients with tinnitus and no hearing loss have adapted a sound generator with total or partial masking (level 3 or 4) for 6 hours a day, divided in two hours in the morning, two hours at midday and two hours in the afternoon. If the tinnitus does not allow him to sleep at night, he should use it all night as well. Patients with tinnitus and hearing loss have adapted a sound generator with an hearing-aid incorporated. The hearing-aid function is started for 6 hours a day, divided into two hours in the morning, two hours at midday and two hours in the afternoon. The sound generator is set up at level 3 or 4 for two hours a day using the quieter period in the day. If the tinnitus does not allow him to sleep at night, he should use it all night as well, set up in the sound generator function. Follow-up should be weekly throughout this first month.

2) Second month of adaptation: Patients with tinnitus and no hearing loss have adapted a sound generator at level 2 for 6 hours a day which are chosen by the patient himself. We give him the choice of passing to level 1 or to level 3 or 4. Patients with tinnitus and hearing loss have adapted a sound generator with an hearing-aid incorporated in the hearing-aid function all the time the patient wishes and the sound generator function for two hours a day to be chosen by the patient who also chooses the level of masking he desires. If the tinnitus does not allow him to sleep at night, he should use it all night as well, set up in the sound generator function. Follow-up should be during this second month every fortnight, though it depends on the patients needs.

3) Third and next months: Personal follow-up in time and type of masking. Monthly follow-up, unless otherwise stated by patient.

The general control pattern changes to every three months, every six months and yearly depending on the results obtained in each individual case.

Adaptation is made monaural in unilateral tinnitus and binaural in bilateral tinnitus.

Result evaluation

Using the THI questionnaire (Tinnitus Handicap Inventory)\textsuperscript{11} in its Spanish version that consists in 25 questions, to which the patient and those who lived with him answered with a “yes”, “sometimes” and “no”. The results are expressed in percentages.

RESULTS

Types of tinnitus

The different types of tinnitus registered in all 17 patients are detailed in Table 1.

Adapted sound generators

Initially 26 sound generators were adapted, of
Table 1: Types of tinnitus in the 17 patients adapted

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<table>
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<tbody>
<tr>
<td>Bilateral</td>
<td>53%</td>
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<tr>
<td></td>
<td>22% same intesity in both ears</td>
</tr>
<tr>
<td></td>
<td>11% right ear predominant</td>
</tr>
<tr>
<td></td>
<td>67% left ear predominant</td>
</tr>
<tr>
<td>Unilateral</td>
<td>47%</td>
</tr>
<tr>
<td></td>
<td>38% only right ear</td>
</tr>
<tr>
<td></td>
<td>62% only in left ear</td>
</tr>
<tr>
<td>Overall</td>
<td></td>
</tr>
<tr>
<td></td>
<td>27% in right ear</td>
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<tr>
<td></td>
<td>73% in left ear</td>
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Table 2: Type of adaptation in all 17 patients

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<table>
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<tbody>
<tr>
<td>Binaural</td>
<td>9 patients</td>
</tr>
<tr>
<td></td>
<td>8 patients with GSA both ears</td>
</tr>
<tr>
<td></td>
<td>1 patient with GSA in one ear and GS in the other</td>
</tr>
<tr>
<td>Monaural</td>
<td>8 patients</td>
</tr>
<tr>
<td></td>
<td>5 patients with GSA</td>
</tr>
<tr>
<td></td>
<td>2 patients with GS</td>
</tr>
<tr>
<td></td>
<td>1 patient with GS and hearing aid in the other ear</td>
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1 patient – seven months with a sound generator and a conventional hearing aid in the other ear without suffering any tinnitus
When tinnitus starts in the other ear a sound generator is adapted to this one.
All 15 patients belonging to the control group had in total 30 (binaural) sound generators with ear phone.

Complementary tests

Tympanogram was normal in 74% of patients, being in the other flat or nearly flat due to middle ear problems. Moderate to mild hearing loss was seen in 94% of them, one patient had normal hearing. The tinnitus intensity varied between 1 and 15 over hearing air threshold, even for the same patient. In the same way but in a lesser degree, tinnitus frequency varied for the same patient distributed in a 91% in the acute frequencies area.

Evaluation results

All 17 patients treated by SST improved subjectively and this improvement was quantified in a 100% of cases according to the THI questionnaire filled by the patient and those who lived with him. Up to this date none of them has given up treatment. Six patients did not feel tinnitus anymore: 1 of them 15 days after adaptation, 3 patients a month after and two patients three months after adaptation, using from then onwards only the hearing aid function not needing any longer the sound generator function. In all 15 patients treated by sound therapy according to TRT an improvement of a 33% was achieved and a 53% gave up treatment.

Reduction of perception

Tinnitus perception diminished in all patients treated by SST. In 6 patients from the very beginning of adaptation, in 1 patient 15 days later, in 2 patients a month later, in three patients two months after treatment was started, in 1 patient three months later, in another three patients four months later and in 1 patient six months after starting treatment.
Adaptation follow-up

Three patients that experienced a reduction of their tinnitus perception, did report an increase of it in situations related to stress. One patient did report it when his wife suffered a CVA episode. Another patient related it to work problems. And the third one had notice it several times and always in relation to personality disorders.

DISCUSSION

SST is an original methodology described for the first time. SST is a way for treating tinnitus with white noise that has its own differential characteristics. Basically it is a sequential total or pure masking, followed by a limit masking and ending with a partial masking. Going from one to the other masking depends on the results obtained and on the patients opinion that will conveniently adapt the therapy to the white noise. Tinnitus of the 17 patients treated by SST was predominant on the left side, this is coincident with other studies that reflect that the most frequently affected ear in tinnitus is the left one.\textsuperscript{12-14} Monaural adaptation is carried out for economical and psychological reasons. The reduction of tinnitus perfection is noticeable as the patient stops feeling the noise, and objectively is also evaluated as the patient goes from level 3 or 4 to level 1 or 2 in the sound generators.

Some German authors\textsuperscript{15-16} have started to recommend a multidisciplinary treatment for tinnitus. The flowchart shown in figure 1 details the clinical guides of the combined treatment between doctors and audiologists for a application done in three steps. Starting with a complete treatment for tinnitus that rejoins several methodological concepts:

1) Tinnitus concept. It is a very useful one from every days clinic: “tinnitus is the noise that the patient suffers and is disturbing him”. This is for every type

<table>
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<th>TRT</th>
<th>SST</th>
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<tr>
<td>Aims</td>
<td>Not to eliminate tinnitus but to get use tort and decrease perception</td>
</tr>
<tr>
<td>Therapeutic advice</td>
<td>The ENT specialist in a tinnitus clinic or tinnitus unit</td>
</tr>
<tr>
<td>Sound therapy</td>
<td>Environmental noises, hearing aids and sound generators</td>
</tr>
<tr>
<td>Binaural and monaural adaptation</td>
<td>Always binaural adaptation in both unilateral and bilateral tinnitus</td>
</tr>
<tr>
<td>Length of treatment</td>
<td>One year that could be extended to two. After this period is considered a failure</td>
</tr>
<tr>
<td>Public and Private medicine</td>
<td>Specialized private tinnitus clinic or especialized public tinnitus unit</td>
</tr>
<tr>
<td>Evaluation</td>
<td>Subjective or by THI questionnaire filled by the patient</td>
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Figure 1: Flowchart showing tinnitus management, enclosing all medical and audiological protocols for tinnitus treatment.
of tinnitus. A person can have tinnitus but may not be disturbed by it. May start to disturb him when he becomes hypersensitive to certain situations and this is generally due to several factors: personal ones (suffering of other diseases), family ones (deaths, loneliness), work related (accidents, retirement), insecurity situations (robbery, assaults), political (social problem, wars). Or any other cause that turns the patient hypersensitive to situations and he starts to feel the noise and gets disturbed by it.

2) Tinnitus management. The patient aids in managing his own tinnitus by varying the time and the different masking types.

3) Shared therapeutic advice. The otolaryngologist is responsible for the medical advice in relation to the sound therapy and the audiologist gives the advice related to the adaptation and its follow-up.

4) Monaural and binaural adaptation. Adaptation may be binaural in bilateral tinnitus and monaural to start with in unilateral tinnitus.

5) Tinnitus as a chronic disease. Tinnitus is considered to be a chronic disease and therefore there is not a set period of time for the treatment to work.

6) The treatment can be carried out both in the National Health System and in the private insurance companies system, the two predominant ones in our society.

7) Dual evaluation. The evaluation of results is done by the THI questionnaire (tinnitus handicap inventory) that is answered by the patient and those who live with him.

Table 3 details the similarities and the differences between the sound therapy by TRT and that by SST.

SST has managed improvement in a 100% of patients and none of them have given up treatment, whilst TRT managed a 33% of improvement and a 53% of patients that gave up, using the same sound generators in both cases and being the same personnel (doctors and audiologists) who carried out both treatments.

Other authors that have used the TRT sound therapy have reported a percentage of improvements that goes from a 23% to an 88%. The most common complaint in patients treated by TRT used to be at the starting of the treatment, saying that now they have two noises instead of just one and therefore they give up the therapy. This problem is not seen when using SST, but all the opposite, they report wellness by not hearing the tinnitus and by having a normal hearing from the moment the treatment is started.

CONCLUSIONS

SST has overcome the sound therapy by TRT and has meant a methodology change in how to use white noise therapy.

REFERENCES

9.- González Méndez MV, Sáinz Quevedo M, Ruiz-Rico