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Audiological Evaluation of Twenty Patients Receiving Pentoxifylline and Prednisone After Sudden Deafness: Prospective Study

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Abstract: Idiopathic sudden deafness is defined as sudden sensorineural hearing loss of undetermined etiology. As a consequence, various treatments have been developed for this disorder. Our study evaluated the effectiveness of pentoxifylline and prednisone in such treatment. We analyzed this treatment's results in our patients through conventional audiograms, and speech audiometry was performed in the acute stage and during the treatment. We diagnosed idiopathic sudden hearing loss in 20 patients (8 female and 12 male). The left ear was involved in 9 patients and the right in 11. All patients had been examined by us within 15 days from the onset of hearing loss. We compared the hearing threshold results in the different periods in this prospective study.

Key Words: speech audiometry; sudden deafness

Hearing is one of our most important senses, and its sudden loss is likely to frighten affected individuals owing to the speed of its evolution, bringing feelings of frustration to such patient and to their physicians. Loss of hearing impairs understanding of words and interactions between individuals and their environment, creating several emotional problems that may lead to a series of difficulties and changes in their lives.

According to Caldas and Caldas Neto [1] and Snow and Telian [2], the definition of sudden deafness (SD) is "a sensorineural hearing loss whose quick installation can last minutes, hours or a few days. The severity of the hearing loss may vary from mild to total loss of perception of the most intense sound. The loss of hearing may be permanent, or the hearing may spontaneously return to normal or near normal. Although sudden deafness is usually unilateral, it may be bilateral." Many times, it is accompanied by other symptoms, such as tinnitus and vertigo.

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Shaia and Sheehy [3] found a 2% incidence of SD in all otological cases, with no significant difference related to gender. In 1996, Hughes et al. [4] reported that nearly 4,000 new cases of SD occur annually in the United States and that 15,000 new cases occur worldwide, most of them without a defined etiology. In 1991, Shikowitz [5] pointed out that although several studies on SD have been carried out, researchers do not have a definition that is universally accepted. This renders it difficult to find a consensus on evaluation, treatment, and prognosis. The global incidence of this disease seems to be low but, in reality, it may be higher because patients who spontaneously recover hearing may never look for medical aid.

SD's etiology is frequently difficult to determine, leading to high rates of idiopathy. Several etiological theories have been proposed to explain SD, such as infection, vascular involvement, and perilymphatic fistulas. Besides these, metabolic disorders, drug toxicity, and several other diseases may contribute to the appearance of SD. For years, many treatment protocols have appeared in the medical literature, each associated with varying success rates. However, they are usually based on emotional and nonscientific considerations, because the exact etiology is unknown. Several drugs have been used, such as vasodilators, diuretics, anticoagulants,

and others. These medications have been used separately or in therapeutic combinations.

In 2000, Loughran [6] undertook an SD survey of 100 otolaryngologists, checking the specialists' answers regarding the examinations they requested and the treatments they adopted for this condition. He did not find a consensus, but most of the doctors surveyed (98.5%) used steroids in the treatment, alone or combined with other drugs. Owing to the difficulty in establishing an etiology for SD, several treatments have been suggested. In our study, we used pentoxifylline and prednisone, after we eliminated through magnetic resonance imaging the possibility of neoplastic processes or demyelinating diseases. These drugs were chosen for their action in the inner ear cells, independent of the etiology.

In 1997, Nakashima et al. [7] researched risk factors for idiopathic SD, such as smoking and drinking habits, diets, environmental sounds, previous diseases, sleeping time, appetite, tiredness, and incidence of common cold. Susceptibility to colds and a history of hypertension and thyroid diseases seemed to be positively associated with risk ($.05 < p < .10$). Smoking and drinking habits and environmental sounds had no significant association with SD. These results suggested that environmental factors, including an affected individual's diet, may be important in the genesis of SD.

The confirmation of deafness with sensorineural characteristics and knowledge of the depth of the lesion are obtained through pure-tone audiometry, speech audiometry (speech reception threshold and speech discrimination score [SDS]), and tympanometry curve and acoustic reflex. Our objective was to analyze the evolution of a hearing loss in patients with SD through pure-tone audiometry and speech audiometry (SDS).

SUBJECTS AND METHOD

Our sample was composed of patients who reported to the otolaryngology emergency room of the Federal University of São Paulo–Paulista Medical School (UNIFESP-EPM), all of whom had received care during the entire year of 2001. All patients were subjected to a complete otolaryngological evaluation with magnetic resonance imaging, pure-tone audiometry, speech audiometry (speech reception threshold and SDS), and tympanometry curve and acoustic reflex. The hearing loss of these patients was monitored through successive audiometric examinations for a minimum period of 2 months, excluding cases of abandonment of treatment.

The pure-tone audiometry (air tone at frequencies of 250, 500, 1,000, 2,000, 3,000, 4,000, 6,000, and 8,000 Hz and bone tone at frequencies of 500, 1,000, 2,000, 3,000, and 4,000 Hz), speech reception threshold, and SDS examinations were carried out at the audiometer (MAICO MA 41, Maico Hearing Instruments, Inc., Minneapolis, MN). For impedance audiometry, the tympanometry curve and acoustic reflexes were obtained using the Interacoustics AZ 7 (Interacoustics, Assens, Denmark) at frequencies of 500, 1,000, 2,000, and 4,000 Hz.

Our sample included 20 patients with unilateral SD (20 ears), of whom 12 were men and 8 were women (right side, 11; left side, 9). Their ages ranged from 25 to 74 years. As parameters for the analysis of our sample we considered the following factors:

- Sudden deafness for up to 2 months
- Normal magnetic resonance image of temporal bone, eliminating the possibility of tumors or demyelinating diseases
- Absence of previous treatment
- Absence of alteration of external or medial ear, normal tympanometry curve
- Audiometry with sensorineural hearing loss

In our analysis, we used as factors for hearing improvement the definition of improvement of hearing loss in terms of change of thresholds, as provided by the American Academy of Otolaryngology–Head and Neck Surgery: improvement of 10 dB or more at frequencies of 500, 1,000, 2,000, and 3,000 Hz and improvement of 15% or more in SDSs. We used the 1970 classification proposed by Davis and Silverman [8] to define the degree of hearing loss (HL; average of 500, 1,000, and 2,000 Hz): normal, 0–25 dB HL; mild, 26–40 dB HL; moderate, 41–70 dB HL; severe, 71–90 dB HL; and profound, greater than 91 dB HL.

We administered prednisone in the amount of 1 mg/kg/day (up to a maximum of 60 mg/day) for 10 days, followed by 40 mg/day for the next 10 days and 20 mg/day for the subsequent 10 days. If hearing levels returned to normal before the end of the first 10 days, the dosage was quickly diminished, followed by 40 mg/day

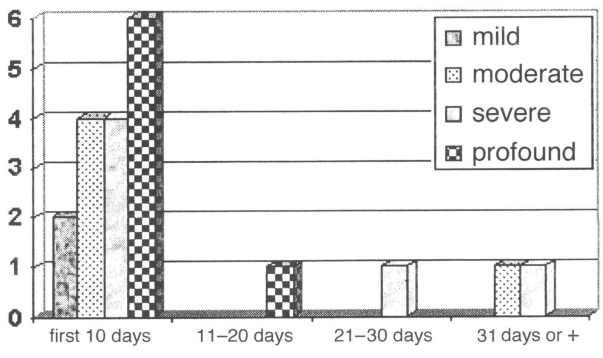

Figure 1. Duration of sudden deafness and level of hearing loss at the beginning of treatment (20 patients).

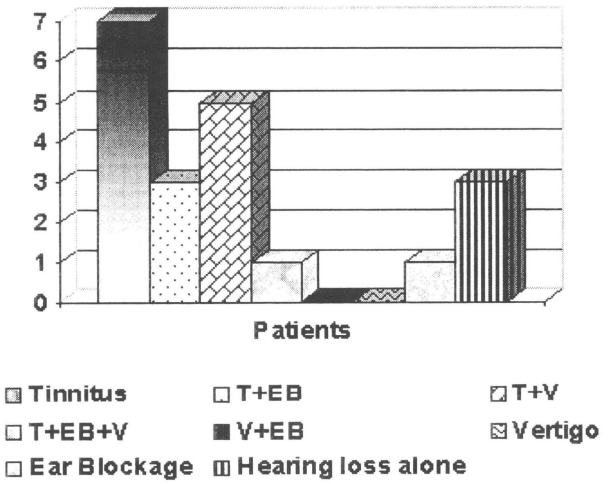

Figure 2. Sudden deafness associated with other symptoms (20 patients).

for the next 5 days and 20 mg/day for the subsequent 5 days. The dosage for pentoxifylline was 600 mg/day (200 mg every 8 hours) for 2 months, even if the hearing returned to the normal level.

RESULTS

Our data are displayed in Figure 1. Usually, owing to sudden loss of hearing, affected individuals look for professional aid as soon as possible, as shown in our protocol wherein 16 of the 20 patients (80%) began the medical treatment and were subjected to the first audiometry examination before the tenth day of SD. Of the sample, two patients (10%) showed a mild level of initial loss, four (20%) showed a moderate level, four (20%) showed a severe level, and six (30%) showed a profound level of hearing loss. Only four patients (20%) sought our services after the tenth day: one (5%) between days 11 and 20 with a profound level of initial loss; one (5%) between days 21 and 30 with a severe initial loss; and two (10%) after more than 31 days, of whom one had moderate loss and the other had severe loss (Fig. 2).

At its beginning, SD is usually associated with other symptoms that may appear before, at the same time as, or a little after the loss of hearing. In our study, seven patients (35%) had SD exclusively associated with tinnitus; three (15%) showed tinnitus plus ear blockage; five (25%) showed tinnitus plus vertigo; one (5%) showed tinnitus plus vertigo plus ear blockage; one (5%) showed ear blockage associated with SD; and three (15%) showed only hearing loss (Table 1). Given these results, the most common symptom associated with the hearing loss was tinnitus, which appeared in 16 patients (80%).

Of the 20 patients in the protocol, 12 (60%) showed a total recovery of hearing and, of these, 6 (30%) showed a variable initial level of hearing loss in the second week of treatment: 2 (10%) with mild loss; 3 (15%) with moderate loss, and 1 (5%) with profound loss. Of four patients (20%) whose hearing normalized in the fourth week, two (10%) started with severe loss, and two (10%) started with profound loss. Of the other two (10%) whose hearing normalized in the seventh week, one (5%) had a moderate level of hearing loss, and the other (5%) had a severe level of hearing loss at the beginning of the treatment (Table 2).

Of all 20 patients, hearing in 5 (25%) did not normalize during the first 2 months. These patients continued treatment but have not yet recovered total hearing.

Table 1. Timing of Recovered Hearing in Relation to Degree of Initial Hearing Loss (12 of 20 patients)

	No. of Patients Recovering Hearing		
Hearing Loss	Treatment Week 2	Treatment Week 4	Treatment Week 7
Mild	2	—	—
Moderate	3	—	1
Severe	—	2	1
Profound	1	2	—

Table 2. Improvement of Hearing Without Total Recovery in Relation to Degree of Initial Hearing Loss (5 of 20 patients)

	No. of Patients with Improved Hearing			
Hearing Loss	Treatment Week 2	Treatment Week 3	Treatment Week 5	Treatment Week 7
Mild	—	—	—	—
Moderate	1	—	—	—
Severe	—	—	—	1
Profound	—	2	1	—

Table 3. Abandonment of Treatment in Relation to Degree of Initial Hearing Loss (3 of 20 patients)

	No. of Patients Who Abandoned Treatment		
Hearing Loss	Improved Week 2	Unimproved Week 3	Unimproved Week 4
Mild	—	—	—
Moderate	—	—	—
Severe	1	1	—
Profound	—	—	1

Table 4. Onset of Improvement in Pure-Tone Threshold and Speech Discrimination Scores (SDSs) in Patients Who Recovered Normal Hearing (12 of 20 patients)

Beginning SDS	First SDS			Pure-Tone Threshold + SDS		
	Week 2	Week 4	Week 7	Week 2	Week 4	Week 7
Good	—	1	—	4	—	—
Poor	—	1	—	2	2	2

Of these, one (5%) who began with a moderate level of hearing loss showed initial improvement in the second week of treatment. Another with severe loss showed improvement only in the seventh week. Of the three patients (15%) who showed profound loss at the outset of SD, two (10%) showed some improvement at the third week, and one (5%) showed some improvement at the fifth week (Table 3).

Owing to the prospective aspect of our study, it is possible to fail to monitor some patients' progress. In our case, three patients (15%) abandoned treatment. One (5%) with a severe initial level of hearing loss did not show improvement until the third week of treatment; another (5%), with a profound level of hearing loss, did not show improvement until the fourth week; and the last (5%) of these patients showed some improvement in the second week even though he had begun with a severe level of hearing loss (Table 4).

All 12 patients (60%) who recovered total hearing showed improvement on the SDS, some associated to tonal thresholds. Of these, two (10%) improved on the SDS only in the fourth week, and one of them already showed a good SDS from the outset. Of the patients who experienced complete improvement, six (30%) improved in the second week, and four already had a good SDS: two (10%) in the fourth week and two (10%) in the seventh week (Table 5).

The five patients (25%) whose hearing did not normalize did not show a good SDS at the outset. Two (10%) began to improve only in the pure-tone thresholds, one in the third week after the beginning of treatment and the other in the fifth week. Of those who began to improve on the SDS as well as in pure-tone thresholds, one began in the second week, another in the third week, and the last in the seventh week (Table 6).

Table 5. Onset of Improvement in Pure-Tone Threshold and Speech Discrimination Scores (SDSs) in Patients Who Did Not Recover Normal Hearing (5 of 20 patients)

Beginning SDS	First Pure-Tone Threshold		Pure-Tone + SDS		
	Week 3	Week 5	Week 2	Week 3	Week 7
Good	—	—	—	—	—
Poor	1	1	1	1	1

Note: All five showed lack of speech reception threshold.

Table 6. Onset of Improvement in Pure-Tone Threshold and Speech Discrimination Scores (SDSs) in Patients Who Abandoned Treatment (3 of 20 patients)

Beginning SDS	Improved Pure-Tone Threshold + SDS	No Improvement	
	Week 2	Week 3	Week 4
Good	—	—	—
Poor	1	1	1

Note: All three patients showed lack of speech reception threshold.

Of the three (15%) patients who abandoned treatment, two did not show any improvement until the third and fourth weeks of treatment. In one case (5%), the complete improvement began to occur, but the patient abandoned treatment after the second week. All had a low SDS (Table 7).

Of the patients with totally recovered hearing, 11 (55%) started treatment before 10 days had elapsed from the onset of SD, and 1 (5%) started treatment after 31 days had passed. Of those whose hearing improved but did not normalize after 2 months, three (15%) started treatment before 10 days had elapsed, one (5%) started between 11 and 20 days, and one (5%) started between 21 and 30 days. Of those who abandoned treatment, two (10%) began treatment before 10 days from the onset of SD, and one (5%) began after 31 days.

DISCUSSION

In 1994, Saeki and Kitahara [9] analyzed 116 patients with SD. All patients were analyzed before the ninth day from onset of SD, and all received the same treatment. Those researchers observed the correlation between hearing and final hearing result through three-dimensional audiograms aiming to evaluate prognostic factors. As a criterion for improvement, those authors

Table 7. Relationship Between Treatment Initiation After Disease Onset and Improvement of Hearing (n = 20)

Time of Treatment Initiation After Disease Onset	Hearing Improvement		
	Normalized	Improved but Not Normalized	Abandoned Treatment
1–10 days	11	3	2
11–20 days	—	1	—
21–30 days	—	1	—
+31 days	1	—	1

used 15 dB or more in average frequencies and classified the groups according to loss configuration, besides classifying them into categories of total deafness (absence of answers in all frequencies) or deafness. As regards recovery, their classifications included total recovery (frequencies of 250, 500, 1,000, 2,000, and 4,000 Hz up to 20 dB or thresholds the same as those of the other ear); strong improvement (improvement of more than 30 dB in all five frequencies); light improvement (improvement occurring between 10 and 29 dB); and no improvement (below 10 dB).

In 1992, Kronenberg et al. [10] carried out a randomized, double-blind prospective study of 27 patients who were of varying ages and of both genders and had SD of unknown origin. The analysis was conducted within 2 weeks from the onset of SD, and the conclusion was that gender and age had no influence on the index of hearing improvement.

In their 1998 retrospective study of 132 SD cases that were monitored for 10 years, Molini et al. [11] also observed the lack of preference for gender and no significant difference with regard to age. For this reason, in our work we did not analyze those factors as variables that could have some influence on the prognosis of SD. For these authors, when the loss was of 60 dB NA or more, the prognosis was less favorable than when the loss was lower, showing that the intensity of the initial hearing damage is an important prognostic factor.

In our work, we observed that of the six patients (30%) with a light or moderate level of hearing loss at the beginning of the SD, five (25%) had normalized hearing in the second week of treatment, and one did not have total recovery in 2 months but started to improve in the second week. Nevertheless, we also observed a significant index of improvement in six patients (30%) with deep and severe levels of hearing loss. Of these, one (5%) had hearing that normalized in the second week, four (20%) in the fourth week, and one (5%) in the seventh week.

In 1995, Sano et al. [12] analyzed 746 SD patients before 16 days had elapsed since onset of symptoms. The level of hearing loss was investigated through audiometry at the beginning and at the recovery of hearing. In their study, these authors noted that recovery was less probable after 9 days had elapsed since onset of SD. In our work, of the 12 patients (60%) whose hearing normalized, 11 (55%) presented with SD before 10 days had passed and obtained total recovery at different times: 5 (25%) in the second week after beginning treatment, 4 (20%) in the fourth week after beginning treatment, and 2 (10%) in the seventh week after beginning treatment. Hearing in one patient (5%) showing SD for more than 1 month improved in the second week after the beginning of treatment. Of those who began treatment before 10 days, two (10%) did not show improvement until the fourth week and abandoned treatment. Thus, the relation between time of SD onset and beginning of recovery showed great diversification and was not significant.

This same result was found by Kronenberg et al. [10] in 1992, when they reported that the delay in beginning treatment and the audiometric curve shape had no influence on the index of hearing improvement. In 1994, Murai et al. [13], like the great majority of SD researchers, analyzed the audiograms focusing on time of loss, level, and frequency. We also analyzed the index of voice improvement as compared with time of recovery from SD. We considered low SDS when it was not compatible with the level of hearing loss. In our study, we observed that in the 12 patients (60%) with totally recovered hearing, the improvement was associated with an improvement in SDS either in isolation (2 patients; 10%) or with pure-tone thresholds (10 patients; 50%). Five patients (25%), among them some with moderate hearing loss, began a slow improvement in only the pure-tone thresholds or in the complete aspect and showed a low SDS at the beginning. These patients have been monitored by us for more than 2 months but have not obtained normalization of hearing.

CONCLUSION

Our preliminary results suggest that the degree of hearing loss may not be very important in determining the prognosis for patients who experience SD. The SDS may provide important data to determine the SD prognosis.

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