



## ORIGINAL ARTICLE

# Efficacy of Three Different Treatment Protocols for Sudden Sensorineural Hearing Loss

## ABSTRACT

**Introduction:** Sudden sensorineural hearing loss (SSNHL) is defined as an acute, unilateral or bilateral hearing loss for sounds in three adjacent frequencies and greater than 30 dB occurring over a period from 24 hours to three days. The unknown etiology of this condition has resulted in diverse treatment modalities in the past.

The aim of our retrospective study was to compare the results of three different therapeutic protocols for the treatment of patients with varying degrees of SSNHL.

**Methods:** The study group consisted of 30 patients who were treated for SSNHL. Three therapeutic modalities were compared: vasodilators (6 patients), corticosteroids (16 patients) and a combination of corticosteroids and hyperbaric oxygen therapy (HBOT), 8 patients.

**Results:** Patients treated with corticosteroid therapy, either alone or in combination with HBOT, experienced clinically and statistically significant ( $p < 0.05$ ) rate of recovery compared to those treated with vasodilators. Six patients had no recovery of auditory function and six others had only slight improvement.

**Conclusion:** Treatment with corticosteroid therapy, single or in combination with HBOT facilitates recovery from hearing loss due to SSNHL.

## KEY WORDS

sensorineural hearing loss, therapeutic protocol, recovery of hearing

DOI: 10.7251/SMD1201015V

(*Scr Med* 2012;43:15-9)

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Submitted: December 25, 2011

Accepted: April 2, 2012

Sudden sensorineural hearing loss (SSNHL) is defined as a rapid loss of hearing over a period of up to 3 days; it is diagnosed when pure tone audiometry shows a loss of  $\geq 30$  dB in three connected frequencies.<sup>1</sup> Hearing loss may vary from partial to total and is usually accompanied by tinnitus. The vestibular system is involved in 30 to 40% of SSNHL cases, resulting in dizziness or vertigo. Partial or complete spontaneous recovery occurs in 50 to 65% of cases.<sup>2</sup> According to Klemm et al,<sup>3</sup> SSNHL occurs in 1600 out of 100,000 persons per year, indicating that SSNHL is not a rare disease.

Although SSNHL is a well-recognized condition, there is no universally accepted treatment protocol for this disorder. Multiple factors, including a limited understanding of the pathophysiology of this disease and the possibility of spontaneous remission, have delayed a standard definition and treatment protocols for SSNHL.

The most commonly used therapeutic agents for SSNHL include antiviral drugs, steroids, hyperbaric oxygen (HBO), as well as vasodilators and rheological/vasoactive substances. Treatment evaluation has been further hampered by the low incidence of SSNHL and the tendency for hearing to recover spontaneously in up to 65% of cases.<sup>4</sup> At this time, the only efficacious treatment for SSNHL to emerge from rigidly controlled clinical trials is systemic corticosteroid therapy in the form of high-dose prednisone taper.<sup>5</sup> Many treatments such as vasodilators for SSNHL have been tested and found ineffective.<sup>2</sup>

The aim of our study is to present and compare the results of three therapeutic protocols used in our department for treatment of patients with varying degrees of SSNHL over a ten-year period from 2000 to 2010.

### Materials and methods

The hospital charts of 30 patients admitted to the Ear, Throat and Nose Department of University Clinical Centre, Banja Luka with a diagnosis of SSNHL were reviewed. The prognostic significance of specific clinical parameters was evaluated and the effectiveness of steroid, HBOT and vasodilator treatments was compared. Only patients presenting with the specific complaint of SSNHL were reviewed. The term *sudden* was restricted to events occurring instantaneously or developing over a period not exceeding 3 days.

SSNHL was defined as at least a 30 dB sensorineural hearing loss, occurring with at least three frequencies. The charts of all patients with the diagnosis of SSNHL from 2000 to 2010 were reviewed, and demographic data, including age and gender, were noted. For this retrospective study, we recorded the course of the disease, evaluation by other physicians, and use of medications before presentation at our institution. Medical records were also reviewed for history of smoking, alcohol ingestion, drug use or other chronic disease.

Factors analyzed included age, gender, dizziness, tinnitus, laterality, the time delay between onset of hearing loss and treatment, the degree of hearing loss, and audiogram shape. Pure tone audiometry was performed before beginning treatment and one month after treatment. Audiograms were done according to published guidelines.<sup>6</sup> Pure tone audiometry evaluated hearing loss by obtaining audiometric thresholds that represented the minimum audible sound levels at frequencies of 500, 1000, 2000, 4000 Hz. We analyzed variables considered to influence recovery in SSNHL, such as patient age, time elapsed since onset, dizziness, tinnitus, gender, laterality, and the appearance of the audiogram shape. A detailed history of dizziness was taken. Vestibular function was examined at 30°C by caloric testing according to the Fitzgerald-Hallpike procedure.

Patients were grouped according to treatment protocols. The first group consisted of six individuals treated during 2000 to 2003 with vasodilator therapy. They were given pentoxifylline (5 ml/100mg) in 250 ml saline solution intravenously three times daily for 7-10 days along with oral cinarizine (75 mg) three times daily for the same period. The second group included 16 patients treated between 2004 and 2007 with corticosteroid therapy according to a protocol established by our department; this consisted of an initial 400 mg dose of methylprednisolone for all 16 patients with successive tapering to 50 mg daily over eight days. The drug was administered intravenously in 250 ml saline solution.<sup>7</sup> A third group of eight patients was treated from 2008 to 2010 using a combination of methylprednisolone (as described for the second group) and HBOT. All patients in this group were treated once daily for 10 days with 100% oxygen in a mono-place hyperbaric chamber (Khru-nichev 303 BLKS) under 2.0 ATA (atmospheres absolute)

pressure for 60 minutes. Each patient was evaluated by audiometry one month later during a follow-up visit when the treatment course and repeat audiograms were reviewed.

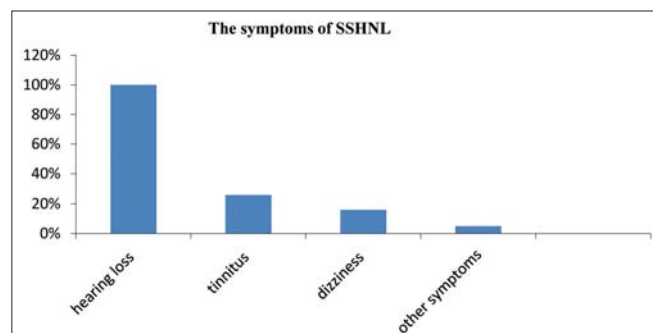
Patient outcomes were evaluated at the one month follow up visit by the Siegel classification, using the average dB gain in four audiometric speech frequencies (0.5, 1, 2, and 4 kHz).

The classification is as follows: no improvement, less than 15 dB of gain; slight improvement, more than 15 dB of gain and a final hearing loss less than 45 dB; moderate improvement, more than 15 dB of gain and final hearing level between 25 and 45 dB; and complete improvement, hearing level better than 25 dB, regardless of the size of the gain.<sup>8</sup> Significant hearing recovery by group was compared by a Chi squared test. Results were considered significant at the  $p < 0.05$  level.

### Results

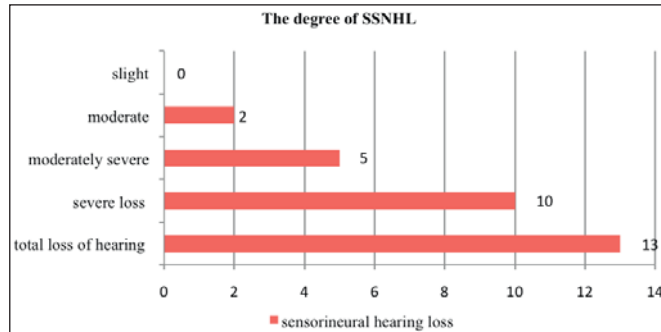
Thirty patients met our criteria for this retrospective study. The average age was 50 with ages ranging from 29 to 72 years. Gender distribution was balanced, with 14 male patients and 16 female. Neither age nor gender influenced the results obtained from the three treatment groups. The average period from the onset of symptoms to hospitalization was 4 days. Factors such as age, gender and time until initiation of treatment did not significantly affect the outcome. Figure 1 shows the distribution of patients according to the symptoms before treatment.

Figure 1. Representation of Symptoms

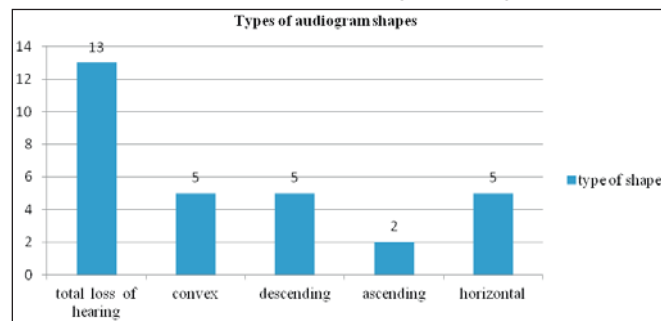


Based upon the degree of the sensorineural hearing loss, 13 patients had a total loss of hearing, ten others had severe loss, five had moderately severe loss, and two had only moderate loss (Figure 2). Figure 3 shows the distribution of audiogram shapes. In 13 of the 30 patients an audiogram could not be obtained due to a total loss of hearing. Among the remaining 17, five patients each had horizontal, convex or descending types of audiogram shape. Two others had an ascending shape. The caloric test done at 30° according to the Fitzgerald-Hallpike procedure recorded regular vestibular *excitability* in 23 of the 30 patients, *hypoexcitability* in four and *non-excitability* of the labyrinth on the side of the affected ear in three others.

**Figure 2**  
The distribution of patients according to the degree of SSNHL



**Figure 3**  
The distribution of patients according to audiogram shapes



Among the patients treated with vasodilators only three experienced slight improvement of hearing one month later. In contrast, among those who were treated with corticosteroids, two had complete return of their hearing, eight others had moderate improvement, and three had slight or no improvement. Among the eight individuals who were treated with a combination of corticosteroid and HBO therapy, two had complete return of hearing while six others had moderate improvement.

Even though we reviewed only a small number of patients we did find some significant differences when comparing the three treatment modalities. Twelve of our 30 patients had no recovery or only slight recovery of hearing function; 18 others experienced moderate improvement to complete restoration of hearing. Patients treated with corticosteroid therapy, either alone or in combination with HBO therapy, had a statistically significant ( $p < 0,05$ ) increase in recovery compared to those treated with vasodilators.

## Discussion

Our retrospective study revealed that patients with SSNHL who were treated with corticosteroid therapy, alone or in combination with HBOT, experienced significant improvement in hearing recovery. Those treated with vasodilators did not.

Despite decades of basic science research and review of clinical outcomes, published results concerning the diag-

nosis and management of SSNHL are inconsistent, and practice guidelines are unclear.<sup>9</sup> The mechanism of action of corticosteroid therapy in sudden hearing loss is unknown, although reduction of cochlear and auditory nerve inflammation is the presumed pathway. The American Academy of Otolaryngology-Head and Neck Surgery Foundation (AAO-HNSF) guidelines give clinicians the option of offering corticosteroids as initial therapy to patients with idiopathic sudden sensorineural hearing loss (ISSNHL).<sup>6</sup>

In addition to the anticipated improvement with corticosteroid treatment, we noted complete restoration of hearing in two of eight patients and a moderate improvement in the remaining six individuals who received HBOT in combination with corticosteroid therapy. Fujimura<sup>10</sup> states that HBOT provides a significant additional effect in combination with steroid therapy for SSNHL, particularly in patients with severe hearing loss. A study by Narozny<sup>11</sup> concluded that HBOT in a multi-place hyperbaric chamber as well as administration of high doses of steroids improves the results of conventional SSNHL treatment; the best results are achieved if the treatment is started as early as possible.

There is currently conflicting evidence for vasodilator and vasoactive substances in the treatment of SSNHL,<sup>2</sup> and the effectiveness of vasodilators in the treatment of ISSNHL remains unproven. Patients from our sample who were treated with medications from the group of vasodilators had significantly less hearing recovery than those treated with steroids alone or in combination with HBOT.

Most of the patients in our sample of 30 individuals had severe or total hearing loss. We found that age and sex did not significantly affect the outcome of the various treatments. The average age in our selected cohort was 50.2 years, in accordance with previous SSNHL reports in the literature.<sup>1</sup> Presenting symptoms included hearing loss, tinnitus, dizziness and other manifestations, such as cephalgia, feeling of increased pressure in the ear. We noted a greater frequency of unilateral than bilateral SSNHL. This was not surprising, since Shibata<sup>12</sup> reported that the frequency of bilateral SSNHL is less than 2%.

We found evidence of vestibular disorder in approximately one fourth of our patient sample. This concurs with Rambold,<sup>13</sup> who points out that dizziness occurs in 20% - 60% of SSNHL patients.

Most authors consider corticosteroids to be the gold standard for therapy of SSNHL. Our own findings and those of others would seem to support this; however Conlin and Parnes<sup>14</sup> reported in their meta-analysis that systemic steroids cannot be considered the gold standard of treatment of SSNHL because they found no statistically significant difference between treatment with steroids and oral placebo and given the limitations of the studies which sup-

porting use of systemic steroids.

Based on retrospective analysis, prognostic indicators for hearing recovery in SSNHL include the severity of hearing loss, presence of vertigo, time between onset and treatment, the hearing of the other ear, and the audiogram shape. However, considering that spontaneous recovery occurs in approximately two thirds of the cases without treatment, usually within the first 2 weeks, no single study has clearly defined how these factors translate into recovery.<sup>15</sup>

How to designate the best treatment for SSNHL among available options remains controversial. At this time, systemic and/or intra-tympanic corticosteroid therapy is the primary treatment for SSNHL, while HBOT continues to be the second line of therapy is.<sup>9-11</sup> Idiopathic etiology, contradictory clinical studies, the potential for placebo effect and the high rate of spontaneous recovery all contribute to the lack of consensus on standard therapeutic protocols for the treatment of this disease. Despite the small sample, our retrospective study indicates that a combination of systemic corticosteroid therapy and HBOT is a viable treatment option.

#### Author contributions

*DV and AA participated in study design and coordination. They carried out the testing, organized the final data file, partly ran statistical analysis, and drafted the manuscript. SS and ZN conceptualized and designed the study, carried out the statistical analysis. DT and AG performed statistical analysis, and revised the manuscript. All authors read and approved the final version of the manuscript.*

#### Conflicts of interest

*No potential conflicts of interest relevant to this article was reported.*

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# Efikasnost tri terapijska pristupa u liječenju akutnog senzorneuralnog oštećenja sluha

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## APSTRAKT

**Uvod.** Akutno senzorneuralno oštećenje sluha (Sudden sensorineural hearing loss-SSNHL) se definiše kao akutno, jednostrano ili obostrano oštećenje sluha veće od 30dB za tri susjedne frekvencije, koje je nastalo u razdoblju od 24 sata do tri dana. Nepoznata etiologija uslovlila je primjenu različitih modaliteta liječenja u prošlosti. Cilj ove retrospektivne studije je bio da se uporede rezultati tri različita terapijska protokola u tretmanu pacijenata sa akutnim senzorneuralnim oštećenjem sluha.

**Metode.** Ispitivana grupa se sastojala od 30 pacijenata koji su liječeni zbog akutnog senzorneuralnog oštećenja sluha. Upoređivana su tri terapijska protokola: vazodilatatori (6 pacijenata), kortikosteroidi (16 pacijenata) i kombinovana terapija kortikosteroidima i hiperbaričnom oksigenoterapijom (8 pacijenata).

**Rezultati.** Pacijenti liječeni kortikosteroidima, bilo pojedinačno ili u kombinaciji s hiperbaričnom oksigenoterapijom imali su klinički i statistički značajan ( $p < 0,05$ ) stepen oporavka u odnosu na one koji su liječeni vazodilatatorima. Kod šest bolesnika nije zabilježen nikakav oporavak slušne funkcije dok je kod šestoro utvrđeno lako poboljšanje.

**Zaključak.** Liječenje kortikosteroidima, pojedinačno ili u kombinaciji s hiperbaričnom oksigenoterapijom doprinosi oporavku sluha kod akutnog senzorneuralnog oštećenja sluha.

## KLJUČNE RIJEČI

senzorneuralno oštećenje sluha, terapijski protokol, oporavak sluha