

# Sudden Sensorineural Hearing Loss. Comparison of Treatment Results with Intratympanic Dexamethasone and Hyperbaric Oxygen. Four Year Clinical Experience

Dr. Matilda Chroni, MD, PHD

ENT Consultant, Dpt of Otolaryngology Head and Neck Surgery, Evaggelismos Hospital, Greece.  
chronimatilda@yahoo.co.uk

**\*Corresponding Author:** Dr. Matilda Chroni, ENT Consultant, Department of Otolaryngology Head and Neck Surgery, Evaggelismos Hospital, Ipsilantou 45-47 10676, Athens, Greece.

## Abstract

**Objective:** To study therapeutic effect of different first line treatment options in a clinical setting in patients presenting with idiopathic Sudden Sensorineural Hearing Loss (SSNHL).

**Patients:** A total of 105 patients were divided in 4 groups. Patients in the control group (42 patients group D) received systemic steroids alone. Patients in the combined treatment groups received additionally i) intratympanic dexamethasone (IT) (group A, 36 patients), ii) IT, plus hyperbaric oxygen therapy (HBOT) (group B, 16 patients), iii) HBOT (group C, 12 patients).

**Main Outcome Measures:** Hearing recovery was evaluated on the basis of PTA averages before and after treatment.

**Results:** Hearing improvement was 47, 02 % for the control group (D). Patients receiving combined treatment with IT showed better results with 61, 32 % hearing improvement, whereas groups B and C 42, 47% and 41% respectively. Even though hearing improvement was better in the intratympanic group, results were not statistically significant with a  $p=0,062$ .

**Conclusion:** Combination therapy of intratympanic dexamethasone and systemic steroids seem to have a beneficial effect on hearing outcome in SSNHL patients.

**Keywords:** Sudden Sensorineural Hearing Loss, Intratympanic dexamethasone, Hyperbaric oxygen

## INTRODUCTION

Sudden sensorineural hearing loss remains a puzzle for the ENT doctor as there is still no definitive aetiology and no specific treatment. Aim of our paper is to present our clinical experience with the disease as it is addressed in a General Hospital. Sudden Sensorineural Hearing Loss (SSNHL) is a condition that is characterized by hearing loss of more than 30 dB in three contiguous frequencies in less than 3 days (1). It is a situation frustrating for the patient who not only has difficulty communicating but is also troubled by tinnitus.

Many factors have been considered as causative factors in sudden sensorineural hearing loss such as viral

cochleitis, vascular injury, autoimmune inflammation and inner ear membrane rupture (2). Incidence is estimated at 5-20 cases per 100.000 annually (3). Initial hearing severity and time interval to treatment onset seem to be the most important prognostic factors to affect treatment outcome (4). Shape of the audiogram and presence of vertigo have also been suggested as prognostic factors (5).

It is difficult to evaluate treatment efficacy as it is known that a large percentage of patients recover spontaneously (6). Studying SSNHL presents certain difficulties as using control groups can raise ethical issues. Patients that suffer sudden hearing loss want to try every possible option they have that will give them a better chance to improve their hearing.

## Sudden Sensorineural Hearing Loss. Comparison of Treatment Results with Intratympanic Dexamethasone and Hyperbaric Oxygen. Four Year Clinical Experience

Since the cause of SSNHL is unknown a variety of treatments have been used steroids, vasodilators hyperbaric oxygen carbogen, intratympanic steroids antiviral drugs and anticoagulants. The abundance of different treatments, pinpoints the fact that an aetiological treatment is lacking. Intratympanic steroid use has the advantage that it allows higher concentrations of steroids in the inner ear while it minimizes systemic absorption (7).

### MATERIALS AND METHODS

#### Patient Selection

A total of 105 patients who were treated for SSNHL in the Dpt of Otolaryngology Head and Neck Surgery at Evangelismos hospital between 2012 and 2016, were enrolled in this prospective study. All patients met the following criteria 1) no previous history of hearing

loss 2) sudden onset of hearing loss 3) unknown cause of hearing loss. Patients with Meniere disease, barotrauma, acoustic neuroma were excluded from the study. All patients were followed up for a year. Magnetic resonance imaging of the internal auditory canal and cerebellopontine angle was performed on all of the patients.

#### Treatment Protocols

All patients received IV prednisolone 25mg 4 times daily with a total dose of 100mg for 4 days then tapering with oral steroids (SYS). Patients that did not improve within 3 days were then allocated to one of the following groups 1) 4 intratympanic dexamethasone injections one every 4 days (IT) 2) treatment with hyperbaric oxygen 15 daily sessions (HBOT), 5 days per week 3) combined treatment with intratympanic steroids and hyperbaric oxygen (table 1).

**Table 1.** Treatment groups

Group	Patients	Treatment
A	36	IT + SYS
B	16	IT+ HBOT+ SYS
C	12	HBOT+ SYS
D ( control group)	42	SYS

Intratympanic dexamethasone injections were performed with the patient in the sitting position with the head tilted 45° to the opposite side. Injection performed with a 25 gauge spinal needle syringe to the posterior inferior portion of the tympanic membrane and 0, 5- 0, 7 ml of dexamethasone 4mg/ml were injected in the middle ear and the patient advised not to swallow for 5 minutes. Patients were hospitalised for 4 days, and had routine blood tests. All patients were evaluated with PTA pretreatment, three months posttreatment and every two months following that for a year.

### RESULTS

In order to examine whether there were statistically significant differences between groups, patients were examined in relation to age and initial hearing

loss severity. Kruskal – Wallis test was used to check for statistical difference between the ages of treatment groups. P-value was 0,111, not statistically significant. Groups were also examined in relation to initial hearing loss severity using Kruskal Walis test, p-value=0,182 shows there was no statistically significant difference.

#### Hearing improvement

The mean of hearing level at 250, 500, 1000, 2000, 4000 and 8000 Hz was calculated for each patient for both ears before and three months after treatment. Results were calculated based on improvement percentage (8), using the following equation:

$$\text{Percent hearing improvement (\%)} = \frac{(\text{HLpre} - \text{HLfinal})}{(\text{HLpre} - \text{HL contralateral ear})} * 100$$

**Table 2.** Therapeutic outcomes based PTA percentage improvement

Group	Hearing improvement %
A	61,34 %
B	42,06 %
C	42,41%
D (control group)	47 %

## Sudden Sensorineural Hearing Loss. Comparison of Treatment Results with Intratympanic Dexamethasone and Hyperbaric Oxygen. Four Year Clinical Experience

Mann-Whitney test was used to compare groups in relation to hearing improvement.

Group A: p- value=0,415, Group B: p value=0,884, Group C p value= 0,646. There was no statistically significant difference in any of the groups.

**Table 4.** PTA improvement results

		Improvement		Total
		0	1	
Treatment	A	5	30	35
		14.3%	85.7%	100.0%
	B	5	11	16
		31.3%	68.8%	100.0%
	C	6	6	12
		50.0%	50.0%	100.0%
	D	14	28	42
		33.3%	66.7%	100.0%
Total		30	75	105
		28.6%	71.4%	100.0%

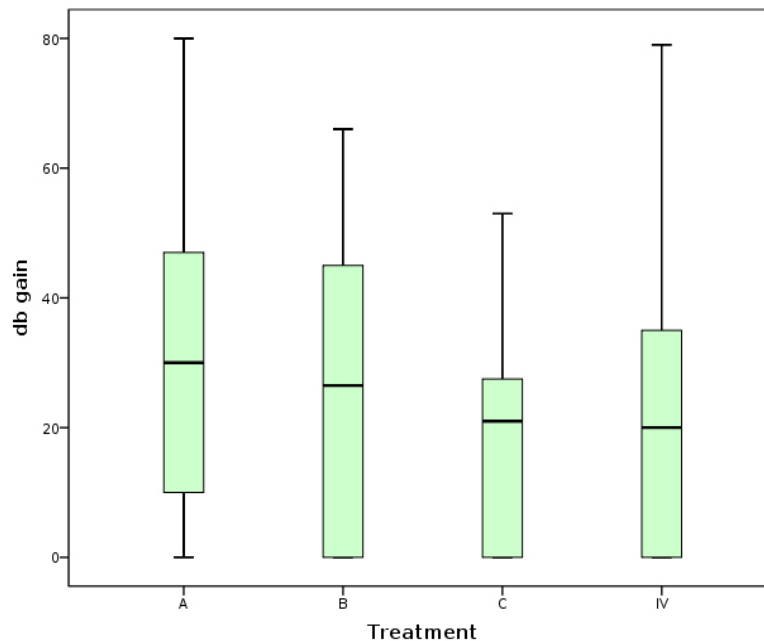
Results were also examined on the basis of PTA improvement for more than 10 dB. Successful treatment was defined as more than 10 dB improvement in PTA. Patients that did not improve were allocated in group 0 and patients that improved in group 1.

X<sup>2</sup> test was used in order to examine results based on 10 dB PTA improvement. There was no statistically

significant difference between groups p-value=0,079. Results were also compared with respect to DB gain

**Table**

Group	Mean dB Gain
A	32
B	26,5
C	17,5
D	20,21



Boxplot graph of dB gain of the 4 groups. Kruskal-Wallis test was used to examine hearing

improvement in relation to dB gain , p-value=0,295, which is statistically non-significant.

## **DISCUSSION**

SSNHL remains one of the most difficult issues of Otolaryngology. Its aetiology still remains unknown and the plethora of papers written on the subject have not been able to suggest a definitive treatment. International consensus on treatment of SSNHL supports that systemic steroids is still the most widespread primary therapy, although evidence of their efficacy cannot be considered as strong (9)

A lot of papers support IT efficacy in treating SSNHL. Lee (10) in a recent animal study describes that intracochlear dexamethasone uptake was higher and more prolonged in animals receiving IT dexamethasone. Tsounis et al compared systemic intratympanic and combined steroids and found no statistically significant difference in the results (11). Han et al (12) and Gao Y (13) published a metaanalysis of controlled trials supporting that combined treatment of IT and systemic steroids confer benefit as a primary treatment of SSNHL, and Jung Da (14) also supported the efficacy of combination treatment. Lee in another paper (7) supported that IT alone is as effective as systemic steroid.

HBOT on the other hand is considered to improve perilympatic partial pressure of oxygen and thus lead to greater improvement from the disease (15).

As far as HBOT is considered Khater et al (16) and Hosokawa et al (17) found improved results with HBOT therapy. Alimoglou (18) found better results with HBOT as salvage therapy and Fujimura (19) concluded that HBOT has significant additional effect in combination with steroid therapy. In a paper by Lamm H (20) concurrent use of IT and HBOT treatment is considered beneficial as a salvage therapy for refractory SSNHL.

On the other hand Nosrati Zarenou supported that steroids do not influence recovery after SSNHL (21) raising questions about steroid treatment efficacy.

Results of the present study show that the overall hearing improvement rate was higher in the intratympanic dexamethasone plus systemic prednisolone group (61%) in comparison to the other

treatments (B= 42, 06%, C=42, 41% and D=47 %). Results were also calculated using another evaluation method where treatment is considered successful when improvement of PTA averages is more than 10 dB. For the IT group this percentage was 85,7% in comparison to 66,7% of the control group. Groups with HBOT have worse results but this could be due to small numbers of patients. The fact that results were not statistically significant clearly suggests that larger series of patients are needed in order to prove treatment efficacy.

## **CONCLUSION**

We conducted a controlled prospective trial of patients with SSNHL comparing systemic steroids as a control group with combination therapy with IT and HBOT. Hearing outcome was better in intratympanic dexamethasone with systemic steroid group but results were not statistically significant. Further investigation is necessary in order to support these results.

## **REFERENCES**

- [1] Stachler RJ, Chandrasekhar SS, Archer SM, Rosenfeld RM, Schwartz SR, Barrs DM, Brown SR, Fife TD, Ford P, Ganiats TG, Hollingsworth DB, Lewandowski CA, Montano JJ, Saunders JE, Tucci DL, Valente M, Warren BE, Yaremchuk KL, Robertson PJ; American Academy of Otolaryngology-Head and Neck Surgery Clinical practice guideline: sudden hearing loss. *Otolaryngol Head Neck Surg.* 2012 Mar; 146(3 Suppl) : S1-35. doi: 10.1177/0194599812436449.
- [2] Rauch SD, Intratympanic steroids for sensorineural hearing loss. *Otolaryngol Clin N Am* 2004; 37: 1061-74.
- [3] Maggie Kuhn, MD, Selena E. Heman-Ackah, MD, MBA, Jamil A. Shaikh, BA, and Pamela C. Roehm, MD, PhD Sudden Sensorineural Hearing Loss A Review of Diagnosis, Treatment, and Prognosis *Trends Amplif.* 2011 Sep; 15(3): 91-105. doi: 10.1177/1084713811408349
- [4] Xie S, Qiang Q, Mei L, He C, Feng Y, Sun H, Wu X Multivariate analysis of prognostic factors

## Sudden Sensorineural Hearing Loss. Comparison of Treatment Results with Intratympanic Dexamethasone and Hyperbaric Oxygen. Four Year Clinical Experience

- for idiopathic sudden sensorineural hearing loss treated with adjuvant hyperbaric oxygen therapy. *Eur Arch Otorhinolaryngol.* 2018 Jan; 275(1): 47-51. doi: 10.1007/s00405-017-4784-4. Epub 2017 Oct 25
- [5] Byl FM Jr. Sudden hearing loss: eight years experience and suggested prognostic table. *Laryngoscope* 1984; 94: 647-61
- [6] Nosrati-Zarenou R, Arlinger S, Hultcrantz E Idiopathic sudden sensorineural hearing loss: results drawn from the Swedish national database. *Acta Otolaryngol.* 2007 Nov; 127(11): 1168-75
- [7] Lee KH, Ryu SH, Lee HM, Park SK, Kim HJ, Chang JI Intratympanic Dexamethasone Injection Effective for the Treatment of Idiopathic Sudden Sensorineural Hearing Loss? *J Audiol Otol.* 2015 Dec; 19(3): 154-8. doi: 10.7874/jao.2015.19.3.154. Epub 2015 Dec 18
- [8] Suzuki H, Koizumi H, Ohkubo J, Hohchi N, Ikezaki S, Kitamura T. Hearing outcome does not depend on the interval of intratympanic steroid administration in idiopathic sudden sensorineural hearing loss. *Eur Arch Otorhinolaryngol.* 2016 Oct; 273(10):3101-7. doi: 10.1007/s00405-016-3930-8. Epub 2016 Feb 15.
- [9] Marx M, Younes E, Chandrasekhar SS, Ito J, Plontke S, O'Leary S, Sterkers O International consensus (ICON) on treatment of sudden sensorineural hearing loss. *Eur Ann Otorhinolaryngol Head Neck Dis.* 2018 Feb; 135(1S): S23-S28. doi: 10.1016/j.anorl.2017.12.011. Epub 2018 Feb 1
- [10] Lee JJ, Jang JH, Choo OS, Lim HJ, Choung YH Laryngoscope. Steroid intracochlear distribution differs by administration method: Systemic versus intratympanic injection. 2018 Jan; 128(1): 189-194. doi: 10.1002/lary.26562. Epub 2017 Mar 17
- [11] Tsounis M, Psillas G, Tsalighopoulos M, Vital V, Maroudias N, Markou K *Eur Arch Otorhinolaryngol.* Systemic, intratympanic and combined administration of steroids for sudden hearing loss. A prospective randomized multicenter trial. 2018 Jan; 275(1): 103-110. doi: 10.1007/s00405-017-4803-5. Epub 2017 Nov 22.
- [12] Han X, Yin X, Du X, Sun C. *Otol Neurotol.* Combined Intratympanic and Systemic Use of Steroids as a First-Line Treatment for Sudden Sensorineural Hearing Loss: A Meta-Analysis of Randomized, Controlled Trials. 2017 Apr; 38(4): 487-495. doi: 10.1097/MAO.0000000000001361.
- [13] Gao Y, Liu D. Combined intratympanic and systemic use of steroids for idiopathic sudden sensorineural hearing loss: a meta-analysis *Eur Arch Otorhinolaryngol.* 2016 Nov; 273(11):3699-3711. Epub 2016 Apr 12
- [14] Jung da J, Park JH, Jang JH, Lee KY. The efficacy of combination therapy for idiopathic sudden sensorineural hearing loss.
- [15] Filipo R, Attanasio G, Viccaro M, Russo FY, Mancini P, Rocco M, Pietropaoli P, Covelli E. Hyperbaric oxygen therapy with short duration intratympanic steroid therapy for sudden hearing loss. *Acta Otolaryngol.* 2012 May; 132(5): 475-81. doi: 10.3109/00016489.2011.647360. Epub 2012 Jan 31. T
- [16] Khater A, El-Anwar MW, Nofal AA, Elbahrawy AT *Int Arch Otorhinolaryngol.* Sudden Sensorineural Hearing Loss: Comparative Study of Different Treatment Modalities 2018 Jul; 22(3): 245-249. doi: 10.1055/s-0037-1605376. Epub 2017 Sep 12
- [17] Hosokawa S, Sugiyama KI, Takahashi G, Hashimoto YI, Hosokawa K, Takebayashi S, Mineta H. Hyperbaric Oxygen Therapy as Adjuvant Treatment for Idiopathic Sudden Sensorineural Hearing Loss after Failure of Systemic Steroids *Audiol Neurootol.* 2017; 22(1):9-14. doi: 10.1159/000464096. Epub 2017 Apr 20.
- [18] Alimoglu Y, Inci E. Is hyperbaric oxygen therapy a salvage treatment option for sudden sensorineural hearing loss? *J Laryngol Otol.* 2016 Oct; 130(10): 943-947. Epub 2016 Aug 30.

## Sudden Sensorineural Hearing Loss. Comparison of Treatment Results with Intratympanic Dexamethasone and Hyperbaric Oxygen. Four Year Clinical Experience

---

- [19] Fujimura T, Suzuki H, Shiomori T, Udaka T, Mori T. Hyperbaric oxygen and steroid therapy for idiopathic sudden sensorineural hearing loss. *Eur Arch Otorhinolaryngol.* 2007 Aug; 264(8):861-6. Epub 2007 Mar 6.
- [20] Lamm H, Müller-Kortkamp C, Warnecke A, Pohl F, Paasche G, Lenarz T, Stolle SR. Concurrent hyperbaric oxygen therapy and intratympanic steroid application as salvage therapy after severe sudden sensorineural hearing loss. *Clin Case Rep.* 2016 Feb 11; 4(3): 287-93. doi: 10.1002/ccr3.510. eCollection 2016 Mar.
- [21] Nosrati-Zarenoe R, Hultcrantz E. Corticosteroid treatment of idiopathic sudden sensorineural hearing loss: randomized triple-blind placebo-controlled trial

**Citation:** Dr. Matilda Chroni. *Sudden Sensorineural Hearing Loss. Comparison of Treatment Results with Intratympanic Dexamethasone and Hyperbaric Oxygen. Four Year Clinical Experience. Open Journal of Otolaryngology.* 2018; 1(1): 29-34.

**Copyright:** © 2018 Dr. Matilda Chroni. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.