

Shiwani Rai<sup>1</sup>  
 Krishna Koirala<sup>1</sup>  
 Pema Sherpa<sup>2</sup>

Department of ENT-HNS  
 Manipal College of Medical Sciences,  
 Pokhara, Nepal<sup>1</sup>

Audiologist and Speech Pathologist  
 Department of ENT-HNS  
 Manipal College of Medical Sciences,  
 Pokhara, Nepal<sup>2</sup>

**Corresponding Author:**  
**Dr. Shiwani Rai**  
 Department of ENT-HNS  
 Manipal College of Medical Sciences,  
 Pokhara, Nepal

**E-mail:** raishiwani@hotmail.com

## EFFECTIVENESS OF EARLY TREATMENT WITH STEROIDS IN OUTCOME OF SUDDEN SENSORINEURAL HEARING LOSS. A STUDY FROM WESTERN NEPAL

### Objective:

To study the effect of early versus delayed treatment of Sudden Sensorineural Hearing Loss (SSNHL) in hearing outcome.

### Material and Methods:

A retrospective study of patients with SSNHL was done from October 2012 to October 2014 to study the effect of early versus late treatment in hearing outcome in ENT department of Manipal Teaching Hospital, Pokhara, Nepal. Patients receiving treatment within 3 days of onset of symptoms were placed in early treatment group (ET) and those receiving treatment after 3 but within 7 days were placed in late treatment group (LT). Hearing outcome was assessed using pure tone average (PTA) and was carried out at presentation and then at 3, 7, 14 and 30 days after treatment. A mixed between and within-subject design ANOVA test was used to analyze the results using SPSS 20.0.

### Results:

There were 29 patients in ET group and 25 patients in LT group. Mean age of the study population was 36.37 years (SD=7.868). The M:F ratio was 0.39:1. There was a significant interaction between time and treatment group, Wilk's Lambda= 0.382,  $F(1.52, 79.196) = 19.83$ ,  $p < 0.001$ , partial eta squared = 0.541. There was a substantial main effect of time,  $F(1.52, 79.196) = 180.36$ ,  $p < 0.001$ , partial eta squared = 0.776 suggesting significant improvement of hearing levels with time. The main effect comparing early and late treatment groups was also significant,  $F(1, 52) = 5.799$ ,  $p = 0.02$ , partial eta squared = 0.100 suggesting significant difference in hearing levels in between the two treatment groups.

### Conclusion:

Onset of treatment after the initial symptom significantly affects the outcome of hearing improvement in SSNHL. There are higher chances of improving if treatment is started within 3 days of onset of symptoms.

**Keywords:** Sudden sensorineural hearing loss, Pure tone audiometry, Early treatment, Late treatment

### INTRODUCTION:

Sudden sensorineural hearing loss (SSNHL) is an audiologic emergency with an annual incidence of 5-20 per 100000.<sup>1</sup> SSNHL is idiopathic most of the times however about 10-15% of cases are due to identifiable causes like Meniere's disease, trauma, autoimmune disease, infectious causes etc.<sup>2-4</sup> Approximately 1% of cases are also due to retro-cochlear disorders like vestibular schwannoma, demyelinating diseases, stroke etc.<sup>5</sup> Around 32-65% of cases of SSNHL show spontaneous recovery within 2-3 weeks.<sup>2,6</sup> Systemic steroids are the most commonly used treatment in SSNHL. Other modalities described in literatures are intratympanic steroids, antivirals, vasodilators, osmotic agents, diuretics, anticoagulants, hyperbaric oxygen, plasma expanders etc. Recovery of SSNHL depends on various prognostic factors like patient's age, presence of vertigo at onset, degree of hearing loss and time between onset of hearing loss and treatment. In this study we analyzed the role of early and late treatment of SSNHL in hearing outcome over a period of time.

### MATERIAL AND METHODS:

A retrospective analysis was done from October 2012 to October 2014 to study the effect of early and late treatment in hearing outcome of patients with SSNHL presenting to the department of ENT-HNS of Manipal Teaching Hospital, Pokhara, Nepal. Patients of all age and both sex were included in the study. The diagnostic criterion for SSNHL was more than 30 dB hearing loss in three consecutive frequencies within 3 days of onset of symptoms. Patients with an identified cause were excluded, and only idiopathic cases were investigated. Fifty-four patients were included after going through the charts according to the inclusion criteria and study duration. These patients were further divided into early

and late treatment group according to the time when the treatment was started; early treatment (ET) group comprised of those receiving treatment within 3 days whereas late treatment (LT) group comprised of those receiving treatment after 3 days and within 7 days of onset of symptoms. Although the treatment was started immediately in all cases after the diagnosis was ascertained, the delay at presentation to the hospital determined the two treatment groups. There were 29 patients in ET group and 25 patients in LT group. The age, gender, affected sides, comorbidities, time period of starting of treatment were recorded. A thorough history was taken about the incident and a detailed examination of the tympanic membrane along with the cranial nerve and the hearing tests were carried out. The degree of hearing loss was measured using Maico 42 (MA 42) audiometer and the pure tone average (PTA) at 0.5, 1 and 2 kHz measured in terms of decibels (dB). Cases with inflammation of the middle or inner ear were excluded. PTA was carried out at the time of admission, at 3<sup>rd</sup> day, 7<sup>th</sup> day, 14<sup>th</sup> day and at 1 month. Magnetic Resonance Imaging (MRI) of the brain was carried out in those patients showing no improvements even after treatment at the end of 1 month to rule out pathologies at the cerebello-pontine angle. After detailed investigation patients were admitted and intravenous steroid (hydrocortisone 100 mg six hourly) was started for seven days along with proton pump inhibitors and vitamin B6/B12. Hearing was assessed at frequent intervals as described as above. Patients were discharged after 7 days on oral prednisolone 1mg/Kg, which was tapered every 5 days. Patients were followed up according to the PTA schedule at day 14 and day 30.

Data were entered into SPSS version 20.0 and analysis was done using mixed between and within-subject design ANOVA test.

**RESULTS:**

During the specified study duration a total of 59 patients with SSNHL were admitted, out of which 5 patients were excluded, as they did not meet the inclusion criteria. The remaining 54 patients were divided in to ET (n=29) and LT (n=25) groups according to the time when the treatment was started. The baseline characteristics of the study participants are presented in table 1.

**Tab. 1: Baseline characteristics:**

Variables	ET Group (PTA)	LT Group (PTA)	Total
Mean Age (SD)	34.62 (8.015)	38.40 (7.331)	36.37 (7.868)
Right Side	22 (75.9)	19 (76)	41 (75.9)
Tinnitus	23 (79.3)	19 (76)	42 (77.8)
Vertigo	9 (31)	3 (12)	12 (22.2)
HTN	10 (34.5)	7 (28)	17 (31.5)
DM	9 (31)	6 (24)	15 (27.8)
CAD	2 (6.9)	3 (12)	5 (9.3)

A mixed between-within subject analysis of variance was conducted to assess the impact of two different interventions (Early treatment, Late treatment) on participants' scores on the pure tone average (PTA), across five time intervals (admission, post-treatment day 3,7,14 and 30). The independent variable consisted of the between-subject factors i.e. treatment group, which had 2 levels (early and late). The dependent variable however consisted of the within-subject factor i.e. hearing level measured as PTA, which consisted of 5 levels according to the time intervals at which the PTA was measured. The assumption of equality of variance on the dependent variables for the treatment groups at each levels of within-subject variable was fulfilled (Levene's test). However the assumption of sphericity according to the Mauchly's test was violated ( $p < 0.001$ ) and hence the degree of freedom were corrected using Greenhouse Geisser estimates of sphericity. There was a significant interaction between time and treatment group, Wilk's Lambda = 0.382,  $F(1.52, 79.196) = 19.83, p < 0.001$ , partial eta squared = 0.541. There was a substantial main effect of time,  $F(1.52, 79.196) = 180.36, p < 0.001$ , partial eta squared = 0.776 suggesting significant improvement of hearing levels with time. Post hoc analysis assessing the hearing levels at the five different time points showed statistical significant changes over all 5 time points ( $P_s < 0.05$ ). The main effect comparing two types of intervention (early and late treatment groups) was also significant,  $F(1,52) = 5.799, p = 0.02$ , partial eta squared = 0.100 suggesting significant difference in hearing levels in between the two treatment groups. The mean PTA scores of the two groups according

**Tab. 2: Descriptive statistics for PTA scores at different times**

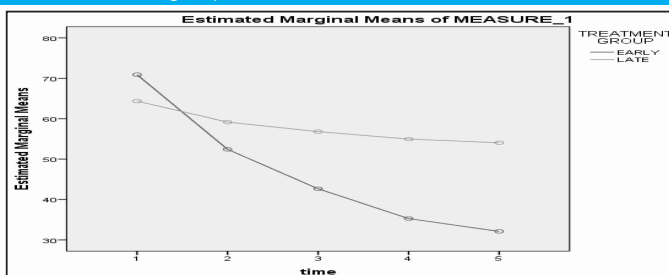
Time	Early Treatment Group Mean PTA (SD)	Late Treatment Group Mean PTA (SD)
Pre Treatment	70.90 (14.14)	64.36 (18.76)
Post Treatment Day3	52.41 (14.04)	59.16 (19.32)
Post Treatment Day7	42.66 (14.59)	56.80 (20.07)
Post Treatment Day14	35.28 (16.83)	54.96 (20.42)
Post Treatment Day30	32.10 (17.83)	54.04 (20.93)

to various time points are listed in Table 2. The estimated marginal means of PTA scores for the two treatment groups are plotted in figure 1.

**DISCUSSION:**

SSNHL was first described in 1944 by De Klem as 30 db or more sensorineural hearing loss over at least 3 continuous audiometric frequencies occurring within 3 days.<sup>7</sup> Most of the SSNHL cases are idiopathic but viral infections, autoimmune disorders, blood vessels disorders, inner ear membrane rupture are among the few causes isolated.<sup>1,3,8,9</sup> SSNHL can occur over a wide age range but it frequently occurs in people between 30 to 50 years of age. Usually both the sex are affected equally.<sup>10</sup> In our series there was slight female preponderance (61.1%). However, the mean age of the patients was 36.37 years as described in most of the studies. The condition is usually unilateral with bilateral cases reported in less than 1.7% cases.<sup>3</sup> There was no case with bilateral involvement in our series and the right ear was involved more (75.9%) than the left. Most of the patients in our series complained of tinnitus (77.8%) and vertigo (22.2%) as the most disturbing symptoms other than hearing loss. The role of vestibular symptoms in prognosis of recovery from SSNHL has been dubious; many series have described it as a negative prognostic factor where as some find no significant correlation with prognosis.<sup>1,2,11-13</sup> Tinnitus was reported in 36.6% cases by Raghunandan et. al<sup>14</sup>; 68% by Psifidis et al<sup>15</sup>; and in 74% by Byl.<sup>1</sup> Vertigo was described in 26.6 % in Raghunandan et. al<sup>14</sup>. These findings are in consistent with our study. The effect of systemic diseases (HTN, DM, CAD) in recovery of SSNHL is not well known. These systemic diseases have been considered as poor prognostic factors in some studies, whereas they were shown to be unrelated to the outcome in some other studies.<sup>16-18</sup> In our series 31.5 % of patients had HTN, 27.8% had DM and 9.3% had CAD. Around 32-65% of the cases of SSNHL show spontaneous recovery.<sup>8,19,21</sup> Majority of such recoveries occur within first 2 weeks according to the literatures and amongst them highest recovery rate is seen within first few days.<sup>2</sup> In our study we found that there was a significant interaction between time and treatment group. There was also a substantial main effect of time on hearing improvement suggesting that the hearing levels improve significantly with time. Post hoc analysis assessing the hearing levels at the five different time points (pre treatment, 3 days, 7 days, 14 days and 30 days) also showed statistical significant changes over all 5 time points in both the group. This shows that time is an important factor in hearing improvement and supports

**Fig 1: Estimated marginal means of PTA scores at different times according to the treatment groups**



the findings of various authors in spontaneous recovery. However, in many occasions hearing loss fails to recover without treatment. In around 10% of cases there might be worsening of hearing in spite of proper treatment. It is thus unadvisable, to not treat a patient with SSNHL and wait for spontaneous recovery. There are almost 60 different treatment modalities described for SSNHL although none of them has proved to be superior to other in randomized trials. Steroids, anticoagulants vasodilators, antiviral agents, vitamins, and hyperbaric oxygen therapy are the most commonly used treatment modalities for SSNHL. In our hospital we use systemic steroid (initially intravenous and later oral in tapering dose) as mainstay of treatment in SSNHL. Wilson et al established the effectiveness of steroids initially in 1980 and thereafter several other trials proved its efficacy.<sup>8,22,23</sup> The mechanism of action of steroids is not clearly understood but it is believed that it acts as an anti-inflammatory agent, causes vasodilation increasing the cochlear microvascular flow and thus decreases endolymphatic hydrops. Systemic application of steroids is known to cause higher concentration of the drug in the inner ear.<sup>14</sup> However, systemic use of steroids is also associated with known risks such as immunosuppression, weight gain, mood swings, osteoporosis, avascular necrosis of the hip, and endocrine changes. It is due to these risks intratympanic steroids are gaining more preference these days. The time of initiation of the treatment is also believed to be one of the important prognostic factors in recovery from SSNHL. Early onset of treatment is believed to be a positive prognostic factor in recovery from SSNHL.<sup>1,2,11,20</sup> In the literature there is no uniformity in describing early and late treatment. Some authors have taken 10 days while other have taken 7 days and 3 days as the cutoff point in defining the two treatment groups. In our study we defined early treatment as those receiving treatment within 3 days while late treatment as those receiving treatment after 3 days and within 7 days. Narozny et al described that a delay of 10 days in starting treatment was found to be a cut off point for poorer prognosis<sup>24</sup>. Lee et al found that there was no significant difference in hearing improvement in patients treated within 3 days and those treated between 3 to 7 days.<sup>10</sup> This finding was inconsistent to our findings, which shows significant difference in treatment started within 3 days and after 3 days. They also found that patients treated after 7 days had significant lower rates of recovery than those treated within 7 days. Our study did not investigate the hearing recovery of patient receiving treatment after 7 days of onset of symptoms. Our study found that there was significant difference in the main effect comparing the two types of intervention (early and late treatment). This suggests that there was significant difference in hearing levels in between the two treatment groups. The mean PTA values at the five different time points are listed in table 2 which shows lower mean PTA in early treatment group than in late treatment group as the time progresses. The mean PTA at pre treatment status in early treatment group was 70.90 dB, which decreased to 32.10 dB at the end of 30 days. However the initial mean PTA in late treatment group failed to show such remarkable improvement over one month (64.36 dB to 54.04 dB).

## CONCLUSION:

Although time itself is an important factor in hearing improvement of SSNHL cases, early treatment after the initial symptoms significantly gives better hearing results. There are higher chances of improvement in hearing, if treatment is started within 3 days of onset of symptoms as shown in our study.

## REFERENCES:

1. Byl FM Jr. Sudden hearing loss: eight years' experience and suggested prognostic table. *Laryngoscope* 1984;94(5 Pt 1):647-61.
2. Mattox DE, Simmons FB. Natural history of sudden sensorineural hearing loss. *Ann Otol Rhinol Laryngol* 1977;86:463-80.
3. Fetterman BL, Saunders JE, Luxford WM. Prognosis and treatment of sudden sensorineural hearing loss. *Am J Otol* 1996;17(4):529-36.
4. Jaffe BF. Sudden deafness: an otologic emergency. *Arch Otolaryngol* 1967;86(1):55-60.
5. Shaia FT, Sheehy JL. Sudden sensori-neural hearing impairment: a report of 1,220 cases. *Laryngoscope* 1976;86(3):389-98.
6. Conlin AE, Parnes LS. Treatment of sudden sensorineural hearing loss: II. A meta-analysis. *Arch Otolaryngol Head Neck Surg* 2007;133(6):582-6.
7. DeKleyn A. Sudden complete or partial loss of function of the octavus system in apparently normal persons. *Acta Otolaryngol* 1994;32:407-29.
8. Wilson WR, Byl FM, Laird N. The efficacy of steroids in the treatment of idiopathic sudden hearing loss. A double-blind clinical study. *Arch Otolaryngol* 1980;106(12):772-6.
9. Stokroos RJ, Albers F, Schirm J. The etiology of idiopathic sudden sensorineural hearing loss: experimental herpes simplex virus infection of the inner ear. *Am J Otol* 1998;19(4):447-52.
10. Lee SH, Lee YJ, Kang BS, Lee BD, Lee JS. A Clinical Analysis of Sudden Sensorineural Hearing Loss Cases. *Korean J Audiol* 2014;18(2):69-75.
11. Shaia FT, Sheehy JL. Sudden sensorineural hearing impairment: a report of 1220 cases. *Laryngoscope* 1976;86:389-98.
12. Sheehy JL. Vasodilator therapy in sensorineural hearing loss. *Laryngoscope* 1960;70:885-914.
13. Saeki N, Kitahara M. Assessment of prognosis in sudden deafness. *Acta Otolaryngol Suppl* 1994;510:56-61.
14. Raghunandan S, Agarwak AK, Natarajan K, Murali S, Anand Kumar RS, Kameswaran M. Effect of Intravenous Administration of Steroids (in the management of sudden sensorineural hearing loss: our experience. *Indian J Otolaryngol Head Neck Surg* 2013;65(3):229-33.
15. Psifidis AD, Psillas GK, Daniilidis JCh. Sudden sensorineural hearing loss: long-term follow-up results. *Otolaryngol Head Neck Surg* 2006;134(5):809-15.
16. Weng SF, Chen YS, Hsu CJ, Tseng FY. Clinical features of sudden sensorineural hearing loss in diabetic patients. *Laryngoscope* 2005;115(9):1676-80.
17. Ulrich D, Aurbach G, Drobik C. A prospective study of hyperlipidemia as a pathogenic factor in sudden hearing loss. *Eur Arch Otorhinolaryngol* 1992;249(5):273-6.
18. Ceylan A, Celenk F, Kemaloglu YK, Bayazit YA, Göksoy N, Ozbilen S. Impact of prognostic factors on recovery from sudden hearing loss. *J Laryngol Otol* 2007;121(11):1035-40.
19. Stokroos RJ, Albers FW, Tenvergert EM. Antiviral treatment of idiopathic sudden sensorineural hearing loss: a prospective, randomized, double-blind clinical trial. *Acta Otolaryngol* 1998;118(4):488-95.
20. Cinamon U, Bendet E, Kronenberg J. Steroids, carbogen or placebo for sudden hearing loss: a prospective double-blind study. *Eur Arch Otorhinolaryngol* 2001;258(9):477-80.
21. Suckfull M, Mees K. Hemoconcentration as a possible pathogenic factor of sudden hearing loss. *Eur Arch Otorhinolaryngol* 1998;255(6):281-4.
22. Moskowitz D, Lee KJ, Smith HW. Steroid use in idiopathic sudden sensorineural hearing loss. *Laryngoscope* 1984;94(5):664-6.
23. Veldmann JE, Hanada T, Meeuwse F. Diagnostic and therapeutic dilemmas in rapidly progressive sensorineural hearing loss and sudden deafness. A reappraisal of immune reactivity in inner ear disorders. *Acta Otolaryngol* 1993;113(3):303-6.