

ORIGINAL ARTICLE

Medicine Science 2024;13(4):861-5

Effect of intratympanic steroid therapy in sudden sensorineural hearing loss: Our clinical experience

 Ahmet Hamdi Kepekci*İstanbul Yeni Yüzyıl University, Health Vocational School, Division of Audiometry, İstanbul, Türkiye*

Received 07 August 2024; Accepted 15 November 2024

Available online 01 December 2024 with doi: 10.5455/medscience.2024.08.093

Content of this journal is licensed under a Creative Commons Attribution-NonCommercial-NonDerivatives 4.0 International License.



Abstract

The goal of this study was to assess the efficacy of intratympanic steroid injection (ITS) in reducing irreversible sensorineural hearing loss in patients with sudden sensorineural hearing loss (SSHL). Between February 2018 and February 2024, a total of eighteen patients diagnosed with SSHL and treated with ITS were analyzed in this retrospective study. Hearing levels of all patients were determined before and after treatment. An audiometer from the brand "Interacoustics AD629 Diagnostic Audiometer" was used for audiological assessment. The data was divided into 2 groups, one for midrange frequencies mean (250-500-1000-2000 Hz) and the other for treble frequencies means hearing level (4000-8000Hz), these measures were compared before and after treatment. Hearing levels improved significantly after treatment. Mean midrange frequencies decreased from 44.35 ± 27.23 dB pre-procedure to 35.46 ± 29.49 dB postprocedure ($p < 0.001$). Treble frequencies were decreased from 58.19 ± 28.87 dB before treatment to 50.28 ± 29.8 dB after the end of therapy ($p < 0.001$). Speech discrimination score improved from 79.41 ± 27.11 preoperatively to 82.44 ± 26.93 ($p < 0.001$). ITS can significantly improve hearing levels in patients with SSHL. The results show that intra-tympanic steroids may be an effective treatment for sudden SSHL. Yet, these findings call for further validation in larger-scale randomized controlled trials. We hope that future research will help in developing treatment protocols for ITS including the optimal dose, duration of administration, and long-term impact.

Keywords: Sudden sensorineural hearing loss, intratympanic steroid injection, corticosteroid therapy, speech discrimination ability, audiological evaluation, hearing levels

Introduction

Sudden sensorineural hearing loss (SSHL) is considered a medical emergency and it presents within 3 days with at least 30 dB HL of loss in three consecutive frequencies (Figure 1, 2) [1]. Most cases of SSHL have no known cause (idiopathic) [1]. In the literature, viral infections such as SARS-Cov 2 and autoimmune diseases are also included among reasons; however vascular events or rupture of labyrinthine membranes can be listed in divergent causes which cause SSHL that should have more specific diagnostic plan [1,2].

Currently, the most commonly used pharmaceutical agents in acute-phase treatment of SSHL are corticosteroids, which purportedly aid hearing recovery by their anti-inflammatory properties [3,4]. Oral steroid therapy in SSHL has been reviewed and evaluated by retrospective studies, demonstrating recovery

of hearing through administration [5]. However, given the side effects and limited efficacy of systemic corticosteroids, interest in intratympanic steroid injection (ITS) has increased.

Systemic steroids cannot be considered the gold standard in the treatment of SSHL, considering the conditions limiting their use [6]. The advantages of ITS include direct administration of the drug into the inner ear and minimization of systemic side effects [7,8].

In this study, we aimed to investigate the effects of ITS on the hearing levels and speech discrimination abilities of the patients. While there are many studies in the literature on the effects of ITS, this study was conducted based on our clinical experience and data found through in-patient records. Thus, our study will fill the gaps in these studies to provide information on the reliability of ITS and assist in the formulation of its treatment protocol.

CITATION

Kepekci AH. Effect of intratympanic steroid therapy in sudden sensorineural hearing loss: Our clinical experience. Med Science. 2024;13(4):861-5.



Corresponding Author: Ahmet Hamdi Kepekci, İstanbul Yeni Yüzyıl University, Health Vocational School, Division of Audiometry, İstanbul, Türkiye
Email: dr.kepekci@gmail.com

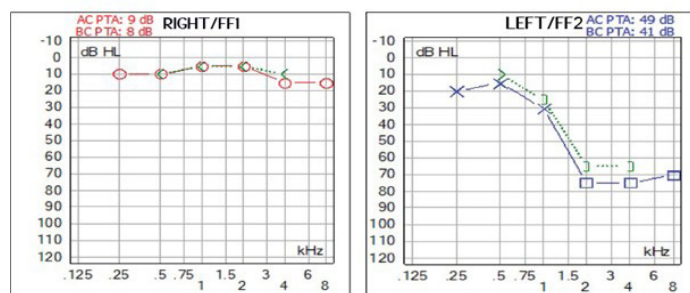


Figure 1. Sudden hearing loss Hhearing loss of more than 30 decibels is observed at frequencies of 2000 kHz, 4000 kHz, and 8000 kHz; kHz – kilohertz

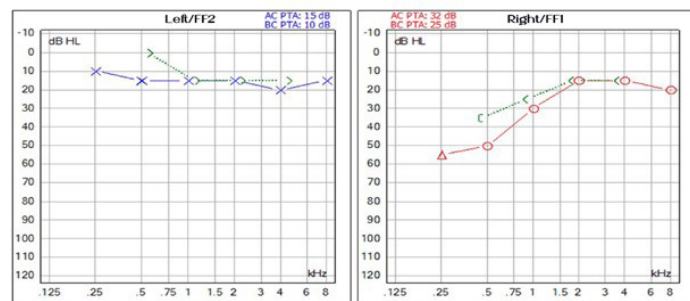


Figure 2. Sudden hearing loss Hhearing loss of more than 30 decibels at frequencies of 250 kHz, 500 kHz, and 1000 kHz; kHz – kilohertz

Material and Methods

In this retrospective study, 18 patients diagnosed in our clinic between 2018 and 2024 were included. Hearing levels and speech discrimination scores before and after treatment were compared. Patients with 30 dB hearing loss at three consecutive frequencies in less than 72 hours were accepted. Among our patients, there were no patients with head trauma, fluctuant hearing loss, noise-induced hearing loss, chronic otitis media, or contraindications to steroids. Additionally, special groups such as pediatric patients, pregnant women, recurrent SSHL patients, and those undergoing middle ear surgery were excluded from the study. Written informed consent was obtained from all patients.

Treatment Start and Control Time

Patients presented to our clinic within an average of 3 to 7 days of the onset of symptoms of SSHL. The literature emphasizes that it is critical to begin treatment as soon as possible to reverse hearing loss [1]. Starting treatment, especially within the first 72 hours, increases the chance of recovering hearing loss [6]. Therefore, ITS treatment was started on the day of presentation. Hearing improvements were typically found to occur within a few weeks, with the final hearing assessment occurring three months after baseline. The study demonstrated that significant hearing improvements occurred within this time frame. The evaluation of hearing after 6 weeks was preferred in the study because the effect of steroid treatment occurs over time, the recovery after treatment becomes stable and it adapts to clinical practices. While the inflammation-reducing effect of steroids develops fully within a few weeks, this period is also considered

sufficient to reliably observe the permanent effects of the treatment. In addition, a 6-week follow-up period was applied in clinical studies to evaluate long-term recovery after treatment for sudden hearing loss [9].

Drug Dosage and Method of Administration

The dose of dexamethasone used in the treatment of ITS was determined based on accepted practices in the literature. In our study, 8 mg/2 ml Dexamethasone phosphate was used as recommended in the literature. The reason for choosing this dosage is to ensure that adequate corticosteroid concentration reaches the inner ear while keeping systemic side effects to a minimum [10]. Other studies in the literature also show that this dose is effective in improving hearing loss. The treatment application was planned as a total of three sessions and repeated at two-day intervals. This treatment protocol was found to be safe and effective in terms of hearing recovery [11]. Under local anesthesia, a 26-G needle was used in the supine position. 1 ml (8 mg/2 ml) of microscopic intratympanic dexamethasone was injected into the posteroinferior quadrant of the eardrum. The patient's head was then tilted 30 degrees to the healthy side for approximately 15 minutes. The same procedure was repeated three times every other day. In addition, all patients underwent a basic audiological evaluation using pure tone and speech audiometry using the Interacoustics AD629 Diagnostic Audiometer (Interacoustics, Denmark) commercial audiometer system. Patients were followed up six weeks after the start of treatment for an audiometric hearing evaluation. Hearing was evaluated at baseline before treatment, immediately after the completion of ITS, and again at regular intervals, such as weekly or bi-weekly, during the six-week follow-up period. No additional treatments such as systemic steroids, vitamin B12, or hyperbaric oxygen therapy were administered; all patients received only ITS. Patients were admitted to our outpatient clinic between the 3rd and 7th days of sudden hearing loss on average, with the minimum being 1 day and the maximum being 14 days.

Hearing Assessment Method

Patients' hearing levels and speech discrimination scores were evaluated with pure tone audiometry and speech audiometry before and after treatment. Hearing levels were measured using the "Interacoustics AD629 Diagnostic Audiometer" device. The obtained data were examined in two main groups: Midrange frequencies mean (250–500–1000–2000 Hz) and Treble frequencies mean (4000–8000 Hz). Speech discrimination scores and pure tone audiogram results were compared statistically before and after treatment.

Ethics committee: The data were analyzed retrospectively by the approval of the Meltem Hospital Local Ethics Committee (15.02.2024, no. 2024/46).

Statistical Analysis

Statistical analysis of the data was performed using IBM SPSS software for Windows 23. A paired t-test and Spearman

correlation analysis were used to compare the differences between hearing levels and speech discrimination scores before and after treatment. The statistical significance level was accepted as $p<0.05$. Data are presented as mean±standard deviation.

Results

The study included 12 male and 6 female patients who came to the ENT outpatient clinic of Private Meltem Hospital between October 2018 and May 2024, were diagnosed with SSHL, and were treated with ITS. Patients were admitted to our outpatient clinic between the 3rd and 7th days of sudden hearing loss on average. ITS treatment was started on the same day after the admission of the patients. In our hospital, ITS treatment is applied to patients presenting with symptoms of SSHL. The hearing loss rates of the patients were variable. In our publication, a statistically significant improvement in hearing thresholds of 9 dB and a 3% improvement in speech discrimination score was observed. Significant improvement was observed in most patients, but not all patients recovered completely. For patients who did not improve, additional treatment options were evaluated, and some were referred to hyperbaric oxygen therapy as a rescue treatment. Patients were followed up for an average of 6 weeks.

There were no complications related to ITS treatment. However, some patients experienced side effects such as mild dizziness and a feeling of fullness in the ear. These side effects were managed with symptomatic treatment. These were dealt with using symptomatic treatment. The age of the patients ranged from 26 years to 81 years with a mean age of $49.17\pm16.53\%$. A significant positive correlation was found between pre-ITS low frequencies and post- ITS low frequencies (Spearman's rank correlation coefficient $\rho=0.825$, $p<0.001$). Pre-treatment treble frequencies correlated significantly with post-ITS treble frequencies (Spearman's rank correlation coefficient $\rho=0.941$, $p<0.01$; Figure 2). Before treatment, less percentage of speech discrimination after ITS was found with higher Treble frequencies that correlate very well in Spearman's rank correlation coefficient $\rho=-0.712$; $p<00.01$). There is a strong negative correlation between pre-treatment pitch frequency and post-ITS speech discrimination (Spearman's rank correlation coefficient $\rho=-0.694$, $p<0.001$). Other correlations were moderate and varied at different significance levels (Table 1). Significant improvements were observed in all three parameters after ITS treatment (Figure 3).

Table 1. Results obtained before treatment and after ITS

Frequency range	Before treatment (dB)	After intratympanic injection (dB)	*p value
Midrange frequencies mean (250-2000 Hz)	44.35±27.23	35.46±29.49	p<0.001
Treble frequencies mean (4000-8000 Hz)	58.19±28.87	50.28±29.28	p<0.001
Speech discrimination score (%)	79.41±27.11	82.44±26.93	p<0.001

*Spearman rank correlation was used to assess the correlation between pre- and post-treatment frequencies

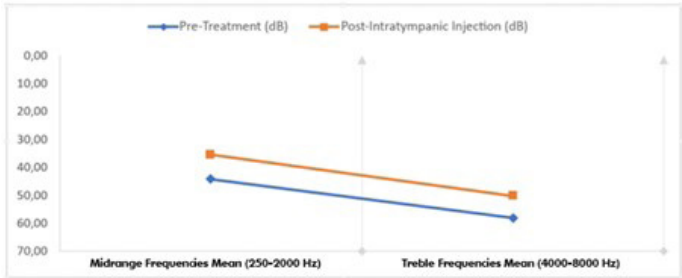


Figure 3. Means midrange frequencies and treble frequencies

This was why the hearing results obtained from two main frequency groups (midrange: 250–500–1000–2000 Hz, trable: 4000-80000 Hz) were studied. Hearing levels in these two frequency groups were assessed both before and after treatment. Source frequency ranges of the hearing data utilized in our study: midrange (250–500–1000–2000 Hz); treble (4000-8000 Hz). Hearing levels in these two octaves before vs. Following treatment were measured and compared against one another. Midrange frequencies mean decreased from 44.35 ± 27.23 dB before treatment to 35.46 ± 29.49 dB after treatment. This change was statistically significant ($p<0.001$).The mean±SD treble frequencies decreased from 58.19 ± 28.87 dB to 50.28 ± 29.28 dB

after treatment and this difference was also statistically significant ($p<0.001$). These data show that ITS treatment provides a significant hearing gain in both mid and high frequencies.

Discussion

The purpose of this study is to evaluate the efficacies and side effects of ITS in the treatment of SSHL. After treating adequately, there is a remarkable improvement in hearing levels so as speech discrimination scores. Our findings are largely consistent with other studies in the literature.ITS is a non-aggressive procedure in which a high concentration of drug reaches the cochlea and systemic side effects are minimized [12]. ITS is preferred, especially in cases where systemic corticosteroid treatment cannot be used due to side effects or efficacy limitations [13,14]. ITS is also used in other otological diseases such as Meniere's disease, autoimmune inner ear diseases, chronic otitis media, and subjective tinnitus [15-18]. The use of ITS in these diseases is preferred because of its potential to reduce inflammation and improve hearing levels [19]. The main molecules used in the treatment of ITS include dexamethasone, methylprednisolone, budesonide, and triamcinolone. Dexamethasone is the most used corticosteroid in the treatment of ITS and is preferred because of its high anti-inflammatory effect. Methylprednisolone and

triamcinolone corticosteroids or other effective corticosteroids in the treatment of ITS are used as alternative treatment options. Dexamethasone in the treatment of ITS is usually administered at a concentration of 1-2 mg/ml and a dose of 0.5–1 ml. Treatment can be done once or twice a week. Treatment is usually continuing for 3–4 weeks.

In summary, the 4-dose protocol is effective for maintaining steroid levels, minimizing side effects, and ensuring patient compliance without compromising the treatment outcome [20,21].

ITS treatment should be started as soon as possible after the onset of hearing loss. Early initiation of treatment is critical for the recovery of hearing loss. In the literature, it is reported that starting treatment within the first 72 hours increases hearing recovery rates [6].

In addition to ITS, other treatment modalities used in the treatment of SSHL include systemic corticosteroid therapy, hyperbaric oxygen therapy (HBOT), antiviral therapy, and vasodilators. HBOT can be used as a second-line treatment, especially in cases of severe hearing loss [22]. Antiviral therapy may be effective in cases where SSHL is caused by viral infections. However, there are conflicting results on the efficacy of antiviral treatments [23].

In our study, significant improvements were observed in midrange and treble frequencies, and speech discrimination scores also improved. The findings support the conclusion that ITS is clinically useful in the treatment of SSHL. First, our findings are compatible with the study by Wilson et al. and overlap with the findings suggesting that corticosteroids are effective in the treatment of SSHL, especially hearing loss, which is of viral origin [6].

These findings are consistent with other studies in the literature. For example, a meta-analysis by Zhao et al reported that ITS had positive effects on hearing gains in high frequencies [7].

The graphs also clearly show the difference between midrange and high frequencies after treatment, supporting the effectiveness of ITS in improving hearing. These findings suggest that ITS contributes to the treatment of both low and high frequency losses in the treatment of SSHL (Figure 3).

Studies in the literature have shown favorable effects of corticosteroids in the treatment of SSHL [5,7]. The efficacy of ITS treatment in our study may be explained by the advantage of administering intratympanic steroids directly into the inner ear and thus minimizing systemic side effects [8]. The potential effects of ITS treatment in clinical applications are also remarkable. By minimizing systemic side effects, ITS allows patients to experience less discomfort during the treatment process. ITS is ideal to avoid the systemic side effects of corticosteroids. With this approach, the treatment is applied directly to the inner ear without going into systemic circulation

thus reducing possible side effects of a therapy. In this study, no serious complications were observed after ITS treatment. Side effects such as mild dizziness and a feeling of fullness in the ear were reported, but these side effects are also frequently reported in the literature and are usually temporary [8].

ITS, treatment efficacy can be increased by combining it with systemic corticosteroid therapy. In this regard, there is much controversy about the efficacy of ITS treatment in SSHL [24,25-27]. There are studies concluding that both intratympanic steroids and systemic steroids alone seem to be equally effective, but the combined use of both intratympanic and systemic steroids is probably superior to the use of both alone [24], and there are also studies in which no significant difference was found between intratympanic steroid treatment and systemic steroid treatment in various meta-analyses in the literature [25-27].

The improvement observed in speech discrimination scores after ITS is also consistent with other studies cited in the literature (Table 1). In particular, the study by Wilson et al. similarly emphasized the effects of corticosteroid treatment on hearing loss and speech ability [28].

In our study, the significant improvement in speech discrimination scores after ITS treatment (Table 1) indicates that the treatment can improve not only hearing loss but also hearing quality. This finding suggests that ITS may be clinically useful, especially for patients who have problems with speech discrimination ability. There are several limitations in our study. Our study is a retrospective analysis and our relatively small sample size may limit generalizability. In addition, even though 6 months of follow-up was in the protocol, this did not occur.

Therefore, the efficacy of ITS in the treatment of SSHL should be confirmed in larger-scale randomized controlled studies.

However, our study provides an additional contribution to the literature. Although many studies have been conducted in the literature on the effectiveness of ITS treatment, detailed analyses on speech discrimination scores are limited. Our study shows that ITS not only improves hearing levels but also provides significant improvement in speech discrimination ability. This is a critical finding that has the potential to increase quality of life after treatment. While many studies in the literature focus on hearing levels, studies analyzing the improvement in speech discrimination scores in such detail are limited. In this sense, our study aims to fill the gap in this area. In addition, the effects of ITS treatment on both mid- and high-pitched frequencies were clearly demonstrated in our study. Since the improvement in mid-frequencies, in particular, covers the hearing ranges that are critical for speech and daily communication, the effect of the gains in these frequencies on daily life is more pronounced. This can positively affect the quality of life by improving the social interactions of patients. There is limited data in the literature on the effects of ITS in this sense, and our study provides new information on this subject [24].

Conclusion

ITS can significantly improve hearing levels and speech discrimination ability in patients with SSHL. These findings suggest that ITS is an effective option in the treatment of SSHL. Future research may contribute to the development of treatment protocols by providing more information on the optimal dosage, duration of administration, and long-term effects of ITS.

Conflict of Interests

The authors declare that there is no conflict of interest in the study.

Financial Disclosure

The authors declare that they have received no financial support for the study.

Ethical Approval

The data were analyzed retrospectively by the approval of the Meltem Hospital Local Ethics Committee (15.02.2024, no. 2024/46).

References

- Stachler RJ, Chandrasekhar SS, Archer SM, et al. Clinical practice guideline. Otolaryngol Head Neck Surg. 2012;146:S1-35.
- Xie W, Karpeta N, Tong B, et al. Etiological analysis of patients with sudden sensorineural hearing loss: a prospective case-control study. Sci Rep. 2023;13:5221.
- Schreiber BE, Agrup C, Haskard DO, Luxon LM. Sudden sensorineural hearing loss. The Lancet. 2010;375:1203-11.
- Harrison RV. Treatment of sensorineural hearing loss with corticosteroids — some facts. Canadian Audiologist. 2022;9.
- Chen C-Y, Halpin C, Rauch SD. Oral steroid treatment of sudden sensorineural hearing loss: a ten year retrospective analysis. Otol Neurotol. 2003;24:728-33.
- Conlin AE, Parnes LS. Treatment of sudden sensorineural hearing loss: I. a systematic review. Arch Otolaryngol Head Neck Surg. 2007;133:573-81.
- Zhao D, Tong B, Wang Q, et al. A comparison of effects of systemic and intratympanic steroid therapies for sudden sensorineural hearing loss: a meta-analysis. J Otol. 2016;11:18-23.
- Swan EEL, Mescher MJ, Sewell WF, et al. Inner ear drug delivery for auditory applications. Adv Drug Deliv Rev. 2008;60:1583-99.
- Ringrose T, Biggs TC, Jones L, et al. Salvage intratympanic steroid therapy for sudden sensorineural hearing loss: our real-life experience in 32 patients. J Laryngol Otol. 2022;136:827-30.
- Dispenza F, De Stefano A, Costantino C, et al. Sudden sensorineural hearing loss: results of intratympanic steroids as salvage treatment. Am J Otolaryngol. 2013;34:296-300.
- Berjís N, Soheilipour S, Musavi A, Hashemi SM. Intratympanic dexamethasone injection vs methylprednisolone for the treatment of refractory sudden sensorineural hearing loss. Adv Biomed Res. 2016;5:111.
- Pai YC, Lee CF. Intratympanic steroid injection for inner ear disease. Tzu Chi Medical Journal. 2013;25:146-9.
- Poetker DM, Reh DD. A comprehensive review of the adverse effects of systemic corticosteroids. Otolaryngologic Otolaryngol Clin North Am. 2010;43:753-68.
- Conn H, Poynard T. Corticosteroids and peptic ulcer: meta-analysis of adverse events during steroid therapy. J Intern Med. 1994;236:619-32.
- Webster KE, Lee A, Galbraith K, et al. Intratympanic corticosteroids for Ménière's disease. Cochrane Database Syst Rev. 2023;2:CD015245.
- Breslin NK, Varadarajan VV, Sobel ES, Haberman RS. Autoimmune inner ear disease: a systematic review of management. Laryngoscope Invest Otolaryngol. 2020;5:1217-26.
- Hembrom R, Singh MK, Ghosh S, et al. A comparative study between the efficacy of intratympanic steroid injection and conventional medical treatment in resistant cases of otitis media with effusion. BJOHNS. 2021;29:11-6.
- Chung J, Lee DY, Kim JS, Kim YH. Effectiveness of intratympanic dexamethasone injection for tinnitus treatment: a systematic review and meta-analysis. Clin Exp Otorhinolaryngol. 2022;15:91-9.
- Williams DM. Clinical pharmacology of corticosteroids. Respir Care. 2018;63:655-70.
- Ren J, Lu Y, Yin T, et al. Intratympanic dexamethasone injections for intractable sudden sensorineural hearing loss. Lin Chuang Er Bi Yan Hou Ke Za Zhi. 2006;20:219-21.
- Liu Rr, Ji-chuan C, Changyou J. Sudden sensorineural hearing loss treated with intratympanic dexamethasone injection. Journal of Otology. 2010;5:4-7.
- Ajduk J, Peček M, Kelava I, et al. Comparison of intratympanic steroid and hyperbaric oxygen salvage therapy hearing outcomes in idiopathic sudden sensorineural hearing loss: a retrospective study. Ear Hear. 2023;44:894-9.
- Awad Z, Huins C, Pothier DD. Antivirals for idiopathic sudden sensorineural hearing loss. Cochrane Database Syst Rev. 2012;2012:CD006987.
- Chrysouli K, Kollia P, Papanikolaou V, Chrysovergis A. The effectiveness of intratympanic steroid injection in addition to systemic corticosteroids in the treatment of idiopathic sudden sensorineural hearing loss. Am J Otolaryngol. 2023;44:103872.
- Lai D, Zhao F, Jalal N, Zheng Y. Intratympanic glucocorticosteroid therapy for idiopathic sudden hearing loss: meta-analysis of randomized controlled trials. Medicine. 2017;96:e8955.
- El Sabbagh NG, Sewitch MJ, Bezdjian A, Daniel SJ. Intratympanic dexamethasone in sudden sensorineural hearing loss: a systematic review and meta-analysis. Laryngoscope. 2017;127:1897-908.
- Torun MT. Ani idiyatik iřitme kaybı tedavisinde sistemik steroide intratimpanik steroid eklenmesi tedavi etkinlięini artırır mı?. Journal of Medical Sciences. 2022;3:47-52.
- 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;106:772-6.