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Intratympanic Steroid Treatment for Idiopathic Sudden Sensorineural Hearing Loss after Failure of Intravenous Therapy

Dr.Dharmendra kumar, Dr. S.P Singh,Dr.Varun kumar Thakur
[1]*Senior Resident DeptOf Otorhinolaryngology J..L.N.M.C.H Bhagalpur,Bihar*
[2]*AssistantProfessordept Of Otorhinolaryngology J..L.N.M.C.H Bhagalpur,Bihar*
Professordept Of Otorhinolaryngology J..L.N.M.C.H Bhagalpur,Bihar

Abstract
Objective:*To assess the outcomes of intratympanic steroids in the management of idiopathic sudden sensorineural hearing loss.*
Method:*A total of 55 patients with idiopathic sudden sen-sorineural hearing loss were included in our study. Pre- and post-injection audiograms were taken to assess the outcomes in improvement in hearing. Hearing outcomes were assessed with respect to duration of onset of treatment and age of the patient.*
Results *A total of 55 patients were included in our study of which unilateral cases were 43 and bilateral cases were 8. .Overall, 29 patients (52.7%)showed improvement in PTA, 24 (43.8%) had no change in hearing, and 2 (3.5%) worsened. The mean PTA pre ITS was 62.7 and after ITS it was 56.3. Maximum improvement was noted at 2000 Hz and 1000 Hz.*
Conclusion: *IST is an effective and safe therapy in sudden sensorineural hearing loss cases that are refractory to standard treatmenThe earlier IST, the hearing losses less than 90 dB and the involvement of the low frequencies seem to influence positively the hearing recovery.*

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I. Introduction

Sudden sensorineural hearing loss (SSNHL) is a common emergency in Otology, known as an acute unilateral deafness, with a sharp onset (usually during 3 days), with more than 30 dB hearing loss at three subsequent frequencies. To observe the etiology of different diseases, various cases including autoimmune inflammation, viral cochleitis, and inner ear membrane rupture have been studied. The most convincing causes are viral and vascular etiologies. The natural background of SSNHL is still unknown; spontaneous recovery happens in almost 30% of cases and it will recover mostly during the first 2 weeks after its onset, and it contains partial response.

Many factors seem to influence recovery; the degree of hearing loss, the audiogram pattern, the existence of vertigo, and the duration between the onset and treatment of SNHL are probably the most important factors.

Different therapies have been tried for SSNHL, none of which was effective. Hyperbaric oxygen, vasodilator drugs, agents that decrease blood viscosity and magnesium, are some examples of previously tested SSNHL treatments. Some studies present that steroids might be effective, while more results are needed. Systemic steroids with prompt administration increase the rate of hearing recovery. Needless to say that steroids in high doses can be followed by systemic effects; hence, it so cannot be used for all patients. Several mechanisms of action are recognized for corticosteroids including anti-inflammatory action, immune suppression, membrane stabilization, increased perfusion, and ion balance regulation. It has been shown that steroids can also be effective if no immune disorder is demonstrated.

The transtympanic route presents two main advantages: (1) it produces significantly higher perilymph concentrations of steroids than intravenous or oral administration; (2) it is possible to reduce the side effects due to systemic absorption. Effectiveness of local application of steroids in SSNHL, Ménière's disease, and in other inner ear conditions has been reported by many authors. Although dexamethasone and methylprednisolone were used traditionally but optimal dosage, drug, and route of administration still remain a matter of debate. Based on these considerations, we started treating SSNHL patients with transtympanic Dexamethasone versus methylprednisolone in order to better understand the real effectiveness of this treatment.

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II. Material & Method

Inclusion criteria

1Sudden onset of hearing loss with less than 72 hours durations with loss of more than 30 db in three consecutivefrequencies .

Exclusion Criteria

1) Patients with age less than 10 years.
2) Patients presenting with vertigo along with hearing loss.
3) History or evidence of acute or chronic otitis media.
4) History of ear surgeries.
5) Patients with history of trauma to the ear.
6) Noise induced hearing loss.

This study was conducted in the department of ENT and Head and neck surgery J.L.N.M.C.H Bhagalpur.It was conducted from December 2015 to Novmber 2016 .A total of 51 patients were included in the study and receiving intratympanic steroids. Detailed history was taken from the patients regarding onset of hearing loss, duration of hearing loss, if there was any pre existing ear pathology or any prior viral infection.

Hearing loss was documented with audiometric testing. Tinnitus was graded with tinnitus handicap index in-ventory by Neumann and McCombe Pain score following injection was assessed with visual analogue scale MRI brain with Gadolinium contrast to rule out acoustic neuroma and other retrocochlear lesions were enrolled in the study: 30 ears in the cartilage group and 30 ears in the fascia group. We collected the data of graft success rates, preoperative and postoperative air bone gaps (ABG), and air conduction thresholds (ACT) of the patients from the Medin integrated medical software system.

Theoperative procedure of intratympanic steroid injection was performed under a microscope and with patient in supine position. After the surgeon confirmed intact tympanic membrane and middle ear status, local anaesthesia was administered with a cotton ball soaked with lidocaine 10% pump spray (Xylocaine), which was applied on the tympanic membrane for 20 minutes. While the patient tilted the head 45° to the healthy side, a 25-gauge spinal needle was introduced into the posteroinferior portion of membrane and 0.4-0.5 mL of methylprednisolone (40 mg/mL) was instilled through this site. The patient was instructed to avoid swallowing or moving for 30 minutes, remaining in the same position. IST was performed on the 1st, 3rd, 5th day up to 7 total injections, one every two or three days.

III. Result

There were 24 men (43.6%) and 31 women (56.4%). The mean age at enrolment for all patients was 49.7 years and ranged from 18 to 83 years. The mean age for the men was 53.2 years and for the women was 46.1 years.Overall, 29 patients (52.7%)showed improvement in PTA, 24 (43.8%) had no change in hearing, and 2 (3.5%) worsened. According to Siegel's criteria, 13 patients showed "complete recovery" with a mean gain of 36.2% (range 12.4% to 86.9%); 10 patients showed "partial recovery" with an average improvement of 18.9% (range 7.8% to 69.2%); 6 patients had a "slight recovery" with a mean gain of 16.2% (range 6.1% to 49.8%) (Figure 2). *Recovery Related to Time to Onset of Symptoms.* Theaverage number of days from onset of symptoms to IST was 33 days with a range of 5 days to 96 days. For the group that responded to IST with a "complete recovery" (n= 7), the median was 12 days; for the group that responded to IST with a "partial or slight recovery" (n= 22), the median was 23 days; for the group that did not respond (n= 26), the mean was 34 days. Statistical analysis shows that there is a significant correlation between hearing recovery and time to onset of symptoms; patients that started IST soon after failures of systemic therapy was detected had an evident advantage (P=.007 Fisher's test).

A total of 16patients (29.1%) had hearing loss greater than 90 dB with an improvement rate of 7.2%; a total of 29 patients (52.7%) had hearing loss of 90 dB or less and greater than to 50 dB with improvement rate of 21.2%; a total of 10 patients (18.2%) had hearing loss less than 50 dB and greater than 30 dB with an improvement rate of 47.6% (Figure 3). Patients with severe losses greater than 90 dB had a poorer recovery (7.2%) compared with losses less than 90 dB (35.6%) (P= 0.06 Fisher's test).Hearing recoveryrelated to patient's age was studied. Fifty-seven percent of patients were under 60 years of age and had an overall recovery rate of 26%. Forty-three percent of patients were 60 years of age or older and had an overall recovery of 32%. Statistical analysis shows no significant correlations between age and improvement after IST (P=.08 Fisher's test).

Recovery Related to Status of the Controlateral Ear. Atotal of 76.5% of patients had normal hearing in the con-tralateral ear. The recovery rate in this group was 31.5%. Only 23.5% of patients had abnormal hearing in the opposite ear. The recovery rate in this group was 22.5%. Statistical analysis shows no significant correlations between recovery and situation of the contralateral ear (P= 1.2 Fisher's test).

Recovery Related to Frequency of Hearing Loss. We haveanalyzed the hearing recovery for each frequency (0.25, 0.5, 1, 2, 4, and 8 kHz) of hearing threshold. A total of 37 patients (67.2%) showed improvement over 30 dB on hearing gain for the frequency of 0.25 and 0.5 kHz. The same result was obtained with 1 kHz frequency in 27 patients (49.1%), with 2 kHz frequency in 23 patients (41.8%), with 4 kHz frequency in 14 patients (25.4%), and with 8 kHz frequency in 9 patients (16.3%) (Figure 4). Statistical analysis shows a significant correlation between recovery and low frequencies (0.25 and 0.5 kHz) of hearing threshold (P=.06 Fisher's test).

IV. Discussion

The ISSHL is a very frightening and incapacitating event, and it severely impairs patient's life quality and social interaction. Considering the high rate of spontaneous recovery, it is difficult to determine if any therapeutic intervention actually improves the hearing. The natural history of untreated patients with ISSHL states that the recovery rates varies from 31% to 65% , while the hearing recovery in treated patients ranges from 35% to 89%. Such aresult may be related to different factors: the variable treat-ment protocols, the type of steroid used, the length of ther-apy, the patient data, the severity of hearing loss, the duration from onset of symptoms to treatment, the method of sta-tistical analysis. At this time, steroids systematic administra-tion is considered to be the most commonly accepted treat-ment for ISSHL.

In 2002 Gloddek et al. demonstrated the immunologi-cally mediated vasculitis relation with ISSHL pathogenesis. The role of endothelial cells in this mechanism is inferred, and these cells are thought to promote vasculitis by secreting cytokines . Moreover, ISSHL seems be considered the result of abnormal activation of endocochlear nuclear factor-κB. This is a molecular transcription factor that plays a keyrole in the normal cellular physiology and in mediating the cellular responses to a pathogenic stress (infectious, mech-anical, or osmotic), with stimulation of synthesis of cytokines and alterations of homeostatic balance of the inner ear. The transient activation of this system might be related to a spon-taneous recovery, whereas a prolonged stimulation should lead to an irreversible damage of cochlear cells (in most cases, the atrophy of Corti's organ).

The precise mechanism through which steroids may im-prove hearing remains unknown; both glucocorticoid and mineralcorticoid receptors may be found in the inner ear . The main roles of steroids in the treatment of ISSHL are: (i) the protection of cochlea from the harmful effects of inflammatory mediators, such as the tumor necrosis factor (TNF-α and NF-κB) and cytokines (interleukin 1 and 6), which is elevated in infection and flogosis; (ii) increasing cochlear blood flow thereby avoiding cochlear ischemia (iii) avoiding noise-induced hearing loss ; (iv) regulating protein synthesis in the inner ear . There the vascular stria regulates Na/K secretion in order to maintain endocochlear potential; it is the most freq-uent site of injury in the ISSHL . Systemic steroid therapy improves vascular stria function and may preserve its mor-phology and therefore its potential for recovering from ISSHL.

The first report of IST in the treatment of ISSHL was by Silverstein in 1996 followed by Parnes in 1999 . Several other reports have been published since this initial report, the majority form 2001. It is demonstrated that intratympanic infusion of steroids leads to a much higher perilymphatic concentration, as compared to the systemic route. Moreover, a substantial basal-apical concentration gradient of steroid in the scala tympani perilymph has been found after round window application.

Usually, intratympanic steroids are used in three main protocols, as initial treatment, as adjunctive treatment given concomitantly with systemic steroids, and as salvage treat-ment after failure of standard therapy.The different criteria of hearing improvement and the wide variability of treatment protocols hinder the interpre-tation of the results. However, according to both randomized and nonrandomized trials , IST, as first-line therapy, seems to be a valuable solution in re-fractory ISSHL, at least as effective as systemic steroids. According to our study, in literature some studies report that IST appear to be more effective in the hearing loss on the low frequencies. Since the intratympanic steroid spreads into the perilymph through the round window, it would be actually expected that hearing improvement might occur in high frequencies (basal turn of the cochlea) than in low frequencies (apex of the cochlea). The differential vulnerability of basal and apical hair cells seems to explain this clinical result. The basal turn of the cochlea is more vulnerable to trauma and free radicals than the apical turn; in daily clinical practice, the hearing loss from noise, ototoxic drugs, or trauma easily occurs in the high frequencial range involving the cochlear base. Besides, the outer and inner hair cells of the cochlear base develop ultrastructural anomalies more quickly than those in the apical turns following severe or total cochlear ischemia .

Although the reports about the combination of topical and systemic therapy are controversial , the last review of the literature confirm that IST can be a reasonable alternative for patients who cannot tolerate systemic therapy or in the failure of intravenous treatment]

V. Conclusion

Intratympanic steroids can be offered as a first line therapy for sudden sensorineural hearing loss as it is mini-mally invasive and can be performed as an office based procedure with no systemic side effects. No major com-plications have been reported in our study and results have been satisfactory.

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