

Comparative efficacies of intratympanic steroid administration and classic therapy in the management of idiopathic sudden sensorineural hearing loss

İdiopatik ani işitme kaybında intratimpanik steroid uygulaması ile klasik tedavi etkinliğinin karşılaştırılması

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Abstract

Objective: Sudden hearing loss is a sensorineural hearing loss with an unknown etiology at ≥ 30 dB which appears in 3 days or within a shorter period of time and obstructs three successive frequencies. Our objective in this study is to assess the effectiveness of the combination of classic therapy and intratympanic steroid treatment in the management of idiopathic sudden sensorineural hearing loss.

Methods: One hundred and forty patients diagnosed with idiopathic sudden sensorineural hearing loss in our clinics between February 2010 and June 2012 were separated into 2 groups. Seventy-six patients [37 women (48.68%) and 39 men (51.32%)] with a mean age of 45.1 ± 14.16 years managed with a combination of classic sudden hearing loss and intratympanic steroid treatment (Group 1) and 64 patients [34 women (53.18%) and 30 men (46.82%)] with a mean age of 47.6 ± 17.74 years managed with only classic sudden hearing loss treatment (Group 2) were included in the study. One month after the study, pure-tone averages and speech discrimination scores of the patients were compared with those obtained 1 month before the treatment.

Results: Pure-tone average of the intratympanic-steroid treatment group was found to be 68.28 dB before the treatment where in the other group it was 67.21 dB without any statistically significant difference between groups. When followed-up 1 month after the therapy, pure-tone average was found to be 33.52 dB in the intratympanic steroid treatment group and 44.46 dB in the classic therapy group with a statistically significant intergroup difference. Gain was up to 34.76 dB in the intratympanic steroid treatment group whereas in the classic therapy group, the difference was 22.75 dB which was found to be statistically significant ($p < 0.05$).

Conclusion: When treating idiopathic sudden hearing loss, intratympanic steroid treatment which was combined with sudden hearing loss treatment protocol tends to yield significant hearing gain when compared with the classic combined treatment.

Key words: Sudden hearing loss, sensorineural hearing loss, intratympanic steroid.

Özet

Amaç: Ani işitme kaybı, nedeni bilinmeyen, üç gün içerisinde veya daha kısa zamanda aniden ortaya çıkan, birbirini takip eden üç frekansı tutan, 30 dB ve üzerindeki sinirsel tipte işitme kaybıdır. Bu çalışmadaki amacımız, intratimpanik steroid tedavisi ile birlikte klasik tedavi birlikteliğinin idiyopatik ani işitme kaybı tedavisinde etkinliğini değerlendirmektir.

Yöntem: Şubat 2010 – Haziran 2012 tarihleri arasında kliniğimizde idiyopatik ani işitme kaybı tanısı alan 140 hasta çalışmaya alınarak iki gruba ayrıldı. İntratimpanik steroid tedavisi ve klasik ani işitme kaybı tedavisi alan 76 hasta [37'si kadın (%48.68), 39'u erkek (%51.32); yaş ortalaması 45.1 ± 14.16] ile sadece klasik tedavi kombinasyonu uygulanan 64 hasta [34'ü kadın (%53.18), 30'u erkek (%46.82); yaş ortalaması 47.6 ± 17.74] çalışmaya dahil edildi. Tedaviden 1 ay sonra hastaların saf ses ortalamaları ve konuşmayı ayırt etme skoru, tedavi öncesindeki saf ses ortalamaları ve konuşmayı ayırt etme skoru ile karşılaştırıldı.

Bulgular: Tedavi öncesi saf ses ortalaması, intratimpanik steroid tedavi grubunda 68.28 dB, diğer grupta 67.21 dB olarak bulundu ve istatistiksel olarak aralarında fark yoktu. Tedavi sonrasında 1. ay kontrolünde saf ses ortalaması, intratimpanik steroid tedavi grubunda 33.52 dB, klasik tedavi grubunda 44.46 dB olarak bulundu ve istatistiksel olarak aralarındaki fark anlamlıydı. İntratimpanik steroid tedavi grubunda kazanç 34.76 dB'e yükselirken, klasik tedavi grubunda fark 22.75 dB olarak ölçüldü ve bu sonuç istatistiksel olarak anlamlı bulundu ($p < 0.05$).

Sonuç: İdiopatik ani işitme kaybı tedavisinde, klasik ani işitme kaybı tedavi protokolü ile kombine edilen intratimpanik steroid uygulaması, işitme kazancı yönünden sadece klasik kombine tedavi alan hastalara kıyasla anlamlı sonuçlar vermektedir.

Anahtar sözcükler: Ani işitme kaybı, sensorinöral işitme kaybı, intratimpanik steroid.

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Sudden hearing loss is conventionally defined as a sensorineural hearing loss with an abrupt onset at ≥ 30 dB within ≤ 3 days and obstructs 3 successive frequencies. Sometimes vertigo or tinnitus may accompany its clinical picture. The etiology of sudden hearing loss (SHL) has not been defined clearly and also different factors are held responsible for its occurrence. Frequently viral, vascular and autoimmune pathologies play a role in the etiology of idiopathic hearing loss. In only 10% of the cases a single etiologic factor can be detected.^[1-3] Various treatment strategies have been tried because of different etiologies of SHL. Histamine, papaverine, atropin, blockage of stellate ganglion, dextrane, betahistine and hyperbaric oxygen treatment can be enumerated among them. Heparin and coumadin have been used for anticoagulation. As supportive treatments bed rest, sedatives, tranquilisants, vitamins, especially vitamin B have been recommended. In SHL, only steroids have established their effectiveness. Spontaneous resolution of SHL has been demonstrated in 32-65% of the cases in various studies, whereas improvement has been reportedly achieved in higher (48-89%) percentage of patients under steroidal therapy.^[3-6]

Among many different approaches and investigations for the treatment of SHL, in intratympanic steroidal therapy, steroids are directly injected into the middle ear. From middle ear through round window, drug passes into inner ear which leads to fewer side effects and higher perilymphatic steroid levels relative to its systemic levels. Intratympanic steroid therapy has gained popularity in recent years in the medical treatment of cochlear diseases. Transtympanic drug application into the inner ear has become prevalent in 1935 with Barany's lidocain application into the middle ear, then in 1950s Shuknecht, later Sakata injected steroids into the inner ear.^[7-9] Nowadays successful outcomes have been reported with intratympanic steroid (ITS) applications.

In the present study, the outcomes of management of SHL with combined classic treatment - ITS therapy, versus classic combination treatment protocol were compared as for hearing gain.

Materials and Methods

This study included a total of 140 patients with the diagnosis of SHL who had applied to our clinics between February 2010 and June 2012 within at most 10 days after the onset of the disease. The patients were divided into 2 groups. Group 1 (ITS + classic SHL treatment) included 76 patients [37 (48.68%) women, 39 (51.32%) men] with a mean age of

45.1 \pm 14.16 years and Group 2 (classic SHL treatment protocol group) included 64 patients [34 (53.18%) women and 30 (46.82 %) men] with a mean age of 47.6 \pm 17.74 years.

Inclusion criteria were the presence of sensorineural type hearing loss occurring suddenly or within a short time without any identified etiology, hearing loss at ≥ 30 dB obstructing three successive frequencies in otologic evaluation, absence of any otologic disease in the affected ear and any past history of SHL treatment.

To determine pre-treatment hearing acuity of the eligible patients complying with the above-mentioned criteria, complete audiologic examinations were performed. Using a Mercury brand silent chamber audiometry device with M-142, 125-12000 frequency range, pure-tone threshold averages, speech reception threshold, speech discrimination score (SDS), tympanograms, acoustic reflex measurements were performed at 250, 500, 1000, 2000 and 4000 frequencies. Before the procedure the state of hearing acuity was assessed with full audiologic examination. In the classic treatment group 1 mg/kg oral methylprednisolone (tapering one quarter of a dose on every 4 days), benzodiazepin (Diazepam 5 mg, tid, po), antiaggregants (Pirasetam 4 \times 3 g, IV) and antacids (4 \times 2 tablets) were used. In the ITS+classic treatment group, the patients were laid in supine position with their head turned 30-40 degrees to the unaffected side and under local anesthesia 0.3-0.5 ml dexamethasone (4 mg/ml) was injected using a dental injector inserted through the junction of posteroinferior-posterosuperior quadrants. The patient was left nearly 30 minutes in this position to ensure complete irrigation of the round window. The patient was asked not to swallow anything during the procedure and for the prevention of vestibular organ irritation during the injection injector and its contents were warmed up to a maintenance temperature. The procedure was applied once daily for 5 days. The results were evaluated in consideration of alterations in pure-tone audiograms (PTAs) at 500, 1000 and 2000 Hz frequencies and SDS. Gains in PTA over 10 dB were recorded as a significant improvement. Evaluations were made before the treatment and at postoperative first months and the results were compared. For both groups, pre-treatment PTAs and SDSs and comparative increase rates in their values estimated at postoperative first months were statistically evaluated using χ^2 ; and t-tests

Results

Classic combination treatment group included 64 patients [34 (53.18 %) women and 30 (46.82%) men] with a mean age of 47.6 \pm 17.74 years. Intratympanic steroid treatment

group comprised of 76 patients [37 (48.68%) women, 39 (51.32%) men] with a mean age of 45.1 ± 14.16 years.

Pre-treatment PTA was 68.28 dB in the ITS and 67.21 dB in the other group without any statistically significant difference between groups ($p > 0.005$). At post-treatment first month control visits, PTA was found to be 33.52 dB in the ITS and 44.46 dB in Group 2 with a statistically significant difference between groups. Hearing gain was increased to 34.76 dB in the ITS group and it was 22.75 dB in the control group, with a statistically significant intergroup difference (Table 1). Besides, pre-treatment median speech discrimination scores of the patients were 72.89 dB and 71.64 dB in the ITS and Group 2, while the corresponding post-treatment SDSs were 86.44 dB and 79.58 dB, respectively with a statistically significant difference between groups ($p < 0.005$).

Discussion

Sudden hearing loss is a sensorineural hearing loss with an unknown etiology and abrupt onset emerging within ≤ 3 days at ≥ 30 dB which obstructs 3 successive frequencies. In only 10% of the cases with SHL any causative factor can be detected. Targeted treatment can be instituted, when an etiological factor can be identified. However one must not forget that spontaneous resolution can occur in 32-65% of the cases. Most frequently SHL can be cured within the first two weeks. Hearing loss occurring at low or intermediate frequencies improves better than sudden hearing loss involving higher frequencies or horizontal semicircular canal function.^[1-4] Cases with decreased speech discrimination scores, children or elders with sudden hearing loss have a poor prognosis. Up to now, many different drugs or drug combinations have been used in the treatment of the sudden hearing loss. Among them histamine, nicotinic acid, carbogens, diatrizoate meglamine, Dextran, Rheomacrodex, heparin, coumadin, Urografin, furosemide, papaverine and

piracetame etc. can be enumerated. Clinical applications have demonstrated that mono-, or combination therapy with steroids is the single established therapy with confirmed efficacy. Partial or complete cure rates during systemic steroid use vary between 49-89% when compared with untreated cases.^[3-6] Some authors have thought to obtain more improved outcomes in the management of SHL with steroid combination therapies and to that end they have formulated some treatment protocols. Vasodilators, volume expanders, vitamins and contrast agents have been used in combination with steroids.^[10-12] Despite successful outcomes of some treatment protocols, some authors suggest that generally these combinations are not more effective than steroid monotherapies.^[13] Currently practiced and accepted SHL treatment is preferably oral steroid administration. Nearly all clinicians agree that within nearly one month, steroids will be able to provide maximal benefit and maintenance of therapies beyond this period will be ineffective. Response rates to systemic steroids range between 49 and 89 percent.^[14,15] Emergence of SHL is presumably attributed to inflammatory processes in the inner ear due to various etiologies as viral infection and ischemia and steroids have been used with their conceivably effectiveness in breaking or reversing this inflammatory cascade. However as is known, systemic steroid administration cannot overcome blood-brain barrier efficiently and thus its adequate levels in CSF and bone tissue cannot be sustained. Indeed, steroids must penetrate into inner ear fluids in order to be effective. To increase steroid concentration in the inner ear fluids, administration of higher systemic doses of steroids can be attempted. However it is apparent that higher doses increase risks of systemic complications. In various studies performed within the last 10 years opinions suggest that additional average hearing gain of 25-50% has been provided by ITS treatment in patients who had not been adequately benefited from systemic steroid therapy. In ITS

Table 1. Intratympanic steroid administration and classic therapy pure tone audiogram results in the pre- and post-treatment periods.

Frequency (Hz)	Classic treatment		ITS+classic therapy	
	Pre-treatment PTA (dB)	Post-treatment PTA (dB)	Pre-treatment PTA (dB)	Post-treatment PTA (dB)
250 Hz	67.45	44.25	69.81	34.54
500 Hz	68.37	46.87	68.11	34.67
1000 Hz	69.42	44.36	67.80	32.11
2000 Hz	62.56	44.52	66.42	34.17
4000 Hz	68.29	42.32	69.26	32.13

ITS: Intratympanic steroid, PTA: Pure-tone audiogram

treatment, since the drug is locally applied into the middle ear, its concentration in the middle ear increases and only minimal amounts of the drug pass into systemic circulation. Diverse opinions and modes of practices have been proposed for the types, doses and routes of administration of steroids to be applied on the middle ear. For instance myringotomy, ventilation tube, catheter or needle injection have been used for the application of steroids into the middle ear.^[16-18] As steroidal formulations and doses, 125 mg/2 ml methylprednisolone or 1 mg/ml or 4 mg/ml dexamethasone have been used.^[16,17] In our study, ITS was injected into the middle ear using a dental injector and a dose of 0.2-0.4 ml dexamethasone (4 mg/ml). Main advantage of this approach is its easier application with relatively lesser morbidities. None of our patients developed complications during or after the procedure.

In an animal study, dexamethasone was administered through venous route and also as an intratympanic application.^[19] After the procedures, drug concentrations in perilymphatic fluid were compared and higher dexamethasone concentrations were demonstrated with intratympanic application of dexamethasone. In that study, histamine administered with intratympanic dexamethasone application favored achievement of higher perilymphatic steroid concentrations.^[14] In various studies, these higher perilymphatic concentrations have been demonstrated.^[20,21] In a separate study, in cases with failed systemic steroid therapy, through an implanted ventilation tube a total of 4 cycles of ITS therapy were instituted within 10-14 days using 0.4 cc steroid injections (25 mg/ml dexamethasone or 125 mg/2 ml methylprednisolone). In 23 SHL patients, ITS therapy was started 72 weeks after the onset of symptoms. In PTA 44% resolution of symptoms was detected after intratympanic steroid therapy. On PTA an average hearing gain of 15.2 dB could be demonstrated. In 8 (35%) of 23 patients improvements in hearing threshold and SBS were observed (average improvements, 48% and 21%, respectively).^[17] In a study by Kopke et al., steroids were applied into the round window through an implanted microcatheter.^[18] A total of 9 patients were included in the study. As detected on PTAs, median hearing gain of 50.7 dB (from 93.2 dB to 42.5 dB) was achieved. In a study performed by Herr et al. in 17 patients with refractory sudden hearing loss, an average improvement rate of 53% has been reported.^[22] Gianoli and Li applied intratympanic steroid injections in 23 patients refractory to oral steroids and in 10 (44%) cases they had achieved an additional hearing gain of 15 dB as detected on PTAs.^[17] In our study, at first postoperative control visits, pure-tone audiograms detected higher improvements in the

median hearing acuities in the ITS group (33.52 dB vs 44.46 dB in Group 2) with a statistically significant intergroup difference. In the ITS group, hearing gain increased to 34.76 dB, while in the control group it was measured as 22.75 dB with a statistically significant difference in favour of ITS. Besides pre-treatment median SDS values in the ITS and classic treatment groups were found to be 72.89 dB and 71.64 dB and the corresponding post-treatment values were assessed as 86.44 dB and 79.58 dB, respectively with statistically significant improvement in the ITS group.

Conclusion

After our review of the studies and available investigations relevant to ITS applications, various advantages of ITS injection therapy can be listed. Amount of steroids entering into systemic circulation after ITS applications can be relatively neglected. Besides, suppression of adrenal cortex after withdrawal of the oral steroids is not encountered in ITS procedures without any need for preventive measures. It can be also used in cases with potential contraindications where intratympanic steroid applications achieve higher drug concentrations in the target organ (perilymphatic fluid) relative to oral administration. It is a minimally invasive and harmless surgical intervention which can be very easily applied under local anesthesia in Meniere's disease. In addition it has an increased cost-effective ratio and can be used in cases with recurrent symptoms. With its above-mentioned advantages, ITS can be easily applied as a combination therapy in the management of ITS. We think that with its improved PTA and SDS outcomes, it will take its place among available classic combination therapies.

Conflict of Interest: No conflicts declared.

References

1. Shikowitz MJ. Sudden sensorineural hearing loss. *Med Clin North Am* 1991;75:1239-50.
2. Byl FJ. Sudden hearing loss: eight years' experience and suggested prognostic table. *Laryngoscope* 1984;94:647-61.
3. Haberkamp TJ, Tanyeri HM. Management of idiopathic sudden sensorineural hearing loss. *Am J Otol* 1999;20:587-95.
4. Moskowitz D, Lee KJ, Smith HW. Steroid use in idiopathic sudden sensorineural hearing loss. *Laryngoscope* 1984;94:664-6.
5. Mattox DE, Simmons FB. Natural history of sudden sensorineural hearing loss. *Ann Otol Rhinol Laryngol* 1986;463-80.
6. Rauch SD. Intratympanic steroids for sensorineural hearing loss. *Otolaryngol Clin North Am* 2004;37:1061-74.
7. Barany R. Die Beeinflussung des Ohrensens durch intravenöse Lokalanästhetica. *Acta Otolaryngol* 1935;23:201-3.
8. Schuknecht HF. Ablation therapy in the management of Meniere's disease. *Acta Otolaryngol* 1957;132:1-42.

9. Sakata E, Itoh A, Ohtsu K, et al. Pathology and treatment of cochlear tinnitus by blocking with %4 lidocaine and Decadron infusion. *Practica Otologica (Kyoto)* 1982;75:2525-35.
10. Zadeh MH, Storper IS, Spitzer JB. Diagnosis and treatment of sudden-onset sensorineural hearing loss: a study of 51 patients. *Otolaryngol Head Neck Surg* 2003;128:92-8.
11. Leong AC, Fairley JW, Padgham ND. Sudden hearing loss. *Clin Otolaryngol* 2007;32:391-4.
12. Conlin AE, Parnes LS. Treatment of sudden sensorineural hearing loss: I. A systematic review. *Arch Otolaryngol Head Neck Surg* 2007;133:573-81.
13. Wilkins SA Jr, Mattox DE, Lyles A. Evaluation of a shotgun regiment for sudden hearing loss. *Otolaryngol Head Neck Surg* 1987;5:74-80.
14. Chandrasekhar SS. Intratympanic dexamethasone for sudden sensorineural hearing loss: clinical and laboratory evaluation. *Otol Neurotol* 2001;22:18-23.
15. Alexiou C, Arnold W, Fauser C, et al. Sudden sensorineural hearing loss: Does application of glucocorticoids make sense? *Arch Otolaryngol Head Neck Surg* 2001;127:253-8.
16. Ho HG, Lin HC, Shu MT, Yang CC, Tsai HT. Effectiveness of intratympanic dexamethasone injection in sudden-deafness patients as salvage treatment. *Laryngoscope* 2004;114:1184-9.
17. Gianoli GJ, Li JC. Transtympanic steroids for treatment of sudden hearing loss. *Otolaryngol Head Neck Surg* 2001;125:142-6.
18. Kopke RD, Hoffer ME, Wester D, O'Leary MJ, Jackson RL. Targeted topical steroid therapy in sudden sensorineural hearing loss. *Otol Neurotol* 2001; 22:475-9.
19. Itoh A, Sakata E. Treatment of vestibular disorders. *Acta Otolaryngol* 1991;481:617-23.
20. Nomura Y. Otological significance of the round window. *Adv Otorhinolaryngol* 1984;33:1-162.
21. Parnes LS, Sun AH, Freeman DJ. Corticosteroids pharmacokinetics in the inner ear fluids: an animal study followed by clinical application. *Laryngoscope* 1999;109:1-17.
22. Herr BD, Marzo SJ. Intratympanic steroid perfusion for refractory sudden sensorineural hearing loss. *Otolaryngol Head Neck Surg* 2005;132:527-31.

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