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Original Article

Effectiveness of intratympanic steroid application in long-term tinnitus cases

Uzun süreli tinnitus olgularinda intratimpanik steroid uygulamasinin etkinliği

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Abstract

Background: To evaluate the effect of intratympanic steroid injection in patients with tinnitus refractory to long-term medical therapy.

Materials and Methods: This retrospective study included 98 patients (62 males, 36 females) with idiopathic subjective tinnitus aged 21–86 years. Patients received four intratympanic methylprednisolone injections administered at 3-day intervals. The Tinnitus Degree Index (TDI) and audiologic assessments were performed before treatment and 2 weeks after the fourth injection.

Results: The mean tinnitus duration was 4.79 ± 5.54 years. The mean TDI score decreased significantly after intratympanic steroid injection in both men and women ($p < 0.05$). Greater improvement (post-treatment minus pre-treatment TDI) was observed in patients with shorter tinnitus duration ($p < 0.05$). Pure-tone thresholds did not change significantly after treatment in either ear ($p > 0.05$).

Conclusions: Intratympanic methylprednisolone injection may reduce tinnitus severity, particularly in patients with relatively shorter tinnitus duration.

Keywords: tinnitus; intratympanic injection; methylprednisolone; steroid

ÖZ

Amaç: Uzun süreli medikal tedaviye yanıt vermeyen tinnitus hastalarında intratimpanik steroid enjeksiyonunun etkisini değerlendirmek.

Gereç ve Yöntem: Bu retrospektif çalışmaya 21–86 yaş aralığında idiyopatik subjektif tinnituslu 98 hasta (62 erkek, 36 kadın) dahil edildi. Hastalara 3 gün arayla toplam dört intratimpanik metilprednizolon enjeksiyonu uygulandı. Tinnitus şiddeti Tinnitus Derece İndeksi (TDI) ile, odyolojik değerlendirmeler ise tedavi öncesi ve dördüncü enjeksiyondan 2 hafta sonra yapıldı.

Bulgular: Ortalama tinnitus süresi 4,79 ± 5,54 yıl idi. İntratimpanik steroid enjeksiyonu sonrası hem erkeklerde hem kadınlarda ortalama TDI skoru anlamlı düzeyde azaldı ($p < 0,05$). Tinnitus süresi ile TDI'daki değişim (tedavi sonrası − tedavi öncesi) arasındaki analizde, daha kısa tinnitus süresi olan hastalarda iyileşmenin daha belirgin olduğu görüldü ($p < 0,05$). Saf ses odyometrisinde tedavi sonrası her iki kulakta da işitme eşikleri açısından anlamlı bir değişiklik saptanmadı ($p > 0,05$).

Sonuç: İntratimpanik metilprednizolon enjeksiyonu, özellikle tinnitus süresi görece kısa olan hastalarda tinnitus şiddetini azaltmada etkili bir seçenek olabilir.

Anahtar Kelimeler: tinnitus; intratimpanik enjeksiyon; metilprednizolon; steroid

Highlights

- Intratympanic methylprednisolone significantly reduces tinnitus severity in patients refractory to long-term medical therapy.
- Treatment efficacy is greater in patients with a shorter duration of tinnitus.
- No significant changes were observed in pure-tone audiometric thresholds after treatment.

Introduction

Tinnitus can be defined as the perception of sound in the absence of an external sound source (1). Subjective tinnitus is the most common form of tinnitus and is reported to affect approximately 10% of the general population and up to 33% of older adults (2,3). The cochlea is considered the most common site of origin of subjective tinnitus; however, disorders at other levels of the auditory pathway may also be responsible (2).

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Tinnitus may cause emotional and physical distress and is frequently accompanied by symptoms such as anxiety, depression, irritability, hearing impairment, hyperacusis, insomnia, and impaired concentration. In addition, severe depression may exacerbate tinnitus (4).
Multiple treatments and medications—including dietary modifications, patient education, vitamin supplements, anxiolytics, antidepressants, herbal medicines, and intratympanic steroid injection—have been used for the management of subjective tinnitus. (2,5,6) The safety of intratympanic steroid injection has been demonstrated in inner ear conditions such as sudden sensorineural hearing loss, Meniere's disease, and acoustic trauma (7). Steroids injected into the middle ear can penetrate the round window membrane and diffuse into inner ear fluids (1,8,9). Several previous studies have suggested potential benefit of intratympanic steroid injection in tinnitus (10,11). In the present study, we evaluated the effects of intratympanic steroid administration on tinnitus severity and hearing thresholds in patients with subjective tinnitus who did not respond to other treatments.

Material and Methods

Study Design and Participants

Between January 2020 and November 2023, 98 patients with idiopathic subjective tinnitus who presented to the Otolaryngology Department of a tertiary care university hospital were included. All patients reported unilateral, persistent tinnitus for at least 6 months and had previously received oral betahistine dihydrochloride without improvement in tinnitus symptoms. Tinnitus lasting longer than 6 months was defined as prolonged tinnitus. After assessment of tinnitus characteristics and duration and review of medical history, all patients underwent a comprehensive otolaryngologic examination. Otomicroscopy and pure-tone audiometry were performed to evaluate possible otologic conditions associated with tinnitus and to assess hearing thresholds. Patients with otitis media, otitis externa, otosclerosis, Ménière's disease, objective tinnitus, profound hearing loss, head trauma, ongoing systemic steroid therapy, acute tinnitus, or tinnitus duration of less than 6 months were excluded.

Intratympanic steroid injection protocol

After topical anesthesia with lidocaine spray via the external auditory canal, patients were placed supine with the head turned approximately 45° to the contralateral side. Using a 25-gauge needle, 0.5 mL of methylprednisolone solution was injected into the posteroinferior quadrant of the tympanic membrane. Patients remained in the same position for approximately 20 minutes. Injections were administered every 3 days for a total of four sessions.

Outcome measures

Tinnitus severity was assessed using a 12-item Tinnitus Degree Index (TDI) questionnaire administered before treatment and 2 weeks after the fourth injection. Each item was scored on a 5-point Likert scale (1 = never, 5 = always), yielding a total score range of 12–60. Severity was categorized as very mild (1–12), mild (13–24), moderate (25–36), severe (37–48), and catastrophic (49–60) **(Table 1)** (12). Hearing thresholds were assessed by pure-tone audiometry before and after treatment, and mean pure-tone thresholds were compared between time points. Procedure-related adverse events (e.g., otalgia and dizziness) were recorded from follow-up notes.

Statistical analysis

All statistical analyses were performed using IBM SPSS Statistics (version 22.0; IBM Corp., Armonk, NY, USA). Normality of continuous variables was assessed using the Kolmogorov–Smirnov test. Continuous variables are presented as mean ± standard deviation (SD). Pre and post-treatment comparisons of continuous outcomes (TDI score and mean pure-tone thresholds) were performed using paired tests (paired t-test for normally distributed variables and Wilcoxon signed-rank test for non-normally distributed variables. The association between tinnitus duration and change in TDI (post-treatment minus pre-treatment) was assessed using Spearman's correlation coefficient. A p value of < 0.05 was considered statistically significant.

Ethical Approval

Patient records were reviewed retrospectively. The declaration of Helsinki recommendations was followed for the conduct of the study. Akdeniz University Faculty of Medicine Clinical Research Ethics Committee approval was obtained (KAEK-865, Date:15.11.2023)

Table 1. Tinnitus Degree Index (items and scoring).

Item	Question	Never (1)	Rarely (2)	Sometimes (3)	Often (4)	Always (5)
1	Does tinnitus make you feel uncomfortable or irritable?	1	2	3	4	5
2	Does tinnitus make you feel tired or stressed?	1	2	3	4	5
3	Does tinnitus make it difficult for you to relax?	1	2	3	4	5
4	Does tinnitus make you feel uncomfortable in silence?	1	2	3	4	5
5	Does tinnitus disturb your concentration?	1	2	3	4	5
6	Does tinnitus make it difficult to maintain satisfactory relationships with those around you?	1	2	3	4	5
7	Does tinnitus affect your performance at home, at work, or in other settings?	1	2	3	4	5
8	Does tinnitus affect your social life and leisure activities?	1	2	3	4	5
9	Does tinnitus affect your enjoyment of life in general?	1	2	3	4	5
10	Does tinnitus affect your ability to fall asleep?	1	2	3	4	5
11	How often do you find it difficult to ignore tinnitus?	1	2	3	4	5
12	How often are you bothered by tinnitus?	1	2	3	4	5

Results

A total of 98 patients were included in the study; 62 were male and 36 were female. The mean age was 53.7 ± 13.5 years. Tinnitus duration ranged from 6 months to 30 years, with a mean duration of 4.79 ± 5.54 years. Demographic characteristics are presented in **(Table 2).**

Table 2. Demographic characteristics of the patients

Variable	Female (n=36)	Male (n=62)	Total (n=98)
Age (years), range	36–86	21–85	21–86
Age (years), mean ± SD	57.06 ± 11.12	51.56 ± 14.37	53.70 ± 13.52
Smoking, n (Yes/No)	6/30	24/38	30/68
Tinnitus duration (years), range	0.5–30	0.5–30	0.5–30
Tinnitus duration (years), mean ± SD	5.20 ± 5.75	4.55 ± 5.47	4.79 ± 5.54

Before intratympanic steroid treatment, tinnitus severity was most frequently classified as moderate (36%) and severe (51%) **(Figure 1).**

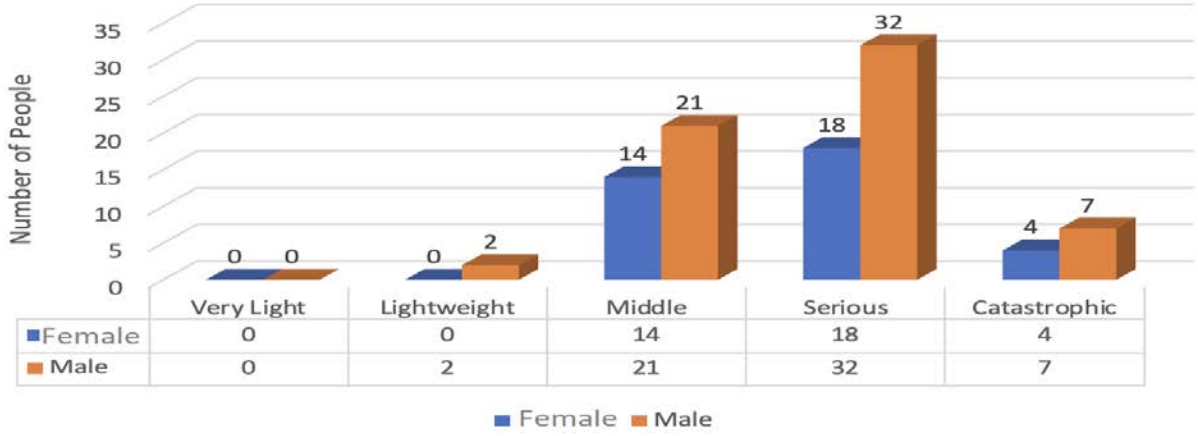

Figure 1. Distribution of tinnitus severity categories based on the Tinnitus Degree Index (TDI) before intratympanic steroid treatment.

After treatment, tinnitus severity was most frequently classified as mild (32%) and moderate (46%) **(Figure 2).**

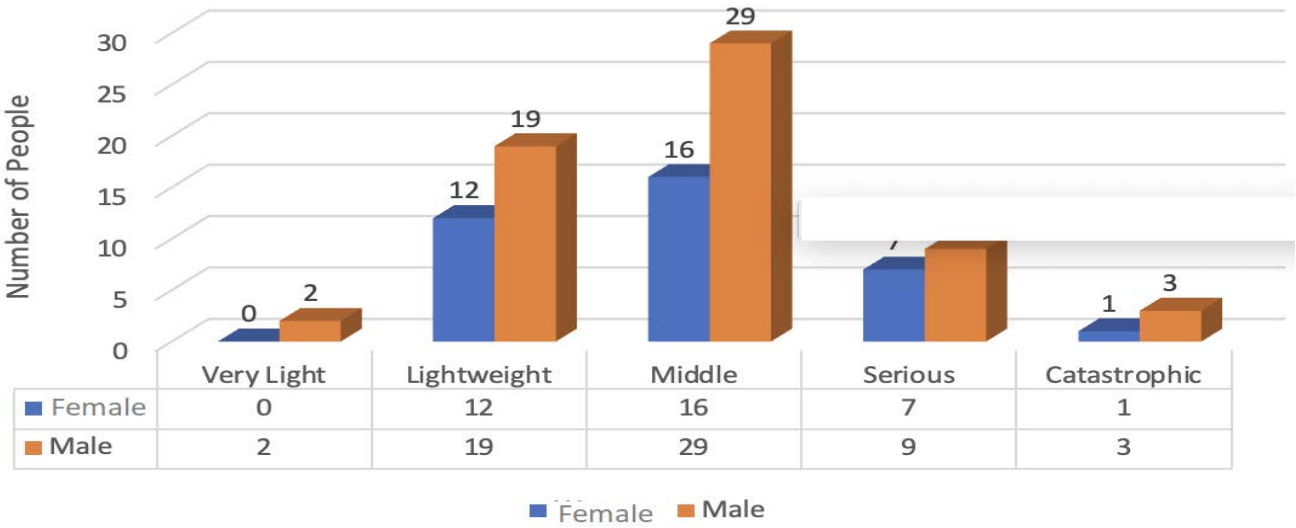

Figure 2. Distribution of tinnitus severity categories based on the Tinnitus Degree Index (TDI) after intratympanic steroid treatment.

Following intratympanic steroid injection, the mean Tinnitus Degree Index score decreased significantly ($p < 0.05$) in both men and women **(Figure 3).**

Figure 3. Comparison of mean TDI scores before and after intratympanic steroid treatment.

Mean pure-tone thresholds before and after intratympanic steroid treatment did not differ significantly for either the right or left ear ($p > 0.05$) **(Table 3).**

Table 3. Mean pure-tone thresholds before and after intratympanic steroid treatment

Ear	Time point	Range	Mean ± SD	p*
Right ear	Pre-treatment	10–65	27.55 ± 15.12	0.067
Right ear	Post-treatment	10–65	26.78 ± 14.38	
Left ear	Pre-treatment	10–70	27.60 ± 15.34	0.066
Left ear	Post-treatment	10–70	26.63 ± 15.28	

* p values represent pre- vs post-treatment comparisons within the same ear (paired analysis).

After intratympanic steroid injection, 11 of 98 patients reported mild otalgia and 9 reported transient dizziness. These complaints resolved spontaneously during follow-up.

Discussion

Tinnitus is a common otologic symptom that can significantly impair quality of life and may lead to social and psychological problems. The main management options include hearing aids with sound therapy/masking features, tinnitus retraining therapy, and various oral medications with limited or inconsistent efficacy. Although tinnitus retraining therapy is considered one of the treatment modalities with the most favorable outcomes, many patients continue to use oral medications. Importantly, none of these approaches is completely effective for all patients (13). Intratympanic therapy is a local treatment option used in inner ear disorders, in which various agents are delivered into the middle ear. It has been used for sudden sensorineural hearing loss, Ménière's disease, tinnitus associated with these disorders, and idiopathic tinnitus (5,10,14–16). The present study was conducted to evaluate the effect of intratympanic steroid treatment on tinnitus severity. Our findings suggest that intratympanic steroid treatment may reduce tinnitus severity, particularly in patients with shorter tinnitus duration.

Steroids injected intratympanically into the middle ear may penetrate the round window membrane and diffuse into inner ear fluids, exerting anti-inflammatory and electrolyte-modulating effects via steroid receptors (17). Although the exact mechanism remains unclear, proposed mechanisms include suppression of abnormal sensory cell excitability or hypersensitivity in the inner ear, reduction of immune-mediated/autoimmune inflammation, direct effects on the cochlear neuroepithelium, and increased cochlear blood flow (18). Nevertheless, the clinical effectiveness of intratympanic steroid injection for tinnitus has not been definitively established.

A major advantage of intratympanic steroid injections is the ability to achieve high local concentrations in the inner ear while minimizing systemic adverse effects. Seong reported no difference between intratympanic steroid and saline injections in tinnitus treatment within 6 months of symptom onset, suggesting that the indication for intratympanic steroid injection should be limited to selected cases (13). In contrast, Yener compared intratympanic dexamethasone with isotonic solution in tinnitus cases refractory to medical treatment and found a statistically significant therapeutic effect on tinnitus severity at the 1st and 6th months (19). Cesarani reported complete improvement in 34% of patients, significant improvement in 40%, and no change in 26% following intratympanic steroid treatment. The authors suggested that intratympanic steroid injections are more effective in acute tinnitus but less effective in chronic tinnitus (10). In our study, tinnitus severity was predominantly moderate (36%) and severe (51%) before treatment, whereas it was predominantly mild (32%) and moderate (46%) after intratympanic steroid treatment.

Sakata reported that intratympanic dexamethasone reduced symptoms in 77% of patients immediately and in 68% at 6 months, with no association between age and treatment efficacy (20). Shulman reported that intratympanic steroid treatment alleviated tinnitus perception in approximately 70% of patients with predominantly cochlear-type tinnitus in both the short and long term (21). The authors emphasized that factors potentially influencing efficacy include injection frequency and duration, tinnitus duration, and fibrosis or ossification of the round window membrane. It has also been suggested that tinnitus duration may be one of the most important determinants of response, with reduced efficacy in patients with longer tinnitus duration (22). Cesarani reported better outcomes when treatment was initiated within 3 months of the onset of subjective idiopathic tinnitus (10). Shim analyzed factors associated with cure rates and found that the time from symptom onset to treatment initiation was the only factor correlated with cure in acute subjective idiopathic tinnitus (23). Similarly, Sakata reported that treatment efficacy tended to decrease as the duration of tinnitus increased (11). In our study, the mean tinnitus duration was 57.48 months, and the reduction in TDI was statistically significant. Moreover, analysis of the relationship between the change in TDI and tinnitus duration suggested greater improvement among patients treated earlier after symptom onset. In the present study, only early outcomes were evaluated, and age was not included in the analysis. These findings suggest that early intratympanic steroid injection may be considered in patients who do not respond to conventional management.

Yener reported no difference in pure-tone hearing levels before and after intratympanic steroid treatment in tinnitus patients (19). Similarly, we found no significant change in pure-tone thresholds after treatment. Araújo reported minimal adverse effects, including mild dizziness and otalgia, which resolved spontaneously after intratympanic steroid injections (14). In our study, transient otalgia and dizziness were observed and resolved during follow-up. No serious complications were observed, suggesting that intratympanic steroid injections may be a safe option for selected tinnitus patients.

Overall, our findings indicate that intratympanic steroid therapy may be an effective alternative in patients with tinnitus who do not respond to conventional treatments, and that better outcomes may be associated with earlier treatment initiation. This study has several limitations. The retrospective design and the absence of a control group

limit causal inference. In addition, the effects of age were not evaluated and long-term outcomes were not assessed. Nevertheless, our findings may inform the design of future prospective, randomized, placebo-controlled, double-blind studies.

Limitations

Larger sample size and multicenter trials are required to validate the findings and improve the generalizability of the study.

Conclusion

In this study, intratympanic methylprednisolone was administered to patients with idiopathic subjective tinnitus who did not improve despite conventional management. Intratympanic steroid therapy was associated with a statistically significant reduction in tinnitus severity without significant changes in hearing thresholds. These results suggest that intratympanic steroid injection may be considered for selected patients, particularly when initiated earlier after symptom onset. Further prospective, randomized, placebo-controlled studies with standardized outcome measures and longer follow-up are warranted.

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Ethical Approval: *Patient records were reviewed retrospectively. Akdeniz University Faculty of Medicine Clinical Research Ethics Committee approval was obtained (KAEK-865, Date:15.11.2023)*

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Data Availability: *The data used to support the findings of this study are available from the corresponding author upon request*

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