RESEARCH ARTICLE

Araştırma Makalesi

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Effect of Comorbid Conditions on Prognosis in Adult Patients with Idiopathic Sudden Sensorineural Hearing Loss

İdiyopatik Ani Sensörinöral İşitme Kayıplı Erişkin Hastalarda Komorbid Durumların Prognoz Üzerine Etkisi

ABSTRACT

Objective

To determine the effects of type 2 diabetes mellitus (DM) and primary (essential) hypertension (HT) on the prognosis of idiopathic sudden sensorineural hearing loss (ISSNHL).

Materials and Methods

Medical records of 160 patients treated with ISSNHL at our clinic between January 1, 2017, and December 31, 2019, were retrospectively reviewed using the hospital information system. Patients were categorized into four groups based on the presence or absence of comorbid conditions: control group, DM, HT, and both DM and HT. Prognosis was evaluated using Siegel's criteria.

Results

According to Siegel's criteria, there was no statistically significant difference in recovery rates or hearing gains between the control group and the comorbidity groups. However, both the initial and final hearing threshold levels were significantly higher in patients with comorbidities compared to the control group.

Conclusion

Hearing gains and recovery rates following treatment were comparable between patients with comorbidities (DM and/or HT) and those without. However, both the initial and final hearing thresholds were significantly elevated in the comorbidity groups.

Keywords

Essential hypertension, Sudden hearing loss, Type 2 diabetes mellitus

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ÖZ

Amaç

Tip 2 diabetes mellitus (DM) ve primer (esansiyel) hipertansiyon (HT) hastalıklarının idiyopatik ani sensörinöral işitme kaybı (İASİK) prognozu üzerindeki etkilerini belirlemek.

Gereç ve Yöntemler

Kliniğimizde, 1 Ocak 2017- 31 Aralık 2019 tarihleri arasında İASİK tanısı ile tedavi edilen 160 hastanın kayıtları, hastane bilgi sistemi üzerinden retrospektif olarak incelendi. Hastalar, komorbidite varlığına göre dört gruba ayrıldı: kontrol grubu, DM grubu, HT grubu ve DM + HT grubu. Prognoz değerlendirmesinde Siegel kriterleri kullanıldı.

Bulgular

Siegel kriterlerine göre, kontrol grubu ile diğer gruplar arasında iyileşme düzeyleri açısından anlamlı bir fark saptanmadı. Gruplar arasında işitme kazançları açısından da istatistiksel olarak anlamlı bir fark bulunmadı. Ancak, komorbid hastalıkları bulunan hasta gruplarında tedavi öncesi işitme eşik değerleri kontrol grubuna kıyasla anlamlı olarak daha yüksek bulundu ve bu fark tedavi sonrası nihai işitme eşik değerlerinde de devam etti.

Sonuçlar

Tip 2 diabetes mellitus ve esansiyel hipertansiyon tanılı İASİK hastalarında tedavi sonrası işitme kazançları ve iyileşme düzeyleri, komorbiditesi bulunmayan hasta grubu ile benzerdir. Bununla birlikte, bu hastaların tedavi başlangıcındaki ve sonundaki işitme eşik değerleri, komorbiditesi bulunmayan hastalara kıyasla anlamlı derecede yüksektir.

Anahtar Kelimeler

Esansiyel hipertansiyon, Ani işitme kaybı, Tip 2 diabetes mellitus

INTRODUCTION

Idiopathic sudden sensorineural hearing loss (ISSNHL) is a rapidly developing clinical condition requiring immediate diagnosis and treatment within 72 hours, often causing significant anxiety and fear in patients. It is diagnosed through pure tone audiometry, which reveals a loss of 30 decibels (dB) or more in bone conduction thresholds across three consecutive frequencies (1). The incidence is equal in both men and women, and both ears are equally affected (2). Although it can be seen in all age groups, it primarily affects individuals between 40 and 50 years of age. The annual incidence is reported to be 5-27 per 100,000 (3).

Regardless of treatment, up to 65% of patients may experience spontaneous recovery (4). The goal of treatment is to reduce the inflammation believed to occur in the inner ear during the disease process and improve cochlear perfusion and oxygenation (5). Many agents have been investigated for treatment, including anti-inflammatory agents, antimicrobials, calcium channel antagonists, vitamins, essential minerals, vasodilators, volume expanders, diuretics, and hyperbaric oxygen therapy. Corticosteroids are the most commonly used agents in treatment, with their probable effect being to reduce inflammation and edema in the inner ear (6). With the widespread use of steroids, recovery rates have increased, reaching up to 89% (7).

Four main theories have been proposed to explain the disease's pathophysiology, based on vascular, viral, immunological, and rupture-related causes of the cochlear membranes. Cochlear hypoperfusion is among the leading proposed mechanisms. The cochlea has a vascular bed without collateral vessels, and cochlear hair cells are metabolically active, making them vulnerable to ischemic damage (8).

Discussions on factors predicting recovery continue. Older age, longer duration from the onset of symptoms to the initiation of treatment, hearing loss primarily at high frequencies [descending audiogram], greater degree of initial hearing loss, and the presence of vestibular symptoms are known to negatively affect prognosis (5).

The effect of comorbid conditions, especially type 2 diabetes mellitus (DM) and essential hypertension (HT), on auditory outcomes remains unclear (5). While some studies identify these conditions as poor prognostic factors, others have found no significant impact on prognosis (9-11).

This study aimed to investigate the separate and combined effects of these two comorbid conditions on ISSNHL prognosis, especially since their exact impact on prognosis has not yet been fully determined.

MATERIAL and METHODS

This study was approved by the Ethics Committee of the University of Health Sciences, Izmir Bozyaka Health Practice and Research Center Hospital (Approval No: 15345988-13, dated July 6, 2020).

Patient Selection

A total of 160 patients who were hospitalized with a diagnosis of idiopathic sudden sensorineural hearing loss (ISSNHL) in the Ear, Nose, and Throat Department between January 1, 2017, and December 31, 2019, were included in the study. Medical records and electronic health system data were reviewed retrospectively.

Inclusion Criteria

Patients aged 18-65 with a decline of 30 dB or more in bone conduction hearing thresholds at three consecutive frequencies within three days in pure-tone audiogram, no history of ear surgery in the affected ear, no prior history of ISSNHL, no 8th cranial nerve pathology detected on magnetic resonance imaging (MRI), and normal hearing levels in the opposite ear were included in the study.

Exclusion Criteria

Patients were excluded if they had a preliminary diagnosis of Meniere's disease, a history of herpes zoster oticus, hearing loss secondary to noise exposure or barotrauma, or evidence of 8th cranial nerve pathology on MRI. Pregnant patients and those with known inner ear pathologies were also excluded. Additionally, patients with chronic systemic comorbidities other than diabetes mellitus (DM) and/or essential hypertension (HT) were not included in the study. This study specifically aimed to investigate the independent and combined effects of DM and HT on the prognosis of ISSNHL. Therefore, other systemic diseases (e.g., hyperlipidemia, coronary artery disease, chronic obstructive pulmonary disease) were excluded to minimize confounding variables and maintain a more homogeneous patient population.

Study Design

After identifying patients who met the inclusion criteria, a retrospective review was conducted using the hospital's electronic medical record system and document archive. Demographic and clinical data—including age, sex, affected side, time from symptom onset to treatment, presence of tinnitus or vestibular symptoms, administered treatments, and the type and degree of hearing loss determined by pure-tone audiometry-were recorded.

Audiometric configurations were categorized into three types: descending, flat, and ascending. This classification was based on a >20 dB difference between low frequencies (500–1000 Hz) and high frequencies (2000–4000 Hz).

Patients were then categorized into four groups: (1) Control group—patients without comorbidities; (2) DM group—patients with diabetes mellitus; (3) HT group- patients with hypertension; and (4) DM+HT group-patients with both comorbidities.

Hearing loss severity was classified into five categories according to the American Speech-Language-Hearing Association: mild (20–39 dB), moderate (40–54 dB), moderately severe (55–69 dB), severe (70–89 dB), and profound (>89 dB). Pre- and post-treatment (one month after treatment) audiometry results were obtained from the hospital system, and prognosis was assessed using Siegel's criteria (Table I).

Table I. Siegel Criteria

Complete Recovery	Patients with a post-treatment hearing level better than 25 dB
Marked Improvement	Patients with more than 15 dB hearing gain and post-treatment hearing level between 25-45 dB
Mild Improvement	Patients with more than 15 dB hearing gain but post-treatment hearing level worse than 45 dB
No Improvement	Patients with less than 15 dB hearing gain and post-treatment hearing level worse than 75 dB

According to the 2017 guidelines of the American Heart Association, patients with a diagnosis of essential hypertension or receiving antihypertensive medication were considered to have HT. Likewise, patients diagnosed with type 2 diabetes mellitus based on the 2019 guidelines of the American Diabetes Association, or those treated with oral antidiabetics or insulin, were classified as having DM. Due to the retrospective design of the study, clinical parameters such as HbA1c levels, fasting glucose, or blood pressure measurements were not consistently available. As a result, the control status of DM or HT could not be assessed.

Treatment Protocol

Medical management was carried out in accordance with the ISSNHL treatment protocol implemented in our otorhinolaryngology clinic since 2017. The protocol consists of the following steps:

1. Patients with an average hearing threshold (mean of 500, 1000, 2000, and 4000 Hz) better than 40 dB and without poor prognostic criteria received a standard dose of systemic steroids (1 mg/kg/day methylprednisolone).
2. Patients with a threshold better than 40 dB but with poor prognostic indicators were treated with a high dose of steroids (250 mg/day methylprednisolone for 3 days).
3. If no improvement (>10 dB gain) was observed on the 3rd-day follow-up audiometry in patients initially treated as per steps 1 or 2, hyperbaric oxygen therapy (HBOT) was initiated. If there was still no response by the 7th day, transtympanic steroid injection was administered.
4. Patients with an initial threshold worse than 40 dB were treated with systemic steroids in combination with HBOT.
5. Patients with thresholds worse than 40 dB and presenting poor prognostic indicators received high-dose steroids plus HBOT as initial therapy.
6. If no improvement was observed on 3rd-day audiometry after treatment according to steps 4 or 5, transtympanic therapy was added.
7. Patients with a recent history (within the past week) of viral upper respiratory tract infection were also treated with antiviral agents.
8. Poor prognostic indicators were defined as: (a) age over 50 years, (b) presence of vertigo, and (c) initiation of treatment more than 3 days after symptom onset.

Statistical Analysis

Descriptive statistics were presented as means and standard deviations for continuous variables, and as frequencies and percentages for categorical variables.

The normality of continuous variables was assessed using the Kolmogorov–Smirnov test. As the final hearing threshold showed a normal distribution, group differences were evaluated using one-way analysis of variance (ANOVA), followed by Duncan's multiple comparison test. Results were reported as means ± standard errors.

Since the hearing gain variable did not follow a normal distribution, comparisons between groups were conducted using the non-parametric Kruskal–Wallis test. Hearing gain was expressed using mean ranks, arithmetic means, and standard deviations.

Associations between categorical variables were analyzed using the Chi-square test.

In addition, a multivariate linear regression analysis was performed to assess the independent effects of comorbidities and clinical variables on the final hearing threshold. Variables included in the model were age, comorbidity group (Control, DM, HT, DM+HT), presence of vertigo, tinnitus, and treatment delay. Beta coefficients (β) and p-values were reported. The presence of vertigo was found to be significantly associated with poorer hearing outcomes. Statistical significance was set at $p < 0.05$.

All analyses were performed using IBM SPSS Statistics for Windows, Version 25.0 (IBM Corp., Armonk, NY, USA).

RESULTS

A total of 160 patients were included in the study (Table II). The mean age was 48.8 ± 12.4 years (range: 18–65), with a nearly equal gender distribution: 81 patients (50.6%) were male and 79 patients (49.4%) were female. The right ear was affected in 69 patients (43.1%), while the left ear was involved in 91 patients (56.9%). The mean duration from the onset of symptoms to the initiation of treatment was 8.7 ± 6.9 days (range: 1–30 days).

Regarding associated symptoms, vertigo was absent in 131 patients (81.9%) and present in 29 patients (18.1%). Tinnitus was reported in 117 patients (73.1%), while 43 patients (26.9%) did not experience tinnitus. In terms of audiogram configuration, 40 patients (25%) had a descending audiogram, 99 patients (61.9%) had a flat audiogram, and 21 patients (13.1%) had an ascending audiogram.

The overall mean pure-tone average (PTA) at initial presentation was 65.3 ± 25.3 dB (range: 36.25–118.5 dB). The group-specific mean PTA values at admission were as follows: 62.7 ± 26.0 dB in the control group (range: 36.25–118.5 dB), 65.1 ± 25.4 dB in the DM group (range: 36.25–113.75 dB), 69.0 ± 23.1 dB in the HT group (range: 38.75–103.75 dB), and 68.3 ± 26.3 dB in the DM-HT group (range: 38.75–108.75 dB). The initial hearing thresholds in all comorbidity groups were significantly higher than those in the control group ($p < 0.05$).

At presentation, 27 patients (17.1%) had mild hearing loss, 35 (22.2%) had moderate loss, 33 (20.9%) had moderately severe loss, 36 (22.8%) had severe loss, and 27 (17.1%) had profound hearing loss.

At the 1-month post-treatment follow-up, the mean air-conduction PTA in the affected ear for the overall population was 47.1 ± 25.9 dB (range: 5–116.25 dB). The mean PTA was 40.2 ± 26.1 dB in the control group (range: 5–116.25 dB), 52.7 ± 25.5 dB in the DM group (range: 7.5–102.5 dB), 54.5 ± 25.1 dB in the HT group (range: 10–83.75 dB), and 49.7 ± 23.3 dB in the DM-HT group (range: 20–100 dB).

The mean hearing gain across the entire cohort was 19.2 ± 20.5 dB (range: 0–107.5 dB). Hearing gain values by group were as follows: 22.6 ± 21.6 dB in the control group (range: 0–20 dB), 16.3 ± 23.6 dB in the DM group (range: 0–107.5 dB), 14.7 ± 16.3 dB in the HT group (range: 0–56.25 dB), and 19.1 ± 16.4 dB in the DM-HT group (range: 0–63.75 dB).

According to Siegel's criteria, no improvement was observed in 78 patients (48.8%), mild improvement in 27 patients (16.9%), partial improvement in 18 patients (11.3%), and complete recovery in 37 patients (23.1%) (Table III).

Table II. Demographic and Clinical Data of the Study Population

Variables	Control	DM	HT	DM-HT	Total
Mean Age	40.9 ± 11.5	53.6 ± 10.3	55.1 ± 9.0	56.4 ± 7.3	48.8 ± 12.4
Side Affected					
Right	31 (44.3%)	18 (52.9%)	14 (45.2%)	6 (24.0%)	69 (43.1%)
Left	39 (55.7%)	16 (47.1%)	17 (54.8%)	19 (76.0%)	91 (56.9%)
Gender					
Male	38 (54.3%)	17 (50.0%)	14 (45.2%)	12 (48.0%)	81 (50.6%)
Female	32 (45.7%)	17 (50.0%)	17 (54.8%)	13 (52.0%)	79 (49.4%)
Mean Time Until Treatment (days)	8.2 ± 6.8	9.2 ± 6.5	6.9 ± 5.9	11.4 ± 8.4	8.7 ± 6.9
Vertigo					
No	59 (84.3%)	28 (82.4%)	24 (77.4%)	20 (80.0%)	131 (81.9%)
Yes	11 (15.7%)	6 (17.6%)	7 (22.6%)	5 (20.0%)	29 (18.1%)
Tinnitus					
No	20 (28.6%)	6 (17.6%)	8 (25.8%)	9 (36.0%)	43 (26.9%)
Yes	50 (71.4%)	28 (82.4%)	23 (74.2%)	16 (64.0%)	117 (73.1%)
Hearing Loss Type on Audiogram					
Descending	15 (21.4%)	8 (23.5%)	9 (29.0%)	8 (32.0%)	40 (25.0%)
Flat	45 (64.3%)	20 (58.8%)	18 (58.1%)	16 (64.0%)	99 (61.9%)
Ascending	10 (14.3%)	6 (17.6%)	4 (12.9%)	1 (4.0%)	21 (13.1%)
Initial Pure Tone Average (dB)	62.7 ± 26.0	65.12 ± 25.4	69.0 ± 23.1	68.3 ± 26.3	65.3 ± 25.3
Variables	**Control**	**DM**	**HT**	**DM-HT**	**Total**
Degree of Hearing Loss at Presentation					
Mild	14 (20.0%)	4 (11.8%)	4 (13.3%)	5 (20.8%)	27 (17.1%)
Moderate	17 (24.3%)	12 (35.3%)	4 (13.3%)	2 (8.3%)	35 (22.2%)
Moderate-Severe	12 (17.1%)	6 (17.6%)	7 (23.3%)	8 (33.3%)	33 (20.9%)
Severe	17 (24.3%)	5 (14.7%)	11 (36.7%)	3 (12.5%)	36 (22.8%)
Profound	10 (14.3%)	7 (20.6%)	4 (13.3%)	6 (25.0%)	27 (17.1%)
Post-Treatment Pure Tone Average (dB)	40.2 ± 26.1	52.7 ± 25.5	54.5 ± 25.1	49.7 ± 23.3	47.1 ± 25.9
Mean Hearing Gain (dB)	22.6 ± 21.6	16.3 ± 23.6	14.7 ± 16.3	19.1 ± 16.4	19.2 ± 20.5

Table III. Overall Recovery Levels According to Siegel's Criteria

Recovery Level	Number of Patients	Percentage of Patients
No Recovery	78	48.8%
Slight Recovery	27	16.9%
Partial Recovery	18	11.3%
Complete Recovery	37	23.1%

Group-specific recovery outcomes based on Siegel's criteria were as follows:
• Control group: no improvement in 40 patients, mild in 14, partial in 7, complete recovery in 9.
• DM group: no improvement in 12, mild in 6, partial in 3, complete in 13.
• HT group: no improvement in 15, mild in 5, partial in 4, complete in 7.
• DM-HT group: no improvement in 11, mild in 2, partial in 4, complete in 8 (Table IV).

There were no statistically significant differences between the groups in terms of recovery rates based on Siegel's criteria ($p > 0.05$). A one-way analysis of variance (ANOVA) was used to compare the final hearing levels between groups (Table V).

The results indicated a statistically significant difference in final hearing thresholds among the groups ($p < 0.05$). Duncan's multiple comparison test revealed that patients in the DM, HT, and DM-HT groups had comparable final hearing levels, all significantly higher than those in the control group. Hearing gain comparisons between groups were evaluated using the non-parametric Kruskal–Wallis test. No statistically significant differences in hearing gain were observed among the groups ($p > 0.05$) (Table VI).

Table IV. Recovery Levels According to Siegel's Criteria Within Study Groups

Recovery Level	Control	DM	HT	DM-HT	p-value
	N (%)	N (%)	N (%)	N (%)	
No Recovery	40 (57.1%)	12 (35.3%)	15 (48.4%)	11 (44.0%)	
Slight Recovery	14 (20.0%)	6 (17.6%)	5 (16.1%)	2 (8.0%)	p = 0.168
Partial Recovery	7 (10.0%)	3 (8.8%)	4 (12.9%)	4 (16.0%)	
Complete Recovery	9 (12.9%)	13 (38.2%)	7 (22.6%)	8 (32.0%)	

Table V. Intergroup Comparison Based on Final Hearing Level

Group	Sample Size	Mean	Standard Error	p-value
Control	70	40.55	3.14	
DM (Diabetes Mellitus)	34	53.16	4.33	p = 0.026
HT (Hypertension)	31	54.54	4.51	
DM-HT (Diabetes Mellitus + Hypertension)	25	49.72	4.66	

Table VI. Intergroup Comparison Based on Hearing Gain

Group	Sample Size	Rank Mean	Mean	Standard Deviation	p-value
Control	70	87.67	22.6214	21.56616	
DM (Diabetes Mellitus)	34	68.59	16.3382	23.63067	
HT (Hypertension)	31	72.26	14.6694	16.32743	p = 0.142
DM-HT (Diabetes Mellitus + Hypertension)	25	86.84	19.1300	16.39965	

To assess the independent contributions of clinical factors to final hearing outcomes, a multivariate linear regression analysis was performed using the final PTA as the dependent variable. The model included age, comorbidity group (control, DM, HT, DM+HT), presence of vertigo, tinnitus, and treatment delay. Among these variables, only the presence of vertigo was independently associated with higher final hearing thresholds, indicating worse hearing outcomes (β = 10.87, p = 0.046). Age, tinnitus, comorbidity status, and treatment delay were not independently associated with final hearing levels (Table VII).

Table VII. Multivariate Linear Regression Analysis for Predictors of Final Hearing Threshold

Variable	Coefficient (β)	95% Confidence Interval	p-value
Intercept	35.76	9.23 to 62.28	0.009
Group: Only DM	4.61	-8.22 to 17.45	0.478
Group: Only HT	7.11	-5.92 to 20.14	0.282
Group: Control	-7.92	-21.22 to 5.38	0.241
Age (years)	0.16	-0.26 to 0.57	0.457
Vertigo (yes)	10.87	0.22 to 21.52	0.046
Tinnitus (yes)	-6.0	-15.29 to 3.29	0.203
Treatment delay (days)	0.39	-0.23 to 1.02	0.217

DISCUSSION

Idiopathic Sudden Sensorineural Hearing Loss (ISSNHL) has garnered substantial attention across various medical disciplines due to its unclear etiology and unpredictable prognosis (12). The difficulty in identifying a specific underlying cause suggests that ISSNHL likely results from diverse cochlear pathologies, such as viral infections, vascular abnormalities, intralabyrinthine membrane ruptures, or autoimmune inner ear disorders. Understanding prognostic factors in this multifactorial condition could provide clinicians with critical tools to better predict long-term auditory outcomes (13).

Several factors have been proposed as predictors of recovery in ISSNHL, including patient age, degree of initial hearing loss, accompanying symptoms (e.g., vertigo, tinnitus), audiogram configuration, delay in treatment initiation, hearing level in the unaffected ear, erythrocyte sedimentation rate, and the presence of metabolic comorbidities (14). Systemic conditions, particularly diabetes mellitus (DM) and hypertension (HT), may negatively impact prognosis by compromising the cochlear microvasculature (15). Although the pathogenesis of ISSNHL remains unclear, one prevailing theory posits that viral cochleitis triggers inflammation and vascular injury, resulting in acute microvascular insufficiency. This is supported by studies linking vascular and hematological abnormalities to impaired cochlear perfusion (16). Although tinnitus and the initial audiogram configuration were included in our multivariate regression model, they were not found to be significant predictors of final hearing threshold. This finding suggests that, within our cohort, these clinical features may not independently influence hearing recovery. However, due to sample size limitations, further research is warranted to clarify their prognostic value in ISSNHL.

Lin et al. (2005) reported significantly better hearing recovery in ISSNHL patients without diabetes compared to those with DM, attributing this to hyperglycemia-induced endothelial damage and microangiopathy (17). Similarly, Kaplan et al. and studies by Ohinata and Pruszewicz found poorer recovery in diabetic patients (15,18,19). Weng et al. highlighted the negative impact of hypertension, DM, and hyperlipidemia on prognosis, noting that nearly half of the diabetic patients presented with severe hearing loss and minimal recovery (9). In this study, 44.8% of the diabetic patients presented with severe hearing loss, and recovery was almost never complete. In contrast, Ceylan et al. (2007) and Weng et al. (2013) reported no significant relationship between comorbidities and recovery outcomes (10, 14). Duck et al. (2012) suggested a cumulative adverse effect of concurrent hypertension and diabetes ,while animal studies by Morizono and Paparella demonstrated cochlear damage with high-fat diets (20, 21). Yan-Yin and Yuan-Ping also found worsened outcomes in elderly patients with coexisting hypertension and dyslipidemia (22). Interestingly, Seo et al. observed that when controlling for age and initial hearing level, diabetes alone did not significantly affect auditory recovery (23). Additionally, Edizer et al. (2015) found a significant association between hypertension and poorer auditory outcomes, with hypertensive patients exhibiting lower recovery levels compared to non-hypertensive individuals (5).

In the present study, no statistically significant differences in hearing gain were observed between comorbidity groups when classified by Siegel's criteria. However, a significant difference in final hearing thresholds was noted. The DM, HT, and DM+HT groups exhibited higher final thresholds than the control group, which initially had better auditory scores. This discrepancy was attributed to higher baseline hearing loss in patients with comorbidities, suggesting that worse final thresholds may reflect initial severity rather than treatment response alone. Multivariate analysis confirmed vertigo as an independent prognostic factor, whereas comorbidities and other clinical variables were not significantly associated with final hearing levels. This suggests that baseline severity, rather than comorbidity per se, may have influenced outcomes. These results align with previous findings by Ceylan and Wen, which also failed to demonstrate a definitive prognostic role for comorbidities (10, 14).

Although a multivariate regression model was performed to adjust for key prognostic variables (age, vertigo, tinnitus, delay in treatment), specific treatment modalities (e.g., high-dose steroids, HBOT, intratympanic injections) were not included as independent variables due to protocol-based administration. Furthermore, although tinnitus and audiogram configuration were recorded and analyzed, they were not found to be independently associated with final hearing outcomes in the multivariate regression model. This may explain why no further emphasis was placed on these variables in the discussion. The lack of association might reflect a limited effect size or confounding by stronger predictors such as vertigo. Further studies with larger sample sizes are warranted to better explore the potential prognostic role of tinnitus and audiometric patterns in ISSNHL. Therefore, the potential influence of treatment heterogeneity was not directly assessed and should be considered a limitation of the study. The retrospective design of this study presents inherent limitations, particularly in the subjective evaluation of symptoms like tinnitus and vertigo. Moreover, the absence of data regarding glycemic and blood pressure control limits the interpretation of comorbidity impact. Since uncontrolled DM and HT may exert a more profound effect on cochlear perfusion, future prospective studies should assess disease control status to clarify these relationships.

Another important limitation of our study is the inability to evaluate the control status of diabetes mellitus and hypertension. Due to the retrospective nature of the study, key clinical parameters such as HbA1c levels, fasting glucose, or blood pressure measurements were not consistently recorded. Since poorly controlled DM or HT may exert a more detrimental effect on cochlear microcirculation, the absence of these data limits our ability to fully interpret the impact of these comorbidities on hearing outcomes. Future prospective studies should include objective measures of disease control to better clarify their prognostic significance in ISSNHL.

CONCLUSIONS

In this study, neither type 2 diabetes mellitus nor essential hypertension was found to significantly affect hearing recovery in patients with idiopathic sudden sensorineural hearing loss. While patients with these comorbidities had worse baseline and final hearing thresholds, recovery rates and hearing gains were comparable across all groups. These findings suggest that comorbid conditions may influence initial severity but not treatment response.

Ethics Committee Approval

This research complies with all the relevant national regulations, institutional policies and is in accordance with the tenets of the Helsinki Declaration, and has been approved by the Izmir Bozyaka Health Practice and Research Center Hospital Ethical Committee, (approval number: 15345988-13, dated July 6, 2020)

Informed Consent

All the participants' rights were protected and written informed consents were obtained before the procedures according to the Helsinki Declaration.

Author Contributions: Concept – U.E.; Design – U.E.; Supervision – T.Ç.; Resources – U.E., T.Ç.; Materials – U.E.; Data Collection and/or Processing - U.E., T.Ç.; Analysis and/ or Interpretation – U.E.,T.Ç.; Literature Search – U.E.; Writing Manuscript – U.E., T.Ç.; Critical Review – T.Ç.

Conflict of Interest

The authors have no conflict of interest to declare.

Financial Disclosure

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