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Psychological stress as a measure for treatment response prediction in idiopathic sudden hearing loss

Daeyoung Roh[a], Janet Ren Chao[b], Do Hoon Kim[a,*], Kyung Hee Yoon[a], Jae Hoon Jung[a], Chang Hyun Lee[a], Ji-Hyeon Shin[c], Min Jae Kim[d], Chan Hum Park[d], Jun Ho Lee[d,**]

[a] Department of Psychiatry, Hallym University College of Medicine, Chuncheon Sacred Heart Hospital, Chuncheon, Republic of Korea
[b] George Washington University, Washington D.C. 20037, USA
[c] Department of Otolaryngology-Head and Neck Surgery, College of Medicine, The Catholic University of Korea, Republic of Korea
[d] Department of Otorhinolaryngology and Head and Neck Surgery, Hallym University Medical Center, Chuncheon, Republic of Korea

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ABSTRACT

Objective: Early prediction of therapeutic outcomes could reduce exposure to ineffective treatments and optimize clinical outcomes. However, none of the known otologic predictors is amenable to therapeutic intervention for idiopathic sudden sensorineural hearing loss (ISSNHL). The aims of this study were to investigate psychological stress as a potential predictor to discriminate outcomes in ISSNHL.

Methods: Various psychological measures were conducted including structured interview assessment tools in patients with recently diagnosed ISSNHL before initiating treatment. Using logistic regression analysis, we identified the predictors of treatment response and estimated the probability of treatment response in 50 ISSNHL patients who participated in a clinical trial.

Results: Treatment non-responders were significantly differentiated from responders by various psychological problems. The depression subscore of Modified form of Stress Response Inventory (SRI-MF) ($p = 0.007$) and duration of hearing loss ($p = 0.045$) significantly predicted treatment response after controlling other clinical correlates. The same predictors were identified from different treatment response measured using Siegel's criteria. The most discriminative measure for treatment response was SRI-MF depression score with an overall classification accuracy of 73%.

Conclusions: We found depressive stress response to be the strong predictor of treatment response in patients with ISSNHL. Our results highlight the potential use of the psychiatric approach as a tool for enhancing therapeutic outcomes. Future stress intervention studies with larger number of ISSNHL patients are needed.

1. Introduction

Idiopathic sudden sensorineural hearing loss (ISSNHL) is a rapid hearing loss of > 30 dB at three different frequencies at least, over 3 days or less [1]. The global incidence of ISSNHL is quoted to be between 5 and 20 out of every 100,000 individuals [2]. To date, many approaches have been tried to treat ISSNHL; however, none have proven consistently successful. One reason is the ambiguous pathogenesis of the disease process. Without a clear understanding of the etiology and pathogenesis of ISSNHL, devising new and effective treatments for ISSNHL in the future will be difficult.

Several studies have reported prognostic factors for ISSNHL including age, the presence or absence of vertigo, the type and severity of hearing loss, the shape of audiogram, and the time from symptoms to the initiation of treatment [3–6]. However, none of these factors is amenable to therapeutic intervention. Psychological factors are also considered to be one of the prognostic factors of ISSNHL. ISSNHL has been reported to be associated with emotional or psychological strain [7,8]. According to previous reports, lifestyle stress can play a role in pathophysiological mechanisms of ISSNHL [9]. In a recent population-based cohort study, depression, the most common stress-related disorder, was considered a risk factor for sudden sensorineural hearing loss [10].

The exact pathophysiology of the influence of psychosocial stress

* Correspondence to: Do Hoon Kim, Department of Psychiatry, Hallym University College of Medicine, Chuncheon Sacred Heart Hospital, 153, Kyo-Dong, Chuncheon, Kangwon, 200-704, Republic of Korea.
** Correspondence to: Jun Ho Lee, Department of Otorhinolaryngology-Head and Neck Surgery, Chuncheon Sacred Heart Hospital, Hallym University College of Medicine, 153, Kyo-Dong, Chuncheon, Kangwon, 200-704, Republic of Korea.
E-mail addresses: dohkim@hallym.or.kr (D.H. Kim), zoonox@nate.com (J.H. Lee).

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remains to be verified, as does the temporal sequence of pathophysiological events. There are few reports regarding psychological burden related to ISSNHL [8,10,11]. However, to the best of our knowledge, no prior study with patients with ISSNHL has investigated their psychosocial measures and its association with treatment response or therapeutic prognosis. In addition, various psychological factors affecting treatment outcome have not been adequately considered in previous research.

Therefore, we aimed to investigate whether the psychological factors in patients are associated with the therapeutic hearing results. Specifically, we hypothesized that psychological stress level is a strong candidate for the prognostic factor of ISSNHL. Additionally, we investigated various psychological covariates, such as depression, anxiety, cognitive deficit, social support, and occupational functioning, likely to contribute to the therapeutic prognosis of ISSNHL.

2. Materials and methods

2.1. Study participants

We enrolled subjects who were diagnosed with ISSNHL. All patients presented at the department of otolaryngology-head and neck surgery in the general hospital and were evaluated with an initial and follow-up pure tone audiometry (PTA). We defined ISSNHL as a sensorineural hearing loss of at least 30 dB in three consecutive speech frequencies that occurred within the previous 3 days [12,13]. Patients with bilateral ISSNHL, a prior history of hearing loss, chronic otitis media, Meniere's disease, or a diagnosis of vestibular schwannoma on magnetic resonance imaging were excluded.

Patients were treated with oral prednisolone at a dose of 60 mg for 5 days with dose reductions of 20 mg every 2 days and an intratympanic steroid (0.3–0.4 cm^3, dexamethasone, 5 mg/mL) injection once daily for 6 days in inpatient settings. In addition, within the first 1 or 2 days after admission, their psychological status was evaluated through consultation with the psychiatry units in the same general hospital before initiating treatment. All of the enrolled patients agreed on the consultation for psychological assessment. The two patients who refused psychological testing were provided medical treatment but excluded from the present study. The institutional review board approved the study protocol (Ethics Approval number: 2016–39).

2.2. Hearing measures and definitions

PTA was performed to determine the severity and pattern of hearing loss. Hearing thresholds were obtained at the following frequencies: 500, 1000, 2000, and 3000 Hz. The PTA was determined by calculating the arithmetic mean of the 500, 1000, 2000, and 3000 Hz thresholds. Hearing recovery was determined by comparing the PTA at the initial exam with that at the follow-up exam. The hearing gain was represented by the absolute value of changes in the averaged hearing levels at 500, 1000, 2000, and 3000 Hz, as recommended by the Committee on Hearing and Equilibrium [14]. Post-treatment hearing outcomes were categorized into two groups: recovery and no recovery (the cutoff value for recovery was 15 dB at the 3-month follow-up). Additionally, the post-treatment hearing outcomes were categorized as complete recovery (patients whose final hearing level was better than 25 dB regardless of the size of the gain), partial recovery (patients who showed > 15 dB of gain and whose final hearing level was between 25 and 45 dB), slight recovery (patients who showed > 15 dB of gain and whose final hearing level was poorer than 45 dB), or no recovery (patients who showed < 15 dB of gain or whose final hearing level was poorer than 75 dB), according to Siegel's criteria [15]. Previously reported prognostic factors were also evaluated, including the patients' subjective sense of dizziness, age, duration between initial hearing loss and initiation of treatment, hearing loss pattern on pure tone audiogram, and hearing loss severity [3–6]. Patients were diagnosed with low-frequency sensorineural hearing loss if they showed average hearing loss > 30 dB at two consecutive low-frequency bands, 250 Hz and 500 Hz, on PTA; experienced onset of otologic symptoms before presentation; and had ≤ 25 dB of normal hearing at hearing thresholds of 1, 2, 3, 4, and 8 kHz.

2.3. Psychological measures

Various psychological features that might be related to stress were quantitatively measured to minimize the confounding factors.

The level of depression and anxiety were assessed using structured interview questionnaires, such as Korean version of Hamilton Rating Scale for Depression (HAM-D) [16,17] and Hamilton Anxiety Rating Scale (HAM-A) [18,19] by an experienced psychologist under the supervision of a senior psychiatrist. Stress levels were assessed with self-reported questionnaires: Modified form (SRI-MF, three subscales of somatization, depression, and anger) [20] of Stress Response Inventory [21]. Perceived cognitive deficit and fatigue level were measured using Korean version of the Perceived Deficit Questionnaire-Depression (PDQ-D) [22,23] and Brief Fatigue Inventory (BFI-10) [24,25] respectively. Functional impairment in everyday life was measured using Korean version of the Sheehan Disability Scale (SDS) [26,27].

Additional self-reported scales applied to the participants are as follows: Connors-Davidson Resilience Scale (CDRISC) [28,29], Multidimensional Scale of Perceived Social Support (MSPSS) [30,31], Social and Occupational Functioning Assessment Acale (SOFAS) [32,33], and World Health Organization Quality of Life instrument (WHOQOL) [34,35].

2.4. Statistical analysis

The demographic and clinical variables were compared between the group with hearing recovery and the group with no hearing recovery following ISSNHL, using an independent *t*-test or the chi-square test. The multiple logistic regression analysis was used to adjust for relevant covariates and identify predictive factors associated with treatment response. After performing the univariate analyses to identify the associated predictors, multivariate analyses were conducted with treatment response as the dependent variable. The Hosmer–Lemeshow goodness-of-fit test is used to assess the overall fit for the logistic regression model. After the choice of most probable variables for prognosis, the cutoff value was calculated via ROC curve. Analyses were performed using SPSS version 18.0 (SPSS, Chicago, NJ, USA). Statistical significance was set at $p < 0.05$.

3. Results

3.1. Demographic and clinical characteristics

Fifty-four patients who were diagnosed with ISSNHL in the Department of Otorhinolaryngology were also evaluated in the Department of Psychiatry using a battery of psychological tests. Three patients were lost to follow-up and had to be excluded from the study. One additional patient was excluded because of Meniere's disease. In total, 50 patients were included in our study. The comparison of patient demographics and clinical results by treatment response (Responder, hearing recovery > 15 dB; Non-responder, hearing recovery ≤ 15 dB) are shown in Table 1.

Among these variables, age was significantly higher (55.5 ± 15.2 years vs. 46.8 ± 12.7 years, $p = 0.034$) and the duration of hearing loss (14.0 ± 17.3 days vs. 4.4 ± 4.2 days, $p = 0.007$) was significantly longer in the non-responder group than the responder group. Siegel's criteria ($p < 0.001$) and low-frequency hearing loss ($p = 0.027$) were significantly different between the two groups. The pre-treatment PTA level was higher in the responder group with a trend toward significance ($t = 2.012$, $p = 0.050$) than the non-responder