CEO Clinical and Experimental Otorhinolaryngology Vol. 3, No. 4: 199-202, December 2010 DOI 10.3342/ceo.2010.3.4.199

Original Article

Is BPPV a Prognostic Factor in Idiopathic Sudden Sensory Hearing Loss?

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Objectives. The prognostic significance of vertigo in patients with idiopathic sudden sensorineural hearing loss (SSNHL) remains a matter of debate because vertigo is associated with many different vestibular disorders. The purpose of this study is to determine the role of benign paroxysmal positional vertigo (BPPV) as a prognostic factor in patients with SSNHL.

Methods. We conducted a retrospective study of 298 patients with SSNHL. Hearing outcomes were evaluated by assessments of pre-treatment hearing and hearing gain. Comparative multivariate analyses between prognostic factors and hearing outcome were conducted.

Results. Thirty-eight (12.7%) SSNHL patients were found to also have BPPV. BPPV showed significant negative prognostic factors in hearing outcome on multivariate analysis (odds ratio, 0.15). In comparison to average pure tone audiometry (PTA), patients diagnosed with SSNHL with BPPV exhibited poorer hearing in pre- and post-treatment PTA compared to SSNHL without BPPV. Old age (>60 years), pre-treatment hearing, and canal paresis were significant outcome predictors.

Conclusion. BPPV in SSNHL patients, representing definitive vestibular damage, was closely related to poor prognosis.

Key Words. *Sudden hearing loss, Vertigo*

INTRODUCTION

Idiopathic sudden sensorineural hearing loss (SSNHL) is commonly associated with tinnitus and ear fullness, and is often accompanied by vertigo. Although some patients recover spontaneously without treatment, therapeutic intervention that includes systemic steroid therapy and intra-tympanic steroid injections is typically used to promote prompt recovery of hearing (1-4). Therapeutic efficacy in patients with SSNHL depends on the treatment regimen and a variety of prognostic factors including age, treatment delay, diabetes mellitus, hypertension, and audiological patterns (5-7).

Vertigo accompanies SSNHL in 30% to 40% cases, and is often considered a poor prognostic factor (2). However, not all studies have confirmed that vertigo is an unfavorable prognostic sign (5). The reason for these inconsistent findings is that vertigo is not a specific disease entity but rather a symptom caused by many different etiologies. The most common diseases associated with vertigo in SSNHL include benign paroxysmal positional vertigo (BPPV), vestibular neuropathy, central vertigo, and non-specific dizziness. Although there have been some attempts to describe the relationships between the results of caloric tests and prognoses (6, 8-10), studies investigating hearing outcome in SSNHL with BPPV are rare.

The purpose of this study is to determine the role of BPPV as a prognostic factor in patients with SSNHL by controlling for confounding factors such as initiation of treatment, age, other vestibular abnormality and diabetes.

• Received July 8, 2010
Accepted after revision August 31, 2010

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MATERIALS AND METHODS

We reviewed the medical records of 298 patients with SSNHL treated in the Department of Otorhinolaryngology-Head and Neck Surgery, Kangbuk Samsung Hospital, Seoul, Korea between January 2004 and January 2009. All patients experienced idiopathic unilateral sensorineural hearing loss (SNHL) that developed within 72 hours and was not associated with other known pathologies, including Meniere's disease, autoimmune disease, ototoxicity, or neoplasm. The patients all had minimum 25 dB hearing loss at three consecutive frequencies. All patients received steroid treatment (injection of methylprednisolone 1 mg/kg for five days then tapered over five days) started concomitantly with low molecular weight dextran. Patients were excluded from the study if they had an interval of ten or more days before initial treatment, if central vertigo was suspected from brain MRI or if they had diabetes that was intolerable of systemic steroid treatment.

Vestibular function test (VFT) was performed by using videonystagmography (VNG) to assess the presence of BPPV and to evaluate canal function. VFT findings were divided into three categories: BPPV; canal paresis (CP); and non-specific findings that include headshaking nystagmus without CP, directional preponderance without CP or non-specific nystagmus. Pure tone audiometry (PTA) was performed on the first day of admission, then every other day after the initiation of treatment and every three weeks after steroid treatments were completed. Subjects with <three months of follow-up were excluded from this study because of uncertain hearing outcome.

The Siegel classification (11) was used to evaluate the outcome of patients on the last visit, using average gain in dB in four audiometric speech frequencies of 500 Hz, 1,000 Hz, 2,000 Hz, and 4,000 Hz. The classification is as follows: no improvement, less than 15 dB of gain; slight improvement, more than 15 dB of gain and a final hearing loss poorer than 45 dB; moderate improvement, more than 15 dB of gain and final hearing level between 25 and 45 dB; and complete improvement, hearing level better than 25 dB regardless of the size of the gain. Multivariate analyses between possible prognostic factors, including BPPV and hearing outcome, was conducted. The pre and post-treatment hearing were also compared between SSNHL with BPPV and without BPPV. We obtained Kangbuk Samsung Hospital Institutional Review Board approval for this study.

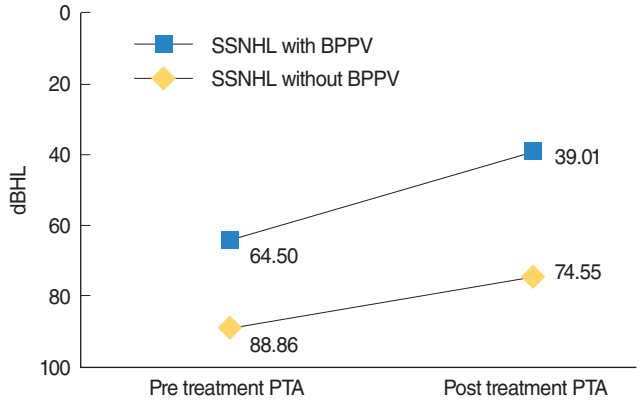

Fig. 1. The average pure tone audiometry (PTA) between pre- and post-treatment in idiopathic sudden sensorineural hearing loss (SSNHL) patients with benign paroxysmal positional vertigo (BPPV) and SSNHL patients without BPPV.

Statistical analysis

Statistical analyses were performed using PASW Statistics ver. 17.0 (SPSS Inc., Chicago, IL, USA). Pearson's chi-square analyses were performed to identify statistically significant differences between the prognostic factors and hearing outcome. Multivariate logistic regression analysis was further performed according to the prognostic factors. For multivariate analysis, we divided hearing results into two categories: the first (good recovery) with moderate to complete improvement and the second (poor recovery) with no to slight improvement. The Mann-Whitney test was performed for average PTA.

RESULTS

The mean interval between pre- and post-treatment PTA was 4.6 months with a range from 3 to 10 months. Mean age in SSNHL was 48.0±16.1 months. SSNHL with BPPV showed worse pretreatment hearing results than SSNHL without BPPV (P=0.01), (Fig. 1). Only with this result, it was hard to conclude that BPPV itself have a negative prognostic sifnificance. We analyse prognostic significance of BPPV with multivariated analysis considering other factor that affect post-treatment hearing reulsts.

Overall hearing outcome showed complete improvement in 112 patients (37.5%), moderate improvement in 33 patients (11.1%), slight improvement in 33 patients (11.1%), and no improvement in 120 patients (40.2%). Thirty-eight patients (12.7%) were diagnosed with BPPV in SSNHL. Table 1 summarizes the hearing results by Siegel classification among SSNHL patients according to the presence of BPPV. In SSNHL with BPPV, 68.4% (26/38) of patients showed profound hearing loss (>90 dB HL of pre-treatment PTA). All patient characteristics are given in Ta-

Table 1. Hearing outcome in SSNHL according to the presence of BPPV

	Complete improvement	Moderate improvement	Slight improvement	No improvement	Total
SSNHL	109 (41.9)	33 (12.6)	21 (8.0)	97 (37.3)	260
SSNHL with BPPV	3 (7.8)	0 (0)	12 (31.5)	23 (60.5)	38

Values are presented as number (%).
SSNHL: idiopathic sudden sensorineural hearing loss; BPPV: benign paroxysmal positional vertigo.

Table 2. Baseline characteristics of patients with SSNHL

Potential prognostic factors	All patients (n=298)	Good recovery (n=145)	Poor recovery (n=153)	*P*-value
BPPV				0.00*
Presence	38	3 (7.9)	35 (92.1)	
Absence	260	142 (54.6)	118 (45.4)	
Sex				0.90
Male	151	74 (49.0)	77 (51.0)	
Female	147	71 (48.3)	76 (51.7)	
Age				0.02*
≤60 years	214	113 (52.8)	101 (47.2)	
>60 years	84	32 (38.1)	52 (61.9)	
Canal paresis				0.00*
Presence	48	2 (4.2)	46 (95.8)	
Absence	250	143 (57.2)	107 (42.8)	
Non-specific finding in VFT				0.80
Presence	28	13 (46.4)	15 (53.6)	
Absence	270	132 (48.9)	138 (51.1)	
Pre-treatment PTA level				0.00*
≤90	226	132 (58.4)	94 (41.6)	
>90	72	13 (18.1)	59 (81.9)	

*Statistically significant.
SSNHL: idiopathic sudden sensorineural hearing loss; BPPV: benign paroxysmal positional vertigo, VFT: vestibular function test; PTA: pure tone audiometry.

ble 2. BPPV, age, CP, and pre-treatment hearing are significantly associated with hearing outcome. However, there were no differences in hearing outcome according to sex or non-specific VFT findings (Table 2). Only 7.9% of patients showed good recovery in SSNHL with BPPV while 54.6% of patients showed good recovery in SSNHL without BPPV.

After excluding the non-significant factors, multivariate analysis of potential prognostic factors demonstrated that BPPV, age, CP, and pre-treatment PTA levels were associated with hearing outcome (Table 3). BPPV, canal paresis and age older than 60 had a worse outcome with adjusted odds ratios (aOR) of 0.43, 0.04, 0.15, respectively. On the other hand, pre-treatment PTA levels ≤90 were significantly correlated with better hearing outcome (aOR=3.38).

DISCUSSION

Many studies have reported prognostic factors associated with SSNHL. The most frequently noted prognostic factors include age, pre-treatment hearing, time to treatment initiation, vertigo, canal paresis and associated systemic disease (8-10). The presence of vertigo is usually considered a poor prognostic factor, but the relationship between vertigo and hearing outcome continues to be debated (11, 12). First, vertigo is not a distinct disease but rather a symptom with several possible etiologies. Vertigo is a common manifestation of a variety of vestibular insults. Second, many previous reports did not account for other prognostic factors that may affect hearing results such as initial hearing status, age, presence of systemic disease, and treatment onset. These factors may interfere with analyzing the role of vertigo in patient prognosis.

Table 3. Multivariate analysis of prognostic factors in patients with SSNHL

Prognostic factors	Adjusted odds ratio (95% confidence interval)	*P*-value
Age (>60 vs. ≤60)	0.43 (0.24-0.78)	0.005
Canal paresis (presence vs. absence)	0.04 (0.01-0.20)	0.000
BPPV (presence vs. absence)	0.15 (0.04-0.58)	0.006
Pre-treatment PTA levels (≤90 vs. >90 dB HL)	3.38 (1.59-7.18)	0.002

SSNHL: idiopathic sudden sensorineural hearing loss; BPPV: benign paroxysmal positional vertigo; PTA: pure tone audiometry.

Many reports have shown that the presence of diabetes and late initiation of treatment from the onset of hearing loss are associated with reduced responsiveness to steroid treatment (6, 13). For this reason, in order to analyze the prognostic significance of BPPV itself, we controlled possible prognostic factors by only including patients who were <10 days from treatment initiation and excluding patients with diabetes.

Abnormal VFT findings in patients with vertigo in our study are composed of BPPV, CP, non-specific findings such as directional prepoderance (DP) without CP, headshaking nystagmus without CP, and other non-specific causes of nystagmus. Among these, VFT findings with prognosis are CP and BPPV. In SSNHL with BPPV, only three of the 38 patients (7.8%) achieved a complete improvement. These findings are inconsistent with those in patients with vertigo in previous reports. Moskowitz et al. (2) and Mamak et al. (14) reported rates of 14% and 23.1%, respectively, for complete recovery in SSNHL patients with vertigo. Non-specific dizziness, which does not affect prognosis unlike BPPV and CP, might be diagnosed in patients with vertigo. We did not add data in this study about involved canal in BPPV patients. Hearing outcome was not different according to the subtype of BPPV. We thought that the presence of BPPV itself reflect serious labyrinthine damage no matter what canals were involved.

The most commonly accepted cause of cochlear damage in SSNHL is viral infection, while hypoperfusion is the etiology in other cases (15). Although most diagnoses are idiopathic for BPPV, labyrinth viral infections are implicated by some reports (16), and Schuhknecht (17) postulated that otoliths may dislodge from infracted utricular macula and accumulate in the semicircular canal. Therefore, SSNHL can be associated with the occurrence of secondary BPPV. Some reports have shown that vertigo is present more frequently in patients with profound hearing loss

(18). The presence of profound hearing loss implies that cochlear damage is probably too extensive for therapy to have a beneficial effect. BPPV may represent severe labyrinth damage that may result in poorer hearing recovery. In our study, many patients with BPPV (68.4%) exhibited profound hearing loss and poor hearing recovery.

Our results showing that age, pre-treatment hearing and CP are associated with prognosis are consistent with other studies (6, 8-10, 19, 20). Although a consensus regarding the prognostic importance of age does not exist (14), most authors suggest that profound hearing loss has a worse prognosis in SSNHL. Khetarpal (21) studied temporal bone histology in patients with sudden deafness and vertigo and suggested that vertigo may be caused by biochemical alterations in the inner ear. Simmons (22) hypothesized that vertigo with SSNHL may be the result of a membrane break near the vestibule. Therefore, canal dysfunction may be another indicator of the extent and the severity of inner ear injury.

In conclusion, this is the study to statistically evaluate the prognostic significance of BPPV in patients with SSNHL adjusting other prognostic factors. SSNHL with BPPV patients were expected to showed poor initial hearing level and BPPV itself have a negative prognostic significance that represent labyrinthine damage.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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