Corticosteroids and Vestibular Exercises in Vestibular Neuritis
Single-blind Randomized Clinical Trial

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IMPORTANCE The management of patients with unilateral acute vestibular neuritis (VN) has not been established to date.

OBJECTIVE To compare the use of vestibular exercises vs corticosteroid therapy in the recovery of patients with acute VN.

DESIGN, SETTING, AND PARTICIPANTS Prospective, single-blind, randomized clinical trial at a primary referral center. Among all patients with acute vertigo, those having VN were eligible for inclusion in the study.

INTERVENTIONS Forty patients with acute VN were randomly assigned to perform vestibular exercises or to receive corticosteroid therapy. After a baseline examination, follow-up evaluations were performed at 1, 6, and 12 months.

MAIN OUTCOMES AND MEASURES Efficacy outcomes included clinical, canal, and otolith recovery. Scores on the European Evaluation of Vertigo Scale and the Dizziness Handicap Inventory were used for the evaluation of clinical recovery. Findings of caloric irrigation and vestibular evoked myogenic potentials indicated canal and otolith improvement, respectively.

RESULTS Comparing the 2 treatment groups, no statistically significant differences were found in clinical, canal, or otolith recovery. At the 6-month examination, the number of patients with complete disease resolution in the corticosteroids group was significantly higher than that in the vestibular exercises group. However, at the end of the follow-up period, 45% (9 of 20) of patients in the vestibular exercises group and 50% (10 of 20) of patients in the corticosteroids group had complete disease resolution (P > .05).

CONCLUSIONS AND RELEVANCE Treating patients who have acute VN with vestibular exercises seems equivalently effective as treating them with corticosteroid therapy in clinical, caloric, and otolith recovery. Corticosteroid therapy seems to enhance earlier complete acute VN resolution, with no added benefit in the long-term prognosis.

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Vestibular neuritis (VN) is among the 3 most common causes of peripheral vestibulopathy (the first is benign paroxysmal positional vertigo); an incidence of 3.5 cases per 100,000 is reported. Data from outpatient clinics specializing in the treatment of dizziness indicate that 7% of their patients have VN.

Despite the benign course of VN, restoration of peripheral function after unilateral vestibular deficit is incomplete. This deficit leads to impaired vision and postural imbalance during walking and especially during rapid head movement toward the affected ear. Clinical recovery is achieved via central compensation in combination with vestibular substitution.

The treatment strategy for peripheral recovery of function after VN has not been established to date. The therapeutic choices are (1) corticosteroids, (2) antiviral therapy (acyclovir or valacyclovir hydrochloride), (3) a combination of corticosteroids and an antiviral agent, and (4) vestibular exercises. The rationale for treating patients having VN with corticosteroids is based on studies documenting positive effects among patients with acute peripheral neuritis such as optic neuritis, idiopathic facial nerve paresis, and idiopathic hearing loss. Vestibular rehabilitation seems to be a safe and effective management of unilateral vestibular hypofunction, maximizing central nervous system compensation.

We performed a prospective, single-blind, randomized clinical trial comparing the treatment effects of vestibular exercises vs corticosteroid therapy in patients with VN. Clinical recovery and vestibular function were assessed at baseline and at 1, 6, and 12 months.

### Methods

#### Patients

The local ethics committee approved the study protocol, and written informed consent was obtained from all patients. This study is registered with clinicaltrials.gov (identifier NCT01231009). All patients (age range, 18-80 years) who were seen in the emergency department of AHEPA University Hospital, Thessaloniki, Greece, with symptoms and signs of VN were recruited for the study.

The initial evaluation of patients included complete neurootologic, neurologic, and cardiovascular examinations. Patient inclusion in the study was based on diagnostic symptoms and signs. Patients with VN had an history of an acute onset of severe prolonged rotary vertigo, nausea, vomiting, and postural imbalance. The main diagnostic signs were the following: no recent hearing loss, no findings of a central lesion on neurologic examination, ipsilateral deficit of the horizontal semicircular canal on the head thrust test, horizontal spontaneous nystagmus with a rotational component toward the unaffected ear, and unilateral reduced caloric response (caloric lateralization ≥25%) on caloric electronystagmography (ENG).

Exclusion criteria were the following: glaucoma; recent infection; signs of central vestibular dysfunction; history of chronic vestibular dysfunction; acute hearing loss (before, during, or after the onset of vertigo); symptoms of a central lesion, such as brainstem or cerebellar disorders; abnormal findings on magnetic resonance imaging of the brainstem or cerebellum; severe hypertension (blood pressure on admission >180 mm Hg systolic or >110 mm Hg diastolic); and severe diabetes mellitus (fasting blood glucose level >180 mg/dL on admission despite treatment) (to convert glucose level to millimoles per liter, multiply by 0.0555). Also excluded were patients with contraindications to the use of corticosteroids such as peptic ulcer disease, psychiatric disorders, pregnancy, and breastfeeding women.

#### Treatment Groups

All study patients were admitted to our department for 10 days. During the acute phase of the disease, all patients regardless of their treatment group allocation received an antiemetic agent (dimehydrinate [150 mg/d]) for a maximum of 3 days and a proton pump inhibitor. Based on computer-generated block randomization, the included patients were randomly assigned to 2 treatment groups.

Patients in the vestibular exercises group performed a vestibular rehabilitation program for 3 weeks. This program consisted of adaptation and substitution exercises (Table 1). They also performed exercises for balance and gait enhancement. During the first week of the program, patients performed the exercises under the supervision of a member of our scientific team (J.K.G.). On discharge from the hospital, they received written instructions and drawings describing the home exercises.

During their hospitalization, patients in the corticosteroids group received intravenous dexamethasone sodium phosphate [24 mg/d], tapering down during 7 days. On discharge from the hospital, all patients received a 14-day supply of the study drug in standardized packages of the daily regimen (dexamethasone sodium phosphate [2 mg/d by mouth], tapering down), with written instructions for taking the drug.

#### Adverse Effects

During the hospitalization, measurements of arterial pressure (3 times a day) and blood glucose level (once a day) were obtained. Patients were informed of the potential adverse effects of the medications and were asked to report them as soon as possible. At the 1-month follow-up evaluation, patients were...
The VEMPs were recorded in the supine position from one side each time using surface electrodes over the unilateral sternocleidomastoid muscle, with a reference electrode on the unilateral clavicle and a ground electrode on the forehead. During the test, the patient was instructed to rotate and raise the head from the pillow to activate the sternocleidomastoid muscle. The VEMPs were considered abnormal if they were absent or if the amplitude asymmetry ratio of the affected side to the unaffected side was 25% or higher. Complete disease resolution was recorded if the EEV score was 0, the DHI score was less than 6, caloric lateralization was less than 25%, and the VEMPs were normal.

Statistical Analysis

Differences in the proportions of patients with abnormal VEMPs and with complete disease resolution were analyzed by Fisher exact test. The means of EEV scores, DHI scores, and caloric lateralization were compared using independent-samples 2-tailed t test.

Results

During the 3 years of the study protocol, 52 patients with symptoms of acute VN were seen in the emergency department of AHEPA University Hospital (Figure 1). Forty patients fulfilled the inclusion criteria and consented to participate in the study. These patients were randomly assigned to the vestibular exercises group (20 patients) or to the corticosteroids group (20 patients). Table 2 summarizes the baseline characteristics of the included patients. No statistically significant differences between the groups were found in the mean age, sex ratio, lesion side, and mean time from the disease onset to admission to our department. The baseline vestibular deficit, as measured with the mean EEV score, the mean caloric lateralization, and abnormal VEMPs also did not differ significantly between the 2 groups.

Clinical recovery, as measured with the EEV and DHI, demonstrated similar improvement among the patients of both study groups. After 1 month of the received treatment, the mean (SD) EEV scores were 3.75 (1.61) in the vestibular exercises group and 4.17 (3.82) in the corticosteroids group (Table 3). The difference in EEV score improvement between the study groups at the 1-month follow-up visit did not reach statistical significance (P > .05). Patient handicaps, as measured with the DHI score, were not significantly different between the study groups at the follow-up evaluations. During 12 follow-up months, patients performing vestibular exercises showed greater improvement in the DHI score compared with patients receiving corticosteroids, although the difference was not statistically significant.

The extent of vestibular paresis, as calculated with the formula by Jongkees et al,13 did not differ significantly between the 2 study groups at the baseline evaluation. At the 1-month follow-up visit, the corticosteroids group showed better canal improvement, although the difference was not statistically significant between the study groups. The mean (SD) caloric lateralizations at the 1-month follow-up visit were 53.25 (14.23)
BPPV was based on the Dix-Hallpike maneuver, which was included in the diagnostic protocol of our follow-up visits. In the 2 patients with secondary BPPV, the VEMPs were preserved, indicating VN of the superior branch. In the corticosteroids group, 1 patient with controlled diabetes mellitus using antidiabetic agents had destabilization of the disease and developed hyperglycemia. Modification of the hypoglycemic dosage normalized the blood glucose level. Patients in the vestibular exercises group reported no adverse effects or complications due to the performed vestibular rehabilitation program.

**Discussion**

Based on the results herein, a 3-week program of vestibular exercises in patients with acute VN seems to be equivalent to dexamethasone therapy (cumulative dose of 96 mg during 21 days) in terms of clinical, canal, and otolith recovery. The role of corticosteroids in the treatment of VN remains uncertain because their beneficial effects have been based on investigations of patients experiencing acute cranial nerve neuropathies such as optic neuritis, Bell palsy, and idiopathic hearing loss.8 In a prospective randomized clinical trial reported in 2004, Strupp et al15 investigated the role of corticosteroids and antiviral agents in patients with acute VN, with the primary outcome being improvement in the mean caloric lateralization on ENG at 12 months after the disease onset. The authors reported that methylprednisolone significantly improved the peripheral vestibular function recovery. Previous authors chose the vestibular paresis formula by Jongkees et al13 as a validated efficacy outcome measure to compare the function of peripheral vestibular function. Despite criticism that the authors did not use a symptom-based outcome measure,77 their choice was justifiable because other studies76,79 have demonstrated that better peripheral vestibular function recovery is associated with...
A smaller persistent dynamic deficit in the vestibulo-ocular reflex and with less oscillopsia and imbalance during head and body movement.

In a randomized clinical trial reported in 2008 using clinical and ENG outcome measures, Shupak et al.20 showed that corticosteroids might enhance earlier recovery but do not benefit the long-term prognosis of patients with VN. A systematic review and meta-analysis21 of all studies exploring the therapeutic effect of corticosteroids in patients with VN supported their use in benefitting the caloric extent and canal paresis recovery but not in improving clinical symptoms. Work by Fishman22 and a recent Cochrane review23 found insufficient evidence to support the use of corticosteroids in the management of patients with VN, stating that well-designed randomized clinical trials with symptom-based outcome measures, in addition to objective measures of vestibular improvement, are needed to clarify the effectiveness of such therapy.22,23

The present study comparing drug administration (corticosteroids) with a physical treatment (vestibular exercises) in patients with acute VN supports that patients treated with corticosteroids have no advantage in the long-term prognosis of their disease. However, the use of corticosteroids seems to accelerate patient recovery both clinically and on caloric ENG.

The role of vestibular exercises is mainly to accelerate and improve central compensation via the mechanisms of habituation training, as well as to increase substitution. Based on the results of clinical studies,10,24 vestibular exercises seem to be effective in reducing the duration of symptoms and the need for medication in patients with acute vertigo. Herdan et al.25,26 in 2 randomized clinical trials showed that vestibular exercises facilitate the recovery of gaze stability during head movement, enhancing the development of programmed eye movement, in patients with unilateral or bilateral vestibular hypofunction. In a 1998 study, Strupp et al.16 reported the efficacy of vestibular exercises in patients with VN who performed vestibular rehabilitation (home-based physical therapy) compared with a group of patients who received no specific intervention (other than encouragement to move).16 Our results suggest that vestibular rehabilitation seems equivalently effective, in terms of clinical, canal, and otolith recovery, as corticosteroid therapy in the recovery of patients with VN.

Considering the natural course of VN, the findings herein confirm a previously reported lack of correlation between clinical disease resolution and caloric lateralization regardless of the performed treatment.5,20,21,27 However, in contrast to the findings by Shupak et al.,20 the clinical recovery efficacy measures (the EEV and DHI scores) in the present study had greater

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### Table 4. Caloric Paresis and Otolith Dysfunction of Patients

<table>
<thead>
<tr>
<th>Variable</th>
<th>Vestibular Exercises (n = 20)</th>
<th>Corticosteroids (n = 20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caloric lateralization, mean (SD), %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>78.75 (16.11)</td>
<td>67.64 (22.00)</td>
</tr>
<tr>
<td>1 mo</td>
<td>53.25 (14.23)</td>
<td>44.88 (18.21)</td>
</tr>
<tr>
<td>6 mo</td>
<td>35.43 (13.02)</td>
<td>27.23 (13.96)</td>
</tr>
<tr>
<td>12 mo</td>
<td>19.31 (9.80)</td>
<td>20.52 (8.99)</td>
</tr>
<tr>
<td>Caloric lateralization improvement, mean (SD), %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>From baseline to 1 mo</td>
<td>31.71 (15.28)</td>
<td>33.42 (15.75)</td>
</tr>
<tr>
<td>From baseline to 6 mo</td>
<td>55.33 (11.79)</td>
<td>58.86 (16.41)</td>
</tr>
<tr>
<td>From baseline to 12 mo</td>
<td>75.95 (9.24)</td>
<td>65.78 (19.70)</td>
</tr>
<tr>
<td>Abnormal VEMPs, No.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>1 mo</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>6 mo</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>12 mo</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Abbreviation: VEMPs, vestibular evoked myogenic potentials.

* P > .05 for all.
improvement than the caloric irrigation findings. At 1 month after the disease onset, the mean EEV score improvements were 78.49% for patients in the vestibular exercises group and 71.05% for patients in the corticosteroids group (Table 3), but the caloric lateralization improvements were only 31.71% and 33.42% for the 2 study groups, respectively (Table 4). The DHI score improvements were 97.70% for patients in the vestibular exercises group and 96.58% for patients in the corticosteroids group at the end of the follow-up period (12 months) (Table 3), but only 60% (12 of 20) of patients in the vestibular exercises group and 45% (9 of 20) of patients in the corticosteroids group had caloric lateralization less than 25% (Table 4). However, only 45% (9 of 20) of patients in the vestibular exercises group and 50% (10 of 20) of patients in the corticosteroids group had complete disease resolution at the end of the follow-up period (Figure 3), with the remaining symptoms being slight oscillopsia and impaired balance after rapid head movement.

The caloric test, the most important assessment in the ENG battery, is invaluable in diagnosing peripheral vestibular disorders such as VN and is the only test that allows the stimulation of each horizontal semicircular canal separately. Despite the usefulness of the caloric test in diagnosing VN, its value is limited to follow-up evaluation in patients with VN due to some inherent characteristics. The caloric test provides a nonphysiological stimulation, producing endolymph accelerations in the range of low frequencies of 0.002 to 0.004 Hz. Previous authors have stated that, in chronic VN, the low-frequency function of the peripheral vestibular system recovers or becomes symmetrical but that deficits in the high-frequency horizontal vestibulo-ocular reflex to the lesioned side are permanent.28 Brandt et al29 reported that the average recovery, based on 10 studies of low-frequency vestibular function, occurs over time, with most of the function being regained within the first month after the disease onset. In the present study, vestibular function after VN (as measured by the nystagmus response to the caloric irrigation) improved over time, with the highest rate of improvement occurring within the first month after the disease onset regardless of the treatment strategy. In chronic VN, the search coil head-impulse test and the video head-impulse test are the most reliable in measuring vestibular function because they provide high-frequency accelerations.28,30

Our study has several limitations. Despite our power analysis based on clinical improvement, a study group with combined treatment would strengthen our conclusions, presuming a larger sample size. Furthermore, our aim was to assess the clinical improvement of patients in the 2 study groups, and our data allow no conclusions about the background improvement, central compensation procedure, or peripheral vestibular function enhancement. Our diagnostic protocol did not include the full range of available examinations to assess the natural course of VN such as subjective visual vertical, ocular torsion, and video head-impulse tests. These tests could add valuable data concerning the improvement of both static and dynamic imbalance in patients after acute VN.

Conclusions

Vestibular exercises in patients with VN seem equivalently effective as corticosteroid therapy based on clinical and laboratory criteria. Corticosteroids seem to enhance earlier complete disease resolution, with no added benefit in the long-term prognosis of patients with VN. Improvement in canal or otolith dysfunction cannot be directly translated into clinical terms, a fact that is confirmed by our study. Multicenter prospective studies with large sample sizes and multiple study outcomes (clinical and laboratory) are needed to clarify the role of vestibular exercises, corticosteroid therapy, or a combination of them in the recovery of patients with acute VN.


