

Original contributions

Effect of vestibular rehabilitation on dizziness in the elderly^{☆,☆☆}

Jae Yun Jung, MD, Ji-Sun Kim, MD, Phil Sang Chung, MD, PhD,
Seung Hoon Woo, MD, Chung Ku Rhee, MD, PhD*

Department of Otolaryngology-Head and Neck Surgery, Dankook University College of Medicine, Cheonan-city, Chungnam-do, South Korea

Received 26 March 2007

Abstract

Objectives: Dizziness in the elderly is relatively common, but only a few studies are available. The purpose of this study was to analyze the effect of vestibular rehabilitation on dizziness in elderly patients.

Materials and methods: A total of 240 patients older than 70 years with dizziness who visited the dizziness center of a tertiary care university hospital from January 2000 to January 2004 were studied. The patients' charts were retrospectively reviewed. Thorough otolaryngologic and neurotologic evaluations and vestibular function testing were performed in every case to determine the specific causes of dizziness. General vestibular rehabilitation therapy (VRT) was performed in 103 cases (VRT group) and it was not done on the other 46 cases (non-VRT group). The intensity of dizziness and disequilibrium was evaluated by the verbal analogue scale and Activities-specific Balance Confidence questionnaires that were obtained at 3 weeks and at 3 months after the initiation of general VRT.

Results: The average age of the patients was 76.5 ± 6.2 years. In 153 cases (63%), no specific causes for dizziness were found, which was attributed to presbyastasis. Improvement in dizziness in the VRT group was significantly higher than in the non-VRT group by the verbal analogue scale and Activities-specific Balance Confidence scale obtained at 3 weeks and at 3 months after the initiation of VRT.

Conclusion: In the majority of elderly patients with dizziness, the etiology of dizziness is not found and is attributed to presbyastasis. General VRT seems to be an effective treatment for this elderly group.

© 2009 Elsevier Inc. All rights reserved.

1. Introduction

Dizziness is a very common problem in the elderly. It may be difficult to discover the cause of dizziness in the elderly because there are so many contributing mechanisms,

as it can be caused by a wide range of pathologies in the vestibular, visual, and proprioceptive systems. Dizziness by a functional loss of any one of these systems can be compensated for. However, partial or complete loss of 2 or more of these systems may not be compensated completely, and a patient may end up experiencing chronic dizziness/disequilibrium. This may occur more often in the elderly. It can even be a more complex problem in the elderly in whom aging degenerative changes of the vestibular neuroepithelium or other components of the balance mechanism may be responsible for the symptoms [1,2]. It may be inappropriate to dismiss dizziness and disequilibrium as due to normal aging or nonspecific entities such as presbyastasis or multiple sensory deficits without giving any efforts to diagnose and treat [2]. Management of an

[☆] This study was supported by the Dankook University Medical Laser Research Fund (R12-2001-050-06007-0).

^{☆☆} All procedures followed were in accordance with the ethical standards of the Responsible Committee on Human Experimentation and with the Helsinki Declaration.

* Corresponding author. Department of Otolaryngology-HNS, Dankook University College of Medicine, San-16 Anseo-dong, Cheonan-city, Chungnam-do 330-714, South Korea.

E-mail address: rheek@dku.edu (C.K. Rhee).

elderly person with dizziness includes vasodilators [3] and vestibular rehabilitation therapy (VRT) [4]. However, there have not been enough studies on dizziness in the elderly assessing the management.

The aim of this study was to analyze the effect of VRT on dizziness in the elderly patients.

2. Method

The medical records of patients older than 70 years with complaints of dizziness and/or disequilibrium at a tertiary

care university hospital in Korea were reviewed retrospectively from February 2000 to January 2004. A carefully structured history was taken to evaluate symptoms of vertigo, dizziness, and disequilibrium both indoor and outdoor. Careful history was taken to detect any coexisting medical diseases. Otolaryngologic examination was performed twice by residents and staff physicians including a detailed clinical assessment; ear-nose-throat examinations including otoscopy; cranial nerves examination; Romberg test; and tandem walking test. In all individuals, electro-nystagmography (Micromedical, Springfield, Ill), rotating

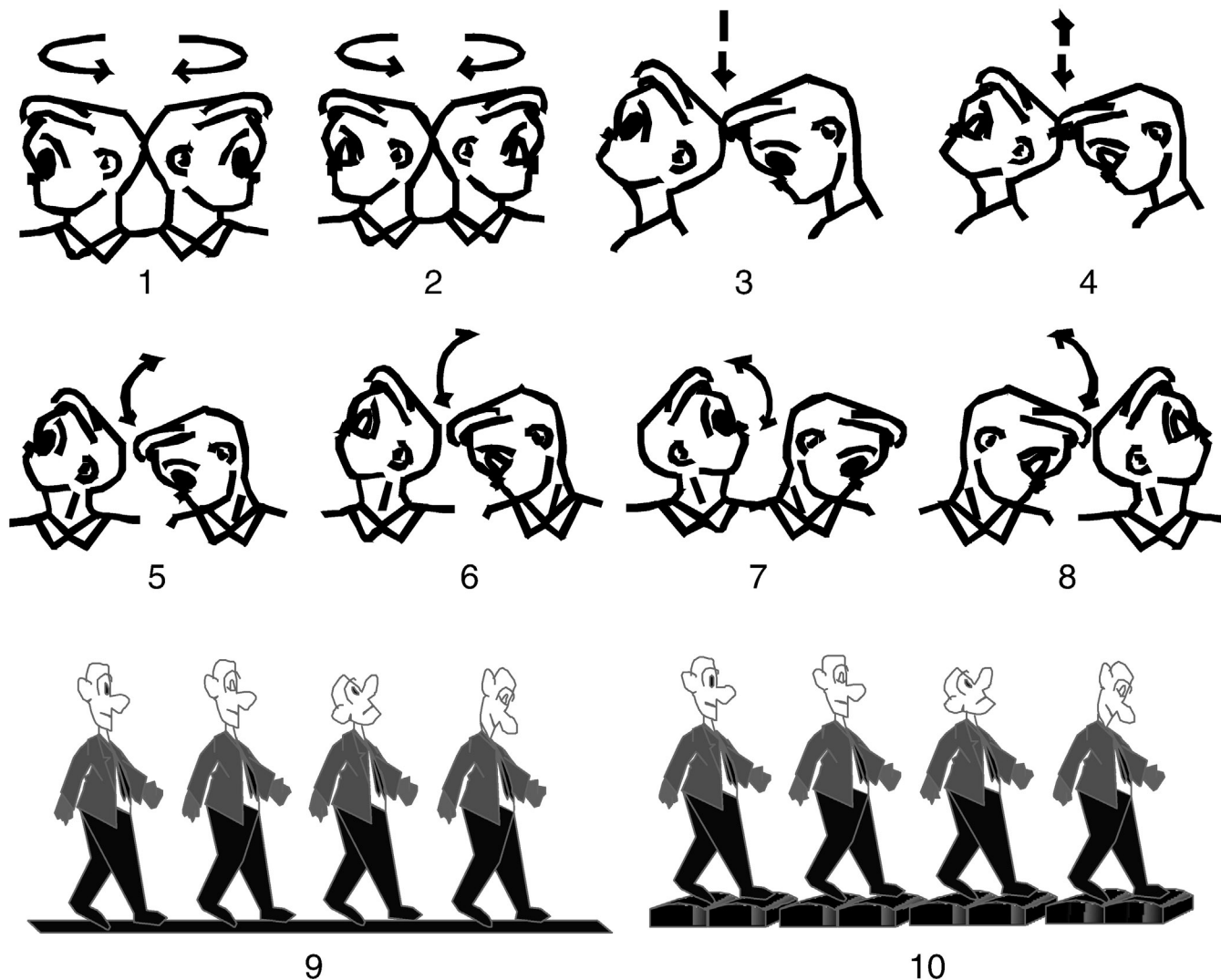


Fig. 1. Exercise 1, While seated, with eyes open, maintaining visual fixation to a target on a wall, turn your head from side to side. First slowly and then gradually increase the speed according to your own pace. Exercise 2, Repeat exercise 1 with eyes closed while maintaining visual fixation to an imaginary target on a wall. Exercises 3 and 4, While seated, with eyes open, maintaining visual fixation to a target on a wall, move your head up and down. Slowly and gradually increase the speed at your own pace. Repeat exercise 3 with eyes closed while maintaining visual fixation to an imaginary target on a wall. Exercises 5 and 6, While seated, with eyes open, turn your head to the right by 45°. Shake your head up and down, maintaining visual fixation to a target on a wall, as in exercise 3. Then, repeat exercise 5, maintaining visual fixation on an imaginary target on a wall, with eyes closed. Exercises 7 and 8, While seated, with eyes open, turn your head to the left by 45°. Shake your head up and down, maintaining visual fixation to a target on a wall, as in exercise 3. Then repeat exercise 7, maintaining visual fixation on an imaginary target on a wall, with eyes closed. Exercises 9 and 10, First, walk 10 to 15 steps with eyes open, then with eyes closed without moving your head. Second, repeat the above while tilting (up and down) and rotating (left/right) your head in a random fashion. While moving your head, try to maintain the visual fixation to a target on a wall or an imaginary target. For your safety, you must do these exercises while someone else is observing you, preferably walking beside you in case you fall. Repeat exercise 9, except pillows are added.

chair testing (Micromedical), and posturography (NeuroCom, Clackamas, Ore) were performed. These tests were interpreted by staff neurootologists. Magnetic resonance imaging (MRI) was carried out when a central causative factor was suspected from otolaryngologic and neurootologic examinations. When no specific cause of dizziness could be found, presbyastasis was diagnosed.

One hundred seven patients were instructed to perform generalized VRT (modified Hamid [5] exercise) at home 3 times daily (VRT group). The concept of this VRT is the habituation and adaptation of the vestibuloocular reflex (VOR) and vestibular-spinal reflex (VSR). A standardized VOR and VSR protocol was developed to provide graded stimulation of visual VOR in the 3 cardinal planes and incorporate VOR and VSR. While seated, with eyes open then with eyes closed, the patient turns the head from side to side or up and down while maintaining visual fixation to a small target on a wall. Then the patient turns the head to the left and right 45°, and moves it up and down with eyes open and closed while maintaining visual fixation to a small target on a wall. The speed of the head motion was increased according to patient's own pace; first slowly and then increasing gradually until the patient felt dizzy. Walking with eyes open then with eyes closed, patients repeat the head movement in the same way (Fig. 1).

This VRT was not taught to the other 46 patients, but they were told to try to carry out daily routine physical activities based on the policy of one staff physician (non-VRT group).

Patients were evaluated using the verbal analogue scale (VAS) and the Activities-specific Balance Confidence (ABC) questionnaire that were obtained at the initial visit, 3 weeks, and 3 months post initiation of the VRT. The questionnaire was administered by a resident who had no relationship with the participants. The resident simply read the questionnaire and let the participants choose the most appropriate statement. The questionnaire was given before the participant met the physical therapist (who had been spending time with the patient), to rule out the possibility of indoctrination by the physical therapist. The VAS (Table 1) was modified from Whitney et al [6] and the ABC (Table 2) was modified from Powell and Myers [7], eliminating 6 items that do not apply to daily activities in rural life in Korea. For the statistical study, repeat measures analysis of variance was used for the

Table 1
Verbal analogue scale

Grade 0	No dizziness
Grade 2	Slight dizziness on working
Grade 4	Slight to moderate dizziness on working
Grade 6	Moderate dizziness on working
Grade 8	Moderately severe dizziness on working
Grade 10	Severe dizziness on working

Table 2
Activities-specific balance confidence scale items

1. Reach at eye level
2. Walk around house
3. Get in/out of car
4. Walk outside
5. Sweep the floor
6. Pick up slipper from floor
7. Walk in crowded mall
8. Walk in crowded/bumped
9. Reach on tiptoes
10. Stand on chair to reach

Items were rated from 0% (no confidence) to 100% (complete confidence).

statistical analysis and *P* value less than or equal to .05 was significant.

3. Results

3.1. Presbyastasis group (*n* = 153)

A total of 240 patients were included initially in this study after excluding 60 patients who had incomplete clinical assessment and tests. Specific causes were identified in 87 (36%). They were benign paroxysmal positional vertigo, Meniere's disease, vestibular neuronitis, and central neurologic diseases such as cerebral circulatory insufficiency and infarct of brain. These 87 cases were excluded from this study. But no such specific causes were detected in 153 (64 %) cases. These 153 cases were defined to have presbyastasis as specific causes could not be found after intense investigations.

- (1) Distribution of age in the VRT group was 76.2 ± 5.6 and in the non-VRT group was 76.8 ± 6.2 .
- (2) Distribution of male-to-female ratio in the VRT group was 51:56 and in the non-VRT group was 21:25.
- (3) The mean duration of symptoms in the VRT group was 42.3 and in the non-VRT group was 43.6.
- (4) Clinical symptoms and coexisting diseases: 153 patients described their dizziness as rotating vertigo, disequilibrium, unsteadiness, positional vertigo, lightheadedness, orthostatic intolerance, and impending fainting. The duration of symptom was 42.8 ± 8.7 days. Majority of the patients, 112 (73 %) cases, had accompanying medical conditions. These were hypertension; diabetes mellitus; other medical conditions such as chronic renal failure, angina pectoris, congestive heart failure; eye diseases such as cataract and glaucoma; psychiatric diseases; and musculoskeletal diseases such as arthritis and herniated disc. All of the patients were in stable medical condition with the necessary medications.
- (5) Vestibular function testing: various abnormalities indicating central and nonspecific findings were

found in 102 (67 %) cases and it was normal in 51 (33 %) cases.

- (6) Magnetic resonance imaging: 103 patients had brain MRI. It was normal in 79 patients. Microangiopathy was reported in 14 patients and 10 patients showed mild senile changes of brain atrophy. These 2 findings were not specifically related to the organic pathology of central vestibular structures.
- (7) Treatment.

In the non-VRT group, the VAS scores were 6.63 ± 1.75 before the initiation of treatment, 5.8 ± 1.77 at 3 weeks posttreatment, and 4.6 ± 1.46 at 3 months posttreatment. In the VRT group, they were 6.80 ± 1.86 before the VRT, 5.28 ± 1.38 at 3 weeks posttreatment, and 3.02 ± 1.32 at 3 months posttreatment. In the non-VRT group, the VAS score was not significantly better at 3 weeks posttreatment ($P = .068$), but the improvement was significant at 3 months after the VRT ($P = .001$). In the VRT group, the VAS score was significantly improved at 3 weeks ($P = .001$) and at 3 months ($P = .001$) after the VRT compared to that before the VRT. The VAS scores of the VRT group were significantly better than those of the non-VRT group at 3 weeks ($P = .04$) and 3 months ($P = .025$) after the initiation of VRT. The VRT group has shown significant improvement in subjective symptoms at 3 weeks and 3 months after the VRT, although the non-VRT group also was significantly better at 3 months.

The ABC scores in the non-VRT group were 44.67 ± 11.52 initially, 49.8 ± 9.93 at 3 weeks from the initial time, and 59 ± 4.33 at 3 months from the initial period. In the VRT group, they were 41.8 ± 10.5 before the VRT, 52.10 ± 6.83 at 3 weeks posttreatment, and 65.55 ± 6.48 at 3 months posttreatment. The ABC score was significantly better at 3 weeks (0.04) and at 3 months (0.01) from the initial time in the non-VRT group. It was also significantly improved in the VRT group at 3 weeks (0.001) and 3 months (0.001) post-VRT. The ABC scores of the VRT group were significantly better than those of the non-VRT group at 3 weeks ($P = .036$) and at 3 months ($P = .01$) post-VRT.

The correlation between the length of dizziness symptom and the treatment outcome was studied. Three groups with a length of dizziness symptoms of less than 7 days, 7 to 30 days, and more than 30 days were compared for treatment outcome by the VRT. There was no significant difference in improvement of symptoms among the three groups.

4. Discussion

Dizziness in the elderly is a common symptom seen by physicians. Among the elderly living in a community, approximately 20% of them report having had dizziness severe enough to interfere with life activities. The prevalence of dizziness increases with age [8]. One third of the elderly aged more than 75 years complained of disequilibrium and

more elderly females complain of dizziness [1]. In this study, 153 of 240 patients older than 70 years with dizziness were diagnosed to have presbyastasis. In nearly 2 of 3 complaints of dizziness in the elderly were found to be caused by presbyastasis, which seems to be very high. Average age was 72.1 ± 2.8 , and female-to-male ratio was 81:72, showing slight female dominance. This was a common disease seen in our department. These findings were comparable to other previous reports [9,10].

The subjective symptoms of the 153 patients were rotating vertigo, disequilibrium or unsteadiness, positional vertigo, lightheadedness, orthostatic clouding, and impending fainting. The symptoms the elderly describe are various and at times it is difficult for them to describe [9]. The term most frequently used in describing their problems was vertigo or dizziness/disequilibrium. It would be important to take time to listen to their complaints as it is the most important step in diagnosing and treating dizziness in the elderly. The symptom of fall was not raised often in our elderly group, probably because we have included only the patients who visited the department of otolaryngology.

The majority of the patients had accompanying medical diseases such as hypertension, diabetes mellitus, eye diseases, psychiatric disease, musculoskeletal diseases, and other medical conditions. These accompanying diseases were identified by careful history taking, intense otolaryngologic and neurologic physical examinations, and close consultation with other disciplinary specialists. All of them have been on medications for their diseases and were found to be in stable medical condition at the onset of dizziness. It would be another important step to identify these accompanying diseases and secure the continuous treatment. Any dizziness due to potential drug interaction was considered at this stage of our study and those cases were eliminated from the study.

Vestibular function testing was abnormal in 102 (67 %) cases and normal in 51 (33 %) cases. These abnormalities usually indicated central pathology, but they were not correlated to MRI findings. It would be important to perform vestibular function testing to rule out any specific causes of dizziness in the elderly. Changes in the cerebral regulatory function probably play an important part in postural disturbance in old people [11].

Magnetic resonance imaging was performed on patients suspected of central pathology. It was normal in 80%, and findings of microangiopathy and brain atrophy were shown in the rest (20%) of the 103 cases. Magnetic resonance imaging studies of older persons with disequilibrium and gait disturbances of unknown causes often show frontal atrophy and subcortical white matter T2 hyperintense foci [12]. Another study showed periventricular diffuse vascular type lesions and global atrophy with normal cerebellum and brain stem [10]. Our MRI results correspond with those of previous studies, and performing MRI may be necessary only to rule out any specific causes of dizziness.

In this study, the non-VRT group did not show any significant improvement of dizziness in 3 weeks by VAS evaluation, but significant improvement was noted by ABC evaluation at this stage. The non-VRT group showed significant improvement in 3 months of therapy by both evaluations. The dizziness of the VRT group was improved significantly in 3 weeks and in 3 months by both evaluations compared to the dizziness before the VRT. The dizziness of the VRT group also was significantly better than that of the non-VRT group in 3 weeks and in 3 months of VRT therapy by both evaluations. The results of this study demonstrated that the home-based general VRT of presbyastasis was effective in controlling symptoms of vertigo or dizziness/disequilibrium and increasing independence in activities of daily living. It appears to be the major contributing therapy for this group of patients with presbyastasis.

The general VRT we used was modified from the Hamid [5] rehabilitation program. We added several exercises that can be applied in daily indoor and outdoor living that can be performed as they improve from dizziness. Vestibular rehabilitation therapy program may help to minimize the effects of age-related deterioration of the vestibular system and its psychological impact [13]. Age and sex are not a significant factor in predicting the outcome of vestibular rehabilitation [6]. Most of the elderly patients with secondary accompanying disease that could have caused dizziness symptoms improved with VRT [6]. Only a few studies on dizziness in the elderly are available, but they all have included specific causes such as unilateral vestibulopathy, benign paroxysmal positional vertigo, central vertigo, or other nonvestibular etiology in their studies [6,14,15], whereas this study excluded such specific causes. All these previous studies as well as the present study on elderly dizziness indicated that VRT was an effective therapy to improve the symptoms of dizziness. The ability to compensate for vestibular loss is probably not compromised in the elderly as long as the central nervous system remains intact, although specific reflex functions may be associated with age-related loss of nerve cells, generalized weakness, or brain shrinkage [4].

The length of time a patient has had dizziness chronically was unrelated to the patient's ability to recover [4]. The same result was shown in this study.

There could be a placebo effect in the VRT group vs the non-VRT group as the VRT was instructed to the VRT group only. It would not be possible to teach any kind of false exercise to the non-VRT control group as any such exercise would improve the symptom of dizziness, although it may not be as effective as regular VRT. Instructing to carry out daily routine physical activities to the non-VRT

group resulted in significant improvement by ABC in 3 weeks and significant improvement by both VAS and ABC evaluations in 3 months of therapy. These results indicate that instructing to carry out daily routine physical activities to the non-VRT group at least may have made the two groups more comparable.

5. Conclusion

Subtle pathologic changes in peripheral and central vestibular systems appear to be the likely causes of presbyastasis. Expanded efforts should be made to find the cause of dizziness and other contributing factors in the elderly. However, the etiology is not found in the majority of elderly patients with dizziness and it is attributed to presbyastasis. The accompanying factors should be stabilized before any management is attempted.

General VRT seems to be an effective treatment to control dizziness in the elderly.

References

- [1] Sloane PD, Baloh RW, Honrubia V. The vestibular system in the diagnosis of brain stem tumors. *Neuroradiology* 1985;27:208.
- [2] Baloh RW. Dizziness in older people. *J Am Geriatr Soc* 1992;40:713-21.
- [3] Belal A, Glorig A. Dysequilibrium of ageing (presbyastasis). *J Laryngol Otol* 1986;100:1037-41.
- [4] Cohen HS, Kimball KT. Increased independence and decreased vertigo after vestibular rehabilitation. *Otolaryngol Head Neck Surg* 2003;128:60-70.
- [5] Hamid MA. Vestibular rehabilitation. *Adv Otolaryngol-Head Neck Surg* 1992;6:27-36.
- [6] Whitney SL, Wrisley DM, Marchetti GF, et al. The effect of age on vestibular rehabilitation outcomes. *Laryngoscope* 2002;112:1785-90.
- [7] Powell LE, Myers AM. The activities-specific balance confidence (AMC) scale. *J Gerontol* 1995;50:28-34.
- [8] Sloane PS, Blazer D, George LK. Dizziness in a community elderly population. *J Am Geriatr Soc* 1989;37A:M101-8.
- [9] Grimby A, Rosenhall U. Health-related quality of life and dizziness in old age. *Gerontol* 1995;41:286-98.
- [10] Ahmad N, Wilson JA, Barr-Hamilton RM. The evaluation of dizziness in elderly patients. *Postgrad Med J* 1992;68:558-61.
- [11] Sixt E, Landahl S. Postural disturbances in a 75-year-old population: I. prevalence and functional consequences. *Age Ageing* 1987;16:383-98.
- [12] Kerber KA, Enrietto JA, Jacobson BA, et al. Disequilibrium in older people. A prospective study. *Neurology* 1998;51:574-80.
- [13] Matheson AJ, Darlington CL, Smith PF. Dizziness in the elderly and age-related degeneration of the vestibular system. *N Z J Psychol* 1999;28:10-6.
- [14] Telian SA, Shepard NT. Update on vestibular rehabilitation therapy. *Otolaryngol Clin North Am* 1996;29:359-71.
- [15] Hohansson M, Akerlund D, Larsen HC, et al. Randomized controlled trial of vestibular rehabilitation combined with cognitive-behavioral therapy for dizziness in older people. *Otolaryngol Head Neck Surg* 2001;125:151-6.