Dizziness and Loss of Balance in Individuals With Diabetes: Relative Contribution of Vestibular Versus Somatosensory Dysfunction

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The risk of falling is increased in people with diabetes who have peripheral neuropathy,[1] and quantitative measurements of balance have demonstrated increased body sway compared to unaffected peers.[2–5] Although differing in form of sensory input, the vestibular system is equally responsible for providing parallel spatially orienting information. Agrawal et al.[6] studied a population of > 21,000 individuals and reported a prevalence rate for vestibular dysfunction of 35.4%; the odds increased with age and were 70% higher among people with diabetes. Morphological studies have suggested that microvascular and connective tissue changes, as well as alterations of inner ear fluid metabolism, may contribute to otolithic injury in people with diabetes.[7,8] The purpose of this study was to determine whether peripheral neuropathy or vestibular dysfunction is more likely to disturb balance in patients with diabetes who have complaints of dizziness.

Design and Methods

Thirty-seven patients with either type 1 or type 2 diabetes who had complaints of dizziness, loss of balance, or falling and were referred to a specialized balance disorders clinic were examined to determine whether vestibular dysfunction, somatosensory dysfunction, or a combination of the two was most likely to contribute to postural disturbance. No subjects had examination evidence of orthostasis or neurological dysfunction other than known peripheral neuropathy. Visual acuities better than 20/40 were present in all patients. The study protocol was approved by the Florida State University institutional review board, and all patients provided written informed consent.

The patients were evaluated for polyneuropathy using a scoring system developed by Valk et al.[9] Tested modalities included strength, deep tendon reflexes, proprioception, vibration, pain, and touch. Vestibular testing consisted of oculomotor examination, Romberg and sharpened Romberg tests, Hallpike's maneuver, and Quix's test.[10] The relative contribution of somatosensory (proprioceptive) and vestibular systems to postural stability were quantitatively analyzed using a computer-linked platform system (EQUITEST Neurocom, Clackamas, Ore.) that examined sway and shear forces (i.e., center of gravity displacements). The system allows analysis of performance of visual, vestibular, and somatosensory systems individually and in varying combinations under both stable and destabilizing conditions. A balance score calculated as a percentage of body sway compared to maximal allowable sway of 12.5° is then assigned.

IN BRIEF

The authors studied patients with diabetes and complaints of dizziness to determine whether peripheral neuropathy or inner ear dysfunction was more likely to disturb balance. Quantitative testing showed that the majority failed to maintain balance in vestibular-related conditions and had normal equilibrium scores in conditions relying on somatosensory input. Vestibular dysfunction should be an immediate consideration in patients with diabetes and complaints of dizziness regardless of the presence of peripheral neuropathy.

Results

Clinical examinations identified 1 subject with no sign of neuropathy, 21 with mild neuropathy, 12 with moderate neuropathy, and 3 with severe neuropathy. Twenty-six patients displayed clinical signs of vestibular dysfunction on one or more tests. Quantitative dynamic platform posturography (DPP) revealed 27 patients with overall substandard equilibrium scores. Of those 27, 25 individuals were substandard in vestibular-derived conditions with normal somatosensory scoring. Five patients were substandard in somatosensory conditions, and three of the five were also deficient in vestibular scores, indicating a multisystem stability disorder.

Discussion

This investigation reconfirms that vestibular deficiency is present in a

high percentage of people with diabetes. Furthermore, this study suggests that vestibular deficiency contributes significantly more to quantitatively demonstrable disequilibrium than does proprioceptive loss resulting from peripheral nerve injury.

Clinical vestibular tests identify dysfunction in a significant percentage of patients with diabetes. It seems plausible that, despite the presence of peripheral neuropathy, balance remains stable because of compensatory parallel sensory input—visual and vestibular—and fails when inner ear dysfunction develops.

These results are significant because, while there are presently few therapeutic interventions for proprioceptive loss, there are a number of well-conceived studies documenting success in vestibular rehabilitation.[11,12] These studies emphasize the higher identification rates of vestibular dysfunction in conditions such as benign positional vertigo and note the availability of both central nervous system and vestibular plasticity. Successful rehabilitation strategies include repositioning maneuvers, retraining in motor strategies, emphasis on use of other sensory inputs, reduction of sensory conflict, adjustment of the gain of the vestibular ocular reflex, adaption to low-contrast sensitivity, and parsing of cognitive allocation.[13,14]

Thus, vestibular dysfunction should be an immediate consideration in people with diabetes who have dizziness complaints regardless of the presence of peripheral neuropathy, and rehabilitation strategies should be considered for those identified as having this dysfunction.

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