PREVENTING PAINFUL FALLS IN OLDER AGED PERSONS

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INTRODUCTION

Continued balance requires a unique integration of inputs from specialized cranial nerves (peripheral vestibular system), brainstem and peripheral nervous system all simultaneously feeding sensory messages into the brain. Balance also requires that the brain, brainstem, cranial nerves, peripheral nervous system and spinal cord are continually working (via efferent systems) to maintain posture in a non-constant, external environment. It is the purpose of this study to ascertain functionally, the latest therapeutic evaluative procedures and their effectiveness, in the quest to reduce the number of painful falls in persons over 60.

An initial assessment of an age-matched series of non-vertiginous control subjects (30) living in Florida, age 60-90, and a comparison with 15 aged-matched, 60-90 year olds, but symptomatic "vertiginous" Florida patients was accomplished. An initial comparison of both group's balance performance on the SportKAT 4000 system was made. Indications as to the individual participant's dysfunction as being due to central nervous system or peripheral vestibular system, (or both) was achieved via video Nystagmography testing and was recorded for each of the symptomatic group. SportKAT analysis was done on the asymptomatic age-matched 30 controls in a nearby town by another neurologist, Alyn Benezette, D.O. (Figure 1) A review of the appropriate literature for social and economic impacts of falls and balance disorders is also provided in this report.

The SportKAT 4000 internal computer scored the data and printed reports that gave an analog tracing of the testee's actual movements on the perturbed floor (see figure 4). A numerical score was given, based on actual time and distance from the center of the platform measured every second, as well as detailed printout of all movements. This time and distance number was titled, "The Balance Index Score", (BIS). A static BIS score above 700 at 6 PSI was considered abnormal. A dynamic (target-following) score above 2400 was considered abnormal. The lower a BIS score the better the patients balance.

The population in nursing homes is significant in our society and falls in these facilities occur quite frequently (1). Eighteen hundred nursing home residents over 60 die from falls each year. The average nursing home notes 4 falls per bed/yr, and hip fractures are quite common in nursing home residents. 330,000 hip fractures result from nursing home falls each year (2). The USA Medicare program reportedly spent $20 billion on the

diagnosis and treatment of falls in recent years. (Published newspaper reports indicated that Florida litigation costs were over $11,000 per bed per year in 2001.) Falls and fear of falling are clearly not only a major social and painful medical problem, but an economic problem as well. Costs of falls are estimated to be $32 billion for the Medicare program in 2020. More than 20% of falls in 85 year olds are fatal. (3) Nursing home residents fell three times as frequently as community-living adults of similar ages. (4)

MATERIALS AND METHODS

Static and Dynamic testing was done exclusively on the standard SportKAT 4000 apparatus on all symptomatic and asymptomatic subjects. This apparatus has a perturbable floor with 20 degrees maximum displacement in 360 degrees. (See Figure1). Floor pressure (PSI) can be, and is, controlled. All test studies were carried out at 6 PSI. The patients and controls mounted this perturbable platform with a handrail and were asked to complete a series of balance assessments. All symptomatic participants had three familiarization experiences on the apparatus, 1 static and 2 dynamic. One minute each, on this apparatus while either holding on, or not holding on to the handrail. Once comfortable on the test apparatus, they then performed a formal "static test", which included standing in place while balancing themselves with a computer screen feedback visible to them for a period of 30 seconds. They were then asked to complete several sequential "dynamic" balance tasks by first following a moving circle on a computer screen with their body moving and mimicking the commuter screen target movement. This was done first in a clockwise direction and then in a counter clockwise direction. The last, and reportedly, most difficult test was the body movements following a square clockwise movements. (**Fig. 9)** All patients were under constant protective observation. throughout the entire time of the study. Results were tabulated and presented.

All of the tested symptomatic participating individuals were asked to perform each of these standard movements for 30 seconds. A printed, objective report was generated with a tracing of the actual recorded movements, and the determinations of the Balance Index Scores (BIS) were made for all patients evaluated for therapy. Scores were typically 3-4 times higher in this dynamic modality, than in the static modality. Previously acquired, but non-published studies have suggested that a dynamic score of less than 2400 is normal, and scores of greater than 2400 are abnormal.

A comparative statistical analysis was made of the outcome of all these studies in this group of 15 vertiginous patients and the age-matched, 30 non-vertiginous, Florida resident controls.

The vertiginous patients who were subsequently selected for therapy or retraining were individually given up to 20 treatment sessions (average 10) at 15 minutes each on the SportKAT 4000 balance apparatus. Their BIS numerical scores and actual pattern printout of activity was carried out initially and sequentially, and then a comparison was made from before therapy to after each therapy session.

A careful, detailed medical/neuralgic history and examination was performed on all vertiginous participants and an informed consent was obtained. This evaluation was not done on the control group, nor were they given any familiarization practices prior to actual testing. Candidate patients with major neurological deficits, such as those with unilateral brain infarction with hemiplegia, or acoustic Neuroma post-op with major deficit, were excluded. Those who demonstrated obvious physical handicaps, such as aphasia, amputations, recent fractures, unstable spine, wheelchair bound and with moderate dementia were excluded.

DISCUSSION

"Falls are among the leading causes of injury-related visits to the emergency department in the United States and the primary etiology of accident-related deaths in persons over age 65 (1). Falls are often associated with significant pain and morbidity. Ninety percent of hip fractures result from falls. Most of these occur in individuals over age 70 (4). One third of community dwelling elderly residents, and 60% (almost 2/3) of nursing home residents, fall each year (5). Risk factors in the elderly include increasing age, medication usage, cognitive impairment and multitude sensory deficits. Treatment is typically directed to an "underlying cause." The mortality rate of falls increases dramatically with increasing age in both sexes and in all racial and ethnic groups. Falls account for 70% of accidental deaths in persons 75 years of age and older. Falls can be a market of poor health and declining function (6). Specialists frequently see patients who are unaware of any deafness (hearing loss), but who complain of and have spontaneous vertigo as well. There are many causes of vertigo and dizziness that are of medical concern. There are also many variables that are necessarily addressed in diagnosing and treating "imbalanced persons." It is said years ago (parenthetically) that the typical physician was noted to have a "decline in spirits" looking at patients who are "dizzy". This is a phenomenon that is perhaps less frequently occurring now with the available diagnostic equipment than it was, as Blackwell first described it in 1963.

It was also stated that one can be reasonably sure that "the patient is happy to move around and complains of dizziness, and at the same time, does not have vertigo". A common, "real" problem is the patient who presents with repeat attacks of spontaneous vertigo, and who was unaware of any deafness, tinnitus (hearing loss), and fullness of the ear (7).

Patients commonly use the term "dizziness" to describe symptoms that range from light-headedness to vertigo (true vertigo). Vertigo is defined as, "an illusory sensation of motion and its specific vestibular abnormality." (8) True vertigo is always used as a term with imbalance and vestibular system dysfunction, and is treated as predicated on the determinable causes (9). Balance disorders in elderly patients are clearly associated with increasing risk of falls. Often, vertigo is difficult to diagnose in the elderly because of chronic medical problems. (10)

Disequilibrium in older people has been previously studied as to the possible identity of both clinical and specific neuro-imaging features. Subcortical white matter brain changes were commonly found along with frontal atrophy on imaging studies in this age group. The authors typically found Disequilibrium of "unknown cause" in older people being associated with frequent falls and concerns about falling. Brain atrophy and white matter "spots" on the MRI were often found in this group of patients. The authors conclude some causes of Vertigo were probably related to small vessel disease (11).

In order for a patient to estimate his or her true special location and steadiness at all times, the brain must combine ongoing information from a variety of sources including vision, touch, joint position, inner ear impulses, and also a known expectation as to their position (12).

A longitudinal study of gait and balance dysfunction in normal, older people was carried out with the conclusion that the longitudinal history shows age-related functional decreases in vestibular, visual, auditory and somatosensory functions. These factors, however, were only WEAKLY CORRELATED with changes in gait and balance (13).

Girardi assessed balance in a group of aging persons and looked at the basic physical findings related to aging. ENT doctors focused on an analysis of balance dysfunction patients on what the primarily observed in the peripheral vestibular system testing. They noted that under microscopic study, Nero epithelial cells of the human vestibular organs decreased in number with age. In humans, pathologic neuronal losses did occur in vestibular nuclei, along with thinning of the temporal bones (14).

Girardi and Konrad reported a significant number of patients seeking treatment, and who had subsequently, undergone what they call "VRT", vestibular rehabilitation training (therapy on a balance apparatus). Following "VTR", the patient did improve balance function. The authors opined that there were 90 million Americans who would have dizziness in their lifetime and would present to a healthcare provider at least once. They estimated that number of dizzy persons to be 42% of the current population. Six million Americans annually seek help for vestibular dysfunction and balance disorders (15).

Predicting increased (in the elderly population) falls was assessed in that report by both computer dynamic postureography and electronystagmography (ENG). It was suggested that falls are a leading cause of morbidity and mortality in persons over the age of 65. The author noted that there will be 40 million people over 65 by the year 2010 and that the number of falls in the elderly population has actually increased. The conclusion was made that of those they tested for vertigo, 78% had some abnormalities, either on postureography of electronystagmography (15).

An objective analysis of vertiginous persons was carried out as to other possible, less frequent etiologies, included a post-traumatic dysfunction of balance, caused by head injury, whiplash, and barotraumas. With increasing violence in a western society, these vertiginous consequences of falls do occur quite frequently (16).

"Mal debarquement" literally means sickness of embarkment. This "sea sickness" is an illusion of movement felt to be occurring in travel by water, ship, boat, or air. It appears not to be peripheral vestibular, but etiologically located somewhere in the balance centers of the brain (18).

The cost-effectiveness of differential diagnostic testing for vertigo patients was addressed as being a significant, ongoing socioeconomic problem, and considerations of costs were noted for various types of diagnostic procedures. Blood work and MRIs were thought to be least cost-effective and video Nystagmography and postureography were considered as most cost-effective techniques. (19)

Dizziness and headache are both troubling and common human conditions that are "episodically occurring" symptom complexes. It was noted that Vertigo was present in 30% of migraineurs (10).

Most of the patients were placed in individualized treatment protocols and were re-studied in order to demonstrate objective re-test findings, such as outcome of balance retraining therapy. These protocols reduced significantly the number of dystaxic and dysmetric movements measured by physical performance testing on the SportKAT 3000.

The overall post-treatment BIS scores were significantly lower for our treatment group, as noted in the table below. (Average 10 therapy sessions peer patient).

SUMMARY:

The SportKAT diagnostic methodology, as utilized and described above, was able to ascertain critical balance dysfunction in fifteen (15) symptomatic people over 60 in Florida. The 15 symptomatic patient group was given benefit of primarily familiarization with the apparatus and their initial test scores were actually lower, even though they were symptomatic, than a group of 30 age-matched controls that were not given familiarization. This underscores the reason for patient familiarization with the testing protocol for patients.

The fifteen symptomatic patients who underwent balance retraining when re-examined showed significantly definitive improvements in their BIS scores and the risk of falls was reduced.

CONCLUSION:

Modern techniques of balance diagnosis and therapy, give us the ability to identify and therapeutically aid those individuals who are subject to painful falls because of central nervous system and or peripheral vestibular dysfunction. The task remains finding which individuals are at risk of falling, to identify their problem as CNS, PVS or both, and bring them into a structured, individually designed balance therapy program in order to prevent a number of painful falls.

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