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Co-diagnosis Frequency of Peripheral Vestibular Disorders and Physical Therapy

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Co-diagnosis Frequency of Peripheral Vestibular Disorders and Physical Therapy

by

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the requirements for the degree
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Each person whose signature appears below certifies that this dissertation in his/her opinion is adequate, in scope and quality, as a dissertation for the degree Doctor of Science.

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ABBREVIATIONS

BVH	Bilateral vestibular hypofunction
BPPV	Benign paroxysmal positional vertigo
CPRS	Computerized Patient Record System
ENG	Electronystagmography
ENT	Ear Nose and Throat
PI	Principle Investigator
PT	Physical Therapy
RVR	Reduced vestibular response
UVH	Unilateral vestibular hypofunction
VH	Vestibular hypofunction
VA	Veteran's Administration
VNG	Videonystagmography

ABSTRACT OF THE DISSERTATION

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Doctor of Science, Graduate Program in Physical Therapy
Loma Linda University, June 2012
Dr. Eric G. Johnson, Chairperson

Dizziness is among the most common reasons that people consult a physician. The two most common causes of dizziness related to peripheral vestibular dysfunction are benign paroxysmal positional vertigo (BPPV) and vestibular hypofunction (VH). Physical therapy (PT) is an effective component of the medical management for both conditions. The occurrence rate of concurrent BPPV and VH in the same patient has not been described in the literature. Identifying patients with co-diagnosis of BPPV and VH will allow the PT to construct a proper treatment sequence. We conducted a retrospective chart review of 500 consecutive medical records of Veteran's Administration male patients with dizziness referred for videonystagmography (VNG). Co-diagnosis of BPPV and VH, ipsilateral versus contralateral presentation, frequency of referral to PT, and age were recorded. Single diagnosis (38%) was more common than co-diagnosis (6.6%), and ipsilateral presentation of co-diagnosis (48.5%) more frequent than contralateral presentation (33.3%). Additionally, 80.7% of patients who tested positive for a peripheral vestibular disorder were not referred to PT. Age may be related to the occurrence of co-diagnosis of BPPV and VH.

CHAPTER ONE

INTRODUCTION

Dizziness is among the most common reasons that patients visit their primary care physician and is the most common symptom reported by elderly patients [9-11]. von Brevern et al. found 8% of individuals in the general population reported moderate to severe dizziness or vertigo [12]. For patients over 75 years of age, dizziness is the most common reason they see their physician [13]. Three sources of dizziness due to peripheral vestibular dysfunction are unilateral vestibular hypofunction (UVH), bilateral vestibular hypofunction (BVH) and benign paroxysmal positional vertigo (BPPV). UVH is the second most common cause of peripheral vestibular dysfunction, following BPPV [14]. Vestibular hypofunction (VH) is described as a disturbance of the vestibulo-ocular reflex (VOR) in one or both of the inner ears [8,15]. The VOR assists in maintaining gaze stability, which allows the eyes to maintain focus on a target while the head is moving [8-16]. BPPV is a common cause of dizziness and is estimated to be responsible for 20% of all reported cases [17]. BPPV is hypothesized to be a condition where otoconia are displaced from the utricle into one of the three semicircular canals. BPPV is classified as either canalithiasis or cupulolithiasis depending upon whether the otoconia are freely mobile within the endolymph or adhered to the cupula, respectively [17-19]. Vestibular dysfunctions have an impact on everyday life and increase fall risk [8].

Community dwelling adults with balance or vestibular dysfunction fall more frequently than those without vestibular dysfunction [1-4]. In order to provide appropriate

rehabilitation for vestibular dysfunction, a thorough evaluation must be performed [20]. The rate of return to normal daily function after BPPV or a VH is very good [5]. In a study examining recovery of function in acute unilateral vestibular loss (UVL), Herdman et al. reported that vestibular adaptation exercises resulted in improved postural stability and in a diminished perception of dysequilibrium [6]. One article reports that patients with BPPV and a history of otologic disease are more likely to present with vestibulopathy than those without otologic disease. [35]. If a patient has multiple sources of dizziness and only one source is treated, there will most likely be an incomplete resolution of symptoms. In the case of a co-diagnosis of BPPV and VH, it is recommended to treat and resolve BPPV first, which can be resolved in 1-3 visits [8]. Identifying patients with co-diagnosis of BPPV and VH will allow the PT to construct a proper treatment sequence. The frequency of co-diagnosis of BPPV and VH in the same patient has not been reported in the literature.

If a suspicion of vestibular-related dizziness is present, patients are often referred by their physician for an objective assessment of the oculomotor and vestibular systems using either electronystagmography (ENG), or videonystagmography (VNG). Both techniques record the movements of the eyes. The ENG uses surface electrodes and the VNG uses infrared technology to record eye movements. The ENG/VNG test battery is the standard test for diagnosis of a vestibular disorder [21-24]. The typical ENG/VNG test battery consists of three parts: oculomotor evaluation, positional testing, and caloric stimulation of the vestibular system [21]. Positional testing assesses for the presence of BPPV using the Hallpike-Dix and roll test. The Hallpike-Dix test assesses for posterior and anterior canal BPPV. The roll test assesses for horizontal canal BPPV. BPPV is

labeled according to the direction of the nystagmus that occurs during the testing. The audiologist performing the VNG test battery notes the direction of the nystagmus. [26-27].

The VNG also includes caloric stimulation of the vestibular system. Caloric stimulation is considered the standard for detecting unilateral peripheral vestibular dysfunction [22-23,28].

Eye movements are recorded with VNG. The peak slow-phase velocity of nystagmus is obtained for each of the 4 irrigations: cold right, cold left, warm right, and warm left. If the total eye speed is <30 degrees/second, the audiologist reports the testing as a bilateral vestibular hypofunction (BVH). If there is a reduced vestibular response (RVR) of 25% or greater between the two ears using Jongkee's formula, then the findings are consistent with a UVH [21,29-30]. VNG will be used throughout this paper to cover both methods of performing the test battery.

The most common cause of UVH is vestibular neuritis [16]. Vestibular neuritis is caused by a virus resulting in inflammation of the vestibular nerve [22,31]. Labyrinthitis is an inflammation of the labyrinth, including both the cochlea and vestibular systems [21]. Both vestibular neuritis and labyrinthitis can cause peripheral vestibular dysfunction, such as BPPV and UVH [21]. We speculated that patients in this study with co-diagnosis would have ipsilateral more often than contralateral vestibular dysfunction [16,21].

The purposes of this study were to determine the occurrence rate of co-diagnosis of VH and BPPV in the same patient, determine frequency of ipsilateral versus contralateral presentation in patients with co-diagnosis, determine the frequency of

referral to physical therapy (PT), and determine if age is related to the prevalence of co-diagnosis.

Methods

Once given VA Institutional Review Board (IRB) approval, we performed a retrospective consecutive chart review at the Jerry L. Pettis Veterans Administration Memorial Medical Center (VAMC Loma Linda) via VA Computerized Patient Record System (CPRS). VA male patients were included if over the age of 18 and referred by their physician for a VNG with a suspicion of vestibular-driven dizziness beginning August 2011 and continuing retrospectively until May 2005. Once 50 chart reviews were collected, a confidence interval based on the proportion of co-diagnoses estimated within +/- 2% was calculated to determine an appropriate sample size (n=500). The medical records were reviewed from most recent and continued retrospectively until 500 consecutive records meeting the inclusion criteria were collected.

Data Collected from the Chart

From the 500 patients meeting the inclusion criteria, the principle investigator (PI) recorded data from patients who had BPPV, UVH, BVH or a peripheral vestibular dysfunction as diagnosed by the VNG. The PI recorded whether each patient had a co-diagnosis, single diagnosis, or no diagnosis of VH or BPPV.

From the 500 patients meeting the inclusion criteria, Table 1 shows how patients were categorized into diagnosis groups, based on the following criteria (**Table 1**):

Table 1. Patient criterion for categorization into diagnosis groups.

Category	Criteria
Benign paroxysmal positional vertigo	Presence of vertical or transient torsional nystagmus in the Hallpike-Dix test; presence of vertical or transient horizontal nystagmus in the roll test
Unilateral vestibular hypofunction	RVR greater than or equal to 25%
Bilateral vestibular hypofunction	Total eye speed less than 30 deg/sec
Normal	No significant caloric asymmetry, no evidence of BPPV or central vestibular dysfunction

If there was a co-diagnosis, contralateral or ipsilateral presentation was recorded. Patient age and referral to PT were also recorded. In the cases of BPPV, there was not adequate information documented in the records to determine the specific canal affected so the PI labeled which side was affected. PT referral was determined based upon a recommendation from the referring Ear Nose and Throat (ENT) physician after the VNG results were recorded and read.

Statistical Analyses

Analysis was performed after data was collected on the first 50 patient medical records to determine an appropriate sample size. The proportion of co-diagnosis was expected to be small, so using 0.5 as the default estimate would have grossly overestimated the sample size needed. As an alternative, once 50 chart reviews were collected, a confidence interval based on the proportion of co-diagnoses estimated to within +/- 2% was calculated to determine the appropriate sample size of 500.

Using SPSS, version 20, (SPSS Inc; Chicago, Illinois), frequencies were calculated for single and co-diagnosis, ipsilateral and contralateral presentation of co-

diagnosis, and referral to PT. Means and standard deviations were computed for age. We used Pearson Chi-Square tests to determine if there was a relationship between referral/no referral to PT and positive/negative UVH. A one-way ANOVA was used to determine the difference in mean age among diagnosis groups. The level of statistical significance was 5%.

Results

The results from 500 chart reviews of VA male subjects from August 2011 and continuing retrospectively until May 2005 are as follows. The mean age was 66.1 years with a standard deviation of 14.0 years. First, we determined the occurrence rate of co-diagnosis of VH and BPPV in the same patient. We found that of the 500 patients sampled, 190 (38.0%) patients had a single diagnosis, and 33 (6.6%) had a co-diagnosis (**Table 2**).

Table 2. Age, frequency of diagnosis, presentation of co-diagnosis as contralateral or ipsilateral, and BPPV

Characteristic	Frequency	Percent
Diagnosis (n=500)		
None	277	55.4
Single	190	38.0
Co-diagnosis	33	6.6
Presentation of Co-diagnosis (n=33)		
Contralateral	11	33.3
Ipsilateral	16	48.5
Bilateral	6	18.2
BPPV (n=500)		
None	425	85.0
Right, Left, or Bilateral	75	15.0

BPPV = benign paroxysmal positional vertigo

The remaining 277 (55.4%) patients were not classified as having either BPPV or VH. Second, we determined the frequency of contralateral versus ipsilateral presentation in patients with co-diagnosis. Of the 33 (6.6%) patients with a co-diagnosis of BPPV and VH, 11 (33.3%) had a contralateral presentation, and 16 (48.5%) had an ipsilateral presentation. The remaining 6 (18.2%) patients had both an ipsilateral and contralateral presentation due to bilateral presentation of BPPV or vestibular hypofunction. At this site, 425 of the 500 (85.0%) patients were negative for BPPV and 75 (15.0%) were positive for BPPV.

Referral to Physical Therapy in Patients with a Vestibular Hypofunction

In this study, we also determined the frequency of referral to PT. The peripheral vestibular dysfunction was considered positive if the RVR was greater than or equal to 25%. There was a significant association between being classified with a vestibular hypofunction and non-referral to PT (p=.02). Of the 119 patients with an RVR ≥ 25%, 96 (80.7%) were not referred to PT and 23 (19.3%) were referred to PT (**Table 3**).

Table 3. Patients with/without a vestibular hypofunction and the frequency of referral to physical therapy.

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	Physical Therapy		
	Referral to PT	No referral to PT	Total
No vestibular hypofunction (<25% RVR) Frequency (%)	42 (11.1)	335 (88.9)	377
Vestibular hypofunction (≥25% RVR) Frequency (%)	23 (19.3)	96 (80.7)	119
Total	65	431 (86.9)	496
Pearson's Chi-Square p-value	.02		

PT = physical therapy, RVR = reduced vestibular response

Overall, 431 of 496 (86.9%) patients were not referred to PT. PT referral in the remaining 4 patients was unable to be determined in the records. The box plot shows outliers not referred to PT with positive vestibular hypofunction (**Figure 1**).

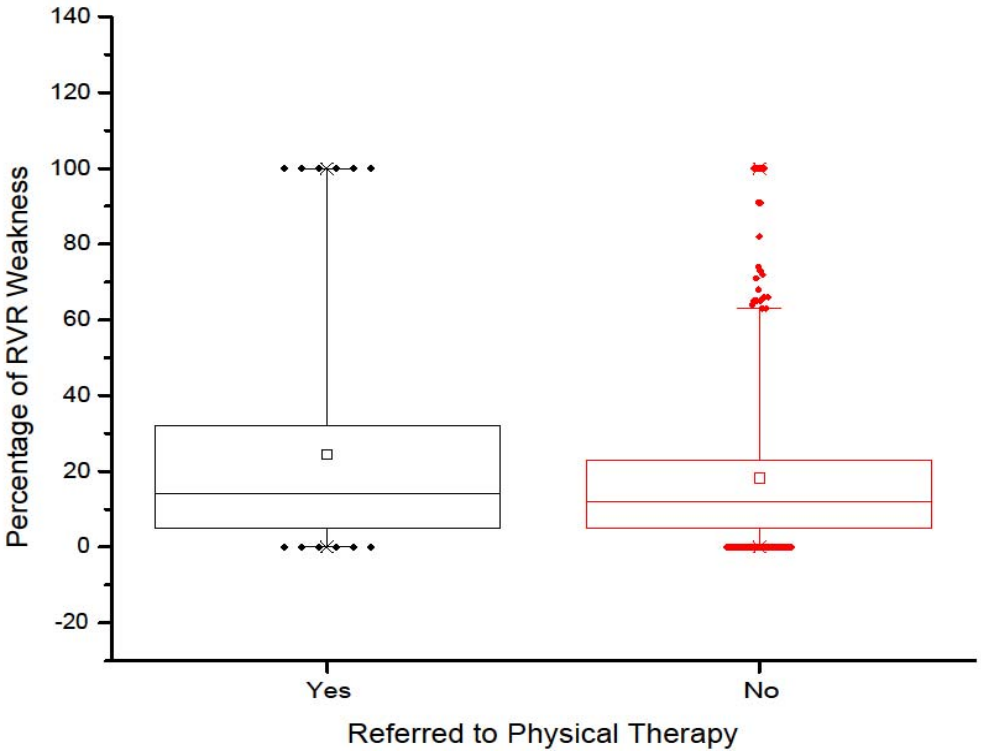

Figure 1. Patient referral rate to physical therapy based on percentage of reduced vestibular response (vestibular hypofunction)

Influence of Age on Co-Diagnosis

Lastly, we determined if age was a risk factor for the prevalence of co-diagnosis. There is a significant difference in mean age among the diagnosis groups (p=.005) (**Table 4**).

Table 4. Influence of age on prevalence of co-diagnosis. (N=500)

Diagnosis	N	Age	SD
None	277	64.3	13.9
Single	190	68.0	13.9
Co-diagnosis	33	70.1	13.6
One-way ANOVA (between groups)		p = .005	

ANOVA = Analysis of Variance, SD=standard deviation

Post Hoc analysis shows the group with co-diagnosis was older than those patients with single diagnosis and significantly older than the group with no diagnosis of BPPV or vestibular hypofunction.

Discussion

In this non-randomized retrospective chart review of 500 male patients referred by their physician for a VNG due to vestibular-related dizziness between August 2011 and May 2005 at the VAMC Loma Linda, California, we found the occurrence rate of co-diagnosis of BPPV and VH was 6.6% (95% confidence interval: 0.044, 0.088), and single diagnosis was 38.0%. Of the 6.6% patients with a co-diagnosis, there were 33.3% with a contralateral presentation and 48.5% with an ipsilateral presentation. This data supports our original hypothesis of increased incidence of ipsilateral presentation. A majority of patients classified as positive for a peripheral vestibular dysfunction were not referred to PT for intervention. Excluding symptom-based referrals, this data indicates that PT referral was not routinely utilized at this facility as a means of intervention for patients who tested positive on the VNG for peripheral vestibular dysfunction. Lastly, we found a

significant difference in mean age among the diagnosis groups (p=.005). The group with co-diagnosis was older than those patients with single diagnosis and significantly older than the group with no diagnosis of BPPV or vestibular hypofunction. This data also suggests that age may be related to the occurrence of co-diagnosis of BPPV and VH.

First, we found the prevalence of ipsilateral presentation of co-diagnosis was greater than contralateral presentation but these results were not statistically significant. Ipsilateral presentation was hypothesized to be increased compared to contralateral presentation by the investigators at the commencement of the study. Because viral infections can lead to both BPPV and UVH, we speculated that patients with co-diagnosis have ipsilateral more often than contralateral vestibular pathologies [16,21]. Further support for this hypothesis is evidenced in Karlberg et al., who reported that ipsilateral inner ear disease, such as acute or chronic unilateral or bilateral peripheral vestibulopathy, that detaches otoconia but does not destroy posterior semicircular canal function can cause BPPV [34]. Another study found that the mean duration for BPPV with idiopathic sudden sensory hearing loss and BPPV with unilateral vestibulopathy, such as vestibular neuritis and herpes zoster oticus, was longer than for other groups [36]. This is important information for the clinician as knowledge of these results may lead to a more rapid resolution of symptoms through a more thorough examination and treatment. The physical therapist evaluating a patient with vestibular-related dizziness may aid in the resolution of symptoms by treating and resolving BPPV first, which can be resolved in 1-3 visits in many cases [8]. Knowledge of incidence of co-diagnosis as well as ipsilateral presentation as predominant gives the clinician a wider knowledge base to assist in the rehabilitation of the vestibular system.

Second, we found a significant association between non-referral to PT and peripheral vestibular dysfunction. This data reflects PT referral based upon VNG findings alone. Based on VNG findings, patients appeared to be under-referred by their physician to PT. At this site, a patient is considered to be positive for a unilateral vestibular hypofunction if the RVR is 25% or greater during VNG testing. We found that 80.7% of patients in this category were not referred to PT. Overall, 65 of 500 patients were referred to PT. PT for vestibular rehabilitation is highly successful and the rate of return to normal daily function after vestibular rehabilitation is good [5-6]. We emphasize that this retrospective chart review was conducted at one facility based on VNG results and these findings cannot be generalized for referral to PT as a whole for vestibular dysfunction. Referral to PT should be made based on patient symptoms and not VNG results alone. In **Appendix A**, we have included a guidelines pamphlet aimed at informing audiology department's decision-makers on available physical therapy interventions.

An additional consideration regarding referral rate to PT must be addressed. Patients with vestibular-driven dizziness are typically referred by their physician for a VNG. Since dizziness is the most common reason patients over the age of 75 see their physician, we speculate that many of these patients had subjective complaints of disequilibrium and increased fall risk [13]. In this retrospective review, 11.1% of patients who tested negative for peripheral vestibular dysfunction were referred to PT. These patients with subjective history of dizziness but an RVR of <25% may not have been referred to PT. Referring these patients to PT should be considered in the future to evaluate fall risk and prescribe vestibular rehabilitation exercises as determined by the clinician. This area warrants further investigation.

Lastly, age may be related to the occurrence of the co-diagnosis of BPPV and VH. The mean age for patients with co-diagnosis was 70.1 years, single diagnosis was 68.0 years, and mean age for no diagnosis was 64.3 years. There is a statistically significant difference between the group with no diagnosis and co-diagnosis of BPPV and VH with age. The fact that dizziness is the most common reason that patients over 75 years see their physician gives support to our finding [13]. As patients age, the ability of the vestibular system to function at sufficient levels to maintain gaze stability decreases [32]. Anatomical studies have shown that the number of nerve cells as well as blood flow within the vestibular system decreases from age 55. It is also shown that as patient's age, the incidence of bilateral vestibular loss becomes more severe [32]. We speculate that the older populations of military veterans have been exposed to greater environmental risk factors over the course of their life and military experience. These risk factors may include introduction of various chemicals, or the occurrence of blast injuries, both which may lead to peripheral vestibular dysfunction [33].

An important consideration regarding age and co-diagnosis as discussed above is the time course of the two separate diagnoses. We cannot determine whether the significant difference between the group with no diagnosis and co-diagnosis was not confounded as time course is not reported in this study. From the data reported, we do not know the time course of the VH and BPPV. It is possible that patients may have a VH from years prior to VNG testing and developed BPPV near the time of VNG testing. A possible explanation is that the increase in co-diagnosis with age may simply be due to the increased incidence of BPPV in the elderly.

Study limitations include the fact that this retrospective chart review was conducted at one site and the information found should not be generalized to all sites conducting VNGs. Also, vertical nystagmus was noted to be prevalent in the patient records of this study. This may be due to the fact that VNG testers differ in the method by which they assess for BPPV during a VNG or the majority of veterans showed centrally-mediated signs of vertigo. As a result, we decided to collect vertical as well as torsional nystagmus when documenting for BPPV.

An additional limitation to this study may be that referral to physical therapy was determined based upon whether the referring ENT further recommended PT based upon the VNG test findings. It is possible that patients who were not referred by their ENT may have been referred by their primary care physician or other specialist for vestibular rehabilitation outside of the LLVA Medical Center. Knowledge of this information was outside the scope of this chart review. Knowledge of this information may have increased the referral rate to PT by both ENT and outside physicians. Lastly, we are not aware of the sequence of the symptoms of UVH and BPPV. Did the patient have a UVH followed soon after by BPPV or a long history of UVH followed recently by BPPV? This information impacts the relation of age to co-diagnosis.

Considering this is a retrospective chart review conducted at one VA facility, it may benefit future research to conduct a multi-site VA study to determine if there are changes in the frequency of co-diagnosis, side of presentation, referral to PT or the impact of age on these areas. It may be of interest to conduct a research study investigating the level of peripheral vestibular dysfunction based on the RVR from the VNG. At what RVR would it benefit a patient to be referred to PT?

Clinicians who evaluate and treat patients with vestibular dysfunction will benefit from the results of this study. From this initial study, we found that ipsilateral presentation of co-diagnosis is most prevalent, the frequency of referral to PT to be low in this population of veterans, and that the incidence of vestibular pathology may be related to age. Vestibular rehabilitation for patients with vestibular pathology may allow increased quality of life for veterans. Further research is warranted in this area.

Conclusion

This retrospective review shows that ipsilateral presentation of co-diagnosis is most prevalent in this population of veterans. It also demonstrates a low frequency of referral to PT in this population of veterans with peripheral vestibular dysfunction and confirmed that the incidence of vestibular pathology increases with age. We believe this study will heighten awareness of the adverse health impact of vestibular lesions for the general practitioners and the importance and benefits of PT. Knowledge of this information allows clinicians to make more informed decisions regarding their patients with vestibular dysfunction. Dysfunction of the peripheral vestibular system is a major clinical contributor to imbalance, ambulation problems and tendency to fall and engender anxiety and often limits daily activities. Future studies may use these results to determine how these lesions may impact veterans leading to better and more targeted patient-centered interventions.

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CHAPTER TWO

LITERATURE REVIEW

Introduction

Dizziness is among the most common reasons that patients visit their primary care physician and is the most common symptom reported in elderly patients.[1-3] von Brevern et al, found, in looking at the general population, 8% of individuals reported moderate to severe dizziness or vertigo.[4] For patients over 75 years of age, dizziness is the most common reason they see their physician.[5] With the high prevalence of dizziness amongst patients reflected in the current literature, and the large number of studies exploring the origin of this dizziness, this area of study cannot be ignored. The investigators in this study set out to determine the frequency of co-diagnosis of unilateral vestibular hypofunction and benign paroxysmal positional vertigo, whether the co-diagnosis is ipsilateral or contralateral in presentation, how age factors into the incidence of co-diagnosis, as well as physical therapy referral in this population.

According to a literature search using the CINAHL and PubMed databases, there are no studies reporting the frequency of a co-diagnosis of these vestibular disorders in the same patient as determined by their physician and/or health care professional. Knowing the rate of occurrence of co-diagnosis will better enable health care providers to a more rapid resolution of symptoms through physician referral and physical therapy intervention. The following literature review is focused on the basis for the above topic of study, stemming from the lack of literature to determine this question.

Literature Review

To provide a background for the purpose of this study, the sources of dizziness arising from peripheral vestibular disorders are discussed. Two sources of dizziness from peripheral vestibular dysfunction are unilateral vestibular hypofunction (UVH) and benign paroxysmal positional vertigo (BPPV). UVH is the second most common cause of peripheral vestibular dysfunction, following BPPV.[33] A vestibular hypofunction is described as a disturbance of the vestibulo-ocular reflex (VOR) in one or both of the inner ears.[7-8] The VOR assists in maintaining gaze stability, which allows the eyes to maintain focus on a target while the head is moving.[8-9] BPPV is a common cause of dizziness and is estimated to be responsible for 20% of all reported cases.[10] BPPV is a condition where debris, called otoconia, are displaced from the utricle into one of the three semicircular canals. BPPV is classified as either canalithiasis or cupulolithiasis depending upon whether the otoconia are free-floating within the endolymph or adhered to the cupula, respectively.[10-12] Vestibular dysfunctions have an impact on everyday life and increase fall risk.[8]

If a suspicion of vestibular-related dizziness is present, patients are often referred by their physician for a videonystagmography (VNG). The VNG provides an objective assessment of the oculomotor and vestibular systems. The VNG is the standard examination for diagnosis of ear disorders affecting one ear at a time.[13-16] The standard VNG consists of three parts: oculomotor evaluation, positional testing, and caloric stimulation of the vestibular system. The VNG uses infrared technology to record eye movements.[13] The VNG is the principle test battery reported in this study.

With the oculomotor evaluation, the subject is asked to have eyes follow objects that jump from place to place, remain still, or move smoothly. This is an assessment of spontaneous and positional tracking, smooth pursuit, optokinetic nystagmus and saccadic eye movements. Eye movements are recorded by a video camera that tracks the pupil of the eye. Any slowness or inaccuracies in the ability to follow the visual target are documented as such by the audiologist.[17]

With positional testing, the subject is placed into the Dix-Hallpike position to assess for posterior and/or anterior canal BPPV. During the Dix-Hallpike, the subject's head is turned 45 degrees to one side. Next, the subject is assisted into supine with the head extended 20-30 degrees over the edge of the table. Vertigo and nystagmus is observed during this time. Last, the head is maintained at 45 degrees and the subject is assisted into a seated position. Vertigo and nystagmus is again be monitored. The test is then repeated on the opposite side. The subject is also tested for horizontal canal BPPV via the roll test. In the roll test, the subject lies supine with the head flexed 20 degrees. The head is quickly turned to one side then repeated on the opposite side. Vertigo and nystagmus are recorded during these exams. The audiologist performing the VNG test battery notes whether the nystagmus is torsional, rotatory, and/or horizontal in nature. BPPV is labeled according to the side that is down when the testing occurs. This test determines if BPPV is present.[18-19]

The VNG, to be performed in this study, includes caloric stimulation of the vestibular system. Caloric stimulation is considered the gold standard for detecting unilateral peripheral vestibular dysfunction.[14-15,20] The caloric test is ordinarily performed with the subject reclining, head inclined 30 deg from horizontal so as to make the lateral

canal horizontal. Water is introduced into the ear canal on one side using a bulb syringe, either 7 degrees centigrade above or below assumed body temperature. The flow rate is such that the ear rapidly equilibrates with the water. The water is stopped after 30 seconds, and nystagmus is observed, while the subject is distracted. Nystagmus commonly builds for about 30 seconds, then gradually decays over about 2 minutes. After a rest of at least 5 minutes, the procedure is repeated with either the opposite temperature water, or on the other side. Eye movements are recorded with VNG. From the peak slow-phase velocity of nystagmus four numbers are obtained: cold right, cold left, warm right, and warm left. If the total response is less than 30 degrees/second, the audiologist administering the exam reports the testing as a bilateral vestibular hypofunction (BVH). If there is a relative vestibular reduction (RVR) of 25% or greater between the two ears using Jongkee's formula, then the findings are consistent with a UVH [13,21-22]

The VNG aids in determining a diagnosis of BPPV, UVH, vestibular labyrinthitis, and/or vestibular neuritis. The most common cause of UVH is vestibular neuritis.[9] Vestibular neuritis is commonly caused by a virus and is an inflammation of the vestibular nerve.[13,23] Labyrinthitis is an inflammation of the labyrinth within the inner ear.[13] Both vestibular neuritis and labyrinthitis often lead to peripheral vestibular dysfunction.[13] In this study, the VNG will assist in determining whether a patient has a co-diagnosis of BPPV and UVH, whether the co-diagnosis is ipsilateral or contralateral in presentation, the role of age, and PT referral in this population.

Conclusion

In order to provide appropriate rehabilitation for a vestibular disorder, a thorough evaluation must be completed.[24] The rate of return to normal daily function after BPPV or a UVH is very good.[25] Bjerlemo et al. reported that 100% of subjects undergoing vestibular rehabilitation had a cessation of spontaneous nystagmus within 6 months, and 52% of the subjects after 2 days.[26] In a study examining recovery of function in acute unilateral vestibular loss (UVL), Herdman et al. reported that vestibular adaptation exercises resulted in improved postural stability and in a diminished perception of disequilibrium.[34] The literature states that people with balance or vestibular disorders fall more frequently than community living adults without vestibular dysfunction.[28-31] Knowing the rate of occurrence of the co-diagnosis will better enable health care providers to a more rapid resolution of symptoms through physician referral and physical therapy intervention. We believe this study will heighten awareness of the adverse health impact of vestibular lesions for the general practitioners and the importance and benefits of PT. Dysfunction of the peripheral vestibular system is a major clinical contributor to imbalance, ambulation problems and tendency to fall and engender anxiety and often limits daily activities. Knowledge of this information allows clinicians to make more informed decisions regarding their patients with vestibular dysfunction.

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CHAPTER THREE

LOMA LINDA VA RESEARCH APPROVAL PROCESS AND

PERSPECTIVE PAPER

This chapter will serve as a perspective paper on my experience with the research approval process at the Jerry L. Pettis Loma Linda Veteran's Administration Memorial Medical Center (LLVA). My goal is that this information will be helpful in guiding future student's decision-making and direction with VA research. I will discuss my personal experience with the process as well as provide a stepwise listing with description of each sequential step in my journey to LLVA Institutional Review Board (IRB) Approval.

Perspectives

If I were offered the opportunity to begin the process of LLVA IRB approval today, would I do so, knowing what I know now? I am writing this perspectives paper to give future students insight into my experience, in order to allow them to make a more informed decision. My desire is to present future students with my experience so that they may make a more informed decision in their VA direction. Hindsight is always 20/20, and as I look back in time, I now see with a clearer perspective, the positive and negative aspects of my experience. I would like to present three elements that I believe need to be met in order for a future student to enter into this process. First, the student needs to understand the steps required for LLVA IRB approval and the time commitment

prior to beginning this process. Second, it is crucial to have a main point of contact administratively at the LLVA if one is traversing through the process. Third, it is critical that the student have an experienced VA – approved researcher to guide them in the process. This paper will further discuss the above elements as well as the learning that took place for me throughout this process.

July 2010 is the month I began my journey for LLVA IRB approval. July 19, 2011 is the date that my project was approved by the LLVA IRB. At the commencement of this process, my expectations did not match up with the reality of what was to come. My prior experience with an IRB approval process was during the course of my Loma Linda University Doctor of Physical Therapy (DPT) program in 2002-2005. My expectations were met during this process of LLU IRB approval. With the LLVA IRB process, there was a one year gap from beginning to end, when I was granted IRB approval. Below, I have provided a stepwise listing to LLVA IRB approval in my experience.

Throughout the year, the majority of my time was spent completing 8-10 hours of VA-related research trainings, travelling to and from the LLVA to meet with different offices to obtain signatures for completion of requirements, as well as waiting for the next phase in each step in the process. There seemed to be increased turn around time with each step and patience was important throughout the process. The positive aspect to the time and requirements needed is that there is a sense of accomplishment at the end of the process, no matter how laborious it was to arrive at the end.

Second, it is critical to have a main point of contact administratively, who is well versed in the procedures and protocols of LLVA student research when the researcher is

coming from outside of the LLVA. The LLVA has set up an individual to serve in this role; however, this role had just been formed when I began the process. As a result, I quickly discovered that there were not clear answers to many of my questions. This led to many changes along the course of the year with the need for introduction and exiting of co-PI's. As the person in this role become more comfortable with the position, I felt increased support and guidance from her from an administrative standpoint. I still feel like I can call her today with any pertinent questions and she will do her best to answer them. As an outsider to the VA system, many concepts appear foreign and it is important to have another person there who can help guide you through the administrative process.

Last, as seen in my stepwise listing to VA IRB approval, I began the process without a VA experienced researcher, and this led to many issues in the long run. Once I was connected with Dr. Firek, MD, who is an experienced researcher in the VA system, I was provided a sense of relief. He guided me through the abstract and proposal resubmission process. He has many connections within the LLVA and when I was not there on a daily basis, he was able to act as our VA liaison. He is engaging and interested in my project. He was also positive and encouraging throughout the process. As seen in the stepwise listing, once I was initially denied VA IRB approval, the ORA put me in touch with Dr. Guthrie, then Dr. Firek. This was an extremely helpful step in the process. The ORA provided me with great assistance in this matter. What I would have changed at the start of the process was increased awareness of the need for an experienced VA researcher. It is so important to have one who knows the workings of the LLVA to guide you along in the process of VA IRB approval.

Despite the pitfalls that I experienced while traversing LLVA IRB approval, I cannot say that I did not learn and grow throughout this process. I believe that this year long process has made me more independent as an individual, made me more comfortable with the VA system and its workings, and allowed me to better appreciate and understand all the steps that must take place prior to VA IRB approval. All of the above growth will make me a prepared researcher in the future.

In conclusion, the student needs to understand the steps required for LLVA IRB approval and the time commitment prior to beginning this process; it is crucial to have a main point of contact administratively at the LLVA if one is traversing through the process; and it is critical that the student have an experienced VA – approved researcher to guide them in the process. I may not have chosen to begin the LLVA IRB process again knowing what I know now; however, retrospectively, I am thankful for the experience that it provided me to grow as a more independent researcher.

Stepwise Listing to VA Institutional Review Board Approval

1. In July 2010, Dr. Eric Johnson, chairperson for my DSc degree, contacted Vicky Nixon-Taylor, LLVA IRB, to make contact regarding our study, and to inquire as to how to begin the process of IRB approval for a research project.
2. We were given the contact information for Candy Reed and Anne MacMurray at the LLVA, whose position is to guide researchers in the LLVA IRB process. This was a new position set up at that time.
3. Dr. Johnson and I set up a meeting with Ms. Reed and Ms. MacMurray at the LLVA in or around September 2010, where we discussed the topic for my

research paper, and were told that Dr. Berry Tsao, AuD, would need to be the principal investigator on the research project as she is a current employee of the LLVA and I am not an employee.

4. I was put in contact with Terry Dent, in the Office of Research Administration (ORA) at the LLVA to begin the processing of my Without Compensation (WOC) employment status at the LLVA, as well as to complete my required LLVA research trainings. I was informed that this will need to be completed prior to submitting to the LLVA IRB for approval.
5. Terry Dent gave me a listing of the 17 required research trainings. I was told that the research trainings would take some amount of time so to get started on them ASAP.
6. I completed the research trainings on the VA Learning Management System (LMS) website from home, over the course of one week, totaling approximately 8-10 hours.
7. I went to the ORA at the LLVA to give Terry Dent my research training completion documents. This was approximately October/November 2010. Now that the research trainings were complete, Terry Dent gave me a list of items that would need to be completed to obtain my WOC employee status.
8. Dr. Johnson was informed that Dr. Berry Tsao, Audiologist for the LLVA, is required to complete the research trainings, along with myself, as neither of us had been involved with the LLVA IRB process.
9. I informed Dr. Berry Tsao, AuD that she would need to complete the research trainings.

10. I met with Elwina Talbert, Credentialing Specialist for the LLVA. She asked me to fill out paperwork for my WOC, to obtain a National Provider Identifier online at https://nppes.cms.hhs.gov, and to return the information to her via fax.
11. I went Employee Health through the LLVA to obtain my Tb testing.
12. I went to the Human Resources (HR) Office of the LLVA to obtain my background check, including fingerprinting. My background check was complete within the month of November 2010.
13. I then went to the Information Technology (IT) department at the LLVA to request my LLVA computer access with the signed forms needed. I was given computer access at the LLVA at this time.
14. I presented my DSc Topic Defense, January 2011, and was accepted into DSc candidacy.
15. At this point, I was ready to submit the paperwork to the LLVA IRB for approval. Candy Reed informed me that I would need to complete all LLVA IRB forms, including forms: Request to Review Research Proposal Personnel list, Initial Application for IRB Review, HIPAA Form (Waiver), Informed Consent Full Waiver. I was also asked to submit an abstract and proposal to the IRB.
16. Not having experience with the necessary requirements for abstract and proposal submissions to the LLVA IRB, I sent many emails back and forth with Candy Reed, who assisted me from an administrative standpoint with the documents needed for IRB approval. Without LLVA guidance from an experienced VA researcher, I submitted my documents to the IRB in March 2011. As I look back, I did not submit enough information to the IRB for them to adequately make a

decision. I had the paperwork ready and edited, but was not aware I needed to submit the proposal in detail.

17. At this point, I was told that I had the option to be the sole principle investigator on my study, and that Dr. Tsao did not have to be a part of the study. So, I agreed, and met with Terry Dent and signed all the appropriate paperwork.
18. May 2011, I was asked to meet with the Information Security Officer (ISO) at the LLVA to discuss VA standards for data collection. I met with Candy Reed, and Craig Curtis, ISO, who made sure I was aware of VA standards for VA research data collection.
19. May 2011, I was informed that the ORA pulled my WOC status, due to the fact that Dr.Tsao signed the original WOC forms, and was never approved to perform research at the LLVA. Candy Reed informed me that I would need to have a LLVA experienced researcher as Co-principle Investigator (PI) on my project to obtain a new WOC.
20. The ORA contacted Dr. Guthrie, a research Audiologist at the LLVA, and asked him to meet with me regarding my project. I met with Dr. Guthrie, and at that time, he told me that he was not able to be a part of my study due to time and his inexperience with the topic of my project. He was helpful in giving me contact information for people at the LLVA.
21. June 14, 2011, I received an email from Maria Rodriguez, LLVA HRPP Administrator, that the LLVA IRB has determined that my IRB proposal was not acceptable for approval. The main issue reported by the IRB chair was not enough

information given in the proposal to make a decision. I contacted Candy Reed to assist me.

22. Within two days, Candy Reed put me in contact with Dr. Firek, MD, as a potential co-PI on my project. I met with Dr. Firek and explained to him that I have an entire proposal prepared but did not submit it due to lack of appropriate guidance. DrFirek and I made edits to my prepared/detailed proposal and he kindly assisted me with placing the proposal in a LLVA IRB-ready format.
23. The end of June 2011, I resubmitted my revised proposal to the LLVA IRB and on July 19, 2011, my IRB proposal was approved.
24. I resubmitted for WOC status to the Chief of Staff Office and it was accepted.
25. I wrote a letter, late August 2011, to obtain 1VPN access, which is a request to perform off-site computer use through the VA intranet. I wanted to collect data from home.
26. Approximately September 8, 2011, I was given 1VPN access to perform data collection from home.
27. I met with Dr.Firek to discuss the CPRS system, which is the VA computerized charting/documentation system. I was cleared to obtain a list of patients seen at the VA Audiology clinic for a VNG retrospectively by Dr. Berry Tsao.
28. I started data collection September 2011 and completed 500 consecutive chart reviews end of November 2011.
29. Since a year had passed since I last did my VA research trainings, Terry Dent requested that I complete the research trainings again, per policy. This took

approximately 4-5 hours, as the longest training only needs to be completed every two years (CITI Training).

30. I was asked to meet with Dr. Donna Strong, PhD, Research Compliance Officer, to review compliance with LLVA data collection protocol procedures and was cleared.
31. I am informed by Candy Reed that I will need to submit paperwork to the LLVA IRB at close of my study to close my project with the LLVA IRB.

CHAPTER FOUR

DISCUSSION

In this non-randomized retrospective chart review of 500 male patients referred by their physician for a VNG due to vestibular-related dizziness between August 2011 and May 2005 at the VAMC Loma Linda, California, we found the occurrence rate of co-diagnosis of BPPV and VH was 6.6% (95% confidence interval: 0.044, 0.088), and single diagnosis was 38.0%. Of the 6.6% patients with a co-diagnosis, there were 33.3% with a contralateral presentation and 48.5% with an ipsilateral presentation. This data supports our original hypothesis of increased incidence of ipsilateral presentation. A majority of patients classified as positive for a peripheral vestibular dysfunction were not referred to PT for intervention. Excluding symptom-based referrals, this data indicates that PT referral was not routinely utilized at this facility as a means of intervention for patients who tested positive on the VNG for peripheral vestibular dysfunction. Lastly, we found a significant difference in mean age among the diagnosis groups (p=.005). The group with co-diagnosis was older than those patients with single diagnosis and significantly older than the group with no diagnosis of BPPV or vestibular hypofunction. This data also suggests that age may be related to the occurrence of co-diagnosis of BPPV and VH.

First, we found the prevalence of ipsilateral presentation of co-diagnosis was greater than contralateral presentation but these results were not statistically significant. Ipsilateral presentation was hypothesized to be increased compared to contralateral presentation by the investigators at the commencement of the study. Because viral

infections can lead to both BPPV and UVH, we speculated that patients with co-diagnosis have ipsilateral more often than contralateral vestibular pathologies [16,21]. Further support for this hypothesis is evidenced in Karlberg et al., who reported that ipsilateral inner ear disease, such as acute or chronic unilateral or bilateral peripheral vestibulopathy, that detaches otoconia but does not destroy posterior semicircular canal function can cause BPPV [34]. Another study found that the mean duration for BPPV with idiopathic sudden sensory hearing loss and BPPV with unilateral vestibulopathy, such as vestibular neuritis and herpes zoster oticus, was longer than for other groups [36]. This is important information for the clinician as knowledge of these results may lead to a more rapid resolution of symptoms through a more thorough examination and treatment. The physical therapist evaluating a patient with vestibular-related dizziness may aid in the resolution of symptoms by treating and resolving BPPV first, which can be resolved in 1-3 visits in many cases [8]. Knowledge of incidence of co-diagnosis as well as ipsilateral presentation as predominant gives the clinician a wider knowledge base to assist in the rehabilitation of the vestibular system.

Second, we found a significant association between non-referral to PT and peripheral vestibular dysfunction. This data reflects PT referral based upon VNG findings alone. Based on VNG findings, patients appeared to be under-referred by their physician to PT. At this site, a patient is considered to be positive for a unilateral vestibular hypofunction if the RVR is 25% or greater during VNG testing. We found that 80.7% of patients in this category were not referred to PT. Overall, 65 of 500 patients were referred to PT. PT for vestibular rehabilitation is highly successful and the rate of return to normal daily function after vestibular rehabilitation is good [5-6]. We emphasize that this

retrospective chart review was conducted at one facility based on VNG results and these findings cannot be generalized for referral to PT as a whole for vestibular dysfunction. Referral to PT should be made based on patient symptoms and not VNG results alone.

An additional consideration regarding referral rate to PT must be addressed. Patients with vestibular-driven dizziness are typically referred by their physician for a VNG. Since dizziness is the most common reason patients over the age of 75 see their physician, we speculate that many of these patients had subjective complaints of disequilibrium and increased fall risk [13]. In this retrospective review, 11.1% of patients who tested negative for peripheral vestibular dysfunction were referred to PT. These patients with subjective history of dizziness but an RVR of <25% may not have been referred to PT. Referring these patients to PT should be considered in the future to evaluate fall risk and prescribe vestibular rehabilitation exercises as determined by the clinician. This area warrants further investigation.

Lastly, age may be related to the occurrence of the co-diagnosis of BPPV and VH. The mean age for patients with co-diagnosis was 70.1 years, single diagnosis was 68.0 years, and mean age for no diagnosis was 64.3 years. There is a statistically significant difference between the group with no diagnosis and co-diagnosis of BPPV and VH with age. The fact that dizziness is the most common reason that patients over 75 years see their physician gives support to our finding [13]. As patients age, the ability of the vestibular system to function at sufficient levels to maintain gaze stability decreases [32]. Anatomical studies have shown that the number of nerve cells as well as blood flow within the vestibular system decreases from age 55. It is also shown that as patient's age, the incidence of bilateral vestibular loss becomes more severe [32]. We speculate that the

older populations of military veterans have been exposed to greater environmental risk factors over the course of their life and military experience. These risk factors may include introduction of various chemicals, or the occurrence of blast injuries, both which may lead to peripheral vestibular dysfunction [33].

An important consideration regarding age and co-diagnosis as discussed above is the time course of the two separate diagnoses. We cannot determine whether the significant difference between the group with no diagnosis and co-diagnosis was not confounded as time course is not reported in this study. From the data reported, we do not know the time course of the VH and BPPV. It is possible that patients may have a VH from years prior to VNG testing and developed BPPV near the time of VNG testing. A possible explanation is that the increase in co-diagnosis with age may simply be due to the increased incidence of BPPV in the elderly.

Study limitations include the fact that this retrospective chart review was conducted at one site and the information found should not be generalized to all sites conducting VNGs. Also, vertical nystagmus was noted to be prevalent in the patient records of this study. This may be due to the fact that VNG testers differ in the method by which they assess for BPPV during a VNG or the majority of veterans showed centrally-mediated signs of vertigo. As a result, we decided to collect vertical as well as torsional nystagmus when documenting for BPPV.

An additional limitation to this study may be that referral to physical therapy was determined based upon whether the referring ENT further recommended PT based upon the VNG test findings. It is possible that patients who were not referred by their ENT may have been referred by their primary care physician or other specialist for vestibular

rehabilitation outside of the LLVA Medical Center. Knowledge of this information was outside the scope of this chart review. Knowledge of this information may have increased the referral rate to PT by both ENT and outside physicians. Lastly, we are not aware of the sequence of the symptoms of UVH and BPPV. Did the patient have a UVH followed soon after by BPPV or a long history of UVH followed recently by BPPV? This information impacts the relation of age to co-diagnosis.

Considering this is a retrospective chart review conducted at one VA facility, it may benefit future research to conduct a multi-site VA study to determine if there are changes in the frequency of co-diagnosis, side of presentation, referral to PT or the impact of age on these areas. It may be of interest to conduct a research study investigating the level of peripheral vestibular dysfunction based on the RVR from the VNG. At what RVR would it benefit a patient to be referred to PT?

Clinicians who evaluate and treat patients with vestibular dysfunction will benefit from the results of this study. From this initial study, we found that ipsilateral presentation of co-diagnosis is most prevalent, the frequency of referral to PT to be low in this population of veterans, and that the incidence of vestibular pathology may be related to age. Vestibular rehabilitation for patients with vestibular pathology may allow increased quality of life for veterans. Further research is warranted in this area.

Conclusion

This retrospective review shows that ipsilateral presentation of co-diagnosis is most prevalent in this population of veterans. It also demonstrates a low frequency of referral to PT in this population of veterans with peripheral vestibular dysfunction and

confirmed that the incidence of vestibular pathology increases with age. We believe this study will heighten awareness of the adverse health impact of vestibular lesions for the general practitioners and the importance and benefits of PT. Knowledge of this information allows clinicians to make more informed decisions regarding their patients with vestibular dysfunction. Dysfunction of the peripheral vestibular system is a major clinical contributor to imbalance, ambulation problems and tendency to fall and engender anxiety and often limits daily activities. Future studies may use these results to determine how these lesions may impact veterans leading to better and more targeted patient-centered interventions.

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APPENDIX A

GUIDELINES PAMPHLET AIMED AT INFORMING AUDIOLOGY DEPARTMENTS DECISION-MAKERS ON AVAILABLE PHYSICAL THERAPY INTERVENTIONS

Who Will Evaluate and Treat Your Patient for Physical Therapy?

- Vestibular rehab is performed by physical therapists with Masters and Doctoral level degrees
- Physical therapists have advanced certification/training in vestibular rehabilitation
- Physical Therapy treatment includes:
  - Canal repositioning maneuver
  - Adaptation, habituation, substitution and balance exercises
  - Strengthening
  - Neuro-Com Balance Master assessment and treatment
- Time Frame for treatment:
  - BPPV: approx. 1-3 visits
  - UVH: approx. 6 wks
  - BVH: approx. 6-12 wks

LLUMC

Loma Linda University Medical Center, Outpatient Rehabilitation

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LLUMC,
Outpatient Rehabilitation

Physical Therapy for Patients with Dizziness

LLUMC
"To Make Man Whole"

909-558-6144

Is physical therapy underutilized for veterans with peripheral vestibular disorders?

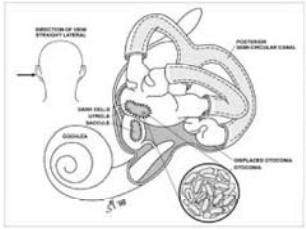
Increased Risk for Falls

How Common is Dizziness?

Dizziness is among the most common reasons that patients visit their primary care physician and is the most common symptom reported in elderly patients.[1] For patients over 75 years of age, dizziness is the most common reason they see their physician.[2] Community dwelling adults with balance or vestibular dysfunction fall more frequently than those without vestibular dysfunction.[3] Vestibular dysfunctions have an impact on everyday life and increase fall risk.

Which Peripheral Vestibular Disorders are Treated by Physical Therapy?

- **Benign paroxysmal positional vertigo (BPPV):** a condition where otoconia are displaced from the utricle into one of the three semicircular canals. Typically resolved in 1-3 visits.
- **Unilateral and bilateral vestibular hypo-function (UVH/BVH)**: a disturbance of the vestibulo-ocular reflex (VOR) in one or both of the inner ears. The VOR assists in maintaining gaze stability, which allows the eyes to maintain focus on a target while the head is moving. Typically adapted within 6 weeks to 12 months.
- **Motion Sensitivity:** Results from an understimulated vestibular system, possibly stemming from one of the above dysfunctions.



Vestibular apparatus showing typical location of otoconia within the inner ear

Current Literature: The Benefits of Physical Therapy for Patients with Peripheral Vestibular Dysfunction

- Vestibular adaptation exercises result in improved postural stability and in a diminished perception of dysequilibrium[4]
- The rate of return to normal daily function is very good[5]
- May result in decreased medical costs, decreased time off work and decreased anxiety

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