



---

## DISORDERS

---

### FALL PREVENTION

Taking precautions and using assistive mobility devices can help prevent falls which are often associations with PVP.

---

## ARTICLE

---

119

---

**DID THIS ARTICLE  
HELP YOU?  
SUPPORT VEDA AT  
VESTIBULAR.ORG**

---

5018 NE 15th Ave.  
Portland, OR 97211  
1-800-837-8428  
info@vestibular.org  
vestibular.org

# Presbyvestibulopathy (PVP)

By Pavan Suresh Krishnan, B.A. and Deepa Galaiya, M.D.

## CASE PRESENTATION

JS is a 75-year-old male presenting with progressive imbalance. He first noticed symptoms five years ago and has had three falls while walking on uneven surfaces without significant injury. He previously led an active lifestyle as a college athlete, and he walked and hiked regularly throughout adulthood. However, these activities have become rarer in the last decade, and in the last few years his wife reports that he rarely leaves the house. He says that he has become apprehensive about using the stairs and walking without the lights on. He can drive during the day but is uncomfortable doing so at night. He has a history of hypertension that he takes medications for but has no other medical problems. He appears dejected and asks, "What is happening to me?"

## WHAT IS PRESBYVESTIBULOPATHY (PVP)?

Dizziness is complicated and often has many different causes. Presbyvestibulopathy is one type of vestibular disorder that occurs with aging and may be a cause of such symptoms for many individuals.

Presbyvestibulopathy (PVP), also known as presbyvertigo, is the age-related functional decline of the vestibular organs in the inner ear, known as the semicircular canals, utricle, and saccule. It is thought to be due to accumulated insults (infection, inflammation, poor cardiovascular health, medications, and/or trauma) and genetic predisposition over the course of a person's life. Consequences of untreated PVP include limited mobility, increasing fall-risk, social isolation, and significantly decreased quality of life (Agrawal et al, 2018).

## HOW COMMON IS PVP?

By 2050, the worldwide population of individuals aged 60 years and older will exceed two billion. In the US, nearly 20% of individuals aged 65 years and older report dizziness or balance problems in the past year (Lin, 2012), while 85% of individuals aged 80 years and older experience balance dysfunction (Agrawal et al, 2009). Such problems have been shown to significantly decrease quality of life, impacting speech, emotion, cognition, and memory. In addition, many patients associate fear and anxiety with their imbalance, leading to limited mobility and social isolation (Harun, 2016). The resulting aggregate economic burden is \$227 billion among individuals aged 60 years and older (Agrawal et al, 2018).



**WHY DOES PVP OCCUR IN AGING INDIVIDUALS?**

Studies demonstrate that age-related breakdown of cells in the vestibular system can cause dizziness, imbalance, and other symptoms of PVP.

The sensory cells of the inner ear, called hair cells, slowly degenerate with age, as do the neurons that transmit information from the hair cells to the brain, including vestibular nerve fibers, ganglion cells, and cerebellar nuclei. This degeneration is similar to what happens in the cochlea (the hearing organ) in presbycusis, or age-related hearing loss.

These findings are supported by vestibular testing in people, which shows a decline in function, mostly in the semicircular canals, then the saccule, and minimally affecting the utricle (Zalewski, 2015). Vestibular tests might even underestimate this decline since they use mild stimuli, which may not adequately detect vestibular dysfunction because of the brain's ability to adapt and compensate, which can hide vestibular decline (Paige, 1992).

Balance is a complex brain function that requires the integration of input from multiple sensory systems such as vision, proprioception (spatial sensors in our feet and spine), and the vestibular organs of the inner ear. When there is a deficiency in the functioning of the inner ear, your eyes and muscles compensate. The older one becomes, however, the more likely there is to be decline in all three of these systems, reducing the brain's ability to compensate for vestibular loss. Reduced sensation, vision acuity, and muscle strength all contribute to the brain's diminished ability to integrate signals from these different systems. Many of these sensory and mechanical losses progress slowly and may not be consciously recognized by the patient. Fear of falling is a result of this multisensory decline, which in turn contributes to anxiety, causing the patient to avoid situations they feel could cause them to fall, which in turn results in a positive feedback loop (i.e. more fear of falling).

**HOW IS PVP DIAGNOSED?**

Dizziness in the geriatric population often involves many factors, requiring careful consideration of the patient's medical history. Often, your physician will start their evaluation by ruling out other common causes of dizziness, such as medication side-effects. Medications that lower blood pressure or affect the nervous system are the most common offenders. In

such cases, your physician may ask you to consider alternatives to medications that may cause or make dizziness worse.

DIAGNOSTIC CRITERIA (Agrawal et al, 2019)
Chronic vestibular syndrome (at least 3 months duration) with at least two of the following symptoms:  <ol style="list-style-type: none"><li>1. Postural imbalance or unsteadiness</li><li>2. Gait disturbance</li><li>3. Chronic dizziness</li><li>4. Recurrent falls</li></ol>
Mild bilateral peripheral vestibular hypofunction
Age >= 60 years
Not better accounted for by another disease or disorder

Why is PVP underdiagnosed and undertreated? Age-related hearing loss, or presbycusis, is often diagnosed with a quantitative hearing test, known as pure-tone audiometry. This is a relatively simple diagnostic test that can be performed quickly and interpreted by a trained healthcare professional.

Unlike pure-tone audiometry, vestibular testing is indirect, time-consuming, and difficult to perform accurately. There is no single quantifiable measurement of balance. Assessment of the vestibular system is accomplished through indirect testing of reflexes. These reflexes include the vestibulocular (VOR) and vestibular spinal reflexes. Standard tests that evaluate the VOR include videonystagmography (VNG), rotational vestibular testing, ocular vestibular evoked myogenic potentials (oVEMPs), and video head impulse testing (vHIT). Similarly, the vestibular spinal reflex is evaluated using computerized dynamic platform posturography (CDP) and cervical vestibular evoked myogenic potentials (cVEMPs). Unlike audiograms, vestibular testing results do not provide a single quantifiable measurement of vestibular function. These tests also require a lot of specialized equipment and a trained professional to



perform, which limits access for many people. For example, in Europe, more than 60% of vestibular physical therapists report no vestibular function testing equipment at their workplace (Meldrum et al 2020).

## HOW IS PVP TREATED?

Vestibular rehabilitation (VR) with a physical therapist is the primary treatment approach. The goal of VR is to retrain the brain to recognize and process signals from the vestibular system and coordinate them with information from vision and muscles, while also addressing psychological problems such as anxiety and panic (Dunlap et al, 2019). Once diagnosed, it can take many months for patients to see improvement. Learn more about VRT at [bit.ly/3tbrJSG](https://bit.ly/3tbrJSG).



It may be necessary to take fall precautions, especially if dizziness is affecting your gait. Precautions include wearing appropriate shoes, removing hazards from the home, and using assistive mobility devices. Check out these articles on fall prevention ([bit.ly/3wWNaYS](https://bit.ly/3wWNaYS)) and safety-proofing your home ([bit.ly/3NqxZyl](https://bit.ly/3NqxZyl)).

Your physician may also refer you to an ophthalmologist (eye doctor) if you are having issues with your sight, or a geriatrician or psychiatrist for help with mood or anxiety problems.

At this time, there are no pharmacological drugs or surgical procedures that have been shown to help patients with PVP.

On the distant horizon, there are studies to develop a vestibular implant that would replace lost vestibular hair cells (Johns Hopkins University, NCT02725463).

## ABOUT THE AUTHORS

Pavan Krishnan is a research coordinator in the Department of Otolaryngology-Head & Neck Surgery at Johns Hopkins School of Medicine and a medical student at Virginia Commonwealth University School of Medicine. He is also a VeDA Ambassador and volunteer writer.

Dr. Deepa Galaiya is a neurotologist and skull base surgeon at Johns Hopkins School of Medicine.

## ADDITIONAL READING

- Phillips, J. S., Mallinson, A. I. & Hamid, M. A. Cost-effective evaluation of the vestibular patient. *Curr Opin Otolaryngol Head Neck Surg* 19, 403-409 (2011).
- Newman-Toker, D. E. et al. Spectrum of dizziness visits to US emergency departments: cross-sectional analysis from a nationally representative sample. *Mayo Clin Proc* 83, 765-775 (2008).
- Roland, L. T. et al. Utility of an Abbreviated Dizziness Questionnaire to Differentiate Between Causes of Vertigo and Guide Appropriate Referral: A Multicenter Prospective Blinded Study. *Otol Neurotol* 36, 1687-1694 (2015).
- Lohman, M. C. et al. Operationalization and Validation of the Stopping Elderly Accidents, Deaths, and Injuries (STEAR) Fall Risk Algorithm in a Nationally Representative Sample. *J Epidemiol Community Health* 71, 1191-1197 (2017).
- Stevens, J. A. The STEADI Tool Kit: A Fall Prevention Resource for Health Care Providers. *IHS Prim Care Provid* 39, 162-166 (2013).
- Halker, R. B., Barrs, D. M., Wellik, K. E., Wingerchuk, D. M. & Demaerschalk, B. M. Establishing a diagnosis of benign paroxysmal positional vertigo through the dix-hallpike and side-lying maneuvers: a critically appraised topic. *Neurologist* 14, 201-204 (2008).
- Kattah, J. C., Talkad, A. V., Wang, D. Z., Hsieh, Y.-H. & Newman-Toker, D. E. HINTS to diagnose stroke in the acute vestibular syndrome: three-step bedside oculomotor examination more sensitive than early MRI diffusion-weighted imaging. *Stroke* 40, 3504-3510 (2009).
- Whitney, S. L., Marchetti, G. F., Schade, A. & Wrisley, D. M. The sensitivity and specificity of the Timed 'Up & Go' and the Dynamic Gait Index for self-reported falls in persons with vestibular disorders. *J Vestib Res* 14, 397-409 (2004).
- Agrawal, Y., Carey, J. P., Hoffman, H. J.,



Sklare, D. A. & Schubert, M. C. The modified Romberg balance test: normative data in US adults. *Otol Neurotol* 32, 1309-1311 (2011).

- Grove, C. R., Heiderscheit, B. C., Pyle, G. M., Loyd, B. J. & Whitney, S. L. The Gait Disorientation Test: A New Method for Screening Adults With Dizziness and Imbalance. *Archives of Physical Medicine and Rehabilitation* 102, 582-590 (2021).

## REFERENCES

1. Agrawal, Y., Pineault, K. G. & Semenov, Y. R. Health-related quality of life and economic burden of vestibular loss in older adults. *Laryngoscope Investig Otolaryngol* 3, 8-15 (2018).
2. Lin, H. W. & Bhattacharyya, N. Balance disorders in the elderly: Epidemiology and functional impact. *The Laryngoscope* 122, 1858-1861 (2012).
3. Agrawal, Y., Carey, J. P., Della Santina, C. C., Schubert, M. C. & Minor, L. B. Disorders of balance and vestibular function in US adults: data from the National Health and Nutrition Examination Survey, 2001-2004. *Arch Intern Med* 169, 938-944 (2009).
4. Harun, A., Li, C., Bridges, J. F. P. & Agrawal, Y. Understanding the Experience of Age-Related Vestibular Loss in Older Individuals: A Qualitative Study. *Patient* 9, 303-309 (2016).
5. Agrawal, Y. et al. Presbyvestibulopathy: Diagnostic criteria Consensus document of the classification committee of the Bárány Society. *VES* 29, 161-170 (2019).
6. Zalewski, C. K. Aging of the Human Vestibular System. *Semin Hear* 36, 175-196 (2015).
7. Paige, G. D. Senescence of human visual-vestibular interactions. 1. Vestibulo-ocular reflex and adaptive plasticity with aging. *J Vestib Res* 2, 133-151 (1992).
8. Meldrum, D. et al. Vestibular rehabilitation in Europe: a survey of clinical and research practice. *J Neurol* 267, 24-35 (2020).
9. Dunlap, P. M., Holmberg, J. M. & Whitney, S. L. Vestibular rehabilitation: advances in peripheral and central vestibular disorders. *Current Opinion in Neurology* 32, 137-144 (2019).
10. Johns Hopkins University. First-in-Human Early Feasibility Study of Safety, Tolerability and Efficacy for a Multichannel Vestibular Implant in Individuals With Bilateral Severe-to-Profound Loss of Vestibular Sensation. <https://clinicaltrials.gov/ct2/show/NCT02725463> (2021).
11. Chow, M. R. et al. Posture, Gait, Quality of Life,

and Hearing with a Vestibular Implant. *New England Journal of Medicine* 384, 521-532 (2021).

---

©2022 Vestibular Disorders Association  
VeDA's publications are protected under copyright.  
For more information, see our permissions guide at  
[vestibular.org](https://vestibular.org). ***This document is not intended as a substitute for professional health care.***



**NOTES:****VESTIBULAR DISORDERS ASSOCIATION**

5018 NE 15th Ave. Portland, OR 97211  
1-800-837-8428 info@vestibular.org vestibular.org

---

## Did this free publication from VeDA help you?

You can ensure that educational articles like this continue to be available to vestibular patients like you by making a tax-deductible gift to VeDA today.

**SUPPORT VEDA**

One-time gift: ☐ \$40 ☐ \$50 ☐ \$75 ☐ \$100 ☐ \$250 ☐ other  
Monthly gift: ☐ \$10 ☐ \$15 ☐ \$25 ☐ \$35 ☐ \$50 ☐ other

☐ Check this box if you prefer that your donation remain anonymous.

**PAYMENT INFORMATION**

Donations gladly accepted online at <http://vestibular.org>. Check or money order in US funds, payable to VeDA.

Visa MC Amex Discover \_\_\_\_\_  
Card number Exp. date CVV code

\_\_\_\_\_  
Billing address of card (if different from mailing information)

**MAILING INFORMATION**

Name \_\_\_\_\_ Telephone \_\_\_\_\_ Email \_\_\_\_\_  
Address \_\_\_\_\_ City \_\_\_\_\_ State/Province \_\_\_\_\_ Zip \_\_\_\_\_  
Country \_\_\_\_\_