

Medicine

Insights into Benign Paroxysmal Positional Vertigo in the Elderly

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Vertigo, the illusion of movement of oneself or one's surroundings in the absence of actual movement, is a common symptom in older adults and, as such, is commonly regarded as an age-related normal or part of the aging process itself, as its incidence increases with age. In neurology and otorhinolaryngology, benign paroxysmal positional vertigo (BPPV) is the most common cause of vertigo. BPPV is a brief, recurrent episode of vertigo caused by changes in head position relative to the direction of gravity. The symptoms of peripheral vestibular disease are vertigo and characteristic nystagmus. The prevalence of undiagnosed BPPV is high due to the fact that many elderly tolerate vertigo symptoms. According to etiology, it can be subdivided into idiopathic BPPV and secondary BPPV, and according to location, it can be subdivided into posterior semicircular canal BPPV, horizontal semicircular canal BPPV, and anterior semicircular canal BPPV.

Keywords: Benign Paroxysmal Positional Vertigo; Semicircular Canal; Neuronal Injury; Elderly; Degeneration

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Epidemiology

Vertigo is the perception of movement of oneself or one's surroundings in the absence of actual movement. Báány first described positional vertigo in 1921, defining it as the sensation of rotation caused by changes in head position relative to gravity. Nevertheless, BPPV was proposed in 1952 by Dix and Hallpike and is the most common cause of vertigo in the elderly, with a cumulative lifetime incidence of 10% in the general population (1). Vertigo is a common and debilitating condition among the elderly. Approximately 30% of individuals over the age of 60

and nearly 50% of individuals over the age of 85 suffer from vertigo (2). Vertigo is a significant risk factor for falls in older adults and a remarkable cause of disability in those over 65 (3, 4).

Approximately 5.6 million outpatients in the United States visit a doctor annually with vertigo as the primary complaint, and 17% to 42% of the vertigo patients are eventually diagnosed with BPPV (5). Nearly one-third of 4,294 patients with vertigo from 13 countries and 28-month data were diagnosed with BPPV in a large study (6). The prevalence of undiagnosed

BPPV in the elderly is also quite high.

Pathogenesis

BPPV is believed to be caused by the discharge of particulate matter into the semicircular canals (possibly due to debris from ear cone cells). Two fundamental theories can explain the pathophysiology of BPPV: canal calculi and cup calculi (7). The term canalolithiasis refers to the shedding of otolith particles from utricular cysts into the lumen of the semicircular canal. When the position of the head changes relative to the direction of gravity, the otolith particles are displaced relative to the wall of the semicircular canal, resulting in endolymph flow. This causes a displacement of the ampullary crest's crest cap, resulting in vertigo. Cupulolithiasis refers to the otolith particles on the utricular cysts that fall off and adhere to the crest cap of the ampulla ridge, resulting in changes in the density of the crest cap relative to the endolymph, rendering it sensitive to gravity and causing repeated attacks of transient dizziness (8). In both hypotheses, the initial causative factor is an ear deformity disorder. Ear cone cells are composed of organic and calcium carbonate components. Detachment and fragmentation of cell membranes increases the likelihood of BPPV (9). Other age-related factors that cause alterations in endolymphatic pH or calcium concentration may aggravate these processes (10).

The posterior semicircular canal is the most common site of BPPV (88.4%), followed by the horizontal semicircular canal (6.4%) and the anterior semicircular canal (5.2%). Because the semicircular canals are at the highest point of the labyrinth, they are rarely involved.

Cause

BPPV can be broken down into two types: idiopathic BPPV, which is caused by auricular cone detachment for no known reason, and secondary BPPV, which is caused by auricular cone detachment for other reasons. Most people with BPPV had idiopathic BPPV, which means they did not know what caused it (61.9%), and only a few had a specific cause found (11). According to different diagnostic criteria and differences in the patients studied, the most common causes were vestibular/peripheral vertigo (5.4%-42.1%), benign peripheral positional vertigo (4.3%-39.5%), vestibular neuritis (0.6%-42.1%) 24.0%, Meniere's disease (1.4%-2.7%), cardiovascular disease (3.8%-56.8%), neurological disease (1.4%-11.4%), and psychogenic vertigo (1.8%-21.6%) (12). People in their later years often have many different diseases and health problems. BPPV can be caused by many diseases, which can lower the quality of life. Some neurological diseases, like tinnitus, hearing loss, and vestibular dysfunction, are often linked to feeling dizzy and having trouble keeping your balance.

Common disorders of the aged, such as hypertension and diabetes, are linked to progressive hearing loss and even sudden-onset sensorineural hearing loss (SSNHL) (13). The connections between diabetes, osteoarthritis, osteoporosis, depression, and BPPV recurrence were evaluated using data from 1,092 BPPV patients at 11 centers in seven countries, 19.8% of patients with BPPV had at least one comorbidity, while 37.4% of patients had two or more comorbidities (14).

The incidence of BPPV was higher in individuals with

type 2 diabetes (46%) than in patients with non-metabolic disease (37%), according to a study of 3,933 patients (15). In a multivariate analysis, blood lipids were found to be a risk factor for BPPV, and they hypothesized that the effect of hyperlipidemia on vascular endothelial function may be strongly associated with small dense low-density lipoprotein (sdLDL) (16), and impairment to the inner ear's vascular endothelial function will result in ischemia of the inner ear, making it simple for otoliths to dislodge and contributing to the development of BPPV (17). Recent research has demonstrated that osteoporosis is one of the risk factors for BPPV, presumably because BPPV is related with an aberrant calcium metabolism (18).

According to a meta-analysis, female gender, hypertension, diabetes, hyperlipidemia, osteoporosis, and vitamin D deficiency were risk factors for BPPV recurrence (19). Furthermore, sleep quality is an independent risk factor for recurrent BPPV (20, 21).

Diagnosis

Practical guidelines for the diagnosis and treatment of BPPV was developed that can be used to diagnose and treat BPPV in older patients (22, 23). Patients with vertigo should have a thorough medical history reviewed before receiving a diagnosis. Following a thorough record-keeping of the physical examination and neurological examination, the symptoms and course of the disease, prior surgical history, infection or trauma history, and medication use should all be considered. At this point, the examiner ought to be able to identify the disease's most likely etiology or at the very least be able to distinguish between peripheral and central vertigo. The Dix-Hallpike test is the gold standard for determining BPPV in the posterior semicircular canal. The patient's head is 45° below horizontal and the affected ear is 45° rotated when they quickly transition from a sitting to a sleeping posture. The test result was positive if with nystagmus. When the supraocular pole on a Dix-Hallpike examination exhibits vertical torsional nystagmus, anterior semicircular canal BPPV can be detected (the vertical component goes to the inferior pole of the eyeball and the torsional component goes to the ground). Shaking the head while being examined may increase the effectiveness of the Dix-Hallpike test in terms of diagnosis.

The lateral recumbency test is an alternative diagnostic test that involves the following steps (24): place the patient in a starting neutral position, turn the patient's head rapidly to the right, check for characteristic nystagmus, return the head to a face-up position, and allow the nystagmus all subsided, then a quick turn to the left to check for nystagmus again, which can be used in patients who cannot use the Dix-Holpike method, but is much less sensitive.

Bilateral roll test can diagnose horizontal semicircular canal BPPV and can be judged as horizontal semicircular canal lithiasis and cup lithiasis according to the duration of nystagmus (25). Specific steps: The patient is in a supine position, the head is raised about 30° above the horizontal plane, the head is quickly turned to one side by 90° and the head angle is kept unchanged for 1 min, the patient's vertigo and nystagmus are recorded, and then the head is turned back In the middle position, the head angle remained unchanged for 1 min, and then the head

was quickly turned 90° to the other side, and the head angle was also kept unchanged for 1 min, and the patient's vertigo and nystagmus were recorded again. In cases where postural examination is not possible due to mobility impairment or other reasons, there may be diagnostic and therapeutic issues, and serum middle ear cone protein can be detected in patients. A new method for BPPV detection is proposed, but further research is needed to confirm this reliability of the method.

For patients with a positive history of BPPV and indeterminate postural tests, or for patients with atypical neurological signs and manifestations of BPPV, such as visual impairment, severe headache, or cranial nerve abnormalities, CT or MRI examinations can also be used for preliminary investigation. Many central and peripheral diseases can produce orthostatic nystagmus, which should be differentiated from BPPV. The most common central nervous system diseases that cause orthostatic vertigo include vertebrobasilar ischemia, which are mainly descending nystagmus, vertigo and vomiting (26). When orthostatic vertigo is suggested, but BPPV testing is negative, other etiologies, such as medical factors, should also be considered, including anticonvulsants, antidepressants, anxiolytics, sedatives, hypnotics, strong analgesics, and antiarrhythmics.

Cervical vertigo refers to a delusional movement caused by cervical degenerative disease and vertebral artery compression (27). Its clinical manifestations are similar to BPPV, but its important distinguishing point is persistent vertigo or nystagmus with neck the following body rotates. Intracranial disease can also cause positional vertigo, which is characterized by prolonged vertigo symptoms, sensorineural hearing loss, postural nystagmus that is less fatigued, and ineffectiveness to reduction maneuvers (28).

Treatments

Medical Treatment

Currently routinely used drugs for the treatment of BPPV include vestibular depressants, such as antihistamines, benzodiazepines or anticholinergics, as well as anti-anxiety and antiemetic drugs, but according to the currently published guidelines (22, 23), currently not pharmacological intervention is recommended. However, in patients with severe clinical symptoms, pharmacological intervention may have a short-term rapid control of autonomic symptoms such as nausea or vomiting. Medical therapy may be an alternative treatment in some patients who refuse to perform a positioning procedure due to excessive dizziness, nausea, or anxiety, or when manual reduction is not possible for physical reasons. In the case of drug therapy, physicians should remind patients that adverse drug reactions include falls, urinary retention, and confusion probably happened. Therefore, in the absence of severe vertigo, drug therapy should not be the first-line treatment option for BPPV in older adults. However, betahistine combined with lidocaine has a significant clinical effect on patients with residual dizziness after successful BPPV through canalith repositioning procedure (CRP), which can further improve the prognosis of patients (29).

Reset Therapy

Since the 1980s, manual reduction therapy for BPPV has achieved long-term and effective development. The BPPV ma-

neuver disperses semicircular canal fragments into the cysts, and the altered gravitational sensitivity during head movement no longer affects the vestibulo-ocular reflex. Brandt-Daroff proposed the first reduction method to effectively treat BPPV (30). However, the main advance in the treatment of BPPV was CRP proposed by Epley in 1992 based on the mechanism of duct stones (31). The effectiveness of CRP is widely recognized, and on the basis of a systematic review of all relevant randomized controlled trials, Epley manipulation was reported to be very effective in the treatment of posterior semicircular canal BPPV without any complications.

In a study of 965 patients with BPPV, CRP provided long-term remission of BPPV with an 85% response rate in the first course of treatment (32). The modified Epley method or the modified Semont method can be used for the treatment of BPPV in the posterior semicircular canal. The modified Epley method is to change the position of the head through a certain sequence and sufficient movement, remove the otolith in the posterior semicircular canal, and reset it to the utricle. Specific steps: (i) The patient takes a sitting position on the treatment bed and rotates the head 45° to the affected side; (ii) Quickly lie on the pillow placed on the shoulder, straighten the neck, and place the head on the bed. Keep the side ear facing down for more than 30 sec and observe until the nystagmus disappears; (iii) Maintain the flexion of the head and neck without turning the trunk, turn the head 90° to the healthy side, and hold for about 30 sec; (iv) Turn the head Rotate the body and the trunk to the unaffected side by 90°; lie on the side on the treatment bed, and maintain it for about 30 sec; (v) Keep the head position, slowly sit up with the help of the nursing staff, turn the head back, and lean forward 20°.

The modified Semont's rule is to move the otolith from the lowest deposition point to the semicircular canal and return to the utricle along it through the inertial action through rapid and large overall movement of the head and limbs to achieve the reset of the otolith (33). Specific steps: (i) The patient takes a sitting position on the treatment bed first, and rotates the head 45° to the unaffected side; (ii) Quickly lies on the side of the affected side, and the area behind the ear touches the bed surface for about 30 sec; (iii) Maintains with the head tilted to the side, sit up with the head and the trunk as a whole, and quickly lie on the side to the unaffected side, so that the forehead of the unaffected side touches the bed surface for about 30 sec; (iv) Then sit up and return to the initial position.

At present, there are two types of horizontal semicircular canal BPPV, one is geotropic nystagmus and the other is dorsal nystagmus. Manipulative repositioning methods for geotropic nystagmus include barbecue roll maneuver (BRM) (34), Vanucchi's forced long-term position method (35), and Gufoni's method (36). Manual repositioning methods for dorsal nystagmus include Appiani maneuver (37) and head-shaking maneuver (38). There are various reduction methods for the treatment of anterior semicircular canal BPPV, including reverse Epley maneuver (39), Kim maneuver (40), Rahko maneuver (41) and Yacovino maneuver (42). Studies have reported that Yacovino method for the treatment of anterior semicircular canal BPPV has a recovery rate of 60.0% for the first manual reduction, and a recovery rate of 75.0% in one week (25). However,

because the recurrence rate is significantly higher in the elderly, studies have shown that vitamin D and calcium supplementation can significantly reduce the recurrence rate of BPPV (43), and corresponding education should be carried out to reduce its potential incidence of falls.

Operation Treatment

With the understanding of the pathophysiology of BPPV and the improvement of the reduction operation, the surgical treatment of BPPV is getting less. Of the more than 5,000 people treated at the Balance Center, less than 1% needed to consider surgery, the report noted (44). Surgical treatment of refractory BPPV includes posterior semicircular canal occlusion and simple nerve resection (45). Because surgical complications include sensorineural or conductive hearing loss and vertigo, surgery is not recommended as a priority in patients with BPPV.

Conclusion

BPPV is the most common cause of vertigo in the elderly, and the incidence of BPPV increases with age, mostly idiopathic

BPPV. Posterior semicircular canal BPPV is the most common type, usually with paroxysmal vertigo, which is associated with rapid changes in head position, usually lasts from a few seconds to 1 min, and is often accompanied by nausea, but lasts longer than vertigo. many. Dix-Hallpike test is the gold standard for the diagnosis of posterior semicircular canal BPPV. If there is vertical dip and torsional nystagmus, it can be diagnosed as anterior semicircular canal BPPV. The diagnosis of horizontal semicircular canal BPPV requires bilateral roll test. The patient's medical history should be combined with the identification of central and peripheral diseases that can produce orthostatic nystagmus. With the understanding of the pathophysiology of BPPV and the development of reduction therapy, drug therapy is not recommended for BPPV first, but for patients with severe clinical symptoms, symptoms can be quickly controlled, and surgical treatment of BPPV is becoming less and less common. The effectiveness of reduction therapy has been widely recognized, but the recurrence rate after reduction is high, so reducing the recurrence rate after reduction is the goal of future efforts. ■

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