

Current knowledge in the diagnosis and treatment of benign paroxysmal positional vertigo

Diagnostyka i leczenia łagodnych napadowych zawrotów głowy ze zmiany położenia – stan aktualny

Stanisław Bień

Emerytowany Profesor Wydziału Lekarskiego i Nauk o Zdrowiu, Uniwersytetu Jana Kochanowskiego w Kielcach

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ABSTRACT:

Benign Paroxysmal Positional Vertigo (BPPV) is the most common disorder of the peripheral part of the Balance System. BPPV is caused by fragments of damaged utricular otolithic membrane, which displaced into the membranous semicircular canals, or stuck to the cupula, are responsible for incorrect cupula movements, due to gravity forces when position of the head is changed. The diagnosis and treatment as often focused of BPPV with canal pathology localized in posterior semicircular canal, but BPPV should also be due to lateral and rarely anterior canal pathology, what requires a different diagnostic methods and treatment. The clinical picture of BPPV may also be distorted due to coexistence with other diseases of Balance System, what doesn't exclude the treatments addressed to the BPPV.

The treatment of BPPV is based on reposition maneuvers, selected and correctly applied in dependence to the canal location of pathology, with aim to relocate otolithic debris back to the utriculus. As a complementary treatment of BPPV the methods of vestibular rehabilitation, psychology support and rarely the surgery are taken into consideration. There is a high effectiveness of immediate treatment of BPPV, but quite often the recurrences take place. The BPPV may also be a self-limited disease, what make effectiveness of treatment difficult to assess.

The key points for clinical practice are the correct criteria of BPPV definition, the extend of demanded diagnostic methods, and appropriate selection of treatment methods. The paper presents actual review of recommendations in this matter.

KEYWORDS:

benign paroxysmal positional vertigo, BPPV, BPPV diagnostic guidelines, BPPV treatment recommendations

STRESZCZENIE:

Łagodne napadowe zawroty głowy ze zmiany położenia (Benign Paroxysmal Positional Vertigo; BPPV) – to najczęstsze schorzenie obwodowej części układu równowagi. Wynika z nieprawidłowego ułożenia fragmentów uszkodzonej błony otolitowej plamki łagiewki, które przemieszczają się grawitacyjnie w świetle błoniastych przewodów półkolistych, bądź przesuwają – pod wpływem zmian położenia głowy – obciążony nimi osklepek. Zasady diagnostyki i leczenia BPPV najczęściej dotyczą patologii w obrębie kanału półkolistego tylnego. Należy jednak pamiętać, że obraz kliniczny i postępowanie w przypadku patologii otolitowej kanału bocznego i – najrzadziej – kanału półkolistego przedniego różnią się. Typowy obraz BPPV może być zniekształcony przy współistnieniu BPPV z innymi schorzeniami układu równowagi, co nie wyklucza terapii typowej dla BPPV.

Podstawową metodą leczenia BPPV są uwalniające manewry repozycyjne, dobrane w zależności od lokalizacji zmian otolitowych, zmierzające do odprowadzenia fragmentów otolitowych na powrót do łagiewki. Jako uzupełnienie leczenia BPPV stosowane są metody rehabilitacyjne, wsparcie psychologiczne i – rzadko – leczenie chirurgiczne. Doraźna skuteczność leczenia BPPV jest wysoka, ale często obserwuje się nawroty dolegliwości. W części przypadków BPPV choroba ustępuje samoistnie, co utrudnia ocenę odległych wyników.

W praktyce klinicznej kluczowe są: określenie kryteriów rozpoznania BPPV, zakresu wymaganej diagnostyki oraz prawidłowy dobór metod terapii. Praca stanowi przegląd aktualnej literatury i zaleceń w tym zakresie.

SŁOWA KLUCZOWE: łagodne napadowe zawroty głowy ze zamiany położenia, zalecenia diagnostyczne, zalecenia terapeutyczne

INTRODUCTION

Benign paroxysmal positional vertigo (BPPV) is one of the most common (17-42%) causes of broadly defined disorders of the balance system; according to some authors, it is the most common disorder of the vestibular system [1, 2, 3, 4, 5, 6]. Discrepancies in the reported incidence rates are due to the different criteria being used to diagnose BPPV as well as to quite high rates of self-recovery or remission of varied duration. The assumption that persistent yet benign vertigo does not lead to life-threatening outcomes in patients may lead to misdiagnosis and mismanagement of patients who are too easily classified into the BPPV population. Therefore, it is worthwhile to review the current diagnostic criteria and management guidelines of BPPV as part of a broader recapitulation of current knowledge on benign paroxysmal positional vertigo [1].

ETIOLOGY

Benign paroxysmal positional vertigo (BPPV) was first described, along with identification of all its important elements, by Barany in 1921 [ref. 7]. The only mistake Barany had made was to ascribe the disorders to abnormal stimulation of utricular and saccular sensory fields. The term “BPPV” was introduced into common use nearly 70 years ago by Margaret Dix and Charles Hallpike from the Royal Neurological Hospital in London who not only described a large group of patients suffering from BPPV, but also developed a test that has henceforth been a gold standard for the diagnosis of the most common form of BPPV consisting of an otolithic pathology within the posterior semicircular canal [8].

The pathomechanism of BPPV was explained by Schuknecht who examined the morphology of the inner ear and proposed the mechanism consisting in cupulolithiasis, i.e. the ampullary cupula within the posterior semicircular canal being overburdened by otolithic fragments displaced from the otolithic membrane of the utricular macula. As head position is being changed in relation to the gravity force vector, pathological stimulation of cupula occurs due to the increased cupular mass [7]. This mechanism was later broadened by Hall, Ruby, and McClure to include the concept of canalithiasis, consisting in cupular movement being due to otolithic fragments freely moving within the membranous semicircular duct within the posterior semi-

circular canal [9]. This was confirmed by Parnes and McClure who, when dissecting the posterior vertical semicircular duct for surgical blockage, identified otolithic fragments flowing freely within the duct’s lumen [10]. The pathomechanism of cupular stimulation in the course of BPPV contradicts the physiological function of cupula consisting in the perception of stimuli due to multiplanar rotation of the head at variable speeds (positive or negative acceleration), with cupular displacement being due to inertial movement of endolymph. In such cases, the gelatinous cupula does not react to the gravitational stimulus since its specific weight does not differ significantly from that of the surrounding endolymph. In cases of stimulation leading to BPPV, displacement of cupula overburdened due to cupulolithiasis is caused by head position being changed relative to the gravity vector. Similarly, non-physiological stimulation may be due to free gravitational displacement of otolithic fragments within the semicircular canal (canalithiasis), resulting in endolymph movements and thus cupular displacement. One mechanism does not rule out the other one; moreover, characteristic reaction latency between the change in the position of the head and the vertigo and nystagmus may be explained by the inertia of the cupular organ [11].

According to the reports, the most common causes of BPPV include head injury [11, 12], history of inner ear infection [11], or degenerative changes within the inner ear in elderly patients [7, 13]. Case reports are available presenting BPPV as being due to a microinjury in the course of otosclerosis surgery [11], long-term immobilization [14], or even Ménière’s disease [ref. 11]. According to Giannini et al., even a vibrational injury caused by a working dentist’s drill may damage the utricular otolithic membrane structures and thus lead to BPPV [15]. However, in their analysis of 249 cases of BPPV, Balloch et al. were unable to pinpoint the exact cause in nearly 48% of patients [11].

Nowadays, extensive literature is available on the pathomechanism, forms, diagnostics, and treatment of BPPV. Despite the fact that the PubMed database contains more than 1300 papers including the keyword “BPPV” and published within the last 30 years, we are still unable to answer all questions regarding this disorder in our everyday practice.

EPIDEMIOLOGY

The reported data on BPPV incidence rates differ due to the

differences in diagnostic criteria rather than to any population-related or other epidemiological factors. An important question is whether the diagnosis of BPPV was made at a general practice level or by a specialist physician and whether it had been confirmed by specific challenge tests. The incidence of BPPV may also be underestimated considering the fact that the disorder may resolve spontaneously in as many as ca. 50% of cases within the period of 3 months [16, 17]. As a result, some patients with less troublesome symptoms may never make it to the physician's office at all. Spontaneous remission of BPPV is also a factor distorting the available data on the efficacy of its treatment.

In Polish literature (n = 8,184 diagnosed for balance disorders at the otorhinolaryngology clinic in Warsaw), BPPV was identified in 15.2% of patients and was second most common group of balance disorders besides vascular balance disorders [18]. Extensive meta-analyses indicate that the incidence rates of BPPV range from 17% to 42% of all patients being diagnosed for balance disorders [1, 5]. BPPV is nearly twice more common in females than in males, and the incidence rates increase dynamically above the year of 50 [5, 6, 13]. Reports of BPPV in children are relatively rare and often involve concomitant migraine [19, 20].

Initially, BPPV was ascribed to be due to changes within the posterior semicircular canal [7, 21]; it was only in 1985 when McClure presented first reports of changes within the lateral semicircular canal [22], and in 1994, when Brandt et al. were the first to present cases of BPPV involving changes within the anterior semicircular canal [23].

On the basis of large analyses, one may assume that BPPV caused by otolithic pathologies within the posterior vertical canal (PC-BPPV) accounts for 70-90% of all cases as compared to 5-22% of cases caused by otolithic pathologies within the lateral (horizontal) canal (HC-BPPV) and 1-3% of cases caused by otolithic pathologies within the anterior vertical canal (AC-BPPV) [1, 24, 25]. Notably, cases with bilateral changes may be encountered as well as cases with otolithic pathologies being present in two semicircular canals on the same side. In addition, cases of canal "switch" may be observed with otolithic fragments being relocated from the posterior canal to the lateral canal, either spontaneously or following reposition maneuvers [1, 26].

CLINICAL PRESENTATION OF BPPV

The clinical presentation of benign paroxysmal positional vertigo (BPPV) is quite precisely described by the very name of the disorder. The diagnosis is based on three key elements:

- interview, in which patient complains of sudden, short episodes of vertigo as the result of changes in body (head) position;
- positive result of the Dix-Hallpike (D-H) challenge test in the case of otolithic debris within the posterior semicircular canal (or, very rarely, within the anterior semicircular canal) or the supine roll test (SRT) in the case of otolithic pathologies within the lateral semicircular canal. The positive result of SRT consists in sudden vertigo accompanied by short episode of nystagmus.
- absence of other symptoms (either audiological, otological, neurological, or general) that might be responsible for similar symptoms and absence of balance system disorders between the episodes of BPPV.

In real life, clinical presentation of BPPV is not this clear or unambiguous. Increasingly often, it was highlighted that BPPV may coexist with other balance system disorders, and thus its clinical presentation may be less specific [1, 6, 28]. Patient's age is an important factor often responsible for deviations from the model presentation of BPPV when other disorders or involution processes are present within the nervous system. This is all the more important that most cases of BPPV are encountered in patients above the age of 50 [6, 13 29].

Despite the assumption that patients with BPPV are free of any symptoms between the acute episodes of vertigo, nearly 50% of patients experience slight, subjective vertigo or, more precisely, sensation of instability, between the typical episodes [27]. BPPV episodes may occur nearly every day, but symptom-free periods may be as long as several weeks [21, 11].

Some authors expand the diagnostic criteria to include the term of "subjective BPPV" where acute, short episodes of vertigo caused by a change in the position of the head are not confirmed in the D-H test or the SRT. These cases are also treated with reposition maneuvers (30, 31). However, much caution must be exercised when qualifying such patients as BPPV cases, and extensive differential diagnostic examinations should be performed.

DIAGNOSTICS

Appropriate, searching interview including examination of circumstances that trigger the disease attacks is the basis of BPPV diagnosis. Typical presentation consists in sudden, intense vertigo, i.e. an illusion of rotation of patient's surroundings or their own body caused by a change in the position of the head relative to the gravity vector. Acute vertigo episodes

last about 30–60 seconds and then resolve completely until the next similar change in patient's head position. However, attempts at triggering successive BPPV episodes usually result in the reaction being less pronounced or not manifested at all. During the interview, patients most commonly report severe episodes of vertigo occurring when they turn to their side while in horizontal position. Sudden, fear-provoking episodes may wake patients up during the night. In their attempts to prevent such episodes, patients may try to protect themselves from accidental changes in body position during sleep. Less frequently, BPPV episodes are caused by the head being bent downwards, upwards, to the left, or to the right. However, one must keep in mind that BPPV may occur concomitantly with other peripheral balance system disorders as well as that symptoms similar to those of BPPV may occur due to disorders within the central balance system, neurological disorders, or broadly defined cardiovascular disorders. The concomitance of BPPV and other disorders is not only the source of potential diagnostic problems. BPPV-specific treatment methods (reposition maneuvers) may be used in coincident disorders irrespectively of any therapeutic actions to eliminate symptoms of other disorders [32].

Challenge test should start with the Dix-Hallpike test. The D-H test consists in changing the position of the head along the plane of the pair of vertical semicircular canals (a posterior semicircular canal and the contralateral anterior semicircular canal). BPPV diagnosis is confirmed when a vertigo episode similar in nature and presentation is provoked in the patient along with accompanying nystagmus and, sometimes, strong vegetative symptoms (nausea). The examiner is able to watch for any signs of nystagmus. When performing the challenge tests, patients should be warned that the unpleasant experience of vertigo may be accompanied by nausea and that, in addition, slight balance disturbances may persist for as long as several hours after the challenge.

Dix-Hallpike (D-H) test – Starting position:

Patient sits on the couch in such a position that when they lie down, their head is located beyond its edge. The patient is instructed to keep their eyes open throughout the challenge test. The examiner directs and secures the head movement by holding the patient's head turned at the angle of 45° towards the ear being examined with both hands. Nystagmus is monitored using Frenzel goggles. The subsequent stages of the test involve: a) patient being vigorously laid down on the couch with their head being simultaneously bent towards the back (ca. 20° angle between patient's chin and the ceiling); b) patient's eyes being monitored for 30 s or until resolution of vertigo and nystagmus; c) patient's body being restored to the

sitting position; and d) patient's eyes being monitored for 30 s or until resolution of vertigo and nystagmus. After about 2–3 minutes, an analogous challenge should be performed with the patient's head being bent at an angle of 45° towards the contralateral ear.

In cases of positive D-H tests, strong vertigo is accompanied by intense oblique/torsional nystagmus (with a quick vertical component directed upwards and, at the same time, the rotational component being directed towards the ear being examined, i.e. to the floor). Both the vertigo and its accompanying nystagmus follow the “crescendo-decrescendo” pattern. The positive result of the D-H test suggests that otolithic pathologies that are the cause of the BPPV symptoms occur in the ear that was directed downwards during the reposition maneuver. Quite commonly, nystagmus is observed again when the patient is restored to the sitting position; the symptom is usually weaker and the direction of rotation is opposite to that observed when the patient is being laid down.

In rare cases the nystagmus triggered by the Dix-Hallpike test may have an atypical vertical component directed downwards (towards the chin) and the rotational component directed towards the ear being examined. This may be indicative of a rare form of BPPV involving an otolithic pathology within the anterior semicircular canal. However, in such cases, the investigator should exclude BPPV-imitating symptoms indicative of pathologies within the brain stem or the cerebellum [33].

Typical features of nystagmus as being triggered in the D-H test include:

- latency period (usually 5–20 s),
- duration (30–60 s),
- oblique/torsional direction with rapid vertical phase directed towards the forehead and rotational component directed towards the ear with otolithic pathologies,
- reaction fatigability (reactions are weaker as the test is being repeated),
- vertigo (usually longer in duration compared to nystagmus),
- reverse direction of nystagmus upon returning to sitting position [2, 11, 27].

An alternative to the D-H test, for example in patients with limited range of motion of the neck that prevents them from bending their head backwards, is the sidelying test [34] where a similar goal, i.e. gravitational dislocation of the head within the plane of semicircular canals, may be achieved while avoiding the critical backward head bend.

Sidelying Test—starting position:

The patient sits on the edge of the couch with their legs hanging down, their head turned 45° towards the ear contralateral to the potentially pathological ear being tested; other aspects of the position as in the D-H test. The subsequent stages of the test include: a) patient being rapidly laid down on their tested side (patient's eyes being monitored for 30 s or until resolution of vertigo and nystagmus); c) patient being quickly returned to the sitting position with their head turn being maintained; d) patient's eyes being monitored for 30 s or until resolution of vertigo and nystagmus. After a short interval of 2-3 minutes, the test should be repeated for the contralateral ear.

In cases when the interview is indicative of BPPV but no or little nystagmus can be triggered in the D-H test, the supine roll test (SRT) should be performed to possibly indicate BPPV related to otolithic pathologies within the lateral semicircular canal. The positive result of the SRT includes vertigo as well as intense horizontal nystagmus. Usually, the subjective reaction as well as the accompanying nystagmus may be triggered in the SRT by turning the patient's head either left or right. This test, being much simpler than the D-H test, is attributed to several researchers (and referred to as the Parnes test, the Pagnini-Lempert test, the Pagnini-McClure test), and essentially comes down to the head position being changed in the plane of the lateral semicircular canal [1, 22, 35, 36].

Supine rotation test (SRT) – Starting position: Patient lies down on their back with their head slightly bent (20-30°) towards their chest (the head bend is optional) [1]; the remaining elements as in the starting position of the D-H test. The subsequent stages of the test involve: a) patient's head being rapidly turned to a side (ca. 60°); b) patient's eyes being monitored for 30 s or until resolution of vertigo and nystagmus; c) slow return to the starting position. After about 2-3 minutes the test should be repeated with the patient's head being turned the other direction.

Usually, the horizontal nystagmus changes its direction, its rapid phase upon the movement towards the right or the left being directed either to the floor (geotropic), or to the ceiling (ageotropic). It is assumed that otolithic pathologies occur in the semicircular canal of the ear showing stronger subjective and nystagmic responses in the SRT, regardless of whether the nystagmus was geotropic, or ageotropic. However, identification of the ear with otolithic pathologies within the lateral canal is impossible in about 20% of cases. In such cases, the treatment should consist in reposition maneuvers being performed for both ears [1]. It is believed that geotropic nystagmus is caused by canalithiasis while ageotropic nystagmus is caused by cupulolithiasis, with the adhesion of otolithic debris

to the cupula occurring either on the canal-side surface or on the proximal utricular surface [1, 4, 37, 38]. Compared to the D-H test reaction, the STT result is usually characterized by shorter latency, longer duration of nystagmus and lower fatigability of reaction upon repeated tests [3, 25].

Both the D-H test and the SRT should be performed bilaterally even if classic attack is observed already during the first attempt. Cases were observed involving otolithic pathologies occurring simultaneously within both vestibular systems. This is more common in cases of BPPV secondary to head injuries [1, 26]. However, also reported were BPPV cases with otolithic pathologies occurring within two different canals of the same ear, or cases with the pathological canal being changed (from PC-BPPV to HC-BPPV) during the treatment as the result of reposition maneuvers [1, 39, 40]. Cases with clinical presentation of BPPV being unambiguous and possibly involving concomitant labyrinth or central balance system disorders should also be taken into account [1, 6, 28, 41].

However, as far as everyday clinical practice is concerned, classical interview of BPPV confirmed by positive D-H test warrants initiation of treatment, while subsequent examination stages (SRT) and differential diagnostic should be limited to cases differing from the most common presentation or cases with no expected effects being achieved during the treatment.

In a number of clinical situations, the possibility to perform tests to confirm BPPV or subsequent reposition maneuvers may be limited. This may be the case for patients with cervical spine disorders (discopathy, significantly reduced mobility, or traumatic injuries), patients with Down syndrome, significant scoliosis, disturbed blood flow within cervical and vertebral arteries, cerebral artery disorders increasing the risk of cerebral strokes, retinal detachment, or significant obesity [1].

Despite the fact that characteristic interview confirmed by the positive result of the D-H test or the SRT are sufficient for BPPV diagnosis and treatment initiation, most patients in the US (>65%) are subjected to additional examinations generating costs of up to 2 billion dollars per year [43]. In Poland, no cost estimations were carried out; however, diagnostic procedures such as MRI scans being performed in cases of short-term episodes of vertigo without any further justification, are quite common.

TREATMENT

The main BPPV treatment method consists in reposition (release) maneuvers selected appropriately according to the side

(ear), location of the pathology within one of the three semicircular canals, and, in some cases, on the form of BPPV (canalithiasis vs. cupulolithiasis). According to the general assumption, reposition maneuvers are aimed at repositioning the freely moving otolithic debris back into the utricle (canalithiasis). In the case of cupulolithiasis, this is preceded by detachment of otolithic debris from the cupular surface. All maneuvers consist of specific sequences of head movements. Before being subjected to any reposition maneuvers, patients should be warned of the possibility of experiencing vertigo and nausea during the maneuvers as well as balance disorders persisting for as much as several hours after the maneuvers. If pronounced vegetative responses were observed in D-H or SR tests preceding the planned reposition maneuvers, appropriate inhibitors (e.g. Diphegan or Torecan) may be administered 1 hour before the scheduled maneuvers.

Epley's maneuver is the most common reposition maneuver in the treatment of BPPV due to otolithic pathologies within the posterior semicircular canal; it is also useful in the rare cases of BPPV due to otolithic pathologies within the anterior semicircular canal. Starting position - Patient sits on the couch (as in the D-H test). Individual stages of the maneuver include: a) a quick movement to bring the patient to the position in which positive reaction was previously achieved (the patient should experience vertigo and nystagmus); b) the position being maintained by at least 2 minutes; c) patient's head being rotated by 90° towards the contralateral ear with backward bend being maintained; c) patient's head being rotated by further 90° so that they nearly face the floor (this requires the patient being laid on their side); d) the position being maintained for at least 2 minutes; and e) slow return to the sitting position. At each stage of the maneuver, the therapist should allow for the recovery of transient vertigo before proceeding to the next step [43].

Semont's maneuver is characterized by similar efficacy, both in the cases of canalithiasis and cupulolithiasis within vertical semicircular canals. In a manner similar to the Epley's maneuver described above, the entire procedure is aimed at gravitational and inertial relocation of otolithic debris within the plane defined by a pair or vertical semicircular canals. Starting position - Patient sits on the edge of the couch, their head turned at the angle of 45° away from the affected ear. Individual stages of the maneuver include: a) a quick movement to lay the patient on the side of the affected ear (face upwards); b) the position being maintained for 2-3 minutes, c) patient being quickly restored to sitting position and further to lie on the contralateral side with the head bend being maintained (so that it finally faces downwards); d) the position being maintained for about 5 minutes; and e) slow return to the sitting position (head facing straight ahead) [33, 44,].

If BPPV was previously determined to be due to the rare location of otolithic pathology within the anterior semicircular canal, the same Semont's maneuver may also be successfully performed, the only difference consisting in that in the starting position, the patient's head is turned by ca. 45° towards the affected ear, and therefore the patient's face would be directed downwards at step "a" and upwards at step "c". If inefficient as part of the first therapeutic session, both maneuvers may be repeated during subsequent sessions [1, 45].

If otolithic pathology is diagnosed within the horizontal semicircular canal and geotropic nystagmus has been observed, the simplest treatment (or, at least, the simplest to describe) is Lempert's Barbecue Roll Maneuver [4, 46]. Barbecue Roll Maneuver - starting position - Patient lies on their side on the couch, the affected ear facing downwards. Individual stages of the maneuver include: a) patient being slowly turned to supine position (90°), i.e. away from the affected side, and the new position is maintained for ca. 15 s or until resolution of vertigo; b) patient being slowly turned in the same direction by further 90° and the new position being maintained for the time required for vertigo to resolve; c) patient being slowly turned in the same direction by another 90° (prone position) and new position being maintained for the time required for vertigo to resolve; d) patient being slowly turned in the same direction by another 90° (starting position) and new position being maintained for the time required for vertigo to resolve; and e) patient being moved to sitting position with their head facing straight ahead and bent towards the chest at an angle of 20-30°.

All reposition maneuvers used in the treatment of BPPV are the result of logical combination of the knowledge of the anatomy of semicircular canals and the knowledge of the gravity force. In this context, one may also mention Gufoni's maneuvers for the treatment of BPPV due to pathologies within the horizontal semicircular canal. The maneuvers are available in two variants for patients with geotropic and ageotropic nystagmus, respectively. Gufoni's maneuver in geotropic nystagmus patients – starting position: Patient sits on the edge of the couch. Individual stages of the maneuver include: a) patient being laid on the side of their healthy ear; b) patient's head being quickly turned downwards by 45-60°; c) the position being maintained for 2 minutes; d) patient being returned to sitting position with their head remaining turned; and e) slow return to the position with patient's head facing straight ahead. In patients with ageotropic nystagmus, Gufoni's maneuver is started with patient being laid on the side of the affected ear and the subsequent steps follow the pattern described above for patients with geotropic nystagmus [1, 47].

Supplementary treatment of BPPV involves broadly defined habituation and rehabilitation to improve the overall postural

fitness, introduced by Cawthorne and Coxey as early as in the 1940 and continuously developed henceforth [4, 48,49, 50]. In Poland, this approach was popularized by Prof. Lucyna Pośpiech [51]. Rehabilitation treatment consists in a broad range of ocular, head, and whole body movements of increasing difficulty levels.

This form of treatment often includes the recommendation of Brandt-Daroff habituation exercises developed specifically for BPPV treatment [52]. Starting position Patient sits on the edge of the couch. Individual stages of the exercise (to be repeated multiple times) include; a) patient body being quickly laid on the BPPV-affected side with head being simultaneously turned upwards by ca. 45°; b) the position being maintained until resolution of vertigo + ca. 30 seconds; c) quick return to the sitting position with head facing straight ahead; d) the position being maintained until resolution of vertigo; e) patient's body being quickly laid on the contralateral side with head being simultaneously turned upwards by ca.

45°; and f) return to the sitting position with head facing straight ahead. According to the recommendations, Brandt-Daroff exercise should be repeated as many as 10-20 times every day until no BPPV episode is experienced on 2 consecutive days [4, 52].

In the light of current knowledge, there are no indications for pharmacological treatment of BPPV (e.g. drugs to improve inner ear microcirculation, cytoprotective drugs, etc.) when no concomitant disorders warranting such treatment are present. The only justified exception may consist in administration of drugs to inhibit the vegetative responses (nausea, vomiting), such as Diphegan or Torrecan, about 1 hour before the reposition maneuvers in patients who had experienced similar symptoms during the diagnostic challenge tests [1].

A significant element of the management of BPPV patients consists in counseling to explain that the complaints, troublesome as they may be, are not life-threatening. The nature of the sudden episodes of vertigo should also be explained in a manner accessible for the patient. In some cases involving less pronounced complaints, the “wait-and-see” (no treatment) approach may be warranted even despite BPPV was confirmed since the rates of spontaneous resolution of the disorders is considerably high [1]. This option, however may be applied only upon patient's agreement.

In extreme cases of persistent BPPV refractory to the above methods, one may resolve to surgical treatment aimed at elimination of the incommensurate, pathological signal from the cupular organ (transection of the posterior ampullary nerve, i.e. the branch of the vestibular nerve collecting signals from

the posterior semicircular canal) or at dissection and occlusion of the posterior semicircular canal so as to destroy the part of the vestibular system being responsible for pathological stimulation while blocking the endolymph movement [53].

Step-by-step as well as illustrated guides to performing reposition maneuvers are provided by a number of handbooks on balance disorders [3, 4, 25]. The simplest and the most accessible guide, however, is provided by the short video manual available through YouTube (www.youtube.com/watch?v=KLt2L-tISPmQ) and recommended in current BPPV diagnostics and treatment guidelines [1].

Also available is the option of the D-H challenge test, as well as the Epley's maneuver being self-administered by the patient using a simple “DizzyFix” device. Having read the instruction manual, the patient places the device on their head and proceeds to perform individual stages of the test of the maneuver while guiding a ball moving within an appropriately shaped tube placed within their field of vision [54].

Numerous articles recommend maximum limitation of head movements following the reposition maneuvers, including the sitting position being maintained for up to 48 hours (also during sleep) and lying on the side with the affected ear facing downwards being avoided for 5 consecutive days [4, 56, 57]. Current recommendations based on a meta-analysis of data from numerous publications question the appropriateness of such troublesome restrictions being applied after reposition maneuvers [1].

Similarly, positive impact of vibrations applied via the mastoid process along with reposition maneuvers to facilitate detachment of otolithic debris from the cupula in cupulolithiasis (as previously postulated by Epley [57, 58]) could not be confirmed [55, 59].

Much confusion regarding reposition maneuvers was introduced by numerous “proprietary modifications” published in the literature [24]. A difficult issue is encountered when the reposition maneuvers are to be used in patients in whom extreme neck torsion is contraindicated or whose limited range of motion prevents proper performance of these maneuvers. Thanks to technological advances, appropriate platforms are now available to reposition patients in precise and repeatable sequences defined at the platform control software level [60, 61].

BPPV TREATMENT OUTCOMES

Resolution of typical vertigo episodes constitutes the main treatment efficacy measure. Some authors are more restrictive

and declare that the patient may be considered cured when no reactions typical for BPPV can be triggered during the challenge tests performed during a follow-up visit (recommended 4 weeks after the treatment) [1, 55, 59].

Nearly 50% of BPPV cases resolve spontaneously within 3 months; however, the disorder may recur after being asymptomatic for several weeks, and sometimes even several years. Therefore, the assessment of the efficacy of the treatment should include a clear statement of time that has passed since the treatment was delivered [61]. According to the reports, the success rates of the reposition maneuver treatment range from 60 to 90%; however, possible recurrence may never be excluded [1, 55, 59]. According to a meta-analysis by Hilton and Pinder (n = 745), the recurrence rates after varying follow-up times following initially efficient Epley's or Semont's maneuver were as high as 36% [59].

Brandt-Daroff exercises or rehabilitation to improve visual and postural reflexes should be provided as supplementation of the reposition maneuver treatment rather than as an alternative treatment, which is justified only in very rare cases. This particularly pertains to the concomitance of BPPV and other vestibular organ damage conditions [63]. The outcomes of BPPV treatment are better for idiopathic BPPV as compared to the cases when BPPV follows or accompanies an inner ear injury, vestibular neuritis, or cochlear damage [63, 64, 65].

No significant differences are observed between the results of Epley's maneuver as compared to Semont's maneuver as well as no definitive recommendations are available with regard to the number of reposition maneuver sessions. In most cases, however, one or two sessions are sufficient to achieve the goal [1, 55].

DISCUSSION

A critical reader of this article may ask the following question: Since BPPV is so common and its treatment is relatively simple, efficient, and not excessively costly, why is this form of balance disorders not being diagnosed and treated in an appropriate

manner? In Polish conditions, the recommendation of the American Academy of Otolaryngology-Head and Neck Surgery stating that BPPV should be diagnosed, and even treated, primarily at the general practice level appears somewhat unrealistic [1]. We would be successful if the current knowledge on the diagnostics and treatment of BPPV, including challenge tests and basic reposition maneuvers, become common in the practice of otorhinolaryngology or neurology specialists collaborating with qualified physical therapists with appropriate expertise in rehabilitation of the balance system. Notably, if the diagnostic criteria of BPPV are not precisely defined, patients may be put at risk of not achieving the expected treatment effects. In extreme cases, however, medical errors may occur.

In the current era of "defensive medicine" characterized by diagnostic examinations being ordered not as much as to confirm the diagnosis as to avoid potential accusations of negligence, it should be highlighted that the interview indicative of BPPV and the positive results of the challenge tests are sufficient for the diagnosis and initiation of treatment of BPPV provided no other deviations are observed in medical history and routine physical examination. Only if the clinical presentation is different from that of typical BPPV, or if proper treatment (reposition maneuvers) is ineffective, a broader range of diagnostic examinations should be applied.

One might ask a question on how would the BPPV diagnostics look like in the future. More than 50 years ago, in his post mortem examinations of patients previously presenting with BPPV symptoms, Schuknecht [7] identified otolithic membrane fragments attached to the cupula within the posterior semicircular canal and thus presented the theory of cupulolithiasis. The canalithiasis mechanism of BPPV was confirmed by subsequent reports by Parnes and McClure who, having dissected the membranous posterior semicircular duct for surgical obturation, identified the presence of free-flowing otolithic debris within the duct's lumen [10]. Today, reports are available where the otolithic debris, both that freely moving within the lumen of membranous semicircular canals and that attached to the cupular surface, can be visualized in T2-weighted high resolution MRI scans [66, 67]. Is this how the future standard diagnostics of BPPV will look like?

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Corresponding author: prof. Stanisław Bień PH, MD, e-mail: stbien@gmail.com

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