Diagnosis and management of posterior semicircular canal benign paroxysmal positional vertigo: A practical approach

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1. Introduction

First described in 1921 by Barany, benign paroxysmal positional vertigo (BPPV) is a common disorder wherein brief episodes of vertigo and nystagmus are produced by certain changes of head position relative to gravity.1 At least half of BPPV cases are idiopathic and most pathological associations provide no clue as to the reason why otoconia becomes dislodged.2 BPPV may develop secondary to any of the inner ear diseases (e.g., vestibular neuritis, labyrinthitis, and Meniere’s disease) that give rise to degeneration and detachment of the otoconia, but do not totally impair semicircular canal function.3 Several other factors have been proposed as etiological factors for BPPV including: head

Abstract Objectives: To identify variables affecting outcome in patients with unilateral and bilateral BPPV.

Materials and methods: Retrospective review of 220 patients diagnosed with posterior SCC underwent treatment successfully with Canalith Repositioning Maneuver. Bilateral and severe cases received medical treatment before starting the maneuver. Scheme for management of the cases had been settled.

Results: One hundred seventy-four patients (74.5%) as the first BPPV episode while 25.5% with recurring episodes. Significant improvement was reported in 84% of patients. Etiology is not playing a role in unilateral or bilateral BPPV. Patients presented with bilateral BPPV were classified into true or unilateral mimicking bilateral BPPV. 46.7% of the patients reported sleeping using one pillow. Daily routine Brandt–Daroff exercises after the success of CRM affect the rate of recurrence.

Conclusion: Canalith repositioning Maneuver provides rapid relief of symptoms of BPPV. Patients with bilateral or severe BPPV required a special protocol to reach complete relief. In addition daily routine Brandt–Daroff exercises decrease the recurrence rate.

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trauma, circumstances in which the head is placed or maintained in an persistent inverted orientation (e.g., dental procedures, visits to the hairdresser, prolonged travels), migraine disease, and upper respiratory infection. BPPV may present bilaterally in 7.5–15% of cases.

Although it has been historically commonplace to reassure patients diagnosed with BPPV that their condition is benign and is likely to spontaneously remit in the subsequent months, recent relatively high quality evidence supports active, expeditious treatment with particle repositioning maneuvers (PRMs).

The aim of this study is to prospectively analyze the profiles of patients who were diagnosed with posterior semicircular canal (PSC) BPPV with special emphasis on their clinical presentation and the response to the PRMs.

2. Material and methods

A consecutive series of patients who were clinically diagnosed with BPPV at Al Ahli Hospital, Doha, Qatar between January 2009 and October 2011 was prospectively studied. Patients with history of brief vertigo provoked by changes in head position and associated with vertigo and nystagmus during the Dix–Hallpike test on physical examination were included in this study. The involvement of the posterior semicircular canal was confirmed during Dix–Hallpike test by the presence of geotropic up beating torsional nystagmus with its characteristic latency, duration, and fatigability and associated with the subjective perception of vertigo. Dix–Hallpike test was performed bilaterally. If characteristic findings of BPPV were identified bilaterally, the amplitude and frequency of nystagmus were compared. Eye movements were recorded by Micromedical two-channel visual eyes using standard test protocol of visual and vestibular stimulation. Patients with atypical clinical presentation with positive Dix–Hallpike test were excluded. In some elderly patients, we performed side lying test. A thorough evaluation was performed to rule out any neurological or otological pathology. This included: evaluation of spontaneous nystagmus, head thrust test, other positional maneuvers, Romberg test and audiological evaluation. Videonystagmography was only performed when the history and clinical findings raised the suspicion of an additional vestibular pathology.

Patients were treated using the Canalith repositioning procedure (CRP) described by Epley. Patients who experienced severe vertigo and cannot tolerate head movement were initially given a 3-day treatment with Betahistine hydrochloride. Patients were re-evaluated at 3–5 day interval to assess the response to treatment. CRP was repeated until successful repositioning had been achieved. In bilateral BPPV, the selection of the side for initiation of CRM was based on comparison of the observed nystagmus. The side in which nystagmus was of higher amplitude, faster or associated with more intense subjective vertigo was selected for repositioning (Scheme 1). Treatment success was judged as complete relief of the symptoms of vertigo and conversion to a negative Dix–Hallpike test on physical examination. If the less affected side is still positive for Dix–Hallpike test we started to do CRP. BPPV was considered persistent if it did not respond to three sessions of CRP within two weeks of initial presentation. Recurrence was considered if positional vertigo developed after at least 2 weeks of a symptom-free interval following previous successful treatments. All patients were instructed to return if vertigo redeveloped. All patients were instructed to perform Brandt–Daroff exercises at home, starting 2 days after successful repositioning and for a period of 2 weeks. Patients were re-examined 3 months and 6 months after testing negatively for vertigo. Patients were instructed to contact us if they redevelop positional induced vertigo in the future. In addition, an attempt was done to contact patients every six months to inquire about the recurrence of the condition. Only patients with a minimum of 2 years follow up were included in the study.

Data were analyzed using SPSS software (Statistical Package for the Social Sciences, version 11.0, SPSS Inc., Chicago, IL, USA). Variables were expressed as numbers and percentages; continuous data were expressed as mean ± standard deviation. Fisher’s exact test and logistic regression tests were used for comparisons.

3. Results

A total of 220 patients diagnosed were included in this study (Table 1). There were 123 females and 97 males with an age range of 19–73 years (mean age 44.3 ± 11.2 years). Duration of symptoms before diagnosis ranged from 2 to 28 days. 164 patients (74.5%) presented as the first BPPV episode, whereas 56 (25.5%) presented with recurring episodes. 93 patients (42.3%) gave a history of visiting general practitioners or emergency departments before consulting a specialist. The cause of the BPPV in the study population was presumed to be related to trauma in 41 patients (18.6%), peripheral vestibulopathy in 20 (9.1%), and it was idiopathic in 159 (72.3%). Female outnumbered males in the idiopathic group (2:1). The history of trauma within one week preceding the presentation was statistically more significant within the bilateral group (P = 0.0153). In 20 patients with peripheral vestibulopathy, unilateral sensorineural hearing loss associated with canal paresis was suggestive of underlying Meniere’s disease in 7 patients. The remaining 13 patients gave a history suggestive of vestibular neuritis within 6 months prior to the presentation. The diagnosis was confirmed by the presence of canal paresis associated with normal cochlear functions. Review of the history revealed the diagnosis of migraine in 32 patients (14.5%) according to the criteria of international headache society. The statement of the patient regarding the direction of movement that precipitated the majority of attacks correlates with the involved ear in 123 patients (55.9%).

After reviewing the medical records of such patients, correct diagnosis was done in only 27 patients (29%). The remaining 66 patients were given nonspecific treatment with no improvement for an average period of 16 ± 5.3 days. Among the group of 127 patients who consulted specialists, incorrect diagnosis and non-specific treatment were reported in 43 patients (34%). The percentage of incorrect diagnosis and the delay in treatment was statistically more significant in the group of patients who initially consulted non-specialized physicians (P < 0.0001) (Table 2). Unilateral PSC BPPV was identified in 148 patients (67.3%). The right PSC was involved in 87 patients, the left canal in 61 patients and bilateral involvement was diagnosed in 72 patients (32.7%). In the patients with bilateral BPPV, symmetrical nystagmus was reported in 45 patients and the remaining 27 patients had
asymmetrical nystagmus. Following successful CRM for the side with the most prominent nystagmus, re-evaluation did not reveal nystagmus or subjective vertigo on the contralateral side in 25 patients with initial diagnosis of bilateral BPPV. The diagnosis in those 25 patients was revised as unilateral BPPV mimicking bilateral BPPV. True bilateral BPPV was identified in 47 patients (21.4%). Asymmetrical nystagmus was statistically more significant in the group with unilateral mimicking bilateral BPPV ($P = 0.0014$) (Table 3).

The correlation was statistically significant in unilateral PSC BPPV in comparison with the bilateral cases who usually reported nonspecific head movements as triggers for their vertigo ($P < 0.0001$). Among the 173 patients with unilateral BPPV, 94 patients (54%) identified a predominant sleeping position. The association between affected ear and the head lying side during sleep was statistically significant ($P = 0.0034$). 103 patients (46.7%) reported sleeping using only one pillow.

### Scheme for treatment of BPPV

#### Table 1 Descriptive table for BPPV patients.

<table>
<thead>
<tr>
<th>Age:</th>
<th>Etiology:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Range: 19–73 years</td>
<td>• Trauma: 41 (18.6%)</td>
</tr>
<tr>
<td>• Mean: 44.3 ± 11.2 year</td>
<td>• Peripheral vestibulopathy: 20 (9.1%)</td>
</tr>
<tr>
<td>Sex:</td>
<td>• Idiopathic: 159 (72.3%).</td>
</tr>
<tr>
<td>• Male: 97 (48.5%)</td>
<td>presented: 164 (74.5%)</td>
</tr>
<tr>
<td>• Female: 123 (51.5%)</td>
<td>Recurring Episodes: 56 (25.5%)</td>
</tr>
</tbody>
</table>

#### Table 2 Comparison of the management of BPPV patients by general practitioner and specialists.

<table>
<thead>
<tr>
<th>Initial presentation</th>
<th>First consulting ENT/audiology or neurology specialist</th>
<th>First consulting general practitioner or emergency department</th>
<th>$P$ value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients</td>
<td>127/220 (57.7%)</td>
<td>93/220 (42.3%)</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Correct diagnosis</td>
<td>84 (66%)</td>
<td>27 (29%)</td>
<td></td>
</tr>
<tr>
<td>Incorrect diagnosis</td>
<td>43 (34%)</td>
<td>66 (71%)</td>
<td></td>
</tr>
<tr>
<td>Unnecessary investigations</td>
<td>37 (29%)</td>
<td>50 (53.8%)</td>
<td>0.0003</td>
</tr>
<tr>
<td>Duration before diagnosis</td>
<td>9.6 ± 5.7</td>
<td>13.6 ± 6.5</td>
<td>&lt; 0.0001</td>
</tr>
</tbody>
</table>

#### Table 3 Type of presentation and bilateral BPPV patients.

<table>
<thead>
<tr>
<th>Type of presentation</th>
<th>Typical rotatory vertigo with evident positional trigger</th>
<th>Atypical sense of dizziness or disequilibrium without an evident positional trigger</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients</td>
<td>151/220 (68.6%)</td>
<td>69/220 (31.4%)</td>
</tr>
<tr>
<td>Age &lt; 50 years</td>
<td>110 (50%)</td>
<td>39 (17.5%)</td>
</tr>
<tr>
<td>Age &gt; 50 years</td>
<td>41 (18.6%)</td>
<td>30 (13.5%)</td>
</tr>
<tr>
<td>Bilateral involvement</td>
<td>Symmetrical nystagmus</td>
<td>Asymmetrical nystagmus</td>
</tr>
<tr>
<td>True bilateral BPPV</td>
<td>38</td>
<td>9</td>
</tr>
<tr>
<td>Unilateral mimicking bilateral BPPV</td>
<td>7</td>
<td>18</td>
</tr>
</tbody>
</table>
Thirty-two patients were severely disabled by the vertigo and could not tolerate immediate CRP. They were given medical treatment with labyrinthine sedative (Betahistine hydrochloride 16 mg three times a day) followed by re-evaluation after 3 days.

Of the 220 patients, 185 (84%) were considered free of symptoms and converted to negative Dix–Hallpike test after CRPs. In 113 patients, treatment was successful after one repositioning session. In the remaining 72 patients, two to four repositioning sessions (average = 3 sessions) were performed until full recovery. 35 patients (15.9%) were considered refractory to positioning maneuvers and subsequent evaluation identified an underlying peripheral vestibular pathology in 13 patients and they were given vestibular suppressant medications. Migraine was a potential cause of persistent BPPV in 14 patients who reported improvement of their symptoms after starting a prophylactic therapy with Betahistine hydrochloride. In the remaining eight patients, no underlying cause for the persistent vestibular dysfunction could be identified. They reported partial improvement of their symptoms by vestibular rehabilitation exercises. During the follow up period, 48 patients out of the one 185 patients (25.9%) who showed complete initial recovery developed recurrence of symptoms. Recurrence was statistically significant in patients with traumatic etiology, underlying vestibular pathology, bilateral BPPV at the initial presentation, those with migraine and in women older than 60 years. 97 patients reported compliance to instructions regarding Brandt–Daroff exercises for 2 weeks following repositioning maneuver. Recurrence in this group of patient was statistically lower than those who were non-compliant to the exercises ($P = 0.011$). Recurrence was reported in the contralateral side in 11 patients.

4. Discussion

BPPV is probably the most common cause of vestibular vertigo accounting for approximately 20–30% of diagnoses in specialized dizziness clinics with an overall lifetime prevalence of 2.4%. However, in spite of the previously published diagnostic and therapeutic recommendations, there is still a significant delay between the initial presentation and the start of successful treatment with the resultant substantial psychosocial and economic consequences. The delay in diagnosis may be attributed to the lack of physician awareness of the condition. In one study, 77% of patients who were finally diagnosed with BPPV underwent unnecessary testing (e.g., MRI, EEG) whereas diagnostic repositioning tests were performed in only 27%. Furthermore, another study showed that most individuals presenting with BPPV to a physician either received no treatment (45%) or non-specific medication for vertigo (27%) whereas only 10% were treated with positioning maneuvers, mostly Brandt–Daroff exercises. Therefore, training of primary care physicians and emergency room doctors; who are first consulted by patients suffering from vertigo, about the clinical characteristics and diagnostic positional testing for BPPV will avoid the delay in diagnosis and unnecessary interventions. Similarly, improvement of the competence of the specialist for otolaryngology and neurology with regard to the diagnosis and treatment of BPPV will definitely increase the chance of performing the effective repositioning maneuvers rather than prescribing non-specific symptomatic medications. The delay in diagnosis may be also attributed to the atypical presentation of BPPV. A study by Kentala and Pyykko reported that 80% of patients experience a rotary vertigo and 47% experience a floating sensation. Atypical presentation of BPPV in this study was commonly reported in elderly patients who usually described postural dizziness or falling tendency rather than the classical rotary vertigo. A high index of suspicion is required in this group of patients who usually suffer from concomitant cardiovascular and neurological comorbidities that further prevent the correct diagnosis.

Cupulolithiasis and Canalolithiasis represent the main pathological explanations for BPPV. This is an oversimplification of an actual complex condition. Several ultrastructural studies identified defects in one or more step involved in otocochria metabolism as potential triggers for BPPV. These include either disorders of otocochria biomineralization or of otocochia adherence to the otolith membrane. Epidemiological studies often make reference to post traumatic and concomitant vestibular pathology as the main triggers for otocochial dislodgement. Most of our patients have Canalolithiasis, we used CRP recommended by Epley in all patients even those patients with Cupulolithiasis. According to the previous literature, Casqueiro et al., emphasized that repositioning treatment appears to be efficacious, regardless of minor differences among maneuvers. If the head is moved in appropriate motion, and rapidly enough approximately 55/s to 75/s, the treatment is likely to be effective. The minor variation in technique may not substantially influence the outcome.

Patients who developed anterior horizontal canal BPPV are excluded. The remaining subgroup of patients without an identifiable etiology for their symptoms is often cited as having idiopathic BPPV. Several studies suggest a contributing role for hormonal, autoimmune, and degenerative factors in the etiology of BPPV. Recently, migraine has also been proposed to be closely associated with BPPV. Migraine was diagnosed in 14.5% of our patients. Another study reported the strongest association for BPPV with migraine; 21% of men and 43% of women with BPPV had a history of migraine. Vasospasm of the labyrinthine arteries is a further putative mechanism linking BPPV and migraine. Vasospasm of the labyrinthine arteries may change the regional blood flow of the inner ear resulting in the release of otoliths. Abnormalities of central processing in the brainstem or vestibulocerebellar pathways were postulated by other authors as the cause of recurrent episodic vertigo in migraineurs.

Furthermore, diabetes, hypertension, hyperlipidemia and vertebrobasilar ischemia were also suggested as predisposing factor for BPPV. This was attributed to labyrinthine ischemia that probably facilitates detachment of otocochia from the otolith membrane. However; well-designed controlled studies are still required to confirm that the association between BPPV and various systemic pathologies is a causal relationship and not just a coincidence.

There are particular characteristics of the clinical course and natural history of BPPV that support the hypothesis of an underlying systemic pathology. First, true bilateral simultaneous BPPV was previously reported in the literature. Blunt trauma to the head or the cervical spine that might affect both temporal bones, is commonly attributed as the main etiological factor for bilateral BPPV. In this study, bilateral BPPV was reported in 21.4% of patients with only 32% of the patients...
giving a history of trauma prior to the onset of their symptoms. This should raise the suspicion of other contributing factors.

Second, BPPV is a recurring disease. Short term recurrence rates range from 7% to 23% within a year of treatment, but long term recurrences may approach 50%, depending on the age of the patient. The potential for contralateral involvement was also demonstrated by a recent study in which 5% of patients developed contralateral symptoms and signs suggestive of revealed or incipient posterior canal BPPV within 2 weeks of performing Epley’s Maneuver to the ipsilateral ear. They postulated that incipient disease in the vestibule of the contralateral ear may be deposited to the posterior semicircular canal, by the reciprocal movements necessary to clear particles from the first ear. Recurrence was reported in the contralateral ear in 11 patients in this study. Therefore, bilateral BPPV developing either simultaneously or subsequently in the contralateral ear might be due to an underlying pathology that is affecting both ears. The time interval between both ears might represent the duration required for accumulation of optimum amount of otoconia. It has been shown by means of physicomathematical models that there should be approximately 62 otoconia within the semicircular canal. These particles need further time to agglomerate in order to exert a hydrodynamic effect when moving in the canal. Therefore, patients with initial bilateral involvement and those who developed multiple recurrences especially if involving the contralateral ear require special attention. A thorough evaluation for an underlying comorbid condition is mandatory as its treatment might affect the long term control of BPPV.

The sleeping posture is an important determinant of the involved ear. In this series the right ear was involved more frequently and there was statistically significant correlation with sleeping on the right side. This was previously documented by several studies. Sleeping on one pillow is another important finding in our patients. This relatively low head position during sleep would place the posterior canal in a more dependent position allowing the otoconia to fall deeper within the canal by the effect of gravitational force. Such finding supports the previous recommendation that remaining upright for one night weekly by raising the pillows is so effective in preventing the recurrence of BPPV. This upright position will maintain a horizontal plan of the utricle and maximize the probability that the extra otoconia will land upon the surface of the dark cells of the otolith membrane rather than entering the semicircular canals. According to Li et al. patients sleeping on their affected side had a higher recurrence rate than those sleeping in other positions at one week after the repositioning maneuver. They concluded that BPPV patients should be advised to refrain from sleeping on their affected side for at least one week after the repositioning maneuver.

There is a general agreement that vestibular suppressant medications are not recommended for the routine treatment of BPPV, other than for the short-term management of vegetative symptoms such as nausea or vomiting in a severely symptomatic patients. In the present study, we prescribed betahistine for patients with severe attacks who cannot tolerate head movement. Recent studies showed that betahistine in addition to CRP is more effective than CRP alone or combined with placebo with regard to improvement of symptoms. It was assumed that after removing the otoconia, betahistine plays an important role for improving blood flow in the inner ear with the resultant restoration of the normal function of motion-sensitive hairs cells and stabilization of the posture. There is little controversy regarding the role of PRMs in the management of BPPV. The selection of CRP was based on previous recommendations that it is an effective and safe therapy that should be offered to patients of all ages with posterior semicircular canal BPPV. Although many experts believe that the Semont’s maneuver is as effective as PRM, based on currently published articles the Semont’s maneuver can only be classified as “possibly effective and there is insufficient evidence to establish the relative efficacy of the Semont’s maneuver to CRP.”

Brandt–Daroff exercises which were designed to habituate symptoms. The patient moved from sitting at the edge of the bed to lying on side (side lying) with the head rotated 45° toward the ceiling. The patient alternated between left side lying and right side lying. Helene reported that modifying the CRM, performing CRM plus a home program, or having involvement of second semicircular canal does not change treatment effectiveness. A Previous study supports this finding, however they recommended, the clinician could use CRM in the office and the give a home exercise for use initially in case of recurrence. On the other hand, Tanimoto et al. found that CRM, alone, was less effective than CRM plus home exercises.

5. Conclusion

Canalith Repositioning Maneuver described by Epley is effective in treatment of posterior semicircular Canal Benign Paroxysmal Positional vertigo. Our study recommended the use of step wise flow-chart for diagnosis and management of patients with unilateral or bilateral posterior canal BPPV. Patients with bilateral BPPV are not all true, some cases are unilateral BPPV mimic bilateral BPPV which relieved after Epley Maneuver to severer side. In addition, daily routine Brandt–Daroff exercises decrease the recurrence rate.

References


