Persistent Vertigo Following Particle Repositioning Maneuvers

An Analysis of Causes

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Objective: To analyze the causes of persistent vertigo following treatment with particle repositioning maneuvers (PRMs) in patients with benign paroxysmal positional vertigo.

Design: Prospective study of outcomes in patients with benign paroxysmal positional vertigo.

Study Setting: Outpatient clinic of a tertiary care referral center.

Patients: A sample of 90 consecutive patients with documented benign paroxysmal positional vertigo of the posterior semicircular canal who had persistent vertigo after at least 3 sessions of PRMs during a period of 2 weeks.

Intervention: Particle repositioning using a modified Epley maneuver.

Main Outcome Measure: Persistent vertigo following at least 3 sessions of PRMs over a period of 2 weeks.

Results: Seven patients showed partial or no improvement following treatment. The causes subsequently determined included coincident horizontal canal positional vertigo (2 cases), Ménière’s disease (2 cases), persistent posterior canal benign paroxysmal positional vertigo in association with cervical spondylosis (2 cases), and a posterior fossa meningioma (1 case).

Conclusions: Patients with persistent or frequently recurring positional vertigo following treatment with PRMs should undergo detailed investigation to exclude coincidental pathology for which specific treatment is required. In patients in whom no coincident pathology requiring therapy is identified, treatment options other than the PRM already instituted should be considered.


Benign paroxysmal positional vertigo (BPPV) is a clinical condition characterized by transient episodes of vertigo when the affected ear is in the dependent position. Although first described by Barany in 1921, the specific characteristics of this disorder were defined in 1952 by Dix and Hallpike who devised a positioning maneuver to diagnose BPPV.

The treatment of BPPV has ranged from nonintervention (on the premise that it is a self-limiting disorder) to aggressive surgical procedures such as posterior ampullary nerve section and posterior canal occlusion. Conservative procedures such as habituation exercises or particle repositioning maneuvers (PRMs) have been recommended by various authors. Habituation exercises, which were devised by Cawthorne in 1944 and later described by Brandt and Daroff and Norre and Beckers, aimed to increase the tolerance of the vestibular system to vertigo rather than eliminate its cause. These exercises have been performed by patients with BPPV either as initial treatment or following nonresponse to PRMs. In recent years various forms of PRMs have become popular, all based on either of 2 theories regarding the etiology of BPPV, the theory of cupulolithiasis and the theory of canalolithiasis.

Some maneuvers were devised on the basis of the Schuknecht theory of cupulolithiasis to disperse debris from their attachment to the cupula. These include the Semont liberatory maneuver and the Brandt-Daroff exercises. The latter consist of a series of repetitive exercises, which could also produce their effect by inducing habituation.

Other maneuvers based on the canalolithiasis theory aim to displace particles from the semicircular canals into the utricle. The maneuver proposed by Epley, which is representative of this cat-
Me´nie`re's disease or vestibular ototoxicity was suspected and evaluated for labyrinthine dysfunction due to conditions such as those with unilateral tinnitus or asymmetrical hearing loss. Electrophysiological audiometry was performed in all patients in whom it or asymmetrical sensorineural hearing loss. Brainstem-evoked potentials, when present, were declared positive when the patient who underwent the Dix-Hallpike test and an absence of positive neurological signs were criteria allowing to proceed with the Epley maneuver. A result was declared positive when the patient who was placed in the Dix-Hallpike position (with the head turned 45° to the affected ear in the sagittal plane and 30° below the horizontal in a head-hanging position) exhibited a torsional nystagmus lasting about 30 seconds after a short latency period. The nystagmus was directed toward the dependent ear and was fatiguable. There was associated vertigo in all patients.

Pure-tone audiometry was performed as a routine procedure in all affected patients to avoid missing an unsuspected mild or asymmetrical sensorineural hearing loss. Brainstem-evoked response audiometry was performed in all patients in whom it was necessary to exclude a retrocochlear disorder, particularly those with unilateral tinnitus or asymmetrical hearing loss. Electromyography was performed in patients in whom associated labyrinthine dysfunction due to conditions such as Ménière’s disease or vestibular ototoxicity was suspected and who were willing to undergo the procedure. A complete clinical neuro-otological examination was also performed. Radiographs of the cervical spine were performed in patients in whom cervical spine disease such as spondylosis was suspected.

The Epley maneuver was performed in the conventional fashion, with the modification that a low-frequency vibrator (such as an electrolarynx or body massager) was used only if the patient demonstrated partial or no response initially. Ten patients required the use of a vibrator. No premedication was given. Responses to the Epley maneuver were evaluated after 2 weeks as follows:

- The response was complete if the patient responded with complete relief of BPPV after 1 to 3 sessions.
- It was partial if the patient had about 75% or more (but less than 100%) relief of BPPV. This was largely a subjective response. Occasionally, the patient could quantify a decrease in number of episodes of vertigo. Nonpositional vertigo, if present, was noted.
- It was absent if the patient had minimal (less than 75%) or no relief of BPPV. Nonpositional vertigo, if present, was noted. Only responses pertaining to symptomatic relief were elicited, and no routine evaluation for the presence or absence of nystagmus was performed.

Patients who failed to obtain complete relief following the Epley maneuver were managed as follows:

- The Hallpike test was repeated to note if there was persistent posterior canal BPPV. If present, vestibular habituation exercises were initiated if the patient was willing. The exercises were modified from the Cawthorne habituation exercises and included gazing in different directions, changing head position, bending and stooping, alternatively sitting and standing, and walking up and down stairs. Patients were instructed to perform these exercises for 15 minutes every day for the ensuing 3 months.
- The patients’ medical history was reviewed and a positional test was performed to exclude lateral semicircular canal BPPV. Patients who gave a positive response to the positional test were administered the lateral semicircular canal PRM as suggested by Lempert and Tiel-Wilck.12
- Nonpositional vertigo, if present, was treated with appropriate medications.

If not already done, contrast-enhanced computed tomography or magnetic resonance imaging was performed to exclude the possibility of an intracranial lesion.

### RESULTS

Of 90 patients who underwent the Epley maneuver, 7 (8%) did not achieve complete relief of symptoms after 2 weeks (Table 1). These 7 patients were administered a PRM with the vibrator. Two patients were discovered to have horizontal semicircular canal BPPV and underwent a specific PRM to which they responded. Of the 5 remaining patients, 2 developed persistent nonpositional episodic vertigo with associated aural fullness and tinnitus, which suggested a diagnosis of Ménière’s disease. Pure-tone audiometry showed a mild, bilateral, low-frequency sensorineural hearing loss. In both these patients BPPV preceded the first attack of Ménière’s disease, which appeared about 2 weeks after PRMs were initiated. After detailed investigation to exclude other causes, the patient was given 16 mg of betahistine hydrochloride 3 times daily and experienced relief. Two other patients had persistent BPPV of the posterior semicircular canal with no associated condition except for cervical spondylosis. Of these patients, 1 responded to 3 months of home-based vestibular habituation therapy as detailed above while the other refused further treatment. The remaining patient, who presented 3 times to the out-

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**Table 1. Clinical Data and Management of 7 Patients Who Did Not Respond to PRMs**

<table>
<thead>
<tr>
<th>Age, y/Sex</th>
<th>Associated Medical Condition</th>
<th>Cause for PRM Failure</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>60/M</td>
<td>Hypertension, diabetes mellitus</td>
<td>BPPV from left HSC</td>
<td>PRM</td>
</tr>
<tr>
<td>48/F</td>
<td>Unknown</td>
<td>BPPV from left HSC</td>
<td>PRM</td>
</tr>
<tr>
<td>49/F</td>
<td>Hypothyroidism</td>
<td>Ménière’s disease</td>
<td>Betahistine hydrochloride</td>
</tr>
<tr>
<td>60/M</td>
<td>Hypertension</td>
<td>Ménière’s disease</td>
<td>Betahistine hydrochloride</td>
</tr>
<tr>
<td>65/M</td>
<td>Cervical spondylosis</td>
<td>Persistent BPPV from PSC</td>
<td>Vestibular habituation therapy</td>
</tr>
<tr>
<td>70/M</td>
<td>Cervical spondylosis</td>
<td>Persistent BPPV from PSC</td>
<td>Refused further treatment</td>
</tr>
<tr>
<td>60/M</td>
<td>Posterior fossa meningioma</td>
<td>Persistent BPPV from PSC</td>
<td>Neurosurgery referral</td>
</tr>
</tbody>
</table>

**Abbreviations:** BPPV, benign paroxysmal positional vertigo; HSC, horizontal semicircular canal; PRM, particle repositioning maneuver; PSC, posterior semicircular canal.

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patient services with acute positional vertigo and experienced partial relief with PRM at each visit, was found on computed tomographic scanning to have a 2 × 3-cm mass in the right posterior fossa, which was later found to be a meningioma.

Analyzing the results of previous studies (Table 2), we found that the failure rate of PMRs varied from 4.5% to 32%. In one report⁷ a definite cause, perilymph fistula, was found to be a meningioma. Other reports⁸ found that the failure rate of PMRs varied from 4.5% to 32%. In one report⁷ a definite cause, perilymph fistula, was present in the 2 nonresponders, for whom definitive treatment was initiated. In others, after other possible causes were excluded, vestibular habituation therapy¹³,¹⁴ was administered and found to be beneficial. Patients who were subsequently found to have horizontal canal BPPV were treated successfully with the appropriate exercises.⁹ Interestingly, in one report,¹⁰ 2 patients tagged “failed cases” sought no further treatment, preferring to live with their BPPV.

### Table 2. Causes and Management of PRM Failure in Previous Reports

<table>
<thead>
<tr>
<th>Source</th>
<th>Patients, No.</th>
<th>Failures, No. (%)</th>
<th>Diagnosis</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parnes and Price-Jones,⁸ 1993</td>
<td>38</td>
<td>4 (10.5)</td>
<td>BPPV from PSC</td>
<td>PSC occlusion</td>
</tr>
<tr>
<td>Herdman et al.,² 1993</td>
<td>30</td>
<td>3 (10)</td>
<td>BPPV from PSC</td>
<td>Retreatment</td>
</tr>
<tr>
<td>Harvey et al.,¹¹ 1994</td>
<td>25</td>
<td>8 (32)</td>
<td>BPPV from PSC</td>
<td>Brandt-Daroff exercises</td>
</tr>
<tr>
<td>Welling and Barnes,¹ 1994</td>
<td>27</td>
<td>4 (22.2)</td>
<td>PLF following stapedectomy, posterior canal occlusion</td>
<td>Fistula closure, neurosurgery referral, vestibular habituation exercises and posterior canal occlusion</td>
</tr>
<tr>
<td>Weider et al.,¹⁰ 1994</td>
<td>44</td>
<td>2 (4.5)</td>
<td>BPPV possibly from PSC</td>
<td>Further treatment refused</td>
</tr>
<tr>
<td>Steenerson and Cronin,¹⁴ 1996</td>
<td>20</td>
<td>3 (15)</td>
<td>BPPV possibly from PSC</td>
<td>Complete relief with vestibular habituation therapy</td>
</tr>
</tbody>
</table>

Abbreviations: BPPV, benign paroxysmal positional vertigo; HSC, horizontal semicircular canal; PLF, perilymph fistula; PRM, particle repositioning maneuver; PSC, posterior semicircular canal.

The exact causal relationship between episodic BPPV and an intracranial space-occupying lesion is debated. One of the mechanisms suggested is that there is vascular compromise of the affected labyrinth as the tumor causes ischemia of the anterior vestibular artery, which leads to posterior canal BPPV.¹⁵ Other treatable conditions that should be excluded include local aural conditions like chronic otitis media, Ménière’s disease, or perilymph fistula.⁷ The 2 patients with Ménière’s disease in the present series had their first attack 2 weeks after starting PRM. The vertigo that appeared was found to be historically different from the characteristic positional vertigo that occurred initially. The appearance of concomitant tinnitus and aural fullness was diagnostic.

Once it is clear that BPPV is not improved by a particular PRM and no other treatable cause for posterior canal BPPV has been identified, an attempt should be made to try an alternative PRM or habituation procedure. It may be that cupulolithiasis, and not canalithiasis, is causing BPPV; hence, the appropriate PRM is required. Some authors describe differentiating between cupulolithiasis and canalithiasis by means of the Dix-Hallpike maneuver.¹⁹ In cupulolithiasis, when the head is placed in the Dix-Hallpike position, there is no latency in the onset of vertigo and nystagmus. Further, nystagmus and vertigo last as long as the head is maintained in the provoking position. In canalithiasis, however, there is usually a latency period of about 1 to 40 seconds before the onset of vertigo and nystagmus when the head is placed in the Dix-Hallpike position, and vertigo and nystagmus disappear within 60 seconds if the head’s position is maintained. When the patients of Harvey and colleagues¹³ responded neither to the PRM nor to a modified liberatory maneuver, the authors prescribed the Brandt-Daroff exercises. Occasionally, vestibular habituation therapy is more effective than PRMs. Steenerson and Cronin¹⁴ found that the 3 patients who had persistent BPPV following PMRs had complete relief of symptoms following institution of vestibular habituation exercises.

Some patients with BPPV have either horizontal canal canalithiasis or a combination of horizontal canal and posterior canal canalithiasis. Such patients do not attain complete relief with PRMs such as the Epley or Semont maneuver alone. Indeed, Herdman and Tusa²⁰ suggest that a few patients who have been treated for posterior semicircular canal BPPV may be found to have horizontal canal BPPV after treatment. The conversion of posterior semicircular canal BPPV to lateral semicircular canal BPPV is believed to be due to the shift of otoconial debris from the posterior canal to the horizontal canal via the utricle. This appeared to be the case in 2 patients in the present
series. Testing for horizontal canal involvement followed by administration of the specific PRM\textsuperscript{12} is required in these cases.

Finally, a certain proportion of patients who have persistent BPPV may benefit from surgical procedures like posterior ampullary nerve section or posterior semicircular canal occlusion. Included in this group are those with vestibular atelectasis. This entity was first described by Merchant and Shucknecht\textsuperscript{21} in a postmortem diagnosis made in individuals whose temporal bones had collapsed walls of the ampullae of the semicircular canal and utricle, causing restriction of movement of the cupula and otolithic membrane. These patients had experienced positional vertigo and persistent unsteadiness. In such patients PRMs are unlikely to be effective. The surgical procedures for BPPV are associated with a small but significant risk of hearing loss, which may be acceptable to patients with severe symptoms.

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