



As the World Turns: Vertigo in the Emergency Department

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A 67 year-old man rolled over in bed early in the morning and suddenly developed severe nausea as well as the unpleasant sensation that the room was spinning around him. The spinning resolved within 30 seconds but recurred again in the opposite direction when he rolled back to his original position. This had never happened to him before. The patient denied tinnitus, hearing loss, recent viral illness, or head trauma.

The patient's past medical history was remarkable only for hypertension for which he took atenolol. Surgical history was unremarkable. He did not smoke, drank only occasionally, and denied illicit drug use. Family history was non-contributory. He had no known drug allergies.

Vital signs revealed a temperature of 37.2, pulse of 70, BP of 140/85, respirations of 12/minute, and oxygen saturation of 98%. The head, eyes, ears, neck, and cardiac examinations were unremarkable. A detailed neurological examination, including mental status, cranial nerves, motor function, sensory function, and cerebellar function, was normal. A Hallpike (aka Nylan-Barany) test was performed and showed torsional nystagmus in the right head-hanging position, along with reproduction of the patient's symptoms.

Key Clinical Questions

What differentiates peripheral from central vertigo?

What differentiates benign paroxysmal positional vertigo (BPPV) from other peripheral causes of vertigo, such as labyrinthitis and vestibular neuritis?

What is the optimum treatment for benign paroxysmal positional vertigo?

Key Learning Points

- When compared to central vertigo, peripheral vertigo tends to have a sudden onset, severe intensity, duration of seconds, no associated neurological findings, nystagmus that is unidirectional and fatigable, and possible hearing loss and tinnitus.
- The diagnosis of benign paroxysmal positional vertigo is based on a characteristic history and a positive Hallpike test. Unlike other causes of peripheral vertigo, BPPV has discrete episodes of vertigo, with each episode lasting usually less than 1 minute in duration. Other common causes of peripheral vertigo (such as labyrinthitis and vestibular neuritis) have vertigo that is continuous for days.
- Once the diagnosis of BPPV is confirmed, the patient should receive the Epley maneuver. This maneuver takes approximately 2-3 minutes to perform and is done at the bedside.

Benign Paroxysmal Positional Vertigo

Background, Risk Factors and Epidemiology

Evaluating the dizzy patient can be difficult, since dizziness is a nonspecific symptom and is difficult to objectively measure. The four major causes of dizziness are vertigo, near-syncope, disequilibrium, and psychogenic dizziness (1,2).

Vertigo is the most common cause of dizziness, and benign paroxysmal positional vertigo (BPPV) is the most common cause of vertigo. Vertigo, which is an illusion of motion, is classically described as “the room is spinning.” However, it is important to realize that patients may use alternative descriptions, such as rocking, tilting, somersaulting, and descending in an elevator. All that matters is that there is an illusion of motion.

BPPV is usually a disease of the elderly (3). Younger patients may also develop BPPV, especially if there is a history of head trauma.

Many ED physicians treat vertigo with an antiemetic and intravenous fluids, and then discharge the patient with meclizine (Antivert). Unfortunately, the prescription of meclizine tends to be a knee-jerk reaction to the chief complaint of dizziness. Although useful in patients with vertigo, this medication may actually worsen symptoms in patients who have one of the other causes of dizziness. In BPPV, the need for meclizine may be moot as the disease can often be cured with a simple bedside maneuver.

Anatomy and Pathophysiology

The labyrinth of the inner ear is composed of the vestibule (made up of the sac-like utricle and saccule) and the 3 semicircular canals. These structures are interconnected and are filled with endolymph. Receptors are located in each structure which inform the brain about the head's position in space. In addition to endolymph, the utricle is unique in that it also contains calcium oxalate crystals called otoliths or otoconia. These otoliths are attached to ciliary hairs on top of a membrane. Since the otoliths are denser than the surrounding endolymph, they are pulled down by gravity. When the head is tilted up or down, the otoliths bend the hair cells and trigger linear receptors, which inform the brain about head-tilt position in space.

Similarly, angular acceleration receptors are located in the cupula of the semicircular canals. These receptors, which are triggered by movement of endolymph when the head turns, inform the brain that the head is turning. Once the head stops turning, the endolymph stops moving, the receptors stop firing, and the brain now knows that the head has stopped turning.

In BPPV, the otoliths become dislodged from the hair cells and membrane to which they were attached, migrate out of the utricle, and enter the semicircular canals (4). The posterior semicircular canal is almost always the involved canal since it is the most dependent of the 3 canals. Now when the patient turns his head, *both* the otoliths and endolymph start to move. Once the patient stops turning his head, the endolymph should stop moving as well. However, the otoliths continue to move and drag the endolymph with them. Angular acceleration receptors in the semicircular canal continue to fire and tell the brain that the head is still turning. The eyes,

however, tell the brain that the head has stopped moving. Receiving conflicting information, the brain resolves this dilemma by rationalizing that the room must be spinning in the opposite direction.

ED Presentation

The BPPV patient typically moves his head and develops nausea and vertigo after a few seconds delay. This usually resolves in less than one minute once the head stops moving. If the patient then turns his head to the original position, the otoliths reverse direction and the room will seem to spin in the opposite direction.

Most BPPV patients are nauseated and some may vomit. Patients quickly learn to avoid head positions which provoke the vertigo.

The neurological examination is completely nonfocal. This is a useful distinguishing feature that differentiates peripheral from central vertigo. In central vertigo, either the cerebellum or vestibular nuclei within the brainstem are affected. Since the vestibular nuclei are so closely located to other nuclei and various axonal tracts, it would be extremely unlikely for a central nervous system lesion to affect only the vestibular nuclei and not other systems as well.

All vertigo patients should receive a Hallpike (also known as Nylan-Barany) test. In this diagnostic test, the patient is sat upright in the gurney with the head turned 45 degrees to either side. The examiner grasps the patient's head and gently lays the patient down to the supine position with the head hanging over the edge of the bed. The patient is told to keep his eyes open. The examiner looks for signs of torsional or rotatory nystagmus and asks the patient if his symptoms recur. The patient is returned to the upright position and the test is repeated with the head turned in the opposite direction. Only one side is usually symptomatic, and it is this side that serves as the starting point for the Epley maneuver (to be discussed in the procedure section).

Lab Studies

If the history is classic and the patient has a positive Hallpike test (defined as torsional or rotatory nystagmus along with reproduction of symptoms while in the head-hanging position), then the ED physician can be confident that he is treating BPPV. No laboratory tests are mandatory in such a case, with the exception of checking electrolytes if the patient has had prolonged vomiting.

Other laboratory tests may be ordered if the diagnosis is in doubt. For example, a dizzy diabetic patient should have a blood sugar level to rule out hypoglycemia. A hemoglobin or hematocrit can also be checked to rule out anemia as a cause of dizziness.

Imaging Studies

If the examiner is confident that the diagnosis is BPPV, then no further imaging studies need to be performed. If the examiner is not confident of the diagnosis or if the patient has a focal neurological examination, then a non-contrast cranial CT should be performed as an initial screening test.

Procedures

The Epley maneuver, also known as the canalith repositioning maneuver, was first described in 1992 (5). Multiple trials suggest that it is an effective treatment for BPPV (6,7). Epley originally pretreated patients and used a mastoid oscillator. Most clinicians perform a modified version (no pretreatment, no mastoid oscillation), and this is described as follows: the patient's head is turned 45 degrees to the side that demonstrated nystagmus and reproduction of symptoms during the diagnostic Hallpike test. As in the Hallpike test, the patient is guided to the supine position with the head hanging over the edge of the gurney. The head is then rotated 90 degrees in the opposite direction with the face upwards, maintaining a dependent position. The patient is then asked to roll onto his side and rotate his head so that he is looking straight to the ground. The patient is then raised to a sitting position while maintaining head rotation. Finally, the head is rotated to a central position and moved forward 45 degrees.

The patient should be warned that he will become symptomatic with each turn of the head. Each position should be held at least 30 seconds, or until nystagmus and reproduction of symptoms has resolved. It is not clear whether the Epley maneuver should be repeated multiple times. Epley himself performs the maneuver up to approximately 5 times (personal communication). Other experts perform the maneuver only one time since they feel that the particles will just continually reintroduce themselves into the canals if the procedure is repeated.

The Epley maneuver takes approximately 2-3 minutes to perform and is done at the patient's bedside. Aside from the expected reproduction of symptoms and occasional vomiting, there have been no reported adverse events from performing the Epley maneuver. Contrary to popular belief, each part of the Epley maneuver does not need to be done rapidly.

After the maneuver, patients are generally advised to stay in an upright position. Once the otoliths re-enter the utricle, they need time to reattach to the hair cells and membrane. The time required for this process is not clear, but it is generally advised that at least 8 hours are needed before the patient can assume a supine position.

Contraindications to performing the Epley maneuver include unstable heart disease, high grade carotid stenosis, ongoing CNS disease (stroke or TIA), and severe neck disease (8). Relative contraindications include pregnant women beyond the 24th week gestation (to avoid the supine hypotension syndrome).

Emergency Department Care

What is convenient about BPPV is that no laboratory tests or imaging tests are usually needed. In addition, the patient often does not require the placement of an intravenous line unless he is actively vomiting or is dehydrated. Instead, the ED physician physically lays his hands on the patient and “cures” him right at the bedside. This is extremely gratifying to both the patient and the physician performing the maneuver.

If the Epley maneuver fails or if the patient needs medication immediately for acute vomiting, then one of 3 classes of vestibular suppressants should be used. The sensory conflict theory states that when there is a mismatch of information from any 2 of the 3 inputs (vestibular, visual, proprioceptive), then in the acute phase nausea and emesis result, but with time, habituation occurs. There are 3 main neurotransmitters that regulate this system: GABA agonists, anticholinergics, and antihistaminics. Intravenous promethazine (Phenergan) is felt by many to be the most appropriate medication in the ED setting. This medication works quickly to relieve vomiting and vertigo through both its antihistaminic and anticholinergic effects. This medication is, however, somewhat sedating. Scopalamine, which is recommended in several textbooks, has a delayed onset of 4-6 hours and hence is not appropriate for the acute treatment of BPPV in the ED. Intravenous benzodiazepines also have some benefit, but many experts avoid them since they can prevent the process of vestibular rehabilitation.

Consultations and Admission

In general, most patients with BPPV respond to the Epley maneuver and can be discharged home. Those with persistent vomiting and vertigo, or those who cannot ambulate may need to be admitted to the hospital. Consultation with a neurologist or otolaryngologist may be appropriate if the diagnosis is in doubt or if the patient is not responding to the Epley maneuver. These patients often have an alternative diagnosis, such as vestibular neuritis.

References

1. Drachman DA, Hart CW. An approach to the dizzy patient. *Neurology* 1972;22:323-334.
2. Kroenke K, Lucas CA, Rosenberg ML, et al. Causes of persistent dizziness: a prospective study of 100 patients in ambulatory care. *Ann Intern Med* 1992;117:898-904.
3. Froehling DA, Silverstein MD, Mohr DN, et al. Benign positional vertigo: incidence and prognosis in a population-based study in Olmsted County, Minnesota. *Mayo Clinic Proc* 1991;66:596-601.
4. Parnes LS, McClure JA. Free-floating endolymph particles: a new operative finding during posterior semicircular canal occlusion. *Laryngoscope*. 1992;102:988-992
5. Epley JM. The canalith repositioning procedure: for treatment of benign paroxysmal positional vertigo. *Otolaryngol Head Neck Surg* 1992;107:399-404
6. Froehling DA, Bowen JM, Mohr DN, et al. The canalith repositioning procedure for the treatment of benign paroxysmal positional vertigo: a randomized controlled trial. *Mayo Clin Proc* 2000;75:695-700.
7. Lynn S, Pool A, Rose D, et al. Randomized trial of the canalith repositioning procedure. *Otolaryngol Head Neck Surg* 1995;113:712-20.
8. Furman JM, Cass SP. Benign Paroxysmal Positional Vertigo. *N Engl J Med*. 1999;341(21):1590-1596.

Patient Outcome

Diagnosis: Benign paroxysmal positional vertigo (BPPV)

Given a classic history, a nonfocal neurological examination, and a positive Hallpike test (torsional nystagmus and reproduction of symptoms in the right head-hanging position), it was felt that the patient had BPPV. The patient received the Epley maneuver with complete resolution of symptoms. His length of stay was only 20 minutes, and he did not require laboratory work, imaging studies, or even an intravenous line. He was extremely pleased with his care in the ED.

Annotated Bibliography

1. Epley JM. The canalith repositioning procedure: for treatment of benign paroxysmal positional vertigo. *Otolaryngol Head Neck Surg* 1992;107:399-404

The original article from which the Epley maneuver was described. Epley used premedication (either transdermal scopolamine patch the night before or oral diazepam given 1 hour prior to the maneuver) and induced vibration with a mastoid oscillator. Nowadays, most clinicians perform the "modified" Epley maneuver (no premedication and no mastoid oscillation)..

2. Parnes LS, McClure JA. Free-floating endolymph particles: a new operative finding during posterior semicircular canal occlusion. *Laryngoscope* 1992;102:988-992.

Prior to this report, BPPV was based on the theoretical assumption that otoliths had migrated into the posterior semicircular canal. This report demonstrated by direct surgical observation the presence of displaced otoliths in the posterior semicircular canal of two BPPV patients.

3. Furman JM, Cass SP. Benign Paroxysmal Positional Vertigo. *N Engl J Med* 1999;341(21):1590-1596.

A recent New England Journal review article summarizing BPPV. Decent drawings depicting both the Hallpike test and Epley maneuver. Also lists contraindications for performing the Epley maneuver.

4. Froehling DA, Bowen JM, Mohr DN, et al. The canalith repositioning maneuver for the treatment of benign paroxysmal positional vertigo: a randomized, controlled trial. *Mayo Clin Proc* 2000;75:695-700.

One of two randomized trials judged to be of sufficient methodologic quality to be included in a recent Cochrane review. Unlike many other trials, this one was performed in an ambulatory clinic as opposed to a specialty clinic. 50 adult patients were randomized to either Epley maneuver or sham maneuver. Median symptom duration was 43 days in the Epley group and 35 days for the sham group. The median duration of followup was 10 days. For the Epley group, 50% had complete resolution of symptoms and 67% had a negative repeat Hallpike test. For the sham group, 19% had complete resolution of symptoms and 38% had a negative repeat Hallpike test.

5. Lynn S, Pool A, Rose D, et al. Randomized trial of the canalith repositioning procedure. *Otolaryngol Head Neck Surg* 1995;113:712-20.

The other study judged to be of sufficient methodological quality to be included in a recent Cochrane review. 36 adult patients who had symptom duration for a minimum of 2 months were randomized to either the Epley maneuver or a sham maneuver. At 5 weeks, patients returned for a followup Hallpike test. The Epley group had significantly more negative responses (88.9%) than did those in the placebo group (26.7%) ($p < 0.001$).

6. Hilton M, Pinder D. The Epley manoeuvre for benign paroxysmal positional vertigo - a systematic review. *Clin Otolaryngol* 2002;27:440-445.

These are the authors who performed a Cochrane review for the Epley maneuver in treating BPPV. They identified 11 randomized trials but excluded 9 because of concern about a high probability of bias. The remaining two studies had a combined total of 86 patients. Patients who received the Epley maneuver were more likely to have complete resolution of their symptoms [odds ratio 4.92 (95% C.I. 1.84-13.16)], and more likely to convert from a positive to negative Hallpike test [odds ratio 5.67 (95% C.I. 2.21-14.56)].

Questions

1. **Which of the following descriptions suggests vertigo?**
 - a. Rocking sensation
 - b. Somersaulting sensation
 - c. Spinning sensation
 - d. Tilting sensation
 - e. All of the above

2. **Which of the following is false regarding peripheral vertigo?**
 - a. The onset is usually abrupt
 - b. The neurological examination is nonfocal
 - c. It can be associated with tinnitus and hearing loss
 - d. The nystagmus is fatiguable
 - e. The duration of vertigo is continuous

3. **In BPPV, which semicircular canal is most often affected?**
 - a. Anterior
 - b. Posterior
 - c. Horizontal
 - d. Vertical
 - e. Superior

4. **Which of the following is NOT characteristic of BPPV?**
 - a. Positive Hallpike test
 - b. Latency of a few seconds after the initial movement of the head
 - c. Vertigo that resolves in less than 1 minute
 - d. Spinning sensation in the same direction no matter which way the head is turned
 - e. All of the above

5. **What is the initial medication that should be used in a patient with active vomiting and vertigo from BPPV?**
 - a. IV Promethazine (Phenergan)
 - b. PO Scopolamine
 - c. PO Meclizine (Antivert)
 - d. IV Benadryl
 - e. IV Prochlorperamide (Compazine)

Answers

1. Answer e.

Although classically described as the “room is spinning,” all of the answers can suggest vertigo, since they all involve an illusion of motion (an illusion is a misperception of a real stimulus).

2. Answer e.

Peripheral vertigo is usually sudden in onset, severe in intensity, has a duration of seconds, has unidirectional and fatigable nystagmus, may have associated hearing loss or tinnitus, and has no associated neurological findings.

3. Answer b.

The posterior semicircular canal is the most dependent of the 3 canals; therefore, otoliths falling out of the utricle are most likely to enter the posterior semicircular canal. There is no “superior” semicircular canal.

4. Answer d

When the head is turned one way, the otoliths move in a certain direction and “the room spins”. If the head is turned back to the original position, the otoliths move in the opposite direction and the room will spin in the opposite direction.

5. Answer a

Based on the sensory conflict theory, vestibular suppressants work by affecting certain neurotransmitters (GABA, cholinergic, and histaminic receptors). IV promethazine is probably the best medication for acute severe vertigo and vomiting in the ED. Scopalamine, which is recommended by certain EM textbooks, has an onset of several hours and is not effective in the acute ED setting. Since intravenous benzodiazepines prevent the process of vestibular rehabilitation, many experts feel they are not first line medications.