

## A Randomized Clinical Trial to Assess the Efficacy of the Epley Maneuver in the Treatment of Acute Benign Positional Vertigo

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### Abstract

**Objectives:** To compare the efficacy of the Epley maneuver with that of a placebo maneuver in patients presenting to the emergency department (ED) with benign positional vertigo (BPV). **Methods:** This was a prospective, randomized, single-blind placebo-controlled trial. Consecutive adult ED patients presenting to a university teaching hospital with BPV were randomized to treatment with either the Epley or placebo maneuver. The severity of vertigo was evaluated on a 0 to 10-point scale before and after the maneuvers. **Results:** Eleven patients were randomized to the Epley group and 11 to the placebo group

before the trial was terminated, based on a planned interim analysis. The median decreases in vertigo severity were 6 (95% confidence interval [95% CI] = 4 to 9) for the Epley group and 1 (95% CI = 0 to 3) for the placebo group ( $p = 0.001$ ). **Conclusions:** The Epley maneuver is a simple bedside maneuver that appears to be more efficacious than a placebo maneuver in the treatment of acute BPV among ED patients. **Key words:** benign positional vertigo; canalith repositioning maneuver; Epley maneuver; dizziness. *ACADEMIC EMERGENCY MEDICINE* 2004; 11:918-924.

Dizziness is a common complaint in patients presenting to the emergency department (ED). In a general internal medicine clinic,<sup>1</sup> as well as in subspecialty dizziness clinics,<sup>2,3</sup> vertigo was found to be the most common cause of dizziness. Vertigo is defined as an illusion of motion and is most commonly caused by benign positional vertigo (BPV). Since BPV usually occurs abruptly and can cause substantial morbidity, many patients seek initial care in the ED. While in the ED, these patients typically receive intravenous fluids and antiemetics and are then discharged on meclizine. Occasionally patients need to be admitted for persistent vomiting or incapacitating dizziness.

Head positioning maneuvers have recently been developed to treat BPV.<sup>4,5</sup> The Epley maneuver has

been the most popular because of its higher success rate and the ability to perform the maneuver gently in the geriatric population.<sup>6</sup>

In specialty clinics, the Epley maneuver has been shown to be a safe and effective treatment for BPV.<sup>4,6-13</sup> There has also been one study examining the efficacy of the Epley maneuver performed by generalist physicians in the ambulatory setting.<sup>14</sup> These studies have required patients to have vertigo for a minimum duration of as much as several months<sup>7,8</sup> or to have had an average duration of symptoms lasting for several months.<sup>4,10-14</sup> However, ED patients with vertigo often have developed it acutely and cannot wait several months to be evaluated and treated. First described in 1992, the Epley maneuver remains relatively unknown to most emergency physicians (EPs).<sup>15</sup> This is unfortunate because this maneuver is a simple bedside manipulation in which the EP has an opportunity to provide the patient with immediate relief without the need for an intravenous line, medications, imaging studies, or laboratory work. To the best of our knowledge, this is the first study to examine the Epley maneuver in ED patients presenting with acute BPV.

In this clinical trial, we wished to test the hypothesis that ED patients with acute onset of BPV, randomized to receive the Epley maneuver, would improve by at least three or more points (on a 0 to 10-point scale) compared with those patients randomized to a placebo maneuver. Our primary endpoint was the between-group difference in before-after improvement in vertigo scores measured before patients were released from the ED.

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## METHODS

**Study Design.** This study was a prospective, randomized, single-blind, placebo-controlled clinical trial designed to compare the changes in vertigo severity scores before and after the Epley and placebo maneuvers. This study was approved by the institutional review board (IRB). However, it mandated that patients in the placebo group receive a rescue Epley maneuver if they did not significantly improve, because it was deemed unethical to withhold a potentially therapeutic intervention in placebo patients. Our study, however, did not have a crossover design because data collection for the primary outcome ended after patients received the maneuver to which they were allocated.

**Study Setting and Population.** The trial was conducted in the teaching hospital ED of a tertiary care center with an annual census of 46,000 patient visits. The ED is staffed by board-certified emergency medicine (EM) attending physicians and residents in EM and other specialties. Patients were enrolled from October 2001 to June 2002. Inclusion criteria included age 18 years or older, a history consistent with the diagnosis of positional vertigo, and a Hallpike test that showed either nystagmus or reproduction of symptoms while in the head-dependent position. Exclusion criteria included evidence of ongoing central nervous system disease, high-grade carotid artery stenosis, unstable heart disease, severe neck disease, restricted mobility, pregnancy beyond the 24th-week gestation, and alternative diagnoses of peripheral vertigo (e.g., vestibular neuritis and labyrinthitis).

**Study Protocol.** We enrolled consecutive adult patients who presented to the ED with BPV 24 hours a day, seven days a week. Two of the study authors (AKC, GS) placed themselves on call in order to facilitate data collection and to ensure proper maneuver technique.

Benign positional vertigo is a clinical diagnosis, and patients were considered to have BPV if they had a history consistent with positional vertigo (e.g., several seconds after moving the head, the patient experiences vertigo that resolves in less than 1 minute if the head is kept still) and a positive Hallpike test (defined as either observation of nystagmus or reproduction of symptoms while in the head-dependent position).<sup>16</sup> We did not require the presence of nystagmus for the diagnosis of BPV because some patients do not exhibit nystagmus due to visual fixation.<sup>17</sup> Patients with labyrinthitis and vestibular neuritis were excluded from the study based on historical information. For these two alternative diagnoses, the vertigo tends to be constant for days, is not necessarily positional, usually follows a viral prodrome, and, in the case of labyrinthitis, affects hear-

ing.<sup>18</sup> In addition, patients who claimed to have vertigo during the interview process (while their heads were still) probably had these alternative diagnoses and hence were excluded.

Written consent in English, Spanish, or Vietnamese was obtained as appropriate from all subjects. The next in a series of sealed, consecutively numbered, opaque envelopes was then opened to determine the maneuver (Epley or placebo) to which the patient would be allocated. A person not connected to the enrollment or allocation process prepared the envelopes. Assignments were generated by the randomization program at [www.randomization.com](http://www.randomization.com). Patients were blinded to allocation but were told during the consent process that if they received the placebo maneuver and did not improve adequately, they then would receive the Epley maneuver.

Patients were interviewed by a trained examiner and a data sheet was completed to record patient age, gender, race, onset and duration of symptoms, previous episodes of vertigo, hearing loss, tinnitus, history of recent viral illness, head trauma, ear infection, and medications used before arrival in the ED. The vertigo score was obtained by asking patients to grade the severity of their vertigo on a 0 to 10-point scale similar to that used in a previous study.<sup>19</sup> The pre-maneuver vertigo score was obtained during the Hallpike test. The post-maneuver score was obtained 15–30 minutes after either the Epley or placebo maneuver was performed. Some experts believe that performing the Hallpike test immediately after the Epley maneuver may cause BPV to recur by allowing the otoliths to re-enter the posterior semicircular canal. Therefore, the post-maneuver score was obtained by asking patients to turn their heads from side to side and rate their vertigo on a 0 to 10-point scale.

The Hallpike test was used to confirm the diagnosis of BPV and to determine in which direction the head needed to be turned at the start of the maneuvers. To perform the Hallpike test, starting from the sitting position, the patient's head was turned 45° to one side. The patient was then guided down to the supine position with the head dependent over the edge of the gurney. Reproduction of symptoms or visualization of torsional nystagmus was noted. The patient was then returned to the sitting position and the test was repeated with the head turned to the opposite side. The side that caused greater nystagmus or reproduction of symptoms was the starting position for the study maneuvers. Furman and Cass, in a recent paper, provide a clear illustration of this test.<sup>16</sup>

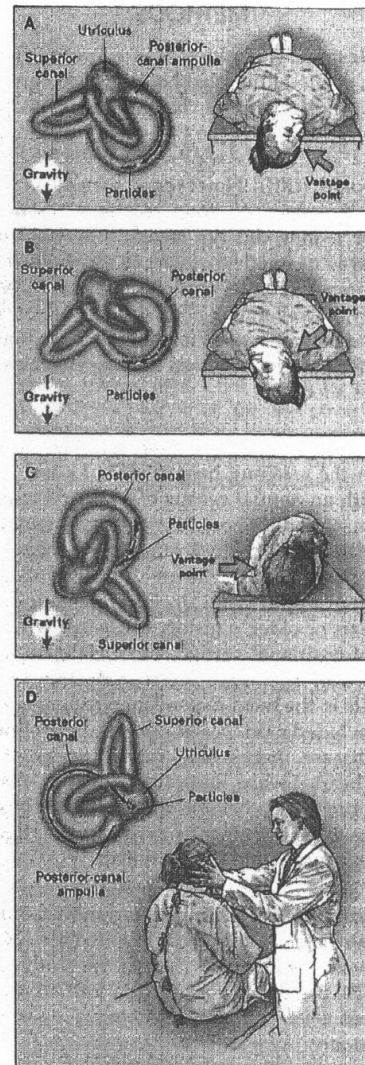
**Study (Epley) Group.** The maneuver used in this trial is known as the "modified" Epley maneuver, which is performed without the use of a mastoid oscillator and premedication as originally described by Epley.<sup>4</sup> As in the Hallpike test, the patient's head was turned 45° to the side causing the greater nystagmus or reproduc-

tion of symptoms. The patient was guided to the supine position with the head hanging over the edge of the gurney. The head was then rotated 90° in the opposite direction, maintaining the head in a dependent position. The patient was then asked to roll onto his or her side with the head rotated so that it faced downward. The patient was then raised to a sitting position and the head was moved forward 45°. Each position was held until resolution of vertigo and/or nystagmus occurred, or for at least 30 seconds. The total time required to perform the maneuver is approximately 2 to 3 minutes, and it can be performed at the patient's bedside. Figure 1 shows a detailed schematic of this maneuver.

Patients in the Epley group who had an improvement of 50% or more in their vertigo (based on the difference between their score during the Hallpike test and 15–30 minutes after the maneuver) were discharged home. Patients who still had not improved by at least 50%, or patients who at any time were actively vomiting or could not tolerate the Epley maneuver, received 25 mg intravenous promethazine. Sixty minutes after receiving promethazine, patients were asked to rank their vertigo on a 0 to 10-point scale. If the patient still had not improved sufficiently to ambulate without assistance or if he or she continued to vomit, further management was per ED attending discretion, and could include consultation or admission.

**Placebo Group.** The patient began by sitting upright on the gurney. The patient was then asked to lie down on his or her side in a lateral decubitus position for 5 minutes. The side used was the side that caused the greater reproduction of symptoms or nystagmus during the Hallpike test. The patient was then asked to return to the original upright sitting position. This placebo maneuver was used in a recently published study.<sup>14</sup>

Patients in the placebo group who had an improvement of 50% or more in their vertigo (difference between their score during the Hallpike test and 15–30 minutes following the maneuver) and who could safely ambulate and were not vomiting were discharged home. Patients in the placebo group who did not improve by 50% received the Epley maneuver after their pre- and post-maneuver vertigo scores had been collected. As noted above, this was mandated by our IRB for ethical reasons. We did not use vertigo scores obtained after the rescue maneuver in our primary data analysis. However, we did obtain vertigo scores from those patients randomized to placebo after they had received the rescue Epley maneuver as a secondary endpoint to see whether they improved. As in those patients randomized to the Epley maneuver, if patients randomized to placebo still did not improve adequately, or if they had any vomiting or inability to tolerate the maneuver, they received 25 mg



**Figure 1.** Performing the Epley maneuver. Reprinted with permission from: Furman JM, Cass SP. Benign paroxysmal positional vertigo. *N Engl J Med.* 1999; 341:1590–6. Copyright 1999, Massachusetts Medical Society.

of intravenous promethazine. When improvement in vertigo score of 50% was achieved, patients were discharged if they could ambulate safely and were not vomiting. If patients still did not improve adequately, further treatment was per ED attending discretion as above.

For both groups, we chose to use a 50% improvement because patients who present with vertigo may also have concomitant symptoms of disequilibrium that they sometimes cannot distinguish from

vertigo.<sup>20,21</sup> Patients who were discharged received prescriptions for meclizine and were instructed to stay upright for at least eight hours.

All ED attending physicians and ED residents underwent in-service training by the lead author that included a short lecture, a video demonstration, and hands-on practice of the Hallpike test, the Epley maneuver, and the placebo maneuver. The original protocol had two of the authors (AKC, GS) performing or directly supervising all maneuvers at the beginning of the study. After this initial period, it was felt that the ED attending physician would have developed sufficient expertise to perform the maneuvers appropriately. However, because the study was prematurely terminated due to an a priori stopping rule, all but two patients were enrolled by the authors.

**Measurements.** The primary outcome was the difference between the two groups in the before-after change in vertigo severity scores (based on the difference between the pre-maneuver score during the Hallpike test and the score 15–30 minutes after the maneuvers were performed). This was assessed by patients on a previously described 0 to 10-point scale.<sup>19</sup> Secondary outcomes included improvement in vertigo score for patients in the placebo group who received a rescue Epley maneuver.

**Data Analysis.** Initial sample size calculations indicated that 60 patients (30 per group) were needed to detect a difference of three points or more on the vertigo scale, assuming a two-tailed alpha of 0.05 and a standard deviation of 4. Stopping rules were mandated by the IRB, and a planned interim analysis of the primary outcome measurement occurred when 22 patients had been enrolled. A between-group pre- and post-maneuver improvement in vertigo scores at the  $p < 0.01$  level was used as the criterion for study termination.

At the outset of the study, we intended to use a t-test to compare the mean changes in vertigo scores

in the two groups. However, as the interim analysis was based on 11 patients per group, a nonparametric test, the Mann-Whitney U test, was used to make this comparison. The differences in change in vertigo scales pre- and post-maneuvers in the Epley and placebo groups were expressed as the median, bounded by a 95% confidence interval (95% CI) based on the ranks of the observations.<sup>22</sup> A Wilcoxon signed-rank test (the nonparametric analog of the paired t-test) was used to assess the change in vertigo scores in patients in the placebo group who received a rescue Epley maneuver. SPSS 11.0 for Windows (SPSS, Inc., Chicago, IL) was used for the statistical analyses.

## RESULTS

As shown in Figure 2, 11 patients were randomized to the Epley group and 11 to the placebo group. Table 1 lists the baseline characteristics of the two groups. Initial pre- and post-maneuver vertigo scores for each patient are shown in Figure 3. There was substantially more improvement in the Epley group than in the placebo group. The median decreases in vertigo severity were 6 (95% CI = 4 to 9) in the Epley group and 1 (95% CI = 0 to 3) in the placebo group ( $p = 0.001$ ).

Figure 3 also shows that the distributions of pre-maneuver scores were different in the two groups ( $p = 0.05$ ). More patients in the placebo group reported high scores than in the Epley group. We assessed the possible bias from this by restricting an analysis to patients who had a pre-maneuver vertigo score of 9 or 10. Even in this small subgroup, the Epley group had a significantly greater decline in vertigo scores than the placebo group ( $p = 0.008$ ).

Fifty-five percent (6 of 11) of patients in the placebo group received a rescue Epley maneuver. Figure 4 shows the results in this subset of patients. The decrease in vertigo severity between the post-maneuver score and the post-rescue score was statistically significant ( $p = 0.027$ ).

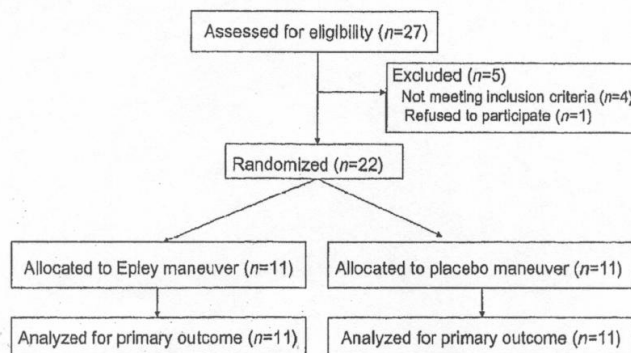


Figure 2. CONSORT flow diagram.

demonstrate nonfatigable horizontal nystagmus with the head turned in either direction. None of the patients encountered in this study were believed to have this horizontal variant.

This study also enrolled patients who had classic symptoms of BPV but no nystagmus on the Hallpike test. We included these patients because it is known that some patients will not show nystagmus due to visual fixation. Such patients require the use of specialized Frenzel lenses or infrared videonystagmography to bring out their nystagmus. Because it is not practical for EDs to carry such specialized equipment, we believed that it was important to include patients without nystagmus since this is how actual ED patients might present. Also, even with this specialized equipment, some patients still may not demonstrate nystagmus. In one study, 61% (26 of 43) of patients with a characteristic history who failed to show nystagmus despite the use of Frenzel lenses and videonystagmography were successfully treated with use of the Epley maneuver.<sup>17</sup> These authors believed that it was not essential to observe a positional and positioning nystagmus, and that symptoms of vertigo connected to positional and positioning tests are sufficient. Given the small number of patients in our study who did not demonstrate nystagmus, subgroup analysis could not be performed in this subset of patients.

## CONCLUSIONS

The Epley maneuver is a simple bedside treatment that appears to be more efficacious than placebo in treating patients presenting to the ED with acute BPV.

## References

1. 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.
2. Drachman DA, Hart CW. An approach to the dizzy patient. *Neurology.* 1972; 22:323-34.
3. Nedzelski JM, Barber HO, McIlmoyl L. Diagnoses in a dizziness unit. *J Otolaryngol.* 1986; 15:101-4.
4. Epley JM. The canalith repositioning procedure: for treatment of benign paroxysmal positional vertigo. *Otolaryngol Head Neck Surg.* 1992; 107:399-404.
5. Semont A, Freyss G, Vitte E. Curing the BPPV with a liberatory maneuver. *Adv Otorhinolaryngol.* 1998; 42:290-3.
6. Parnes LS, Price-Jones RG. Particle repositioning maneuver for benign paroxysmal positional vertigo. *Ann Otol Rhinol Laryngol.* 1993; 102:325-31.
7. Lynn S, Pool A, Rose D, Brey R, Suman V. Randomized trial of the canalith repositioning procedure. *Otolaryngol Head Neck Surg.* 1995; 113:712-20.
8. Wolf M, Hertanu T, Novikov I, Kronenberg J. Epley's manoeuvre for benign paroxysmal positional vertigo: a prospective study. *Clin Otolaryngol.* 1999; 24:43-6.
9. Asawavichianginda S, Isipradit P, Snidvongs K, Supiyaphun P. Canalith repositioning for benign paroxysmal positional vertigo: a randomized controlled trial. *Ear Nose Throat J.* 2000; 79:732-7.
10. Herdman SJ, Tusa RJ, Zee DS, Proctor LR, Mattox DE. Single treatment approaches to benign paroxysmal positional vertigo. *Arch Otolaryngol Head Neck Surg.* 1993; 119:450-4.
11. Appiani GC, Gagliardi M, Urbani L, Lucertini M. The Epley maneuver for the treatment of benign paroxysmal positional vertigo. *Eur Arch Otorhinolaryngol.* 1996; 253:31-4.
12. Cohen HS, Jerabek J. Efficacy of treatments for posterior canal benign paroxysmal positional vertigo. *Laryngoscope.* 1999; 109: 584-90.
13. Dal T, Ozluoglu LN, Ergin NT. The canalith repositioning maneuver in patients with benign positional vertigo. *Eur Arch Otorhinolaryngol.* 2000; 257:133-6.
14. 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.
15. Goldman B. Vertigo and dizziness. In: Tintinelli JE, Kelen GD, Stapczynski JS (eds). *Emergency Medicine: A Comprehensive Study Guide, Sixth edition.* New York, NY: McGraw-Hill, 2004.
16. Furman JM, Cass SP. Benign paroxysmal positional vertigo. *N Engl J Med.* 1999; 341:1590-6.
17. Tirelli G, D'Orlando E, Giacomarra FV, Russolo M. Benign positional vertigo without detectable nystagmus. *Laryngoscope.* 2001; 111:1053-6.
18. Ruckenstein MJ. Vertigo and dysequilibrium with associated hearing loss. *Otolaryngol Clin North Am.* 2000; 33:535-62.
19. Marill KA, Walsh MJ, Nelson BK. Intravenous lorazepam versus dimenhydrinate for treatment of vertigo in the emergency department: a randomized clinical trial. *Ann Emerg Med.* 2000; 36:310-9.
20. Blatt PG, Georgakakis GA, Herdman SJ, Clendaniel RA, Tusa RJ. The effect of the canalith repositioning maneuver on resolving postural instability in patients with benign paroxysmal positional vertigo. *Am J Otol.* 2000; 21:356-63.
21. Black FC, Nashner LM. Postural disturbance in patients with benign paroxysmal positional nystagmus. *Ann Otol Rhinol Laryngol.* 1984; 93:595-9.
22. Altman DG. *Practical Statistics for Medical Research.* New York, NY: Chapman & Hall, 1991.
23. McCaig LF, Burt CW. National Hospital Ambulatory Medical Care Survey: 2001 emergency department summary. Advance data from vital and health statistics; no 335; Hyattsville, MD: National Center for Health Statistics, 2003.
24. Li JC, Li CJ, Epley J, Weinberg L. Cost-effective management of benign positional vertigo using canalith repositioning. *Otolaryngol Head Neck Surg.* 2000; 122:334-9.
25. Parnes LS, McClure JA. Free-floating endolymph particles: a new operative finding during posterior semicircular canal occlusion. *Laryngoscope.* 1992; 102:988-92.
26. Piantadosi S. Data-dependent stopping. In: *Clinical Trials: A Methodological Perspective.* New York, NY: Wiley, 1997.

TABLE 1. Patient Baseline Characteristics

	Epley (n = 11)	Placebo (n = 11)
Age (yr) (mean $\pm$ SD)	55 $\pm$ 15	46 $\pm$ 15
Male (%)	45	45
Nystagmus present on Hallpike test (%)	75	67
Onset of symptoms (hr) (mean $\pm$ SD)	28 $\pm$ 26	30 $\pm$ 40
Previous history of vertigo (%)	64	55
History of head trauma (%)	42	33
History of ear infection (%)	17	33

Twenty-seven percent (3 of 11) of patients in the Epley group received intravenous promethazine compared with 64% (7 of 11) of patients in the placebo group (95% CI for difference of 36% = -2% to 75%).

## DISCUSSION

Dizziness is a common ED complaint, accounting for nearly 1.5 million visits to U.S. EDs in 2001.<sup>23</sup> Many patients with dizziness have vertigo, of which BPV is the most common cause.<sup>1-3,14</sup> BPV is associated with significant morbidity and cost. A recent survey found that the average BPV patient consulted four physi-

cians for vertigo, at an average cost of more than \$2,000 for negative workups and unsuccessful treatments.<sup>24</sup> Many vertiginous patients present to the ED because their symptoms develop quite suddenly and they are often unable to see a primary care physician or an office-based specialist immediately. Therefore, it is important for the EP to be able to treat this condition.

We found a statistically significant difference in improvement in vertigo severity scores when we compared the Epley maneuver with a placebo maneuver among ED patients presenting with acute BPV. The median improvements in vertigo severity were 6 for the Epley group and 1 for the placebo group. Whether or not this also represents a clinically significant difference cannot be determined with certainty because the quantitative changes on this vertigo scale, similar to those of most numerical scales, have not been translated into clinical terms. We speculate, however, that a between-group difference in improvement of approximately 50% seems likely to be not only statistically significant, but also clinically important.

The putative etiology of BPV provides a pathophysiologically plausible explanation for our findings. BPV results from the inappropriate presence of calcium particles (otoliths) in the semicircular canals of the inner ear.<sup>25</sup> The labyrinth of the inner ear is

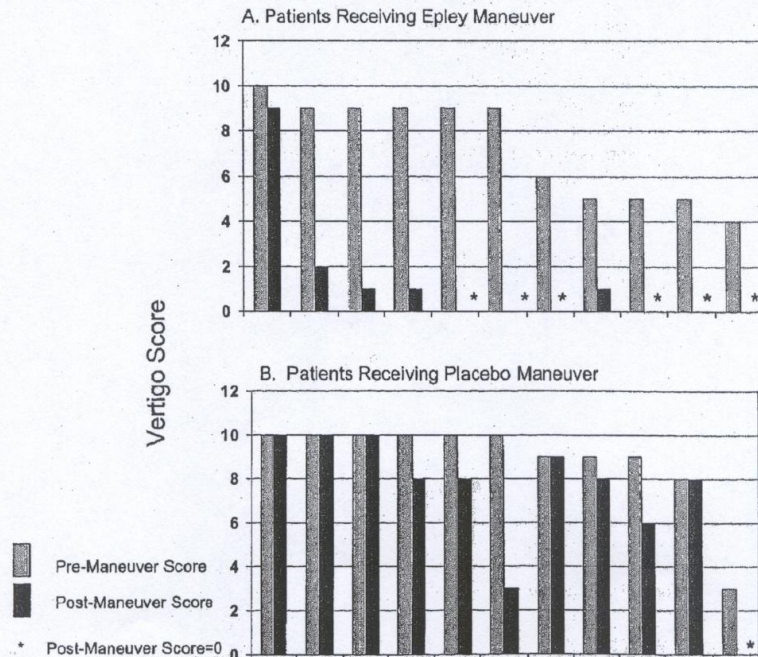


Figure 3. Pre-manuever and post-manuever vertigo scores. (A) Patients receiving Epley maneuver, (B) Patients receiving placebo maneuver. \*Post-manuever score = 0.

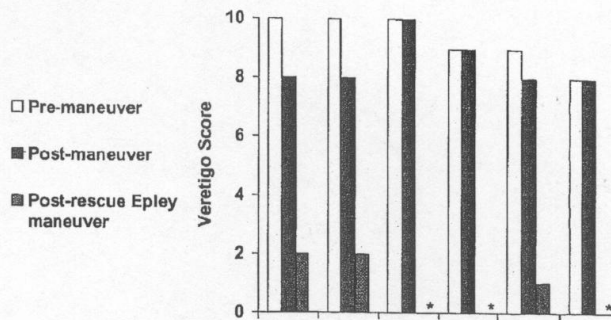


Figure 4. Vertigo scores for placebo patients who received a rescue Epley maneuver. \*Post-manuever score = 0.

composed in part of the sac-like utricle, which is connected to three semicircular canals filled with endolymph. Otoliths, which are normally attached to a membrane in the utricle, are denser than the surrounding endolymph and are pulled downward by gravity, thus providing linear acceleration information to the brain. When the head is turned sideways, endolymph moves and triggers receptors located in the semicircular canals. This angular acceleration information informs the brain that the head is turning. Once the head stops turning, the endolymph stops moving, and the receptors stop firing. In BPV, the otoliths become displaced from the utricle and usually enter the posterior semicircular canal, which is the most dependent of the three semicircular canals. When the head turns and stops, the receptors in the semicircular canals continue to fire inappropriately because the otoliths continue to move and cause motion in the surrounding endolymphatic fluid. The brain now receives conflicting information: stimuli from the inner ear tell the brain that the head is turning, but visual input tells the brain that the head is still. The brain reconciles this conflicting sensory input by concluding that it must be the environment that is turning (in the other direction). The inappropriate presence of these otoliths in the semicircular canal has been directly observed during surgery in patients with intractable vertigo.<sup>25</sup>

The Epley maneuver, first described in 1992, provides an opportunity for the EP to cure BPV in a matter of minutes. Epley reasoned that if the problem with BPV were the inappropriate presence of otoliths in the posterior semicircular canal, then the logical treatment would be to relocate these particles from the semicircular canal back into their proper place in the utricle. Studies of the Epley maneuver have been encouraging, with response rates of 51% to 84%.<sup>4,6,10</sup> However, these studies were performed in office settings and specialty clinics and may not reflect results seen in the ED. Almost all studies included patients who had an average duration of symptoms of several months, either as a requirement for the study

or as an average of those patients who were enrolled. The ED patient population tends to consist of patients with acute onset of BPV who may be much sicker and need to be seen more urgently. Our findings suggest that application of the Epley maneuver in the ED substantially improves the symptoms of acute BPV and is consistent with earlier work demonstrating the efficacy of this maneuver in patients with subacute/chronic BPV treated in other outpatient settings.

## LIMITATIONS

The major limitation of this study is the small sample size. However, the effect size was greater than anticipated, and principles of ethical research and the local IRB dictated that the study be prematurely stopped once the null hypothesis was soundly rejected. In addition, because the stopping rules kept us from randomizing more patients to the less effective treatment arm, bias may have occurred favoring a treatment effect.<sup>26</sup>

Bias may have also been introduced because the physician could not be blinded to which treatment patients received. Although the patients were blinded, they were informed (by IRB request) that if they did not improve after receiving the placebo maneuver, they would then receive the study maneuver. It is also possible that the placebo maneuver actually made patients worse. However, the same placebo maneuver was used in previously published studies.

The study is also limited in that the majority of the maneuvers were performed by the two lead authors. Thus, the generalizability of the results comes into question. In addition, the authors chose to use a 10-point scale in this study; however, this scale has not been validated in vertigo patients. Another potential bias may have occurred because the same individual who performed the maneuver also recorded the vertigo severity scores.

Rarely, BPV can be caused by otoliths that enter the horizontal canal. These patients, however, usually present with more intense symptoms and