

# Efficacy and Safety of Semicircular Canal Occlusion for Intractable Horizontal Semicircular Benign Paroxysmal Positional Vertigo

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## Abstract

**Background:** Some studies have suggested that semicircular canal occlusion is effective and safe for treating intractable posterior semicircular benign paroxysmal positional vertigo (PSC-BPPV), and adverse effects of canal occlusions for intractable horizontal semicircular BPPV (HSC-BPPV) were rarely reported. The aim of this study was to retrospectively discuss the efficacy of semicircular canal occlusion for intractable HSC-BPPV with at least 2 years of follow-up.

**Methods:** From 2000 to 2011, 3 female patients (average age =  $60 \pm 6.9$  years), with a diagnosis of HSC-BPPV refractory to head-shake and barbecue roll maneuver, underwent semicircular canal occlusion treatment in our hospital. The supine roll test was performed to diagnose HSC-BPPV and evaluate the treatment efficacy.

**Results:** All patients with intractable HSC-BPPV had complete resolution of their positional vertigo after semicircular canal occlusion with a negative supine roll test. All patients reported transient postoperative disequilibrium, nausea, and vomiting, which resolved within 2 weeks. In addition, 1 patient (33.3%) had transient tinnitus, which resolved after 4 months. There were no other significant long-term complications.

**Conclusion:** Semicircular canal occlusion appears to be a safe and well-tolerated treatment modality for intractable HSC-BPPV. However, further studies with large sample sizes are needed to confirm our conclusion.

## Keywords

semicircular canal occlusion, benign paroxysmal positional vertigo, supine roll test, canalolithiasis, cupulolithiasis, nystagmus

## Background

Benign paroxysmal positional vertigo (BPPV) is a common vestibular disorder that causes brief episodes of vertigo and nystagmus when the patient gets out of bed, rolls over in bed, tilts the head back, or bends forward.<sup>1-3</sup> Benign paroxysmal positional vertigo is attributable to otolithic debris attached to the cupula (cupulolithiasis) or displaced from the utricular macula into the lumen of 1 or more semicircular canals (canalolithiasis), rendering the canal(s) sensitive to gravity from inappropriate endolymph flow and thereby resulting in vertigo following positional changes in the planes of the sensitized canal(s).<sup>1,4,5</sup>

Based on different deposition sites of otolith, BPPV can be divided into anterior semicircular canal BPPV (ASC-BPPV), posterior semicircular canal BPPV (PSC-BPPV), horizontal semicircular canal BPPV (HSC-BPPV), and mixed types. Among them, PSC-BPPV and HSC-BPPV are predominantly involved, with an incidence of 60% to 90% and 5% to 30%, respectively.<sup>6,7</sup> Therefore, accurate diagnosis and treatment of PSC-BPPV and HSC-BPPV are of particular importance.

The diagnosis is usually made with the Dix-Hallpike maneuver for PSC-BPPV, or supine roll test (the Pagnini-McClure maneuver) in cases of HSC-BPPV.<sup>8,9</sup> Most patients suffering from PSC-BPPV can be cured by the particle repositioning maneuver (PRM), including the Epley and Semont maneuver, which repositions the displaced debris into the vestibule.<sup>10</sup> With regard to intractable BPPV,

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**Table 1.** Summary of Cases.

Case	1	2	3
Age, y/sex	56/female	56/female	68/female
Duration of symptoms, mo	4	24	48
Affected side	Bilateral (L > R)	Bilateral (R > L)	Bilateral (R > L)
Nystagmus direction	Horizontal apogeotropic	Horizontal geotropic	Horizontal apogeotropic
Triggering position	Lying down or getting up	Turning the head	Lying down or getting up
Triggering test	S-R (+)	S-R (+)	S-R (+)
Diagnosis result	R-HSC-cup	R-HSC-can	L-HSC-cup
Failed interventions	Lempert barbecue, head-shaking, × 2	Lempert barbecue, × 2	Lempert barbecue, × 3
Successful interventions	R-HSC-occlusion	R-HSC-occlusion	L-HSC-occlusion
Postoperative complications (recovery time)	Mild N and V (4 d), transient imbalance (10 d)	Mild N and V (7 d), transient imbalance (9 d), tinnitus in right ear (4 mo)	Mild N and V (8 d), transient imbalance (15 d)
Follow-up, mo	48	50	24
Long-term outcomes	S-R (-), without symptoms	S-R (-), without symptoms	S-R (-), without symptoms

Abbreviations: BPPV, benign paroxysmal positional vertigo; HSC-can, BPPV due to horizontal semicircular canalolithiasis; HSC-cup, BPPV due to horizontal semicircular cupulolithiasis; HSC-occlusion, horizontal semicircular canal occlusion; L, left; N, nausea; R, right; S-R, supine roll; V, vomiting.

surgical occlusion of the posterior semicircular canal that prevents endolymph flow is advocated, achieving a nearly 100% success rate.<sup>11,12</sup> Because HSC-BPPV does not positively respond to the Epley maneuver used for PSC-BPPV,<sup>13</sup> recent studies suggest employing the Lempert barbecue roll or Gufoni maneuver.<sup>8,14,15</sup> Although a higher success rate (approximately 70%-90%) can be obtained,<sup>15-18</sup> some patients are still resistant to the repositioning maneuver and require operative intervention. In 2004, Horii et al<sup>19</sup> treated a 54-year-old patient with intractable HSC-BPPV using canal occlusions and obtained satisfactory results. However, the follow-up time in this study was short (7 months). More important, few studies are designed to explore the value of canal occlusions for HSC-BPPV subsequently. Therefore, the goal of this study was to further investigate the effectiveness, safety, and adverse effects of canal occlusions for 3 HSC-BPPV patients with at least 2 years of follow-up.

## Materials and Methods

Three female patients (average age = 60 ± 6.9 years) with a diagnosis of HSC-BPPV refractory to head-shake and barbecue roll maneuver on at least 2 occasions were selected to undergo semicircular canal occlusions between 2000 and 2011 at Changzheng Hospital. Based on the results of the supine roll test, 2 patients exhibited horizontal cupulolithiasis that induces apogeotropic nystagmus, and 1 patient exhibited horizontal canalolithiasis that induces geotropic nystagmus (Table 1). In addition, there were no abnormalities of the following examinations for all patients before the surgical intervention: (1) general ear, nose, and throat assessment; (2) audiologic evaluation (pure tone audiometry, tympanometry, and stapedial reflex study); (3)

neurologic examination via magnetic resonance imaging scan; (4) spontaneous nystagmus; and (5) saccade, gaze, smooth pursuit, and bithermal caloric tests<sup>20</sup> via electronystagmography.

The horizontal semicircular canal occlusions were all performed through the standard transmastoid approach.<sup>11,12,21</sup> A small diamond burr under magnification was used to gain a 1-mm × 2-mm fenestration. A plug was fashioned from a mix of dry cortical bone dust and fibrinogen sealant. This plug was then gently packed into the fenestration. Temporalis fascia was placed over the occlusion and covered with bone dust and tissue glue (Tisseel; Immuno Ltd, Toronto, Canada) to further prevent perilymph leakage. All cases were carried out under the care of the senior author (S.L. or J.F.).

All patients were assessed for resolution of their vertiginous symptoms and postural stability, postoperatively, at 2 weeks after surgery and at 3-month intervals thereafter. Absence of vertigo and a negative supine roll test were considered successful outcomes. Hearing preservation was determined by audiometric testing.

## Results

All 3 patients had complete resolution of their BPPV symptoms including paroxysmal vertigo and visual rotation on the first day after semicircular canal occlusion with a negative supine roll test. Although all patients showed transient postoperative disequilibrium, nausea, and vomiting, these symptoms disappeared within 7 to 15 days. Postoperatively, patient 2 developed a transient tinnitus, which resolved after 4 months. Recurrence was not observed after 24 to 50 months of follow-up.

## Discussion

As a variant of positional vertigo, HSC-BPPV usually exhibits shorter latency, longer time constant (from a few seconds to 1 minute), and bidirectional (geotropic or apogeotropic) nystagmus compared with PSC-BPPV.<sup>2</sup> Furthermore, geotropic nystagmus is more intense when the head rotates to the affected side, whereas apogeotropic HSC-BPPV is linked with longer and more intense nystagmus when the head rotates to the unaffected side.<sup>22</sup> According to these criteria, our patients were diagnosed with R-HSC-BPPV or L-HSC-BPPV. Rotations of 270 or 360 degrees around the yaw axis (so-called barbecue maneuver) toward the unaffected ear are common procedures for treating geotropic HSC-BPPV.<sup>23</sup> Apogeotropic HSC-BPPV is attributed to either cupulolithiasis or canalolithiasis within the anterior arm of the horizontal semicircular canal. Thus, in addition to the barbecue maneuver, a head-shaking regimen in the horizontal plane has also been proposed, which can detach the otolithic debris from the cupula.<sup>24</sup> In our study, all 3 patients with HSC-BPPV underwent at least 2 occasions of the Lempert barbecue maneuver and/or head-shaking on each side. However, their positional vertigo persisted, which seriously affected their quality of life and work and social activities. Therefore, surgical intervention was advocated.

At present, the surgical interventions for BPPV include singular neurectomy (posterior ampullary nerve) and semicircular canal occlusion. Although singular neurectomy has proved to be an efficient procedure to control the symptoms of intractable BPPV, it has a high risk of resulting in postoperative hearing loss.<sup>25</sup> There is a long history of surgical treatment of BPPV using semicircular canal occlusion.<sup>11,12,26-28</sup> However, this procedure was mainly used in PSC-BPPV. There are few attempts to use semicircular canal occlusion in HSC-BPPV because of the self-limiting rare incidence of intractable HSC-BPPV.<sup>29</sup> In this study, our results showed that, similar to PSC-BPPV, semicircular canal occlusion intervention was also effective in improving the BPPV symptoms of 3 HSC-BPPV patients, which is in accordance with the study by Horii et al.<sup>19</sup> However, transient imbalance, nausea, vomiting, and tinnitus were also observed. We considered that this may be attributed to the canal occlusion procedure itself or the inner ear condition that initially caused BPPV (ie, inner ear trauma or vestibular neuronitis).<sup>12</sup>

The limitations of this study include its retrospective nature and the small number of patients. These issues require additional research and can be addressed with more studies evaluating the use of semicircular canal occlusion in patients with HSC-BPPV.

## Conclusion

Our findings suggest that semicircular canal occlusion seems to be a safe and well-tolerated treatment approach for alleviating the BPPV symptoms of HSC-BPPV patients. The higher

success rate (100%) and lower incidence of serious complications (eg, hearing loss) in the long term make it preferable to singular neurectomy and thus worthy of clinical promotion.

## Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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## References

1. Xiang-Dong G. Benign paroxysmal positional vertigo. *J Neurosci Rural Pract*. 2011;2(1):109-110.
2. Lee SH, Kim JS. Benign paroxysmal positional vertigo. *J Clin Neurol*. 2010;6(2):51-63.
3. Bertholon P, Tringali S, Faye MB, Christophe Antoine J, Martin C. Prospective study of positional nystagmus in 100 consecutive patients. *Ann Otol Rhinol Laryngol*. 2006;115(8):587-594.
4. Oas JG. Benign paroxysmal positional vertigo. *Ann NY Acad Sci*. 2001;942(1):201-209.
5. Parnes LS, McClure JA. Free-floating endolymph particles: a new operative finding during posterior semicircular canal occlusion. *Laryngoscope*. 1992;102(9):988-992.
6. Moon SY, Kim JS, Kim BK, et al. Clinical characteristics of benign paroxysmal positional vertigo in Korea: a multicenter study. *J Korean Med Sci*. 2006;21(3):539-543.
7. Parnes LS, Agrawal SK, Atlas J. Diagnosis and management of benign paroxysmal positional vertigo (BPPV). *Can Med Assoc J*. 2003;169(7):681-693.
8. Bhattacharyya N, Baugh RF, Orvidas L, et al. Clinical practice guideline: benign paroxysmal positional vertigo. *Otolaryngol Head Neck Surg*. 2008;139(5):S47-S81.
9. Heidenreich KD, Carender WJ, Heidenreich MJ, Telian SA. Strategies to distinguish benign paroxysmal positional vertigo from rotational vertebrobasilar ischemia. *Ann Vasc Surg*. 2010;24(4):553.e1-553.e5.
10. Parnes LS, Agrawal SK, Atlas J. Diagnosis and management of benign paroxysmal positional vertigo (BPPV). *CMAJ*. 2003;169(7):681-693.
11. Beyea JA, Agrawal SK, Parnes LS. Transmastoid semicircular canal occlusion: a safe and highly effective treatment for benign paroxysmal positional vertigo and superior canal dehiscence. *Laryngoscope*. 2012;122(8):1862-1866.
12. Ramakrishna J, Goebel JA, Parnes LS. Efficacy and safety of bilateral posterior canal occlusion in patients with refractory benign paroxysmal positional vertigo: case report series. *Otol Neurotol*. 2012;33(4):640-642.
13. Lempert T, Tiel-Wilck K. A positional maneuver for treatment of horizontal-canal benign positional vertigo. *Laryngoscope*. 1996;106(4):476-478.
14. Fife T, Iverson D, Lempert T, et al. Practice parameter: therapies for benign paroxysmal positional vertigo (an

- evidence-based review). Report of the Quality Standards Subcommittee of the American Academy of Neurology. *Neurology*. 2008;70(22):2067-2074.
15. Nuti D, Agus G, Barbieri MT, Passali D. The management of horizontal-canal paroxysmal positional vertigo. *Acta Otolaryngol*. 1998;118(4):455-460.
  16. Casani AP, Nacci A, Dallan I, Panicucci E, Gufoni M, Sellari-Franceschini S. Horizontal semicircular canal benign paroxysmal positional vertigo: effectiveness of two different methods of treatment. *Audiol Neurootol*. 2010;16(3):175-184.
  17. Casani AP, Vannucci G, Fattori B, Berrettini S. The treatment of horizontal canal positional vertigo: our experience in 66 cases. *Laryngoscope*. 2002;112(1):172-178.
  18. Kim JS, Oh SY, Lee SH, et al. Randomized clinical trial for geotropic horizontal canal benign paroxysmal positional vertigo. *Neurology*. 2012;79(7):700-707.
  19. Horii A, Imai T, Mishiro Y, et al. Horizontal canal type BPPV: bilaterally affected case treated with canal plugging and Lempert's maneuver. *ORL*. 2004;65(6):366-369.
  20. Lin S, Fan J, Sun A, Guan J, Liu H, Zhu Q. Efficacy of laser occlusion of posterior semicircular canal for benign paroxysmal positional vertigo: case report. *J Laryngol Otol*. 2010;124(05):e5.
  21. Walsh R, Bath A, Cullen J, Rutka J. Long-term results of posterior semicircular canal occlusion for intractable benign paroxysmal positional vertigo. *Clin Otolaryngol Allied Sci*. 1999;24(4):316-323.
  22. D'Agostino R, Melagrana A, Taborelli G. Benign positional paroxysmal vertigo of horizontal semicircular canal in the child: case report. *Int J Pediatr Otorhinolaryngol*. 2003;67(5):549-551.
  23. Escher A, Ruffieux C, Maire R. Efficacy of the barbecue manoeuvre in benign paroxysmal vertigo of the horizontal canal. *Eur Arch Otorhinolaryngol*. 2007;264(10):1239-1241.
  24. Oh SY, Kim JS, Jeong SH, et al. Treatment of apogeotropic benign positional vertigo: comparison of therapeutic head-shaking and modified Semont maneuver. *J Neurol*. 2009;256(8):1330-1336.
  25. Pournaras I, Kos I, Guyot JP. Benign paroxysmal positional vertigo: a series of eight singular neurectomies. *Acta Otolaryngol*. 2008;128(1):5-8.
  26. Parnes LS, McClure JA. Effect on brainstem auditory evoked responses of posterior semicircular canal occlusion in guinea pigs. *J Otolaryngol*. 1985;14(3):145-150.
  27. Parnes LS, McClure JA. Posterior semicircular canal occlusion for intractable benign paroxysmal positional vertigo. *Ann Otol Rhinol Laryngol*. 1990;99(5, pt 1):330-334.
  28. Parnes LS, McClure JA. Posterior semicircular canal occlusion in the normal hearing ear. *Otolaryngol Head Neck Surg*. 1991;104(1):52-57.
  29. Choi SJ, Lee JB, Lim HJ, et al. Clinical features of recurrent or persistent benign paroxysmal positional vertigo. *Otolaryngol Head Neck Surg*. 2012;147(5):919-924. doi:10.1177/0194599812454642.

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