Anterior semicircular canal benign paroxysmal positional vertigo: A series of 20 patients

S. Imbaud-Genieys*

Centre d'Explorations Fonctionnelles Otoneurologiques, 10, rue Falguière, 75015 Paris, France

KEYWORDS
Anterior semicircular canal benign positional paroxysmal vertigo; Videonystagmoscopy; Torsional nystagmus

Summary
Objectives: The purpose of this study is to define the diagnostic criteria for anterior semicircular canal benign paroxysmal positional vertigo (BPPV) based on clinical data and the available anatomical and pathophysiological data.
Material and method: Between July 2006 and June 2007, 4320 patients consulting for otoneurological disease were investigated by otological examination, videonystagmography and neurological examination.
Result: BPPV was diagnosed in 1430 patients, involving the posterior semicircular canal in 1325 patients, the horizontal semicircular canal in 85 patients, the posterior semicircular canal and ipsilateral anterior (superior) semicircular canal in 19 patients and the anterior semicircular canal only in one patient. In the 20 patients with anterior semicircular canal BPPV, the Dix-Hallpike (DH) test induced ageotropic horizontal torsional nystagmus beating towards the uppermost ear in the lateral supine position with reversal on standing. The modified Epley manoeuvre was effective in 94.1% of cases on the 8th day and in 97.5% of cases at 1 month.
Discussion/Conclusion: Nystagmus beating towards the uppermost ear on the DH test is consistent with BPPV involving the anterior semicircular canal of the uppermost ear. The torsional component of nystagmus and not just the vertical component must be taken into account to facilitate the diagnosis with videonystagmography glasses and identify the affected side. The anterior semicircular canal is rarely affected due to its anatomical position. Settling of otococia in this canal requires hyperextension of the head. Treatment is simple, consisting of the modified Epley particle repositioning manoeuvre.
© 2013 Published by Elsevier Masson SAS.

Introduction
Benign paroxysmal positional vertigo (BPPV) is the leading cause of vertigo in adults. The clinical characteristics of BPPV of the posterior or horizontal semicircular canals (SCC) are well known and widely accepted. However, the same does not apply to BPPV involving the anterior SCC. In every case, the diagnosis is based on clinical history and observation of the characteristic nystagmus induced by the Dix-Hallpike (DH) test [1].

In BPPV of the posterior SCC, nystagmus occurs after a latency of several seconds. It is horizontal, torsional, geotropism and is reversed when the patient sits up. The
affected ear is the lowermost ear when the patient is tilted in the lateral supine position.

In BPPV of the horizontal (lateral) SCC, nystagmus is horizontal, geotropic or ageotropic, when placed in the lateral supine position and disappears on sitting straight. Geotropic nystagmus is generally considered to indicate canalithiasis [2–3] affecting the canal on the side with the more intense nystagmus. Nystagmus beating towards the affected side may also be observed when flexing the head anteriorly, or sometimes during the “Head shaking test”. Ageotropic nystagmus is generally considered to indicate cupulolithiasis [3–8] affecting the canal on the side on which vertigo and nystagmus are least intense. Nystagmus may also be observed when the patient is lying on the back with the head flat on the bed, which disappears when the patient’s head is turned 10° to 20° towards the affected side.

The diagnostic criteria for BPPV of the anterior (superior) SCC are less clearly defined. Several authors have reported that nystagmus is vertical downbeating with a minor torsional component [9–13], appearing regardless of the side to which the head is turned, making it impossible to determine the affected side.

During this study, we observed 20 patients in whom the DH test induced ageotropic horizontal torsional nystagmus in the lateral supine position with reversal on sitting straight. In line with the available anatomical and pathophysiological data, we propose that these patients presented BPPV of the anterior SCC of the uppermost ear. These diagnostic criteria are simple and allow easy identification of the affected side. In most cases, BPPV of the anterior SCC was associated with BPPV of the posterior SCC.

Material and methods

Between July 2006 and June 2007, 4320 patients consulted for otoneurological disease comprising vertigo, instability, falls and/or auditory signs. When the clinical history was compatible with BPPV, i.e., for patients describing brief episodes of rotational vertigo when turning in bed, on lying down and standing up, when bending forwards or when extending the head backwards, or vertigo lasting several minutes only when turning in bed, the work-up was completed by physical examination and videonystagmography.

Physical examination consisted of otoscopic examination, Romberg and Fukuda tests, a finger-pointing test (the patient is seated in front of the examiner with the eyes closed and is asked to raise and lower his/her arms 10 times in the vertical axis to demonstrate any postural deviation), cranial nerve examination, cerebellar examination, measurement of visual perception of the subjective vertical, mean of 12 measurements. Videonystagmography consisted of evaluation of oculomotor activity (jerks, tracking) and nystagmic responses to bithermal caloric tests. Finally, a DH test was performed according to a strict protocol. The patient was seated on the examination table facing the examiner with the head rotated 45° towards the side considered to be healthy, and the head was then pushed towards the opposite side in a lateral supine position, with the nose raised in the air. The patient was maintained in this position for at least 1 minute or until resolution of nystagmus and vertigo when the test was positive. The direction of the nystagmus was evaluated, horizontal-torsional or purely horizontal, geotropic or ageotropic, and its duration was measured. The patient was then returned to the sitting position and was observed for the development of nystagmus and vertigo and their characteristics were described. The same procedure was performed on the opposite side.

Diagnostic criteria

The diagnostic criteria for BPPV of the horizontal or posterior SCC were those classically recognized and described in the introduction. The criteria for BPPV of the anterior SCC were the presence of vertigo with ageotropic horizontal-torsional nystagmus on the DH test, occurring after a brief latency, rapidly exhausted after several seconds, with reversal when sitting straight. The affected side was the uppermost ear associated with vertigo (Fig. 1a and b). All patients presenting the criteria of BPPV of the anterior SCC were evaluated by gadolinium-enhanced brain MRI to eliminate a posterior fossa lesion, as cerebellar tumour can present with positional vertigo and vertical downbeating nystagmus [13].

Treatment

All patients with BPPV of the posterior and/or anterior SCC were treated by modified Epley manoeuvre with the head in hyperextension without a vibrator [14]. The same manoeuvre was performed for BPPV of a posterior or anterior canal (right-sided manoeuvre for all cases of right BPPV, and left-sided manoeuvre for all cases of left BPPV). Patients were reviewed 1 week later. The particle repositioning manoeuvre was considered to be effective in the absence of development of a nystagmus or positional vertigo during the DH test. If signs were still present, a second particle repositioning manoeuvre was performed and the patient was taught how to perform this manoeuvre by using an explanatory diagram so that it could be repeated at home if necessary. All patients were reviewed at 1 month.

Patients with BPPV of the horizontal semicircular canal were treated by “barbecue” roll followed, if necessary, by gentle rotation to the right and to the left which they were taught to perform for themselves for 3 days. Patients were reviewed after 1 week and 1 month.

Results

BPPV was diagnosed in 1430 patients, 504 men and 926 women with a mean age of 60.6 years. The diagnostic criteria corresponded to BPPV of the posterior SCC in 1325 cases, BPPV of the horizontal SCC in 85 cases, BPPV of the posterior SCC associated with BPPV of the ipsilateral anterior SCC in 19 cases and BPPV of the anterior SCC in one case.

In patients with BPPV of the posterior and anterior SCC, Epley’s manoeuvre was effective in 94.1% of cases at 1 week and 97.5% of cases at 1 month. In patients with BPPV of the horizontal SCC, “barbecue” roll was effective in 96% of cases at 1 week and at 1 month. The first manoeuvre was effective in the single case of isolated BPPV of the anterior
Anterior semicircular canal benign paroxysmal positional vertigo

Figure 1  a: right Dix-Hallpike test. In benign paroxysmal positional vertigo (BPPV) of the posterior semicircular canals (SCC), geotropic torsional nystagmus is observed when changing from the seated position (A) to the lateral supine position (B) with reversal when the patient sits up (C). The affected ear is the lowermost ear, in this case the right ear; b: left Dix-Hallpike test. In BPPV of the anterior semicircular canal, ageotropic torsional nystagmus is observed when changing from the seated position (A) to the lateral supine position (B) with reversal when the patient sits up (C). The affected ear is the uppermost ear, in this case the right ear.

Figure 2  Efficacy of the Epley particle repositioning manoeuvre. In this series, the success rate of the particle repositioning manoeuvre was identical regardless of the semicircular canal affected, posterior, lateral or anterior.

SCC (Fig. 2). Gadolinium-enhanced brain MRI was normal in every case of BPPV of the anterior SCC.

Discussion

Several authors consider that downbeating vertical nystagmus with a minor torsional component is characteristic of the diagnosis of BPPV of an anterior SCC [9—12]. As nystagmus is observed regardless of the side to which the head is turned, it is impossible to determine the affected side. However, by taking into account the coplanar relations of the various SCC, the anterior and contralateral posterior SCC appear to be situated in almost the same plane, with only a narrow angle between the two [10]. Nystagmus induced by stimulation of either of these two SCC is therefore the same, horizontal-torsional. In BPPV of the right posterior SCC, when the patient is placed in the right lateral decubitus position, canalithiasis induces ampullofugal deflection of the cupula, resulting in geotropic horizontal-torsional nystagmus (torsional with an upbeat vertical component) with reversal on standing due to ampullopetal stimulation of the cupula (Figs. 1a and 3). In BPPV of the right anterior SCC, nystagmus is also horizontal-torsional, but induced in the left lateral supine position. Canalithiasis induces ampullofugal deflection of the cupula, resulting in ageotropic horizontal-torsional nystagmus (torsional with a downbeating vertical component) with reversal on standing due to ampullopetal stimulation of the cupula (Figs. 1b and 3) [14—18]. We therefore propose that it is essential to take the torsional component of nystagmus into account rather than just the vertical component, as the torsional component allows identification of the affected side.

The present series comprised only one case of isolated anterior semicircular canal BPPV, representing less than 1% of all cases of BPPV diagnosed during the year of the study. In the literature, some authors consider that atypical forms of BPPV represent less than 1% of all cases [19]. However, the frequency of BPPV of the anterior SCC may be higher than it appears, as some studies estimate that it represents 1.2 to 21.2% of all cases of BPPV [10]. In addition to this single case of isolated BPPV of the anterior SCC, another 19 cases presented horizontal-torsional nystagmus on the DH test on both sides, but which was geotropic on one side and ageotropic on the other side. These findings are compatible with BPPV of the anterior and posterior SCC of the same ear. Involvement of two semicircular canals on the same side...
would support the idea that the ageotropic torsional nystagmus observed in the BPPV of the anterior canal is not due to a different type of stimulation of the posterior canal due to the initial position of the otoliths in the canal or to their molecular weight (resulting in different settling in the posterior canal), but to stimulation of the anterior semicircular canal.

BPPV of the posterior SCC, the most inferior canal, is much more frequent than BPPV of the anterior SCC, as gravitational forces predispose to settling of particles in this canal, particularly when the patient is in the lateral supine position. In contrast, the anterior SCC is the highest point of the labyrinth in the upright position. Only very marked hyperextension of the head would allow deposition of otoliths in this canal. Moreover, in our series, the only case of isolated BPPV of the anterior SCC was observed in a plumber, after a long period of work underneath a hand basin with his head in forced hyperextension and turned towards the affected side. The degree of hyperextension of the head can explain the relative frequency of involvement of each semicircular canal. The position of this patient’s head allowed settling of particles in the anterior canal, while less marked hyperextension would have induced settling in the posterior and anterior canals. Even less marked hyperextension would have resulted in settling in the posterior canal only.

Epley’s manoeuvre was effective in the great majority of cases of BPPV of the posterior and anterior canals. In contrast with some authors, such as Crevits [20], who proposed a prolonged manoeuvre in a forced position, which applies considerable strain on the cervical vertebrae and which requires a 24-hour hospital admission, or Lorin, who used a rotating armchair [21], we consider that this manoeuvre does not require any specific equipment and can be performed as an outpatient office procedure. It was effective in 94.6% of cases of BPPV of the posterior SCC. Epley’s manoeuvre for BPPV of the anterior SCC is identical to that used for BPPV of the posterior SCC on the same side. Consequently, a single manoeuvre is required to treat BPPV of the ipsilateral posterior and anterior SCC. According to two studies, this manoeuvre is also effective in the case of isolated BPPV of the anterior SCC. According to Lopez-Escamez et al., who performed Epley’s manoeuvre on D1, D7, then four times over a period of 1 month, the success rate was 71% [12]. According to Jackson et al., the success rate was even 100% after an average of 1.32 manoeuvres [17]. This manoeuvre was effective in the single case observed in the present series.

Brain MRI must be systematically performed in all cases of BPPV not meeting the strict criteria of BPPV of the posterior SCC, i.e., in all cases of BPPV of the anterior SCC, or not responding to a particle repositioning manoeuvre, in order to ensure the absence of a posterior fossa tumour [13].

Conclusion

BPPV of the anterior SCC is uncommon. On the basis of our experience, it can be simply diagnosed with videonystagmography glasses by defining the horizontal and torsional characteristics of the nystagmus induced in the various positions of the DH test, in order to identify the affected side. This study proposes a simple definition of the diagnostic criteria for this type of BPPV and a simple treatment that can be easily performed in the office.

Disclosure of interest

The author declares that she has no conflicts of interest concerning this article.

Acknowledgements

The author is grateful to Professor Jean-Philippe Guyot for his helpful collaboration.

References

Anterior semicircular canal benign paroxysmal positional vertigo


