Abstract — We evaluated a new therapeutic maneuver—Prolonged Position on the healthy side, for Benign Paroxysmal Positional Vertigo (BPPV) of the horizontal semicircular canal. We devised this type of physical treatment in accordance with the “canalolithiasis” theory of BPPV, in order to try to free the horizontal semicircular canal of otoconial debris. We compared the results obtained by Prolonged Position with two other physical therapies by dividing our horizontal canal BPPV patients into three therapeutic groups: 1) 35 patients treated with Prolonged Position; 2) 24 patients treated with head shaking in a supine position; 3) 15 patients for whom therapy was omitted. More than 90% of the patients treated with Prolonged Position recovered within 3 days, although 6 patients out of 35 subsequently developed BPPV of the posterior semicircular canal, which then responded well to a particular repositioning maneuver. The results of Prolonged Position were significantly better than those obtained by performing head shaking or by omitting treatment. Prolonged Position can be applied to patients of all ages and general conditions and does not require hospitalization.

Keywords — vertigo; positional nystagmus; horizontal semicircular canal; canalolithiasis; physical therapy.

Introduction

Benign paroxysmal positional vertigo (BPPV) is a clinical entity characterized by violent paroxysmal vertigo induced by position changes in the plane of the canal. BPPV due to an involvement of the posterior semicircular canal (PSC) is well known (1). The most convincing pathophysiological theory of BPPV is that some particles heavier than endolymph (probably otoconial debris detached from the utricular macula) either lie over the cupula (cupulolithiasis) or are free-floating in the endolymph of the PSC (canalolithiasis) (2).

Recently some authors described a syndrome due to an involvement of the horizontal semicircular canal (HSC) (3-5,6). HSC-BPPV is characterized by a violent paroxysmal vertigo that arises when the patient lies supine and turns his head or body to either side. In the typical form of HSC-BPPV, a paroxysmal geotropic nystagmus is found both in the right-lateral and left-lateral positions.

The most appealing pathophysiological explanation of HSC-BPPV is that of a “canalolithiasis”: some free-floating particles heavier than endolymph are thought to penetrate into the nonampullary arm of the canal.

Even though HSC-BPPV has been known since 1985, until now no positional maneuver has proven consistently effective in treatment. Here we propose a form of physical treatment for HSC-BPPV based on the fact that the particles in the nonampullary arm of the canal can gradually move out of it through its nonampullary end.

Materials and Methods

From July 1993 to September 1994, we diagnosed 35 cases of HSC-BPPV; (21 females and 14 males aged from 30 to 88 years, with an av-
Figure 1. Right horizontal BPPV. a) When the patient rolls onto his healthy left semicircular canal side, a left-beating paroxysmal nystagmus is produced. Arrow indicates when the head is turned. b) Slow phase velocity trend of positional nystagmus on the healthy side. Positional nystagmus disappears in about 15 seconds and doesn’t show any inversion. c) When the patient rolls onto his affected (right) side a violent paroxysmal right-beating nystagmus is produced. Arrow indicates when the head is turned. d) Slow phase velocity trend of positional nystagmus on the affected side. Right positional nystagmus disappears in about 25 seconds; primary positional nystagmus is followed after a few seconds by a left secondary apogeotropic nystagmus.
Severe positional vertigo occurred in all patients when they turned over in bed. They underwent a standard otoneurological examination of the vestibulo-ocular reflex, during which we looked for spontaneous, gaze-evoked, rebound, positional and positioning nystagmus, both during fixation and under Frenzel’s glasses. We were able to perform caloric testing (according to Fitzgerald–Hallpike’s method) in five patients.

All patients were first examined during the acute phase of the disorder, and they all had a typical paroxysmal geotropic nystagmus in the left and right lateral positions (Figure 1).

As therapy, we urged them to go home, lie on their beds, and turn their heads or whole body from the supine position towards their healthy side, and to stay in this position for about 12 hours (“Forced Prolonged Position”). They were told to return to the same position after they needed to get up during this period.

The rationale for this therapy is that when the patient lies on his healthy side, the affected ear is uppermost, and its HSC is in a gravitationally vertical position. If the patient remains in this position for a long time, the floating particles lying in the nonampullary arm of the canal can gradually slip out of the canal towards the vestibule by the force of gravity (Figure 2).

The patients were asked to come back to the hospital to repeat the otoneurological examina-

Figure 2. The Forced Prolonged Position maneuver in a patient with right HSC affected. The patient lies on his healthy side for 12 hours. Under the effect of gravity the particles gradually slip into the vestibule from the non-ampullary arm of the HSC.
tion within 3 days after lying on their healthy side for 12 hours straight.

We compared this group of patients with two other groups: one was made up of 15 patients examined between 1987 and 1990 who hadn’t undergone any treatment for HSC-BPPV; the other was made up of 24 patients whom we had diagnosed as having HSC-BPPV between 1990 and the beginning of 1993 and who had undergone some physical therapy such as head shaking in the supine position: with this treatment we first performed three series of 30 rapid right-left shakes of the head around the yaw axis, with the patient in the supine position. Then we asked the patients to repeat the same maneuver at home twice a day for at least 3 days. The aim of this treatment was to crumble and remove all the particles from the canal.

The patients in the latter two groups were also first examined during the acute phase of the disorder and then within the following 3 days.

We applied chi-square analysis to evaluate the statistical significance of our data.

Results

1) The group of patients treated with Forced Prolonged Position on their healthy side: At review, 26 (74.3%) of our patients were totally symptom free and, at the otoneurological examination, they didn’t show any nystagmus in any position. In 6 patients (17.1%), the HSC-BPPV changed into a BPPV of the homolateral PSC. These patients were successfully treated by means of Semont’s maneuver (7), and they all recovered rapidly.

From a clinical point of view, only three patients (8.6%) did not show any changes at the first review; they took longer to recover (15, 40, and 43 days) and during this period they repeated our therapy and were submitted to an MRI that excluded a possible central cause. Recovery was rapid and complete in all cases.

2) The group of patients not undergoing any treatment: In this group, only 4 of the 15 patients (26%) recovered within 3 days. The other patients were monitored until the BPPV resolved; the maximum and average recovery times were 60 and 19 days, respectively. Two patients in this group later developed PSC-BPPV.

3) The group of patients treated with head shaking in a supine position: After 72 hours, only 17% of the patients recovered (4 patients out of 24). In one, the HSC-BPPV changed into PSC-BPPV. This patient was successfully treated by Semont’s maneuver. The remaining 20 patients were monitored until they recovered. The maximum and average recovery times were 57 and 22 days, respectively. Three patients in this group developed a PSC-BPPV after a brief period of well-being.

Table 1 illustrates the chi-square test data: the results are statistically significant concerning the effectiveness of the therapy we propose, while there is no statistically significant difference between the second and third groups.

Discussion

In 1985, Cipparrone and colleagues (3) hypothesized the existence of a BPPV due to involvement of the HSC. In the same year, McClure (4) first reported some clinical features of this disorder in 7 patients. In 1989, Pagnini and colleagues (5) confirmed the clinical features of HSC-BPPV in 15 patients and described the similarities to and differences from the PSC-BPPV.

HSC-BPPV is characterized by a violent paroxysmal vertigo that arises when the patient lies supine and turns his head or body to the right or to the left side. In the typical form of HSC-BPPV, a geotropic paroxysmal (it gradually builds up then decreases in amplitude until it disappears) direction-changing nystagmus is found in the right-lateral and left-lateral positions.

Nystagmus arises after a short period of latency and lasts from 10 to 30 seconds. Nystag-
is also geotropic. McClure (4) and colleagues (5) state that nystagmus is more intense on one side because of Ewald's second law: if the particles are in the posterior aspect of the nonampullary end of the canal, this produces an ampullopetal flow of the endolymph and, in turn, an excitatory discharge of the ampullary nerve. This then generates a horizontal nystagmus that beats towards the nonaffected ear, and this nystagmus is also geotropic. McClure (4) and Pagnini and colleagues (5) state that nystagmus is more intense on one side because of Ewald's second law: if the particles are in the posterior aspect of the HSC an ampullopetal flow of the endolymph is generated only when the patient rolls onto his affected side.

In 1985 McClure (4) hypothesized that in the case of HSC-BPPV the particles penetrate into the nonampullary arm of the canal: when the patient turns his head towards his affected side, the particles move towards the ampullary end of the canal. This produces an ampullopetal flow of the endolymph and, in turn, an excitatory discharge of the ampullary nerve. This then generates a horizontal nystagmus that beats towards the same ear and is therefore geotropic. On the contrary, when the patient turns his head towards the other side, the particles move towards the nonampullary end of the HSC and produce both an ampullofugal flow and an inhibitory discharge of the ampullary nerve. This then generates a horizontal nystagmus that beats towards the nonaffected ear, and this nystagmus is also geotropic. McClure (4) and Pagnini and colleagues (5) state that nystagmus is more intense on one side because of Ewald's second law: if the particles are in the posterior aspect of the HSC an ampullopetal flow of the endolymph is generated only when the patient rolls onto his affected side.

Balogh and colleagues (6) thought that the explanation for this amplitude asymmetry is that the mass has a much smaller distance to move in the canal with rotation towards the normal side compared with rotation towards the abnormal side. Thus, the bad side is identified as the one in which we find that nystagmus is more intense and where it shows an apogeotropic spontaneous inversion.

Recently Lempert (8) has suggested a method to move debris from the HSC: it consists of a single 270° barbecue rotation towards the unaffected side performed in rapid steps of 90° with 30-second intervals. He started motion with head rotation from the supine position to the healthy side; then the patient rolled over to prone position, and finally the head was rotated quickly to the opposite lateral position with the affected ear undermost. A similar procedure has been proposed by Baloh (9): he suggested a 360° rotation around the yaw axis in four 90° quick steps. The initial step was towards the healthy side and each position was held for about 1 min. These authors both reported successful treatment, but only for two patients each.

In this paper, we report the results of a new therapeutic procedure that we applied to a group of patients with HSC-BPPV. Our technique is based on the concept, now generally accepted, that HSC-BPPV has a pathophysiological mechanism similar to the one generating PSC-BPPV. That is, there are some particles heavier than endolymph that are free to move into the semicircular canal and that are capable of causing some abnormal endolymphatic movement due to the force of gravity. In agreement with McClure's hypothesis, we believe that when nystagmus is of the paroxysmal geotropic type, the particles must be in the posterior aspect of HSC. They move under the effect of gravity when the patient rolls on his yaw plane from the supine position.

This process can be prevented by freeing the canal of all its particles. We wish to point out that the canal's only opening is at its nonampullary end.

In elaborating our therapy we started out from the fact that Epley's (10) and Semont's (7) maneuvers (the most effective for treating PSC-BPPV) make the particles slip out of the canal through its nonampullary end. Our experience led us to discover that therapy for HSC-BPPV is effective only when the patient lies on his healthy side for a long time. This is so because the affected HSC is then in a vertical position and its nonampullary end is downwards. Consequently, the force of gravity gradually draws the heavy particles into the vestibule. We tried to maintain the patient in this position for a shorter period of time (about 10 to 20 minutes) so that the pathology could be resolved at the time of the examination, but this method was ineffective. Maybe if the patient would lie for some minutes on the bad side before lying on his healthy side, the particles could settle at the bottom of the HSC. On the other hand, we are afraid that in this way the particles could settle too close to the ampulla and nystagmus could transform itself into the apogeotropic type.
We consider the results achieved by our method satisfactory: over 90% of the patients treated with Forced Prolonged Position recovered from their HSC-BPPV within 3 days. Whereas over 74% recovered immediately, another 17% developed a PSC-BPPV and were then symptom-free almost immediately after being treated by Semont’s maneuver.

Our method failed in three instances: one patient had suffered a severe head trauma and had both a bilateral PSC-BPPV and a unilateral HSC-BPPV. The other two patients were limited in their movements by both their obesity and marked cervical spondylosis, and they had difficulty maintaining the forced position for a long time. All three required a long period of treatment (other physical therapy such as Brandt-Daroff (11) exercises) to fully recover. The results we obtained by Forced Prolonged Position are significantly better than those obtained by performing head shaking in a supine position or by omitting all treatment. On the other hand, there is no significant difference between the untreated group and the group undergoing head shaking.

Moreover, our methodology can be easily applied to patients of all ages and general conditions; it doesn’t require any physical effort, and it is very easy for the patient to understand and perform.

Our therapy does not require hospitalization, but the patient should undergo an otoneurological examination within 3 days after treatment to verify the recovery of HSC-BPPV and to exclude its conversion into a PSC-BPPV.

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REFERENCES