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Comparison of repositioning maneuvers for benign paroxysmal positional vertigo of posterior semicircular canal: advantages of hybrid maneuver☆,☆☆

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Abstract

Objective: The prevalence of benign paroxysmal positional vertigo (BPPV) is becoming more frequent in elderly population. The presence of comorbid factors has to be considered before assessment as well as before commencing any repositioning treatment. Our aims were evaluation of the maneuvers efficacy and evaluation of the applicability of hybrid maneuver (HM) in patients with physical limitation.

Study design and setting: This is a randomized study in 2 tertiary referral centers.

Intervention: This is a therapeutic intervention.

Patients: All consecutive patients with diagnosis of BPPV of posterior canal matching the inclusion criteria were enrolled. Patients underwent treatment soon after the initial diagnosis in all cases with a repositioning maneuver. The maneuver was casually selected among Semont, Epley, and hybrid. Patients were divided into 3 groups according to the maneuver adopted.

Results: Eighty-eight patients with posterior canal BPPV were enrolled for treatment. Fisher exact test showed that no statistical differences exist between HM and other maneuvers in terms of efficacy. Latency of repositioning nystagmus appeared longer in HM in comparison with other maneuvers ($P < .05$). Efficacy of maneuvers used for BPPV decreases in case of cupulolithiasis ($P < .0001$). We found no relationship between age, sex, and length of disturbance on response to maneuvers.

Conclusions: All maneuvers evaluated demonstrated similar efficacy. The HM, as our data showed, allows us to obtain a good percentage of success similar to most maneuvers used. It is also more comfortable for the patients with hip or neck functional limitation allowing an effective treatment of the posterior canal BPPV.

1. Introduction

Benign paroxysmal positional vertigo (BPPV) is the most common cause of peripheral vertigo. It accounts for approximately 24% of all cases of peripheral vestibular disorders [1], and the incidence is approximately 64 of 100 000 per year [2]. Patients present with a history of vertigo arising in certain head positions or during some movements of the head with respect to the horizontal plane.

Symptoms of this inner ear disease are thought to arise when otoconia move from the utricle into semicircular canals. Displacement of such debris, called otoconia, determines an endolymphatic fluid movement leading to a stimulation of ampullar receptors, thereby eliciting vertigo.

Classic BPPV involves the posterior semicircular canal (PSC) and represents the most common type of BPPV [3–6].

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Lateral semicircular canal BPPV accounts approximately for only 10% to 20% of all the patients presenting with BPPV [7]. Development of an anterior semicircular canal BPPV does not occur frequently because of the anatomical position of the semicircular canal, which is anterior with respect to the utricle.

Exact etiology of BPPV is still debatable. More than 50% of all reported cases are idiopathic in nature [8]. Adler [9] was the first to describe manifestations of BPPV in posttraumatic cases. A whiplash injury may be a cause of otoconia detachment with subsequent BPPV [10]. Generally, patients affected by idiopathic BPPV are older than those due to posttraumatic ones. Occasionally, BPPV has been described to be secondary to inner ear disorders [11], after stapes surgery or other otologic procedures [12]. When an inner ear cause is thought to be the origin of BPPV, it should be described as secondary BPPV [13]. Diagnosis of posttraumatic or secondary BPPV is not different from the idiopathic form, but the treatment may require more canalith repositioning maneuvers (CRM) to achieve satisfactory results [10]. Fortunately, in patients affected by vertigo crisis due to idiopathic BPPV, correct diagnostic evaluation and appropriate management allow, in most cases, to solve the problem quickly, without the need for any medical treatment.

Several effective repositioning maneuvers exist to manage PSC-BPPV. The methods proposed by Semont et al [14] and Epley [15], although differing in their position and movements, act with the mechanism of displacement of the otoconial debris around the long arm of the posterior canal, through the common crus, and back into the utricle. This rule is well applied with these maneuvers that reach a very good recovery rate. Eighty percent of patients become free of symptoms after a single maneuver [14-16].

A hybrid maneuver (HM) for PSC BPPV was recently described to treat those patients who exhibit contraindications to neck hyperextension or patients with hip, back, or other diseases that may affect mobility. This maneuver, until now, has only been reported by the authors who originally described the procedure [17].

We report a comparative study between 3 types of CRMs to treat PSC BPPV. Our aims were (1) evaluation of the maneuvers efficacy and (2) evaluation of the applicability of maneuvers in patients with physical limitation.

2. Materials and methods

All consecutive patients with diagnosis of BPPV of PSC referred to our centers were enrolled in this study in the period of March 2011 to July 2011. We recorded data of the patients: anagraphic data, history, and symptoms. All patients underwent a complete otoneurologic examination including otoscopy, pure tone audiometry, tympanometry, and nystagmus observation under infrared videonystagmoscopy. The diagnosis was based on clinical examination with a side-lying maneuver to test the involved side [18]. This diagnostic test was adopted to avoid differences between groups.

Patients with multiple semicircular canal involvement, with lateral or anterior semicircular canal BPPV, with neurologic or psychiatric disease, with other forms of peripheral or central vertigo, and with head trauma were excluded from this study. Patients with history of whiplash injury were excluded as well as patients with history of falls due to the vertigo. In addition, patients with unilateral sensorineural hearing loss and with a clinical history highly suspicious for a retrocochlear disease underwent a cerebellopontine angle magnetic resonance imaging evaluation to exclude the presence of tumor causing a malignant paroxysmal positional vertigo [19].

All diagnostic tests and evaluations were done before group assignments. The posttreatment tests were scheduled 1 week after first treatment and control diagnostic tests were programmed after 2 and 4 weeks.

Patients underwent treatment soon after the initial diagnosis in all cases with one of CRMs. The maneuver was randomly selected among Semont repositioning maneuver (SRM), Epley repositioning maneuver (ERM), and HM. We repeated the CRM once in the same session in the event of no response. The criterion to deem success or failure of the CRM done was the response to side-lying position repeated at the end of each CRM by an operator blinded to the treatment entourage. A new session was scheduled after 3 days in case of no response in the first session. Patients were divided into 3 groups according to the maneuver adopted: group A, SRM; group B, ERM; group C, HM. Patients with neck motion limitations, hip or back disease, and obese patients were grouped separately and were always treated with HM. The value of discomfort felt by patients (with and without comorbidity) treated with CRMs was obtained adopting a visual analog scale (VAS) consisting of a black line of 10-cm length on which the patients indicate the subjective sensation of pain or discomfort related to movement and holding positions, specifying to not include vertigo-related distress.

All subjects were instructed to avoid taking vestibular suppressant medications before their first visit and during the week before the control visit, when a side-lying position was repeated to exclude a recurrence. No postural restrictions after the canalith repositioning maneuvers were counseled to the patients in accordance with our published data [20]. The procedures followed were in accordance with the ethical standards of the Helsinki Declaration and with our institutional review board.

3. Results

During the period of study, 88 patients with PSC BPPV were enrolled for treatment. Forty-eight of the patients were females, whereas the remaining 40 patients were males. The patients belonged to the age range between 32 and 80 years with a mean of 52.56 years. The symptom period varied between 5 days to 2 months. No patients included in the study were treated previously for BPPV. All patients of the

series matched the inclusion criteria stated above. The groups' subdivision is summarized in Table 1. Fisher exact test showed that no statistical differences exist between HM and other CRMs ($P = .23$) in terms of efficacy in resolution of the signs and symptoms of BPPV. Although the numbers of failures were higher in ERM group, there was no statistical difference noted after the Fisher exact test ($P = .22$). Latency of repositioning nystagmus appeared longer in HM in comparison with SRM and ERM with an average duration of 14.66 seconds (t test, $P < .05$). The number of required maneuvers to achieve repositioning of the debris was higher in ERM group. All data have been summarized in Table 1.

Stratification of the patients according to the presumed pathophysiology of BPPV is displayed in Table 2. Efficacy of maneuvers used for BPPV decreases in statistical significance with the Fisher exact test ($P < .0001$) if the maneuvers are applied to cupulolithiasis patients.

Although other descriptive variables were considered to identify some factors influencing the treatment, we found no relationship between age, sex, and length of disturbance on response to maneuvers. The follow-up was correctly recorded in all patients, and we noted only 2 recurrences in the ERM group. These 2 patients were then managed with HM with resolution of symptoms. These 2 HMs were not considered in the data analysis.

A separate group of 19 patients with comorbidity (ie, hip disease; neck and column functional limitation; and obesity, body mass index >30) were grouped separately and managed with HM. There were no significant differences between the 2 groups treated with HM (Table 3).

4. Discussion

Pathophysiology of BPPV is described based on 2 main hypotheses. Canalithiasis is the most widely accepted theory to justify the symptoms of BPPV [21,22]. In this theory, it is proposed that otoconia, usually fixed within the utricle, become free and fall into semicircular canals (PSC is the most commonly involved). When head is moved into the stimulating position, the particles move initially consensually with the head and then fall following the direction of gravity dragging the endolymph with them. The subsequent drag has to overcome both the resistance of endolymph entering into the semicircular canal as well as the resistance of the cupula. The resultant deflection of cupula signals to the brain that the head is spinning, triggering the vestibuloocular reflex resulting in the characteristic nystagmus. The latency observed between the assumed position and the starting of nystagmus is related to the time in which the particles overcome the inner ear fluids' resistance.

The cupololithiasis theory was suggested by Schucknecht [23] in 1969. During postmortem histologic study of temporal bones, deposits of basophilic debris were noted on the cupula of the PSC. The theory stated that such deposits made the cupula unstable to gravity in certain head positions. In this

Table 1
Characteristic of groups studied

Groups	Group A (Semont)	Group B (Epley)	Group C (hybrid)
Patients	30	27	31
M/F ratio	17/13	15/12	13/19
Age (y)	51.61 (35-75)	51.76 (36-68)	54.32 (32-80)
Latency of positional nystagmus	4.12 s (0-8)	3.87 s (0-6)	4.35 s (0-9)
Duration of positional nystagmus	5.53 s (3-10)	5.12 s (4-8)	7.19 s (3-13)
Latency of repositioning nystagmus	9.15 s (2-11)	8.46 s (2-10)	14.66 s (3-30)
Duration of repositioning nystagmus	5.53 s (3-8)	5.34 s (1-8)	5.58 s (1-10)
No. of required maneuvers per patient	1.1 (1-2)	1.8 (1-4)	1.5 (1-4)
No. of failed maneuvers	3 (10%)	6 (22.2%)	5 (16.1%)

The table shows the differences of both diagnostic and repositioning nystagmus among the groups evaluated. Four patients of the 5 failures in the HM group had cupulolithiasis of PSC.

Table 2
Summary of the failed maneuvers stratified according with the hypothetic pathophysiology underlying the BPPV

	Type of PSC BPPV	No. of cases	Failed maneuvers
Semont	Canalithiasis	28	1
	Cupulolithiasis	2	2
Epley	Canalithiasis	24	4
	Cupulolithiasis	3	2
Hybrid	Canalithiasis	26	1
	Cupulolithiasis	5	4

As known, the cupulolithiasis patients entail a greater difficulty in achieving the repositioning of particles.

Table 3
Patients treated with HM

	BPPV without other disease (group C)	BPPV in patients with comorbidity
Patients	31	19
M/F ratio	13/19	8/11
Age (y)	54.32 (32-80)	65.3 (57-80)
Latency of positional nystagmus	4.35 s (0-9)	4.21 s (3-6)
Duration of positional nystagmus	7.19 s (3-13)	7.32 s (3-10)
Latency of repositioning nystagmus	14.66 s (3-30)	15.01 s (5-27)
Duration of repositioning nystagmus	5.58 s (1-10)	5.12 s (4-7)
No. of required maneuvers per patient	1.5 (1-4)	2.3 (2-4)
No. of failed maneuvers	5 (16.1%)	4 (21.03%)
Discomfort feeling (VAS)	3	4

This table shows 2 groups of patients treated with HM. The first column reports the same group of the first otherwise healthy BPPV patients' evaluation; the second column shows the data of patients with comorbidity, treated, and analyzed separately. The data obtained indicate a similar efficacy of the HM even in the presence of limitation to body movement. The subjective feeling of discomfort was obtained adopting a VAS.

theory, the otoconia are thought to get fixed on the cupula itself, thereby making it more sensitive to gravity. Upon stimulation by the appropriate head position, signal from the cupula comes on quickly and continues while the head is maintained in the critical position. This pathology is probably responsible for those patients resistant to several CRMs because the fixed particles are more difficult to reposition.

Laboratory investigations showed that both canalithiasis and cupulolithiasis are possible mechanisms of BPPV [24,25].

In our series, we considered the diagnosis of cupulolithiasis in those patients with longer duration of nystagmus on diagnostic maneuver. In these patients effectively, the main difficulty was to achieve repositioning of the debris and resolution of the symptoms. Therefore, in these cases, we adopted further head shaking to facilitate detachment of debris and achieve subsequent repositioning. The stratification of patients according to the presumed pathophysiology of BPPV (ie, canalithiasis or cupulolithiasis) confirmed that the form of BPPV linked to debris attached to the cupula is more difficult to manage with the maneuvers (Table 2).

Prevalence of BPPV is more common in patients older than 50 years. Today, it is showing a more frequent trend in elderly population as well. We noted a high incidence of BPPV in patients older than 65 years as can be seen in our series. In elderly patients, presence of comorbid factors has to be considered before assessment as well as before commencing any repositioning treatment. The most common ailments affecting patients older than 65 years are vertebrobasilar insufficiency, limited range of motion of the vertebral column (ranging from cervical vertebrae to lower back), cervical arthritis, and hip disturbance. Humphriss et al [26] did not recommend the Dix-Hallpike maneuver in patients with such diseases, in particular in multiple associated pathologies, because the head should hang off the examination table. Hyperextension and torsion of head for diagnostic purpose could be acceptable for a few seconds in case of Dix-Hallpike maneuver. However, in case of ERM, head needs to be maintained in this position for at least 60 to 180 seconds [27,28], with the added risk of further treatment in case of failure. The Semont maneuver includes a rapid lateral motion of the body from the involved side to the uninvolved side in reaching the liberatory position. Such movement is better avoided in case of patients with hip disease or vertebral column illnesses. In addition, in obese patients, the slow movement of the head and body, due to the big mass and limitation of body movements, could adversely affect the very efficacy of the maneuver.

During the CRMs, head is generally maintained in every position for 30 to 120 seconds, the practice varies, but we standardized our protocols for each maneuver, holding the positions assumed by the patients for 60 seconds.

It may also be difficult when treating very elderly or obese patients who find it difficult to turn over the trunk and the head to quickly assume the positions in the unaffected side. In such category of patients, we considered the more effective and comfortable HM because of its simplicity in reaching the correct position of head without delay and distress.

In the HM, the side-lying maneuver of SRM is its first position. This is similar to the SRM and avoids hyperextension of the neck found with the ERM. The head of the patient is then turned 45° away from the affected ear, and the patient is moved into a side-lying position on the involved side. The second position is a roll from the involved side to the uninvolved side. This is similar to the positioning used in the ERM. A liberatory headshake is then performed. Finally, the patient is returned to an upright, seated position [17].

In this study, we separately analyzed patients with hip, neck, or vertebral column diseases to compare the efficacy of HM with the most used CRMs (Semont and Epley) in a homogeneous series. The most interesting data emerging from the analysis were the high efficacy of HM when matched with the other 2 maneuvers. The Fisher exact test showed that no statistical differences exist between HM and other CRMs ($P = .23$). In our daily practice, we treat all patients with the aforementioned orthopedic illnesses and very obese subjects with HM with a good subjective comfort feeling. The rate of resolution of vertigo due to BPPV in such patients is similar to data reported in those patients without comorbidity. It is interesting to note that the discomfort felt by patients was indicated on VAS as 3 (mean) in otherwise healthy subjects with BPPV and 4 in patients of BPPV with comorbidities. Probably, these very similar results are likely to be due to the vertigo induced by the maneuver rather than a pain elicited during the movement; however, the discomfort is acceptable. It would be interesting to know about the amount of discomfort, as per the same VAS, in patients of BPPV undergoing treatment with one of the classic CRMs. However, we consider it ethically incorrect to subject the patients to this, particularly when we have a less painful option with equal efficacy.

There is still a place for Brandt-Daroff exercises that can be a useful home treatment particularly in cases where the symptoms are intermittent and it has not been possible to identify which ear is involved [29]. The patients should be reviewed in person so that their test can be repeated and further management given as appropriate. A week between treatments is ideal as it gives long enough for the patients to understand whether the symptoms have resolved but is not so long that they would have to suffer unnecessarily prolonged symptoms if the initial treatment has not accomplished a complete result. Untreated BPPV runs a variable course but frequently settles in weeks or months.

5. Conclusions

Repositioning maneuvers are the most effective treatment modality for BPPV. Although there are well known techniques to manage the BPPV, sometimes, such maneuvers have to be applied to patients with problems, often due to comorbidities entailing limitation of body movements. All

the maneuvers evaluated demonstrated similar efficacy without any statistically significant differences. The HM, as our data showed, allows us to obtain a good percentage of success similar to most CRMs used. It is also more comfortable for the patients with hip or neck functional limitation allowing an effective treatment of the PSC BPPV.

Another observation from the study is that mere existence of comorbidities along with BPPV does not affect the results of therapy adversely as shown by the highly comparable recurrence rates.

The recurrence rates that we noted were similar to those reported at 10% to 40%. It is important that patients are aware of this to avoid unnecessary anxiety and to address promptly the problems that they are facing. Particle repositioning provides a treatment, not a cure.

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