The Journal of Laryngology & Otology (2006), ***120***, *528–533.*

doi:10.1017/S0022215106000958
Printed in the United Kingdom
First published online 24 March 2006

Main Article

Prognosis of patients with benign paroxysmal positional vertigo treated with repositioning manoeuvres

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Abstract

Objective: To evaluate the prognostic factors in benign paroxysmal positional vertigo (BPPV) treated with canalith repositioning procedures (CRPs).

Material and methods: Retrospective study of consecutive BPPV cases diagnosed over three years. All patients underwent a complete otolaryngologic, audiologic and neurotologic evaluation. The appropriate CRP was performed, depending on the type of BPPV. Prognostic factors studied included age, sex, aetiology, duration of disease, abnormal electronystagmographic findings, canal involvement, improper performance of manoeuvres, response on first or repeat treatment, and presence of recurrences.

Results: One hundred and fifty-five patients were studied, 66 men and 89 women, with mean ages of 58.7 and 60.4 years, respectively. Age and the involvement of two canals or bilateral disease had an effect on initial treatment outcome and were correlated to increased recurrences but not to repeat treatment outcome. Secondary BPPV, abnormal electronystagmographic findings and improper performance of manoeuvres had a significant effect both on initial and repeat treatment, but not on recurrences. Sex and duration of symptoms had no effect.

Conclusion: Canalith repositioning procedures provide fast and long-lasting treatment of BPPV in most patients. However, in a small subgroup of patients, failures may be noticed that may be attributed to various prognostic factors.

Key words: Benign Paroxysmal Positional Vertigo; Treatment Outcome; Vertigo; Nystagmus

Introduction

Brandt and Daroff[1] reported in 1980 the first effective therapy for benign paroxysmal positional vertigo (BPPV) of the posterior semicircular canal, consisting of a set of physiotherapeutic exercises. However, a more effective and practical treatment was obtained by the introduction of Semont's liberatory manoeuvre,[2] based on the theory of cupulolithiasis, and Epley's canalith repositioning procedure (CRP),[3] based on the theory of canalolithiasis. Baloh *et al.*[4] in 1993, and Lempert[5] and Vannucchi *et al.*[6] in 1994, independently presented repositioning manoeuvres for the treatment of horizontal canal BPPV. Finally, Herdman in 1997[7] reported a few cases with anterior canal BPPV, treated by the same CRP used for the much commoner posterior canal vertigo.

In most of the reported series of patients with BPPV treated by manoeuvres,[8] excellent results were obtained. However, there was a significant number of patients who either did not respond to therapy and required repeated manoeuvres in multiple sessions or who responded initially but developed rapid recurrence of their symptoms. In most published studies, in-depth analysis of non-responding cases has not been attempted. The aim of the present study was to evaluate the prognostic factors that may be associated with difficult-to-treat cases.

Material and methods

Over a period of three years, 173 consecutive BPPV cases diagnosed at the neurotology unit of our ENT department were included in the study. The clinical records of these patients were retrospectively reviewed. Patients with a clinical examination, laboratory findings and imaging studies suggesting pathologic conditions of the central nervous system were excluded from the study. The patient's age, sex, and the aetiology and duration of their symptoms were recorded. Patients were divided into three groups, according to the duration of their symptoms, i.e. whether: (1) short (less than one month); (2) moderate (one to 12 months); or (3) long (exceeding 12 months).

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Accepted for publication: 17 October 2005.

All patients underwent a complete otolaryngologic, audiological and neurotologic evaluation, including pure tone audiometry, measurements of acoustic immitance and, occasionally, auditory brainstem response. Eye movements were recorded by electronystagmography (ENG) using a standard test protocol of visual and vestibular stimulation, described elsewhere.[9]

The Dix–Hallpike manoeuvre was performed on all patients to establish the diagnosis of posterior or anterior canal BPPV. Intense vertigo accompanied by a burst of nystagmus with the typical characteristics of latency, crescendo and transcience was considered necessary to establish the diagnosis. A diagnosis of posterior canal involvement was based on the type of paroxysmal positioning nystagmus produced during the Dix–Hallpike manoeuvre. The direction of the vertical component of the fast phase of the nystagmus response was upward and the torsional component of the nystagmus was beating towards the 'down-side' affected ear: counterclockwise during the right Dix–Hallpike manoeuvre when the right ear was involved, and clockwise during the left Dix–Hallpike manoeuvre when the left ear was involved.[9] Anterior canal involvement was characterized mainly by positioning nystagmus down-beating and torsion toward the affected uppermost ear.[10] Finally, the horizontal canal type of vertigo was diagnosed by the presence of horizontal geotropic and apogeotropic paroxysmal nystagmus provoked by turning the head from the supine to either lateral position.[11]

Patients with posterior or anterior canal BPPV were treated by the modified Epley CRP and patients with horizontal canal BPPV were treated by the Vannucchi manoeuvre. The appropriate manoeuvre was applied once, and its improper performance in occasional cases was noted. In case of failure or incomplete remission of symptoms, the same manoeuvre was repeated after 15 days. Assessment of the success of the treatment included both the patient's report of relief from vertigo and a negative Dix–Hallpike test result. In the case of a new failure, the Semont's liberatory manoeuvre was used. Follow-up care included communication by phone and, in case of recurrence of symptoms, re-examination and repeat of the repositioning procedures, according to the same plan. Although three years' absence of symptoms is generally considered as a definitive cure, treatment success in this study was determined after only two years of follow-up, because longer follow-up data were unavailable for many patients.

TABLE I

CLINICAL FEATURES OF PATIENTS TREATED FOR BPPV

Number	
Total	155
Men	66
Women	89
Mean age (years)	
Total	59.9 (±12.6)
Men	58.7 (±13.0)
Women	60.4 (±12.4)
Age range (years)	
Total	25–86
Men	29–86
Women	25–86
Canal involvement (*n*)	
Posterior	128
Horizontal	14
Anterior	3
Bilateral	7
Two canals	3
Aetiology (*n*)	
Idiopathic	116
Metatraumatic	11
Cochleovestibular disease	23
Other causes	5

BPPV = benign paroxysmal positional vertigo

Prognostic factors studied included age, sex, aetiology, duration of disease, abnormal ENG findings, canal involvement, improper performance of manoeuvres, response on first or repeat treatment, and presence of recurrences. Pearson χ^2, likelihood ratio, linear-by-linear association and cross-tabulation tests were used for the statistical analysis of the data. Statistical significance was accepted at the $p < 0.05$ level.

Results

One hundred and seventy-three patients were diagnosed during the three-year period as suffering from BPPV. In 18, detailed test and follow-up data were not available and these patients were excluded from the study. Therefore, 155 patients were finally studied in total.

The clinical features of the patients are presented in Table I. A total of 128 patients showed posterior canal involvement. There were 14 patients with horizontal canal BPPV and three patients with findings

TABLE II

COMPARISON OF PATIENTS' SEX AND BPPV CRP TREATMENT OUTCOME

	1st treatment*		Repeat treatment†			Recurrence‡	
	Men	Women	Men	Women		Men	Women
Success	56	70	62	81	Absence	54	70
Failure	10	19	4	8	Presence	8	11
Total	66	89	66	89	Total	62	81

*Pearson chi-square = 1.6 (not significant (NS)), likelihood ratio = 1.7 (NS), linear-by-linear association = 1.6 (NS). †Pearson chi-square = 0.5 (NS), likelihood ratio = 0.6 (NS), linear-by-linear association = 0.5 (NS). ‡Pearson chi-square = 0.1 (NS), likelihood ratio = 0.1 (NS), linear-by-linear association = 0.1 (NS). BPPV = benign paroxysmal positional vertigo; CRP = canalith repositioning procedure

https://doi.org/10.1017/S0022215106000958 Published online by Cambridge University Press

TABLE III
COMPARISON OF BPPV AETIOLOGY AND CRP TREATMENT OUTCOME

	Idiopathic (*n*)	Trauma (*n*)	Cochleovestibular disease (*n*)	Other (*n*)	Total (*n*)
*1st treatment**					
Success	107	2	12	4	125
Failure	9	9	11	1	30
Total	116	11	23	5	155
Repeat treatment†					
Success	113	4	21	5	143
Failure	3	7	2	0	12
Total	116	11	23	5	155
Recurrence‡					
Absence	101	3	15	5	124
Presence	12	1	6	0	19
Total	113	4	21	5	143

*Pearson chi-square = 49.4 ($p < 0.001$), likelihood ratio = 41.7 ($p < 0.001$), linear-by-linear association = 17.7 ($p < 0.001$). †Pearson chi-square = 52.8 ($p < 0.001$), likelihood ratio = 28.5 ($p < 0.001$), linear-by-linear association = 3.5 ($p < 0.05$). ‡Pearson chi-square = 6.1 (not significant (NS)), likelihood ratio = 5.9 (NS), linear-by-linear association = 1.9 (NS). BPPV = benign paroxysmal positional vertigo; CRP = canalith repositioning procedure

compatible with anterior canal involvement. Bilateral involvement was evident in seven patients and involvement of two canals was found in three more cases. From their clinical histories, the aetiology of patients' BPPV was metatraumatic in 11 patients, cochleovestibular (including Ménière's disease, vestibular neuronitis and otosclerosis) in 23 patients and due to other causes (including viral disease) in five patients.

A *t*-test of the mean ages of patients with successful outcomes and patients with treatment failure showed statistically significant differences between the two groups on both occasions, for initial treatment ($t = 4.0$, $p < 0.001$) and for the number of recurrences ($t = 3.8$, $p < 0.001$). Younger patients responded better to therapy than older patients. However, the mean age differences on repeated treatment were not significant ($t = 0.3$, $p = 0.76$).

Table II compares patient sex and treatment outcomes, for both initial and repeat treatments and also for recurrences. Non-significant statistical differences for sex were found in all circumstances. Table III compares BPPV aetiology and treatment outcome; significant differences were found on both initial and repeat treatment but not on recurrences. The comparison of duration of BPPV symptoms and treatment outcome showed statistically non-significant differences on all occasions (Table IV), although a significant number of our patients had a long duration of disease.

Table V compares abnormal ENG findings and treatment outcome, for both initial and repeat treatment and also for recurrences. Statistically significant differences were found on initial and repeat treatment. The recurrence rate was similar in both groups. A comparison of semicircular canal involvement and treatment outcome was also performed (Table VI). A statistically significant difference was evident for initial treatment and recurrences, but not for repeat treatment. It appeared that bilateral involvement and involvement of two canals caused this difference on initial treatment, because these cases were cured only after repeat treatment. However, in cases with bilateral involvement, recurrences were again increased in long term follow up.

Finally, the effect of improper performance of manoeuvres on treatment outcome was studied (Table VII). Improper performance was due to various reasons, including poor cooperation, obesity, neck stiffness and vertebral spine anomalies. Statistically significant differences were found on initial treatment and on repeat treatment outcomes. Recurrences were similar in both groups.

Discussion

Canalith repositioning procedures have been proven as the standard treatment of BPPV, and high success rates have been reported.[12] However, there have

TABLE IV
COMPARISON OF DURATION OF BPPV AND CRP TREATMENT OUTCOME

	1st treatment*			Repeat treatment†				Recurrence‡		
	SD	MD	LD	SD	MD	LD		SD	MD	LD
Success	39	53	33	44	61	38	Absence	40	52	32
Failure	8	13	9	3	5	4	Presence	5	8	6
Total	47	66	42	47	66	42	Total	45	60	38

*Pearson chi-square = 0.2 (not significant (NS)), likelihood ratio = 0.2 (NS), linear-by-linear association = 0.2 (NS). †Pearson chi-square = 0.3 (NS), likelihood ratio = 0.3 (NS), linear-by-linear association = 0.3 (NS). ‡Pearson chi-square = 0.3 (NS), likelihood ratio = 0.3 (NS), linear-by-linear association = 0.3 (NS). BPPV = benign paroxysmal positional vertigo; CRP = canalith repositioning procedure; SD = short duration; MD = moderate duration; LD = long duration

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TABLE V
COMPARISON OF ENG FINDINGS AND BPPV CRP TREATMENT OUTCOME

	Abnormal ENG	Normal ENG	Total
*1st treatment**			
Success	42	83	125
Failure	21	9	30
Total	63	92	155
Repeat treatment†			
Success	54	89	143
Failure	9	3	12
Total	63	92	155
Recurrence‡			
Absence	52	72	124
Presence	8	11	19
Total	60	83	143

*Pearson chi-square = 13.2 ($p < 0.001$), likelihood ratio = 13.1 ($p < 0.001$), linear-by-linear association = 13.1 ($p < 0.001$). †Pearson chi-square = 6.3 ($p < 0.05$), likelihood ratio = 6.3 ($p < 0.05$), linear-by-linear association = 6.3 ($p < 0.05$). ‡Pearson chi-square = 0.1 (not significant (NS)), likelihood ratio = 0.1 (NS), linear-by-linear association = 0.1 (NS). ENG = electronystagmography; BPPV = benign paroxysmal positional vertigo; CRP = canalith repositioning procedure

been only a few studies of the subgroup of patients who do not respond to treatment or in whom symptoms recur.[13,14] Furthermore, in most of these studies, only one factor is considered, such as aetiology,[15,16] additional vestibular pathology[17] or the number of treatments.[18] At present, it is still controversial which factors are associated with treatment failure.

Age seemed to affect treatment outcome in our study. Elderly patients responded less well to initial CRP treatment. This may have been due to poor cooperation, fatigue or limited mobility. Furthermore, disease may be more extensive in older patients and otoconia debris may be produced more frequently and in larger quantities than in younger patients. These reasons may explain the increased number of recurrences in the elderly. Macias *et al*.[14] did not find any statistically significant correlation between age and the number of treatment visits, although all of their patients who received more than three treatments were over the age of 50 years. In studies with smaller samples,[13,19,20] no effect of age on BPPV treatment outcome was found; Levrat *et al*.[21] came to the same conclusion, although they used the Semont manoeuvre and not the Epley CRP. Patients' sex was found to have no significant effect on the outcome of BPPV treatment; this is in accordance with the findings of other reports.[13,14,19,21,22]

The aetiology of BPPV proved to be an important prognostic factor. Patients with a history of head and neck trauma associated with the disease responded poorly to CRP treatment, with a cure rate of only 36 per cent after two treatments. Patients with cochleovestibular disease responded less well on initial treatment but approached the success rate of patients with idiopathic BPPV on repeat treatment. Other causes of secondary BPPV, such as prolonged bed rest or viral infections, did not affect treatment outcome. We did not find any significant differences between groups with different BPPV aetiology, regarding recurrences. Most reports generally agree that secondary BPPV has a worse prognosis than idiopathic BPPV.[13,15,16] Our findings agree especially with those of Del Rio and Arriaga,[15] who found that post-traumatic BPPV had the lowest initial success rates and a low recurrence rate. These authors also found a high rate of recurrence in patients with hydrops. Although we did not find statistically significant differences in recurrence according to BPPV aetiology, four out of our six patients with cochleovestibular disease who experienced recurrence during the two years of follow up (Table III) suffered from Ménière's disease. The same finding has been reported elsewhere.[20] The differences observed between patients with idiopathic and secondary BPPV may imply that the pathology or pathophysiology of secondary BPPV may differ quantitively or qualitatively from that of idiopathic BPPV.[13,23] It is possible that patients in each group have different characteristics and that their disease follows a different course and responds differently to treatment.

The duration of symptoms remains a controversial issue. We did not find this to be a significant factor, and we obtained complete cure in several patients

TABLE VI
COMPARISON OF BPPV CANAL INVOLVEMENT AND CRP TREATMENT OUTCOME

	Posterior canal	Horizontal canal	Anterior canal	Bilateral	Two canals	Total
*Initial treatment**						
Success	110	12	3	0	0	125
Failure	18	2	0	7	3	30
Total	128	14	3	7	3	155
Repeat treatment†						
Success	118	14	3	6	2	143
Failure	10	0	0	1	1	12
Total	128	14	3	7	3	155
Recurrences‡						
Absence	107	11	3	2	1	124
Presence	13	1	0	4	1	19
Total	120	12	3	6	2	143

*Pearson chi-square = 44.9 ($p < 0.001$), likelihood ratio = 36.8 ($p < 0.001$), linear-by-linear association = 32.7 ($p < 0.001$). †Pearson chi-square = 4.5 (not significant (NS)), likelihood ratio = 4.7 (NS), linear-by-linear association = 0.9 (NS). ‡Pearson chi-square = 18.5 ($p < 0.001$), likelihood ratio = 12.4 ($p < 0.05$), linear-by-linear association = 11.1 ($p < 0.001$). BPPV = benign paroxysmal positional vertigo; CRP = canalith repositioning procedure

https://doi.org/10.1017/S0022215106000958 Published online by Cambridge University Press

TABLE VII
COMPARISON OF CRP TECHNIQUE AND TREATMENT OUTCOME

	Proper CRP technique	Improper CRP technique	Total
*1st treatment**			
Success	120	5	125
Failure	16	14	30
Total	136	19	155
Repeat treatment†			
Success	132	11	143
Failure	4	8	12
Total	136	19	155
Recurrence‡			
Absence	114	10	124
Presence	18	1	19
Total	132	11	143

*Pearson chi-square = 40.9 ($p < 0.001$), likelihood ratio = 31.8 ($p < 0.001$), linear-by-linear association = 40.6 ($p < 0.001$). †Pearson chi-square = 35.8 ($p < 0.001$), likelihood ratio = 22.4 ($p < 0.001$), linear-by-linear association = 35.5 ($p < 0.001$). ‡Pearson chi-square = 0.1 (not significant (NS)), likelihood ratio = 0.2 (NS), linear-by-linear association = 0.1 (NS). CRP = canalith repositioning procedure

with a history of many years of disease. Most authors agree with our findings,[13,20,22] but some do not.[21,24]

Electronystagmography findings were a significant prognostic factor in BPPV treatment. It has been reported that abnormal ENG findings are quite common in BPPV patients; they occurred in almost 41 per cent of our patients. In this subgroup, outcome was worse on both initial and repeat treatment. This may be explained by more extensive damage of the labyrinth in such cases[25] and by the mechanical theory of CRP, according to which CRP clears only symptoms arising from the posterior semicircular canal by the repositioning of otoconial debris into the utricle.[18] Our findings agree with those of previous reports on the same issue.[18,26]

A factor that has been occasionally studied in the past is the effect of the location of disease on the treatment outcome. Macias *et al.*[14] found that BPPV involving any location other than a single posterior semicircular canal required more than one treatment visit. Furthermore, they found that BPPV of the horizontal semicircular canal variety responded less to therapy than did BPPV of the posterior canal. Sakaida *et al.*[19] also reported that patients with horizontal canal BPPV had a significantly higher recurrence rate over long term follow up than those with posterior canal BPPV. Vannucchi *et al.*[27] proposed the 'forced prolonged position manoeuvre' for the treatment of horizontal BPPV and reported high rates of treatment success, approaching 92 per cent. We used the same manoeuvre and obtained successful outcomes in 12 of 14 (86 per cent) patients with BPPV of the horizontal canal. However, we found significant differences in the treatment outcomes of patients with bilateral or two-canal involvement. All of these patients needed repeat treatment for complete cure of their disease. Additionally, we found increased recurrences in patients with bilateral canal involvement, but we had only one patient with BPPV of the horizontal canal, who presented with recurrence of the disease.

Improper performance of the CRP manoeuvre is obviously an adverse factor in the treatment of BPPV. We observed suboptimal performance of CRT in 30 of our patients. Seventy-four per cent of these failed on initial treatment; the failure rate was reduced to 42 per cent on repeat treatment. The main reasons for improper treatment are poor cooperation from the patient, fatigue, significant arthritic disorders of the cervical vertebrae, limited neck mobility and obesity.[14,28] These problems occur quite often in patients with BPPV and are the main reason why we do not usually perform the Semont CRP manoeuvre, which is more demanding, except in cases of repeated failure of the Epley CRP.

Finally, another issue that should be considered is the occasional poor outcome in patients with idiopathic BPPV in the absence of any unfavourable prognostic factors. Parnes and Price-Jones[29] proposed three possible mechanisms for poor outcome of the particle repositioning manoeuvre. Firstly, following an improperly performed manoeuvre, particles may reverse their direction of movement, creating a utriculopetal endolymph current. Secondly, an obstruction within the membranous duct may exist. Thirdly, cupulolithiasis may be the pathogenetic mechanism that underlies some cases of BPPV resistant to CRP treatment. Another possible mechanism for CRP treatment failure may be the variance observed in the anatomic location of the semicircular canals.[30]

We did not study the effect of the implicated pathogenetic mechanism: cupulolithiasis or canalolithiasis. Either cupulolithiasis or free-floating endolymph particles would give rise to utriculofugal cupular displacement during the Dix–Hallpike manoeuvre,[29] with an increase in the resting discharge rate of first-order vestibular neurons, resulting in the observed nystagmic response. The two conditions, thus, may be difficult to differentiate by history or response to standard Dix–Hallpike testing.

Conclusion

From this study, it is evident that CRP provides rapid and long-lasting relief of BPPV in most patients. However, in a small subgroup, repeated treatment may be needed; recurrences may also occur quite

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often. Various prognostic factors contribute to a poor outcome of CRP treatment for BPPV.

- **In most patients with benign paroxysmal positional vertigo (BPPV) treated by repositioning manoeuvres, excellent results are obtained. However, there are a significant number of patients who either do not respond to initial therapy and require repeat manoeuvres in multiple sessions or do respond initially but develop rapid recurrence of their symptoms**
- **In most published studies, in-depth analysis of non-responding cases has not been attempted. This study evaluated multiple prognostic factors affecting treatment outcome**
- **Age and bilateral involvement or involvement of two canals had a significant effect on initial treatment outcome but not on that of repeat treatment. These factors were also correlated with increased recurrence rates**
- **Secondary BPPV, abnormal electronystagmography findings and improper repositioning manoeuvre technique had significant effects on the manoeuvre's efficacy, both on initial and on repeat treatment, but had no effect on recurrence rates**
- **Sex of patient and duration of symptoms before initial consultation had no effect on either treatment outcome or recurrence rates**

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Professor S Korres takes responsibility for the integrity of the content of the paper.
Competing interests: None declared