Eur Arch Otorhinolaryngol (2016) 273:573–580
DOI 10.1007/s00405-015-3583-z

OTOLOGY

Repositioning chairs in benign paroxysmal positional vertigo: implications and clinical outcome

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Received: 16 December 2014 / Accepted: 24 February 2015 / Published online: 7 March 2015

Abstract The objective was to evaluate the clinical value of repositioning chairs in management of refractory benign paroxysmal positional vertigo (BPPV) and to study how different BPPV subtypes respond to treatment. We performed a retrospective chart review of 150 consecutive cases with refractory vertigo referred to our clinic within a 10-month period. The BPPV patients were managed with classical manual manoeuvres, the Epley Omniax® rotator (EO) or the TRV chair (TRV). In addition, a comprehensive review of the literature was performed. BPPV was identified in 95 cases. The number of needed treatments for posterior canalolithiasis versus posterior cupulolithiasis, horizontal cupulolithiasis and multi-canal affection was significant ($p < 0.01$). Thirty-seven (38 %) patients required only one repositioning manoeuvre and the overall symptom relief was 91.7–100 % after 3 treatments. Eleven patients (12 %) experienced relapse within the ½-year follow-up period. Horizontal cupulolithiasis and multi-canal affection constituted the most resilient cases. The literature search identified 9 repositioning chair studies. The EO and the TRV are highly valuable assets in diagnosis and management of BPPV of particularly complex and refractory cases. However, further validation is anticipated through controlled clinical trials.

Previous presentations: parts of the retrospective data were presented at the Congress of the Nordic Association of Otolaryngology, Copenhagen, May 2014.

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Keywords Vertigo · Repositioning manoeuvres · Treatment · Biaxial chair · TRV chair · Epley Omniax chair

Introduction

Benign paroxysmal positional vertigo (BPPV) is a condition characterised by brief episodes of vertigo produced by changes in head position [1]. The contemporary hypothesis of the primary pathology is that detached otolith material is either jammed in the semi-circular canal cupules (cupulolithiasis) or freely located within the semi-circular canal endolymphatic space (canalolithiasis) [2, 3]. Both conditions induce mechanical or gravitational pull on the vestibular neuroepithelia, which cause repetitive distortion of the vestibular input perceived by the brain and generate a monosymptomatic rotatory vertigo. Generally, symptoms are characterised by brief motion triggered spinning but may vary depending on the type [4–6].

BPPV represents the most common cause of otogenic vertigo. The cumulative lifetime incidence of BPPV is nearly 10 % at 80 years. BPPV affects all ages but the incidence is steadily increasing by 38 % per 10 years of life, with a peak incidence between 50 and 70 years. Idiopathic BPPV is approximately twice as common in women as in men. Due to an increasing life expectancy in the population the incidence of BPPV is assumed to increase [6–9].

Although BPPV may resolve spontaneously, various manual treatment manoeuvres exist. In 1992, John Epley described the canalith reposition procedure, which was a major clinical breakthrough [10]. The improved remission following the Epley procedure compared to spontaneous remission has been substantiated in several clinical trials [11]. The type of BPPV affects treatment success and

cupulolithiasis, horizontal BPPV and multi-canal BPPV show more resistance to treatment than the most prevalent posterior canalolithiasis [12–16]. Between 10 and 20 % of patients with suspected BPPV cannot be adequately diagnosed and treated with conventional manoeuvres [1], which has led to the development of semi-automated mechanical alternatives. At Portland Otologic Clinic Dr. Epley developed the Epley Omniax rotator (EO) [14] and at Clinique Marignane, Marseille the TRV chair (TRV) was developed by Dr. Richard-Vitton [17].

These are mechanical devices that allow 360-degree circular movement of the patient in the planes of all semicircular canal with simultaneous and precise monitoring of eye movements via infrared goggles [12–15]. The advantage of the EO is the electrical remote control while the advantage of the TRV is the price. Both chairs easily accommodate old or immobile patients.

The repositioning chairs have been suggested to be useful in particularly the less common forms of BPPV that are difficult to diagnose and complicated to manage by manual forces [4, 14, 21]. However, management and optimal treatment of BPPV in mechanical chairs are sparsely described. No review exists concerning this topic and the advantages in light of diagnosis and therapy on the various BPPV subtypes remain largely unexplored.

Through evaluation of our results, this study aims to explore the potential advantages of mechanical chairs in clinical practice on complicated cases and subtypes of BPPV and to review the literature.

Materials and methods

Between January 2013 and October 2013, a cohort of 150 consecutive cases with refractory vertigo and suspected BPPV were referred to our tertiary unit from county and university hospitals in Denmark as well as private otorhinolaryngologists and neurologists due to resistance in treatment. Patients were managed with classical manual manoeuvres (Dix–Hallpike and classic Epley (CE) manoeuvre), the Epley Omniax® rotator (Vesticon, Portland, USA) or the TRV chair (Interacoustics, model TRV, France). Allocation to treatment was based on symptomatology such as duration of vertigo attacks, frequency of symptoms, precipitating and exacerbating factors, and relation to sleep. The chairs perform Dix–Hallpike manoeuvre and supine roll test for diagnostic purposes [9] and for therapeutic posterior canal BPPV (p-BPPV) the Semont or Epley manoeuvres can be performed [10, 16] (Fig. 1). Further, Barbecue manoeuvres [9, 17, 18] for horizontal canal BPPV (h-BPPV) and manoeuvres for anterior canal BPPV(a-BPPV) [13, 14, 19] are feasible. For accurate eye monitoring and analysis, we use head-mounted videonystagmography (VNG) goggles (Synapsis in the classic manoeuvres or integrated VNG in the EO and Interacoustics in the TRV) that eliminate visual fixation. In treatment of cupulolithiasis, the EO can be combined with a mastoid oscillation feature. For the TRV, a potentiation (shock) feature may be utilised that consists of repeated decelerating forces transferred manually "en bloc" to the chair and patient.

Fig. 1 A right Epley manoeuver performed in the TRV chair

Criteria for BPPV were positional elicited nystagmus during the semi-circular canal specific procedures. The follow-up period was 6 months.

Statistical analysis

Non-parametric statistical test was applied since data were not normally distributed given the small sample size of the sub-groups. The Mann–Whitney U test was used for comparing the difference between groups concerning the number of necessary treatments.

Fischer's exact test was used for comparing groups in regard to cure and relapse rates.

The significance level of $p < 0.05$ was corrected for multiple comparisons by the Bonferroni correction (0.05/8) thus $p < 0.00625$ indicated significant results.

In addition to the retrospective study, we performed a literature search using the medical database PubMed search engine addressing the word vertigo together with the following keywords: Epley Omniax chair, Epley Omniax rotator, TRV chair, TRV armchair, TRV–CRP, armchair, biaxial rotational chair, repositioning chair. The search was performed on November 18, 2014. Articles published in English and French were included. The search was not limited by a time period.

Results and analysis

A total of 150 patients were omitted to the clinic due to dizziness complaints. Of these, 95 were diagnosed with BPPV. However, only 67 patients were referred with a BPPV diagnosis, whereas 15 of these suffered from other vestibular diseases (Table 1). Repositioning chairs were used to diagnose 81/95 cases (85.3 %).

Summarising, affection of the p-BPPV constituted 68 % of all cases and the h-BPPV 32 %. Twenty-five subjects had multi-canal affection of which one case involved the anterior canal. Canalolithiasis (CAN) and cupulolithiasis (CUP) accounted for 61 and 39 %, respectively. BPPV subtypes distribution and corresponding treatment aspects are shown in Table 2. The average duration of symptoms before the first contact with our unit was 35 months. Mean number of treatments for all groups was 3. The differences between the number of treatments for posterior canalithiasis (p-CAN) versus horizontal cupulolithiasis (h-CUP) and multi-canal affection were significant (both with $p < 0.00625$), but the difference between p-CAN compared to posterior cupulolithiasis (p-CUP) and horizontal canalithiasis (h-CAN) was non-significant ($p = 0.01$ and $p = 0.27$, respectively). Thirty-seven (38 %) patients were treated sufficiently with only one repositioning manoeuvre.

Table 1 Demographic and clinical features of subjects ($N = 150$)

Sex ratio (female/male) with confirmed BPPV	68/28 (70.8 %/29.2 %)
Subjects diagnosed with BPPV	95 (63.3 %)
Referred with BPPV of all subjects	67 (44.7 %)
Referred with BPPV with subsequent confirmed BPPV	52 (54.7 %)
Referred with BPPV without subsequent confirmed BPPV	15 (27.3 %)
Mean age ± SD with confirmed BPPV	60 ± 17

Sensitivity for referred diagnosis in regard to BPPV = 54.74 % (95 % CI 44.19–64.98 %); specificity for referred diagnosis in regard to BPPV = 72.73 % (95 % CI 59.04–83.85 %)

Table 2 Distribution of BPPV subtypes, treatment modalities and characteristics

Subtype	CE	EO	TRV	Combo
p-CAN (45.3 %)				
$N = 43$ (79.6 % of p-BPPV)	9	8	16	7
N treatments = 2 (mean)	1	1.6	1.8	16.9
Months of treatment (mean)	0	0.8	1	7.9
Months of symptoms (mean)	23.9	11	55.8	17.5
Symptom relief (97.1 %)	4	8	14	7
No symptom relief (2.9 %)	0	0	1	0
N relapse = 5	0	1	2	2
p-CUP (11.6 %)				
$N = 11$ (20.4 % of p-BPPV)	–	3	6	2
N treatments = 3 (mean)	–	3.7	2	2
Months of treatment (mean)	–	2	1.8	7.5
Months of symptoms (mean)	–	28	39.2	12
Symptom relief (100 %)	–	3	5	2
No symptom relief (0 %)	–	0	0	0
N relapse = 1	–	0	1	0
h-CAN (7.4 %)				
$N = 7$ (43.7 % of h-BPPV)	–	2	4	1
N treatments = 2 (mean)	–	3	1.75	4
Months of treatment (mean)	–	1	1	10
Months of symptoms (mean)	–	1	33.5	0
Symptom relief (100 %)	–	2	4	1
No symptom relief (0 %)	–	0	0	0
N relapse = 0	–	0	0	0
h-CUP (11.6 %)				
$N = 9$ (56.3 % of h-BPPV)	–	–	5	4
N treatments = 7 (mean)	–	–	4.6	9
Months of treatment (mean)	–	–	2.4	6
Months of symptoms (mean)	–	–	76.25	27
Symptom relief (100 %)	–	–	5	4
No symptom relief (0 %)	–	–	0	0
N relapse = 1	–	–	0	1
Multi-canal (23.3 %)				
$N = 25$[a]	–	6	7	11
N treatments = 7 (mean)	–	2.3	6	9.8
Months of treatment (mean)	–	1.5	4	4.8
Months of symptoms (mean)	–	31.1	7.8	23.4
Symptom relief (91.7 %)	–	6	7	9
No symptom relief (8.3 %)	–	0	0	2
N relapse = 4	–	1	1	2

Conventional Epley treatment was exclusively (not exhaustively) applied to p-CAN cases

Combo combination treatment of more than one modality, in particular Epley Omniax-TRV chair combination

[a] Distribution of multi-canal cases; nine (36 %) p-CAN/h-CUP; eight (32 %) p-CUP/h-CUP; five (20 %) p-CAN/h-CAN; two (8 %) p-CAN/p-CUP; one (4 %) p-CAN/a-CAN

Symptom relief was between 91.7 and 100 % depending on the BPPV subtype. A number of 54 (57 %) patients were completely cured, 27 (28 %) partly cured with symptom reduction and 3 (3 %) patients were not cured. Due to loss to follow-up, end result was unknown for 11 (12 %) patients of which 9 belonged to the p-CAN group. There was a tendency that h-CUP patients did not experience full recovery (33 % completely cured, 66 % partly cured) and by testing complete symptom relief (cured versus not cured) of the p-CUP and h-CUP there was a non-significant trend of $p = 0.02$. Similarly, comparison of the multi-canal conditions, there was a non-significant difference in cure rate between multi-canal p-CAN/h-CAN and p-CUP/h-CUP ($p = 0.06$).

There were 11 patients (12 %) experiencing relapse and the average time before relapse was 5 months. Fischer's exact test showed no significant difference in relapse between groups.

No patients worsened after treatment.

Literature search identified 9 studies. Due to foreign language, 2 studies were excluded resulting in 7 included studies of which 2 were retrospective [15, 19] and 4 were prospective studies [4, 20–22]. One included article was descriptive and studied no patients [14]. Two articles [15, 21] address the EO, 4 [4, 14, 20, 22] the TRV and finally 1 article [19] is about a third type of repositioning chair for anterior BPPV (a-BPPV]. One study [22] compared repositioning chair treatment with the effect of manual CRP, in contrary to the other studies that did not assign control groups. Three studies addressed all BPPV subtypes [4, 15, 20], whereas 3 other studies investigated solely p-BPPV [22], h-BPPV [21] and a-BPPV [19], respectively (Table 3).

Discussion

This study evaluates our experience with repositioning chairs and provides a review of the current literature on this topic. Both the EO chair and the TRV chair are readily available in our clinic. Accordingly, we have a unique opportunity to choose between different treatment options along the manual conventional treatment.

In our population, patient characteristics with regard to gender and age match the literature well [5, 8, 13, 27–30]. On the contrary, our population was characterised by considerably more horizontal BPPV and multi-canal BPPV than previous estimates that range from around 6–10 % [14, 16, 28, 30] and less than 8 % [13, 16, 31], respectively. Many studies do not investigate cupulolithiasis that accounted for 39 % of our patients.

We believe that at least some of our 25 % multi-canal and 39 % horizontal patients would have been diagnosed insufficiently without the application of repositioning devices and also that these patients hypothetically could have ended up in an "unresolved vertigo" category. Among the referrals, the sensitivity of being diagnosed with BPPV was low (Table 1). In addition to indispensable treatment, the chairs have thus contributed to approximating the true prevalence of each subtype and their responses to repositioning therapy.

In the present study, manual Epley method was used as a first choice to treat simple cases of p-CAN [11]. The most difficult cases were allocated to one of the positioning devices or a combination of both.

From the literature, we identified a single study [22] that prospectively compared the TRV chair treatment with manual canalith repositioning manoeuvres in 165 patients

Table 3 Studies included for reviewing

References	N^a	Type of study	End points	Follow-up
Wang [4]	726 (209)	Prospective	Demography and characteristics of BPPV with TRV chair	1 week
Tan [26]	165 (165)	Prospective	Treatment efficacy of TRV chair vs. CRP on p-BPPV	1, 4 weeks, 3, 6 months
Lechner [15]	60 (31)	Prospective	Description of horizontal nystagmus in h-BPPV with Epley Omniax rotator	~1 week
Richard-Vitton [21]	465 (152)	Prospective	Detection of new BPPV subtype with TRV chair	3 days
Lorin [25]	722 (16)	Retrospective	VNG characteristics and treatment results of a particular sedimentation manoeuvre on a-BPPV	4–16 days
Richard-Vitton [17]	–	Descriptive	Description of TRV chair	–
Nakayama [14]	986 (833)	Retrospective	Efficacy of analysing and treating BPPV with Epley Omniax rotator	Unknown

Han et al. from 2013 and You et al. from 2014 were excluded due to foreign language

CRP manual canalith repositioning procedure (Epley manoeuvre)

[a] Numbers in brackets represent included patients with BPPV

with p-BPPV. They found the TRV to be superior to CRP (85 vs 73 % success rate). The results for CRP are consistent with results in previous studies of the manual Epley manoeuvre [28]. The above-mentioned study does not distinguish between p-CAN and p-CUP cases. We experienced a symptom reduction of 97.1 % in p-CAN patients of which 79.8 % was completely cured. H-CUP and multicanal CUP had the lowest curing rates.

In our clinic, CUP is not routinely managed by manual procedures, which consequently allows selection bias. Further, our results may reflect that our study was a non-blinded non-randomised one and the availability of the two chairs (with mastoid oscillation in the EO or the shock treatment option for the TRV) made the physicians more prone to offer one of these options. The 12 cases diagnosed solely with conventional Dix–Hallpike manoeuvers were all found to belong to the p-CAN subtype, and subsequently 9 of these subjects were treated with CE since this option was straightforward. All the other cases either required or were found to benefit from non-manual techniques indicating that the chairs are superior to manual procedures in ensuring accurate diagnosis. Unique for the TRV is a shock function for potentiating or facilitating manipulation of otoliths. We speculate that the application of decelerating forces potentially may be more effective than sole gravitational forces in the mobilisation of jammed otolith particles and treatments of CUP as indicated by our results. However, randomised controlled trials are needed.

The follow-up period of this study was 6 months. There seems to be no consensus in the literature on the length of follow-up of BPPV patients [4, 13, 20, 25–27, 33, 34]. In the present study, eleven patients were lost to follow-up. We argue that some of these likely have recovered from BPPV, reducing motivation for further contact to the clinic. Regardless of treatment or spontaneous remission, there is often a relapse in BPPV mostly within the first year and the relapse rate after 5 years is 33–50 % with higher incidence among BPPV secondary to trauma [23, 29, 31, 32]. In our population, 12 % of the patients experienced relapse approximately ½ year after ended treatment. Although it is plausible that a longer observation period would reveal additional relapse cases, we believe that the management with repositioning chairs accounts for our low relapse rate compared to studies on manual manoeuvres. All treatment groups except the classic manoeuvre group had relapse cases, but the classic modality exclusively treated p-CAN. On the contrary, the relatively large share of relapses among the TRV chair group and combination therapy group could reflect that the indications for this type of treatment cover the most resilient cases. Indeed, the TRV and combination therapy were overrepresented when it came to CUP that is prone to relapse and difficult to eliminate [21, 33]. The symptom duration could also account for some difference in treatment efficacy. The mean duration of symptoms was highest for patients treated with the repositioning chairs. Somatization or a psychological component could also be an explanation [8, 34].

At long-term (6 months) follow-up, Tan et al. [22] noticed no significant difference in p-BPPV between the CRP group and the TRV group. There was a trend though, and due to risk of type-II errors the authors advocated for trials with larger sample sizes. Frequently, BPPV resolves spontaneously [1, 11] yet data are not unambiguous. Over time, the natural history of BPPV will possibly equalise and obscure a treatment effect at long-term follow-up. Indeed, the Dutch guidelines advice watchful waiting over the Epley manoeuvre though a recent systematic review concluded that the Epley manoeuvre should be applied over watchful waiting [35]. Waiting implies a longer duration of symptoms with the associated discomfort and potential hazards, e.g. risk of falling [9]. Even specialists have difficulties in diagnosing and managing BPPV, which is unfortunate as the condition should be detected and treated as early as possible to eliminate the risk of persistent symptoms, mistakes in drug administration and co-morbidities [26, 36, 37]. The high medical and society costs associated with insufficient or incorrect management of BPPV constitute another reason for putting effort in new promising approaches [1, 38]. Only 55 % of our confirmed BPPV patients had BPPV as referral diagnosis indicating that manual manoeuvres performed by physicians and even otorhinolaryngologists are highly inadequate in ensuring correct diagnosis. All cases that were not p-CAN were diagnosed with repositioning chairs either with or without prior attempts by manual procedures. Richard-Vitton et al. [20] investigated all subtypes and reported an immediate identification of involved semi-circular canal in 90 % of 152 subjects investigated by the TRV.

Nakayama and Epley [15] described the EO system by reviewing the charts of 986 subjects with positional vertigo symptoms managed with the chair. They found that a relatively small number of procedures were required to resolving the 833 confirmed patients; 1–3 chair sessions for all single canal cases, of which 99 % of p-BPPV cases resolved after one treatment and 89 % similarly for h-BPPV. Richard-Vitton et al. [20] experienced that on average, 1.6 visits in the TRV chair resulted in resolution of BPPV. Another study performed repositioning manoeuvres on 209 patients [4]. Out of the 202 patients successfully treated 148 (73.3 %) had 1 procedure and the rest (26.7 %) required 2 procedures. The number of manual CRP treatments necessary to release patients from their condition has previously been reported to be between 2.0 and 2.4 treatments depending on the semi-circular canal affected [39], and another study [33] found that 2.5 manual procedures were required. One included study [21]

compared the results of h-CAN treatment with those of h-CUP where 6 patients each required up to 7 treatments and one required 15 treatments. None of the included articles studied both marketed chairs. Two articles accounted for their experience with different BPPV subtypes as well as multi-canal cases [4, 14].

We found no difference regarding h-CUP and h-CAN treatments in the present study, which however may be due to a type-II error. The multi-canal cases required most treatments with a significant difference compared to the frequent p-CAN ($p < 0.01$). P-CAN similarly required significantly less treatments than p-CUP and h-CUP. The mean number of treatments in our clinic was 3, and highest for the group managed with both chairs where the mean number was 8. Importantly though, due to the unique setup in our clinic, most referred patients are beyond standard treatment at primary referral centres. Regardless of whether this is attributed to incorrect diagnosis or insufficient treatment, patients have often endured long waiting time (up to 8 months). This means that possible spontaneous remission is inherently removed from the study population. Thus our patient pool represents an exceptionally selected subgroup of BPPV cases. This may contribute, at least in part to why many of the patients required several treatment sessions.

Our data include only one case of a-BPPV. Moreover this case had affection of p-CAN. It was treated twice and cured with the EO. Lorin [19] treated 16 individuals suffering from a-BPPV in a special vertical rotatory chair performing a "sedimentation CRP". Evaluations were made until 16 days after treatment. The article concluded that the rotatory chair was effective in diagnosing and treating a-BPPV.

The limited literature concerning the application of repositioning chairs reflects an inadequate amount of research on a condition that affects a sizeable share of the population [5, 8, 30]. The studies have different end points, design and level of evidence and moreover they differ regarding the application of the chair and BPPV subtypes. However, the results presented appear to be unambiguous with regard to the treatment effect where the repositioning chairs are superior to traditional BPPV management. It is deduced that the TRV limits time consumption, expenses, and inconvenience that are extrapolated to lower risk of falling, higher productivity, increased daily activity and quality of life [22, 40]. In addition, it is suggested that the TRV should be first choice treatment in p-BPPV [22].

The included studies agreed that the repositioning chairs were advantageous to patients otherwise unsuited for conventional treatment methods [4, 20, 22]. It is well known that patients with physical limitations experience struggle with performing or cooperating to the manual procedures [5, 13, 45, 46]. This highlights an important aspect of the repositioning chairs, since people with psychical handicaps and elderly patients are more prone to acquire BPPV [9]. Hence, conditions that contraindicate manual manoeuvres are not necessarily an obstruction for repositioning chair treatment that is safe [4, 14, 15, 22]. One study reported cases of nausea and sweating associated with TRV treatment [22]. This is analogous with the complications caused by the manual Epley manoeuvre [1, 38]. Among our cohort, there were two cases of anxiety conditions (claustrophobia) that prevented further management in the repositioning chairs. Another problem with conventional management of BPPV is the difficulty in assessing eye movements accurately [47]. Matching our experience, the studies in this review find that the repositioning chairs overcome this issue due to the head-mounted VNG goggles, the precise fixation of the patient and the feasibility of handling the chair in the correct positions [4, 14, 15, 20].

Our results and the included studies provide a clue of the treatment strengths and weaknesses of the available BPPV repositioning treatment modalities. Reposition devices are implicated in complex forms of BPPV. We believe that larger referral centres could benefit from a reposition device to manage namely the rarer forms of BPPV. One study [26] suggests that a reposition device should be applied to the common variant p-CAN. Though the less frequent subtypes represent small shares, the epidemiologic number is quite sizable (and probably severely underestimated) given that BPPV is a very common condition [5, 8, 29].

Conclusion

In summary, the EO and TRV are highly valuable assets in diagnosis and management of BPPV and our experience advocates a need for repositioning chairs of particularly complex or refractory cases. However, controlled clinical trials on large material are needed given the high number of BPPV subtypes. The future will hopefully bring more research on the treatment of BPPV in biaxial rotational chairs.

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